Outline of a potential project within the 7th Framework Program

MIRAGE

Mediterranean **I**ntermittent **R**iver Man**AGE**ment

(mirage: …. “an optical phenomenon that creates the illusion of water” …., here understood in the sense of imagination the forthcoming impact of flow and rewetting after the antecedent dry period)

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1. Scientific and technical issues

1.1 Concept and objectives

The proposed research project MIRAGE aims to provide specific key knowledge for a better **assessment** of **ecological integrity** (or ecological status in the words of the European Water Framework Directive) in Mediterranean **temporary streams.**

MIRAGE will develop the practical **measurements** necessary to understand their **impact on nutrient dynamics, toxic substances and organic matter** and to link these aspects to an **integrative flood management**.

Using thematic investigations in all South-European member states and Morocco, the project will undertake an **integrative co-development of exemplary River Basin Management Plans** in two mirror basins in Greece and Italy to **support the applicability of the EU Water Framework Directive** for temporary streams.

This will be a central element of **Integrated Water Resources Management**.

To date, adequate implementation of the EU WFD and the development of *River Basin Management Plans* (RBMP) including the *Programme of Measures* (PoM) for temporary streams has been nearly impossible for a number of reasons and urgently requires new concepts of hydrological and ecological characterization, as well as a revised and better integrated understanding of the impact of management measures, both under extreme floods and in the context of seasonal dry periods.

Temporary streams are characterised by an accumulation of pollutants and nutrients during dry periods and an export of them within a very short period (i.e. during the first-flood events) to the receiving water bodies downstream. The flashy nature of such hydrologic systems creates management problems during the wet and dry periods in terms of floods and droughts respectively (Tzoraki et al., 2007). Managers of temporary river watersheds are confronted with a multitude of problems that range from ensuring sufficient quantity of water throughout the year, to managing floods, water quality and soil contamination problems. Remedial actions on contaminated waters and soils to reduce pollution and improve the water quality do not always produce the expected results due to the non-linear response of such watersheds (Nikolaidis et al., 1998). In many cases remedial action has been applied without a clear target or objective because the Reference Conditions have not been correctly analysed and understood. This is a crucial point for the application of the WFD.

While previous EU projects, such as tempQsim, Medalus and others have provided important insights into the dynamics of sediments, pollutants and the occurrence first flush effects, statements concerning temporary streams and especially their particular water quality dynamics are not clearly included in the EU Water Framework Directive. This has limited the investment of effort to plan reasonable and effective water management strategies and so properly fulfil the requirements of the WFD.

Water management of temporary streams and the related application of the EU WFD requires consideration of their distinct hydrological character and their characteristic sequence of pollution accumulation (including the dry phase) and transport during flood events. Since these streams can be dry for many months, the mutual linkages between aquatic and terrestrial phases are of pivotal importance. Advanced concepts from the field of ecohydrology are therefore required to ensure appropriate ecological management.

During its 3 years of study, the MIRAGE project will comprehensively contribute to (i) the provision of suitable reference conditions against which management measures must be judged and (ii) specific knowledge of how best management practices can be applied to improve ecological conditions related to the occurrence of pollution accumulation and first flush effects.

The MIRAGE project builds upon on the long term experience gained during former and ongoing projects including tempQsim, Floodmed, AquaStress, Medalus, RECONDES, DESIRE, STAR, AgriBMP, and EnviFriendly that have been funded by successive EU programs and will integrate knowledge on process dynamics based on new investigations to support the Integrated Water Resources Management strategies for temporary streams.

Specifically the MIRAGE research and project objectives are

- to derive a hydrological characterisation of temporary streams for the Mediterranean region,
- to provide an applicable set of reference conditions related to the specific ecosystem dynamics of temporary streams in the Mediterranean region based on the tight link between terrestrial and aquatic states (both structural and functional approaches),
- to link the Programme of Measures to the effect of dry periods on the accumulation and transformation of nutrients, sediments and hazardous substances on the land and in river channels,
- to specify and to test relevant measures that support the achievement of good ecological status as requested in the EU WFD and to make recommendations for integrative catchment management for both floods and drought periods,

- to support actively the concrete implementation of the WFD and the development of integrated water resources management strategies in six complementary Mediterranean river basins on the basis of advanced ecohydrology concepts,
- to develop and apply the knowledge-base necessary for scenario analyses examining water scarcity impacts due to climate change and land use change as well as threats to ecosystems such as transitional waters,
- to support the general application of the EU WFD in Mediterranean river basins by providing guidelines on using temporary stream characterization and relating this to the choice of appropriate measures.

The project will attempt to understanding the behaviour of temporary rivers - with respect to hydrologic, biogeochemical and sediment transport processes - at three scales, namely the region (Mediterranean area), the catchment, and the sub-catchment. This will allow us to scale up and down hydrological, biogeochemical and ecological processes.

The hydrological characterisation of temporary streams, in combination with the study of extreme events, is a central element of the project. The uniqueness of temporary stream hydrology is the main reason that prevents the simple transfer of results from regions with perennial streams. Furthermore, the targeted tight integration of the *ecological* reference condition and the *hydrological* reference conditions is an overdue requirement in addressing the scaling up from local to regional, and to the European scale in order to support the harmonization and development of water management policies for the Mediterranean region.

The distinct hydrological variability of temporary streams clearly also drives the pollution dynamics and therefore the investigation of practical measures related to (i) inputs from nutrients and organic matter from sewage effluents, (ii) erosive loss of debris, particulates and adsorbed nutrients, (iii) remediation of hazardous substances from stream sediments and (iv) an integrative flood management.

As temporary streams become most of the time (ephemeral streams) or at least for a certain time (intermittent streams) dry, the link to the terrestrial ecosystem is to be considered as crucial. In addition, many processes affecting the ecological status in temporary streams, such as bank erosion and the resuspension of previously deposited materials, are related both to the main thalweg channel as well as to the para- and/or orthofluvial floodplain (i.e. active channel and riparian zone, Fig. 1). In addition, measures for managing waste water, floods and irrigation may also have a strong impact on the floodplain.

Therefore one key aspect of the proposed project is to consider the link to the terrestrial ecosystem dynamics both for the determination of reference conditions and also for investigating the potential impacts of measures and their potential inclusion in RBMP's.

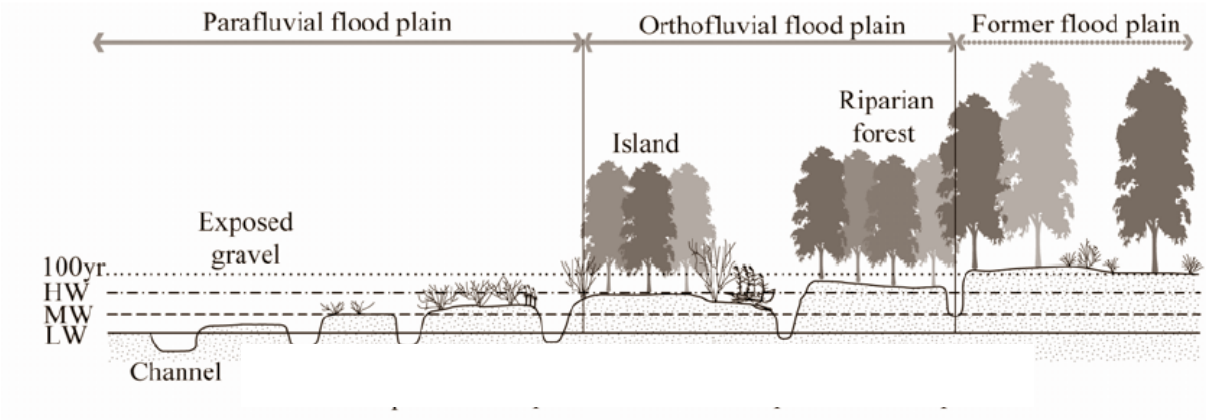

Fig. 1: Schematic cross sections of a meandering (upper graph) and a braided study river (at the local investigation scale)

The specific selection of the project study sites is mainly driven by the need to represent at least all South European Countries with their national strategies to implement the WFD and to increase the joint effort between water managers, modelling experts and experts for assessing the ecological impact of measures. All basins are selected because they are affected by significant pollution. Further selection criteria include a history of field experiments on erosion control and studies of the impact of sewage water effluents on stream water quality.

The two mirror basins *Evrotas (*Greece) and *Candelaro* (Italy) were chosen because they provide a representative mix of environmental pressures for temporary streams and because there has already been a continuous ongoing collaboration with the local authorities in charge of implementing the EU Water Framework Directive. Hence, the transfer of experience and common guidelines is seen as a key way to support the WFD implementation in all the investigated sites and more widely.

Socio-economic aspects of management will be fully included in the development of future scenarios and management alternatives. The project will maintain a special Stakeholder Council, will maintain the link to the CIS working groups, will disseminate the results to the Water Directors and will supportsthe streamlining of policy recommendations based on the project, in relation to the emerging need for full application of the WFD across all Mediterranean basins.

1.2 Progress beyond state-of-the-art

Previous results have emphasised the need to extend the research from nutrients to a wider range of pollutants, and to develop related measures. The impact of pollution dynamics (Tournoud et al., 2004; Garcia et al., 2007; Tzoraki et al., 2007) and the flushy behaviour were intensively investigated during the tempQsim project along a gradient of anthropogenic pressures. In particular the occurrence of first flush effects has been investigated in depth (Obermann et al. 2007).

The fact that an adequate selection and dimensioning of measures related to the request of the WFD for the development of *Programme of Measures* (PoM) and the *River Basin Management Plans* (RBMP) is not possible for Mediterranean basins characterized by temporary streams provides a major research challenge. This is mainly related to (i) missing reference conditions, taking into account the complex ecosystem functioning, to (ii) the prediction of measure impacts under extreme conditions (i.e. alternating between very dry periods to flush floods), and to (iii) limited experience to link it into an IWRM appropriate for temporary streams.

1.2.1 Supporting the WFD in Mediterranean temporary river basins (corresponding to WP 2)

The Water Framework Directive pays little attention to temporary waters. Actually, the terms “temporary” or “ephemeral” do not exist in the text of the WFD. The water quantity aspects are not directly considered in the determination of the good status of water, but indirectly through the ecological status. The characterisation and monitoring of “water bodies” requested by the WFD is particularly difficult when these are dry for weeks to months (and even years). Yet, the future availability of water resources is only taken into consideration in economical analysis where ‘long term forecasts of supply and demand for water’ are required.

There is a significant gap of scientific knowledge regarding how to manage temporary rivers. Most Mediterranean member states lag behind in the implementation of the WFD. This is related to transposition in national laws (The full implementation and acceptance of the WFD by the Greek Government was just approved through the Presidential Order 51 on the 7th of March 2007), to the grouping of basins according to Art. 3, the identification of competent authorities and the coordination of the Art. 5 reporting, or to incomplete information in Art. 5 reports on surface water bodies at risk of failing the WFD requirements (Com, 2007). In respect to the submission of Art. 5 reports, the Commission started legal action on “non-communication” against Spain (case A2005/2316), Portugal (A2005/2318), Greece (case A20052317) and Italy (case 2005/2315). The cases against Greece and Italy are still unresolved (Com, 2007).

A great deal of the responsibility of the delay in WFD implementation is due to insufficient knowledge of how to manage Mediterranean River Basins under extreme conditions such as flash floods and droughts. The lack of knowledge due to measurements and processes as well as insufficient modelling tools make management of temporary systems according to the WFD a very challenging task. The main problem with modelling temporary river catchments is that not a single model can simulate these catchments in an integrated manner. The tempQsim project developed a toolbox of models that can now be used in sequence or in parallel to simulate such catchments (Tzoraki and Nikolaidis, 2007). Tools to support the identification and dimensioning of measures are already available (such as SWAT, tempQsim-stream, Karst-HSPF, tempQsim Reach, MARIAM or PESCAS). Missing features are mainly a better integration and coupling between these models.

Another unsolved main challenge in the implementation of the WFD in the Mediterranean region is the need to reaching consensus among the various stakeholders due to the multitude of water managers (water companies for every village and town, local irrigation association, other water users, prefecture, government) in a specific catchment. This polyphony makes the development of a PoMs and acceptable integrated RBMPs extremely difficult. To set up RBMPs including PoMs (Art. 13&11 WFD) until 2009 requires a significant increase in specific related research on managing temporary streams.

1.2.2 Hydrological characterization of intermittent streams (corresponding to WP 3)

Linking the hydrological reference conditions to the ecological reference conditions is imperative, as temporary streams are notably complex ecologically because of the alternation of a wet period with high abiotic constraints (i.e. flow pressure) and a dry period as a recurrent natural disturbance (Williams 2006), with high biotic constraints (i.e. predation) (Gasith and Resh 1999, Bonada et al. 2006b). In addition, dry periods may differ in length and in their degree of predictability (Lake 2003) which may limit the application of general ecological theories in these systems. The complexity of these streams has limited our knowledge as compared to permanent streams, but

during the last decade, studies on temporary streams have increased, particularly in areas where these systems are commonly found, such as in the Mediterranean Basin (e.g. Rieradevall et al. 2002, Acuña et al. 2005).

Until now a practical usable hydrological characterization for temporary streams is missing and prevents the organised differentiation of ecological stream types and reference conditions. Moreover, despite some initial works (Gallart et al., 2006, Froebrich et al. submitted), such a framework at European scale is not available. Stream gauging networks in the Mediterranean pay little attention to temporary streams (Camarasa and Segura, 2001). Despite their ecological importance, low discharges are frequently weakly recorded and there is little information on the periods when streams flow only through pools that are not connected on the surface, and when they have completely dry beds.

Missing hydrological reference conditions also prevent a reliable discrimination between exceptional droughts and recurrent seasonal aridity. Here additional work is required to estimate the impact of water quantity deficits on the ecological status and to enable a reasonable integration of drought management sub-plans within the RBMPs for temporary streams. Facing the prospect of climate change (Henrichs & Alcamo 2001, Eisenreich 2005), significant anthropogenic modifications of flow regimes in the Mediterranean and records showing a decreasing trend of runoff into the Mediterranean Sea, the definition of hydrological reference conditions becomes of even more urgent importance (Com, 2007).

1.2.3 Structural and functional assessment of temporary streams: From aquatic and terrestrial perspectives (corresponding to WP 4)

Temporary streams are expanding, contracting, and fragmenting ecosystems that shift between dry and wet conditions with wetted channel segments connecting at various time and space scales (Stanley et al. 1997, Doering et al. 2007). Temporary streams have primarily been investigated during wet conditions (but see Wishart 2000, Adis & Junk 2002). However, even small changes in precipitation and flow regimes can dramatically alter the spatial extent of wetted channels, and the duration and severity of dry and wet periods, creating a system with exceptionally high variability. At the same time the Mediterranean catchments contain very rich and irreplaceable biota (e.g. Smith & Darwall, 2006, Tockner et al. 2008). Permanent pools serve as important refugia for aquatic organisms during the dry period (e.g. Hamilton et al. 2005), and on the other hand temporary sections provide key habitats for fish (Wigington et al. 2006) as well as for terrestrial upland communities.

The uniqueness of temporary streams is that they provide a wide range of temporal ecotones that correspond to the shifts from aquatic to terrestrial conditions and *vice versa* (Tockner et al. 2000, in rev., Larnard et al. 2007). These ecotones maintain the diversity of aquatic and terrestrial assemblages, regulating the transfer and transformation of matter, and defining the resilience of the system. The performance during the wet period depends on the conditions during the dry period - and *vice versa* ("boom" and "bust" cycles, Bunn et al. 2006). It is therefore pivotal to understand the functional linkages across spatial and temporal ecotones (e.g. Sanzone et al. 2003, Paetzold et al. 2006, Langhans & Tockner 2006).

Hence, there is an urgent need for novel quantitative tools to assess temporary streams. Even though significant resources have been directed towards the development of protocols and metrics in Europe (Bonada et al. 2006a), few of these projects have considered temporary river catchments (Vidal-Abarca et al. 2003, Morais et al. 2004). Direct transference of tools and methods that have been developed for permanent streams (Hering et al. 2004, 2006) to temporary streams simply does not work. To assess the present state and future trends of temporary streams a "Reference Condition Approach" is required (Stoddard *et al*., 2006).

Although standard methodologies for establishing reference conditions are available for permanent streams (Wallin et al. 2003, Bailey *et al.,* 2004, Njiboer *et al*., 2004), they are absent for temporary streams (for first attempts see Bonada et al 2004; Morais et al. 2004, Sanchez-Montoya *et al.* subm.). This is a difficult task mainly due to the long history of human alterations in the Mediterranean (Allen, 2001), as well as due to the spatiotemporal complexity of temporary streams.

1.2.4 Management of point source pollution (corresponding to WP 5)

Control of point source pollution in Mediterranean river basins is an essential measure to achieve the objectives of the WFD (Jarvie et al., 2005). However, current water treatment concepts are not adequate for temporary streams. The pollutant status of temporary rivers is highly affected by direct inputs (Torrecilla et al., 2005): dilution during low and no flow cannot take place (Prat and Munee, 2000) and flow velocities are not high enough for flushing pollutants downstream. Accumulation and transformation of chemical elements and organic matter are observed in disconnected pools during the low flow period (De Groot and Van Wijicj, 1993; Tournoud et al., 2005). Riverbed sediments and biotas play a major role in providing a pollutant reservoir that may be remobilized during floods (Dorioz et al., 1998). Hence, the first floods are considered to be a critical moment in the hydrological and hydrochemical functioning of these rivers (Durand et al., 1993, Obermann et al., 2007). The remobilization of the accumulated pollutants in the riverbed depends on both the physico-chemical conditions and the bioavailability of the compounds (Baldwin and Mitchell, 2000; Qui and McComb, 1996; Qui and McComb, 2002). The transport capacity of the remobilized elements will also depend upon the hydraulic conditions, i.e. flow magnitude and flow continuity. Additional difficulties arise because continuous point source discharges can change the hydrological

conditions in a channel, creating or connecting pools, or even setting up perennial flow conditions (Hassan and Egozi, 2001).

Hence many questions remain to support the PoM, in particular in terms of efficiency of management options for intermittent rivers. The impact of a direct pollutant input on the chemical and ecological status of intermittent rivers need to be addressed, in terms of zone of influence, dilution effects, etc. For this purpose, exchanges between the water column and riverbed, particularly downstream from an effluent outfall need to be studied in detail for intermittent flow conditions. In the same way, at local scale, there is also a real need to estimate the stock of pollutants and its availability for removal, downstream from the input. Trapping rates for chemical elements, organic matter and bacteria in the riverbed must also be evaluated, as well as the role of biology and biofilms in the accumulation and transformation of pollutants. The bioavailability and the reversibility of the pollutant storage, especially after periods of severe desiccation, must also be studied.

1.2.5 Erosion control and reduction of non-point source pollution (corresponding to WP 6)

The Mediterranean region is very prone to soil erosion processes and flash floods that mobilize high sediment loads along the river system both on the bed and in suspension. Both the, quality and quantity of sediments affect downstream areas. Links to nutrients and hazardous contaminants such as heavy metals, pesticides, agrochemicals and other micro-pollutants threaten the ecological status of water bodies and must be considered in the PoM.

One of the most efficient measures to reduce non-point pollution is to prevent the delivery of sediment-bound pollutants. Most of the management plans implemented to reduce sediment yield are based on identifying areas of gross soil erosion rates without considering the spatial variations in sediment transport capacity. Given that the source areas that deliver most sediment at the basin scale are not necessarily the areas with the highest local soil erosion rates, these management plans currently account mainly for on-site soil erosion problems. However the sediment delivery ratio (SDR) is determined by the relative dominance of either hillslope or channel erosion (de Vente et al., 2007). Therefore, the development of management plans and assessment of their impacts should not only consider the areas with the highest calculated soil erosion rates, but also total erosion, sediment transport capacity and sediment yield have to be taken into account. Thus, the decision about *which* soil conservation measures are to be implemented *where,* requires the use of spatially distributed erosion-sediment transport models.

There is a good understanding of the soil management, and of the rural and forest engineering measures to be adopted to reduce erosion, promote infiltration and prevent sediment export (Bautista et al. 2003). However their effectiveness has not been adequately tested for basins with temporary streams, where water deficit conditions restrict vegetation growth and storm events create extreme flush conditions. Furthermore, the hydrological regime of temporary rivers impose a sequence of dry and wet periods in the channel which affects the time of sediment exposure and redox conditions thereby influencing pollutant solubility. Integrated soil-sediment-water strategies for Mediterranean stream basins therefore require (i) spatially distributed models that couple erosion and sediment transport processes and (ii) more knowledge on both the specific accumulation of nutrients, pollutants and organic matter during the dry period and (iii) the assessment of the impacts of land use changes driven by the adoption of river management plan, future socio-economic activities and climate change on quantity and quality of sediments during floods.

1.2.6 Assessment of hazardous substance accumulation in temporary streams (corresponding to WP 7)

A consideration of pollution by the 33 substances from the *Priority List* is a priority concern for the adequate development of RBMPs in the Mediterranean. Nevertheless for temporary streams a better knowledge of particle bound compounds and their re-suspension in extreme hydrological conditions is still essential to define measures for achieving the Maximum Allowable Concentrations.

The water quality issues in historically ephemeral streams, with a special emphasis on the effects of emerging pollutants, is reviewed in Brooks et al. (2006). The evolution of DOC in surface and ground waters during transition from drought to precipitation in an intermittent Mediterranean stream showed differential microbial degradation in the two hydrological phases (Romanì et al., 2006) which leads to different molecular weight distribution of the organic carbon and in consequence, different adsorption properties for hazardous substances. Other studies have reported the sorption behaviour of micro-pollutants on suspended matter and sediments in permanent rivers (Isobe et al., 2001) while similar studies on temporary rivers are lacking although drying/rewetting conditions can strongly influence the partition mechanisms. Several studies on the effects of photo-degradation of DOM on the binding of organic micro-pollutants showed a decreased affinity of DOM for binding (Lou et al, 2006) that could increase the free dissolved fraction of micro-pollutants and thus their availability and toxicity to aquatic organisms.

In temporary streams the microbial communities, that are the principal actors in organic matter biological transformations, continuously adapt to microclimate changes with rapid and short-term physiological adjustments (Mamilov & Dilly 2002). Previous experiments within the project tempQsim (Amalfitano et al. submitted) showed

that the dry periods temporarily limit microbial mineralization and alter bacterial community structure. The effect of toxic substances on cell growth and physiological functions of bacteria, and consequently the capacity of bacteria to degrade hazardous compounds, have been poorly analysed. In recent studies the degradation compounds of various widely used substances (i.e. alkylphenols) have been analysed for their effects on the growth and physiological functions of bacteria utilising tests commonly used in microbiological studies. Among these compounds nonylphenol showed cell growth inhibition and changes in cellular oxygen consumption (Okai et al. 2000, FEMS Microbiol. Lett.) by selected bacterial species.

1.2.7 Integrated flood management for water quality (corresponding to WP 8)

Integrated Flood Management is generally concerned with the link between water use, flood risk, socio-economic development and the protection of natural ecosystems through appropriate institutional frameworks and public participation (WMO). However, the inclusion of water quality aspects has been very limited, particularly for temporary streams.

In ungauged or sparsely gauged catchments the implementation of flood management strategies is severely limited by knowledge gaps in estimation of return periods and orders of magnitude of floods Temporary waters in the Mediterranean are often sparsely gauged, and in addition discharge is not always strongly connected to rainfall, although rainfall records are often less sparse. The use of rainfall data to estimate floods in this region requires additional work in determining the approximate magnitude for return periods of floods and hence exceptional events carrying high nutrient loads. The approach taken will be to improve the applicability in Mediterranean regions of simple rain-fall runoff models such as those proposed for the UK Flood estimation Handbook (FEH) (Institute of Hydrology, Kjeldsen, 2005), and use this as a basis for determining regional flood risk.

In the Framework of the FLOODMED and EnviFriendly projects, a number of measures have already been identified as being useful for a flood management in the Mediterranean river basins. According to the Lakonia Prefecture Flood Management Plan measures may be divided into 3 categories (i) for regions with high elevation and high slope: creating a cascade of shallow retaining dams that change the slope of the river and its energy; upland reforestation (ii) for regions with medium elevation and mild slope: creating canals, groundwater wells, using natural geological features such as tectonic fractures to direct the flood water to groundwater (enrichment), clearing the river canal of obstructions to the movement of the water, and (iii) for regions with low elevation and low slope: riparian zone restoration and river bank erosion protection measures.

Future work is required to link such potential measures to the estimation of significant design floods and related impacts on water quality.

1.2.8 Research challenge to be addressed

The main research challenge of the MIRAGE project is to provide for the first time a possibility to assess and plan measures suited to the dynamics of temporary streams and in line with the objectives of the Water Framework Directive. MIRAGE will develop a concise framework for characterising the hydrological and ecological dynamics as well as for systematically describing the measured impact for the specific conditions of temporary streams.

Analysis of the environmental pressures for temporary streams within the Sebou basin in Morocco will also lead to a new transferability of results and will help to overcome some potential limitations by supporting only the RBMP under the EU Water Framework Directive view point.

At present the intercalibration of temporary streams is impossible due to the lack of comparable methodologies in the different countries. In addition the introduction of functional indicators and approaches will expand the possibilities of the WFD for assessing the ecological status of such streams.

However, the impact of an ambitious interdisciplinary project such as MIRAGE is through the integrated application of a set of linked innovations rather than by a single innovation.

The EU Water Framework Directive

The particular research challenge related to the WFD is first to overcome the current gaps in the WFD and then to use these findings to drive the development of River Basin Management Plans in the Mediterranean. The experience gained will also help to support the already delayed implementation of the WFD in South European Member states.

By these means, the project will significantly extend the experience gained during the investigation of Pilot River basins under the CIS.

Ecosystem functioning and reference conditions

Basically the study will focus on key environmental variables and functions, adding further value to the tools used in the implementation of the WFD. The project will research the functional linkages across spatial and temporal ecotones (e.g. Sanzone et al. 2003, Paetzold et al. 2006, Langhans & Tockner 2006)and so contribute to the development of a novel integrative tool for managing these complex ecosystems. The need for strong linkages

between terrestrial and aquatic communities is not usual in river studies and provides one of the most novel aspects of this study.

Results will be explicitly linked to the varying hydrological conditions across Mediterranean river basins. This will also lead to a novel and systematic specification of combined hydrological and ecological reference conditions, to guide the selection of best available conditions in the sense of the System B of the EU WFD, thus contributing directly to the possibility of transferring project results to other Mediterranean river basins.

A rational assessment of the pressures and potential impacts of future measures will only become possible when the specific reference conditions for temporary streams have been adequately defined as part of the project.

Individual measures for improving the targeted ecological status

Significant innovation is also targeted in the further understanding of specific practical measures with respect to their impact on streamflow and water quality under the alternation of droughts and extreme flush flow conditions. Specific advances are expected to provide a new understanding of the effectiveness of alternative measures, related to the occurrence of first flush impacts and their possible mitigation.

New understanding will be gained on adapting waste water management, taking into account the impact of effluents during the absence of dilution and the alteration of flow regime towards a more perennial but more polluted system.

Likewise new insights will be gained on how soil conservation practices and erosion control measures may prevent the delivery of particulates pollutants from land under extreme flush conditions and lead to an significant extension of current knowledge in soil conservation and sediment transport.

The project will also provide novel methods to assess the impact of accumulating hazardous substances from the priority list into dry stream beds and their potential impact of remobilisation.

Together, these findings will, in a number of directions, extend current development on integrated flood management towards the inclusion of water quality aspects and will link integrated flood management for Mediterranean basins with the objectives of the WFD, a goal which has hitherto not been feasible.

Finally improved understanding on the interactions between measures and their impact in temporary streams will present essential background knowledge to strengthen the use of improved mathematical models developed under the tempQsim project to underpin practical support in accordance with the objectives of the WFD.

By synthesizing these various innovations within the development of river basin management plans, the project MIRAGE will also address the integrated assessment of measures through their impact on water quality and ecosystem functioning at the catchment scale for temporary streams.

Means to determine the climate and global change impact

Climate change is anticipated to affect mean values but mostly the frequency of extreme precipitation events and long drought events. Temporary rivers are extremely sensitive to climate change. Water management of temporary river basins should be viewed in light of climate change scenarios.

A major research challenge of the project is to develop the scientific knowledge base necessary for scenario analysis by examining water scarcity impacts due to climate change and land use change as well as threats to ecosystems. Here, the planned systematic description of hydrological and ecological reference conditions is seen as an essential precursor to determining potential hazards, both in the existing record and in response to prospective climate change.

Similarly, the improved insight into hydrological and ecological reference conditions for temporary streams will also enable an improved estimation of environmental flow requirements.

1.3 S/T methodology and associated work plan

1.3.1 Overall strategy

The workprogram is tailored to achieve the main objectives of the project. It is characterised by an integrated interaction of research components across different disciplines and varying levels of application at the included study sites.

Most parts of the workprogram will benefit form the consortium experience during the projects tempQsim, Medalus and AquaStress. However, the central focus of the MIRAGE is now to address significant environmental pressures as still common in many Mediterranean basins.

The project work will comprise both scientific fundamental research as well as an applied component Fig. 2. Fundamental research will be done in particular for the hydrological characterisation of temporary streams at regional Mediterranean scale, to investigate the ecosystem functioning and linking of aquatic and terrestrial components and to integrate the hydrological and ecological characterization of temporary streams. The results obtained will be used for the further development of applicable reference conditions for temporary streams to support the EU WFD Art. 5 assessment in Mediterranean basins.

To address the future achievement of good ecological status or best available status, MIRAGE will use the improved knowledge on river system functioning to adapt current measures in the field of waste water treatment, erosion control and integrated flood management to the specific pollution and flood dynamics of temporary streams. For this specific research will be done on a local scale in the study sites in order to analyse impacts and effectivity/efficiency of control measures, also to support the future implementation of the Art. 11/13 of the EU WFD.

On the applied side, the results of these specialised workpackages will be brought into a wider context of European relevance. Standardised protocols for the integrated assessment (structural and functional) of the ecological and hydrological status of temporary rivers will enable a refinement of the definition of reference conditions in these environments as well as to quantify the foreseen deterioration by typical anthropogenic pressures.

MIRAGE will give S&T support to the development of Integrated Water Resources Management Strategies focused on two larger catchments dominated by temporary streams: the Evrotas River Basin in Greece and the Candelaro River Basin in Italy. Both basins have watershed areas (2000-3000 m^2) that are large enough and are comparable to the size of basins where the WFD will be implemented.

Based on the SH-perceptions and needs, a targeted implementation following the meaning of the WFD will be envisaged. The requirements of the WFD will be interpreted for temporary rivers with the goal to give a general guidance to stakeholders in these regions.

In addition, MIRAGE will learn from the experience of other researchers and international projects and consortia (enhancing in this way the knowledge base of problems experienced considered in this project) by organizing conferences and participating actively in International blogs on sustainability and water resources management issues in the Mediterranean such as the Med EUWI blog.

Links between MIRAGE and various activities where the JRC and other partners are involved such as intercalibration, establishment of reference condition, priority substances, and also various working group of the CIS such as water scarcity, EU med initiative, etc. will be established at the on-set of the project. Such action will provide input for the generalization of guidance documents on the best management and remediation practices and the development of river basin management plans in basins with temporary streams beyond the issues involved in the river basins of the project.

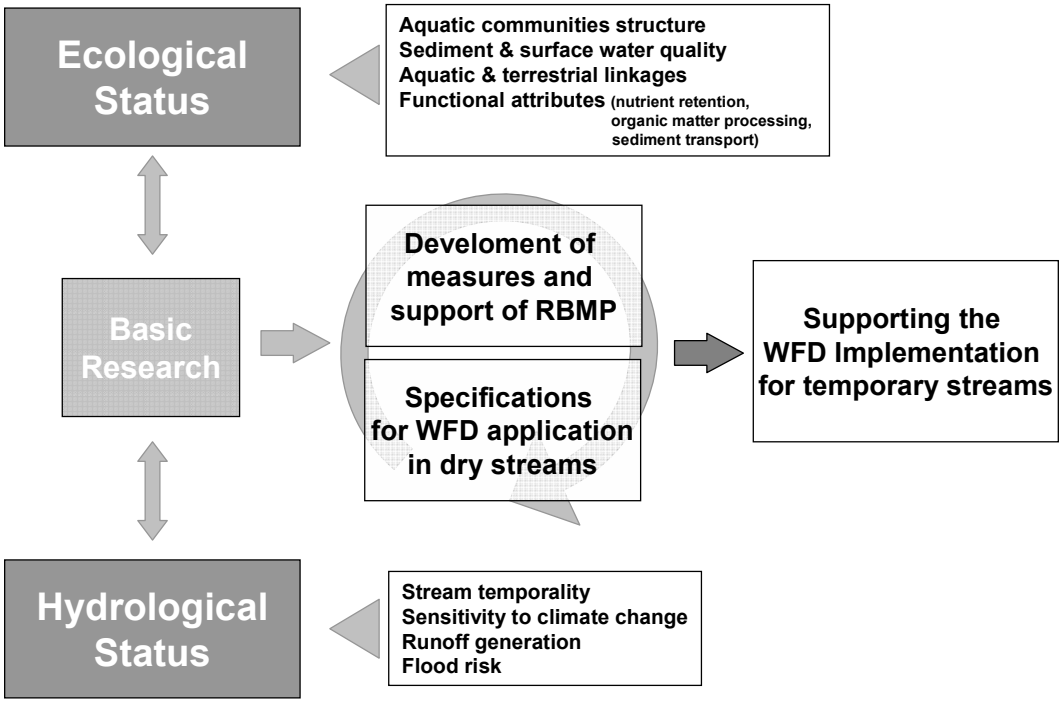

Fig. 2: Link of thematic main components

1.3.2 Proposed concept of interaction between Mirror basins and study sites

For a systematic review of the different practice in implementing the EU WFD and development of RBMP's it is attractive to study at least the situation at all South European Member states. Further it is considered as required, to study not only one selected pressure and the corresponding measure, but the set of most relevant ones. Similarly to come up with practical results, the investigations should be done at catchment scale should address the link of the watershed to its impact on transitional water bodies as well as the potential impact of climate change.

For a rational use of limited financial and personnel resources as well as for the need to streamline the information flow, it is not reasonable to carry out all investigations in parallel at all study catchments.

Therefore the project MIRAGE will address in a systematic way specific investigation in *study sites* and the integration of results in the *two mirror basins* (Fig. 3):

Study sites: Locations, where particular pre-existing knowledge and data on a certain **dominant pressure** already exists, experimental facilities are available and measures are already implemented (Vène, Vallcebre, Sebou, Taibilla, Enxoé).

Mirror basins: Basins in which the **combination of pressures** will be addressed, additional investigations, such as the link to transitional water bodies and the integrated flood management will be executed, and finally under the truly involvement of local stakeholders and basin management authorities the concrete development of the **River Basin Management Plan** will be supported (Evrotas and Candelaro).

By this, the activities in the *mirror basins* will be consistent with the study sites. So they will mirror back, the experience of integrating specific potential measures into the development of River Basin Management plans for temporary streams and to show how the EU WFD can be specified and adapted accordingly.

This experience will be provided back to the responsible basin management authorities at the study sites and will support the specific consideration of measures in the future development of RBMP as requested under Art 11/13 WFD.

In order to enable a later hydrological and ecological characterization at the regional Mediterranean scale, these investigations will be executed at all locations (Tab. 1), resulting also in a coherent description of the ecological status and dominant pressures. For the Vène, the Vallcebre, and the Sebou catchment, pressures from sewage effluents are dominating. For the Taibilla and the Enxoé environmental degradations resulting from erosion and particulates are dominating.

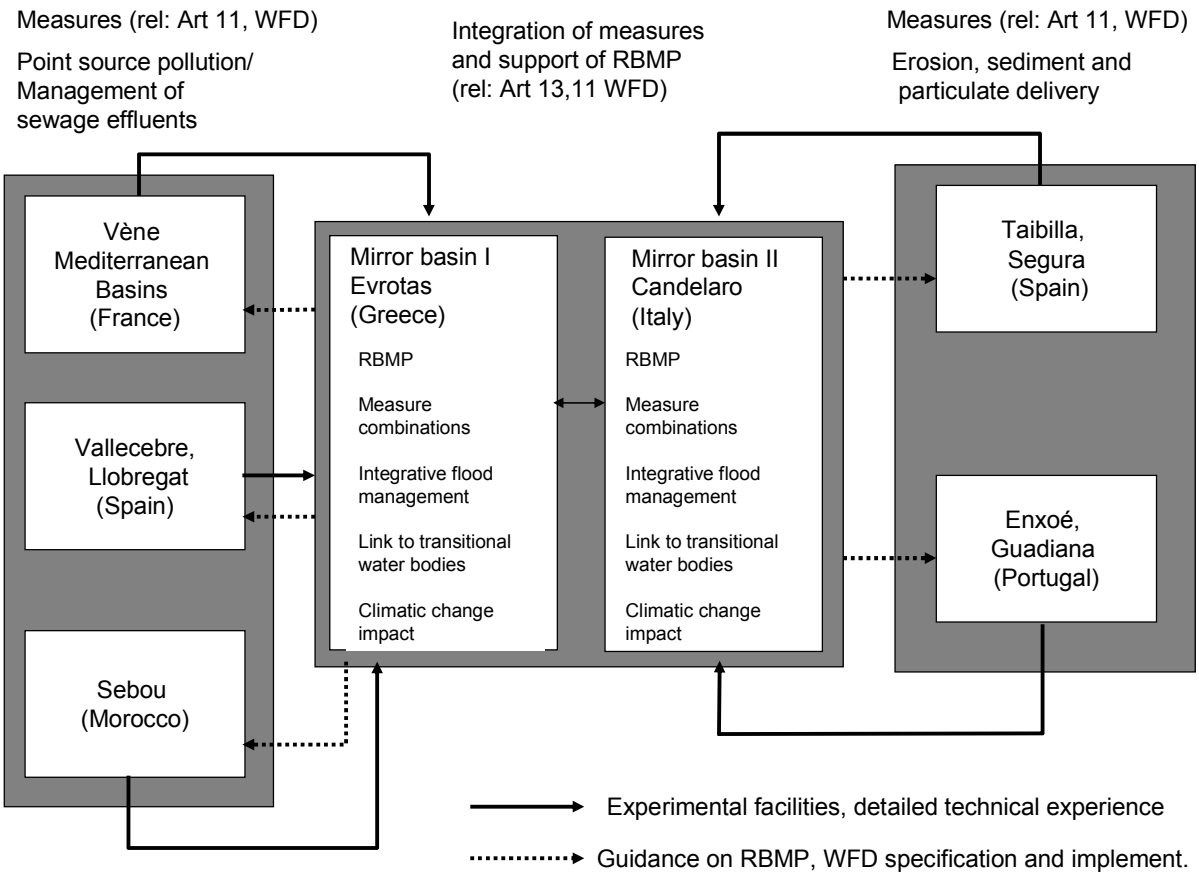

Fig. 3: Interaction of mirror basins with the study sites

The inclusion of the Sebou basin in Morocco, was mainly based on the fact that it will be one of the two pilot basins for strengthening the exchange of experience from Europe to the Mediterranean pilot basins within the EUWI-Med activities and to adapt potentially the WISE-RTD system accordingly. By this the Sebou basin will support the link to the SPI-Water project.

Furthermore the Université Sidi Mohamed Ben Abdellah de Fes has an reputation and track record in studying temporary streams and guarantees the effective common execution of investigations and exchange of data. By

providing deeper insight into the local specific environmental problems the involvement of the Oued Fes will also serve as a benchmark to check the transferability of measures.

Tab. 1: Central issues to be addressed in the selected mirror basins and study sites

Activity	**Evrotas (Greece)**	**Candelaro (Italy)**	Sebou - Oued Fes (Morocco)	Vène (France)	Vallcebre (Spain)	Enxoé (Portugal)	Taibilla (Spain)
Supporting the RBMP development	●	●	●	●	●	●	●
Hydrological characterisation	●	●	●	●	●	●	●
Ecological characterisation	●	●	●	●	●	●	●
Nutrient dynamics & organic matter	●	●	●	●	●		
Erosion control and reduction of sediment bound pollution	●	●	●			●	●
Assessment of hazardous substances	●	●	●	●			
Management of floods and flush effects	●	●	○	○	○	○	○

Supporting the science –policy dialogue

For supporting the active transfer of results into the practice and to strengthen the science – policy dialogue, a Stakeholder Council as specific body within the project, is planned. The stakeholder council will gather representatives of the water authorities for both mirror basins and from the individual study sites, the MENBO, as well as delegates from the Water Directors from Italy and Greece. It is also targeted to include delegates of the Water Directors from Spain and Portugal during the project lifetime. The Stakeholder council will act as concrete forum for information exchange between the EC (WD's), MENBO, local authorities and researchers. While the results on reference conditions, experience in PoM and RBMP support will be communicated directly to the local basin authorities, the planned Stakeholder Council workshop meetings will help to broaden the dissemination from the local level to the European level.

Specific objectives of the Stakeholder Council are

- To discuss current practical and administrative limitations of implementing the EU WFD for temporary streams and member state level and for the MPC
- To provide an ongoing information flow from the national progress in implementing of the EU WFD to the researchers
- To review the progress in research on specific knowledge gaps and to evaluate the practical applicability
- To support the link of reference conditions developed and the increased consideration of water quality deterioration into an active European drought and water stress management
- To maintain the links to the CIS Network "Water scarcity and droughts" and to the Mediterranean EUWI/WFD Joint Process
- To summarize finally a policy recommendation for a road map towards a specific consideration of temporary streams in Mediterranean River basins

Because of the increasing priority on droughts in the Mediterranean, the stakeholder council will maintain in particular a very close contact to the CIS Expert Network "Water scarcity and droughts".

The Stakeholder Council will be jointly organised by the Coordinator and Thierry Davy (Representative of the French Water Agencies, representing also the French Water Director). Specific meetings are already planned and described in Part 3.2.

Tab. 2:Composition of the stakeholder council

Study site/ member state	Institution	Name	e-mail
CIS-Expert Network	Representative of French Water Agencies	Thierry Davy	thierry.davy@scarlet.be
Italy	Representative of WD, Italian Ministry of Environment	Giorgio Pineschi	pineschi.giorgio@ minambiente.it
Spain, Portugal	tbdxxx	Tbd	Tbd
Greece	Representative of the WD, Ministry of Environment Greece	Dr. E. Tiligadas	etiligad@otenet.gr ggded7@otenet.gr
MENBO		T. Estrela	tbc
Candelaro	Autorità di Bacino della Puglia	Prof. Antonio Di Santo	a.disanto@poliba.it
	Apulia Regional Administration	TBD	TBD
Evrotas	Prefecture of Lakonia, Land Reclamation Survey	Vassilis Papadoulakis	papkal1@otenet.gr
	Region of Peloponnesus	Katerina Mploumpidou	
Enxoé (Guadiana)	INAG	Fernanda Rocha Rui Rodrigues	frocha@inag.pt rrr@inag.pt
Taibilla (Segura)	Confederación Hidrográfica del Segura (CHS), Water Resources Planning Department	Mario Urrea	mario.urrea@chs.mma.es
Vallcebre	Catalan Agency of Water,	Gabriel Borràs	gborras@gencat.net
Vène (Département of Hérault)	Conseil Général de l'Hérault (CG34), Direction de l'aménagement rural et de l'Environnement, Gestion Globale de l'Eau – Montpellier FRANCE	Irina Valarié Jean-Louis Brouillet	i-valarie@cg34.fr dare-gestionglobaleeau @cg34.fr
Sebou (Morocco)	ABH-Sebou	Ahmed Belkheiri Head of the Agency	abhsebou@iam.net.ma

1.3.3 Workpackage roles and their interaction

As shown in Fig. 4, the work packages are ordered in a hierarchical way to facilitate interactions and syntheses.

WP 2 is considered as the central area, where the investigations for the mirror basins will be coordinated, results of the other WP's used to support the development of the RBMP, and to derive finally S/T and policy recommendations for an adequate consideration of temporary waters in IWRM.

In principal the workpackage WP3 (hydrology) and WP4 (ecology) will provide the overall knowledge for the hydrological and ecological characterization, whereas WP4 will use the information developed in WP3 to systematize the reference conditions accordingly. Results will enter the WP2 be used to support the later specifications of the WFD and the support of the RBMP in WP2.

WP 5 (point source pollution), WP 6 (Erosion, sediment and particulate delivery), and WP 7(Hazardous substances) will investigate their specific topic by use of detailed field and laboratory experiments). Here in particular, the innovative revised consideration of measure design and applicability for the problems met at temporary streams will be undertaken. WP8 (integrated flood management) is on the one side similar to WP5 – WP8 providing a practical measure for improving the ecological status, but will link on the same time also the pollution dynamics from point and non point source pollution to the occurrence of floods, resulting first flush effects and the significance/ return period of major loadings to sensitive water bodies downstream. Results are commonly entering into WP2 for supporting the selection of measures within the RBMP.

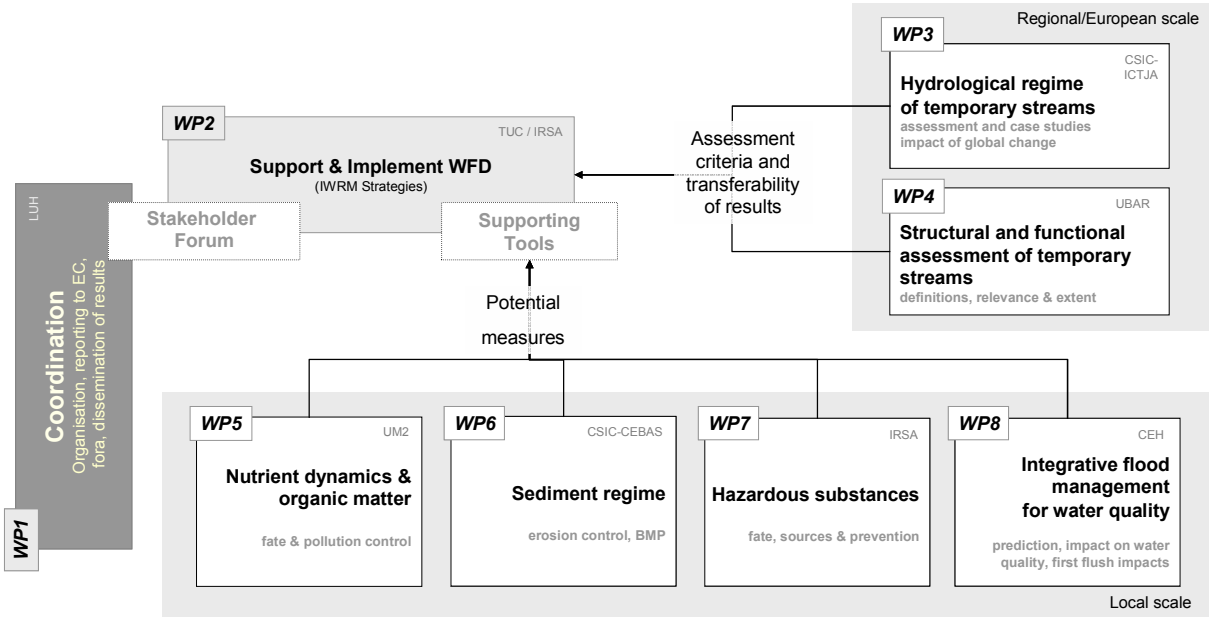

Fig. 4: General structure of work packages

WP 1 - Coordination – Management of Mirage

WP1 covers all management issues. It will facilitate the set up of regional stakeholder groups, accompanying the discussion and implementation of measures. It will establish links between the partners and workpackages, ease communication by providing a common web platform based on a modern content management system and will organise data exchange.

Additional effort is foreseen to maintain the project database by the continuous use of the tempQsim data base format, enabling a practical exchange of project data amongst the partners and to facilitate the future integration into European standards as currently under development by JRC.

Special effort is addressed to link the activities to new CIS working groups and droughts and the EUWI-MED, under the planning of joint workshops.

The MIRAGE project will also include links to the SPI-Water project, providing the science/policy interface and in case of successful funding to other relevant projects under the area ENV.7.1.3.3.3 (targeting European drought policy) and ENV.2007.2.1.2.1. Assessing the ecological status of water bodies, providing specific input for the temporary streams in the Mediterranean.

Further contributions will be made to the IWA Dry area Forum, the Integrated Project AquaStress for linking water quality aspects to an integrated water stress management.

WP 2 - Support and Implement the WFD

This is the central point of integration among the partners in the project providing S&T support concentrated on the two mirror basins.

This WP addresses two aspects of integrated water resources management, (i) the science required to develop credible management scenarios and (ii) the socio-economic aspects of management with stakeholder participation. Preliminary basin management plans for both mirror basins already have been developed as part of a number of previous projects. The stakeholders in charge of river basin management in the two mirror basins are:

1. The Prefecture of Laconia (PR-LRS) has already created the Office of Integrated Water Resources Management and Sustainable Development (part of the Land Reclamation Survey) which is closely working with the Region of Peloponnesus and the Hellenic Ministry of Environment which has the overall responsibility for the implementation of the WFD.
2. The Autorità di Bacino della Puglia (ABP) is responsible for implementing the WFD. Results will be considered also by the Italian Ministry of Environment for future management for other dry streams in Italy.

The planned activities will therefore build upon research that has already been conducted in these basins from other national and EU projects. Additional scientific knowledge will be developed in WP 3-8 to examine water scarcity scenarios and evaluate the impacts of climate and land use change as well as threats to ecosystems such as transitional waters.

Together, the already existing research and the advancements in WP3-8 will be used to propose IWRM strategies for the Mediterranean climate leading to adequate **Integrated Watershed Management Plans** in the Mirror Basins in line with the WFD and to give **S&T support** as well as **policy guidance** to support the implementation of these measures.

A prioritisation of options will be determined, and an integrated water resources management policy guidance will be developed specifically for temporary rivers with regard to CIS-Guidelines and experience from the Mediterranean Pilot Basins in close interaction with DG Env. and the Common Implementation Strategy Group. This will address in particular the structure for planning measures following the DPSIR approach. Special emphasis will be given to basins where the application of the ecological status could be withheld.

The development of ***Integrated Watershed Management Plans*** in the mirror basins will be supported by

- Integrated assessment of ecological status considering interaction of aquatic and dry phase
- links between ecological status and remedial actions and sediment transport
- modelling approaches for heavy metals and toxic organics (interaction with WP7)
- assessment of existing remedial technologies (e.g. outcomes of LIFE Environment-EnviFriendly project) to reduce in-stream organic pollution and diffuse pollution (riparian zone restoration and phytoremediation, source control of e.g. olive mill and orange juice factory wastes, and in-stream remediation of organic pollutants)
- assessment of areas vulnerable to flooding and management of flood risk (flood vulnerability maps)
- Guidelines on bank stabilization and sediment removal
- Polluted sediments (from WP5 and WP7)
- methodology to categorize subcatchments based on typology,

Specific ***S&T support*** and ***Policy guidance*** will be given for

- Sources and sinks in conjunction to agri-environmental measures
- innovative assessment of bed load /river sediment removal in conjunction to coastal zone erosion as well as the ecological status (WP3) before and after removal
- study of particle size of transported sediment and bed load in combination with historical coast stability
- Guidelines for modelling hydrology and sediment transport, aid managers in model selection
- scaling up and scaling down methodologies for extrapolation to unmonitored basins
- Climate change scenarios to quantify impacts, e.g. on survival of endangered species, such as e.g. *L. Keadicus*
- assess the impacts of water quality and sediment transport on the Laconian gulf of Evrotas
- role of reservoir construction and management (affecting the minimum ecological flow (WP3 and 4), the delivery of sediments to the coastal area (WP6), the transport of nutrients (WP5) and pollutants (WP7), as well as affect river bank erosion (WP6))
- impacts on transitional waters (coastal wetlands and lagoons, e.g. in the delta of Evrotas River, area of Elos which is a NATURA site)

Basically, the practical application of the existing legislative framework and the comparison with emerging needs for reaching an adequate ecological status of temporary waters will provide the background to discuss systematic modifications of the WFD (e.g. through Article 21).

Stakeholders from the two mirror basins are involved in MIRAGE from the beginning. The consensus process will be facilitated and monitored by social scientists throughout the project, e.g. PL-LRS will develop a consensus building process in Evrotas.

WP2 will lead to adequate River Basin Management Plans following the WFD guidelines in view of 2009 and beyond where revision of the WFD are foreseen.

Expected outcome: *Guidance on IWRM in catchments of temporary waters in line with the WFD.*

WP 3 - Hydrological regime of temporary streams

In this work package we propose to improve the **classification and characterisation of temporary waters**, to assist in the definition of reference conditions in connection with ecological studies made within WP4, to survey and forecast the distribution of the impacts related with temporary waters, and to develop scenarios of likely future change due to climate change, land use change etc. The deliverables aim to provide a relevant contribution to application and further development of the WFD, in the context of catchment and regional management and

policy development across the spectrum of water stressed conditions for catchments that include temporary waters.

Stream discharge and flow continuity will be monitored in test reaches in order to classify hydrological criteria for biological sampling sites used in WP4 as well as in the definition of protocols for determining reference conditions in temporary streams. The site selection protocols developed will be designed to meet the needs of both ecologists and fluvial hydrologists, providing indicator features that can be identified in the field and from air-photo or high resolution satellite images. The occurrence and connectivity of pools as well as the state of the hyporheic zone in dry conditions will be monitored in suitable reference and near-reference test reaches.

Stream hydrographs from a sample of catchments and sub-catchments will be analysed in order to investigate the patterns of temporality, as well as to search for medium-term trends in flows and regimes over time. Temporary waters vary both in the normal seasonal patterns of flow and dry periods, ranging from extremes of ephemerality to regimes with only occasional summer dry periods; and in the inter-annual variations in these patterns that result from both normal climatic fluctuations and progressive climate change. As well as the over-arching climatic drivers, modified by local responses to macro- (e.g. elevation) and micro- (e.g. aspect) topography, these analyses will take into account local tectonic, geological and groundwater relationships as well as human modifications through channel modification and agriculture. These conditions will be explored through literature review, interviews with catchment managers and discussion within the consortium.

Hydrological modelling in WP3 will be applied at two scales, both focussing primarily on seasonal variations in flow and water balance rather than detailed flood routing. First models will be set up and calibrated and validated for test catchments in which we propose to develop the regional models for runoff and water quality, and providing a tool for classifying other Mediterranean catchments in relation to applicable management tools. These models will build explicitly on the study of temporality, and work with similar regime indicators. Second these models will be generalised and simplified for the regional scale, also building on the existing PESERA model, to assess the areal pattern and intensity of water quantity and quality impacts, and the consequent applicability of alternative management regimes at a Mediterranean-wide scale.

Expected outcome*: Hydrological characterisation of temporary waters in line with the WFD, at both catchment and regional scales.*

WP 4 - Structural and functional assessment of temporary streams: A linked aquatic and terrestrial perspective

This WP will (i) focus on the **functional linkages between aquatic and terrestrial** assemblages across spatiotemporal ecotones, (ii) identify the **key environmental predictors** that create and maintain these assemblages and linkages (e.g. spatial and temporal availability of refugia), and (iii) develop a **process-based evaluation** strategy for temporary streams by quantifying the trophic linkages between aquatic and terrestrial assemblages and by quantifying ecosystem metabolism. The overall goal is to provide a **novel integrated assessment tool** for temporary streams by combining **structural condition with functional performance**.

Aquatic and terrestrial assemblages are highly dependent on flow conditions, the key environmental predictor. This is particularly true for temporary streams, where the river only flows part of the year. The first few weeks, the assemblage is more comparable between streams than in summer. During the drying phase the aquatic assemblage becomes more divergent depending on the permanency of pools. Finally the river falls completely dry at the surface and the terrestrial phase starts. We will quantify the faunal succession along both phases in selected study streams (**structural studies**). A protocol to measure the structural changes will be developed for both aquatic and terrestrial phase which includes a **multimetric index** specifically designed for temporary streams in the aquatic **and** in the terrestrial phase.

The **functional linkage** between aquatic and terrestrial assemblages will be studied using stable isotope ratios of carbon and nitrogen (e.g. Paetzold et al. 2005). We predict that the strength of trophic linkage depends on flow permanency (both spatially and temporally), as well as on pollution. In addition, we will use the stable isotope ratios as a community-wide measure of the trophic structure in temporary streams (Layman et al. 2007), similar to the geomorphic approach used to assess the state of rivers and streams. This would be a novel way to assess the community structure of temporary streams.

Ecosystem metabolism includes gross primary production (GPP) and ecosystem respiration (ER). Hydraulic and hydrological alterations, temperature increase, nutrient inputs, and riparian zone and catchment modifications affect ecosystem metabolism (Odum 1968). Ecosystem metabolism is therefore very meaningful across all types and sizes of streams and rivers and can be measured fairly accurately. Therefore, it has the great potential as an integrative **functional indicator** of a river (e.g. for assessing the resilience of a system following a disturbance or perturbations (e.g. Acuña et al. 2004).

Finally the effect of human activities on aquatic and terrestrial invertebrates (and on structural and functional conditions) will be investigated. The effects of point and diffuse pollution will be assessed. In addition to the more detailed studies of pollution effects carried out in other workpackages we will test effects on aquatic macroinvertebrate structure and function following the rationale of the WFD. In order to compare temporary streams in distant geographical regions a “Reference Condition Approach” (Reynoldson et al. 1997) is required. The biological communities of both the aquatic and terrestrial phases in human-altered streams will be compared

to more pristine streams of similar hydrogeomorphic and physicochemical condition (type-specific conditions according to REFCOND guide).

Finally, the **impact of climate change** on the ecological status of the temporary river will be predicted. Based on field investigations an assessment methodology will be developed to identify the expected changes in biodiversity and ecosystem functioning as a consequence of prolonged droughts and increased flow variability. The extent of the impact will be quantified and measures on how to mitigate the impact will be identified and developed.

Expected outcome: *Integrated assessment toolbox including structural and functional indicators in line with the WFD, advance in knowledge on functional linkage between aquatic and terrestrial assemblages.*

WP 5 - Nutrient dynamics and organic matter

In the European countries, pollutant point sources are, most of the time, subject to restrictive standards of emissions for their different pollutants. So it is often considered that, nowadays, pollution point sources do not have a considerable impact on river water quality. Yet, in intermittent rivers, standards must be revised and that is the aim of WP5.

The WP5 will study the dynamics of chemical element and organic matter in intermittent river reaches impacted by point pollution sources. Different kinds of point sources will be studied at a local reach scale: domestic waste water treatment plants, raw waste water effluents from food industries (as oil mills, wineries) and sewage overflows. The different types of inputs will be compared in terms of their impacts on water quality, so that thresholds of acceptable emission levels could be assessed for intermittent rivers.

WP5 is foreseen to gather operational data on (a) existing treatment plant types or infrastructure; (b) accumulation and transformation of nutrient, organic matter in biofilms and sediment in the riverbed, downstream from direct inputs, in low flow conditions; (c) flush effect of first floods on the riverbed pollutant reservoir. The expected outcome of WP5 is a review about how the impact of pollutant point sources has to be considered in dry basins from the WFD point of view.

This WP requires specific monitoring actions. Experiments will be developed at local reach scale to assess accumulation and transformation processes as well as flush effects. The in-stream processes which play an important role in accumulation, transformation and remobilization of pollutants will be compared for different types of direct inputs and for various hydrological conditions. Their inter-annual variability will be studied. A special emphasis will be put on the role of biofilms, bacteria and organic matter on pollutant dynamics, in bed sediments during low flow periods, as well as on the role of particulate matter remobilization on pollutant loads during first floods. Hence, it will be possible to evaluate the assimilative capacity of intermittent rivers regarding direct inputs of nutrients, organic matter and bacteria.

It is foreseen to characterize the acceptable direct input levels in intermittent rivers and consequently to define the adequate waste water treatment techniques for the Mediterranean region. The WP5 will enable the guidelines with levels and characteristics of acceptable direct inputs and define preferences in the waste water treatments and temporal releases of waste water to temporary streams. The final goal of this WP is the definition of practical management options to satisfy the criteria of the EU-WFD.

Expected outcome: *Advance in knowledge of nutrient and organic matter dynamics and guidance on related measures in temporary waters.*

WP 6 - Sediment regime

The EU Water Framework Directive (WFD) does not specifically address sediment management. But it offers an opportunity to further improve our knowledge about the relation between sediment quality and water quality and to harmonise quality assessment and sediment management on a river-basin scale. On the other hand the recent EU Soil Protection Directive address the problem of soil erosion as one of the main threats of European soils identifying non-point pollution as one of the off-site impacts of erosion.

MIRAGE will address two types of soil erosion and sediment transport mechanism that predominate in Mediterranean countries. Traditional erosion patterns predominate in areas such as the Iberian peninsula where the morphology of the terrain is hilly where as river bank erosion predominate in areas where the morphology is mountainous such as Greece and Italy.

Soil erosion and surface runoff may be the major source of organic carbon and contaminants in particulate forms It is well documented that there is a link between land surface erosion and the diffuse contamination of surface water. This relationship is complex due to sediment deposition in sink areas of the catchment and the uncertainties in sediment delivery ratio. The main goal of the analysis is identify sediment sources areas and estimate sediment delivery ratio. Methodologies to be used are the following: soil erosion/landscape models based on GIS, remote sensing techniques (multispectral satellite images analysis), monitoring of sediment concentration and load, and sediment fingerprint techniques. . Different management scenarios to reduce sediment deliver to river system will be tested by using simulation models previously tested in target catchments.

River bank erosion is a significant type of erosion in Mediterranean countries due to the flashy nature of their rivers. MIRAGE will use fine resolution remote sensing techniques to identify eroding areas with the river

floodplain and the coastal zone of Evrotas and Candelaro basins and we will quantify the bed load changes. In addition, MIRAGE will investigate the long-term conditions of the coastal zone impacted by the episodic sediment supply, based on aerial photograph analysis over the past decades, in order to identify potential erosion/accretion problems in the study areas. This information will feed management scenarios dealing actually with the proper use of sediment accumulated along the river banks under normal conditions and especially during storm events.

Expected outcome: *Advance in knowledge of particulate dynamics, the influence on water quality and guidance on related measures in temporary waters.*

WP 7 - Hazardous substances

The WP deals with hazardous substances included in the WFD priority list and other pollutants assessed on the basis of CIS project template.

In temporary rivers, the dynamic and fate of sediment-adsorbed organic and inorganic compounds derived from point (industrial or urban waste discharge) or non-point sources (agricultural application, or by air diffusion of volatile and dust adsorbed compounds) are strongly influenced by *sediment aging*, and chemical, physical and biological *degradation* under high temperature and dry conditions.

Accumulation and transformation during no-flow periods consistently modify the availability of hazardous substances and, consequently, their effect on the receiving water bodies. The mobilization of these compounds under different seasonal conditions should be investigated in order to fully assess their environmental risks. The knowledge of environmental fate in these particular conditions will help the local authorities to implement correct monitoring plans and protocols for priority and hazardous substances under WFD requirements.

Investigations concerning water and sediment quality (presence of hazardous substances, transformations, partition and transport through suspended matter) and the effects on benthic organisms (bioavailability) during and after high flushes following drought periods will contribute in the identification of management strategies for temporary waters bodies.

The WP will consider the fate of hazardous substances in relation to (a) changes in the sediment physical micro-environment (humidity, temperature, solar radiation and adsorption characteristics of the sediment) and (b) variations in microbial activity and composition.

Field work, on selected sites at sub-catchment scale, will assess hazardous substances distribution and temporal variations in relation to seasons and different hydrological conditions.

Experimental work, under controlled conditions, will allow testing and comparing, on different sediments, mechanisms and rates of degradation of selected substances under physical (e.g. photochemical degradation) and biological (e.g. bacterial uptake or/and degradation) agents.

The study of the distribution and fate of these hazardous compounds that are widely distributed is a "*high-risk, high-gain*" research emerging argument. Information gathered will allow to conduct scenario analysis on impacts/changes of pollution due to climate, land uses, remedial action, etc.

Expected outcome: *Advance in knowledge of nutrient and organic matter dynamics and guidance on related measures in temporary waters.*

WP 8 – Integrative flood management for water quality

Evidence from individual catchment studies, and management options suggested by conditions in particular catchments must be seen in the light of the wider problem of flush events at the scale of the whole of the Mediterranean region. Characterisation of flush effect risks, and their potential for management at Mediterranean scale, can draw on a large pool of existing monitoring data, both catchment characteristics and event drivers including storm histories, land management and the location and characteristics of point source inputs.

Greater linkage of water quality aspects is a clear requirement in the investigation of integrated flood management strategies.. This is likely to result in a better combined use of measures leading to improved cost-effectiveness. Further, investment to improve water quality alone is often difficult to achieve, while flood damage may be generally accepted by the catchment population as a direct threat.

The WP on integrative flood management for water quality will cover three areas (i) estimation of flush-associated risks at the scale of the Mediterranean basin (ii) assessment of the effect on flush-associated risks of wider scale application of management measures investigated at the study sites and (iii) a preliminary assessment of the effect of these measures on ecohydrology at Mediterranean scale.

The determination of flood probability will be estimated from national-scale daily rainfall and runoff data by applying simple rainfall-runoff models which are in routine use for flood estimation in the UK following the Flood Estimation Handbook (FEH) approach (Institute of Hydrology, 1999; Kjeldsen, 2005). Suitable daily rainfall data are available. Runoff data will be obtained from the relevant national organisations.

The occurrence of floods is not directly correlated with first flush events, and the relationship between floods and flushes will be empirically determined from available water quality data or from experimental results, for example

from tempQsim. Combining this empirical model with the FEH-type relationship between rainfall and runoff will provide a simple empirical relationship between rainfall and flush events based on readily accessible national databases. This approach depends on the availability of national-scale data. The probability distributions estimated will be combined with the benefits of management options for particular types of event to generate estimates of the potential annual benefits of optimal management.

The FLOODMED and EnviFriendly projects have identified a number of measures for flood management in the Mediterranean river basins. These measures will have an impact on some first flush effects, but an additional regional assessment of management needed for flush events is lacking. The likely regional impact of the suggested measures will be estimated using the inferred return periods of flush events based on national-scale data.

Expected outcome: *Advance in knowledge of flush-associated risks related to water quality, assessment and guidance on related measures in temporary waters.*

1.3.4 Risk identification

As with any other planned study, there will be potential risks related to MIRAGE, which will be identified as well as the strategies to avoid a major influence on the planned outcomes. MIRAGE will pose no physical risks to human beings, animals or the environment in the implementation of the project. All activities will include an assessment of the associated risks, which will lie within the responsibility of the Project Coordinator and the WP leaders. Any issues of risk will be addressed by the Steering Group, and will be continuously monitored.

No rain during study, lack of extended run-off data

The absence of significant rain events in the basins can be compensated by the approach of using multiple sites. Additionally, there is an intensive use of already available data-sets foreseen: Vallcebre (more than 10 years record); Vène (more than 10 years record), RESEL Spanish network (Ministry of Environment) etc.

Data for specific tasks will not be available

In case that no data is available or the measurements fail to some extent in the basins, the planned laboratory experimental work to simulate extreme conditions for evaluating pollutants fate and transformations can be used to partially compensate for missing information.

Problems of the implementation in the Mirror Basins, heterogeneous implementation of the WFD in the member states and lack of an available Common Implementation Strategy

These problems are accounted for, as MIRAGE includes two Mirror basins. In case there are severe problems in the two, one or two of the other study sites can take over the part of a Mirror Basin.

No stakeholder interest in participation and results

Stakeholders of the two mirror basins in Evrotas (PL-LRS) and Candelaro (ABP) are included as a partner. So they will be actively involved in the process and are interested in the implementation of the outcomes. In addition, socio-economic studies have been already conducted at the Evrotas River Basin by National Centre for Social Research (in the LIFE-EnviFriendly project) which have attracted strong interest of the stakeholders. NCSR will participate in this project as subcontractors of TUC ensuring in this way the continuation of stakeholder participation.

Conflicting interests of different stakeholders

Problems concerning an implementation of the WFD may emerge caused by other stakeholders in the mirror basins which are not included as partners. In these cases these do not influence the project goals, as no part of the project builds on the final implementation of the WFD but will deliver exemplary guidance on this topic to the Mirror Basins.

Problems in partner communication

As most of the partners are known to each other and have successfully worked before, there is a common understanding and a shared vision of the project goals and the procedures.

Problems with software development and application for these specific rivers

There have been already developed a lot of the necessary tools, models and procedures for the application in temporary rivers in former projects. All partners have significant experience with these and there will be no delay due to unforeseen limitations in the tools.

1.3.5 Timing of workpackages

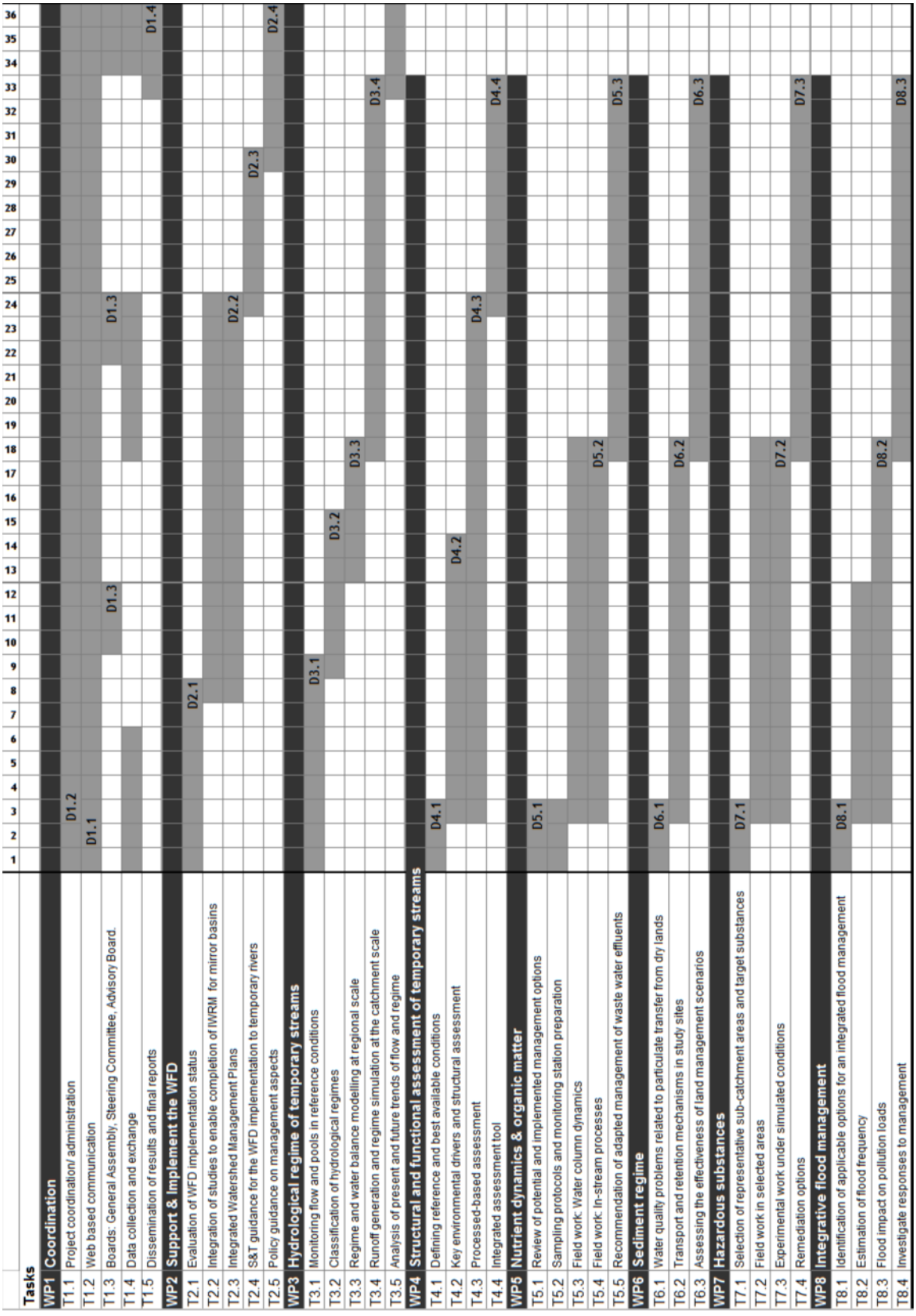

Fig. 5: : Time schedule of the project

1.3.6 Work package list

Work package No.	Work package title	Type of activity[1]	Lead participant No.	Person-months	Start month	End month
1	Coordination – Management of MIRAGE	MGT	1	31	1	36
2	Support & Implement the WFD	RTD	2	103	1	36
3	Hydrological regime of temporary streams	RTD	5	82	1	36
4	Structural and functional assessment of temporary streams	RTD	6	77	1	33
5	Nutrient dynamics & organic matter	RTD	8	64	1	33
6	Sediment regime	RTD	5	85	1	33
7	Hazardous substances	RTD	4	24	1	33
8	Integrative flood management for water quality	RTD	10	81	1	33
	TOTAL			547		

[1] **RTD** = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities); **DEM** = Demonstration; **MGT** = Management of the consortium; **OTHER** = Other specific activities, if applicable in this call.

1.3.7 Deliverables list

Del. no.	Deliverable name	WP no.	Nature[2]	Dissemination level[3]	Delivery date
1.1	Web and communication service	1	P	PU	2
1.2	Manual of agreed protocols, harmonised procedures for data collection	1	R	RE	3
1.3	Administrative and scientific periodical reports, workshop proceedings, Minutes	1	R	RE	6, 12, 18, 24, 30
1.4	Final report	1	R	PU	36
2.1	Review of WFD implementation status	2	R	PU	8
2.2	Development of Integrated Watershed Management Plans	2	R	PU	24
2.3	S&T guidance for the WFD implementation to temporary rivers including scenario analysis on climate and land use change impacts	2	R	PU	30
2.4	Policy guidance on management aspects of Mediterranean temporary river basins	2	R	PU	36
3.1	Recommendations for differentiation of hydrological stream types	3	R, O (Model output)	PU	9
3.2	Collective data sets and records	3	R	RE	15
3.3	Characterisation of hydrological conditions at catchment scale	3	R	PU	24
3.4	Characterisation of hydrological conditions at regional scale	3	R, O (Model)	PU	33
4.1	Reference conditions definition protocol for temporary streams	4	R	PU	3
4.2	Quantitative data on the relationship between aquatic and terrestrial assemblages along dry-wet gradients	4	R	RE	14
4.3	Metrics to measure the ecological status linking aquatic and terrestrial communities	4	R	PU	24
4.4	An integrated assessment toolbox, including structural and functional indicators, and a robust stream metabolisms model applicable for temporary streams	4	R	PU	33
5.1	Revision of management options (sewage effluents)	5	R	PU	3
5.2	Summary of experimental results and field work	5	R	RE	24
5.3	Recommendations for adopting specific management strategies	5	R	PU	33
6.1	Revision of management options (Particulate substances)	6	R	PU	3
6.2	Summary of experimental results and field work	6	R	RE	24

[2] **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

[3] **PU** = Public; **PP** = Restricted to other programme participants (including the Commission Services); **RE** = Restricted to a group specified by the consortium (including the Commission Services); **CO** = Confidential, only for members of the consortium (including the Commission Services).

6.3	Recommendations for adopting specific land management strategies	6	R	PU	33
7.1	Revision of management options (hazardous substances)	7	R	PU	3
7.2	Summary of experimental results and field work	7	R	RE	24
7.3	Recommendations for adopting management strategies	7	R	PU	33
8.1	Revision of management options (Integrative flood management)	8	R	PU	3
8.2	Summary of experimental results and field work	8	R	RE	24
8.3	Recommendations for adapted integrated flood management strategies	8	R	PU	33

1.3.8 Work package descriptions

WP 1

Work package number.	1				**Start date or starting event:**							Month 1				
Work package title	**Coordination – Management of MIRAGE**															
Activity type[4]	MGT															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	12	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1

Objectives

- coordinate and administer the project,
- collect and revise reports and deliverables, collect data,
- communicate within the project, with end-users, with the DG Research, with the public
- exchange knowledge, results and procedures with related PRB-activities, clustered projects, WFD CIS group

Description of work (possibly broken down into tasks), and role of participants

Task 1.1: Project management, coordination, administration (LUH, TUC, CSCIC, UBAR, UM2, CSIC, IRSA, CEH**)**

This task is related to the coordination of the whole project and includes:

- management the WP-Work, financial and legal administration and information flow and progress reporting to the DG-Research,
- organizing and chairing project meetings and conferences
- managing conflict in the event of difficulties and deviations from the work plan
- taking on the responsibility for the deliverables
- keeping regular contact with the coordinators of ongoing related projects

This will be facilitated by frequent checks for deviations from the work plan, frequent status information, prompt attention to difficulties encountered by the teams, and continuous information flow between the WP-Leaders.

Ongoing news on successes or problems will be discussed at regular phone conferences.

Task 1.2: Web based communication (LUH)

Communication processes will be supported via a number of web based services. This will include:

- a website based on a database driven content management system (CMS) containing project documentation and presentation to the public with adjustable user access control, including publicly accessible areas and project internals,
- an online document store for central storage, as well as distribution of material such as protocols, reports, memos or project publications,
- a web based calendar for harmonization and reminder of deadlines and due dates,
- other means of online communication, such as chats and discussion forums for subject-related exchange of experiences,
- mailing lists (establishment of mail recipient groups) for persons, grouped by subject (e.g. WPs) and function (e.g. WP-Leader, SH),

[4] **RTD** = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities); **DEM** = Demonstration; **MGT** = Management of the consortium; **OTHER** = Other specific activities, if applicable.

- an email subject key for efficient mail management.

Task 1.3: Boards: General Assembly, Steering Committee, Advisory Board (LUH, TUC, IRSA, ABP, PL-LRS**)**

Preparation, invitation, organisation and chairing of the meetings, editing of reports and minutes as well as control of decision implementation. Planning of Stakeholder Council workshops for discussion and evaluation of project progress.

Task 1.4: Data collection and exchange (LUH, all**)**

The Coordinator will provide storage capacity, implementation and maintenance for the collection of the already available data (project beginning) and for the measured data during the project duration (mid-term and end of project).

The data will be collected from the responsible catchment team and sorted in the categories:

- GIS-based information (e.g. hydrographical, pedological, socio-economic information, visualization of results, Arc-Info format),
- time-series data (measurement results, simulation results).

The collected, verified and sorted data will be inserted in a database.

Task 1.5: Dissemination of results and final reports (LUH)

Dissemination of the scientific outputs, developed protocols and management plans to international organisations. Publication of the final report and distribution of reprints.

Deliverables (brief description and month of delivery)

D1.1 Prototype: Web and communication service (Month 2)

D1.2 Report: Manual of agreed protocols, harmonised procedures for data collection, quality control and archiving (Month 3)

D1.3 Reports: Administrative and scientific periodical reports, workshop proceedings, Minutes (Month 6, 12, 18, 24, 30)

D1.4 Final report (Month 36)

WP 2

Work package number.	2				Start date or starting event:							Month 1				
Work package title	Support and Implement the WFD															
Activity type[5]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	9	15	13	14	7	5	3	3	2	2	2	2	8	6	6	6

Objectives

- Integration of knowledge developed in all WPs
- S&T support and guidance on WFD implementation to temporary rivers
- Policy guidance regarding management aspects of temporary river basins

Description of work

Task 2.1 Evaluation of WFD implementation status (TUC, CNR-IRSA, UBAR, JRC-IES, ABP, PL-LRS**)**

A comprehensive and critical evaluation of the implementation of the WFD status in the two mirror basins will be conducted after taking under consideration the CIS-Guidelines and experience from past Pilot River Basin exercises in the Mediterranean. The evaluation will be conducted at two stages. First, the partners that are involved in the basin together with the local stakeholders will assemble the appropriate documentation, conduct the review of the status and then summarize the findings in a written report that will be submitted to the WFD Committee for review. The WFD Committee will be comprised by project partners involved in the CIS process (such as JRC-ISPRA) and members from the Advisory Board. Then a site visit and the evaluation of the report will take place. The revised report of each mirror basin will provide the "road-map" for the completion of the WFD implementation.

Task 2.2 Integration of studies to enable completion of IWRM Plans for mirror basins (CNR-IRSA, TUC, LUH, CSIC, UBAR, UM2, CEH, FST-Fes, ABP, PL-LRS**)**

Knowledge developed in WP 3 through 8 will be integrated and applied to the two mirror basins. The following scientific issues regarding Integrated Water Resources Management of the two temporary river basins and coastal zones will be addressed:

- Assessment of areas vulnerable to flooding and management of flood risk.
- Develop design guidelines on bank stabilization and sediment removal from the river.
- Modelling the hydrology and sediment transport of temporary rivers.
- Assessment of polluted sediments and development of best management guidelines
- Best management practices of sources and sinks.
- Development of modelling approaches for heavy metals and toxic organics.
- Development of innovative methods to assess pollutant accumulation impacts on sediments.
- Assess existing remedial technologies to reduce in-stream organic pollution and diffuse pollution from groundwater.
- Assess the links between ecological status and remedial actions and sediment transport

Task 2.3 Integrated Watershed Management Plans (TUC, CNR-IRSA, JRC-IES, ABP, PL-LRS**)**

Following the DPSIR framework, the remaining aspects of the WFD implementation identified in Task 2.1 will be addressed using the knowledge developed in WP 3-8 and integrated in Task 2.2. For each site, management scenarios will be developed in close collaboration with all involved stakeholders. A prioritisation of options will be

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determined, and an integrated water resources management plan will be developed. A basin wide assessment of urgent action areas will be identified by integrating aquatic and terrestrial ecology and eco-hydrology perspectives and following the general requirements of the WFD. The IWCZ Management Plans will be reviewed by the WFD Committee and changes will be made based on their recommendation.

Task 2.4 S&T guidance for the WFD implementation to temporary rivers (TUC, CNR-IRSA, JRC-IES, LUH, CSIC, UM2, UNIVLEEDS, EAWAG, IMAR, HCMR**)**

A guidance document will be developed that will provide S&T support for the implementation of WFD to temporary rivers. The document will provide in an integrated fashion a summary of the scientific and technological knowledge developed in this project to be used by watershed managers.

Scenario analysis on climate and land use change impacts to temporary rivers

The scientific knowledge-base necessary for scenario analysis that will be developed in the WP 3-8 will be applied to examine water scarcity scenarios and evaluate the impacts of climate and land use change as well as threats to ecosystems such as transitional waters in the two mirror river basins.

Task 2.5 Policy guidance on management aspects (CNR-IRSA, TUC, JRC-IES, LUH**)**

A document will be developed (based on the S&T guidance including climate change aspects) providing guidance for policy alternatives regarding management aspects of temporary rivers. For the generalization of the best management and remediation practices and the development of temporary river basin management plans beyond the issues involved in the river basins of the project, input will be obtained from regional stakeholders, CIS working groups and related Mediterranean research initiatives. In addition to obtaining input through the participation in international blogs on sustainability and water resources management such as the Med EUWI blog, a specific workshop will be organized in order to gather such a group and obtain their opinion. Finally, the document will provide a framework for systematic modifications of the WFD that would be specific for the management of temporary rivers.

Deliverables

D2.1 Report: Review of WFD implementation status (Month 8)

D2.2 Report: Development of Integrated Watershed Management Plans (Month 24)

D2.3 Report: **S&T guidance** for the WFD implementation to temporary rivers including scenario analysis on climate and land use change impacts (Month 30)

D2.4 Report: **Policy guidance** on management aspects of Mediterranean temporary river basins (Month 36)

WP 3

Work package number.	3				**Start date or starting event:**							Month 1				
Work package title	Hydrological regime of temporary streams															
Activity type[6]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	0	1	0	7	33	0	0	7	17	0	0	4	0	5	1	2

Objectives

- Define types of stream temporality at different spatial scales in the context of water management purposes. Identify degrees and causes of temporality.
- Assess the spatial distribution and relevance of water temporality in the Mediterranean region. Assess likely changes driven by Climate Change.
- Analyse present and likely future trends in water regimes driven by climate and land use change as well as water management options in a set of Mediterranean catchments.
- Implement methods to assist the determination of actual and reference hydromorphological conditions for the implementation of WFD in areas with relevant temporary waters

Description of work

Task 3.1: Monitoring flow and pools in reference conditions (CSIC, CNR-IRSA, HCMR, FST-Fes**)**

Stream discharge in wet conditions and the occurrence and connectivity of pools as well as the state of the hyporheic zone in dry conditions will be monitored in a set of reference and near-reference sites. This will guide the sampling of biological communities needed for a sound establishment of the characteristics of reference conditions in connexion with WP4 (Task 4.1).

Task 3.2: Classification of hydrological regimes (CSIC, UNIVLEEDS, EAWAG, ABP, PL-LRS**)**

Through literature review, hydrograph analyses, interviews with catchment managers and briefing among hydrologists and ecologists in the consortium, a classification of stream regimes occurring in the Mediterranean and the test catchments will be proposed based on system B in the WFD. This will include climatic drivers, setting of the climatic and altitude zones traversed by the stream, general and local exchanges with groundwater, and human modifications of the natural regime. A special attention will be paid to the occurrence of floods that may flush relevant amounts of nutrients, sediments and pollutants, as well as the depth and duration of no-flow and dry spells that play a major control on biological communities. The results will be exchanged with WP4 (Tasks 4.1, 4.2, 4.7 and 4.8) in order to establish the relationships between regimes and biota in the study sites.

Task 3.3: Regime and water balance modelling at regional scale (UNIVLEEDS, CSIC**)**

Regional scale modelling of water balance will be based on a hydrological partition of available precipitation, developing from routines already tested within the PESERA model and currently being applied within EU desertification projects. This partition is based on climate and land use, taking account of the distribution of storms and vegetation cover within each month. Additional components include an explicit analysis of groundwater resources, a simplified analysis of waste water loadings based on population and treatment level (based by default on economic development), and irrigation needs, derived from crop type and summer Remote Sensing coverage for irrigated areas. These components will refine the natural background water balance to improve estimates of accumulated (along the channel network) monthly runoff for the entire region. Existing routines will be updated making use of the results of Task 3.4.

Task 3.4: Runoff generation and regime simulation at the catchment scale (CSIC, UNIVLEEDS, CNR-IRSA, UM2, IMAR**)**

Fine scale modelling will be designed to be compatible with the coarse scale partition of rainfall, but using hourly precipitation data to estimate flood hydrographs for target catchments. The models will be based on a series of

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simple modal response types, for example dominated by (a) subsurface flow, (b) Infiltration excess overland flow, (c) snowmelt response and (c) local intense storm cells, optimising the behaviour of each catchment as a seasonally changing combination of these modal types, to generate a simple but broadly applicable generic model. This model will be tested for the determination of the reference conditions and cross-checked with results from tasks 3.1 and 3.2.

Task 3.5: Analysis of present and future trends of flow and regime (CSIC, UNIVLEEDS, TUC**)**

An outline of climate change impact on hydrological reference conditions in temporary streams will be given. Temporal trends of flow will be analysed in a set of gauging stations with historical data around the Mediterranean. Temporal changes of flow or regime will be analysed using diverse statistical tests. Water balance modelling using climatic data as well as water consumption data as in task 3.3 will be used to derive the climatic and consumption drivers of the observed trends. Land use and cover will be investigated as potential causes for changes in catchment water balance. Using the observed sensitivity to the drivers, long-term forecasts of water resources will be established for a set of climate, land use and water management likely scenarios.

Deliverables

D3.1 Report: Recommendations for differentiation of hydrological stream types (Month 9)

D3.2 Report: Collective data sets and records, flow and pool records in reference conditions (to WP4) (Month 15)

D3.3 Report: Characterisation of hydrological conditions at **catchment scale**, classification of hydrological regimes (to WP2) (including model for water balance and catchment scale water balance and flow regime assessment) (to WP4) (Month 24)

D3.4 Report: Characterisation of hydrological conditions at **regional scale**, classification of hydrological regimes (to WP2) regional scale model for runoff generation and regime) and implications of CC impacts for management (Month 33)

WP 4

Work package number.	4				**Start date or starting event:**				Month 1							
Work package title	Structural and functional assessment of temporary streams: A linked aquatic and terrestrial perspective															
Activity type[7]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	0	0	0	7	4	20	8	1	0	0	26	5	10	0	1	0

Objectives

- To identify the key environmental predictors for aquatic and terrestrial assemblages in temporary streams, both at local and regional scales
- To define reference conditions for assessing the ecological status of temporary streams, following the guidelines of the WFD
- To quantify the functional linkages across spatial and temporal ecotones and develop "stream metabolism" as a functional integrator and indicator for assessing temporary streams
- To provide a novel integrated assessment tool box for temporary streams by combining structural and functional indicators

Description of work

Task 4.1 Defining reference and best available conditions (UBAR, EAWAG**)**

Reference conditions will be pre-assessed at three different scales (i.e. basin, reach, and site). At each scale the physical, chemical, biological pressures that are expected to impact aquatic and terrestrial assemblages will be identified and quantified. This is primarily a desk study linked to cursory field work.

Task 4.2 Key environmental drivers and structural assessment (UBAR, EAWAG, CRN-IRSA, CSIC, UMU, UM2, IMAR, HCMR**)**

Depending on the specific flow conditions, as defined in WP3, critical transition periods for structural and functional conditions will be identified. Environmental conditions (i.e. specific conductivity, pH, oxygen and nutrient concentrations, soil water content, temperature) and biological indicators (i.e. algae and invertebrates) will be quantified during the wet and dry phases using standard methods. Physicochemical parameters will be measured at short intervals in sites (daily or even hourly) were continuous records of flow are possible (using auto-samplers), and at regular intervals in sites where no continuous measures exist. During the wet phase samples of diatoms will be collected following the CEN normative to study the community dynamics, while quantitative samples of macroinvertebrates will be taken according the AQEM methodology. Terrestrial invertebrates will be quantitatively (30X30 cm frame) sampled during the dry phase (see Petzold et al. 2005). Replicated biological samples will be taken following the most important hydrologic events: (i) one week after peak flow, (ii) when base flow has been regained, (iii) when the river nearly ceases at the end of the season, and at the beginning and at the end of the dry phase (for terrestrial invertebrates).

Task 4.3 Processed-based assessment (EAWAG, UBAR**)**

Functional performance of temporary streams

Gross primary production and ecosystem respiration will be measured during wet and dry phases over a 2 year period. Sediment temperature, grain size distribution, water content, % of maximum water holding capacity, and organic matter content will be characterized seasonally in each habitat prior to the measurement of respiration. Sediment and soil respiration will be measured seasonally using a respiration chamber attached to a portable infrared gas analyzer (IRGA). This technique is standardized for soil respiration but not for aquatic respiration, so that a special chamber design will be developed to accurately measure respiration in both terrestrial and aquatic compartments (Doering et al. in review). During the wet period, we will apply the single-station oxygen method (Uehlinger 2006) and metabolism will be calculated using the RIVERMET programme (Izagirre et al. 2007).

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Functional linkages across temporal and spatial ecotones

Natural abundances of stable isotopes will be applied to assess the flow of nutrients and matter across the aquatic-terrestrial interface through invertebrates (e.g. Thorp *et al*., 1998; Paetzold *et al*., 2005). Replicated samples of aquatic and terrestrial invertebrates, as well as of potential aquatic and terrestrial food sources will be collected seasonally along a temporality/harshness (cf. Fritz & Dodds 2005) and a human impact gradient. Linear mixing models will be used to rebuild the food-web in the temporary river ecosystem along these gradients. Finally, a set of novel metrics, as proposed by Layman (2007), will be used to assess the community structure of temporary streams (based on stable isotope ratios).

Task 4.4 Integrated assessment tool (UBAR, EAWAG, ABP**)**

Structural conditions will be determined using metrics such as Richness (S) and Diversity (H'), among others. For the aquatic phase and according to the WFD the expression of ecological status will be derived from the calculation of **multimetric** indices adapted for temporary streams (e.g. ICM-STAR used in the intercalibration exercises). Also the novel functional indicators measured in task 4.3 will be related to the structural measures used for WFD implementation. Finally, a new Integrated Assessment Tool will be developed and tested in selected Mirage study sites.

Deliverables (brief description and month of delivery)

D4.1 Protocol: Reference conditions definition protocol for temporary streams, guidelines for sampling aquatic and terrestrial assemblages, and protocol for quantifying functional linkages and measuring stream ecosystem processes (during drying and rewetting periods) (Month 3).

D4.2 Report: Metrics to measure the ecological status linking aquatic and terrestrial communities. Methodological document (based on concomitant laboratory and first field studies) on assessing the hydromorphological and ecological conditions in temporary streams including a functional-measures template (Months 14).

D4.3 Report: Quantitative data on the relationship between aquatic and terrestrial assemblages along dry-wet gradients (impacted and reference conditions). Quantitative data on ecosystem metabolisms along temporality and human impact gradients, and prototype of a metabolism model (to WP2) (Months 24).

D4.4 Report: An integrated assessment toolbox, including structural and functional indicators, and a robust stream metabolisms model applicable for temporary streams (Month 33).

WP 5

Work package number.	5				**Start date or starting event:**							Month 1				
Work package title	Nutrient dynamics & organic matter: impact of pollution point sources															
Activity type[8]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	12	6	0	4	0	7	0	21	0	0	0	0	0	12	1	1

Objectives

- Analysis of the impact of different types of pollution point sources (domestic waste water treatment plants, sewage overflows, raw waste water effluents of small food industries like oil mills, orange juice plants or wineries) on water quality dynamics, at reach scale.
- Definition of direct input thresholds to maintain an acceptable water quality level.
- Prioritization of the different types of direct input in terms of pollution acceptability for the river and its downstream environment, both in low flow conditions and during floods.

Description of work

The main work is to monitor the dynamics of nutrient and organic matter in the water column and the riverbed compartments (biofilms, sediments) in a reach subject to direct inputs and to identify the main in-stream processes impacting these dynamics. The Tasks 5.2 and 5.3 will be developed in close collaboration with WP7 (Task 7.2).

Task 5.1 Review of potential and implemented management options (UM2, LUH, CNR-IRSA**)**

Through literature reviews, queries and interviews of water resources managers in the test sites, pollution point sources and related water quality problems will be identified. “Hot spots” of point sources will be chosen for exemplifying the main types of direct inputs. Surveys will then be carried out to select study reaches in each test sites, in relation with WP4 (Task 4.1), for field work and experiments.

Task 5.2 Sampling protocols and monitoring station preparation (UM2, UBAR**)**

The objectives are to set up monitoring stations and to manage the field work. This task involves the installation of the gauging and sampling stations. It also includes the definition of the sampling protocols in the water column and in the sediment as well as the coordination of the field campaigns during low flow periods and floods, in relation with WP7 (Task 7.3).

Task 5.3 Field work: Water column dynamics (UM2, FST-Fes**)**

The objectives are to analyse the spatial variability and temporal dynamics of pollutants in the water column, and to define for each type of direct input its impact and influence distance. This task is based on the analysis of the hydrological conditions, the flow dynamics and the variability of the pollution point sources. It involves:

- Analysis of the flow conditions, at the reach scale: duration of the low flow and dry periods and hydraulic characteristics in pools, in relation with WP3 (Task 3.1 and 3.3); flood frequency and magnitude, in relation with WP8 (Task 8.2).
- Study of continuous or non-continuous pollution point sources: characterization of temporal dynamics of flow and concentrations, at different time scales (day, month, season).
- Study of concentrations in the water column, along the reach, downstream from the direct input: characterization of temporal and spatial dynamics of concentrations, in different hydraulics conditions (low flow and flood events); evaluation of the range of influence of pollution point sources in relation with WP3 (Task 3.3).
- Study of pollutant fluxes along the reach, downstream from the direct input: characterization of temporal and spatial dynamics of pollutant fluxes, in different hydraulics conditions (low flow and

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flood events); assessment of accumulation / remobilization processes in the reach.

- Development of a general sketch describing nutrient and organic matter budget at reach-scale, during low flow period and first floods based on the water / pollutant inputs and outputs: ranking of the different compartments of the river reach on pollutant fluxes; evaluation of first flush effects.

Task 5.4 Field work: In-stream processes (UM2, FST-Fes**)**

The objectives are to analyse the relationship between the water column and the riverbed as well as to determine the pollutant accumulation, transformation and bioavailability in the sediments. Field experiments will be carried out to assess the potential of the different riverbed compartments (biofilms, biotas and sediments) to accumulate pollutants. This task involves:

- Study of the riverbed compartments in low flow conditions: characterization of the dynamics of nutrients and organic matter; evaluation of accumulation rates; characterization of the effect of desiccation and summer storms on the stocks; characterization of bioavailability and exchangeability of the pollutants, as well as their potentiality to be remobilised during first floods.
- Definition of the range of influence of pollution point sources in intermittent rivers, in relation with WP3 (Task 3.3).
- Development of a general sketch of in-stream dynamics of nutrients and organic matter at reach scale: evaluation of the availability of the sediment stocks, at the end of the low flow periods.

Task 5.5 Recommendation of adapted management of waste water effluents (UM2, LUH, TUC, UBAR, ABP, PL-LRS**)**

This task will be developed in close collaboration with WP2, WP3, WP4 and WP7.

The work will provide S&T support for the assessment of guidelines and recommendations for managing waste waters and choosing the well-adapted treatment systems in relation with hydrological characteristic of the intermittent river.

Deliverables (brief description and month of delivery)

D 5.1 Report: Revision of management options (Month 3)

D 5.2 Report, Data: Summary of experimental results for nutrient and organic matter dynamics (in exchange with WP5-8, to WP2) (Month 24)

D 5.3 Report: Outline of management option applicability (in relation with WP7) (Month 33)

WP 6

Work package number.	6				**Start date or starting event:**							Month 1				
Work package title	Sediment regime															
Activity type[9]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	4	7	3	2	38	0	9	0	0	0	0	13	7	0	1	1

Objectives

- Provide methods to identify sediment sources and estimate sediment delivery ratio at catchment scales in a context of water management.
- Analyse the relationships between soil erosion-sedimentation dynamics in-stream and ecological and chemical status of temporary and ephemeral streams.
- Assess the impacts of land management options and soil conservation measures on sediment loads and water quantity and quality in a set of Mediterranean catchments

Description of work

Task 6.1 Water quality problems related to particulate transfer from dry lands and applicable management options (CSIC, UMU, LUH, JRC-IES**)**

Through literature reviews, queries and interviews of water resources managers in target areas, soil erosion risk and related water quality problems related to particulate transfer from dry lands at the Mediterranean scale will be identified and classified.

A specific review of potential management options will be executed to identify their suitability, advantages and disadvantages to control the delivery from particulate nutrients and organic matter from land during storms.

Results will be used to integrate later the specific experimental and modelling outcomes into a larger framework, supporting the development of RBMPs.

Task 6.2 Transport and retention mechanisms in study sites (CSIC, UMU, IMAR, HCMR**)**

Identification of sediment/particulate sources at catchment scale

The studies of sediment sources at catchment scale will be based on the joint use of remote sensing methods (analysis of multispectral satellite data), GIS and fingerprint techniques. A protocol will be established to carry out this task through the study sites and mirror catchments.

Characterisation erosional/sink reaches in temporal and ephemeral streams, assessment of bank erosion

Stream reaches where scour is predominant, direct sediment sources to the stream and sink sediments will be identify by a field mapping methodology with the help of an adopted erosion-sediment transport model. Special attention to be paid to the impact of permanent (check-dams) and temporary (woody debris) transverse obstacles on the hydromorphological features. River bank erosion will be assessed and monitored by high resolution remote sensing techniques to identify eroding areas in the river floodplain.

Sediment/particulate data collection

Sediment data will be obtained in each of the target areas. This task will include the compilation of existing sediment records coming from on going sediment monitoring systems and reservoirs's bathymetry, field campaigns to record sediment loads during floods in selected catchments, and the set up of new sediment recorder stations (in collaboration with task 2.3; WP2).

Establish relationship between sediment and water quality status

A sampling scheme at both river reach and drainage area scale will be designed to account for the nutrient, carbon and other selected compounds inputs associated to sediment loads in ecological and chemical status.

[9] **RTD** = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities); **DEM** = Demonstration; **MGT** = Management of the consortium; **OTHER** = Other specific activities, if applicable.

Relationships between erosion/deposition pattern, channel bank erosion and sediment loads delivered from contributing upstream catchment will be established. This task will be complementary and coordinated with in-stream bed nutrient dynamics studies carried out by WP5 and WP7.

Modelling sediment transfer and estimate sediment delivery at catchment scale

A spatially distributed erosion and sediment transport model will be developed to estimate sediment yield at catchment scale. The model will be based on considering the control exerted by topography on sediment transport capacity and landscape dynamics. The runoff generation module will be based on the hydrological model developed in WP4. The model will be used to assess the impacts of different land management scenarios (task 6.3) and to outline the basin management plan of mirror catchment (in collaboration with WP2).

Task 6.3 Assessing the effectiveness of land management scenarios (CSIC, LUH, TUC, CNR-IRSA, IMAR, ABP, PL-LRS**)**

Different management scenarios, resulting from those defined in WP2 will be run at catchment scale. The spatially distributed erosion and sediment transport model will be used to simulate sediment yield and non-point source pollution delivery under the scenarios proposed. Published data on erosion rates under different land uses and efficiency of soil conservation measures will be used. Additional experimental work on impact of soil conservation practices on sediment and nutrient export will be carried out in specific locations.

Results will be processed and generalized to provide recommendations on specific applicable measures for improving the ecological status in temporary streams

Deliverables (brief description and month of delivery)

D6.1 Report: Revision of water quality aspects and applicable management options (Month 3)

D6.2 Protocol: Summary of experimental results and field work on transport and retention mechanisms in study sites, including a protocol of methodology for identification of sediment sources areas in study sites (in exchange with WP5-8, to WP2) (Month 24)

D6.3 Report: Recommendations for adopting specific land management strategies (Month 33)

WP 7

Work package number.	7				**Start date or starting event:**							Month 1				
Work package title	Hazardous substances															
Activity type[10]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	0	4	0	12	0	0	0	6	0	0	0	0	0	2	0	0

Objectives

- assess the presence and the distribution in water and in sediments of selected hazardous substances included in the WFD priority list and other pollutants assessed on the basis of CIS in sub-catchments areas of temporary rivers under different hydrological conditions (flow - no flow)
- investigate the dynamic and fate of these compounds under different hydrological conditions (flow - no flow), as affected by sediment moisture, microbial activities, physical stressors
- determine the effect of dry periods on the accumulation and the transformation of selected compounds in river banks and channels
- provide information to local authorities to set up and implement appropriate monitoring plans for hazardous substances under WFD requirements

Description of work

Task 7.1 Selection of representative sub-catchment areas and target substances (CNR-IRSA, UM2**)**

Because the presence of hazardous substances is associated to land uses in the catchment and in the surrounding areas, preliminary surveys will be carried out to define target substances and “hot spot” for specific field studies.

Task 7.2 Field work in selected areas (CNR-IRSA, UM2, TUC, FST-Fes**)**

Samples will be collected on selected sites, in the river bed and banks, to analyse hazardous substances distribution and temporal variations in relation to different hydrological conditions. The resuspension and partition in water and particulate matter will be studied following water pulses after dried periods. Sampling will be agreed with WP3 (to consider hydrological regime) and WP4 (to eventually evaluate bioaccumulation in biological communities and links to the trophic chain). Monitoring problems related to different hydrological conditions will be discussed under the light of FWD chemical monitoring requirements. Mirror catchments will be extended monitored for same substances, while other catchments will be studied only for site-specific compounds.

Compounds considered for monitoring their presence and fate will belong to following classes: alkylphenols and bisphenol-A (determined by HPLC with fluorescence detection); polycyclic aromatic hydrocarbons (by HPLC with programmable fluorescence detection and/or MS detection), pesticides (by GC-MS or LC-MS analysis) and heavy metals (by ICP-MS). Tributyltin will be also considered as priority dangerous compound.

Chemical analysis of target compounds will be standardized and replicable both in the environmental samples and in lab experiments. A set of high-level specifications will be elaborated to define methodologies, standards and protocols for sampling and analyses. Reference laboratories will be connected for sharing samples and carrying on inter-calibration exercises. Sampling campaigns in selected areas will be preliminary planned.

Field results will be validated and collected in a common database as part of the data base collected in WP 1. Data will be available to all partners and used as base for laboratory experiments. Temporal and spatial distribution will be mapped together with hydrological behaviour.

Task 7.3 Experimental work under simulated conditions (CNR-IRSA)

Experiments will be carried out under laboratory controlled conditions utilising natural river sediments and native biological communities.

[10] **RTD** = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities); **DEM** = Demonstration; **MGT** = Management of the consortium; **OTHER** = Other specific activities, if applicable.

Target compounds will be spiked and their persistence under different water content conditions will be tested. Effect on microbial metabolism, resistance to degradation and bioaccumulation will be described. Maximum load under rewetting condition will be estimated considering dissolution and resuspension. The effect of photochemical degradation will be included by exposing spiked sediments to direct solar radiation.

Transformation processes resulting from experimental studies will be compared and hypothesis on goal substances fate and dynamics will be described.

Task 7.4 Remediation options (CNR-IRSA, TUC**)**

The work will provide S&T support for the assessment of polluted sediments and development of best management guidelines. Best management practices of sources and sinks will be considered in conjunction to agri-environmental measures established in the region.

Deliverables (brief description and month of delivery)

D7.1 Report: Revision of management options (hazardous substances) (Month 3)

D7.2 Report: Summary of experimental results and field work, mapping of spatial and temporal distribution of selected hazardous substances (to WP6) including results from inter-calibration exercises (in exchange with WP5-8, to WP2) (Month 24)

D7.3 Report: Recommendations for adopting management strategies (Month 33)

WP 8

Work package number.	8				**Start date or starting event:**				Month 1							
Work package title	Integrative flood management for water quality															
Activity type[11]	RTD															
Participant number.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM per participant	9	7	4	5	16	0	6	6	0	12	0	6	6	0	2	2

Objectives

- Regional-scale estimation of return periods of first flush events by severity
- Risk assessment of flush effects in relation to environmental and commercial losses
- Assessment of the effect of possible management strategies

Description of work

Task 8. 1 Identification of applicable options for an integrated flood management (CEH, CSIC, TUC, LUH **)**

Management options (e.g. retention areas, small dams, levees, embankments, diversion channels, land use and catchment management, flood plain zoning, regulation and development) and results from the international projects FLOODMED (http://floodmed.chi.civil.ntua.gr) APFM (http://www.apfm.info), FLOODside (http://www.floodsite.net/), or national efforts e.g. Rimax will be systematically reviewed.

Results will be summarized in a cross reference matrix to indicate 1a) the influence of flood management in reducing pollutant release and transport 1b) their negative impact on the ecological status of temporary streams, and 2) their applicability to the mirror basins.

Task 8.2 Estimation of flood frequency (CEH, LUH**)**

Retrieve rainfall, flow and water quality data

National daily rainfall time series, and daily flow series will be retrieved from suitable natural catchments in the Mediterranean region. Readily available water quality data from the study sites (e.g. Vallcebre, 12 year detailed record, Vène, 12 year bimonthly record) will also be used and where necessary, special additional data will be retrieved from WP 5-7. From these data flood return periods will be estimated both directly and by first estimating return periods for rainfall events, and using design storms as inputs to a simple rainfall-runoff model derived from the Flood Estimation Handbook (FEH) methodology (Institute of Hydrology, 1999; Kjeldsen, 2005).

Results from national scale investigations will be applied at a local scale using existing rainfall runoff time series to provide estimates of the return period and magnitude of significant floods. Where possible, typical sequences of significant floods and antecedent dry periods will be investigated.

Task 8.3 Flood impact on pollution loads (CEH, CSIC, LUH, UM2, UMU, HCMR**)**

First flush effects on receiving waters will be characterised using RMF and NCL-methods (Obermann, et al. 2007) at annual and seasonal scales for the study sites mainly for N and P dynamics (including effects of e.g. nitrification, denitrification, biological retention, adsorption to sediments) and how this is influenced by the length of dry period.

Water quality standards for temporal streams will be suggested. Possible management scenarios and the impact of anthropogenic influences on this dynamics will be evaluated and new strategies will be proposed.

Assess losses associated with flush events

Losses associated with flush events will be assessed by considering how these losses are related to flow conditions. The amount of nutrients exported by flush events (fractions of nitrogen and phosphorus) will be quantified, and the relationship between losses and previous flow conditions (permanent *vs* intermittent *vs* dry channels) will be determined. Results from in-stream processes related to nutrient retention (as nitrification, denitrification, biological retention, adsorption to sediments), reported by WP 5 (task 5.3) will be analyzed for first

[11] **RTD** = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities); **DEM** = Demonstration; **MGT** = Management of the consortium; **OTHER** = Other specific activities, if applicable.

flush events. This assessment will be based on national experience of environmental and commercial costs associated with flush events.

Development of a simple empirical model relating flow and flush events

The model will take into account the time of year, catchment characteristics, length of preceding dry period and any other factors which examination of the data suggests are important. The model will aim to capture those aspects of flush events which are associated with the greatest environmental and commercial losses, providing a link between flow conditions and losses due to flush events.

Impact of dry weather deposition and duration of dry period

Based on existing approaches, a method to quantify the amount of deposited organic matter by vegetation will be developed. Landuse data will be used to investigate the impact of annual variations in leaf yield on organics sediment loads in the streams.

Task 8.4 Investigate responses to management (CEH, LUH, TUC, IMAR, ABP, PL-LRS**)**

The exploration of the controls of the flush response will guide the exploration of cause-effect relationships and facilitate process understanding and the refinement of management scenarios.

The change in the statistical distribution of first flushes and their associated losses will be investigated in the context of changes in catchment management (as suggested from WP 2), or changes in climate related to Task 8.1.The associated change in annual risk will be assessed.

Statistics of return periods and annual risk

Using the results of the water quality analysis and assessment of loss, statistics of return periods will be calculated for first flush events and their associated losses at a range of severities. This will provide a measure of annual risk.

Integrated flood management

Existing flood management plans will be evaluated and updated. The methodologies developed in Task 8.1 and 8.2 will be used to assess the areas in each watershed vulnerable to flooding and assess the effectiveness of flood management concerning the combined impact on water quantity and quality

Deliverables (brief description and month of delivery)

D8.1 Report: Revision of management options (Integrative flood management) (Month 3)

D8.2 Report: Summary of experimental results and processed data, statistical characterisation of daily rainfall and flow sequences (application of the FEH approach), assessment of losses in relation to empirical relationship between rainfall, floods and first flush events (in exchange with WP5-8, to WP2) (Month 24)

D8.3 Report: Recommendations for adapted integrated flood management strategies (Month 33)

1.3.9 Summary of staff effort

Participant no./short name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total person months
LUH	12	9	0	0	12	4	0	9	46
TUC	2	15	1	0	6	7	4	7	42
JRC	1	13	0	0	0	3	0	4	21
IRSA	2	14	7	7	4	2	12	5	53
CSIC	3	7	33	4	0	38	0	16	101
UBAR	1	5	0	20	7	0	0	0	33
UMU	1	3	0	8	0	9	0	6	27
UM2	1	3	7	1	21	0	6	6	45
UNIVLEEDS	1	2	17	0	0	0	0	0	20
CEH	1	2	0	0	0	0	0	12	15
EAWAG	1	2	0	26	0	0	0	0	29
IMAR	1	2	4	5	0	13	0	6	31
HCMR	1	8	0	10	0	7	0	6	32
FST-Fes	1	6	5	0	12	0	2	0	26
APB	1	6	1	1	1	1	0	2	13
PL-LRS	1	6	2	0	1	1	0	2	13

1.3.10 List of milestones

Milestone number.	Milestone name	Work package(s) involved	Expected date	Means of verification
1	Preparation completed: Establish monitoring stations & scientific/end-user dialogue (panel)	WP3,4,5,6,7,8, WP2	M3	Report & Minutes
2	Protocols: Identify reference sites for ecological sampling reaches, WFD-Review, common vision of SH and Consortium	WP1, 2	M12	First Annual Report
3	Experimental results and field work and assessment of mapping of spatial and temporal distribution completed	WP3-8	M24	Second Annual Report
4	S&T guidance for the WFD implementation to temporary rivers from all study sites compiled to report for mirror sites	WP2	M30	Guidance Document via WISE-RTD
5	Final recommendation for WFD relevant measures (management options)	WP3-8	M33	Guidance Document via WISE-RTD
6	Policy guidance on management aspects of Mediterranean temporary river basins, principles	WP2-8	M36	Guidance Document via WISE-RTD, Final Report

2. Implementation

2.1 Management structure and procedures

The MIRAGE project consortium will comprise 16 principal contractors who will operate within eight work packages. The partners (Universities, Research organisations and Basin Authorities) were thoroughly selected due to their intensive previous experiences and commitment in recent and ongoing projects, their publication records and their long-term strategic interest in the project topics.

In view of the complexity and multidisciplinary nature of the project as well as the number of participants, coordination is allocated its own specific work package (WP1) in order to support the decision making and knowledge exchange, information and dissemination of results.

This Project will establish robust organization and coordination mechanisms, which are based upon the highly effective and successful structural elements of several former EU projects, which have been managed by the Coordinator.

The Coordinator Jochen Froebrich has extensive long-standing experience in science management as well as in various EU projects, as detailed below. This long-standing experience will guarantee an efficient management and a strict and successful execution of the entire schedule of the CP according to the workplan.

The operational management of MIRAGE will be jointly realised by the coordinator, the Steering Group (SG) and the General Assembly (GA). They will be supported by an advisory board.

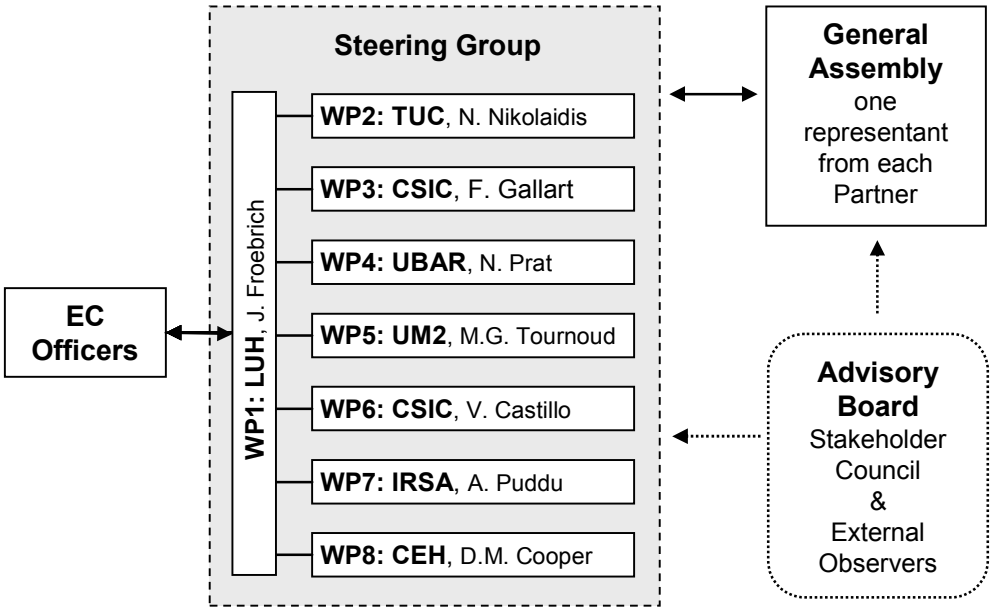


Fig. 6: Organisation structure (solid lines), external advice (dotted lines)

These bodies are explained in the following.

2.1.1 Project Coordinator

Dr. Jochen Froebrich will be project coordinator responsible for overall project management. He already supervised projects concerned with environmental impacts at the soil/water interface and development of modelling tools.

Dr. Froebrich coordinated amongst others the EU – FP5–project tempQsim (EVK1-CT2002-00112) “Evaluation and improvement of water quality models for application to temporary waters in Southern European catchments”, the EU-INTAS project IWMT (“Development of integrated water management strategies for the Tuyamuyn reservoir complex”, INTAS-00-1043) and the EU-INTAS project OPAL “(“Pollution avoidance and clean up strategies for the lower Amu Darya”, INTAS-01-080).

He is currently coordinating the EU Project JAYHUN (“Interstate Water Resource Risk Management: Towards A Sustainable Future for the Aral Basin”, Contract no. INCO 516761) and is leader of the Domain II (Water saving) of Workblock 3 (Water Stress Mitigation Options) in the IP AQUASTRESS (“Mitigation of Water Stress through

new Approaches to Integrating Management, Technical, Economic and Institutional Instruments", FP6, Contract no. 511231-2). These activities will allow close links and interaction with MIRAGE.

Dr. Froebrich is located at the Water Resources Management Division of the Institute for Water Quality and Waste Management (as part of the Leibniz Universität Hannover). He will guarantee the administrative and scientific coordination of the MIRAGE project. The Leibniz Universität Hannover has the experience and facilities to organise international meetings and conferences to support the progress of the project.

The coordinator will be supported by Dr. Matthias Obermann as project manager to facilitate the daily information flow and by Elke Buchholz of the EU liaison Office Hannover /Hildesheim as administrative and legal advisor. Mrs. Buchholz will be available to advise on important questions of financial management, administrative coordination, IPR and conflict mediation. Both have long time experience in collaboration with most of the Consortium members from their active participation in the execution of AQUASTRESS and tempQsim.

The EU Liaison Office (founded in 1992) advises and supports presently about 90 FP6 projects of eight higher education institutions in the region of Hanover in all administrative and legal questions. Additionally, it has extensive experience in carrying out its own EU-projects in the education and mobility programmes and in the administrative management of research and networking projects in FP5 and FP6. The EU-Liaison Office is part of the Leibniz Universität Hannover (LUH).

The role of the coordinator is to ensure that each phase of the project follows the schedule agreed by the consortium and to function as intermediary between the partners and the Commission. He will monitor the progress against time and budget allocations and ensure that the project fulfils the objectives listed as milestones and deliverables.

The coordinator also leads WP1 and is therefore also responsible for the dissemination of results and the management of the common data base.

2.1.2 General Assembly (GA)

The General Assembly, as the consortiums highest decision making body will be in charge of the overall direction of MIRAGE. The GA is composed by one authorised representatives of each partner which has one vote. Each representative will have a named deputy.

Any member of the project, of the Stakeholders Council and the Advisory board or external experts and other qualified persons may be invited to attend meetings of this council as a advisor without vote.

The General Assembly will be chaired by the coordinator or a chosen representative. The chairperson sets the agenda for meetings and secures the implementation of decisions taken by the GA in the SG. The chairperson can convene meetings of the GA by request of the SG and upon request of 1/3 of the representatives with vote of the GA.

The GA will decide amongst others about consortium budget shifts and financial allocations and may authorise by unanimous vote minus the concerned partner about an exclusion of a partner in case of severe malpractice. In this case, all members with a vote must be present or represented.

In other cases, a majority of two thirds of the present or represented member will allow a binding decision.

2.1.3 Steering Group (SG)

The Steering Group (SG) is the main decision making instrument of the regular project management. It is formed by all WP-leaders, unless otherwise decided by the General Assembly. This way, a best possible delegation of tasks is guaranteed. The SG will be chaired by the coordinator or a chosen representative. He will set the agenda for SG-meetings

The Steering Group advises the project coordinator and the General Assembly in handling all matters related to the coordination of the project, and will be consulted by these two in case of deviations.

The SG provides strategic scientific management to solve problems that lie within the remit of the MIRAGE project. It will agree on the proceeding of the workplan and modifications if these are caused by unexpected deviations.

The SG will meet at least twice a year. It is intended that the SG will reach decisions by consensus but where this is not possible decisions will be reached by a simple majority, the project coordinator having a casting vote. In case of absence of a member, the partner may choose a representative as proxy.

The documentation of alignment with the workplan is prepared by the WP Leaders and presented in the frame of the SG. In case of necessary modifications, the WP Leaders will discuss and agree on a proposal for future modifications. This proposal will be presented to the General Assembly.

In case of emergency situations the coordinator is authorised to take preliminary decisions which then have to be validated by the General Assembly.

2.1.4 Workpackage Leaders (WPL)

Each of the work packages will be coordinated by a work package leader with a related scientific background matching the WP-topic to ensure the performance and progress of the work package with regard to the deliverables and project milestones. The WPL will be in charge of gathering material from all contractors participating in the WP in order to produce the reports according to the deliverable list and the work plan. The WPLs will report to the Steering Group via the Coordinator. The different WPLs have been appointed by the partners according to their specialisation, scientific expertise and management skills.

The WPLs will be responsible for:

- monitoring the progress of the WP against time and budget allocations
- ensuring that the work package fulfils the objectives listed as milestones and deliverables, alerting in case of delay or default
- delivering the required information about the work package for the preparation of all plans and reports and timely transmission to Coordinator and the Deputy Coordinator.

The WPLs are responsible for collecting information to be sent to the project coordinator for the periodical scientific and periodic reports.

2.1.5 Stakeholders Council (SC) and Advisory Board (AB)

The Advisory Board (AB) will overview the scientific activities of the project and will act as a constant review panel expressing its opinions on research related decisions, reports and any issue on demand by the project coordinator or the SG. The AB will meet at least twice during the life of the project: envisaged at the beginning and at the mid-term of the project activities, but the members of the Board may be contacted at any time, whenever their expertise or their advice is needed on specific questions. The meetings will be scheduled according to meetings of the General Assembly or the Steering Group.

The AB comprises the stakeholder council and additional external specialists in topics related to the research issues of MIRAGE.

The stakeholder council is the core component of the AB. Representatives from each stakeholder organisation are included, to achieve a close connection between the scientific work and the later implementation of management options.

The external observers are an open panel of experts from the scientific community, many of them being coordinators from the ongoing EU-projects in related or similar fields to achieve the best integration of MIRAGE with other projects and activities.

Additional experts may be called to this panel for consultation as the need arises. These will support the project through their advice and give an outside view of the project progress during evaluation processes. They are chosen according to their experience of the behaviour of temporary waters and water management in semiarid regions. Selected representatives will be invited for oral presentations at the project meetings and conferences.

The Steering Group will propose a chair person from the members of the Stakeholders Council to chair the AB and SC. This chair person has to be validated by the AB members.

All AB members will be asked to sign confidentiality agreements to ensure protection of intellectual property rights of the consortium and its members.

Tab. 3: Additional external experts

Country	Institution	Name	Specialisation

2.1.6 Communication strategy

An active communication strategy will be implemented, under the administrative responsibility of the Coordinator, to establish a strong identity of MIRAGE in order to obtain maximum transparency for all partners involved and to increase the synergy of the co-operation. Interactive meetings and workshops will rotate between the project sites. All information (such as minutes of meetings, visit reports, task reports, relevant publications, etc) will be

communicated to the partners. The communication strategy also aims to effectively communicate with parties outside the consortium, such as with other European project consortia. The communication strategy - which includes a planning for project presentations to be given and conferences to be attended on behalf of the consortium - will be dealt with by the Steering Group and will be a topic at each annual meeting of the GA.

Communication within the project will be a main task of WP1. It is based on:

- email correspondence as the primary means of day to day communication,
- an internet server hosting the web pages of the project with download areas (reports, protocols, templates and internal circulars with restricted access), calendars, and forums;
- the use of mail-lists and electronic discussion on the web server for the project,
- telephone and internet-based IRC-conferences and
- series of internal bulletins circulated as email messages after every milestone to all partners, end users and members of the AB.

Larger data files will be stored centralized on a webserver of the co-ordinator. Access to this document and data store will be dependent on the working status of the files and the partners involved in its development (read/write, read-only, or no access), as well as on the document itself.

Communication will be achieved through regular project meetings comprising members of all teams, smaller workpackage meetings and national meetings among the scientific partners and stakeholders. Any WP leader is obliged to report periodically to the coordinator on the progress of the respective WP through a workflow report. Scientific reports are to be prepared for presentation and discussion at each 6-month meeting, and incorporated into the annual and final reports required by the Commission.

The coordinator and the SC, in a close accordance with the whole consortium, also have the task of ensuring communication outside the project. This will be achieved through a number of contributions to congresses, workshops and meetings in which the ideas and aims of the MIRAGE project will be presented to the scientific community and potential users. Public relation processes will be supported also by publishing short articles on the project homepage.

A Consortium Agreement will be signed among partners to establish the rules for exchanging data, software and other resources within the project. It will also regulate the authorship for joint publications.

2.1.7 Interaction of deliverables and milestones

There is a clear definition of the deliverables and their interdependencies in MIRAGE as shown in Fig. 7. In order to ease the work in the different WPs, periods where no exchange with other WPs is needed are alternated by phases of collaboration. These phases of collaboration will concentrated around meeting events and workshops.

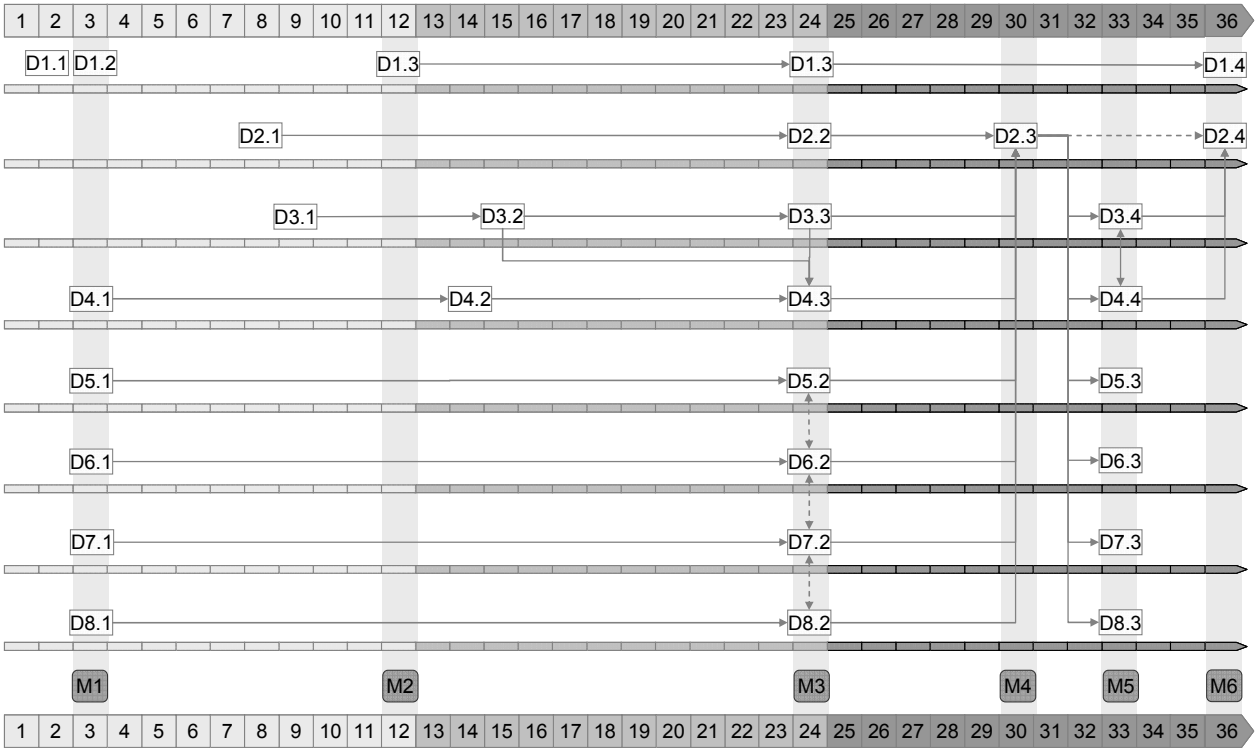


Fig. 7: Interdependencies of project components, exchange of deliverables and information flow

As it is shown in Fig. 7, results from WPs 3-8 will be integrated in WP2 (D2.3 S&T guidance). Based on this integration, WP2 will then give a feedback to the case studies and Mirror (Basins management strategies).

Every main achievement of the project is marked by a milestone.

2.1.8 Quality Assurance and deviation control

One important management task is quality assurance. This is particularly important for the field activities. Quality assessment is within the main responsibility of the WPLs and will consider

1. Field work in the test sites
2. Data storage and analysis
3. Compilation of guidance documents
4. Software development

The WPLs will prepare, in a close collaboration with the consortium, the protocols defining the standards for field measurements, the control of automatic sampling stations and guarantee a comparable appearance of the guidance documents and protocols under consideration of a corporate identity for the project in form of common templates.

Email communication in each workpackage group will ensure rapid detection of difficulties, so that activities can be adjusted to minimise deviation from the planned targets.

All significant deviations will be reported to the SG. In the event of unforeseen serious problems (for example insufficient rainfall in the first measurement period to detect first-flush events) the GA will decide, which of the already outlined alternative strategies will be followed to achieve the overall target. In such cases, the inclusion of the AB will assist in the provision of other resources such as alternative data sources or laboratories.

2.2 Individual participants

2.2.1 P1: LUH - Leibniz Universität Hannover, Institute for Water Quality and Waste Management, Water Resources Management Division

The Water Resources Management Division of the Institute for Water Quality and Waste Management under the direction of Prof. Dr.-Ing. K.-H. Rosenwinkel has specialised in work on operational water management strategies and their implementation in practice for almost 25 years. The division has particular expertise both in semiarid and arid regions and in multidisciplinary projects. Areas of work are technology studies, river basin management, computer simulation models, and innovative IT developments. The development of computer models aims to provide tools to quantify both vulnerability and availability of surface water resources. Prominent results were the developments of the water quality models Lac (complex reservoir quality model for semiarid regions including sediment quality), SIDIS. All the models are designed to provide solutions and management strategies in practical engineering projects and enduser-related problems. LUH will be coordinating the project.

Jochen Froebrich (Dr.-Ing., m) is head of the Water Resources Management Division. Within the proposed project he will act as main scientific advisor and support the administrative coordination of the project. Dr. Froebrich has worked on a variety of multidiscipline projects in North Africa, South Europe and Central Asia. His current research interests focus on the inclusion water quality aspects in water management under water scarcity. He is specialized on water quality dynamics in rivers and their impact on lakes and reservoirs. He initiated several large EU projects, e.g. the project tempQsim for the development of enhanced water quality models for intermittent streams.

Current research activities comprise the coordination of the EU project JAYHUN, which addresses risk management and adaptation strategies for future climate and global change for the Amu Darya Basin (Central Asia). In parallel he is leading the Domain Water Availability in the Integrated EU Project AquaStress (a collaborative effort of more than 35 Institutes addressing future water deficits in Europe and the Mediterranean).

Matthias Obermann (Dr.-Ing., m) is a Researcher at the Division of Water Resources Management since 2003 and will function as project manager. He specialized in the assessment of first flush dynamics, the investigation of fractioned transport of suspended matter in intermittent streams and the simulation of waste water impact and bacterial dynamics during the dry summer period. During the FP5 project tempQsim he participated in the development of the tempQsim-STREAM model. During a DAAD fellowship, he continued testing of the model at Hydroscience Montpellier, France (partner UM2 in MIRAGE). In March 2007 he achieved his doctoral degree.

Elke Buchholz (f) will be administrative manager from the EU-Liaison-Office Hannover/Hildesheim (LUH). The EU Liaison Office (founded in 1992) advises and supports presently about 70 FP6 projects of eight higher education institutions in the region of Hanover in all administrative and legal questions. Additionally, it has extensive experience in carrying out its own EU-projects in the education and mobility programmes and in the administrative management of research and networking projects in FP5 and FP6. The EU-Liaison Office is part of the Leibniz Universität Hannover (LUH).

Selected Publications

Obermann, M., Froebrich, J., Perrin, J.-L. and Tournoud, M.-G., 2007. Impact of significant floods on the annual load in an agricultural catchment in the mediterranean. Journal of Hydrology, 334(1-2): 99-108.

Wegerich, K., Olsson, O., Froebrich, J. (2007): Reliving the past in a changed environment: Hydropower ambitions, opportunities and constraints in Tajikistan. Energy Policy 35: 3815-3825

Froebrich, J.(2005): Enhanced reservoir operation - concept for improving water quality and water management in water stressed areas, International Agricultural Engineering Journal 2005, 14(4):147-160.

Froebrich, J., Olsson, O., Bauer, M., Normatov, I., Petrov, G. (2006): Improved dam operation in the Amu Darya river basin including transboundary aspects, Dams and Reservoirs, Societies and Environment in the 21st century, Berga et al (eds), 2006, Taylor&Francis Group, London, ISBN 0-415-40423-1, pp. 97-103.

Froebrich, J., Kayumov. O. (2004): Water management aspects of Amu Darya, Options for future strategies, in: J.C.L. Nihoul et al. (eds.) Dying and Dead Seas, 49-76, Kluwer Academic Publishers

2.2.2 P2: TUC - Technical University of Crete

The Technical University of Crete was founded in 1977 in Chania, Greece and accepted its first students in 1984. The purpose of the institution is to conduct research and provide teaching in new engineering fields, as well as develop links with industry. The personnel consists of 101 full-time professors, 114 teaching and laboratory assistants, and 165 administrative employees. The school has a total enrolment of 2500 undergraduate students and 500 graduate students. It employees 17 professors and has 400 undergraduate and 100 graduate students. One of the laboratories in the Department is the "Hydrogeochemical Engineering and Soils Remediation Laboratory (HERS)". The purpose of the laboratory is to conduct water quality management at the watershed scale, development and use of hydrogeochemical watershed, surface and ground water models, sustainable development of water resources, aassessment and remediation of soils polluted by heavy metals, and development of new technologies and use of existing ones for the remediation of soils and aquatic ecosystems from inorganic pollutants.

Nikolaos Nikolaidis is a professor in the Department of Environmental Engineering. Prior to joining TUC, he was a professor and director of the Environmental Engineering Program at the University of Connecticut, USA. His areas of expertise include: Watershed Scale Studies and Modeling, Heavy Metal Site Assessment and Remediation, and Pollution Prevention and Sustainable Development. He is using a "holistic" approach in solving environmental problems by conducting field studies, laboratory experimentation and mathematical modeling. Dr. Nikolaidis has developed four environmental models and he is currently participating in many European and Greek funded watershed studies (EUROCAT, tempQsim, EnviFriendly, AquaTrain). He has published over 60 papers in international journals and book chapters during the past 20 years.

E. Psillakis (PhD, f) is an assistant professor at TUC. She received her degree in Chemistry from the Université Montpellier II (U.S.T.L.), Montpellier, France. (1994) and her PhD from the University of Bristol, Bristol, U.K. (1997). Her current research activities focus on the development and application of novel analytical methodologies used for the extraction/ preconcentration of toxic organic micropollutants from environmental samples. Another area of interest is the application of these methods for monitoring the performance of different wastewater treatment methods such ultrasonic degradation and other advanced oxidation methods. She has more than 42 publications in ISI Journals. In 2007 Psillakis was awarded a Fulbright research scholarship and recently she received a "Top cited article 2001-2006 Award" from the Journal of Chromatography.

O. Tzoraki (PhD, f) is a research scientist at TUC. She received her PhD in Environmental Engineering (2007) and her expertise is field, laboratory and modeling studies of temporary rivers.

Selected Publications

Nikolaidis, N.P., H. Heng, R. Semagin, and J.C. Clausen, 1998. Non-Linear Response of a Mixed Land Use Watershed to Nitrogen Loading. Agriculture, Ecosystems and Environment, 67, 251-265.

Tzoraki, O., N.P. Nikolaidis, Y. Amaxidis, and N.Th. Skoulikidis, 2007. In-Stream Biogeochemical Processes of a Temporary River. Environmental Science and Technology 41(4), 1225-1231.

Tzoraki, O. and N.P. Nikolaidis, 2007. A Generalized Framework for Modeling the Hydrologic and Biogeochemical Response of a Mediterranean Temporary River Basin. Journal of Hydrology (In Press)

Nikolaidis, N.P., A. Karageorgis, V. Kapimalis, G. Marconis, P. Drakopoulou, H. Kontoyiannis, E. Krasakopoulou, A. Pavlidou, and K. Pagou, 2006. Circulation and Nutrient Modeling of Thermaikos Gulf, Greece. Journal of Marine Systems, 60, pp. 51-62.

Karageorgis A.P., Skourtos M.S., Kapsimalis V., Kontogianni A.D., Skoulikidis N.Th., Pagou K., Nikolaidis N.P., Drakopoulou P., Zanou B., Karamanos H., Levkov Z., Anagnostou Ch., (2005). An integrated approach to watershed management within the DPSIR Framework: Axios River catchment and Thermaikos Gulf. Regional Environ. Change, 5: 138-160.

L. Vidal, E. Psillakis, C. E. Domini, N. Grané, F. Marken, A. Canals "An ionic liquid as a solvent for headspace single drop microextraction of chlorobenzenes from water samples" In Press Anal. Chim. Acta, (doi:10.1016/j.aca.2006.10.053).

E. Psillakis and N. Kalogerakis, "Developments in liquid-phase microextraction". TrAC-Trend Anal. Chem, 2003, 22, 565-574.

E. Psillakis and N. Kalogerakis, "Hollow-Fibre Liquid-Phase Microextraction of phthalate esters from water". J. Chromatogr. A, 2003, 999, 145-153.

E. Psillakis and N. Kalogerakis, "Developments in single-drop microextraction". TrAC-Trend Anal. Chem., 2002, 21/1, 53-63.

2.2.3 P3: JRC-IES - Joint Research Centre (IT), Institute for Environment and Sustainability, Rural, Water and Ecosystem Resources Unit

The mission of the Joint Research Centre (EC-JRC, Ispra, Italy) is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a Directorate General of the European Commission, the EC-JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national. The EC-JRC Institute for Environment and Sustainability (IES) has developed over the years skills and tools to provide neutral and Europe-wide expertise in the environmental field. The IES has considerable experience and expertise in the study of the mechanism and transfer processes by which contaminants are released into the environment, their transformation and environmental impact. The Rural, Water and Ecosystem Resources Unit of IES carries out research in support of EU policies on the impact of pollutant releases on water and soil quality. A major strength of the IES is its access to a unique set of European-wide databases ranging from Land Cover (e.g. CORINE, LUCAS) to Soil Types including the European. Furthermore the JRC is active in the modelling and spatio-temporal analysis for European soil degradation and desertification assessment. Furthermore, it provides technical and scientific support to DG DEV in relation to the EC contribution to the UNCCD.

The Rural, Water and Ecosystem Resources Unit was leading the work for the development of a Catchment Information Repository in the EUROHARP project (financed by DG-Research) for a network of 17 river basins located in Europe. The unit was also involved in the tempQsim project dealing with nutrient fluxes in temporary streams, and in CHESS dealing with the impact of climate change on nutrient losses. In addition, the Rural, Water and Ecosystem Resources Unit is ensuring the Technical Secretariat of the Pilot River Basin Testing in the working group Water Framework Directive and Agriculture in the frame of the Common Implementation Strategy of the WFD.

Giovanni Bidoglio (PhD, m) is the Head of the Rural, Water and Ecosystem Resources Unit. He has more than 15 years of experience in experimental and modelling research on impacts induced by land-use on pollutant release and transport from point and diffuse sources. He is responsible for interfacing research activities of the IES Rural, Water and Ecosystem Resources Unit with DG ENV policy on soil and water protection. He has strong experience in monitoring and modelling the fate of organic pollutants at various scale. G. Bidoglio is a member of the Editorial Board of Journal of Hydrology. He has authored or co-authored more than 50 peer-reviewed publications.

Fayçal Bouraoui (PhD, m) is a soil hydrologist with experience in the field to large scale modelling of agrochemical, and water transfer in the unsaturated and saturated zones, also through coupling of distributed models and GIS. His main research areas concern the development of modelling tools for predicting the transformation and transport of non-point source pollutants at the watershed scale. His work is also focusing on the parameterisation of hydrological models at different spatial scale.

Bruna Grizzetti (PhD, f) is an environmental hydrologist with experience in the large scale modelling of agrochemical. She has been involved in the development of models to estimate the contribution of agriculture to nutrient fluxes in streams.

Selected Publications

Bouraoui F., S. Benabdallah, A. Jrad, G. Bidoglio Application of the SWAT model on the Medjerda river basin (Tunisia). Physics and Chemistry of the Earth 30 (2005) 497–507

Grizzetti, B., Bouraoui, F., De Marsily, G., Bidoglio, G., 2005 A Statistical Method for Source Apportionment of Riverine Nitrogen Loads. Journal of Hydrology, 304:302-315

Bouraoui F., Grizzetti B., Granlund K, Rekolainen S, Bidlglio G., 2004. Impact of Climate Change on the Water Cycle and Nutrient Losses in a Finnish Catchment. Climatic Change 66: 109-126

Bouraoui F., L. Galbiati and G. Bidoglio. 2002. Climate Change Impacts on Nutrient Loads in a UK Hydrology and Earth System Sciences, 6(2): 197-210

Bouraoui, F., and T. A. Dillaha, 2000. ANSWERS-2000. Nonpoint source planning model. J. Environmental Engineering A.S.C.E. 126 (11)

Bidoglio, G., Eijsackers H., and McGrath, S. P., (Eds.) 1998. Long-Term Perspectives of Effects of Rural Land-Use Changes on Soil Contaminants. Agriculture, Ecosystems and Environment 67.

2.2.4 P4: CNR-IRSA - Istituto di Ricerca Sulle Acque

The Water Research Institute (IRSA) is an Institute of the Italian National Research Council (CNR), operating by a multidisciplinary approach on strategic national and international problems, whose solution requires a critical mass of experts. IRSA conducts research on the main aspects concerning water (quality, management, treatment) and acts as consultant for Ministries and central public bodies.
IRSA has more than 60 permanent research staff, working in three sections located Italy along: Rome, (the headquarter, fundamental research), Bari, (Water and Wastewater Technologies), and Milano, (Ecotoxicology and Hydrobiology). The annual budget for Research is 8.0 Million Euros, deriving by Italian Government, EU contracts and institutional research commitments.

At present many challenging subjects constitutes the core of research activities:
Water and wastewater treatment: sludge disposal; new generation bioreactors; advanced oxydation technologies for micropollutants removal; wastewater reclamation and contaminated aquifers remediation; biomolecular tools for proper description and operation of biological treatment process
Water management: sustainability of groundwater resources; surface water –groundwater interaction;, groundwater quality management and protection; water management in semiarid areas; modeling of contamination from diffused sources; IT tools development for water resources planning and management.
Water quality: contaminants origin, transport and effect on natural ecosystems; fate of pollutants and circulation-degradation processes in large water bodies; analytical tools for water pollution control and prevention, microbial processes in water and sediments.

IRSA has been participating in 25 European projects, mainly devoted to climate change (Chess), implementation of WFD (HarmonIT, HarmonRib, Rebecca, Euroharp, tempQSim), land use management (AgriBMP-Water), wastewater treatment and reclamation (Macobs, Dynafilm, Eurodemo) and coordinates Aquastress (IP); Innowatech (STREP); Perbiof (LIFE).

Antonio Lo Porto (Dr., m), Research scientist at the CNR-IRSA, is involved in researches on the integrated use of GIS, simulation models and statistical methods to study diffuse water pollution from agricultural sources, management plans for river basins, techniques for planning and designing measures to mitigate impacts on receiving water bodies. He is a contract professor since 2005 (Tuscia University) in River Basin Management. Involved in several EU funded R&D projects as “CHESS”, “AgriBMPWater”, “EuroHarp”, “TempQsim” (Work Package leader), FloodMed (Member of the Steering Group) as well as to three COST actions (# 832, # 837 and #869 in which he is co-chairing a WG). He is a member of the Editorial Boards of the Journal of Spatial Hydrology and of the International Journal of Applied Agricultural Research.

Alberto Puddu (Dr., m) is Senior scientist at CNR-IRSA since 1988. Since the early 90' Alberto's interest has been increasingly focused on bacteria metabolism in relation to mucilage phenomena in Northern Adriatic Sea (PRISMA, chief scientist in “Ecophysiological studies”, and MAT projects), carbon and organic matter circulation in lagoons (ISPESL project, chief scientist in microbial ecology program) and sediment microbial processes in temporary rivers (EU tempQsim project). Presently he is involved in the EU Integrated Project SESAME (Southern European Seas: Assessing and Modelling Ecosystem changes, subtask leader). Actual fields of interest: microbial ecology (bacteria, phytoplankton, toxicity, biogeochemical cycles, sink and sources of CO_2).

Selected Publications

Amalfitano S., Fazi S., Zoppini A., Barra Caracciolo A., Grenni P. & Puddu A. 2007 Responses of benthic bacteria to experimental drying in sediments from Mediterranean temporary rivers. Submitted to Microbial Ecology.

Ripa, M.N., Leone, A., Garnier, M. and Lo Porto, A., 2006. Agricultural land use and best management practices to control nonpoint water pollution. Environmental Management, 38(2): 253-266.

Leone A., Ripa N., Boccia L., Lo Porto A. 2006. Phosphorus Export from Agricultural Land: A Simple and Quick Method. Biosystems Engineering, accepted..

B. Kronvang, H. Behrendt, A. Lo Porto et al. 2006. Ensemble modelling of nutrient loads and nutrient load partitioning in 17 European catchments. Hydrology and Earth System Sciences. submitted

Fazi S., Amalfitano S., Pernthaler J., Puddu A. 2005. Bacterial communities associated with benthic organic matter in headwater stream microhabitats. Environmental Microbiology 7 (10) 1633-1640.

Patrolecco L., Capri S., De Angelis S., Pagnotta R., Polesello S. and Valsecchi S., 2006. Partition of nonylphenol and related compounds among different aquatic compartments in Tiber river (central Italy), Water, Air, and Soil Pollution, 172, 151–166.

2.2.5 P5: CSIC - Consejo Superior de Investigaciones Científicas

The Consejo Superior de Investigaciones Científicas is the leading Institution for scientific research in Spain. It covers all the aspects of science and has a network of Institutes throughout the whole Spain.

The research team on Hydrology and erosion belongs to the Department on Environmental Geo-sciences of the Institute of Earth Sciences Jaume Almera (CSIC). This team started research work on hydrological and geomorphic processes in mountain areas in early 1982. Since 1989, the work has been focused on experimental hydrology at the small basin scale through the set up of the Vallcebre research basins, in order to study the hydrological consequences of environmental changes. Continued research in the Vallcebre catchments has made possible the evaluation of diverse hydrological and erosion models within several projects such as the EC VAHMPIRE and tempQsim projects. Scientific strength of this research team is reinforced by its integration in the Intercentre Network for Land and Water Conservation of the CSIC, that co-ordinates research teams in seven Centres of the CSIC established in different regions of Spain, and particularly the Centro de Edafología y Biología Aplicada del Segura in Murcia.

The Centro de Edafología y Biología Aplicada del Segura (CEBAS) is an Institute of CSIC with more than 40 years of research experience concerning the sustainable use of soil. The group concerned in this proposal (Soil and Water Department) is staffed by qualified scientists with over 20 years' research experience in soil science, hydrology and land rehabilitation and forestry, including extensive work in areas of high erosion risk, using experimental plots and micro-catchments and modelling. The group has been involved in developing a new European methodology for assessing soil erosion (EUROSEM/EUROWISE) for six years, dealing mainly with model validation using field plots. Their current research projects deal with the assessment of forest and hydrological restoration programmes developed by Forest and Water Authorities to reduce soil erosion and sediment yield. Over the last ten years, more than 50 scientific paper in peer-reviewed international journal have been published.

Victor Castillo (PhD) is a Doctor in Forest Sciences (Hydrology) and a tenured scientist at the "Centro de Edafología y Biología Aplicada del Segura" (CSIC). He has experience in hydrological and erosion modelling, soil degradation processes and evaluation of land rehabilitation methods, especially afforestation, land-use planning, environmental impact assessment. Dr. Castillo published some 30 scientific papers and co-operatives research projects in EU and South America. He has been involved in the European projects DM2E, EUROSEM, MEDALUS III, MWISED and tempQsim and chaired the Working Technical Group on Soil Erosion established by EU during the preparation of European Soil Thematic Strategy

Francesc Gallart (PhD) is a Doctor in Geology and tenured at the Institute of Earth Sciences "Jaume Almera" (CSIC). He has experience in Geomorphic and hydrological processes in mountain areas, geomorphic and hydrological modelling, monitoring and experimental designs. Dr. Gallart is a national correspondant of the ERB network. He has been project leader (6 national projects), scientist in charge as contractor (3 EC projects), co-ordinator of one EC project, Vice-Director of the Institute, co-ordinator of the Intercentre Network for Land and Water Conservation (CSIC). Francesc Gallart has been involved in the European projects DM2E, MEDALUS, VAHMPIRE and tempQsim.

Selected Publications

Gallart, F., Llorens, P., Latron, J., Regüés, D. (2002) Hydrological processes and their seasonal controls in a small Mediterranean mountain catchment in the Pyrenees. Hydrology and Earth System Sciences, 6 (3), 527-537.

Gallart, F., Latron, J., Llorens, P. and Beven, K., 2007. Using internal catchment information to reduce the uncertainty of discharge and baseflow predictions. Advances in Water Resources, 30(4): 808-823.

Gallart, F. and Llorens, P., 2004. Observations on land cover changes and the headwaters of the Ebro catchment, water resources in Iberian Peninsula. Physics and Chemistry of the Earth, 29(11-12): 769-773.

Latron, J. and Gallart, F., 2007. Seasonal dynamics of runoff-contributing areas in a small Mediterranean research catchment (Vallcebre, Eastern Pyrenees). Journal of Hydrology, 335(1-2): 194-206.

Garcia-Pintado, J., Martinez-Mena, M., Barbera, G.G., Albaladejo, J. and Castillo, V.M., 2007. Anthropogenic nutrient sources and loads from a Mediterranean catchment into a coastal lagoon: Mar Menor, Spain. Science of the Total Environment, 373(1): 220-239.

Martinez-Mena, M., Castillo V. and Albaladejo, J. (2002) Relations between interrill erosion processes and sediment particle size distribution in a semiarid Mediterranean area of SE Spain. Geomorphology 45: 261-275.

Castillo V.M., Mosch, W.M., Conesa-García, C., Barberá, G.G, Navarro-Cano, J.A. and López-Bermúdez, F. 2007 Effectiveness and geomorphological impacts of check-dams for soil erosion control in a semiarid Mediterranean catchment Catena doi:10.1016/j.catena.2006.11.009.

2.2.6 P6: UBAR - Universitat de Barcelona

The Department of Ecology of the University of Barcelona (DEUB) was founded in 1967. Research in the Department concerns nearly all fields in ecology following the paths of Margalef's work and ideas, with groups leading Spanish research in Marine Biology and Oceanography and Limnology. The Department begins each year, as an average, 20 research programmes and 60 are running continuously. Presently 21 full time professors and un to 60 students work in the Department.

The F.E.M. (Freshwater Ecology and Management) research group is the group of the DEUB that will participate in MIRAGE. This activity of the group is mainly in the field of river ecology but we study also mountain lakes and wetlands. Recent research in rivers is focused in basic and applied topics. One of our major research activity is the study of biological indicators to characterise ecological status of rivers and streams. FEM have been conducting a study of Ecological status of 75 sites in Catalonia during the last 12 years, including some temporary streams and we have coordinate the project GUADALMED that has studied more than 250 sites along the Mediterranean coast. It is involved in a study of Andean rivers in which it is aimed to set up a protocol of evaluation of water quality using macroinvertebrates. The Department of Ecology is also studying the effects of forest fires on the ecology of Mediterranean streams, following the recovery of the communities after the fire (we are in the four year of the continuous studies). The F.E.M. initiated a research line of restoration ecology where the specific issues related to Mediterranean streams will be investigated. Other research activities are related to molecular taxonomy of aquatic macroinvertebrates and the study of wetlands close to Barcelona, both for fundamental studies on its fauna and flora and ecological status research using macroinvertebrates.

Research teams working at the Universitat de Barcelona (UB) are mixed and composed by personnel contracted by the UB and personnel contracted by other institutions associated to the UB, which are considered as Third Party by the EC. Partner UB will participate in this EC project together with one associated Third Party called Fundació Bosch i Gimpera (FBG) (Bosch i Gimpera Foundation, http://www.fbg.ub.es, a non-profit foundation).

Narcis Prat (PhD, m) is a Full Professor of the Department of Ecology and head of the F.E.M. GROUP. Dr. Prat is leading several national and international projects including a study of streams in Ecuador and Peru were his group is currently developing a protocol to determine the ecological status. He has published up to 100 papers in national and international journals during the past 30 years.

Maria Rieradevall (PhD, f) is co-leading the group F.E.M. Prof. **Rieradevall** is also a specialist in streams, and now focussing her work in wetlands, both in basic studies (including taxonomy) and applied issues, working also in the implementation of WFD. Dr. Rieradevall is one os the key specialist in paleolimnological studies in lakes, she has published several papers on these topics. Dr. Rieradevall is also a leading specialist in Spain (together with Dr. Prat) in the study of chironomids, one of the major groups living in aquatic ecosystems. She has published up to 30 papers in international journals.

Núria Bonada (PhD) is now researcher and professor at the Univ. of Granada. She is a leading person in the use of species traits characteristics of macroinvertebrates in river ecology studies and will participate in the project due to her deep knowledge on temporary streams.

Selected Publications

Bonada, N.; Prat, N.; Resh, V.H and Statzner, B. 2006 Developments in Aquatic Insect Biomonitoring: A Comparative Analysys of Recent Approaches. Annu. Rev. Entomol, 52: 495-523

Bonada, N.; Dallas, H.; Rieradevall, M.; prat, N. & Day, J. 2006. A comparison of two rapid bioassessment protocols used in 2 regions with Mediterranean climates, the Iberian Peninsula and South Africa. J.N.Am. Benthol. Soc. 25:487-500.

Bonada, N.; Rieradevall, M.; Prat, N.; Resh, V.H. 2006 Benthic macroinvertebrates assemblages and macrohabitat connectivity in Mediterranean-climate streams of northern California. Journal of the North American Benthological Society, 25 32-43.

Vila-Escalé, M.; Vegas, T. and Prat, N. 2007 Release of polycyclic aromatic compounds into a Mediterranean creek (Catalonia, NE Spain) after a forest fire. Water Research, 41:2171-2179...

2.2.7 P7: UMU - Universidad de Murcia

The Ecology and Hydrology Department of Murcia University is formed by six researching groups working on different aspects of ecology of aquatic, marine and terrestrial ecosystems. Presently 14 full time professors and more than 50 PhD and MSc students are working in the Department.

The Freshwater Ecology Group includes 3 tenure professors: Dr. Rosario Vidal-Abarca, Dr. Luisa Suárez and Dr. Rosa Gómez, 3 PhD students and 2 MSc students. This team has a long experience on stream and wetland ecology in arid and semi-arid zones. Their research is focused on composition and structure of aquatic macroinvertebrate communities, dynamic of nutrients (N & P) in temporary systems, stream and wetland nutrient retention, and the effect of perturbations by floods and drought on ecosystem structure and function. They also work in more applied ecology as the implementation of the WFD in arid zones, with a main activity in assessment the Ecological Status of Rivers and three years ago the group has been involved in developing new methodology for apply WFD in Segura River Basin, including temporary and dry streams.

The Freshwater Ecology Group has more than 20 years of research experience. They have published about 70 scientific papers in national and international journals, 10 books and more than 25 book chapters. Moreover, they have participated in 32 research programs, financed by national and regional governments. Presently 3 research programs have been developed over ecological indicators for Mediterranean wetlands, the role of wetlands associated to dry and temporary streams for nutrients control, and on reference conditions in Segura River Basin financed by National Government.

For these activities they have a laboratory equipped with the normal media to proceed in this type of research. Moreover to conduct the field work they have the necessary equipment to collect, measure physical and chemical parameter, store, and sort out the samples.

Rosa Gómez (Dr., f) is a Full Professor at the Department of Ecology and is co-leading the FEG together to Dr. Suárez and Dr. Vidal-Abarca. She also is leading several national projects including the reference condition for arid (Mediterranean) wetlands. Her research focus is on nutrient dynamics (N & P) in arid streams and wetlands, spatial and temporal variability and the role of temporary streams in nutrient retention.

Rosario Vidal-Abarca (Dr., f) is a Full Professor at the Department of Ecology and head of the Freshwater Ecology Group (FEG). Dr. Vidal-Abarca is leading several national projects including a study on ecological status of arid wetlands. She is working on different aspects of arid stream structure and functioning as well as the implementation of the WFD in arid zones.

Luisa Suárez (Dr., f) is a Full Professor at the Department of Ecology and is co-leading the FEG. Dr. Suárez is leading several national projects including the study on ecological status of arid wetlands. Her research focus is on the implementation of the WFD in arid zones, with a main activity in assessment the Ecological Status of Rivers, including temporary and dry streams.

Selected Publications

Fisher SG, Grimm NB, Martí E, Gómez R. 1998. Hierarchy, spatial configuration and nutrient cycling in a desert stream. Australian Journal of Ecology 23:41-52.

Bonada N, Prat N, Munné A, Rieradevall M, Alba-Tercedor J, Álvarez M, Avilés J, Casas J, Jaímez-Cuéllar P, Mellado A, Moyá G, Pardo I, Robles S, Ramón G, Suárez ML, Toro M, Vidal-Abarca, MR, Vivas S, Zamora-Muñoz C. 2002. Criterios para la selección de condiciones de referencia en los ríos mediterráneos. Resultados del proyecto GUADALMED. Limnética 21 (3-4): 99-114

Sanchez-Montoya, M.M.; M.L. Suárez; M.R. Vidal-Abarca. 2005. Propuesta de criterios para la selección de estaciones de referencia en ríos mediterráneos en el contexto de la Directiva Marco del Agua. Tecnología del agua, 266: 42-52.

Gómez R, Hurtadol, Vidal-Abarca MR, Suárez ML. 2005. Ramblas in south-east Spain: threatened and valuable ecosystems. Aquatic Conservation: Marine and Freshwater Ecosystems 15(4):387-402.

2.2.8 P8: UM2 - HydroSciences Montpellier, IRD – Universités Montpellier

The HydroSciences Montpellier (UM2) research team is a joint research unit, run by Université Montpellier 2, IRD (French Research Institute for Development), Université Montpellier 1 and CNRS (French National Centre for Scientific Research). Its staff includes hydrologists, hydrogeologists, chemists and microbiologists, belonging the four organisms. Among other topics, this group is actively engaged in watershed modelling (including hydrological processes and contaminant aspects) in Mediterranean and tropical areas.

UM2 research team has participated in more than ten European projects, among which the FP5 tempQsim project, during the last five years and is involved in other international projects including the UNESCO project FRIEND. Within these programs, UM2 has been responsible for hydrological processes and modelling, nutrient and trace element behaviour, remediation processes, water re-use and database development.

HydroSciences Montpellier is located at the Université Montpellier 2, in the Maison des Sciences de l'Eau, which brings together various other research teams from IRD, CNRS, all working on the water-related issues.

Research programmes in Mediterranean catchments have three main goals: (i) to link water resources to climate and land use, using hydrological modelling in order to simulate possible changes in water resources, (ii) to evaluate the impact of intense rainfall frequencies on extreme flood events and flooding in rural or urban zones, in order to help water management in urban areas and flood forecasting and (iii) to relate catchment loads of chemical pollutants (nutrients, metals) to rainfall inputs, hydrological behaviour, land use and other human activities, in order to develop management strategies for the protection of receiving coastal waters.

Marie-George Tournoud (PhD) is an Associate Professor at Université Montpellier 2. She leads the 'Floods and water quality dynamics in Mediterranean rivers' UM2 research group, that involves two IRD researchers, another Associate Professor and a research engineer. Her research interests focus on hydrology, water quality, river and watershed modelling in small catchment under Mediterranean climate. She has already been coordinator in several national research programs on river loads observation and modelling funded and was involved in two European projects. She is responsible of an experimental catchment in which hydrological and water quality processes are observed and modelled.

Jean-Louis Perrin (PhD) is a Research scientist at IRD. He is specialized in the analysis of hydrological processes at catchment scale, through a coupled approach based on in situ observations (climatological data, discharge measurement, soil hydrodynamics, …) and modelling (using models as TopModel, MERCEDES). He also works more specially on the study of interactions between hydrology and water quality dynamics (water physico-chemistry, nitrogen, phosphorus, …) in Mediterranean rivers. He is involved in model testing and improvement for hydrology and water quality simulations in Mediterranean environments.

Chrystelle Bancon (PhD) is an Associate Professor at Université Montpellier 2. She is a specialist in analytical chemistry and especially in speciation of organotin compounds by hyphenated techniques (GC-PFPD, GC-ICP-MS). She has been involved in the development of analytical techniques for speciation of metals and organometallic compounds (organotin, organomercury) in aquatic systems and terrestrial environment at trace levels, for performing monitoring of these contaminants in the freshwaters and understanding of mechanisms of accumulation and remobilisation.

Selected Publications

Bancon-Montigny C., Lespes G., Potin-Gautier M., 2004. Organotin survey in the Adour-Garonne Basin Water Research, 38(4): 933-946.

Perrin J.L., Tournoud M.G., Grillot C., submitted. Hydrological processes controlling flow generation in a small Mediterranean catchment under karstic influence. Hydrological Sciences Journal.

Tournoud, M.-G., Payraudeau, S., Cernesson, F. and Salles, C., 2006. Origins and quantification of nitrogen inputs into a coastal lagoon: Application to the Thau lagoon (France). Ecological Modelling, 193(1-2): 19--33.

Tournoud, M.G., Perrin, J.L., Gimbert, F. and Picot, B., 2005. Spatial evolution of nitrogen and phosphorus loads along a small Mediterranean river: implication of bed sediments. Hydrological Processes, 19(18): 3581-3592.

2.2.9 P9: UNIVLEEDS - University of Leeds, School of Geography

As one of the largest research-oriented university geography departments in the United Kingdom, the School of Geography supports a wide range of research expertise in physical and human geography, as well as in the links between the two. In addition to an academic staff of over fifty, the School also has a large and growing postgraduate community, with approximately one hundred students registered for either research degrees or taught Masters courses.

The University of Leeds has expertise in integrated modelling, , hydrology, nutrient cycling and erosion at catchment to regional scales. The River Basin Processes and Management research group in the School regularly publishes in top journals including Nature and Science. Researchers from the University of Leeds have led land degradation research in Europe and Africa through a series of projects funded by the EU (e.g. MEDALUS, DESERTLINKS, PESERA, DESURVEY, DESIRE) and UK Government Research Councils. The team conducts strategic and applied research that connects environmental knowledge to public and private sector decision making at local, regional, national and international levels.

Prof. Mike Kirkby (PhD, m) is a geomorphologist and hydrologist, working at Leeds since 1973. He has considerable experience of relevant hydrological modelling. Through the MEDALUS series of projects (FP 2-4), the PESERA project (FP 5), the DESERTLINKS project (FP 5) and the tempQsim project (FP 6) he has led development of a series of mutually consistent models at a wide range of spatial scales, and linked to the 10-100 year time spans relevant to global change and other aspects of environmental planning. Prof. Kirkby has relevant field experience, particulary in S. E. Spain, in developing realistic theoretical concepts and gathering, with others, calibration and validation data. He will take the overall lead in model development and application, bringing particular expertise in surface and nearsurface hillslope hydrology.

Pippa Chapman (PhD, f) has been a lecturer and researcher in the School of Geography since 1999. Her research has been primarily concerned with the link between terrestrial and aquatic nutrient cycles, in particular the processes that control the transport of solutes and sediment from soils to surface waters. This work is based on a combination of field and laboratory experimentation and assessing the impact of sampling and pre-treatment on both the amount and composition of nutrients in solution has played an important part of this work.

Brian Irvine (PhD, m) is a post-doctoral Research Fellow who has been at Leeds since 2001, working with Prof. Kirkby on EU and Nationally funded projects, concerned with Desertification, Water Quality and Sustainable Land management. He has principally been concerned with coding, maintaining and developing for a number of purposes and projects, the PESERA model and a number of spin-off developments from this, linking FORTRAN code to ARC-GIS layers for input and output of spatial data.

Selected Publications

Kirkby, M.J., Le Bissonais, Y.L., Coulthard, T.J., Daroussin, J. and McMahon, M.D., 2000. The development of land quality indicators for soil degradation by water erosion. Agriculture Ecosystems & Environment, 81(2): 125-136.

Kirkby, M., 2002. Modelling the interactions between soil surface properties and water erosion. Catena, 46(2-3): 89-102.

Carling, P.A., Irvine, B.J., Hill, A. and Wood, M., 2001. Reducing sediment inputs to Scottish streams: a review of the efficacy of soil conservation practices in upland forestry. Science of the Total Environment, 265(1-3): 209-227.

Clark, M.J., Cresser, M.S., Smart, R., Chapman, P.J. and Edwards, A.C., 2004. The influence of catchment characteristics on the seasonality of carbon and nitrogen species concentrations in upland rivers of Northern Scotland. Biogeochemistry, 68(1): 1-19.

Lane, S.N., Brookes, C.J., Kirkby, A.J. and Holden, J., 2004. A network-indexbased version of TOPMODEL for use with high-resolution digital topographic data. Hydrological Processes, 18(1): 191-201.

Schofield, R.V. and Kirkby, M.J., 2003. Application of salinization indicators and initial development of potential global soil salinization scenario under climatic change. Global Biogeochemical Cycles, 17(3).

Kirkby, M.J., 2003. A consistent framework for modelling geomorphic processes and landform evolution. In 'Prediction in Geomorphology', edited by P.R. Wilcock and R.M. Iverson. *Geophysical Monograph Series* Vol. 135. American Geophysical Union, Washington DC, 256 pp.

2.2.10 P10: CEH – Centre for Ecology and Hydrology, Wallingford

CEH is the UK's Centre of Excellence for research in the land and freshwater environmental sciences. CEH staff have specialist skills in a wide range of environmental disciplines, ranging from the smallest scale (the gene) to the largest scale (whole Earth systems). The CEH Science Programme is aimed at improving understanding both of the environment as we see it today and the natural processes that underlie the Earth's support systems - for example climate & water resources. CEH is particularly interested in the impacts of human activity on natural environments and aims to generate workable solutions to today's pressing environmental problems. Its parent organisation is the UK Natural Environment Research Council.

CEH Wallingford, formerly the Institute of Hydrology, has developed river basin monitoring and management systems currently in use in the UK. Such systems have also been implemented in partnership with national organisations in many other parts of the world. These systems include data collection, analysis and decision support covering issues such as land use and climate change impacts, flow forecasting, water resource and water quality management, and socio-economic impact assessment. The institute has the breadth of resources which enable it to undertake fundamental research into hydrological processes, development of sustainability criteria, through to management system design, development, implementation, training and maintenance. CEH Wallingford is involved in the development of the next generation of whole catchment management systems for the UK Environment Agency and the European Commission to meet the requirements of the proposed EU Water Framework Directive.

David Cooper (PhD, m) has been a statistical and mathematical modeller at Wallingford since 1978. His recent research has focussed on catchment-scale water quality modelling, including the development of GIS-based diffuse source models linked to instream models for nutrient transport through catchments. These have been supported by new statistically-based surveys estimating contributions from a range of landscape classes. Dr Cooper has a particular interest in the design of experiments and surveys in support of modelling, and the reduction in model uncertainty which can be achieved through improved design. He was a member of the tempQsim team, and also contributes to the EU Eurolimpacs project.

Thomas Kjeldsen (PhD, m) Research scientist at CEH since 2003 with particular interest in hydrological modelling and flood risk estimation. His work has mainly focused on the development of national procedures for flood risk modelling in the UK as well as issues of uncertainty in hydrological modelling and effective transfer of model parameters from gauged to ungauged catchments.

Selected Publications

Cooper, D.M., Helliwell, R.C., Coull, M.C., 2004. Predicting acid neutralising capacity from landscape classification: application to Galloway, south-west Scotland. *Hydrological Processes,* **18***,* 455-471.

Cooper, D.M., 2004. Some effects of sampling design on water quality estimation in streams. *Hydrol. Sci. J*. **49**, 6, 1055-1080.

Cooper, D.M., 2005. Evidence of sulphur and nitrogen deposition signals at the United Kingdom Acid Waters Monitoring Network sites. *Env. Poll*. **137**, 41-54

Davies, J., Jenkins, A., Monteith, D.T., Evans, C.D., Cooper, D.M., 2005. Trends in surface water chemistry of acidified UK Freshwaters, 1988-2002. *Env. Poll* **137**, 27-39

Evans, C.D., Monteith, D.T., Cooper, D.M., 2005. Long-term increases in surface water dissolved organic carbon: observations, possible causes and environmental impacts. *Env. Poll*. **137**,

Evans, C.D., Cooper, D.M., Juggins, S, Jenkins, A., Norris, D., 2006. A linked spatial and temporal model of the chemical and biological status of a large, acid-sensitive river network. *Science of the Total Environment*, **365**, 167-185.

Kjeldsen TR and Jones DA (2007) Estimation of the index flood using data transfer in the UK. Hydrological Sciences Journal, 52(1), 86-98.

Kay AL, Jones DA, Crooks SM, Kjeldsen TR and Fung CF (2007) An investigation of site-similarity approaches to generalisation of a rainfall-runoff model. Hydrology and Earth System Sciences, 11(1), 500-515.

Kjeldsen TR and Jones DA (2006) Prediction uncertainty in a median based index flood method using L-moments. Water Resources Research, 42, W07414, doi :10.1029 / 2005WR004069.

Kjeldsen TR and Rosbjerg D (2004) Choice of Reliability-Resilience-Vulnerability estimators for risk-assessments of water resources systems. Hydrological Sciences Journal, 49(5), 755-767.

2.2.11 P11: EAWAG/Swiss Federal Institute for Aquatic Science and Technology, Switzerland

Eawag, the Swiss National Water Institute, is part of the ETH-Domain. 400 employees are active at the locations in Duebendorf (near Zurich) and Kastanienbaum (near Lucerne). Practically all research projects at Eawag are interdisciplinary or even transdisciplinary oriented. Therefore, exchange not only occurs among biologists, engineers and social scientists, but intensive contacts are also maintained with specialists and decision-makers of the private and public sector as well as professional associations. The main focuses of Eawag's aquatic research can be summerised as «Water as habitat and resource» (Aquatic Ecosystems), «Water in urban areas» (Urban Water Management) and «Pollutants in the water» (Chemicals and Effects). Eawag has been involved in many European research projects, including projects dealing with the climate change in lakes (e.g. CLIME), temporary waters (tempQsim), and on impacts of global change on European freshwater ecosystems (Europlimpacs), to name a few.

Klement Tockner (PhD, m) heads the research unit Floodplain Ecology at the Swiss Federal Institute of Aquatic Sciences and Technology and is professor at ETH Zuerich. He has special expertise on invertebrate ecology, ecosystem functioning, floodplain ecology, and landscape ecology. He has published more than 130 scientific papers (~60 ISI papers). Dr. Tockner is Co-Editor-in-Chief of the journal Aquatic Sciences and Associate Editor of Ecosystems.

Christopher T. Robinson (PhD, m) is a senior research scientist in the Department if Aquatic Ecology, EAWAG and has a principal research interest in the ecology of alpine streams. He has over 20 years experience in field stream ecology, mostly involving disturbance ecology, population genetics, and recently, alpine stream hydrology. He has been involved in various research projects on temporary streams during this period, the latest effort examining the metabolic and bacterial responses to inundation in an ephemeral river in New Zealand. Other studies on temporary streams addressed topics of invertebrate life histories, community dynamics, population genetics and life history plasticity, and ecosystem hydrology.

Selected Publications

Tockner, K., Uehlinger and U. Robinson, C.T. (Eds) 2008. Rivers of Europe. Elsevier.

Paetzold, A., Yoshimura, C. and Tockner, K. Differential effects of flow regulation and channel regulation on riparian arthropod diversity and density. Journal of Applied Ecology. In revision.

Langhans, S. D. and K. Tockner. 2006. The role of timing, duration, and frequency of inundation in controlling leaf-litter decomposition in a river-floodplain ecosystem (Tagliamento, NE Italy). Oecologia. 147: 501-509.

Malard, F., Uehlinger, U., Zah, R., and Tockner, K. 2006. Flood pulses and riverscape dynamics in a braided glacial river. Ecology. 87: 704-716

Döring, M., Uehlinger, U., Schläpfer, D., Rotach, A. and Tockner, K. 2007. Large-scale expansion and contraction dynamics along an unconstrained Alpine alluvial corridor (Tagliamento River, northeast Italy). Earth Surface Processes and Landforms. In press.

Doering M, Uehlinger U, Ackerman T, Woodtli M, Tockner K. Soil and sediment respiration pattern in a complex river floodplain mosaic (Tagliamento River, Northeast Italy). Ecology, in review.

Paetzold, A. Bernet, J. and Tockner, K. 2006. Rapid response of riparian arthropods to aquatic subsidy pulses. Freshwater Biology. 51: 1103-1115.

Larned, S.T., T. Datry and C. T. Robinson. In press. Invertebrate and microbial responses to inundation in an ephemeral river reach in New Zealand: effects of preceding dry periods. *Aquatic Sciences: Research Across Boundaries*.

Robinson, C.T. and S. Matthaei. In press. Hydrological heterogeneity of an Alpine stream/lake network in Switzerland. *Hydrological Processes*.

Monaghan, M.T., C.T. Robinson, P. Spaak, and J.V. Ward. 2005. Macroinvertebrate diversity in fragmented alpine streams: Implications for freshwater conservation. *Aquatic Sciences: Research Across Boundaries* 67: 454-464.

Rüegg, J. and C. T. Robinson. 2004. Comparison of macroinvertebrate assemblages of permanent and temporary streams in an Alpine flood plain, Switzerland. *Archiv für Hydrobiologie* 161: 489-510.

2.2.12 P12: IMAR - Institute of Marine Research

The Institute of Marine Research is a non-profit institution grouping most of Portuguese Universities. It was created in 1992 when the Portuguese Ministry of Science and Technology promoted the reorganisation of the Portuguese Research Infrastructure grouping small research units to give them higher operational capacity.

Initially IMAR grouped mainly people interested into marine systems but, pushed by the need for the integrated study of marine and fresh water systems and by the modelling and field-laboratory developments, the institute became more and more active into the study of fresh water systems.

IMAR is organised into research centres distributed by Portuguese Universities, accordingly to the affiliation of its members. MIRAGE will involve researchers from Instituto Superior Técnico (Technical University of Lisbon), and from the University of Évora.

IMAR participated in the FP5 project tempQsim in the development of adopted simulation tools for semi-arid temporary river systems. Within that project IMAR studied a temporary system in Alentejo (Southern Portugal) and gave an important contribution for the modelling activity carried in the project, concerned with river hydraulics, sediment transport and biogeochemical processes in the river network. Those developments were then included in an integrated model for the whole catchment hydrology (MohidLand) that will be a basic tool for the investigations foreseen within MIRAGE (www.mohid.com).

Ramiro Neves (PhD, m) is an Associate Professor at IST. He is the scientific coordinator of MOHID development and he will be the coordinator of the modelling work to be carried out by IMAR. Prof. Neves has also coordinated the work of this team in several National and European research projects funded by FP6 (INSEA, ECOMANAGE, MABENE, EUROSTRATAFORM and in previous programs, as MAST (JEEP 92, OMEX, EUROMODEL, OPCOM) and Environment (MATURE, EUROSAM). He has also large experience of results exploitation. His group is presently carrying modelling activities for 5 companies running wastewater systems and for the Portuguese Water Authority, in the framework of the application of EU water-related Directives. These applied projects represent about 50% of the funding of his research group. Ramiro Neves has oriented 11 PhD theses and more than 25 MSc theses on mathematical modelling of the Aquatic Environment. Presently he teaches Fluid Mechanics and Environmental Modelling for Environmental Engineering students.

Maria Gonçalves (PhD, f) is a Soil Science Scientist at “Estação Agronómica Nacional, EAN”, a Research Laboratory associated to INIAP, the National Institute for Agronomical Sciences and Fisheries. Maria Gonçalves is the Head of the Soil Science Department and has been actively involved into National and International Research Projects, being the National representative of the European Soil Bureau. She will be the lead scientist for soil and erosion studies where she will benefit from the experience obtained in the ENVASSO project directly concerned with erosion and soil preservation.

Selected Publications

Gonçalves, M. C., J. Šimůnek, T. B. Ramos, J. C. Martins, M. J. Neves, and F. P. Pires. 2006. Multicomponent solute transport in soil lysimeters irrigated with waters of different quality, Water Resour. Res., 42, W08401, doi:10.1029/2005WR004802.

Ramos, T. B., Gonçalves, M. C., Martins, J. C., van Genuchten, M. Th. & Pires, F. P. 2006. Estimation of soil hydraulic properties from numerical inversion of tension disc infiltrometer data and using laboratory methods. Vadose Zone J. 2006.5: 684-696. Published online 26 May 2006; doi: 10.2136/vzj2005.0074.

Mesquita, M. E., Gonçalves, M. C., Gonçalves, A. R. & Neves, M. J. 2005. Effect of electrolyte concentration on sodium adsorption. Application of competitive extended Freundlich isotherms. Arid Land Research and Management, 19: 161-172. http://journalsonline.tandf.co.uk/openurl.asp?genre=article&id=doi:10.1080/15324980590916567

Leitão, P., Coelho, H., Santos, A., Neves, R. (2006) 'Modelling the main features of the Algarve coastal circulation during July 2004: A downscaling approach', Journal of Atmospheric & Ocean Science, 10:4, 421 – 462 URL: http://dx.doi.org/10.1080/17417530601127704

Trancoso A., S. Saraiva, L. Fernandes, P. Pina, P. Leitão and R. Neves (2005). Modelling MacroAlgae in Estuaries. Ecological Modelling vol. 187, (2-3) , Pages 232-246

Nobre, A.M., Ferreira, J.G., Newton, A., Simas, T., Icely, J.D., Neves, R. (2005). Management of coastal eutrophication: Integration of field data, ecosystem-scale simulations and screening models. Journal of Marine Systems, 56 (3/4), 375-390

2.2.13 P13: HCMR - Hellenic Centre for Marine Research

The Hellenic Centre for Marine Research (HCMR) is a large governmental research institution, which accommodates five research Institutes, and is supervised by the General Secretariat of Research and Technology (Ministry of Development). It is the main responsible for the Oceanographic, Inland Waters, Marine Biology and Genetics, Fisheries and Aquaculture research in Greece, constituted of five relevant Institutes. The overall objective of the **Institute of Inland Waters (IIW)** is to develop and/or apply tools and methodologies for the conservation, management and rational exploitation of the aquatic resources. The major research directions of the IIW are: a) Ecological quality assessments and monitoring, b) Biodiversity conservation and environmental restoration and c) Integrated river basin management. The **Institute of Oceanography (IO)** supports research on the fields of Physical, Chemical, Biological Oceanography, Marine Geology and Geophysics and Operational Oceanography. The HCMR-IO has a long tradition in projects related to coastal zone issues and the impact of human activities on it. Eutrophication, heavy metal pollution, coastal erosion and socio-economic aspects have been investigated though the co-ordination and/or participation in several EU and national research projects. Field and laboratory measurements and methods are continuously updated to support relevant surveys. In addition, a **GIS** department supports all types of mapmaking and Internet visualisation of thematic layers of information (ARC-IMS).

The HCMR in the particular proposal will contribute to the ecological quality assessment of of Evrotas River basin, particularly focusing on the impact of drying and pollution on chemical and ecological aspects, of aquatic systems and endangered species, including the assessment of geochemical background levels and diachronic evolution of pollution. The study will additionally focus on biogeochemical aspects of the coastal zone, including the evolution of the coastline the last 60 years.

Nikolaos Skoulikidis (PhD, m) is geologist and received his PhD from the University of Hamburg on biogeochemistry of major Greek rivers and a principal researcher in the Institute of Inland Waters, HCMR. He has coordinated, or has been involved in over 40 international and national projects concerning river basin management, chemical and ecological quality assessment, EIA of aquatic ecosystems. He has currently carried out a national project concerning the ecological quality of a temporal river basin in Crete.

Elias Dimitriou (PhD, m) is a researcher with expertise in Hydrodynamic numerical modelling at catchment scale, water resources management, wetland hydrology and remote sensing and GIS environmental applications. He was participated in many relevant projects and he is now the coordinator of a Life Nature project entitled: ‘Actions for the conservation of Mediterranean Temporary Ponds in Crete’.

Aris Karageorgis (PhD, m) is geologists on marine sedimentology, principal researcher in the IO, HCMR and has coordinated and participated in numerous international and national research projects related to the marine and coastal environment, He has recently coordinated on behalf of Greece the EUROCAT project on Axios river basin.

Selected Publications

Skoulikidis, N.T., Gritzalis, K.C., Kouvarda, T. and Buffagni, A., 2004. The development of an ecological quality assessment and classification system for Greek running waters based on benthic macroinvertebrates. Hydrobiologia, 516(1): 149-160.

Dimitriou, E., Karaouzas, I., Skoulikidis, N. and Zacharias, I., 2006. Assessing the environmental status of Mediterranean temporary ponds in Greece. Annales De Limnologie-International Journal of Limnology, 42(1): 33-41.

Gritzalis, K.C., Karaouzas, I. and Skoulikidis, N., 2006. Assessing the ecological quality of running waters of Thrace region (NE Greece) by the use of macroinvertebrate indicators. Fresenius Environmental Bulletin, 15(9B): 1182-1188.

Skoulikidis, N.T., Amaxidis, Y., Bertahas, I., Laschou, S. and Gritzalis, K., 2006. Analysis of factors driving stream water composition and synthesis of management tools - A case study on small/medium Greek catchments. Science of the Total Environment, 362(1-3): 205-241.

Karageorgis, A.P., Skourtos, M.S., Kapsimalis, V., Kontogianni, A.D., Skoulikidis, N.Th., Pagou, K., Nikolaidis, N.P., Drakopoulou, P., Zanou, B., Karamanos, H., Levkov, Z., and Anagnostou, Ch., 2005. An integrated approach to watershed management within the DPSIR framework: Axios River catchment and Thermaikos Gulf. *Regional Environmental Change*, 5, 138-160, DOI 10.1007/s10113-004-0078-7

2.2.14 P14: FST-Fes - Faculté des Sciences et Techniques – Université Sidi Mohamed Ben Abdellah de Fes

The FST-Fes team is part of the large education and research establishment of the Fes University, with several fields of research. This team is involved in several international cooperation projects with E.U. member states and with other countries outside the E.U. (e.g. Canada, United States, Tunisia).

The research of the team focuses on surface water hydrology, water pollution, hydrogeology, modelling (surface rainfall-runoff), monitoring and data processing, water resource management as well as GIS and remote sensing. The team has access to the University's centre of physico-chemical analysis (CURI), which is equipped with up-to-date analytic apparatus (e.g. ICP-AIES mass spectrometer). This team has led different research projects on the Sebou basin and its tributaries. Flow and water quality were both studied. Rainfall-runoff processes were studied in semi-arid context at different scales (spot, catchment and regional scales). Extreme flow frequencies in the Middle Sebou were characterized for flood prediction purposes. In addition, Oued Fes was investigated to quantify urban and industrial pollution sources, to characterize their temporal dynamics and to evaluate their impacts on surface water quality. Further studies were carried out to determine groundwater vulnerability and establish protection perimeters around wells. These works were done in close collaboration with ABH-Sebou, which is in charge of managing water supply and water quality in the Sebou Basin.

Lahcen Benaabidate (PhD, m) is an environmental hydrologist (Hydrology and Water quality), Professor at the Faculty of Sciences and Technology of Fez since 1995. He is the director of the Laboratory of Georesources and Environment and responsible of the research team "Water and Environment". He leads researches (supervising several PhDs) on surface water hydrology and quality in the Sebou catchment. Currently he is the coordinator of the study "Surface Hydrology and Water quality in the FST-Fes".

Abdelkader El Garouani (PhD, m) is a Professor at the Faculty of Sciences and Technology of Fez since 1997, working on Geographical Information System and remote sensing. He is the leader of the research team "Geomatic and Natural resources".

Selected Publications

Koukal, B., Dominik, J., Vignati, D., Arpagaus, P., Santiago, S., Ouddane, B.& Benaabidate, L., 2004 : Assessment of water quality and toxicity of polluted Rivers Fez and Sebou in the region of Fez (Morocco) (2004). Environmental Pollution, 131 (2004) pp. 163- 172.

Jarar Oulidi, H., Benaabidate, L. & El Jaafari, S., 2005 : Impact de la désertification sur les systèmes d'irrigation dans la plaine de Tafilalt (Maroc). Le Journal de l'Eau et de l'Environnement, ISSN 1112 – 3834, n°5, Juin.

Ouardi, J., ELGhmari, A., Valles, V., Benaabidate, L. & EL Bouadili, A., 2006 : Caractérisation géochimiques et statistiques des eaux souterraines du périmètre irrigué de Tadla (MAROC). Le Journal de l'Eau et de l'Environnement, ISSN 1112 – 3834, n°7, Décembre, 2006.

Bouasria, S, Sadki, O, Benaabidate, L., Boumaggar, H. & Hammoumi, N., 2007: Geochemistry and speciation of particulate trace metals in Atlantic coastal sediments between Safi and Souira-Qdima (Morocco). Earth & Life, (2007-1-30), Vol. 2, n°.1, pp.: 1-25.

Sadki O., Benaabidate, L., Zian A., CHAREF A. & Gueddari M., 2005: Thermal springs in Northern Tunisia: geochemical study and their relation with tectonic features. Africa Geosciences Review. Vol 12, n°3, pp. 213-224.

El Garouani, A. And Tribak, A. 2006 - Relation between hydrology and climate in Innaoune watershed (Morrocan pre-Rif). Red Books, IAHS Publication, n° 308, 2006, 447-453 pp.

El Garouani, A. And Merzouk, A. 2006 - Demarcation of the protection zones around Hachef dam (Morocco) by remote sensing and GIS. WATER SCIENCES Journal, 19 (1) 2006 1-10 pp.

El Garouani, A., Merzouk, A. And Ozer, A. 2003 - Cartography and quantitative evaluation of water erosion in Moroccan pre-Rif. Red Books, IAHS Publication, n° 278, 2003, 380-386 pp.

El Garouani, A., Ennabli, M. And Boussema, M.R. 2000 - Use of GIS and remote sensing data for actual evapotranspiration estimation at regional scale. International Journal of Remote Sensing, V. 21, (15), 2811-2830

El Garouani, A., Jabrane, R, Boussema, M.R. And Merzouk, A. 1999 - Contribution of satellite imagery to saturated zone detection and to evapotranspiration zoning in Medjerda low valley (Tunisia). SECHERESSE, Sciences et changements planétaires Journal, N° 2, Vol. 10, Jun 1999, 117-122 pp.

2.2.15 P15: ABP - Autorità di Bacino della Puglia

The Autorità di Bacino was instituted after Italian Law n. 183/1989 that has established to plan and to program, in the environmental field, for catchment basins through the river basin plan (Piano di Bacino). The same law has instituted 6 Authorities of national relief (Po, Tevere, Arno, Adige, Triveneto, Volturno-Liras-Garigliano), n. 18 interregional Authorities and have delegated to the regions the task to characterize the Authorities of regional relief. The Puglia Region instituted its interregional Autorità in 2002, competence are on the regional hydrographical systems, like defined from the deliberation of the regional Council n. 109 of 18 December 1991, and on the interregional catchment basin Ofanto. The Autorità, for the purposes of the interregional agreements and in compliance with law 183/1989, pursues the unitary government of river basins and integrated use of the water resources. It addresses, coordinates and controls the cognitive activities of planning, programming and operating for the single regional catchment basins and the interregional one of the Ofanto river.

Institutional committee: President of the Puglia Region, chair; the Presidents of the Region Basilicata and Campania; Presidents of the provinces of Bari, Brindisi, Lecce, Foggia, Taranto, Avellino, Potenza; delegates from the regional Councils for Public Works, Environment, Urban planning and Agriculture and Forestry of the Regions Puglia, Basilicata and Campania.

Technical committee: regional employees in service with managing qualification designate from the regions interested; a provincial civil employee with designated managing qualification from every provinces interested; a civil employee for every administrations indicated by law 183/1989 and successive modifications and integrations; the representative of the Regional EPA; experts and advisors.

Technique-Operating secretariat: General secretary (Head); Offices: Secretariat, Studies and Documentation, Plans and Programs.

Antonio Di Santo (PhD, m), Professor of Hydraulic Construction at the Technical University of Bari, Department of Water Engineering and Chemistry, in charge as Segretario Generale (head of technical secretary).

Antonio Castorani (PhD, m), Professor of Hydraulic Construction at the Technical University of Bari, Department of Water Engineering and Chemistry, scientific coordinator of special programs.

Umberto Fratino (PhD, m), Professor of Hydraulic Construction, at the Technical University of Bari, Department of Water Engineering and Chemistry, coordinator for the analysis and identification of ephemeral river network.

Vito Iacobellis (PhD, m), Professor of Water Resources at the Technical University of Bari, Department of Water Engineering and Chemistry, coordinator for the analysis and optimization of water balance management.

2.2.16 P16: PL-LRS - Prefecture of Lakonia, Water Resources Division, Sparta, Greece

The mission of the Prefecture of Lakonia - Land Reclamation Survey is to manage all agricultural related water uses. The office has permanent personnel for monitoring water quality and quality, performs inspections and assign water use permits. It maintains a more than 50 year long historical record of water related information. The Survey has more than 15 full time personnel with appropriate sampling equipment, it conducts regular water quantity and quality sampling. The Survey interacts heavily with the Regional Water management office and the Ministries of Environment and Agriculture. The Prefecture of Lakonia has participated in several European projects such as LIFE Environment (EnviFriendly), and INTERREG.

Papadoulakis Vassilis (m), State Hydrogeologist, He is the director of the hydro-geological office of the Land Reclamation Survey of the Pref. of Lakonia. He has 20 years experience in groundwater research, management of water resources, quantitative and qualitative control of irrigation waters, groundwater well design and construction and design of small dams.

Kouvatsos Georgios (m), State Health Inspector. He is the director of public health office for the Prefecture of Lakonia. He has 20 years of experience in water quality control, management of drinking water and sewage water disposal.

Mpourazanis Georgios (m), is an agriculturist and received his BS from the Agricultural University of Athens. He has an M.Sc. degree in Agricultural Engineering an another one in Environmental Management. He is responsible for the implementation of the Common Agricultural Policy in the Lakonia Prefecture.

Selected Publications

Tavitian C., Papadoulakis V. and Dionyssopoulou S. 2006. Total Salinization of the granoular Pliocene aquifer in the Plytra graben" Proceedings of an International Conference Chania, Greece. Protection and Restoration of the Environment. Έκδοση TUC.

Andrianaki, M., O. Tzoraki, F Stamati, V. Papadoulakis H. Bertahas, E. Psillakis, and NP Nikolaidis, 2007. Monitored Natural Attenuation of Nutrients in the Evrotas River Watershed. Proceedings of EEDYP Conference, June 14-16, Chania, Greece.

Bourazanis G., 2004. A free water surface constructed wetland used for treating municipal wastewater in Sparta, Proccedings of European Water Resources Association on «Water Resources Management, Risk and Challenges for the 21st Century» Ismere, Turkey, Vol. II pp. 557-567.

Bourazanis G. and Kerkides P., 2005. Contribution to the evaluation of some theoretical models, calculating hydraulic conductivity in unsaturated soils, Proccedings of the 6ου International Conference of the European Water Resources Association on «Sharing a Common Vision of our Water Resources» 7-10/9/2005 Menton, France.

2.3 Consortium as a whole

The participants fall into to four different functional groups:

CT - catchment teams ("catchment owners"): these teams are responsible for organising the field work, for providing local data to the other teams and ensuring the stakeholder contacts. They are located near the case study sites and have to ensure that the necessary measurement infrastructure in the field is in place. This includes meteorological stations, weirs, flow gauges, sampling site access and automatic sampling stations).

FT - field research teams: these teams work in "guest catchments", supporting the local teams with their expertise, especially in the field of channel bed processes. They provide their expensive laboratory equipment and staff for sampling trips, if necessary.

IT – investigating teams: these teams process and analyse data and results of the catchment teams. They do not necessarily contribute to measurements done by the CT and FT and experiments, but will generate new procedures, models, tools and protocols in order to gain additional insights.

SH – stakeholder: the stakeholder representatives of the mirror basins will be actively involved in the project. They will have full access to working documents of the project and will be invited to all project meetings and workshops.

Tab. 4: Participants

	Partner	Acronym	Lead Scientist	Participant	Main Role
1	Leibniz Universität Hannover	LUH	Jochen Froebrich (m)	Matthias Obermann (m) Elke Buchholz (f) Melanie Bauer (f) K.-H. Rosenwinkel (m)	IT
2	Technical University of Crete	TUC	Nikolaos Nikolaidis (m)	E. Psillakis (f) Ourania Tzoraki (f) Konstantina Tyrovola (f) Thodoris Koussouris (m) Kostas Tsakiris (m)	IT, FT
3	Joint Research Centre (IT), Institute for Environment and Sustainability, Rural, Water and Ecosystem Resources Unit	JRC-IES	Giovanni Bidoglio (m)	Faycal Bouraouri (m) Bruna Grizzetti (f)	IT
4a 4b	Istituto di Ricerca Sulle Acque	CNR-IRSA	Antonio Lo Porto (m) Alberto Puddu (m)	Andrea Buffagni (m) Silvio Capri (m) Anna Maria De Girolamo (f) Stefano Fazi (m) Luisa Patrolecco (f) Stefano Polesello (m) Ivan Portoghese (m) Michele Vurro (m) Annamaria Zoppini (f)	CT, IT
5a 5b	Consejo Superior de Investigaciones Científicas	CSIC	Victor Castillo (m) Francesc Gallart (m)	Maria Martínez-Mena García (f) Carolina Boix Fayos (f)	CT, IT
6	University of Barcelona	UBAR	Narcís Prat (m)	Maria Rieradevall (f) Núria Bonada (f)	CT, IT
7	University of Murcia	UMU	Rosa Gómez (f)	Rosario Vidal-Abarca (f) Luisa Suárez (f)	CT
8	HydroSciences Montpellier, IRD – Universités Montpellier	UM2	Marie-George Tournoud (f) Jean Louis Perrin (m)	Bernadette Picot (f) Christian Salles (m) Chrystelle Bancon-Montigny (f) Nanée Chahinian (f) Claire Rodier (f) Marie-Ange Cordier (f) David Rosain (m) Frédéric Hernandez (m) Hadil Ibrahim (m)	CT, IT
9	University of Leeds	UNIVLEEDS	Mike Kirkby(m)	Brian Irvine (m) Pippa Chapman (f)	IT
10	CEH Wallingford	CEH	David Cooper (m)	Thomas Kjeldsen (m)	IT
11	EAWAG/Swiss Federal Institute for Aquatic Science and Technology,	EAWAG	Klement Tockner (m)	Christopher T. Robinson	FT

	Switzerland				
10	Institute of Marine Research	IMAR	Ramiro Neves (m)	Maria Gonçalves	CT
11	HCMR	HCMR	Nikolaos Skoulikidis (m)	Elias Dimitriou (m) Aris Karageorgis (m)	CT
12	Faculté des Sciences et Techniques – Université Sidi Mohamed Ben Abdellah de Fes	FST-Fes	Lahcen Benaabidate (m)	Abdelkader El Garouani (m) Mustapha Ijjali (m) Abderrahim Lahrach (m) Naoual Rais (m) Raouf Jabrane (m)	CT
13	Autorità di Bacino della Puglia	ABP	Antonio Di Santo (m)	Antonio Castorani (m) Umberto Fratino (m) Vito Iacobellis (m)	SH
14	Prefecture of Lakonia, Land Reclamation Survey, Sparta, Greece	PL-LRS	Vassilis Papadoulakis (m)	Kouvatsos Georgios (m) Mpourazanis Georgios (m)	SH

Composition and Interdisciplinary

The consortium of MIRAGE was selected and composed according to four main criteria:

1. representation of a broad variety of South European member countries of the EU (Portugal, Spain, South-France, Italy, Greece), complemented by other member countries (UK, Germany, Switzerland) as well as a Mediterranean Partner country (Morocco) with experience in semiarid regions.
2. long-term and documented experience in studying temporary waters and river modelling,
3. already existing collaboration between stakeholders and researchers,
4. experience in international and especially EU–research projects to achieve the benefit of past experience and cross-fertilization with past and existing projects.

Even though most of the institutes are working in comparable fields of water related topics, they all have a slightly different perspective and focus from which the project will benefit as a whole.

As many teams are working on several workpackages, each team will contribute within their own research field and experience.

Tab. 5 highlights the special skills of each team and indicates the balance of the consortium and positive cross cuttings. This will allow some partners to function as interfaces to other groups.

Tab. 5: Participants and related work topics

		Sediment & Geo-chemistry	Ecology & Micro-biology	Hydrology & Hydro-dynamics	Hazardous Substances	Water quality modelling	WFD implemen-tation & European policy	Manage-ment plans & RBMP
13	HCMR	●	•	·	•			
14	FST-Fes	●	·	•				
5	CSIC	●		●				
11	EAWAG	•	●	•				
7	UMU	•	●		•			
8	UM2	•	•	●	•	•		
9	UNIVLEEDS	•		●		•	·	
10	CEH			●		•		
4	CNR-IRSA		•	•	●	•	●	●
12	IMAR			•		●	•	
1	LUH			•		●	•	
2	TUC	•			•	•	●	•
3	JRC-IES	•				•	●	•
6	UBAR		●		•		●	•
15	ABP						•	●
16	PL-LRS						•	●

2.4 Resources to be committed

2.4.1 Human resources

All partners included into the field measurement work have the necessary equipment and laboratory staff needed to fulfil the sampling analysis.

Every partner will spend a significant number of long term experienced staff to the project. As outlined in the description of the consortium, the demands due to the multidisciplinary character of the project will be fully satisfied by the included partners.

Subcontracting is used in those cases, were additional mostly technical work is to do.

2.4.2 Durable equipment – sampling stations

Despite their significance for water management and definition of reference conditions in the Mediterranean, long time water quality data and data on invertebrates are scarce.

The long term hydrological behaviour of the case study areas has been monitored by equipment already in place. In some cases additional installation of equipment for detailed monitoring of specific aspects will be necessary.

Additional instrumentation will, in most cases, be needed to study the nutrient and pollutant dynamics and the impact of first flush effects on water quality and ecology.

The use of automatic sampling equipment and continuous monitoring stations are the only way to obtain satisfactory water quality data during short time scale events such as the first flush. In some catchments there are already automatic stations, and costs will be reduced if these can be used with modification. In other catchments an additional sampling station may be required depending on the different pollution inputs from tributaries.

2.4.3 Laboratory equipment for water quality and invertebrates analysis

All necessary laboratory equipment and most of the field equipment for the detailed investigation of river processes is at hand in the consortium (see Tab. 6).

Tab. 6: Durable equipment available among field and catchment teams of the consortium

Resource \ Partner	TUC	CNR-IRSA	CSIC	UBAR	UMUR	UM2	EAWAG	IMAR	HCMR	FST-Fes
General chemical laboratory		●	●	●	●	●	●	●	●	●
General sediment physical laboratory									●	●
Epifluorescence microscope		●					●	◦	●	*
CHN-Analyser		●	●	●	◦		●	◦	●	●
GPS		●	●	●	●	●	●	●	●	●
Automatic water sampler	●		●			●	●	●	●	
Portable meters (O_2, pH, Cond, Temp)	●	●	●	●	●	●	●	●	●	●
Computer facilities	●	●	●	●	●	●	●	●	●	●
Library	●	●	●	●	●	●	●	●	●	●
Vehicles for field work		●	●	●	●	●	●	●	●	
Microbial and biological laboratory		●		●	●		●	◦		●
HPLC system		●		●	◦	●	●	●		●
Lab enzymological analyser		●						◦		
Scintillation counter		●						◦		
Flow cytometer		●								
Respirometer							●	●		
XRD Analyser									●	●
XRF Analyser									●	
TOC Analyser		●		●	◦	●	●		●	●
AAS		●		●		●				★
CNS-Analyser (Soil, sediment)		●		●	◦					
GIS/RS laboratory		●	●	●		●	●			●
ICP-MS		●				●				
GC-PFPD		●				●				
ADCP current meter						●				

● available, ◦ access (sometimes limited), ★ ICP

3. Impact

3.1 Expected impacts listed in the work programme

The submitted proposal responds directly to the topic in the programme area Activity 6.2 Sustainable Management of resources, Sub-Activity 6.2.1 Conservation and sustainable Management of natural and man-made resources and biodiversity, Area 6.2.1.2 Water resources, Topic Temporary Water bodies Management. The proposed project addresses exactly these issues. The present project will provide scientifically-sound and novel knowledge for the sustainable management of temporary streams in the Circum-Mediterranean region under rapid changing environmental conditions (climate change, land-use change).

The project meets the strategic objectives of the Decision of the European Parliament and of the Council concerning the Seventh Framework Programme (DECISION No 1982/2006/EC) by bringing together 14 academic research groups and 2 Water management agencies from 9 different countries to establish the required critical mass of expertise.

As being most dominant water bodies in the Mediterranean, but often neglected, research on temporary water bodies management is of crucial importance. Probably the greatest impact of the project will be to provide for the first time a coherent framework for implementing the WFD in South European member states. Disregarding the problems of institutional settings and transposition of the Directive into national laws, which are beyond the capabilities of any research project, the current review “First stage in implementing the Water Framework Directive 2000/60/EC” (Comm, 2007) made very clear that the problems in delaying the implementation at the South European Member states are largely due to a significant knowledge gaps.

As well as adding the specific knowledge needed to support the management of temporary streams, the most important impacts of the project will be to support (i) improvements in the ecological status of temporary streams by Implementing the EU WFD in south European basins, (ii) the support of drought management strategies for these water bodies and finally (iii) to support the Mediterranean EUWI/MED Joint Process that facilitates good water management practices and targets the Millenium Development Goals. Due to the special nature of temporary streams these measures will also interact with policies for sustainable management of soils and terrestrial ecosystems.

3.1.1 Better understanding of the dynamics of temporary water bodies by researchers, water managers and environmentalists, research

The project has a major part to play in adding our scientific understanding of temporary streams by research into hydrological and ecological reference conditions, ecosystem functioning, specific management options for point source pollution, novel strategies for mitigating sediment and particulate delivery as well as the assessment of hazardous substance risk within extreme hydrological conditions. MIRAGE will look after a good balance between fundamental research, on ecosystem characterisation and innovative measures for pollution control, and applied research to integrate these findings related to the practical demands of water managers in Mediterranean basins.

This project will contribute to the knowledge base of River Basin Management Plans (RBMP of 6 years duration) in view of their 2009 completion date and beyond, including their anticipated revision. Such revision will be necessary in order to assess climate change impacts and evaluate the consequent ecological status change. The project will also provide key information for the development of an alternative Program of Measures based on scenarios analysis that will assess the impacts of various pressures on temporary river basins. Such scenarios will be tested at various scales, regional scale: Mediterranean region including North Africa; basin scale and local scale.

Much greater integration amongst researchers, water managers, environmentalists, and members of the common implementation strategy of the WFD will be achieved as we process the results on the two mirror basins in Italy and Greece. This will be very fully supported by the water agencies involved, the Prefecture of Lakonia (Greece), Autorità di Bacino della Puglia (Italy). Moreover the integration will further benefit from interactions with the stakeholder council, including the water agencies from other test sites, representatives from the Water Directors of the Mediterranean member states and the MENBO.

3.1.2 S&T support to the development of integrated water resource management strategies by relevant national and regional authorities in line with the EU Water Framework Directive Contributions to standards/policies

Reference conditions for determination of the Ecological Status and current impact at regional scale (Mediterranean river basins)

A significant impact will be achieved by integrating past work in developing and testing of reference conditions, past work during the Intercalibration Exercise (Prat) and by extending it to the analysis of relevant terrestrial - aquatic links, which is essential for streams with a significant dry period. The multi-scale approach take in the MIRAGE proposal will capture and describe the complex intricate scale dependent relationships between elements such as geology, chemistry, land use and water erosion and their impact at the reach scale on the ecology. Here in particular, the inclusion of flow and sediment regime analysis and the definition of river typology will yield a more precise definition of river types in the Mediterranean region in a harmonised, coherent and seamless way.

At the European level, MIRAGE will therefore be able to propose one of the first harmonised methodologies for river classification through the System B, establishment of reference condition and ecological status, thus allowing water managers to fulfil their obligations with regards to the WFD and to improve the possibility to compare data and indicators coming from various member states.

The project will significantly complement the work on reference conditions performed by the European Commission and the Member Sates on the harmonisation and intercalibration of ecological water quality assessment systems with which a close collaboration is envisaged. Results will be transferred actively by the JRC and the Consortium members by maintaining the links to the Intercalibration Exercise.

EU-WFD Art. 5 (due to 2004), Improving the characterisation of river basins, pressures, impacts

MIRAGE will provide the scientific basis required to improve the Article 5 reports (on initial status) to be elaborated by the individual member states. This is mainly achieved by linking the compulsory consideration of temporary stream dynamics into the in-depth analyses of pressures, impacts at the mirror basins in close collaboration with the involved basin authorities.

Examples of an adapted assessment of water bodies at risk for Mediterranean River basins will be available by the synthesis of related guidance documents also for other basin authorities via the WISE-RTD.

EU-WFD Art. 8 (for 2008), Establishing the monitoring network

Project results on structural and functional indicatorstogether with measured data on extreme dynamic pollution loads will help in recommending appropriate monitoring systems for individual member states. The MIRAGE project will be extending the experience already gained during the tempQsim project on the water quality monitoring to incorporate the ecological aspects of temporary streams.

EU-WFD Art 13. and Art. 14 (for 2008), Present draft river basin management plan to the public

The project will provide examples and experiences for drafting the RBMP's and their public discussion as required by Art. 14 for Mediterranean River basins.

For the **Evrotas** catchment the Water Bureau of the Region of Eastern Peloponnese supported by the Prefecture of Lakonia and its Land Reclamation Service is in charge to draft the RBMP. MIRAGE will actively supporting the public participation in (i) organising stakeholder meetings for reaching consensus also among the local 27 water managers (water companies for every village and town, local irrigation association, other water users, prefecture, government) in the watershed (ii) outlining site specific scientific knowledge to deal with the WFD implementation and influencing the recruitment and training of authorities staff; (iii) providing the links for the environmental management with the socio-economic aspects of the implementation of the WFD and especially its impacts on rural development, which have not been fully assessed nor have been understood how to be dealt with.

Art. 13 and Art. 11 (for 2009), finalise river basin management plan including the Programme of Measure – European level

Due to the already existing delays of the WFD implementation, the project MIRAGE is extremely timely to provide a major contribution for harmonising the adequate consideration of Mediterranean specific within the development of river basin management plans. Here the MIRAGE will certainly fill the gaps, also emerging from the past Pilot Basin investigations related to the specific measures required.

The processing of project experience gaining from the piloting co-development of the RBMP and PoM in the mirror basins in Italy and Greece, as well as its active interaction with the CIS Working groups, the CIS Expert Network and the Water Directors of the South European member states will deliver a major leap forward towards a common vision on measures required to achieve the WFD objectives.

The impact on European level will be increased as the director of the Greek Water Resources Management Authority will approve Evrotas as a PRB to exhibit the dynamics of temporary streams.

(Art. 13 and Art. 11), finalise river basin management plan including the Programme of Measure for 2009 – local level

At all sites in MIRAGE there are urgent environmental issues to be solved and already under investigation by the local authorities. This will help to speed up the transfer of results from science to practice and more important to provide the feedback mechanisms even during the project lifetime.

As a central component of the project, the investigations of specific PoM's and their consideration within the RBMP will enter directly into the official planning and provide specific proposals on effective and applicable measures in the field of pollution control, development of the flood plains, erosion control and the outline of integrative flood management strategies.

In the case of **Catalonia**, the data collected in Vallcebre will be used specifically to support the development of adapted sewage treatment concepts. Also the upper part of the basin also contains open mine activity that although already partially restored, has produced hydro-morphological changes that make it impossible to restore the riparian forest. The results of the project will help in proposing further restoration measures.

The ACA is currently defining the RBMP for Catalonia (coastal basin totally included in its territory). Data from MIRAGE focusing on temporary streams and experience gained from the mirror basins will help in the further elaboration of this Plan, specially in defining the water needs for the development of river communities and potential conflicts in water use.

At the local scale the Vallcebre stream is now severely polluted downstream of the village, and the data gathered will permit definition of an appropiate reference condition and therefore the measures necessary to restore good ecological status. As the proposed sewage treatment for this municipality is still not defined, data from the project will be transferred into the ACA planning process accordingly

In the **Thau lagoon basin**, the CG34 (Département de l'Hérault) is in charge of helping municipalities to conceive and finance their waste water treatment facilities.

The rivers, flowing intermittently into the Thau lagoon, are impacting bathing areas and the associated socio-economic activities. In fact, these rivers are polluted by waste water treatment plant effluents. The pollution brought by these rivers contributes to damage the ecological status of the sensitive downstream environments and to disrupt socio-economic activities such as shellfish farming and/or tourism, through distrophic crisis (e.g. eutrophication, toxic algae blooms etc.) and sanitary crisis (e.g. high concentrations of hazardous substances, accumulation of enteric bacteria).

It is of first importance to reduce pollutants inputs from the rivers both in order to comply with the WFD assessments in the coastal water bodies and in order to maintain the socio economic development of the region.

In this framework the MIRAGE project, and its contribution to the study of the impact of pollution point sources on intermittent rivers, will help the stakeholder (CG34) to define acceptable standards of emissions for waste water treatment plant, to choose well-adapted treatment systems, in relation with hydrological characteristic of the intermittent river and to elaborate the specifications for practical management options to satisfy the criteria of the EU-WFD.

Daughter Directive on environmental quality standards for the priority substances

Information on chemical substances as priority substances varies in the Art. 5 reports and is often very incomplete. Therefore the project MIRAGE will contribute to the improved applicability of the Daughter Directive on environmental quality standards for priority substances in Mediterranean river basins and will support the Chemical Monitoring Activity led by the Commission which is in charge of delivering a manual on monitoring practices for the EU. The issue of ecological classification in temporary rivers has been addressed in recent years, although not yet finalised. In contrast, the problems connected with Environmental Quality Standard (EQS) compliance in these peculiar environments, in order to assess the chemical status, have never been satisfactorily addressed by the scientific community. The WFD Annex V.1.3.4 suggests increased frequency during periods where use might lead to seasonal differences. While the monitoring frequencies quoted in the Directive may not be practical for Mediterranean rivers running dry several months a year, the project will provide practical suggestions for an adapted sampling frequency.

This leads to an open issue regarding the data reporting in these particular conditions. It was noted that reporting of data on a seasonally modified monitoring regime requires careful thought to ensure that the approach taken does not create anomalies with regard to the assessment of compliance.

Using the outcomes of WP7 (hazardous substances), the project will carry out expirimental campaigns to establish the variability in concentrations of pollutants during critical hydrological conditions. These will include very low flow conditions and rewetting after a drought period. In these cases one possible approach is to compare the data with the Maximum Allowable Concentrations (MAC), as suggested by the incoming Directive on EQS of priority substances.

Knowledge of the concentration trends during peculiar hydrological situations is also the basis for concentrations reaching the MACs and so creating an acute ecological risk.

Supporting of drought management plans in accordance with the WFD objectives and "Communication on water scarcity and drought"

By focusing on river systems facing already extreme disturbances and by including the investigation of future changes in describing adequate hydrological reference conditions, the project will have a major impact in supporting the modified planning and implementation of the WFD under current and future drought conditions, the set up of *drought management plans,* supporting also thoroughly the Expert Network of the Common Implementation Strategy of the WFD on water scarcity and droughts. (WS&D), and increasing political attention to temporary streams at Mediterranean basins.

By demonstrating the importance of temporary streams at European Scale, the MIRAGE project will clearly contribute to the *Module 1* "In-depth assessment" as proposed by the WS&D Expert Network.

The *Module 2* "Links between WS&D and the WFD" will gain support from the development of reference conditions and the associated outline PoM recommendations. Results will be processed for future indicators of drought and water stress assessment and therefore contribute to the requested short term actions. Furthermore the integrative consideration of water scarcity aspects and PoM in the mirror basins will provide a sound basis for the future development of drought sub-plans also as part of the PoM. Together the two mirror basins will then provide a pilot study for the interaction between quantitative and quality water management aspects.

Through climate change scenarios during the investigation of potential PoMs, MIRAGE will address the impact of prolonged droughts and hence anticipate any future deterioration of the water status by considering preventive measures, integrating the ecosystem resilience as one important aspect of mitigating the effect of exceptional droughts.

Results from the Segura basin and the Taibilla subcatchment, together with studies in Catalonia will actively contribute to the current development of drought management plans for Spain. This will be specifically related to an understanding of current hydrological dynamics and maintenance of satisfactory ecological and water quality status.

By these results and its close interaction with the WS&D Expert Network, MIRAGE will already provide best practice examples in the view of the "Communication on water scarcity and drought", which is expected for July 2007, and should also give a clear picture of existing EU tools, current gaps and propose new EU tools for the future. It also provides the knowledge base for future effective adaptation of water management to minimise the climate change impact in the sense of the EU post-2012 Climate Change Policy.

Supporting the Mediterranean EUWI/WFD Joint Process (Med-JP)

Through its cross-Mediterranean network, the MIRAGE project will contribute key elements to the Med EU Water initiative by identifying critical elements to be addressed in relation to integrated water management in catchments characterised by ephemeral streams including issues such as flood, erosion control, ecological status, etc. Links across the Mediterranean to North Africa will also enhance cooperation and transfer of know-how, a key component of the Med EU Water Initiative.

As one of the two Mediterranean Pilot basins (MPB), the MIRAGE research at the Sebou basin will actively support the Mediterranean EUWI/WFD Joint process. By involving experts both from Morocco and from Europe in the collaborative research on pollution mitigation measures within the Oued Fes, the project will contribute to the objectives of the Med-JP by supporting the identification of potential difficulties in applying the WFD principles to southern Mediterranean Partner Countries. More specifically the project will have a significant impact on the "Phase II objectives" of the Med-JP by demonstrating the experience gained in developing improved water management practices. In addition the project will promote the sharing of experience, again applying PoM principles identified for the European Mirror basins to address conditions in the MPC, and learning how to make the necessary adaptations.

The results and experience gained from the collaborative investigation of measures in the Sebou basin will be summarized in a document supporting the water resources management (in the view of the EUWI), and the future convergence of legislation for non-EU countries. These will be made available to the Med Working group "Water Scarcity and Drought" via the MIRAGE project and to upcoming activities in the MPB Sebou on testing measures for achieving the objectives of the WFD via the SPI-Water project and by attending the annual meetings of the Med WFD experts.

3.1.3 Wider impact related to objectives of Theme 6 - Environment

The MIRAGE project is providing a leading example for the promotion of sustainable management of the environment and its resources through advancing our knowledge on the interactions between the climate, biosphere, ecosystems and human activities in Mediterranean river basins and to address in a integrated way the applicability of environmental measures, management and service as the main objective of the Theme 6.

Focusing on the key objective of Activity 6.2, research performed in MIRAGE will in particular dedicated to the knowledge needed for the sustainable on particular endangered resources and ecosystems. In particular the envisaged sustaining of ecosystem services and the linkage between terrestrial and aquatic ecosystems will help to mitigate the degradation and loss of important compositional, structural and functional elements of ecosystems (for biodiversity, water, soil and marine resources) in the Mediterranean. Here MIRAGE will underline the objectives of the 6th Environmental Action Plan and Key issue (2) and support the Commission Communication on Halting the Loss of Biodiversity by 2010 (COM(2006)216).

Relating to the The green paper on climate change MIRAGE will dedicate a specific part of the work to investigating the impacts of climate change in modifying the regional distribution of temporary waters, and also to investigating the most appropriate combinations of remedial measure under potential climate change scenarios.

A major link to the Common Agricultural Policy is considered by investigating the impact on land use and best management practice on pollution emission and control for the mirror basins. It is anticipated that the project will have an impact on the future soil strategy, by integrating soil conservation measures, a consideration of related reduction of pollution emission and the inclusion of such aspects into an integrated flood management.

This is also considered of relevance in relation to the proposal of the Commission for a Directive on the assessment and management of floods and droughts. Close coordination is foreseen, in particular with respect to the plans which will be prepared in synchronisation and coordination with WFD river basin management plans.

The project MIRAGE will further strengthen the Thematic Strategy for the Marine Environment as a commission proposal for achieve good environmental status of the EU's marine waters by 2021 and thereby extending the protective scope of the WFD into the open sea. This will be made by demonstrating the impact of pollution loads to the coastal areas within the mirror basins and to indicate the requested PoM.

In a whole MIRAGE is also related to the following International Conventions (1) UN Framework Convention on Climate Change (UNFCCC), UN Convention in Biological Diversity, UN Convention on Combating Desertification, International Strategy for Natural Disaster Reduction, (2) Kyoto and Montreal protocols, (3) World Summit on Sustainable Development, Global Earth Observation System of System initiative (GEOSS), (4) Intergovernmental Panel on Climate Change (IPCC).

3.1.4 EU added value

A project of the scale and ambition of MIRAGE requires the mobilisation of multi-disciplinary expertise and necessary critical mass, which is not available in any one or even several member states. To be cost effective, MIRAGE will bring together Europe's leading scientists in their field and integrate mainly a variety of pre-existing results, tools and experience already available at the different member states. In supporting the harmonised implementation of the EU-WFD in the Mediterranean MIRAGE is of strategic importance to the EU as a whole.

The necessary research on hydrological and ecological reference conditions and on the related management measures exceeds any individual national capacity and clearly requires also thematically a collaboration at an European scale (including the exchange of experiences from Mediterranean non EU countries) , as temporary streams are widespread across the Mediterranean. They represent a challenge for widespread and consistent implementation of the WFD, requiring the compilation of comparable data sets, using the same protocols for different basins to provide strictly comparable results. This problem has been demonstrated in the *Intercalibration Exercise* of the MED-GIG in which it has been difficult to find adequate data to compare temporary streams across different Mediterranean climates within Europe. When several years are used the fluctuations of the EQR values are very large and this makes it difficult to make direct comparison of data and thresholds between classes. Any recommendation for supporting the PoM and RBMP development, in the Frame of the EU-WFD implementation, also has to consider national differences in institutional settings and regional practice.Not only are the type- specific conditions very different from other (mainly humid) streams where the WFD has been applied, but conditions vary from year to year increasing the difficulty in making direct comparisons without long-time series of data from streams in different parts of Europe to widen the possibilities of comparison between streams and variations in seasonal response.

Even considering the high environmental standards, it is commonly anticipated that for Western Europe there will be more jobs in environmental engineering than in mechanical engineering in the coming years. A leading example is given by the Programme AGUA, Ministry of Environment of Spain.
In the context of improving water supply and water quality in the Mediterranean provinces of Spain (Málaga, Almería, Murcia, Valencia, Castellón, Barcelona, Gerona) there is planned investment of €2400 M in water quality related topics. It will include the treatment of desalination plant effluents, cleaning polluted sediments, increasing wastewater treatment for reusing water resources (the most important in cost terms) , riparian forest, etc.. This demonstrates clearly the potential impact on jobs and growth especially for the South European Member states. The appropriate planning of a Programme of Measures using the project results will lead to direct the very large investments needed in the right direction and will ultimately be a factor in implementing those investments.

3.1.5 Integration of national and international research activities

The project will also integrate ongoing efforts undertaken in the LIFE project Envifriendly, supporting the development of remediation measures for the Evrotas mirror basin, deriving further benefit from the links established in MIRAGE with the regional stakeholder, water managers and the public.

Other important links, leading to integration of project activities into the European Research Area, will be the collaboration with four existing IPs: with AquaStress by exchanging knowledge on combinations of options and innovative water stress management, with NeWater by exchanging experience in the IWRM, with Desurvey on desertification issues, and, very significantly, with WATCH, providing insight into improved climate change scenarios, predictions and boundary conditions for the investigations within the MIRAGE.

3.1.6 Improvement of European Competitiveness

The MIRAGE project will have a specific impact on the central objective of the FP 7, to increase the 'knowledge triangle' - research, education and innovation. Providing critical key knowledge to enable a sustainable management of temporary streams under current and future aridity will make a significant contribution to fulfilling the Lisbon socio-economic strategy launched in 2000: to make Europe the most competitive and dynamic knowledge-based economy in the world by 2010.

Where a knowledge gaps has allowed some failures in the implementation of policies, targeted research will now assume the role of a catalyst for improvement. For Mediterranean river basins, the MIRAGE project clearly addresses the provision of this missing knowledge, which is seen as essential for fostering implementation of the WFD.

As for other semi-arid regions, Mediterranean river basins are under significant anthropogenic pressures leading to a wide variety of environmental problems. By focusing on this particular issue, MIRAGE will help to promote the role of European researchers in becoming leading experts in this field.

The outcome of this project will have drastic societal impacts by strengthening Europes scientific role in developing holistic strategies for an Integrated Water Resources Management, by raising the public awareness of the need for increased and sustainable water quality and quantity protection in Southern European member states and Mediterranean non EU countries, and by providing the grounds for fostering the investments in environmental technology for waste water treatment, soil conservation measures and rational water use in the spirit of the EU-WFD.

3.1.7 Exclusion of risk factor

The risk of not achieving the objectives of the proposed project is considerable low. In principal the project consortium consist of team members which had meanwhile experience on collaboration in cooperation projects for several years, optimising the share of information and common support.

Factors potentially affecting the achievement of the impacts listed, are in particular the limitation to reach a stakeholder consensus for finalising the RBMP drafts. In such a case, the project will deliver in any case meaningful piloting examples, which may be adopted in other basis.

In addition to this, the project approach considers two mirror basin, enabling a comparability, but also a back up-strategy in case that in one of it, more difficulties in the consensus building would arise.

Further contingency plans are outlined in the Part II, 2.18.

3.2 Dissemination and exploitation of project results, and management of intellectual property

Dissemination will be within the responsibility by all partners and in particular for the Coordinator and WP-Leaders, facilitating the synthesis of results. The project will provide regular newsletter and the electronic project website, which will be linked to the WISE-RTD portal. Frequent information exchange will be also maintained with the www.emwis.org and the individual websites of the involved basin authorities and partner institutes in national language.

In principal the dissemination of MIRAGE results will address three target groups (i) the scientific community within the ERA and international, (ii) the water managers and authorities concerned with IWRM of temporary streams and (iii) the wider public. For each target group specific dissemination pathways had been explored.

3.2.1 Disseminating of project results to the scientific community

Peer reviewed publications

The major dissemination pathway of the project will be the publication of results in peer review journals. Following the experience gained during the tempQsim project, the Workpackages will focus on producing synthesis

publications in peer reviewed journals as accomplishment to the administrative reports. A clear planning of the structure, method and content of the paper before the Kick-off meeting will help to smooth the information flow. The Annex contain a list of tentative titles and targeted journals for each WP.

Books

Integrating the research results from tempQsim, AquaStress, and MIRAGE, a book project will be initiated by the Coordinator with the tentative title "Management of temporary streams", inviting in particular co-authors from the consortium and selected external experts.

Scientific conferences

Beside the regular presentation of results by project participants to national and international conferences, a set of main events have been already identified.

Following the tempQsim project, MIRAGE will contribute significantly to the **XIIIth World Water Congress, Montpellier**, France, 25-28 August 2008. Specifically the interaction of water quality dynamics in temporary streams and needs for integrated water resources management will be addressed, in close cooperation with the Partner HSM as one of the main organisers.

One project meeting will be held back to back of the upcoming annual General Assembly of **European Geophysical Union (EGU)** to present mature results of the MIRAGE. Since the tempQsim project, both Mike Kirkby and Francesc Gallart had organised three successive sessions on Dryland Hydrology (HS39-HS49). It is planned to offer this session in continuously again, in order to invite the wider scientific community for an active dialogue, and to present advances of the project.

In the context of disseminating up to data EU research, the Mirage project will contribute significantly to the **5th World Water Forum** of the World Water Council, Istanbul 15 – 22 March, 2009 (www.worldwaterforum5.org). Here in particular experience from the joint collaboration between the EU and non EU Mediterranean pilot basins will be presented, addressing bridging of conceptual barriers in sustainable water management. The dissemination of results at the 5th World Water Forum also will address audience of water managers.

The final project conference (Month 33) will be held as a individual session **"Towards sustainable management of temporary streams, WFD Implementation in Mediterranean basins**" during a international conference of high impact and should mainly address the science policy dialogue and dissemination of practical experience related to the implementation. Ways will be explored to organise this session e.g. in a regular EWRA or IWA conference for 2010. In case of funding MIRAGE will maintain the close collaboration with the coordination action under "ENV.2007.1.3.3.3. Investigating Europe's risk from droughts", actively supporting the preparation of a central European Conference on water management in drought prone regions.

3.2.2 Disseminating of project results to the water authorities in charge to implement the WFD and to manage temporary streams

Stakeholder Council

The Stakeholder Council will be the main dissemination pathway to address the water authorities in charge to implement the EU-WFD.

To save time and personnel resources, the stakeholder council meetings will be held always back to back of relevant meetings organised by the WS&D Expert Network. Thierry Davy, as leader of the WS&D Expert Network will make the link with MIRAGE participation to the 3 topics of the group (exemptions to WFD due to drought, drought management plan, agriculture and drought).

The project will facilitate three assemblies, with already planned objectives and target outcomes.

1. First assembly: Back to back to the "Workshop on integration of drought management plans in the Programme of Measure of the WFD and in the RBMP" in Spain organised by the Expert network (first semester 2008).

i) Communication of views on strategy to link drought management sub plans to the WFD and the development of RBMP's to be ready for 2009 to the project.

ii) Presentation of research gaps on reference conditions supporting the development of indicators for distinguishing of droughts and aridity (WP3 and WP4), as well as presenting of research needs to integrate drought management sub-plans as a component of the PoM with other measures to reach the targeted ecological status.

Expected outcome: provisional guidance document on needs and ways for linking PoM and drought management subplans.

2. Second assembly: Back to back to an informal meeting of the Mediterranean Water Ministers (End of 2008) (tentatively in Italy).

i) Communication of the state of play of MIRAGE activities, outlining ways ahead for supporting the PoM and RBMP development for Mediterranean basins. Exchange of experience in practical, administrative and legal requirements. Discussion on upcoming Art. 21 Committee issues, progress in national implementation.

ii) Presentation on potential adaptation strategies for considering management of temporary water in Mediterranean Basins.

Expected outcome: Informal position paper on adapting the WFD implementation, review of the project progress and recommendation on corrective actions where needed.

3. **Third assembly:** Back to back to the planned Workshop "Integrating quantitative measures to PoM and RBMP for temporary rivers" (Beginning 2009, Brussels).

i) Communication of national relevance of temporary streams and individual roadmaps for further considerations.

ii) Presentation on project results on suitable measures, experience gained from the study sites and ways of their inclusion into the PoM.

Expected outcome: Informal position paper on strengthening the planning of PoM and RBMP in respect to temporary streams, used also as guidance document to streamline the testing of RBMP development at the mirror basins.

Results, minutes and position papers will be made available via the EMWIS and WISE-RTD portals.

The project will also explore ways to support the organisation of other potentially upcoming workshops such as “Building a programme of measures to integrate drought measures inside of the PoM for the 9 PRB” , tentatively at JRC Ispra, end of 2007, or “Workshop on impacts on drought and floods” organised during the French presidency (second semester of 2008) (location tbd). The stakeholders involved will be invited on a voluntary basis. The project scientist will be at least represented by the coordinator and the WP-Leader.

3.2.3 Supporting Mediterranean EUWI/WFD Joint Process

As member of the Med Thematic Working Groups (Med WGs) “Water Scarcity and Droughts” the coordinator will support the disseminating of experience in the development of measures applicable for temporary streams, PoM and RBMPs and hence to strengthen the further development of the “Mediterranean EUWI/WFD Joint Process”. Together with the project partners FST-FES and the AGH Sebou, MIRAGE experts will also support the initiative of the Mediterranean Pilot Basins (MPB), reviewing the transferability of results from the WFD process and the use of information provided by the WISE-RTD in close collaboration of the SPI-Water Project. Both the FST-FES experts as a project representative will attend the planned annual workshops.

3.2.4 Disseminating of project results to the wider public

Beside the intensive use of electronic media, via the maintenance of a project website, linked to the WISE-RTD as well as to the EMWIS portals and active public information is targeted in both Mirror basins.

A specific Info-Day will be held back to back of the project meetings, inviting a larger group of stakeholders and the interested public. A special small booklet introducing the project context and benefiting already from tempQsim results on water quality dynamics in temporary streams will be prepared in local language. A special information flyer to address public schools and non-expert, raising the awareness between water quality, ecosystem dynamics and droughts will be disseminated.

Synergies to the AquaStress IP will be used to disseminate MIRAGE project results at summer schools and training events.

3.2.5 Intellectual property rights

MIRAGE will mainly relate to intellectual property rights for protecting data ownership, methods developed, scientific knowledge and conclusions.

The dissemination process is made under the responsibility of the owner and in respect of the IPR provisions of the Grant Agreement and the Consortium Agreement. The dissemination process cannot start until knowledge is protected.

Tab. 7: Planned Publications for MIRAGE

Workpackage	Tentative title	Targeted journal
WP1	Froebrich et al. Supporting the development of RBMP for temporary rivers in the Mediterranean	Environmental Management Elsevier
WP2	Nikolaidis, Lo Porto et al. Adapting the WFD towards the needs of temporary streams	Environmental Management Elsevier
WP3/WP4	Prat, Gallart et al. Hydrological and ecological reference conditions for Mediterranean temporary streams	Hydrobiologia
WP3	Tockner, Prat et al. Aquatic-terrestrial linkages in temporary streams	Bioscience
WP5	Perrin et al. Impact of sewage effluent, waster water management ad accumulation of organic matter in temporary streams	Environment, Science and Technology
WP6	Castillo et al. Impact of erosion control, sediment and particulates delivery on ecological status in temporary streams	Earth Science Reviews
WP7	Puddu et al. Assessment of accumulated hazardous substances in stream beds of temporary rivers	Environment, Science and Technology
WP8	Cooper et al. New approaches towards an integrative flood management including water quantity and quality aspects in temporary streams	J. Hydrology

4. Ethical Issues

The activities of this project are in compliance with the ethical principles formulated in the Seventh Framework Programme Guide for Applicants. If, during the course of the project, conflicts with these principles should arise, the Consortium will ensure that the Commission is informed, and conflicts are solved according to legal and ethical standards of the member states, as well as of the Commission.

	YES	PAGE
Informed Consent		
• Does the proposal involve children?		
• Does the proposal involve patients or persons not able to give consent?		
• Does the proposal involve adult healthy volunteers?		
• Does the proposal involve Human Genetic Material?		
• Does the proposal involve Human biological samples?		
• Does the proposal involve Human data collection?		
Privacy [1)]		
• Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		
• Does the proposal involve tracking the location or observation of people?		
Research on Animals		
• Does the proposal involve research on animals?		
• Are those animals transgenic small laboratory animals?		
• Are those animals transgenic farm animals?		
• Are those animals cloning farm animals?		
• Are those animals non-human primates?		
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)		
• Benefit to local community (capacity building ie access to healthcare, education etc)		
Dual Use		
• Research having potential military / terrorist application		
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	**X**	

[1)] Privacy statement: Due to technical requirements, a limited number of personal information may need to be collected. These information will include (at the most) the full name of the person, email, telephone, and possibly other contact data; and will be used solely for supporting the communication processes within the project. If the introduction of personal passwords will be necessary, e.g. to enable project members to log into protected web areas, the Consortium will provide appropriate technical means to ensure that the privacy of such information is preserved. No personal information collected during the project will be given out of hand, or will be used for purposes other than the ones stated herein, such as advertisement. After project completion, all personal information will be deleted.

5. Consideration of gender aspects

A number of steps is done in order to raise the awareness for gender issues within the project. The major approach is to encourage women's participation in research both as scientists/technologists and within the evaluation, consultation and implementation processes. Therefore, the members of MIRAGE propose the following activities:

1.) Increase participation of female researchers in the project: all participants declare a voluntary commitment how to handle job vacancies within the activities of the project:

- targeted address of job vacancies to female researchers and encourage their application;
- give preference to female job applicants if female and male applicants have the same qualifications;
- check the possibility of part-time work and flexible work practice (e.g. teleworking) in order to increase number of women with family responsibilities and to provide incentives for women to return to work following maternity leave

2.) Visibility: using of gender-neutral language in meetings, official documents and correspondence.

In the project women are directly involved in the scientific management of the project and in the scientific partnership as scientific team leader in the project:

- 2 women are directly involved in the scientific management of the project;
- 21 women are involved in the scientific partnership as scientific partner.

Total women participation is 30% of the total personnel committed to the project (excluding personnel to be hired from the EU contribution). The percentage of women participating within MIRAGE reflects the low representation of women in this research area (~25 % of the engineering absolvents are women) in general.

Even though we recognise that the ratio of senior women scientists in our project is relatively low compared to men (<10%) we believe that we are being pro-active in ultimately contributing to changing this over the medium to longer term.

6. Annexes

6.1 Annex I - Test Sites

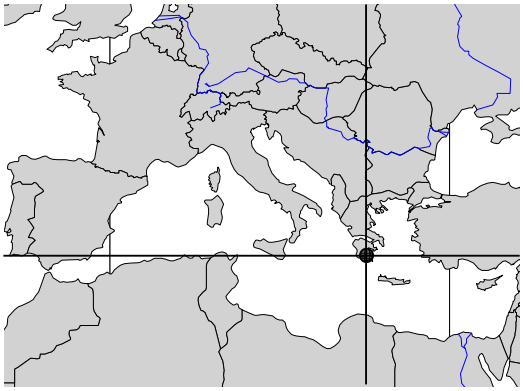
6.1.1 Evrotas, Greece

The Evrotas river basin is the main basin of the greek Water District (03) as stated in the "Report On The Pressures And Qualitative Characteristics Of Water Bodies In The Water Districts Of Greece And A Methodological Approach For Further Analysis."

The Water District (03) of East Peloponnesos occupies a total area of 8.477 km^2 and consists of the major parts of the Prefectures of Lakonia (94.3%), Argolida (92.4%), Arkadia (51.6%) and smaller parts of the Prefecture of Attiki (17.9%) and Korinthia (4.2%).

Evrotas River belongs to a large, mid-altitude Mediterranean basin of 2410 km^2 with an elevation ranging between 0 and 2400 m.

Mirror Basin: Evrotas



Characterisation - The rivers' catchment belongs to Arkadia and Lakonia Prefectures/ southwestern Pelopponisos. The river flows from Taygetos Mountain and ends up, after 90 km, in to the Lakonian Gulf. In summer, as a result of the combined action of water abstraction and drought, several river parts dry out. Its minimum, maximum and mean annual discharge at Vordonia is 0.0, 9.0 and 1.7 m^3/s respectively (period 1986-1997).

Pressures - The main river uses in Evrotas catchment are water abstraction for irrigation and sand removal from the riverbed for construction activities. Water abstraction is carried out by direct pumping or through the construction of small dams and drainage channels. In addition, numerous drillings, which are often situated near the springs, are operating during the irrigation period. The magnitude of water abstractions depends on the climatic characteristics of the year and the type of cultivation. In addition, the river at its lower portion has been straightened. The river receives point and non-point pollution. The main point pollution sources are connected with agricultural activities and concern oil mill wastes, wastes of orange juice manufacturing, orange-landfills and municipal waste disposal. Autumn and winter rainfalls "flush" sediments, organic matter and pollutants into the river. Orange juice manufacturing, orange landfills and oil mill wastes are considered to severely affect aquatic quality and threat biota. Peloponnisos is a biodiversity hotspot. The river is characterised by very rich aquatic vegetation. These valuable habitats are severely impacted by water abstraction. Freshwater biota is additionally affected by eutrophication, which results from pollution. Riparian forests (Platanus orientalis, Salix sp., Tamarix sp.) exist along extensive parts of the valley. The riparian forests provide protection against bank erosion and floods and offer cover for wildlife and many other ecosystem services. These forests are often felled or cleared illegally for agricultural expansion within the river's riparian zone or near floodplain areas.

Part of the river valley is designated as an Important Bird Area (Annex I of Directive 79/409) and the lower portion of the river as a NATURA 2000 site.

Impact - Evrotas dryes out in summer with a reduction of riparian areas and an alteration of the hydrological regime. This leads to a severe biodiversity threat (habitat destruction) and increasing erosion (loss of fertile agricultural land) as well as an eutrophication increase in standing waters, aquatic quality degradation (riparian forests "filter" pollution) and degradationof potable water quality.

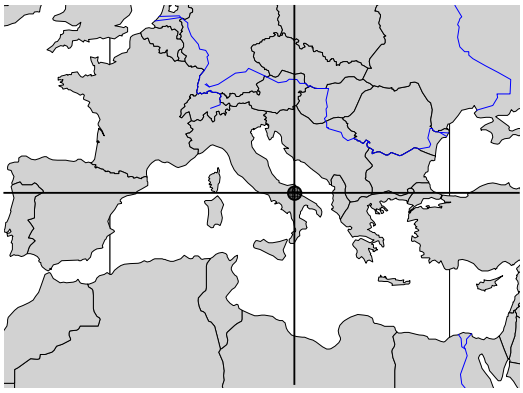
(Watershed management plans are being developed that involve the environmental pressure and impact assessment of the area, the assessment of the ecological quality of the waters in the watershed and the coastal zone, the assessment of the trends of the agricultural production behaviour and the calibration of the watershed and coastal zone models for the area.)

The final deliverable of the proposed project is the creation of a Local Development Observatory that will be housed at the Prefecture and it will be staffed by employees from the local authorities. The training of the staff will be carried out as part of this project. The Observatory will become the central watershed manager and it will play a vital role in the implementation of the Water Framework Directive.

6.1.2 Candelaro, Italy

The Candelaro River is located in the Apulia Region (S-E Italy) and flows to the edge of the Gargano in direction NO-SE in correspondence of a fault formed during the rising of the promontory.

Mirror Basin: Candelaro



Characterisation - It has a length of about 67 km and it collect the water of a basin of about 1800 km2, characterised by a mean elevation of 300 m, a maximum of 1150 m and a minimum of 0 m above the sea level. The left slope of the basin is rather small while the right one is very wide and signed by a large number of tributaries. The most important are the torrent Celone, Salsola and Triolo. These streams originate in the Subappennino Dauno, receive water from several sub-tributaries, flow through the plain of the Capitanata from SO to NE and go into the Candelaro in correspondence of its middle course. The superficial density of the hydrographic network is rather elevated; the final water body is the Adriatic Sea. The Candelaro feeds some wetlands downstream that are protected under national and regional regulations. The mean annual rainfall is around 600 mm; the mean annual runoff is around 160 mm and the mean annual potential evapo-traspiration is around 1100 mm.

Pressures

- a water lack for the satisfaction of the uses; during the last twenty years, it has been observed a change in the agricultural practices in this area from an extensive grain farming to a wide horticultural activity that requires a larger amount of water;
- a hydrography characterised by a torrential regime, with very small discharges during the summer;
- the rainfall rate decreased of about 30% during the last 40 years; this produced a progressive increase of the areas considered subject to the risk of desertification;
- special attentions must be addressed to the presence of nutrients, produced by the intensive agricultural practices, to physical and chemical changes of the soils and to microbiological risks for the waters;
- in the catchment several WWTP's discharges exist that are responsible all together for 1.5 cm/s, that is the average dry season flow;
- the over-exploitation of groundwater for irrigation brought to a progressive impoverishment of the aquifer and, in several zones, to a total absence of shallow groundwater;
- concerning the hydrogeological protection, a number of landslides have been censed in the basin;
- the industrial activity in the area consists in several medium-small food industry plants;
- the basin has recently witnessed several flood events that have been responsible for deaths and damages

Status and Impact

- influenced by a typical Mediterranean climate;
- characterised by scarcity of water resources;
- subjected to intensive agricultural exploitation.

6.1.3 Sebou, Morocco

The Sebou River drains a large catchment (40000 km²), extending from the upper part of the Middle Atlas mountain (2796 m) to the Atlantic Ocean, near the city of Kenitra. It is the second Moroccan catchment in terms of area (5.6 % of the total area).

Characterisation - The annual precipitation ranges from 300 mm in the middle of the basin to 1000 mm in the high mountain area, with an annual mean of about 600 mm. This basin represents more than 31 % of the Moroccan surface water resources (5600 Mm³) and 32 % of groundwater resources (1300 Mm³).

Study Site: Sebou

Sebou basin is the most important agricultural area of Morocco, with 17500 km² of cultivated areas, of which 30% are irrigated and use 2100 Mm³ of water per year. Compared to the national production, 65 % of olive oil, 60 % of leather and 50 % of sugar productions originate in the Sebou basin. It is one of the most populated regions of Morocco with 6.2 million of inhabitants of which 51 % live in rural zones. Three large cities Fez, Meknes and Kenitra show fast growing rates due to rural exodus. Water supply and waste water management are under the authority of the Agence de Bassin Hydraulique du Sebou (ABH-Sebou).

Pressures - Social and economical development is threatened by increasing water scarcity and deterioration of water quality which makes this region a national priority in terms of water resource management. The pollution of Sebou River is a major issue in the National Debate on Water which is in progress in Morocco today, with a special focus on Oued Fez (907 km²) which drains the urban area of Fez. In this area, water pollution is mainly due to domestic and industrial activities.

Oued Fez is an intermittent river, upstream of the city of Fez. Due to important over-exploitation of its groundwater resources combined to a decrease in annual precipitation, its mean annual discharge is about 60 L/s today, as opposed to 300 L/s in the eighties. Its upper part is mostly devoted to rural activities that do not impact the surface water quality. It collects, in its downstream part, the effluents of handcraft activities (tanneries, breweries, textile, oil mills, canneries, coppersmiths and pottery), plus the waste waters of 1.4 M inhabitants. Over the last few years, the region of Fez experienced extensive industrial development. Most operations are still being carried out traditionally, and little attention is given to environmental and sanitary conditions both within and outside the workshops. Sewage water (i.e. some 200000 m³/day, of which 47 % is due to domestic effluents) is flushed directly into the nearby watercourses, without any treatment. Consequently, considerable amounts of chemicals and bacteria of sanitary concern find their way into the river.

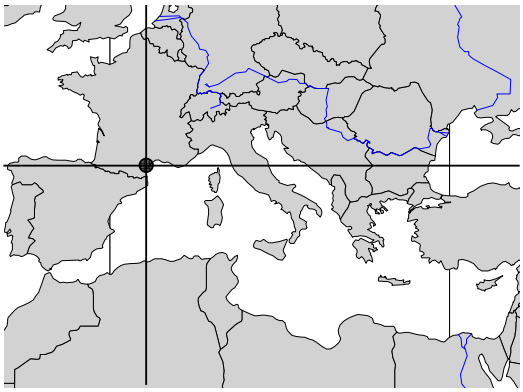
Status and Impact - Oued Fez flows into the Sebou River, just 1km downstream from the city of Fez. After the confluence, the water quality of the Sebou River is highly degraded over a long distance. Yet, water is pumped to irrigate gardening crops which are sold on Fez markets. This raises important food safety and public health concerns. To cope with this problem and try to reduce the pollutant inputs to Oued Fez and the Sebou River, the construction of a large waste water treatment plant has been planned for the near future, by the Ministère de l'Aménagement du Territoire, de l'Eau et de l'Environnement (MATEE).

In this context, Oued Fez stands out as a typical example of Mediterranean semi-arid river, subject to the combined effects of drought and high anthropogenic pressures resulting in major water pollution issues. Taking into account the specificity of the semi-arid hydrological context, Oued Fez permits to study and quantify the effect of the lack of waste water treatment facilities on water quality, specifically heavy metals, nutrients and organic matter. A better understanding of contaminant dynamics and self-purifying processes in this river will help the implementation of actions and steps, aiming the improvement of water quality in the Sebou River.

6.1.4 Vène (Département of Hérault, France)

Along the French Mediterranean coast, and in particular in the Département of Hérault, there are many brackish lagoons. The Thau lagoon, the largest and deepest one, is located near the city of Montpellier. It is mainly devoted to shellfish farming and is very attractive for tourist activities.

Study Site: Vène



Characterisation - The total area of the Thau lagoon catchment is about 290 km². It is drained by 10 intermittent rivers of which 3 important ones: the Soupié, the Pallas and the Vène. Rivers are strongly influenced by the Mediterranean climate. They are characterised by a long low flow period in summer; in the fall season these rivers are affected by intense floods. The mean annual rainfall is about 670 mm and the mean annual runoff about 310 mm. The altitude range from 322 m to 0 m and the hill slopes are 4 %. The relief is characterized by two limestone massifs, the Causse d'Aumelas (at the North part) and La Gardiole (at the East part) where important karstic springs draining large zones outside the topographic catchment, contribute to the discharge of some rivers like the Vène and the Pallas. The rest of the catchment, with a marly basement, is considered as a coastal plain.

Pressures - The anthropogenic activities have a major influence on both the hydrological regime and the water quality. Few industries are located in these areas, mainly devoted to tourist activities. More than 1 million tourists settle in the coastal zone in July and August, attracted by beach and seaside activities. Permanent population increases very fast (over 1.5% per year), because of mild winter temperatures. Agricultural activities, mainly market gardening and vineyards, are concentrated in the plain. They are associated to wineries. Waste water treatment plants (WWTP) were designed to face the significant variations of population and activities over the year; in fact they are the main source of flow and pollution during the summer and autumn period. The ecological status of these rivers is difficult to evaluate. The management of the pollutant fluxes flowing from the catchments to the lagoons is one of the most important challenges to maintain and/or improve the ecological status of these water bodies.

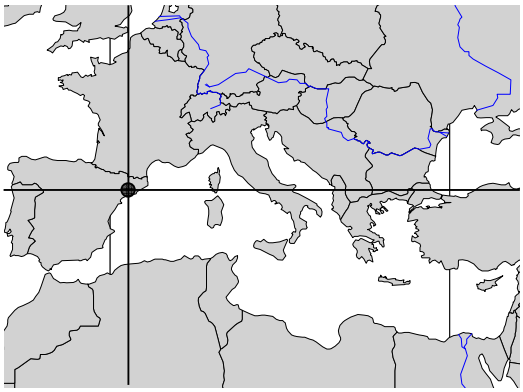
Status and Impact - The catchment is mainly dedicated to the agriculture (54% of the total surface, from which 25%¨with vineyards). Urban areas represent 9% of the total surface, the lagoon is surrounded by 5 important towns or villages (Sète, Balaruc-les-Bains, Bouzigues, Mèze and Marseillan). The population reaches 85 000 inhabitants (160 000 inhab. in summer) essentially concentrated on the lagoon shore. 90% of the waste water are collected and treated in 8 WWTP. In fact, domestic activities are the main sources of pollution on the catchment. The continental inputs impact positively on the lagoon productivity. But some harmful consequences have to be studied: (1) the accumulation of nutrients and organic matter that might lead to the eutrophication of the lagoon (dystrophic crisis often happen during the hot summer periods); (2) the accumulation of trace elements and hazardous substances that might lead to the contamination of the aquatic fauna; (3) the intermittent behaviour of the rivers: during long dry period, between June and September, river discharges are low or inexistent and point-source pollutant inputs are accumulated in the dry rivers bed or in pools; these pollutants are flushed during the autumn floods bringing acute pollutions (in particular from bacteria of sanitary concern) in the lagoon.

6.1.5 Vallcebre, Spain

The Vallcebre catchment (22 km^2) is located in a middle mountain area in the headwaters of the Llobregat River, which is the main natural supplier of water for the urban area of Barcelona.

Characterisation - Annual precipitation is about 950 mm and annual potential evapotranspiration is 700 mm. During summer, evapotranspiration largely exceeds precipitation, inducing water deficit and the interruption of flow in streams of first and second order. A set of sub-catchments were instrumented in 1990 and have been used since then as research sites for the study of hydrological and erosion processes in relationship with climate variability and land-use changes (Gallart et al. 2002). The detailed (20-minute step) and long (12 years) records of precipitation, streamflow and suspended sediment concentrations will be used for several tasks in MIRAGE.

Study Site: Vallcebre



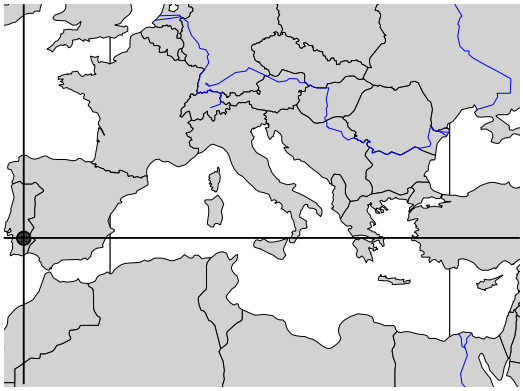
Pressures - The land was used mainly for farming in the past, but present-day main uses are forestry as well as sheep and horse breeding, with low pressures on water quantity and quality. Nevertheless, some extension in the catchment was used in the recent past for open-air coal mining, and urban effluents from the village of Vallcebre are released untreated into the stream. Natural intense erosion in badlands yield high sediment and solute (sulphate) concentrations in the waters of some streams.

Status and Impact - In most of the drainage net, and particularly within the instrumented catchments, the ecological status may be considered as the reference in these headwaters environments. This will allow the investigation of the influence of the natural regime (flow interruptions and channel drying), and quality (sediments and solutes) on the biological communities under reference conditions. Other reaches affected by hydromorphological (modification of the stream channel by mining activities) and water quality (point pollution by untreated effluents from the Vallcebre village) pressures will be used for studying the impacts on the biological communities in different phases of the hydrological regime.

6.1.6 Enxoé, Portugal

Ardila is a tributary of the Guadiana River, discharging in the Pedrógão reservoir, located downstream of the Alqueva reservoir, one of the largest artificial reservoirs in Europe. Pedrógão is used combined with Alqueva for managing the cycle turbining-pumping characteristic of reservoirs used for power generation. “Ardila” is also the generic designation of an “irrigation perimeter” using water from Alqueva that will include 5 smaller reservoirs: Brenhas, Brinches, Amoreira, Serpa and Enxoé. The closest preciptations stations show (for 40 years of measures) an average precipitation of about 550 mm. Monthly averages of maximum temperatures show an average of 33ºC in July and 13ºC in January. On the other hand Monthly averages of minimum temperatures show an average of 16ºC in July and August and 5ºC in January. All these areas are located in the Guadiana watershed which is a transboundary river of the Iberia Peninsula. Enxoé Reservoir Watershed will be the study area. This watershed has a total area of 60 km^2.

Study Site: Enxoé



Characterisation - Enxoé reservoir (Located SE) was completed in the year 2000. Some of the main characteristics of the reservoir include a flooded area of 142,6 ha and a Reservoir volume 6,65 hm3.

In December 2001 was a very rainy period, with intense floods in that area and reservoir received large amounts of water and sediments. Then the trophic level increased strongly and the deeper layers ran into anoxic conditions up to 2006

Pressures - The eutrophicated status reached by the reservoir immediately after 2001 floods was dominated by cianobacteria as a consequence of the Phosphorous excess, which was a consequence of the intense erosion in the catchment. The role of fecal organic matter produced by extensive cattle grow existing in the area is not yet clear.

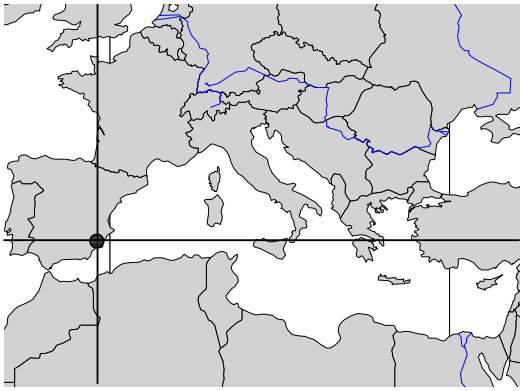
This is a typical problem in Alentejo, where the temporary waters are associated to dry soils and poor vegetation at the end of summer permitting strong erosion events and the accumulation of phosphorous into the many reservoirs existing in the zone, generating eutrophication by cianobacteria. In the older reservoirs the accumulation of phosphorous is a permanent process and the depletion of nitrate in summer makes cianobacteria the only primary producer viable that stimulated by new nitrogen carried by the first rainy events generates strong blooms in autumn.

Status and Impact - The control of soil and river bed erosion (phosphorous generation) is then a critical aspect of water management in Alentejo. Irrigation is a major driver of soil erosion and was a main reason for selecting the Ardila as the case study. The eutrophication of the Enxoé reservoir (1) generates the data necessary for assessing the downstream implications of phosphorous remobilization and (2) facilitates the link with the endusers, since the pollution of this reservoir had strong socio-economic implications because the reservoir should also provide water for urban supply.

6.1.7 Taibilla, Spain

Taibilla river is a headwater tributary of Segura river. It is at the Betic ranges leeward of Atlantic lows. Geographic coordinates of the centre of the basin are approximately 38º 08' N and 2º 14' N. The basin is mainly located on Albacete province of Region of Castilla-La Mancha, but also a headwater sector is into the Region of Murcia. It belongs to Segura Basin a 15,000 km^2 catchment, mostly semiarid that send water to Mediterranean sea in SE Iberian Peninsula. The closest largest town is Murcia 120 km SE of the basin.

Study Site: Taibilla



Characterisation - The catchment area is 600 km^2. Altitude ranges from 2080 to 800 m. The dominant lithology consists of marls, limestones, marly limestones and sandstones of the Cretaceous, Oligocene and Miocene. The climate is in the transition subhumid to semiarid and rainfall is around 500 mm per year. The altitude average temperature is about 11-13º Cº.

Most important land uses are forests and pastures. Also it is interesting to note the presence of remnants of *Juniperus thurifera* forest, a formation characteristic of dry and cold uplands in the Mediterranean and therefore very representative of the environment of the basin. Agricultural land uses are cereal (barley, wheat, oats) and walnut plantations together little orchards on the wells and valley bottom. It is not an export oriented agriculture as in other parts of SE Spain. Sheep breeding is an important activity and upper areas of the ranges are usually pastures.

The catchment feeds the Taibilla reservoir that is the main reservoir of the "Mancomunidad de los Canales del Taibilla". This institution is in charge of providing drinking water resources to 55 municipalities of Murcia region and southern part of neighbour province of Alicante. Annual flow of the river is about 35-40 hm^3 in the last decade.

Pressures - The catchment has known important land use changes since the second half of the XX century. These changes consist mainly of a progressive abandonment of the dry-farming activities and grazing and an increase of the forest cover. This changes parallel to the massive depopulation of the area that has plummeted from a maximum of 5000 inhabitants at the 1940s to less of 1600 at the present. This depopulated uplands of the Betic ranges have been targeted by National and Regional administration for reforestation enhancing strongly natural trends on vegetation.

Low population and negligible industrial activity make effluents relatively unimportant although some urban associated pollution is found downwater Nerpio the main town on the basin. This can affect to the water quality on the reservoir supplying resources for 2.5 million inhabitants in Murcia and Alicante provinces.

Groundwater extraction is negligible but trends are very worrying. Until recently groundwater pumping in all the headwater of Segura basin was very limited but in the last 10 years a strong expansion of this activity has been observed an is each day closer to Taibill catchment.

Growing agro-tourism activities has been also noticed in the catchments over the last years. Also they have been established activities of hunting of deers. It is important to note that these activities could in the immediate future to affect water quality in the basin as agro-tourism increase population in the absence of upgrading water treatment and it is concentrated close to rivers. On the other hand deer hunting tends to over stockage cattle and nitrogen and phosphorus enrichment may be expected.

Status and Impact - The interest of this target areas is not only as a reference site for dry Mediterranean environments but also as a study site for assessing the impact of land use changes on quantity and quality of water resources. In fact Taibilla river is the key actor in water supply to 2.5 million inhabitants in SE Spain as well to their industrial activities.

By mid 1960s the flow of the river Taibilla was not enough and temporarily resources were abstracted of Segura river. Demand continued increasing linearly and now MCT (Commonwealth of Channels of Taibilla) obtains water from Tagus river through a 300 km channel (beginning at the end of 1970s) and very recently through desalination. Desalination it is expected to increase hugely in the next years. At the present, Taibilla river itself only covers 15-20% of the total demand, but if flow was that of 1950s it could cover double of this quantity and substitute part of the desalinated water with consequent repercussion on energy demand and CO_2 emissions. Water quality of the Taibilla was very good in the past compared to other sources in SE Spain but expected trends (tourism and human use) could reduce severely this quality.

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6.3 Annex III – Letters of intent

6.3.1 Mancomunidad de Canales del Taibilla

MANCOMUNIDAD DE LOS CANALES
DEL TAIBILLA
DIRECTOR

Panel de Evaluación de Expertos Independientes
7º Programa Marco de I+D
Comisión Europea

La Mancomunidad de Canales del Taibilla esta interesada en el proyecto MIRAGE (Mediterranean Intermittent River Management).

Consideramos que los objetivos de dicho proyecto son de gran relevancia para nuestro trabajo en garantizar un suministro de agua en cantidad y calidad adecuada a 2,5 millones de habitantes del Sureste de España. Asimismo, estaríamos interesados en intercambiar opiniones durante la ejecución del proyecto y aplicar en nuestra gestión los resultados de la investigación.

La Mancomunidad de Canales del Taibilla es un Organismo Autónomo del Ministerio de Medio Ambiente de España, encargada del suministro de agua a los habitantes de la Región de Murcia y Sur de la Comunidad Valenciana.

Cartagena, 27 de abril de 2007

Ministerio de Medio Ambiente
Mancomunidad de los Canales del Taibilla
Dirección

Eduardo Salinas Campello

6.3.2 Ministerio de Medio Ambiente

26/04 2007 18:13 FAX 915975927 MIMAM-D.G.DEL AGUA 001/001

MINISTERIO
DE MEDIO AMBIENTE

SECRETARIA DE ESTADO
PARA EL TERRITORIO Y LA
BIODIVERSIDAD

DIRECCIÓN GENERAL DEL
AGUA

FAX

FROM	Javier Ruza Rodríguez
TO	Jochen Froebrich Water resources management division Institute of water quality and waste management (ISAH) University of Hannover
SUBJECT	
DATE	26/04/ 2007
FAX N	+49 511 762 19413
N. PAGES	1

To whom it may concern,

With this letter we confirm that the topics addressed into the research proposal

MIRAGE
Mediterranean Intermittent River Management

are of high relevance for our work in the field of water management and in case that it is funded, we agree to exchange views on the needs and applicability of results from the proposed research project.

Yours sincerely

Javier Ruza Rodríguez

Jefe del Area de Control y Vigilancia de la Calidad de las Aguas
Head of Unit for Water Quality Monitoring and Pollution Control

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6.3.3 Agència Catalana de L'Aigua

25/04 '07 08:05 FAX 934518116 AGENCIA CAT.DE L'AIGUA 001

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Mr. Jochen Froebrich

Water resources management division
Institute of water quality and waste management (ISAH)
University of Hannover

FAX +49 511 762 19413

Dear Mr. Froebrich and to whom it may concern,

With this letter we confirm that the topics addressed into the research proposal: MIRAGE (Mediterranean Intermittent River Management) are of high relevance for our work in the field of water management and in case that it is funded, we agree to exchange views on the needs and applicability of results from the proposed research project.

In the case of Catalan Water Agency (ACA), in addition of the general results of the project, we are deeply interested in the results in the basin to be studied in Catalonia, Vallcebre. In this basin the Agency has to build a sewage plant in the next years, and the design and performance of this plant will be influenced by the results of this project.

We have a great interest with the application of the multimetric indexes in temporary rivers. The results in this basin will be incorporated in our data base and used in the intercalibration exercise currently going on in the EU. The Catalan Water Agency is an active partner into the Mediterranean GIG.

For all these reasons, the MIRAGE project is of great interest to the Catalan Water Agency.

Yours sincerely,

Gabriel Borràs
Director of the Planning Area
for Sustainable Water Uses

Antoni Munné
Head of Unit for Water
Framework Directive Implementation

Barcelona, 24th April, 2007

Generalitat de Catalunya
Departament de Medi Ambient i Habitatge

6.3.4 Département Hèrault

République
Française

Département
Hérault
Conseil Général

Direction Générale
des Services

Montpellier, le 25 AVR. 2007

To whom it may concern

Pôle environnement, eau
cadre de vie et aménagement rural
Direction de l'eau et des milieux aquatiques

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Références : LMIRAGE.doc

Letter of intent

With this letter we confirm that the topics adressed into the research proposal

MIRAGE (Mediterranean Intermittent River Management)

are of high relevance for our work in the field of water management and in case that it is funded, we agree to exchange views on the needs and applicabilty of results from the proposed research project.

Your sincerely

President

Pour le Président du Conseil Général
et par délégation
Le Directeur du Pôle Environnement, Eau
cadre de vie et aménagement rural

Serge MIQUEL

L'HÉRAULT ACCUEILLE
LA COUPE DU MONDE
DE RUGBY 2007

DÉPARTEMENT HÔTE
RWC RUGBY 2007 FRANCE
HÉRAULT

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