Activity 5

Task 5.2.1: Upgrading MOHID and Dynamic Risk Tool:

Coastal Risk & Lagrangian Spill Wizard Plugins – manual and installation guide

ARCOPOLplatform

Improving maritime safety and Atlantic Regions' coastal pollution response through technology transfer, training and innovation

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1 Summary

This document reports the major developments performed in upgrading the Dynamic Risk Tool previously released in ARCOPOLplus project, with manual and installation guide is also included, as well as the implementation methodology to be potentially used by other interested regions.

This work is developed under the scope of task and deliverable of ARCOPOL PLATFORM project, in Activity 5: Upgrading MOHID and Dynamic Risk Tool – task 5.2.1.

Dynamic Risk Tool is a software framework integrated in MOHID Studio, providing real-time and historic shoreline risk maps and levels, risk of accidents for each vessel (with Coastal Risk plugin), and now, also fast, reliable, easy and user-friendly on-demand 3D simulations of oil, HNS, inert and atmospheric pollutants (with Lagrangian Wizard plugin). The software is available in http://arcopol.maretec.org (direct link: http://arcopol.maretec.org/Tools/Plus/RiskTool/DynamicRiskTool_Installer.zip).

The developed system dynamically produce quantified risks in both real time and historic data, integrating best available information from numerical forecasts and the existing monitoring tools.

Coastal pollution risk levels associated to potential oil spill incidents are provided, taking into account regional statistic information on vessel accidents and coastal vulnerability indexes (Environmental Sensitivity Index and Socio-Economic Index, determined in EROCIPS project), real time vessel information (positioning, cargo type, speed and vessel type) obtained from AIS through API (from different AIS data sources, like AISHUB.net or MarineTraffic), best-available metocean numerical forecasts (hydrodynamics, meteorology - including visibility, wave conditions) and simulated scenarios by the oil spill fate and behaviour component of MOHID Water Modelling System.

Different spill fate and behaviour simulations are continuously generated and processed in background (assuming hypothetical spills from vessels), based on variable vessel information, and metocean conditions, and results from these simulations are

used in the quantification the consequences of potential spills. System is able to compute risk levels based in 400 one-day simultaneous spill simulations (400 vessels) in less than 15 minutes.

The development of Lagrangian Wizard plugin, giving the possibility of generating on-demand fate and behavior simulations of pollutants and floating objects in the same platform (MOHID Studio) used for mapping coastal risk, this is a powerful tool to cross different layers of information, providing added value for decision-making. The same system that shows vessel positions, also allows the possibility of generating simulations from detected oil spills from EMSA's CLEANSEANET operational service, and also to run the spill model in backtracking mode – this feature can help authorities tracking and investigating the pollution source. The Lagrangian Wizard plugin can use metocean forecasting data obtained from external data sources, through a very fast adaptation if they are available in common online standardized catalogues, like Copernicus Marine Services, THREDDS / OPENDAP, or FTP using CF conventions.

The system was initially implemented in Continental Portugal and in this version has been extended to Galician Coast. Software has also migrated to a multifunctional GIS desktop system (MOHID Studio) to allow a better sustainability of software maintenance as well as permitting the integrated visualization of different data layers (metocean data, oil spill trajectories, or any other user-added layer).

As a realtime tool, DynamicRiskTool can provide an innovative approach to risk mapping, providing decision-makers with an improved decision support model and also an intelligent risk-based traffic monitoring (e.g. prioritization of individual ships and geographical areas; strategic tug positioning; implementation of dynamic risk-based vessel traffic monitoring), as well as other tactical capacities as result of integrating the Lagrangian Wizard tool - anticipating the fate of specific pollutants, and adjusting response actions based on that.

Also as a planning tool, this software can be used as a risk assessment tool from historic data, allowing the identification of typical risk patterns and "hot spots" and the development of sensitivity analysis to specific conditions.

Finally, the upgrades included in this task also allowed the distribution of model results and risk mapping layers to external platforms. This was developed using web services (using OGC WMS protocol), and demonstrated in a demo responsive website (http://arcopol.actionmodulers.dtdns.net) that is fed by WMS, and that can be opened in multiple platforms, including laptops, tablets or smartphones.

2 Introduction

2.1 Copyright

MOHID Water Modelling System is priority software of the Technical University of Lisbon.

2.2 Warranty

The warranty given by Action Modulers is limited as specified in your Software License Agreement. Please note that numerical modelling software programs are very complex system and may not be free of errors, so you are advised to validate your work. Action Modulers shall not be responsible for any damage arising out of the use of this document, MOHID Studio, MOHID Water Modelling System or any related program or document.

2.3 Further Information

For further information about MOHID Studio please contact:

Action Modulers, Consultores de Segurança Lda.
Estrada Principal, Nº 29 R/C
2640-583 Mafra, Portugal
Tel.: +351 261 813 660
Fax: +351 261 813 666
E-mail: geral@actionmodulers.pt

Web: http://www.actionmodulers.com

2.4 System Requirements

This document explains how to install MOHID Studio step-by-step. Before start with the installation the user should ensure that all the system requires are fulfilled (check requirements on the Table 2-1).

Component	Requirements
Operating System	Windows 7, 8, Server or later
Processor	1.8 GHz or faster processor
Memory	2GB of RAM
Disk Space[1]	500 MB
Display Resolution	1280x1024 or higher resolution
Display Colour Depth	32 bits
Additional Software	Micrososf.NET Framework 4.0 Microsoft Excel 2007 or later

Table 2-1: System Minimum Requirements

MOHID Studio requires the .NET Framework 4.0, full version, to be installed on your system[2].

To export values from MOHID Studio to XLS data sheet file a version of Microsoft Excel 2007 (or later) is required. The version recommended is Microsoft Excel 2010, though MOHID Studio also imports values from Microsoft Excel 97-2003.

[1] – Disk Space required by MOHID Studio only. The disk space requited for additional software and projects is not included.

[2] .NET Framework 4.0 will be installed, if necessary, automatically by the MOHID Studio installer. It is also possible to download from the Microsoft Website:
http://www.microsoft.com/en-us/download/details.aspx?id=17851

3 MOHID Studio

3.1 Install MOHID Studio

The MOHID Studio installation is a simple 5 step wizard installation. All the steps are represented in the figures from this subsection.

3.1.1 Step 1 – Welcome

The welcome installation wizard setup is presented to the user. Press the next button to continue (represented in Figure 3-1).

Figure 3-1: MOHID Studio installation: step 1.

3.1.2 Step 2 – License Agreement

The MOHID Studio license agreement is presented to the user. After read it and accept the license agreement, press the next button to continue (represented in Figure 3-2).

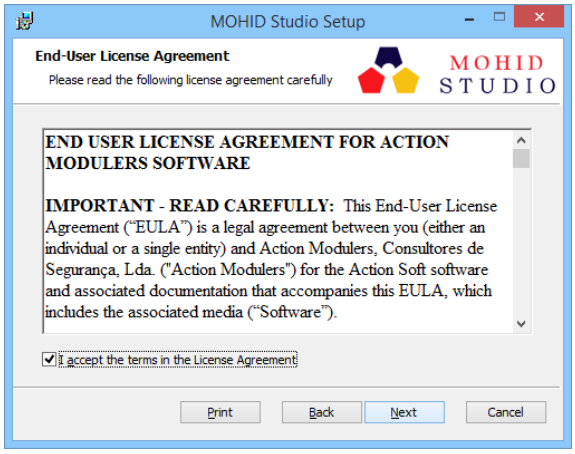


Figure 3-2: MOHID Studio installation: step 2.

3.1.3 Step 3 – Custom Setup

In this step the user can select the plugins to add into MOHID Studio. A list of plugins is presented, as represented in Figure 3-3. For the ARCOPOL+ installation the only plugin required is the “Coastal Risk Module”. To install one plugin, press the image before the plugin and a menu will appear (represented in Figure 3-4). To make one plugin available choose the first option: “Will be installed on local hard drive“. To make a plugin unavailable choose the last option: “Entire feature will be unavailable”.

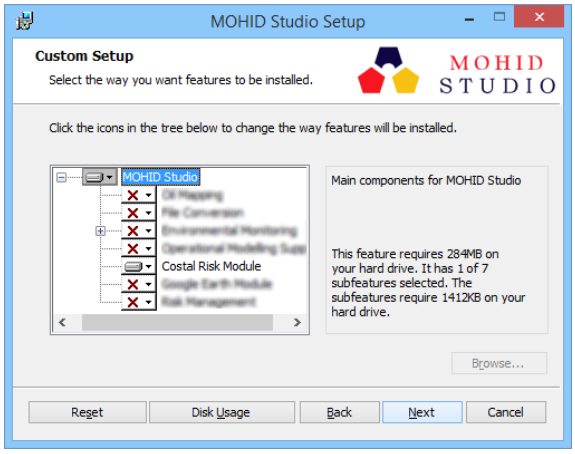


Figure 3-3: MOHID Studio installation: step 3.

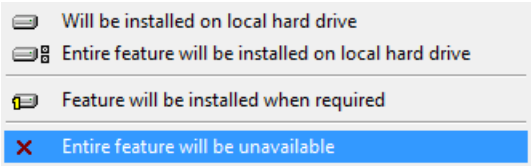


Figure 3-4: MOHID Studio installation: step 3a.

3.1.4 Step 4 – Installation

MOHID Studio is now ready to install. Press the Install button to continue (represented in Figure 3-5). This step might need Administration privileges.

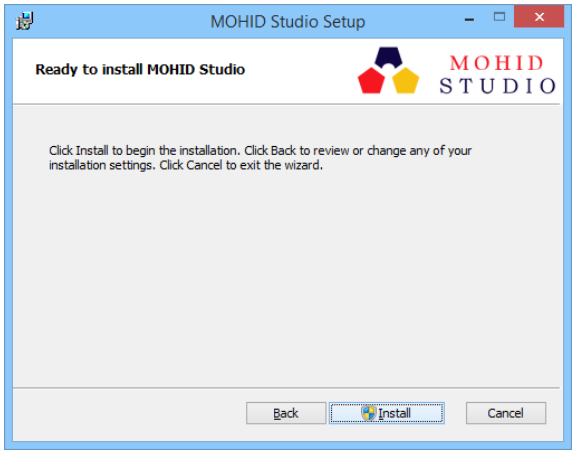


Figure 3-5: MOHID Studio installation: step 4.

3.1.5 Step 5 – Installation complete

MOHID Studio installation was completed with success (represented in Figure 3-6). MOHID Studio is now installed and available on your start menu. The MOHID Studio is installed in your program files folder:

32 bits CPU: C:\Program Files\Action Modulers\MOHID Studio

64 bits CPU: C:\Program Files (x86)\Action Modulers\MOHID Studio

For more information about MOHID Studio please read the MOHID Studio User Guide.

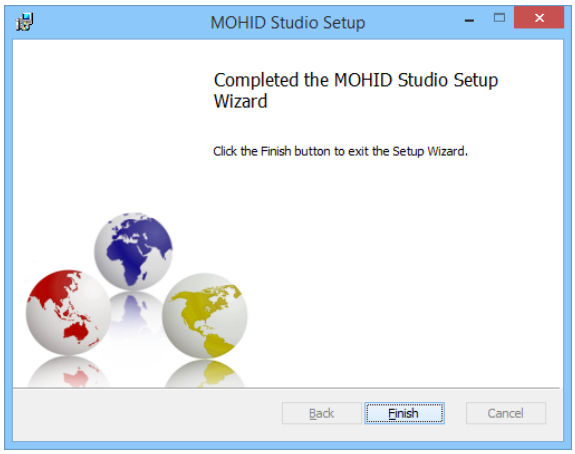


Figure 3-6: MOHID Studio installation: step 5.

3.2 Load Layers

To load special layers from ARCOPOL+ project, press the button “Objects” in the group “Manage Layers” from the map tab menu (represented in Figure 3-7). A new window

will appear, as represented in Figure 3-8. In this window the user should select the layers that wish to load into MOHID Studio map.

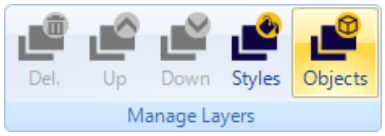


Figure 3-7: Load layers button.

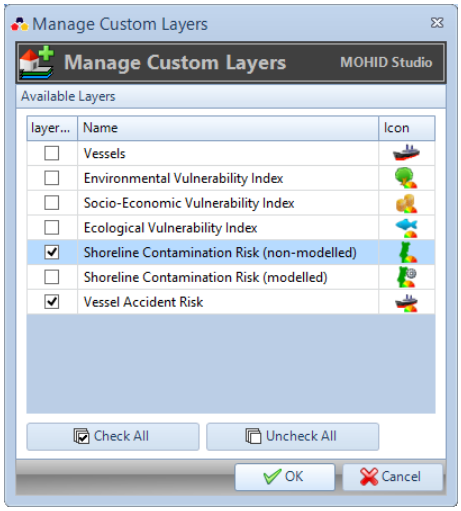


Figure 3-8: Load layers window.

After the user select the desired layers, the user can set the visibility of the layer on the Layers menu, next to map (represented in Figure 3-9). The user can query the objects to see their properties. For more information, please read the MOHID Studio User Guide.

Figure 3-9: Map: Loaded layers.

4 Action Server

Action Server is the “brain” of the system: it is the service responsible to continuously download (AIS data, operational model results) and compute all the information layers needed and to store it in the database. This service runs in background, in order to keep all the information obtained (vessel characteristics, numerical model results, and risk levels) in a continuous way.

The released version has been updated to export all the results via WMS service / WMS Server. Therefore, Action Server is now used not only to feed MOHID Studio Graphic User Interface, but also to feed external interfaces and platforms that can communicate through WMS (e.g. Google Earth – see Figure 4-1; specific websites, etc.), which is in fact demonstrated by the demo website http://arcopol.actionmodulers.dtdns.net/ .

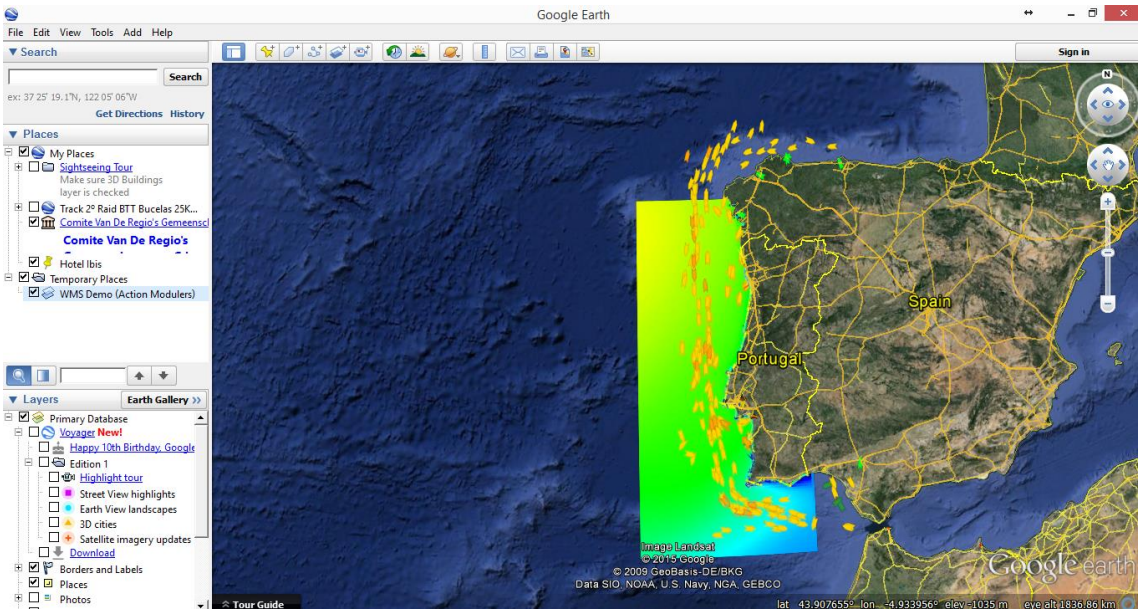


Figure 4-1 Visualization of Dynamic Risk Tool data layers in Google Earth, via WMS Server integrated in Action Server

4.1 Install Action Server

The Action Server installation is a simple 5 step wizard installation. All the steps are represented in the figures from this subsection.

4.1.1 Step 1 – Welcome

The welcome installation wizard setup is presented to the user. Press the next button to continue (represented in Figure 4-2).

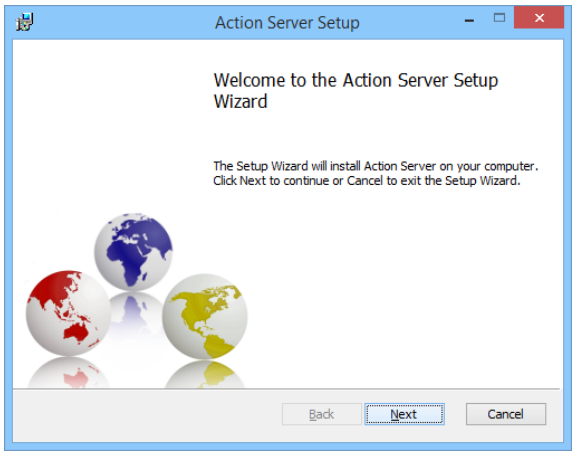


Figure 4-2: Action Server installation: step 1.

4.1.2 Step 2 – License Agreement

The Action Server license agreement is presented to the user. After read it and accept the license agreement, press the next button to continue (represented in Figure 4-3).

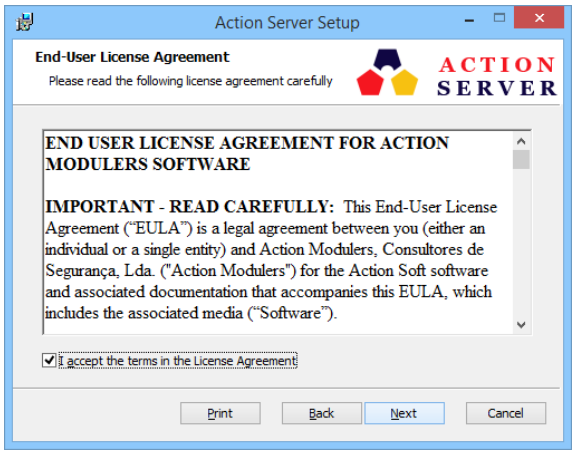


Figure 4-3: Action Server installation: step 2.

4.1.3 Step 3 – Custom Setup

In this step the user can select the plugins to add into Action Server. A list of plugins is presented, as represented in Figure 3-3. For the ARCOPOL+ installation the plugins required are: "Coastal Risk Calculator", "Maretec Data Downloader" and "Vessel Position Tracker". To install one plugin, press the image before the plugin and a menu

will appear (represented in Figure 4-5). To make one plugin available choose the first option: “Will be installed on local hard drive“. To make a plugin unavailable choose the last option: “Entire feature will be unavailable”.

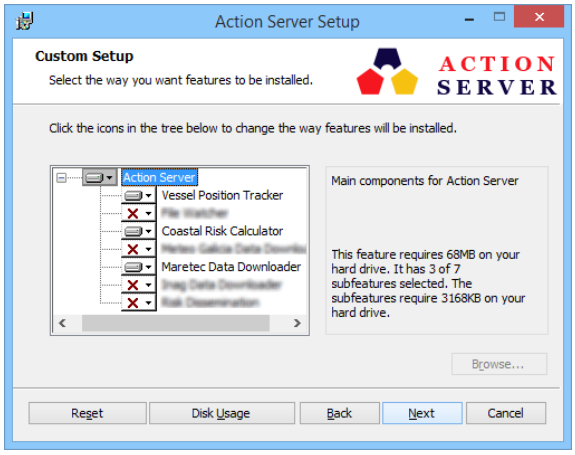


Figure 4-4: Action Server installation: step 3.

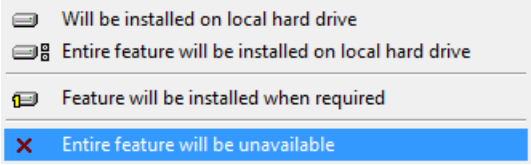


Figure 4-5: Action Server installation: step 3a.

4.1.4 Step 4 – Installation

Action Server is now ready to install. Press the Install button to continue (represented in Figure 4-6). This step might need Administration privileges.

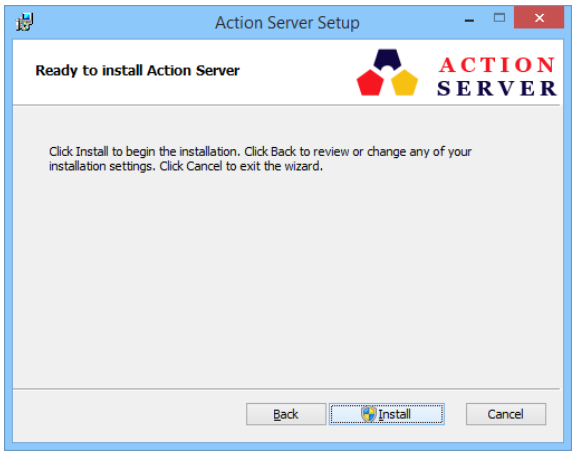


Figure 4-6: Action Server installation: step 4.

4.1.5 Step 5 – Installation complete

Action Server installation was completed with success (represented in Figure 4-7). Action Server is now installed and available on your start menu. The MOHID Studio is installed in your program files folder:

32 bits CPU: C:\Program Files\Action Modulers\Action Server

64 bits CPU: C:\Program Files (x86)\Action Modulers\ Action Server

For more information about Action Server please read the Action Server User Guide.

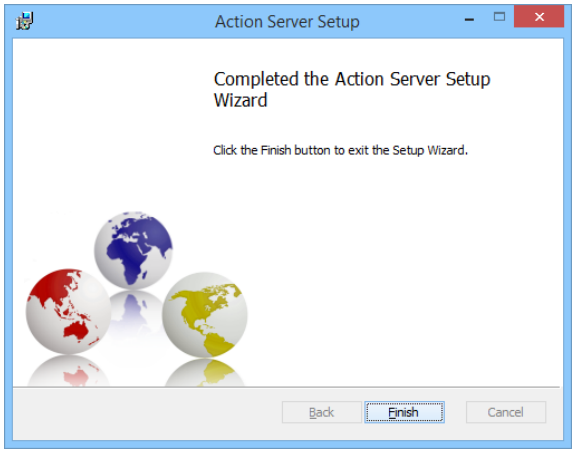


Figure 4-7: Action Server installation: step 5.

4.2 Configuration

After the Action Server is installed is necessary to configure the service. Go to "Services" (Services.msc) and select the "Action Server" service, as represented in Figure 4-8. Press the right button of the mouse above selected line and then select the "Properties" option. A new window will appear (represented in Figure 4-9).

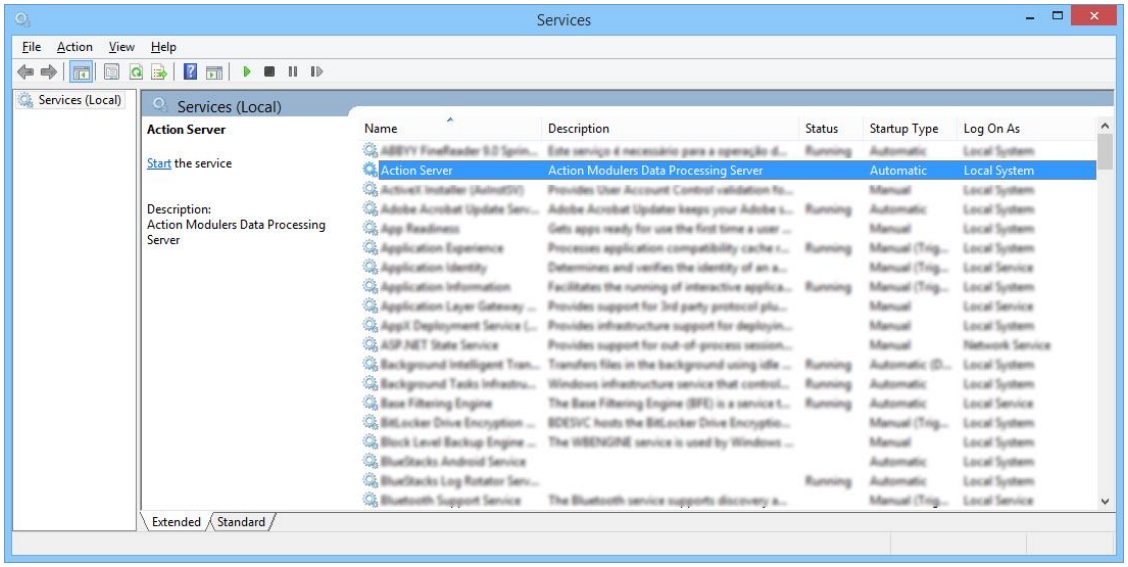


Figure 4-8: Action Server configuration: step 1.

In the "General" tab change the startup type to "Automatic (Delayed Start)", as represented in Figure 4-9.

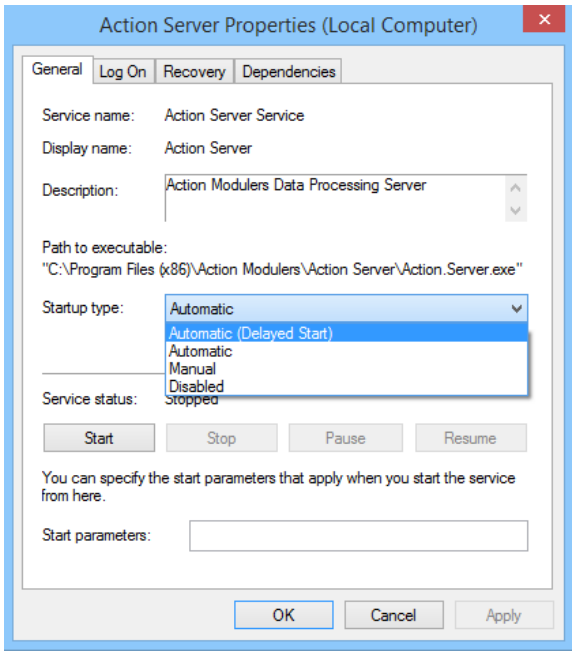


Figure 4-9: Action Server configuration: step 2.

In the "Recovery" tab change the first failure, second failure and subsequent failures to "Restart the Service", as represented in Figure 4-10.

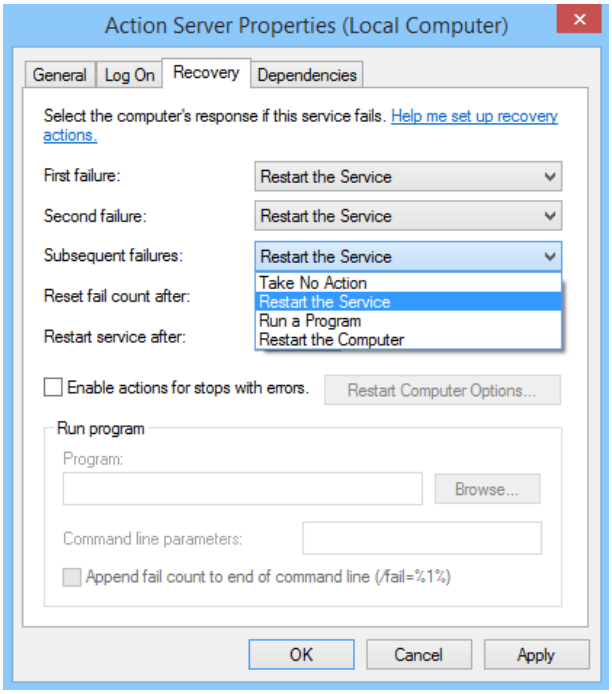


Figure 4-10: Action Server configuration: step 3.

The Action Service is now ready to run. Before press the start service button, check if all the plugins configurations are correct.

4.3 Plugins Configuration

The Action Server Configuration Files are located in the folder:

C:\ProgramData\Action Modulers\Action.Server\

4.3.1 Plugin: Coastal Risk Calculator

The configuration for the plugin Coastal Risk Calculator can be changed on the file "CoastalRisk.config" on the configuration folder. In this file is possible to change the determine risk schedule and all the parameters used for the risk determination. The begging of the "CoastalRisk.config" is represented in Figure 4-11.

```
<RiskCalculationCronExpression>55 0/20 * * * ?</RiskCalculationCronExpression>
<VesselBackWindowMinutes>30</VesselBackWindowMinutes>
<PathToShapeFileShallowWaterFile>
C:\ProgramData\Action Modulers\Action.Server\Storage\Portugal3MilesZone.shp
</PathToShapeFileShallowWaterFile>
<DetermineRiskUsingLagrangian>true</DetermineRiskUsingLagrangian>
<ModelDomainNameForMeteorological>MM5</ModelDomainNameForMeteorological>
<ModelDomainNameForHydrodynamic>MOHID</ModelDomainNameForHydrodynamic>
<ModelDomainNameForWaves>WW3</ModelDomainNameForWaves>
<WorkingModelRootDirectory>C:\Temp\Arcopol\Modelo</WorkingModelRootDirectory>
<ModelRootDirectory>C:\Temp\Arcopol\Modelo</ModelRootDirectory>
<MohidExecutableFileName>exe\MOHIDWater_release_single.exe</MohidExecutableFileName>
<ModelGridDataFileName>GeneralData\Batim\Portugal_20080707Final.dat</ModelGridDataFileName>
<PathToFileMM5 />
<PathToFileMohid />
<PathToFileWW3 />
<PathToFileKml>
C:\ProgramData\Action Modulers\MOHID Studio\Storage\atlascosteiro.kml
</PathToFileKml>
<LagrangianRunTimeInHours>24</LagrangianRunTimeInHours>
<MinWaterDepth>0</MinWaterDepth>
<LUnitValue>1000</LUnitValue>
```

Figure 4-11: Block of Configuration from file CoastalRisk.config.

Risk Calculation Cron Expression – Schedule to determine the coastal risk. The Coastal Risk calculation include: the vessel risk, the coastal risk without Lagrangian model and with Lagrangian model (optional).

Vessel Back Window Minutes – This is the interval of vessel positions that will be used. The default value is 30 minutes. This meaning that if you determine the coastal risk at 9h00m, all the vessels position between 8h30m and 9h30m will be consider. The position that is used is the position that has the time closer to the coastal risk determination time. For example, id a vessel has positions at: 8h32m, 8h47m, 9h02m, 9h17m, the position that will be used is the 9h02m. In the service mode, the coastal risk only gets positions from the past, because it is a real time service. In this case, the position used would be the 8h47m. [See more information about this in the subsection about Risk on Demand – subsection 5.6].

The rest of the properties from the Coastal Risk configuration are described in subsection 5.6.1. All the configurations are similar, but here are defined in a file. The user can set all the definition through the Risk on Demand window and then save them into a file and replace with this one. This allows an easier way ,through the User Interface, to configure this file for the first time. For more information read the subsection 5.6.

4.3.2 Plugin: Maretec Data Downloader

The configuration for the plugin Maretec Data Downloader can be changed on the file "MaretecDataDownloader.config" on the configuration folder. In this file is possible to change the download schedule and all the credentials for FTP access. Inside the configuration file there is one or more blocks like the one represented in Figure 4-12.

```
<MaretecDataDownloader>
  <ModelDomainName>MM5</ModelDomainName>
  <DownloadResults>true</DownloadResults>
  <InsertIntoDatabase>true</InsertIntoDatabase>
  <ExtractTimeSeries>false</ExtractTimeSeries>
  <StorageDirectory>C:\Arcopol\MM5</StorageDirectory>
  <FTPHost>ftp.mohid.com</FTPHost>
  <FTPUsername>arcopol</FTPUsername>
  <FTPPassword>arcopol</FTPPassword>
  <FTPUsePassiveMode>true</FTPUsePassiveMode>
  <FTPEnableSsl>false</FTPEnableSsl>
  <FTPTimeOut>100000</FTPTimeOut>
  <FTPEnableProxy>false</FTPEnableProxy>
  <FTPProxyHost />
  <FTPProxyLogin />
  <FTPProxyPassword />
  <GetTheMostRecentFileFromFTP>true</GetTheMostRecentFileFromFTP>
  <FtpMinimumDownloadFileSizeWithoutError>14000000</FtpMinimumDownloadFileSizeWithoutError>
</MaretecDataDownloader>
```

Figure 4-12: Block of Configuration from file MaratecDataDownloader.config.

This block (from Figure 4-12) represents one file to download and can be repeated for each block. The model domain needs to be defined (in this project there are 3 model domains: MM5, MOHID, WW3). If the property "Download Results" is set to false, the file will not be downloaded. The results from file, after successfully downloaded can be added to database (if the property "Insert Into Database" is set to true) and extracted to time series (if the property "Extract Time Series" is set to true).

The Storage Directory is the folder where all the files will be storage after downloaded.

The properties relative to FTP should be filled with the FTP access, credentials and preferences (Passive mode, time out, proxy…).

The option to "Get the most recent file from FTP", if is set to true, checks if the file from FTP is newer than the file that was already downloaded (for the same model domain and for the same period of time). If the new file is downloaded, the data from the previous download will be replaced by this one. This allows the user to have always the most recent data file from the FTP.

The last property, “FTP minimum download file size without error”, indicates the minimal acceptable size (in bytes) of the file for this model domain. This is simple error validation. If the file size is below of this value, the file will be deleted and will be downloaded on the next time.

4.3.3 Plugin: Vessel Position Tracker

The configuration for the plugin Vessel Poition Tracker can be changed on the file “Vessel.config” on the configuration folder. In this file is possible to change the download schedule and all the credentials for FTP access. Inside the configuration file there is one or more blocks like the one represented in Figure 4-13.

```
<VesselDownloadCronExpression>14 0/3 * * * ?</VesselDownloadCronExpression>
<VesselPositionUpdateInterval>15</VesselPositionUpdateInterval>
<ThreadSleepTimeAfterDownloadRequest>498</ThreadSleepTimeAfterDownloadRequest>
<VesselPropertiesUpdateInterval>60000</VesselPropertiesUpdateInterval>
<LinkToDownloadKmzFileFromWeb>
http://www.marinetraffic.com/ais/getkml.aspx?minlat=34.0&amp;
&amp;maxlat=45.0&amp;&amp;minlon=-13.0&amp;&amp;maxlon=-5.5
</LinkToDownloadKmzFileFromWeb>
<CopyErrorFilesToTempDirectory>true</CopyErrorFilesToTempDirectory>
<SaveCopyOfDownloadedKmzFile>false</SaveCopyOfDownloadedKmzFile>
<StorageDirectory>C:\ProgramData\Action Modulers\Action.Server\Storage</StorageDirectory>
<DownloadRegionLongitudeWest>-12.6</DownloadRegionLongitudeWest>
<DownloadRegionLongitudeEast>-5.1</DownloadRegionLongitudeEast>
<DownloadRegionLatitudeNorth>45</DownloadRegionLatitudeNorth>
<DownloadRegionLatitudeSouth>34.38</DownloadRegionLatitudeSouth>
<FilterVesselTypebyCargoFishingTanker>true</FilterVesselTypebyCargoFishingTanker>
```

Figure 4-13: Block of Configuration from file Vessel.config.

Vessel Download Cron Expression – Schedule to download the KMZ file (with vessel positions) from marine traffic.

Vessel Position Update Interval – Number of minutes between the update positions of the same vessel. Example:

download file1: 9h00m (saved in database)

download file2: 9h03m (not saved in database)

download file3: 9h06m (not saved in database)

download file4: 9h09m (not saved in database)

download file5: 9h12m (not saved in database)

download file7: 9h15m (saved in database)

download file8: 9h18m (not saved in database)

Only the file1 and file7 will be saved in database. Sometimes the vessel position is missing in one file. If the file1 contain the vessel position and if the file7 does not contain the position for this vessel, the vessel will be updated on the next time, file 8. Than wait another 15 minutes.

Thread Sleep Time After Download Request – Number of milliseconds to wait before require for more information from marine traffic website.

Thread Sleep Time After Download Request – Number of milliseconds to wait before require for more information from marine traffic website.

Vessel Properties Update Interval – Number of minutes between vessel properties update. After the vessel is saved into the database, the vessel properties (name, flag…) will be updated in time to time.

Link To Download KMZ File From Web – Link to download the KML file from the Marine Traffic website.

Copy Error Files To Temp Directory – If the user wishes to save the kmz files that are downloaded with errors in the storage directory. This is usefully for debug and understanding the missing updates.

Save Copy Of Downloaded Kmz File – If the user wishes to save the kmz files that are downloaded from Marine Traffic website containing the vessel positions. The file will be saved in storage directory. This is usefully to compare the vessel positions or to load vessels into Google Earth.

Storage Directory – Folder where all the downloaded files will be saved.

Download Region Longitude West – This define the window section for the Longitude West coordinate. Only vessels inside this window will be updated.

Download Region Longitude East – This define the window section for the Longitude East coordinate. Only vessels inside this window will be updated.

Download Region Latitude West – This define the window section for the Latitude West coordinate. Only vessels inside this window will be updated.

Download Region Latitude East – This define the window section for the Latitude East coordinate. Only vessels inside this window will be updated.

Filter Vessel Type by Cargo Fishing Tanker – This property filter the vessels by vessel type. This property must be true for ARCOPOL+ project in order to download properties and update only vessels wity type of cargo, fishing and tanker. This flag reduce the amount of data in database and reduce the requests to Marine Traffic. All vessels that has a different type of vessel are ignored.

5 Coastal Risk Plugin – MOHID Studio

5.1 Introduction

The Coastal Risk Plugin, represented in Figure 5-1, allows the user to view the vessel details and positions, the vulnerability indexes (Environmental, Socio-Economic and Ecological), the vessel risk values, the coastal risk values, analyse the risk and determine the coastal risk on demand.

Figure 5-1: Coastal Risk Tab in MOHID Studio.

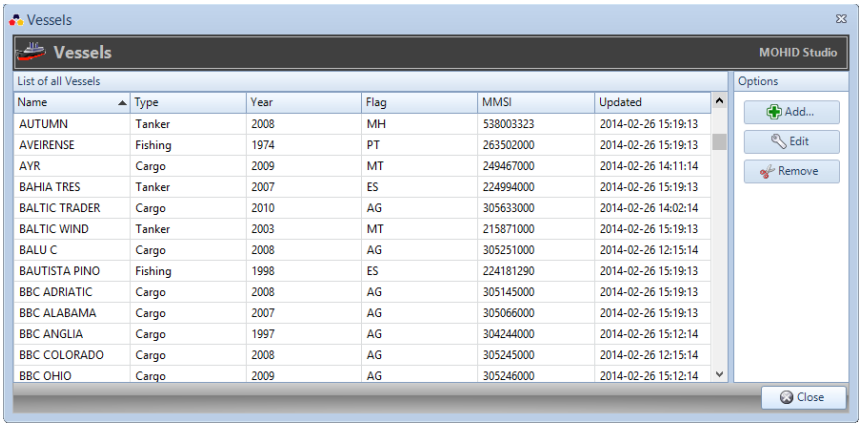
5.2 Upgrades from previous version

Several improvements were developed in ARCOPOLplatform in this plugin, in relation to the version released in ARCOPOLplus:

- Several bugs previously identified were removed and corrected: coastal risk computational velocity, memory management in on-demand risk calculation, visualization of vessel pictures; among others;
- Customization of colour scales associated to coastline risk levels inside graphic user interface;
- Automatic update of graphic visualization of realtime risk maps (making this system available to display realtime risk maps in video wall projectors).
- Optimization of installation process;
- Integration of different AIS data sources for vessel positions and characteristics, using API technologies (e.g. AISHUB.net, MarineTraffic).

5.3 Vessels

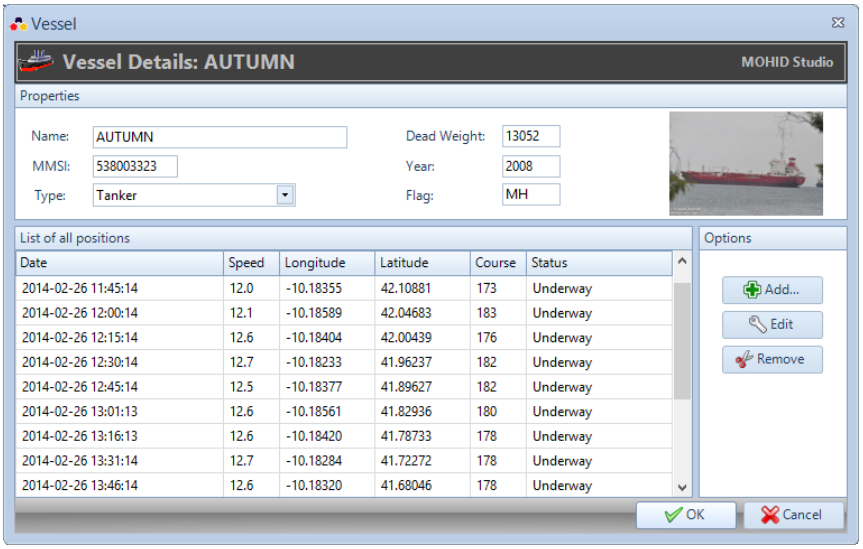
The vessel window list displays the list of all vessels witch has the vessel type: cargo, fishing and taker vessels (represented on Figure 5-2). To check the vessel details and positions, select a row and press the “Edit” button.



Name	Type	Year	Flag	MMSI	Updated
AUTUMN	Tanker	2008	MH	538003323	2014-02-26 15:19:13
AVEIRENSE	Fishing	1974	PT	263502000	2014-02-26 15:19:13
AYR	Cargo	2009	MT	249467000	2014-02-26 14:11:14
BAHIA TRES	Tanker	2007	ES	224994000	2014-02-26 15:19:13
BALTIC TRADER	Cargo	2010	AG	305633000	2014-02-26 14:02:14
BALTIC WIND	Tanker	2003	MT	215871000	2014-02-26 15:19:13
BALU C	Cargo	2008	AG	305251000	2014-02-26 12:15:14
BAUTISTA PINO	Fishing	1998	ES	224181290	2014-02-26 15:19:13
BBC ADRIATIC	Cargo	2008	AG	305145000	2014-02-26 15:19:13
BBC ALABAMA	Cargo	2007	AG	305066000	2014-02-26 15:19:13
BBC ANGLIA	Cargo	1997	AG	304244000	2014-02-26 15:12:14
BBC COLORADO	Cargo	2008	AG	305245000	2014-02-26 12:15:14
BBC OHIO	Cargo	2009	AG	305246000	2014-02-26 15:12:14

Figure 5-2: Vessel List Window.

A new window will open, represented on Figure 5-3, containing the entire vessel details available (name, MMSI, type of vessel, dead weight, year, flag and photo) and all positions. It is possible to add, edit or remove vessel positions. The vessel picture might not appear (requires internet connection to display the picture).



Date	Speed	Longitude	Latitude	Course	Status
2014-02-26 11:45:14	12.0	-10.18355	42.10881	173	Underway
2014-02-26 12:00:14	12.1	-10.18589	42.04683	183	Underway
2014-02-26 12:15:14	12.6	-10.18404	42.00439	176	Underway
2014-02-26 12:30:14	12.7	-10.18233	41.96237	182	Underway
2014-02-26 12:45:14	12.5	-10.18377	41.89627	182	Underway
2014-02-26 13:01:13	12.6	-10.18561	41.82936	180	Underway
2014-02-26 13:16:13	12.6	-10.18420	41.78733	178	Underway
2014-02-26 13:31:14	12.7	-10.18284	41.72272	178	Underway
2014-02-26 13:46:14	12.6	-10.18320	41.68046	178	Underway

Figure 5-3: Vessel Detail Window.

5.4 Vulnerability Indexes

The Vulnerability Indexes group allows the user to check the values defined for each section of the geo location area. There are three types of Vulnerability Indexes in this application: Environmental Vulnerability Index (represented in Figure 5-4), Socio-Economic Vulnerability Index (represented in Figure 5-5) and Ecological Vulnerability Index (represented in Figure 5-6).

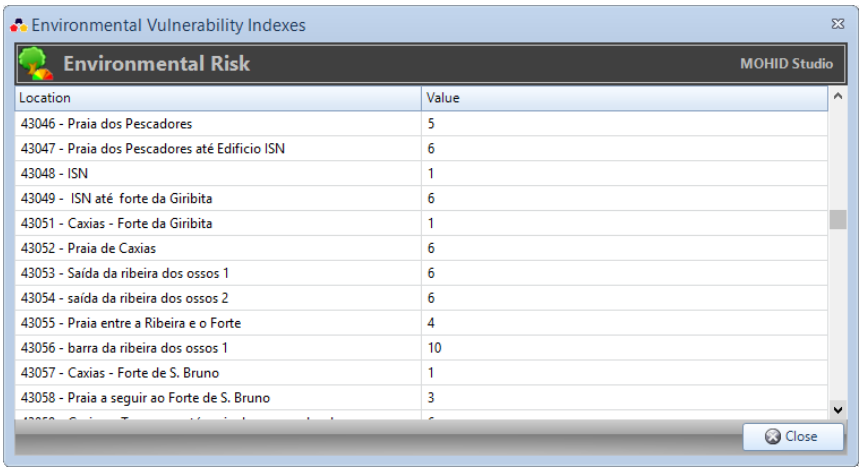


Figure 5-4: Environmental Vulnerability Index Window.

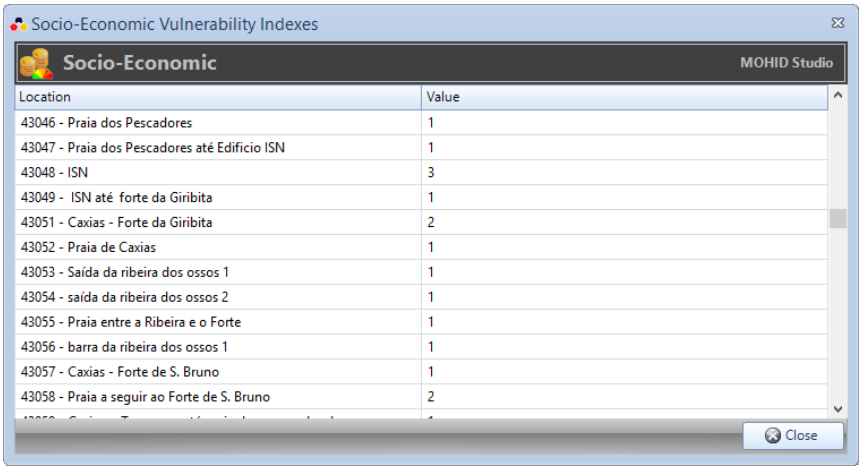


Figure 5-5: Socio-Economic Vulnerability Index Window.

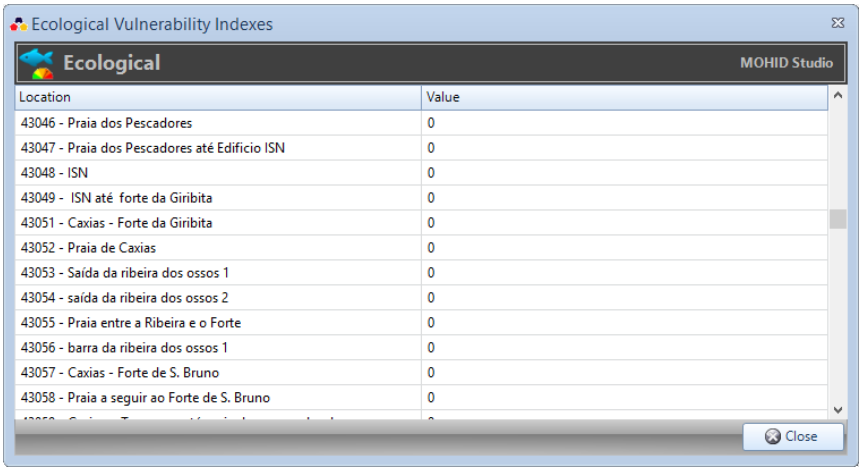


Figure 5-6: Ecological Vulnerability Index Window.

5.5 Risks

In the group of Risks there are two distinct types of Risks: Geo Location Risks and Vessel Risks. Each one is described over the next sub-sections.

5.5.1 Geo Location Risk

The Geo Location Risk Window displays all geo locations in the database (represented in Figure 5-7). After select one geo location (select the entire row), press the “Details” button and the Geo Location Risk Detail Window will appear (represented in Figure 5-8).

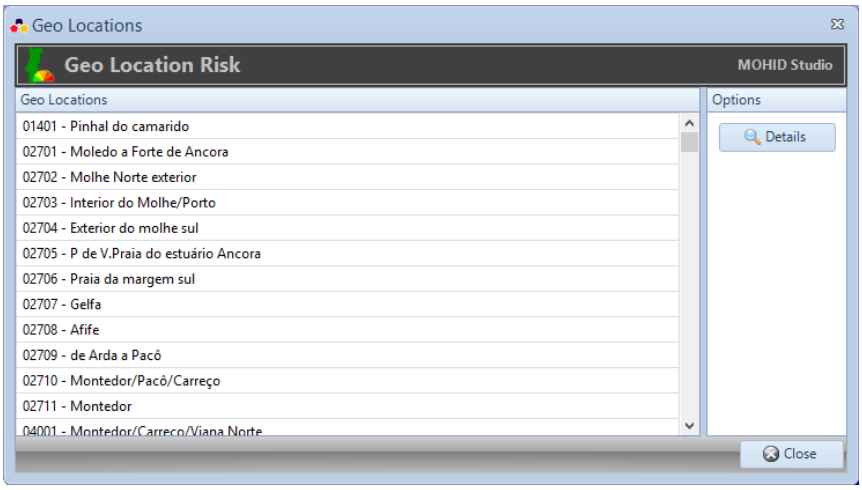
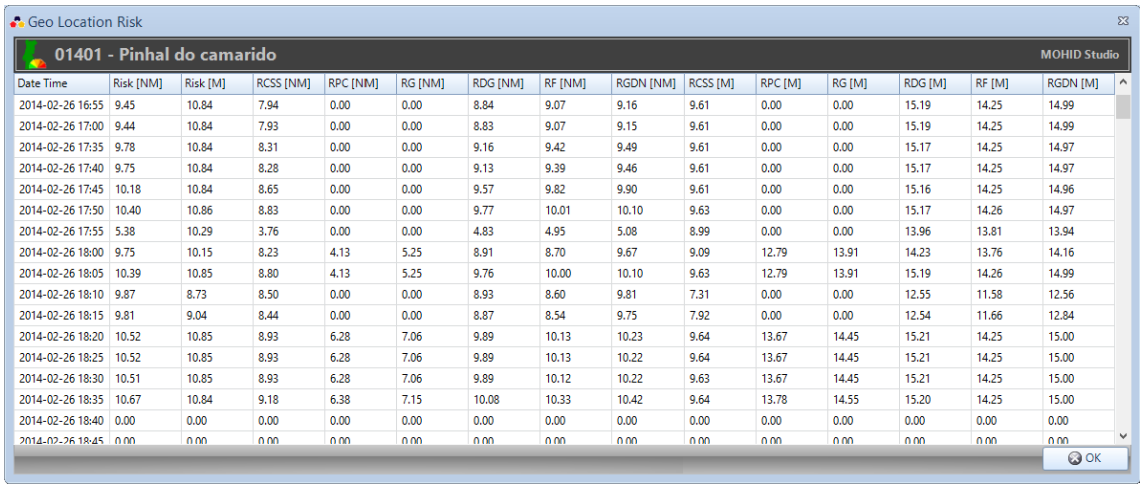


Figure 5-7: Geo Location Risk Window.

In the Geo Location Risk Detail Window is possible to see and analyse the value of the coastal risk values determined for each instant. Each column represents a different type of risk (risk of collision ship-to-ship, risk of grounding,…) and each risk is displayed twice: determined value for the non-modelled risk and the determined value for the Lagrangian modelled risk. The meaning of each column is represented in Table 5-1.



Date Time	Risk [NM]	Risk [M]	RCSS [NM]	RPC [NM]	RG [NM]	RDG [NM]	RF [NM]	RGDN [NM]	RCSS [M]	RPC [M]	RG [M]	RDG [M]	RF [M]	RGDN [M]
2014-02-26 16:55	9.45	10.84	7.94	0.00	0.00	8.84	9.07	9.16	9.61	0.00	0.00	15.19	14.25	14.99
2014-02-26 17:00	9.44	10.84	7.93	0.00	0.00	8.83	9.07	9.15	9.61	0.00	0.00	15.19	14.25	14.99
2014-02-26 17:35	9.78	10.84	8.31	0.00	0.00	9.16	9.42	9.49	9.61	0.00	0.00	15.17	14.25	14.97
2014-02-26 17:40	9.75	10.84	8.28	0.00	0.00	9.13	9.39	9.46	9.61	0.00	0.00	15.17	14.25	14.97
2014-02-26 17:45	10.18	10.84	8.65	0.00	0.00	9.57	9.82	9.90	9.61	0.00	0.00	15.16	14.25	14.96
2014-02-26 17:50	10.40	10.86	8.83	0.00	0.00	9.77	10.01	10.10	9.63	0.00	0.00	15.17	14.26	14.97
2014-02-26 17:55	5.38	10.29	3.76	0.00	0.00	4.83	4.95	5.08	8.99	0.00	0.00	13.96	13.81	13.94
2014-02-26 18:00	9.75	10.15	8.23	4.13	5.25	8.91	8.70	9.67	9.09	12.79	13.91	14.23	13.76	14.16
2014-02-26 18:05	10.39	10.85	8.80	4.13	5.25	9.76	10.00	10.10	9.63	12.79	13.91	15.19	14.26	14.99
2014-02-26 18:10	9.87	8.73	8.50	0.00	0.00	8.93	8.60	9.81	7.31	0.00	0.00	12.55	11.58	12.56
2014-02-26 18:15	9.81	9.04	8.44	0.00	0.00	8.87	8.54	9.75	7.92	0.00	0.00	12.54	11.66	12.84
2014-02-26 18:20	10.52	10.85	8.93	6.28	7.06	9.89	10.13	10.23	9.64	13.67	14.45	15.21	14.25	15.00
2014-02-26 18:25	10.52	10.85	8.93	6.28	7.06	9.89	10.13	10.22	9.64	13.67	14.45	15.21	14.25	15.00
2014-02-26 18:30	10.51	10.85	8.93	6.28	7.06	9.89	10.12	10.22	9.63	13.67	14.45	15.21	14.25	15.00
2014-02-26 18:35	10.67	10.84	9.18	6.38	7.15	10.08	10.33	10.42	9.64	13.78	14.55	15.20	14.25	15.00
2014-02-26 18:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014-02-26 18:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 5-8: Geo Location Risk Detail Window.

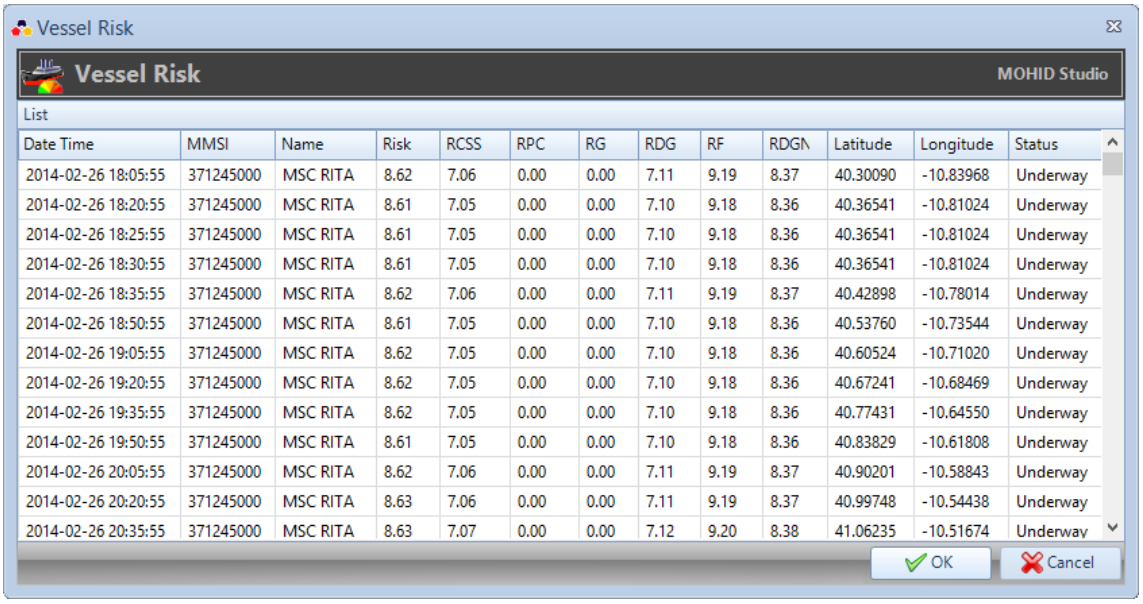
Column Name	Risk Name
Risk [NM]	Integrated Risk [Non-Modelled]
Risk [M]	Integrated Risk [Modelled]
RCSS [NM]	Risk of Collision Ship to Ship [Non-Modelled]
RPC [NM]	Risk of Port Collision [Non-Modelled]
RG [NM]	Risk of Grounding [Non-Modelled]
RDG [NM]	Risk of Drift Grounding [Non-Modelled]
RF [NM]	Risk of Foundering [Non-Modelled]
RDGN [NM]	Risk of Drift Grounding During Navigation [Non-Modelled]
RCSS [M]	Risk of Collision Ship to Ship [Modelled]

RPC [M]	Risk of Port Collision [Modelled]
RG [M]	Risk of Grounding [Modelled]
RDG [M]	Risk of Drift Grounding [Modelled]
RF [M]	Risk of Foundering [Modelled]
RDGN [M]	Risk of Drift Grounding During Navigation [Modelled]

Table 5-1: Fields from Geo Location Risk Detail Window.

5.5.2 Vessel Risk

The Vessel Risk Window displays all the vessel risks in the database (represented in Figure 5-9). The meaning of each column is represented in Table 5-1.



Date Time	MMSI	Name	Risk	RCSS	RPC	RG	RDG	RF	RDGN	Latitude	Longitude	Status
2014-02-26 18:05:55	371245000	MSC RITA	8.62	7.06	0.00	0.00	7.11	9.19	8.37	40.30090	-10.83968	Underway
2014-02-26 18:20:55	371245000	MSC RITA	8.61	7.05	0.00	0.00	7.10	9.18	8.36	40.36541	-10.81024	Underway
2014-02-26 18:25:55	371245000	MSC RITA	8.61	7.05	0.00	0.00	7.10	9.18	8.36	40.36541	-10.81024	Underway
2014-02-26 18:30:55	371245000	MSC RITA	8.61	7.05	0.00	0.00	7.10	9.18	8.36	40.36541	-10.81024	Underway
2014-02-26 18:35:55	371245000	MSC RITA	8.62	7.06	0.00	0.00	7.11	9.19	8.37	40.42898	-10.78014	Underway
2014-02-26 18:50:55	371245000	MSC RITA	8.61	7.05	0.00	0.00	7.10	9.18	8.36	40.53760	-10.73544	Underway
2014-02-26 19:05:55	371245000	MSC RITA	8.62	7.05	0.00	0.00	7.10	9.18	8.36	40.60524	-10.71020	Underway
2014-02-26 19:20:55	371245000	MSC RITA	8.62	7.05	0.00	0.00	7.10	9.18	8.36	40.67241	-10.68469	Underway
2014-02-26 19:35:55	371245000	MSC RITA	8.62	7.05	0.00	0.00	7.10	9.18	8.36	40.77431	-10.64550	Underway
2014-02-26 19:50:55	371245000	MSC RITA	8.61	7.05	0.00	0.00	7.10	9.18	8.36	40.83829	-10.61808	Underway
2014-02-26 20:05:55	371245000	MSC RITA	8.62	7.06	0.00	0.00	7.11	9.19	8.37	40.90201	-10.58843	Underway
2014-02-26 20:20:55	371245000	MSC RITA	8.63	7.06	0.00	0.00	7.11	9.19	8.37	40.99748	-10.54438	Underway
2014-02-26 20:35:55	371245000	MSC RITA	8.63	7.07	0.00	0.00	7.12	9.20	8.38	41.06235	-10.51674	Underway

Figure 5-9: Vessel Risk Detail Window.

5.6 Risk on Demand

The group Risk on Demand contains a button that allows the user to determine the vessel risk and the coastal risk on demand. This feature gives the user the liberty to determine the risk on a selected instant. After pressing the button “On Demand” a new side window will open, as represented in Figure 5-10. This windows is divided into two sections: Configuration and Date Time Interval.

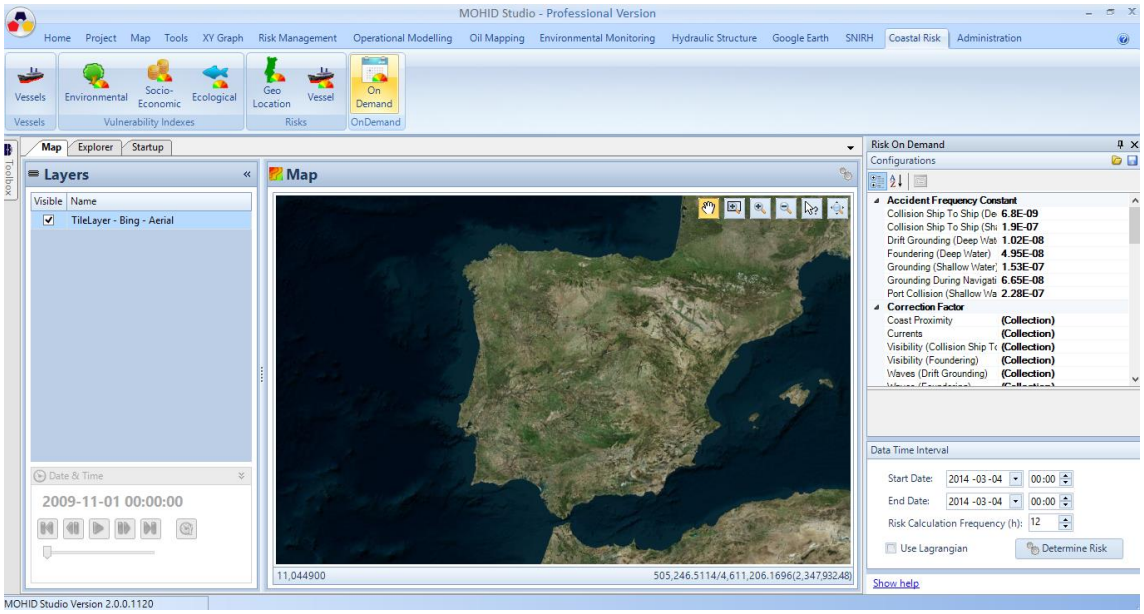


Figure 5-10: Risk on Demand Window.

5.6.1 Configuration

The Configuration of the Risk on Demand Window (represented in Figure 5-11) can be a little tricky, so we will explain the basic steps. This configuration allows the user to select almost each parameter of the risk determination.

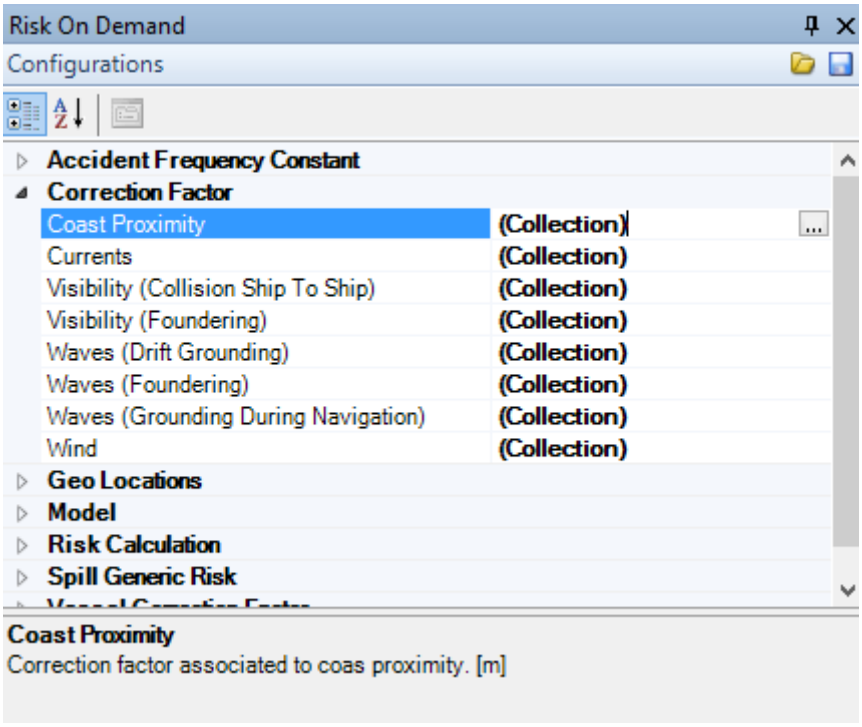


Figure 5-11: Risk on Demand window – Configuration group.

The Risk on Demand window has the parameters organized in groups. Each group is explained in the next subsections. After a property is selected, as shown in Figure 5-11, a brief description of the property is described below (at the grey bar).

The user can save the configuration file (save button located on the top right – Figure 5-11) or can load a previous saved configuration file (open button located on the top right – Figure 5-11).

5.6.1.1 Accident Frequency Constant

The accident frequency constant is an essential parameter to determine the vessel risk and the coastal risk. These values can be changed by the user in order to adjust the risk calculation. The default values are presented on the Table 5-2.

Type of Risk	Shallow Waters	Deep Waters
Risk of Collision Ship to Ship	1.9×10^{-7}	6.8×10^{-9}
Risk of Port Collision	2.28×10^{-7}	-
Risk of Grounding	1.53×10^{-7}	-
Risk of Drift Grounding	-	1.02×10^{-8}
Risk of Foundering	-	4.95×10^{-8}
Risk of Drift Grounding During Navigation	-	6.65×10^{-8}

Table 5-2: Accident Frequency Constant default values.

5.6.1.2 Correction Factors

The correction factors allow the user to reduce the impact of using constant values. These values can be changed by the user in order to adjust the risk calculation. The default values are presented on the next tables for: shoreline proximity (Table 5-3), currents velocity (Table 5-4), visibility for risk type of ship to ship collision (Table 5-5), visibility for risk type of foundering (Table 5-6), waves (Table 5-7) and wind velocity (Table 5-8).

For tables where the value is present “below” from a certain value (and the minimum value is not defined), the user should set the minimum value as “0”. Where the maximum value is not defined, the user should insert a larger number. The minimum and maximum values can’t be null or not defined.

The correction factors appear as “(Collection)” (see Figure 5-11). To edit this field, press the button with “…” and a new window will open (represented in Figure 5-12). In this case, the correction factor value is 2 (field name = “ValueKey”) for shoreline values between 0 (field name = “ValueMin”) and the 11112 m (field name = “ValueMax”). This value corresponds to the first row of the Table 5-3.

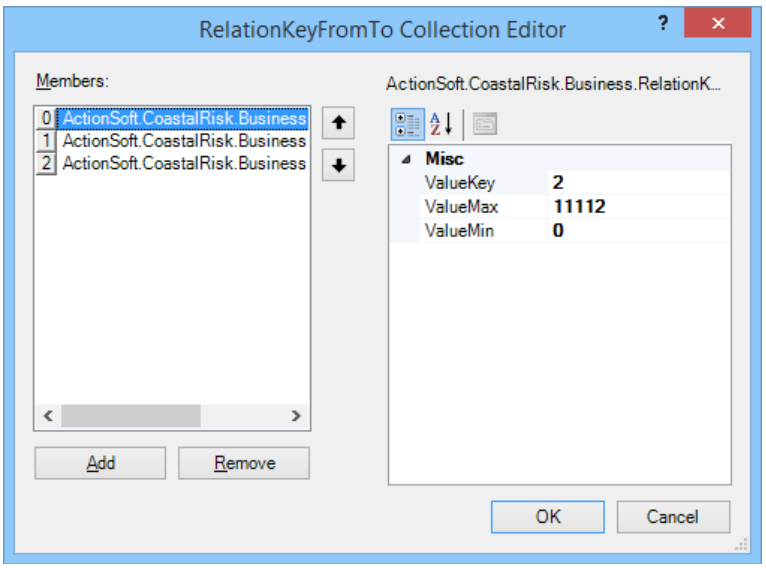


Figure 5-12: Configuration – Edit Correction Factor values.

Proximity to shoreline (in m)	Multiplying correction factor
<= 11112	2.0
11112 < … <= 14816	1.0
> 14816	0.8

Table 5-3: Correction factor associated to proximity to shoreline default values.

Currents velocity (in m/s)	Multiplying correction factor

<= 0.3601	0.4
0.3601 < … <= 0.5144	0.8
0.5144 < … <= 1.0289	1.2
1.0289 < … <= 1.5433	1.6
> 1.5433	2.0

Table 5-4: Correction factor associated to currents velocity default values.

Visibility (in m)	Multiplying correction factor
<= 1852	1.76
> 1852	0.24

Table 5-5: Correction factor associated to visibility (Risk of Collision Ship to Ship) default values.

Visibility (in m)	Multiplying correction factor
<= 1852	1.4
> 1852	0.6

Table 5-6: Correction factor associated to visibility (Risk of Foundering) default values.

Risk Type	Multiplying correction factor – Waves (in m)	
	<= 2.5	**> 2.5**
Drift Grounding	0.22	1.78
Foundering	0.1	1.0
Grounding during Navigation	0.6	1.4

Table 5-7: Correction factor associated to waves default values.

Wind velocity (in m/s)	Multiplying correction factor
<= 8.3333	0.8
8.3333< … <= 13.8889	1.2
13.8889 < … <= 25	1.6
> 25	2.0

Table 5-8: Correction factor associated to wind default values.

5.6.1.3 Geo Locations

Path to file: KML – Insert here the path to file "atlascosteiro.kml". This file should contain the coastal sections and the vulnerability indexes for environment, socio-economic and ecological. If the field is empty, the risk will be determined for all the coastal sections in the database. (To check all the coastal sections from database, read section: 5.5.1).

Path to file: Shallow Water – Insert here the path to file "Portugal3MilesZone.shp". This file should contain the coastal area for the shallow water zone.

5.6.1.4 Model

Backup Input Files – TRUE / FALSE. It is possible to save the initial conditions from the Lagrangian model. If this field is "TRUE", a zip file will be created in Storage Directory containing the folders: "data", "exe" and "General Conditions". The file name will be similar to: "Input_Files_yyyymmdd_hhmmss.zip". The date instant corresponds to the start instant of the simulation. In case of more than one simulation start at the same instant, the file name will be similar to: "Input_Files_yyyymmdd_hhmmss_n.zip" (where "n" corresponds to a number). If this field is "FALSE" the initial conditions will be deleted after the model finish the execution.

Backup Result Files – TRUE / FALSE. It is possible to save the result files from the Lagrangian model to analyze them after the model execution. If this field is "TRUE", a zip file will be created in Storage Directory containing the "res" folder. The file name

will be similar to: “Result_Files_yyyymmdd_hhmmss.zip”. The date time instant in the file name corresponds to the start instant of the simulation. In case of more than one simulation start at the same instant, the file name will be similar to: “Result _Files_yyyymmdd_hhmmss_n.zip” (where “n” corresponds to a number). If this field is “FALSE” the result files (*.tro) from model will be deleted after the model finish the execution and all the calculus are finished.

L unit – 1000 [m]. This field corresponds to the shoreline distance unit, also known as “Length Unit” in the Q* formula [$Q^* = (Q \times M)/L_{stretch} \times L_{unit}$].

Model Executable File – “exe\MOHIDWater_release_single.exe”. This field is the relative path (from the Root Directory) to the execution model file. The Lagrangian model that will be executable is the file indicated in this field.

Model Grid File – “GeneralData\Batim\Portugal_20080707Final.dat”. This field is the relative path (from the Root Directory) to the grid file used by the Lagrangian model.

Model Name: Hydrodynamic – “MOHID”. This field contains the model domain name for hydrodynamics.

Model Name: Meteorological – “MM5”. This field contains the model domain name for meteorological.

Model Name: Waves – “WW3”. This field contains the model domain name for waves.

Model Root Directory – This field contains the absolute path for the model root directory. The Model Root Directory is the base folder of the Lagrangian model. This folder contains the folders: “data”, “exe”, “General Data”, “Model Runs” and “res”.

Path to file: Hydrodynamic – This field can be empty or containing a path to an HDF5 file. This is the hydrodynamic data that will be used for the model. If the field is empty, the database values are used for the model execution. If the user input an HDF5 file, the values from the file will be used for the model execution.

Path to file: Meteorological – This field can be empty or containing a path to an HDF5 file. This is the meteorological data that will be used for the model. If the field is

empty, the database values are used for the model execution. If the user input an HDF5 file, the values from the file will be used for the model execution.

Path to file: Waves – This field can be empty or containing a path to an HDF5 file. This is the wave data that will be used for the model. If the field is empty, the database values are used for the model execution. If the user input an HDF5 file, the values from the file will be used for the model execution.

Run Time – 24 [hour]. This field represents the number of hours that the Lagrangian model will simulate forward in time.

Storage Directory – This field contains the absolute path for the storage directory. This is the folder where the input and result files will be saved, if the user wish to storage them.

Use Lagrangian – TRUE / FALSE. If the Lagrangian model should be used for determine the coastal risk.

Water Depth (Minimum) – 0 [m]. Minimum Water Depth where the vessel can be located.

5.6.1.5 Risk Calculation

Vessel Window – 30 [minute]. This field represents the time window (in minutes) that will be added to an instant, in order to get more vessel positions. If the instant is 10h, the application will get from database for each vessel the closest position to 10h, between 9h30m and 10h30m. This interval is needed because the vessel position update may not be at the precise instant.

5.6.1.6 Spill Generic Risk

The default values used for the spill generic list are presented on Table 5-9 and Table 5-10.

Type of Vessel	Shallow Waters

Cargo	0.1
Fishing	0.3
Tanker	0.2

Table 5-9: Default values for Correction factor based on spill site used, in function of ship type.

Parameter	Default value
Minimum value to display Coastal Risk	6
Percentile	98

Table 5-10: Default parameters values for determine the Coastal Risk.

5.6.1.7 Correction Vessel Factor

The values for the correction factor used for the vessel risk determination are presented for: vessel type Cargo (Table 5-11), vessel type Fishing (Table 5-12) and for vessel type Tankers (Table 5-13).

Type of Risk	Shallow Waters	Deep Waters
Risk of Collision Ship to Ship	2	3.343
Risk of Port Collision	1	-
Risk of Grounding	1.6	-
Risk of Drift Grounding	-	2.133
Risk of Foundering	-	3.606
Risk of Drift Grounding During Navigation	-	4.286

Table 5-11: Default values for: Correction vessel factor – Cargo.

Type of Risk	Shallow Waters	Deep Waters
Risk of Collision Ship to Ship	0.3	-

Risk of Port Collision	0.7	-
Risk of Grounding	0.2	-

Table 5-12: Default values for: Correction vessel factor – Fishing.

Type of Risk	Shallow Waters	Deep Waters
Risk of Collision Ship to Ship	1.7	1.629
Risk of Port Collision	1	-
Risk of Grounding	1.6	-
Risk of Drift Grounding	-	1.6
Risk of Foundering	-	0.113
Risk of Drift Grounding During Navigation	-	0.612

Table 5-13: Default values for: Correction vessel factor – Tanker.

5.6.2 Date Time Interval

On the Date Time Interval group (represented on Figure 5-13) the user can define the mode of the risk determination. First the user should select a start instant and end instant. The Risk Calculation Frequency defines the hour of the loop. The checkbox, if checked, indicates that the Lagrangian model will be executed for the risk determination. If not, only the non-modelled risk will be determined. After the configuration is complete, press the button Determine Risk. Note: The result might be a little slow, depends on the quantity of vessels and the number of coastal section.

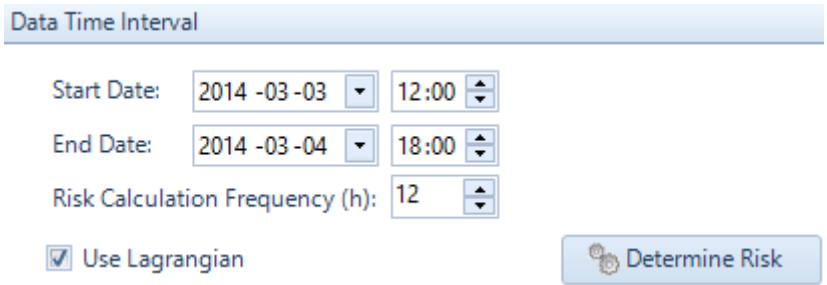


Figure 5-13: Risk on Demand – Date Time Interval group.

For example, if the user wishes to determine the risk at each 6 hours for a 24 hour period, the configuration should be similar to the one represented on Figure 5-14.

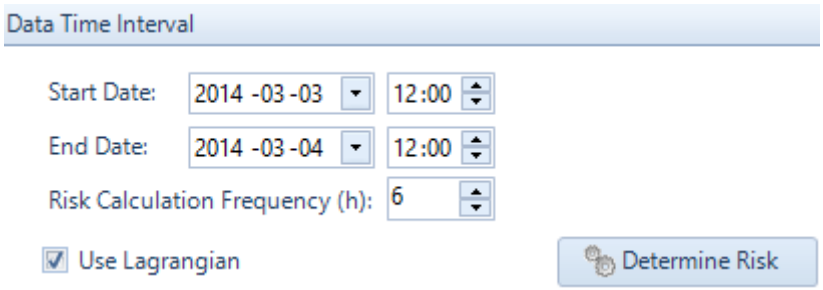
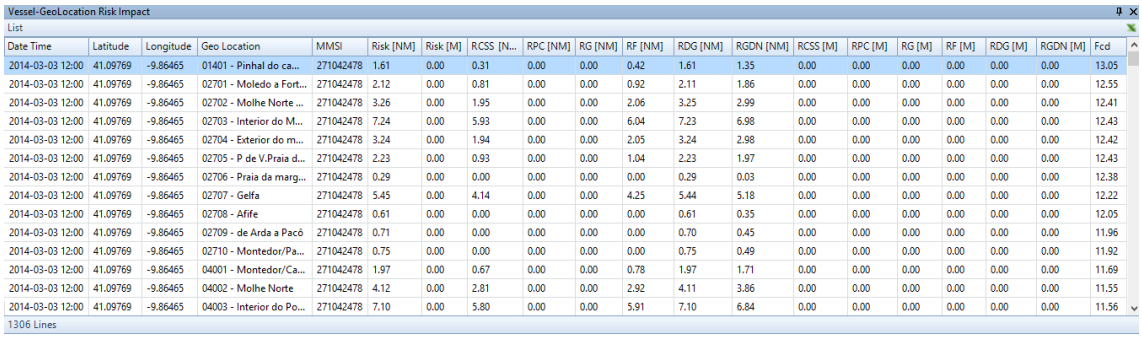


Figure 5-14: Example of the date time interval configurations for several runs.

5.6.3 Results

After finish the determination of coastal risk a new window with the results will appear (represented on Figure 5-15). The meaning of each column is represented in Table 5-1. The results from this window can be exported to a XLS file (top right button).


Vessel-GeoLocation Risk Impact

List

Date Time	Latitude	Longitude	Geo Location	MMSI	Risk [NM]	Risk [M]	RCSS [N...	RPC [NM]	RG [NM]	RF [NM]	RDG [NM]	RGDN [NM]	RCSS [M]	RPC [M]	RG [M]	RF [M]	RDG [M]	RGDN [M]	Fcd
2014-03-03 12:00	41.09769	-9.86465	01401 - Pinhal do ca...	271042478	1.61	0.00	0.31	0.00	0.00	0.42	1.61	1.35	0.00	0.00	0.00	0.00	0.00	0.00	13.05
2014-03-03 12:00	41.09769	-9.86465	02701 - Moledo a Fort...	271042478	2.12	0.00	0.81	0.00	0.00	0.92	2.11	1.86	0.00	0.00	0.00	0.00	0.00	0.00	12.55
2014-03-03 12:00	41.09769	-9.86465	02702 - Molhe Norte ...	271042478	3.26	0.00	1.95	0.00	0.00	2.06	3.25	2.99	0.00	0.00	0.00	0.00	0.00	0.00	12.41
2014-03-03 12:00	41.09769	-9.86465	02703 - Interior do M...	271042478	7.24	0.00	5.93	0.00	0.00	6.04	7.23	6.98	0.00	0.00	0.00	0.00	0.00	0.00	12.43
2014-03-03 12:00	41.09769	-9.86465	02704 - Exterior do m...	271042478	3.24	0.00	1.94	0.00	0.00	2.05	3.24	2.98	0.00	0.00	0.00	0.00	0.00	0.00	12.42
2014-03-03 12:00	41.09769	-9.86465	02705 - P de V.Praia d...	271042478	2.23	0.00	0.93	0.00	0.00	1.04	2.23	1.97	0.00	0.00	0.00	0.00	0.00	0.00	12.43
2014-03-03 12:00	41.09769	-9.86465	02706 - Praia da marg...	271042478	0.29	0.00	0.00	0.00	0.00	0.00	0.29	0.03	0.00	0.00	0.00	0.00	0.00	0.00	12.38
2014-03-03 12:00	41.09769	-9.86465	02707 - Gelfa	271042478	5.45	0.00	4.14	0.00	0.00	4.25	5.44	5.18	0.00	0.00	0.00	0.00	0.00	0.00	12.22
2014-03-03 12:00	41.09769	-9.86465	02708 - Afife	271042478	0.61	0.00	0.00	0.00	0.00	0.00	0.61	0.35	0.00	0.00	0.00	0.00	0.00	0.00	12.05
2014-03-03 12:00	41.09769	-9.86465	02709 - de Arda a Pacô	271042478	0.71	0.00	0.00	0.00	0.00	0.00	0.70	0.45	0.00	0.00	0.00	0.00	0.00	0.00	11.96
2014-03-03 12:00	41.09769	-9.86465	02710 - Montedor/Pa...	271042478	0.75	0.00	0.00	0.00	0.00	0.00	0.75	0.49	0.00	0.00	0.00	0.00	0.00	0.00	11.92
2014-03-03 12:00	41.09769	-9.86465	04001 - Montedor/Ca...	271042478	1.97	0.00	0.67	0.00	0.00	0.78	1.97	1.71	0.00	0.00	0.00	0.00	0.00	0.00	11.69
2014-03-03 12:00	41.09769	-9.86465	04002 - Molhe Norte	271042478	4.12	0.00	2.81	0.00	0.00	2.92	4.11	3.86	0.00	0.00	0.00	0.00	0.00	0.00	11.55
2014-03-03 12:00	41.09769	-9.86465	04003 - Interior do Po...	271042478	7.10	0.00	5.80	0.00	0.00	5.91	7.10	6.84	0.00	0.00	0.00	0.00	0.00	0.00	11.56

1306 Lines

Figure 5-15: Risk on Demand – Results window.

Along with the results window from Risk on demand, 2 (or 3) layers are appended to the map: Risk on Demand – Vessel Risk; Risk on Demand – Coastal Risk (Non-Modelled) and Coastal Risk (Modelled) [only appears if Lagrangian mode was selected], as represented in Figure 5-16.

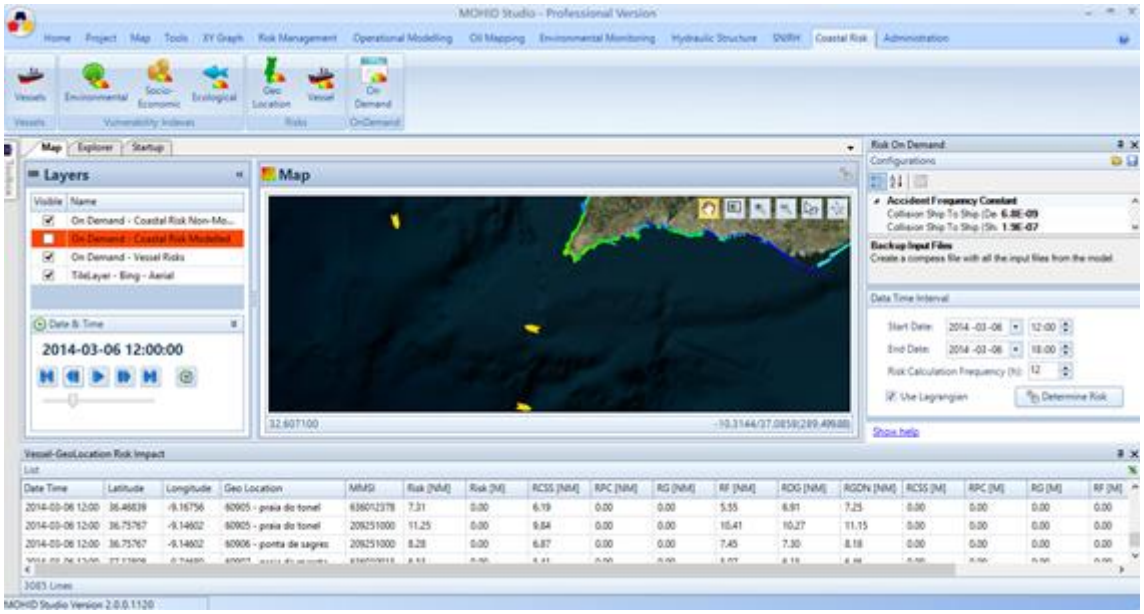


Figure 5-16: Risk on Demand – Layers visualization.

6 Database

Action Server and MOHID Studio, by default, use a SQL Lite database. This database is automatically generated by MOHID Studio during the first run. Alternatively, the user can also use a Microsoft SQL Server database.

6.1 SQL Server

For the Coastal Risk tool is recommended a SQL Server database in order to store the large amount of data. SQL Lite has a limitation of capacity and SQL Server allows the user to storage more data.

After the installation of MOHID Studio and Action Server, if the user pretends to use a SQL Server data base, the connection sting must be changed in the files:

1) C:\Program Files (x86)\Action Modulers\Action Server\Action.Server.exe.config

2) C:\Program Files (x86)\Action Modulers\Action\MOHID Studio.exe.config

The new connection string should be similar to this one:

<property name="connection.connection_string">

Data Source=MACHINE_NAME\SQL_INSTANCE_NAME; Initial Catalog=DataBaseName

</property>

7 Lagrangian Spill Wizard Plugin – MOHID Studio

7.1 Introduction

The Lagrangian Spill Wizard was built to help the MOHID Studio User (from first-time to advanced user) to implement in a straightforward way a MOHID Water spill simulation.

The user chooses the time of simulation, the substance released and the location, the meteo-ocean conditions (constant or from model results) and the processes to account. The wizard collects the options, prepares the MOHID data files accordingly and runs the simulation.

7.2 Starting the Wizard

The Lagrangian Spill Wizard is a plugin that can be added/removed from Studio and can be started both in the Toolbox (Figure 7-1) or in Project menu (Figure 7-2).

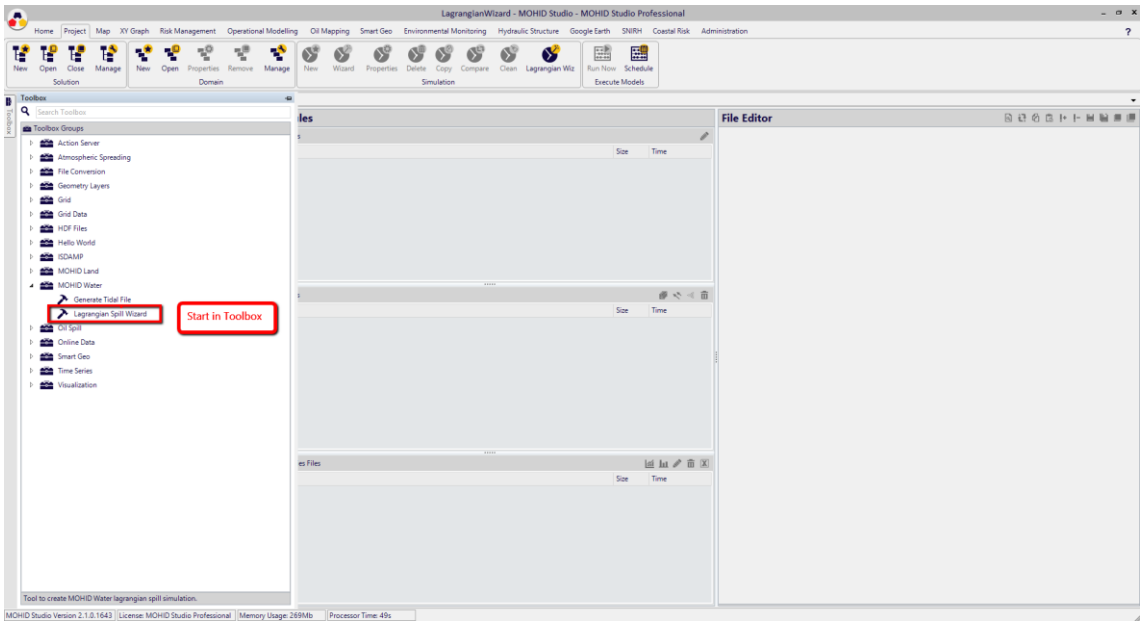


Figure 7-1: Start the Lagrangian Spill Wizard from the toolbox.

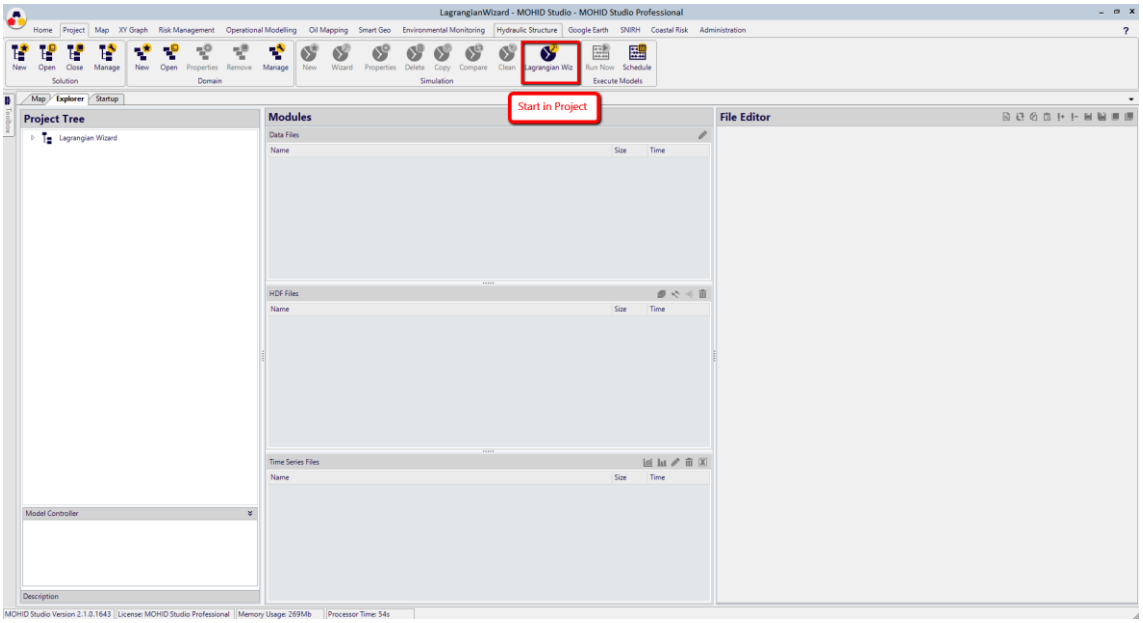


Figure 7-2: Start the Lagrangian Spill Wizard from the Project menu.

In order to be able to start the wizard, it is needed to have at least one MOHID Water project opened in "Explorer" tab. If not the wizard will warn the user to open a MOHID Water project first. One of the projects opened will be the chosen to add the new simulation to (shown below).

If at least one MOHID Water Project is open, opening the wizard will pop up the welcome screen (Figure 7-3).

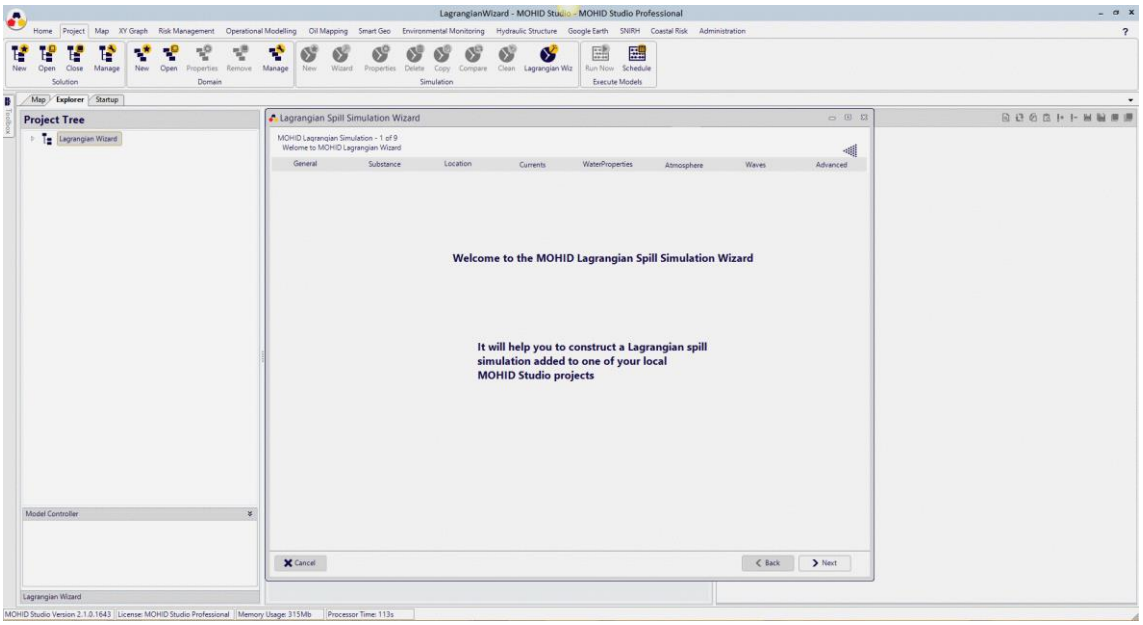


Figure 7-3: Langrangian Spill Wizard welcome screen.

7.3 General Settings

In the welcome screen if pressed “Next”, appears the “General Settings” window where the user may define in which of the open MOHID Water projects the new simulation will be created, the simulation name, the time horizon and if the option backtracking should be activated.

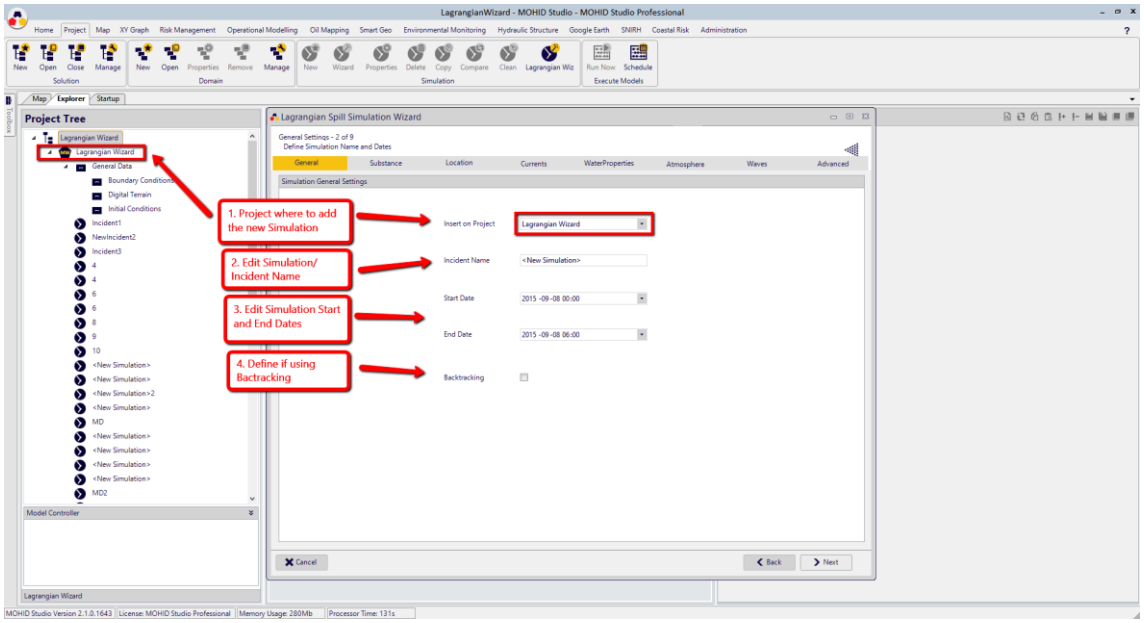


Figure 7-4: Lagrangian Spill Wizard General Settings.

7.4 Spill Substance

In the “General Settings” window if pressed “Next”, appears the “Substance Settings” window that allows the user to select different types of substance:

- Oil Spill
- Chemical Spill
- Large Floating Object
- Small Floating Object
- Human Body
- Passive Tracer
- Airborne Emission

Each substance type has different option associated, where oil and chemical spills need to select a substance and this can be done using:

- Online database of substances (not available for now)
- MOHID Studio database of substances (a pre filled database exists for oil spills) - Figure 7-6.
- Substance classes (representative of main substances families) - Figure 7-5.
- User defined substance (the user may define a new substance and add it to MOHID Studio database that will be available for selection) - Figure 7-7.

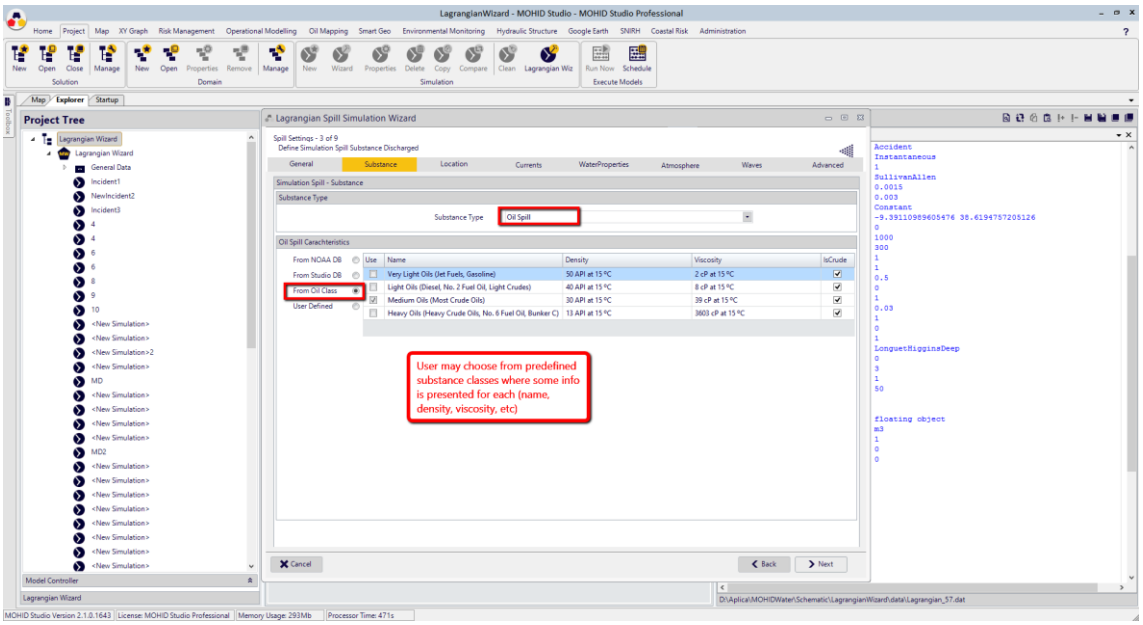


Figure 7-5: Oil Spill defined substance from substance classes.

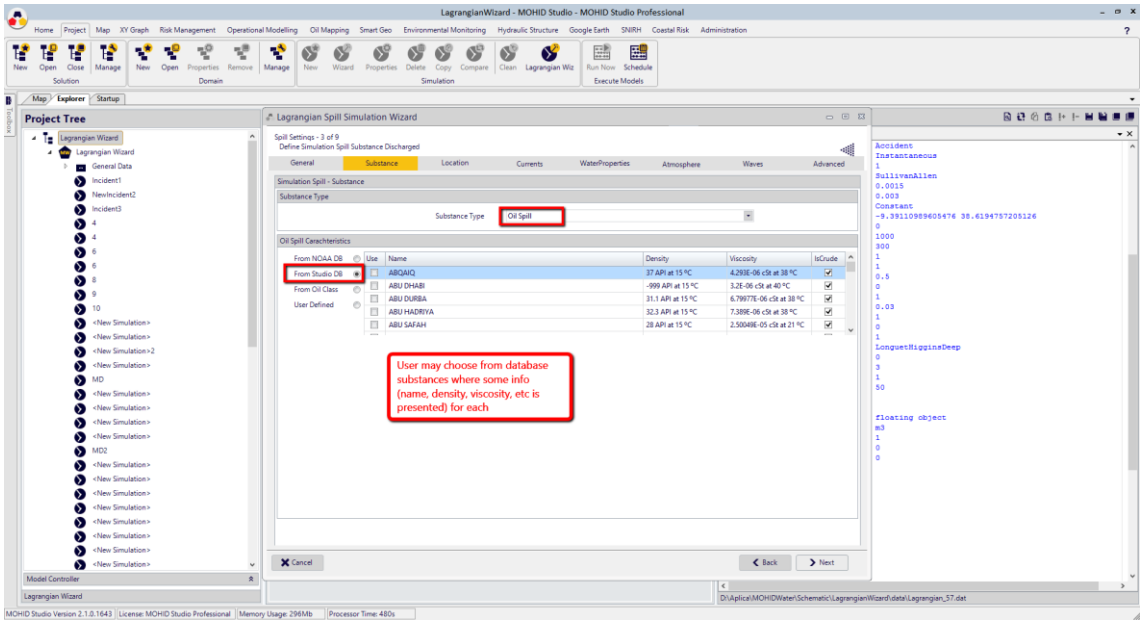


Figure 7-6: Oil Spill defined substances from MOHD Studio database.

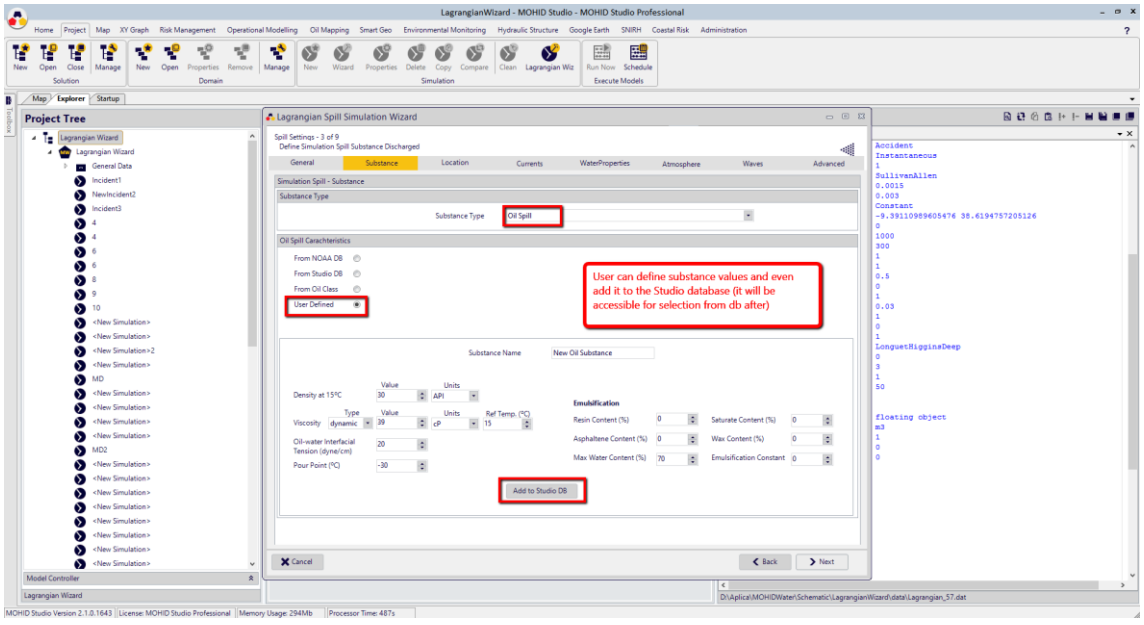


Figure 7-7: Oil spill substance defined by the user.

Other types of spill have different or any option to enter by the user.

7.5 Spill Location and Timing

In the “Substance Settings” window if pressed “Next”, appears the “Location Settings” window - Figure 7-8, where the user can define the spill location in two ways:

- A point spill by clicking in map
- An area (polygon) spill by clicking in map, by opening a MOHID polygon (.xy or .xml) or by opening EMSA Clean Sea Net spills (.tgz files).

For now is only possible to select one spill location.

The interactive map is a mirror of the MOHID Studio Map so all the layers and extent are the same.

The user may also define if the spill will be continuous (during all simulation dates) or instantaneous (at simulation start) and define the options associated.

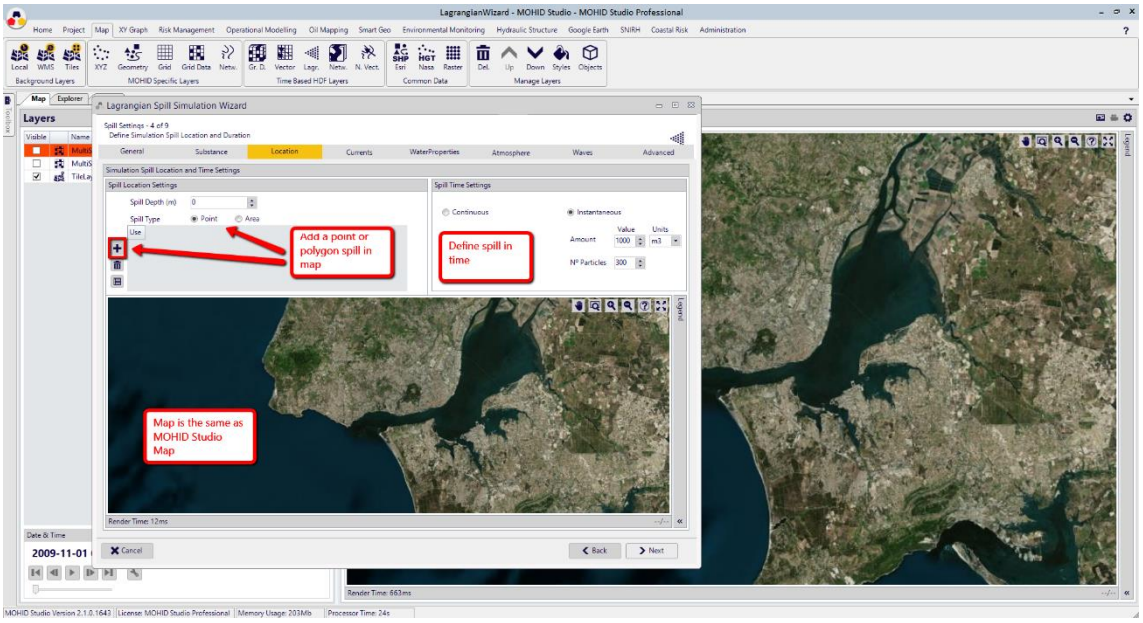


Figure 7-8. Spill Location and Timing Settings.

7.6 Forcing Conditions

After the "Location Settings" window appears 4 windows ("Currents", "Water Properties", "Atmosphere" and "Waves" settings), where the user may define the simulation forcing conditions, that can be:

Constant (same value in space and time)

From Model Results

The constant condition is imposed by setting values (e.g. current direction and intensity - Figure 7-9) and the model results condition (e.g. Figure 7-10) needs that results are already stored in MOHID Studio database. This can achieved automatically by using Action Server (described earlier) that can download everyday model forecast results or by manually importing model HDF files results into the database (in Toolbox use tool "HDF -> Import into data base").

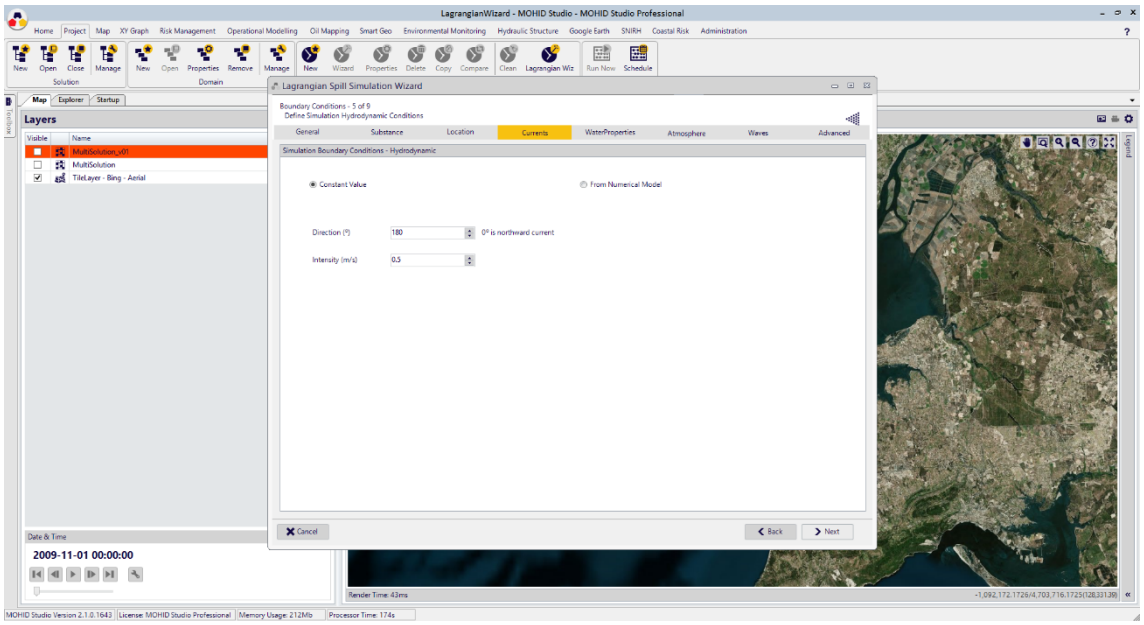


Figure 7-9: Example of currents forcing – constant values.

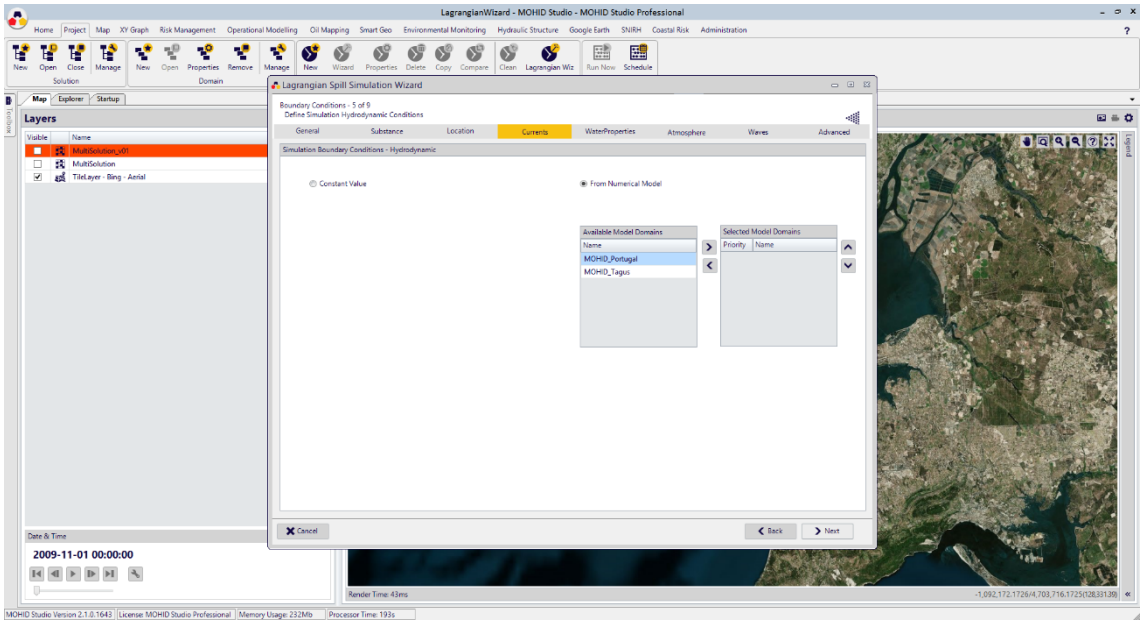


Figure 7-10: Example of currents forcing – from model domains

The 4 windows for forcing conditions (currents, water properties, atmosphere and waves) are very similar. In both the user may define constant values for the properties or select the model domains to use and their priority. The model will use the model results by priority, if one particle does not have results from the first model domain available (e.g. due to spatial extent), it tries on the next and so on.

The available model domains are selected from the ones in database that

include spill location,

have results in the defined dates,

have the required properties for forcing.

The wizard warns the user if no model domains with the above criteria exist in the database. The user may close the wizard and upload model results or change simulation dates and/or spill location that are consistent with model results uploaded or select to force with constant conditions.

The user needs to select the model domains to use from the available (if any) by adding them to the “Selected Model Domains” box and can change priority by moving them up and down.

7.7 Advanced Settings

After all forcing conditions windows (Currents, Water Properties, Atmosphere and Waves) the user may select advanced options as horizontal and vertical turbulent diffusion or processes to compute. In Figure 7-11 is presented an example of advanced settings for an oil spill where the processes to connect/disconnect ate the ones associated to oil, existing other processes for instance for chemical properties.

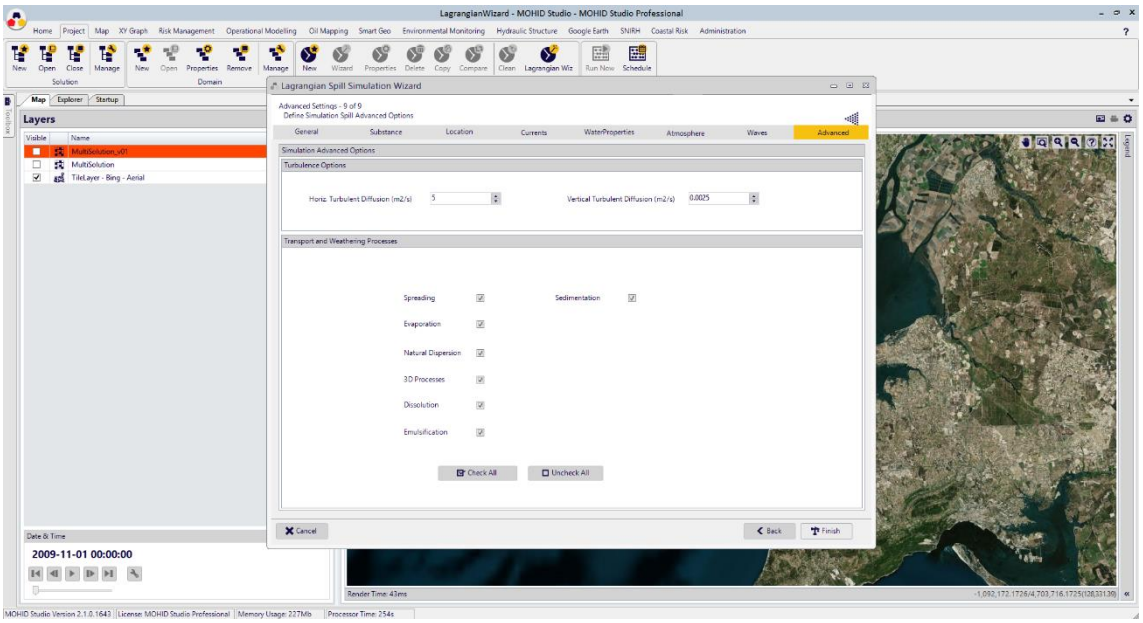


Figure 7-11: Example of advanced settings for oil spill.

7.8 Finishing

By clicking on “Finish” on the last window, the wizard prepares the new simulation by collecting user entered data. The MOHID Water input files are prepared accordingly (module data files and bathymetry) and the user is asked if wants to run the simulation at the moment (Figure 7-12). The simulation starts to run as any other simulation behaviour in MOHID Studio (Figure 7-13). When finished the user may check the log to verify if the simulation completed successfully.

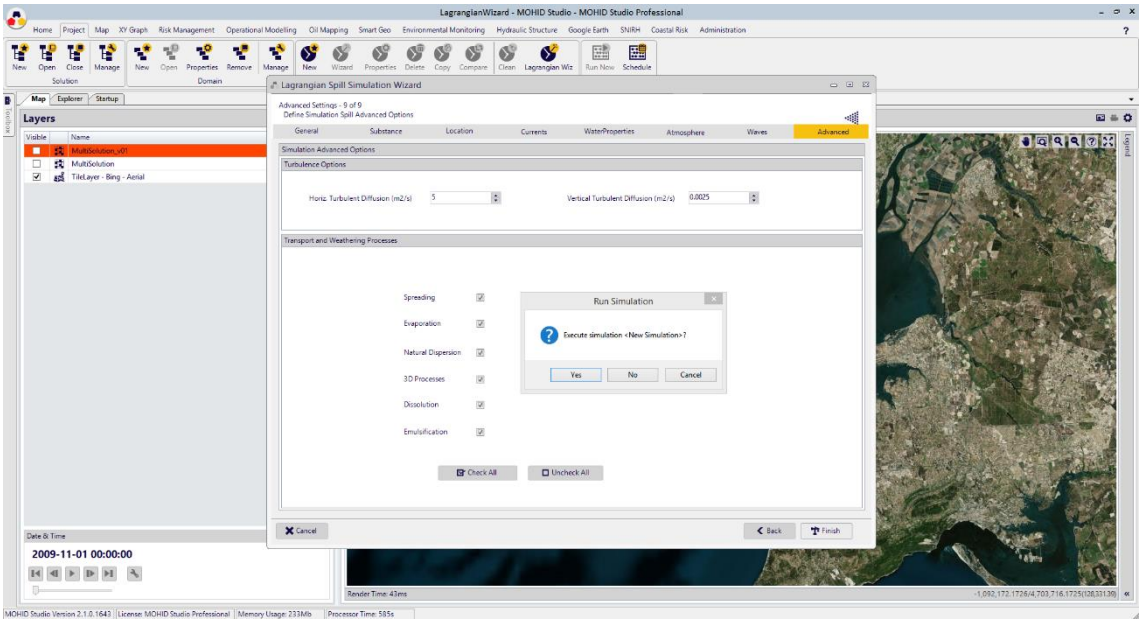


Figure 7-12: Simulation prepared. Run simulation now?

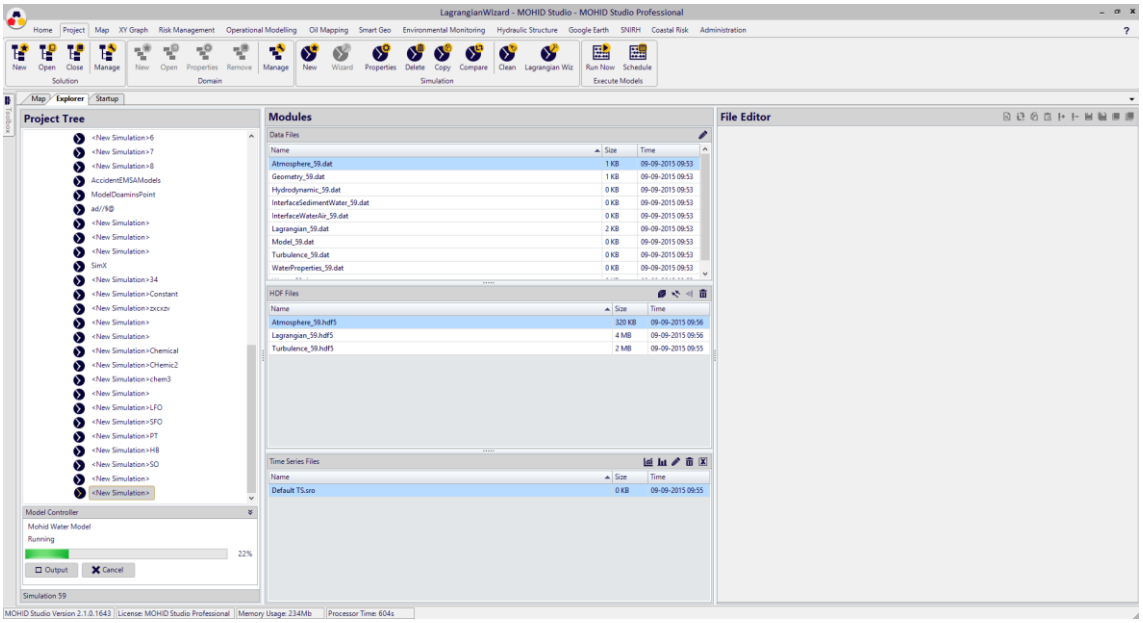


Figure 7-13: Simulation running in the background (lower left)

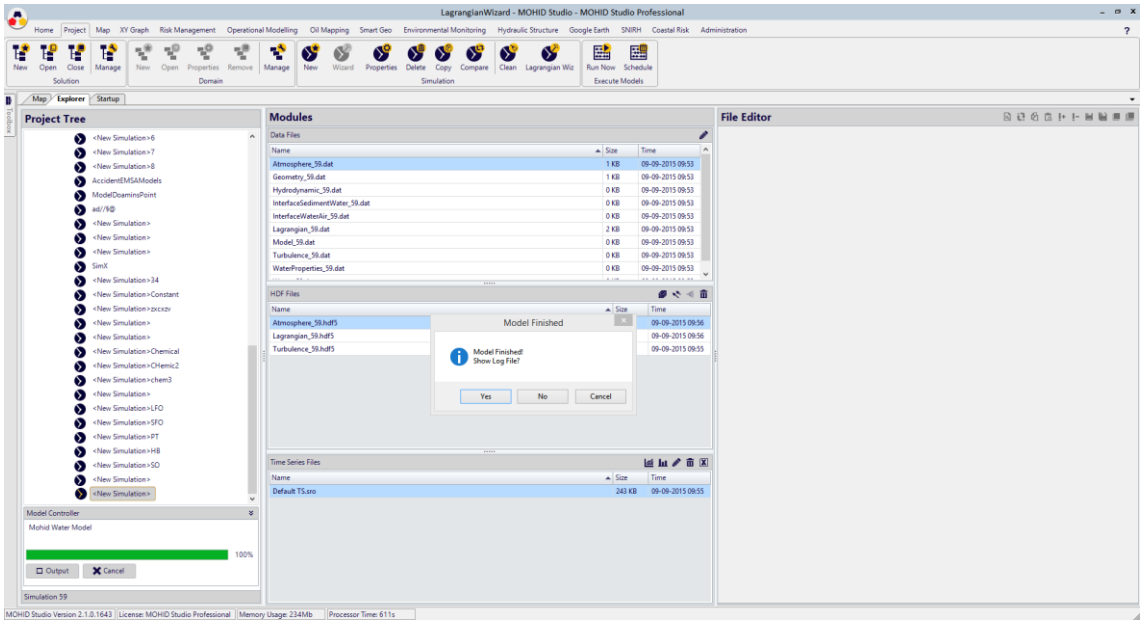


Figure 7-14: Simulation finished.

7.9 Exploring the Lagrangian Results

In order to explore Lagrangian results a new tool was created so that the visualization of the spill results could be straightforward for a first-time user.

The tool is present in Toolbox (Figure 7-15) under “Visualization -> Lagrangian Results” and double clicking opens the tool window.

When a simulation is selected, the tool shows the available lagrangian particle and eulerian results (grid results) - Figure 7-16.

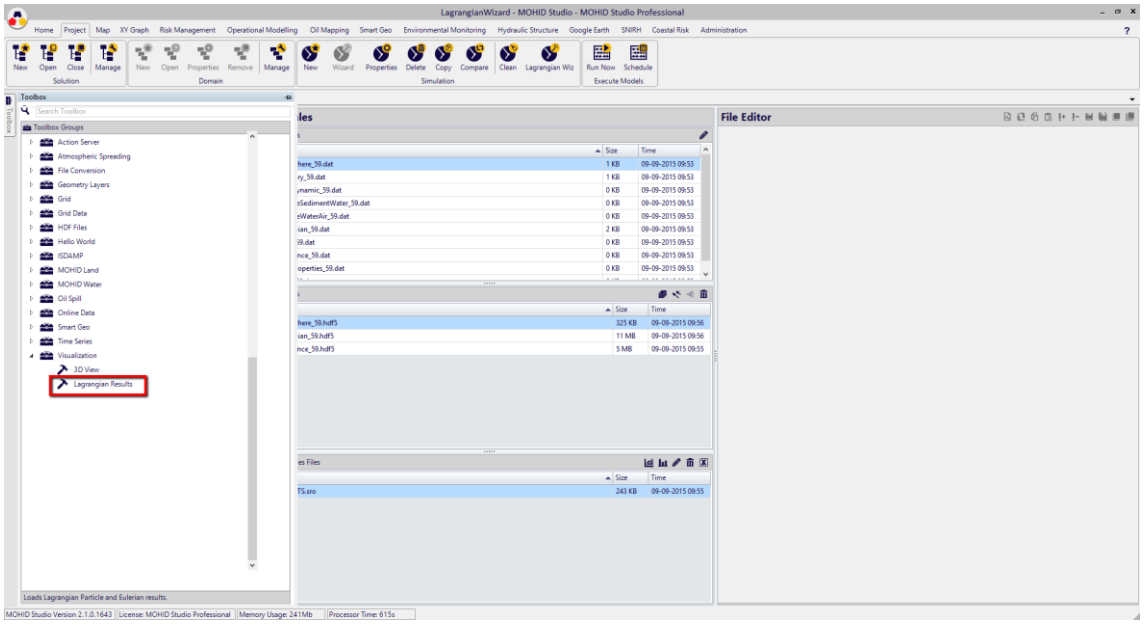


Figure 7-15: Lagrangian Results tool in MOHID Studio

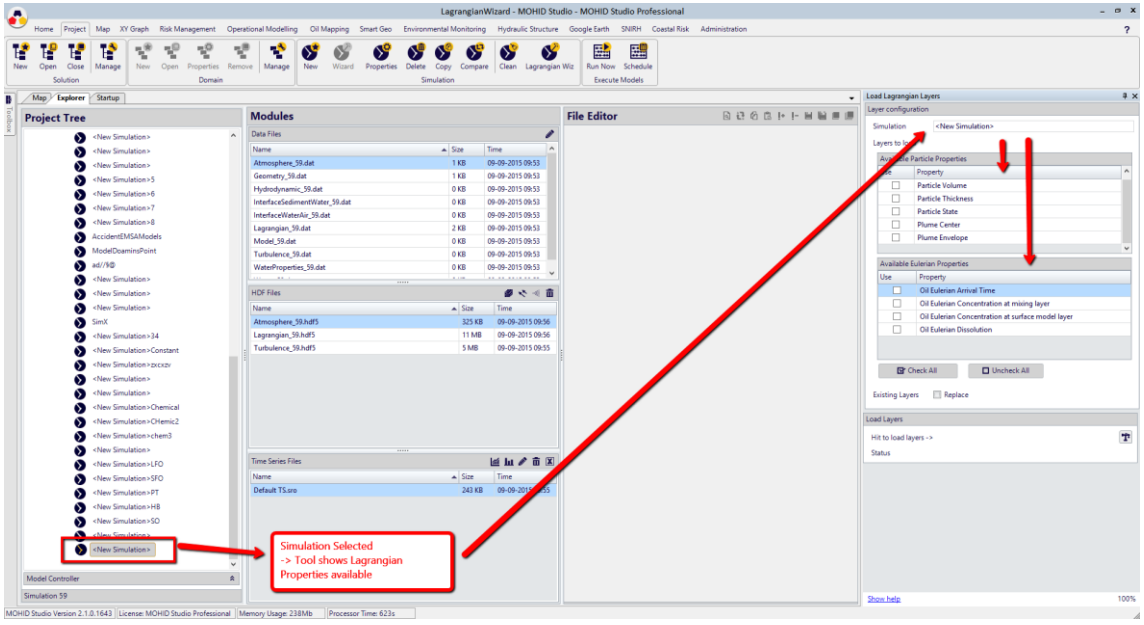


Figure 7-16: Lagrangian Results tool when a simulation is selected.

The lagrangian results are displayed trough a “friendly” name (as opposed to HDF names that sometimes are not very explicit) to help on deciding the properties to plot.

By selecting properties to plot and pressing “Process” button, the selected layers will appear on “Map” tab on the same order as the selected lists.

The plume “center of mass” and plume envelope plotting was a feature also added to MOHID Studio through the use of the tool, since this info is not directly available from the MOHID results in HDF. As an example is shown the plume center position, the center line and plume envelope and particles for a given oil spill in Figure 7-17. The center position is plotted every instant and represents the plume “center of mass” at the instant. The center line represents the line connecting the center position of the plume for all instants, and the plume envelope is plotted every instant as the polygon containing all particles.

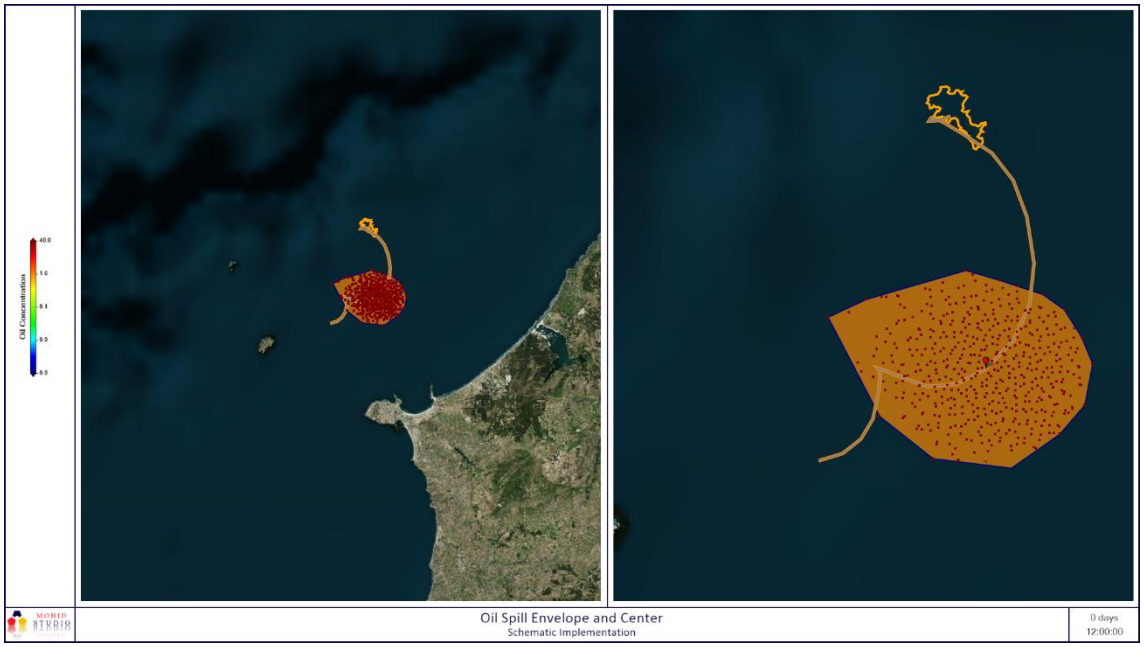


Figure 7-17: Result of Plume Center and Plume Envelope from tool Lagrangian Results.

8 WMS Server Demo Website

A Demo website - http://arcopol.actionmodulers.dtdns.net/ - was developed to illustrate the WMS server components implemented, in association to the Dynamic Risk Tool upgraded in ARCOPOLplatform.

Different data layers can be distributed via WMS, including vessel positions, vessel accident risk, shoreline contamination risk and metocean model outputs. These different layers are shown in the demo website (Figure 8-1) and can be configured using MOHID Studio.

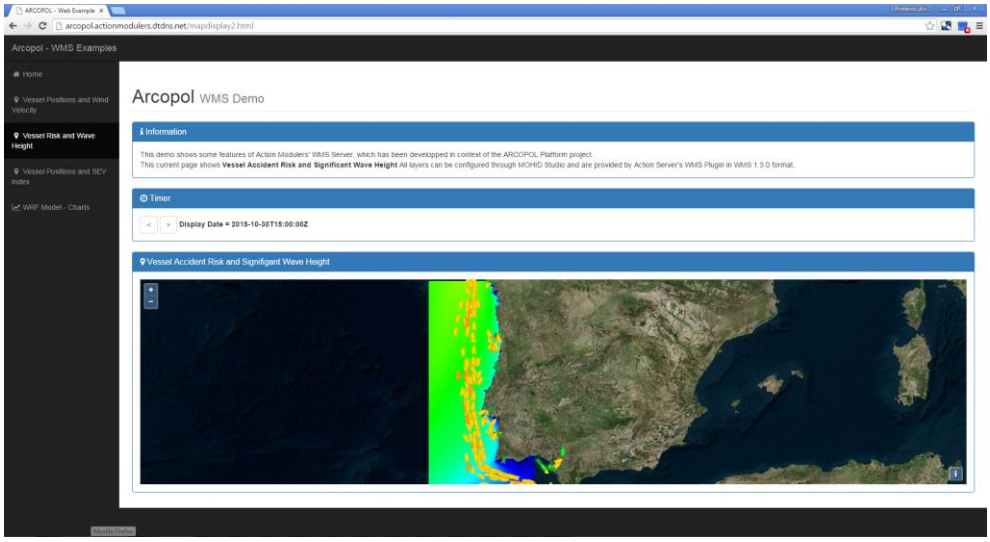


Figure 8-1: WMS Server demo website opened in browser in standard PC

Since the developed website is web responsive, it is easily adaptable to mobile platforms like tablets and smartphones (Figure 8-2).

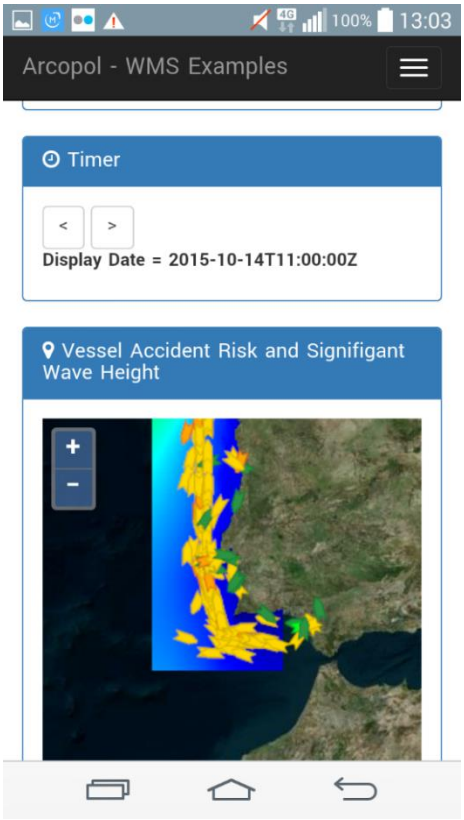


Figure 8-2: WMS Server demo website opened in browser in Android smartphone

9 Implementation Methodology / Transferability to Other Regions

As already mentioned, this application was initially implemented in the Portuguese Coast, with the aim to test it initially, and then adapted to the Galician Coast.

All the developments were performed having in mind the purpose of generalization and minimization of the effort needed when transferring the tool for other regions.

The effort needed when transfering the tool is to proceed with some minor adaptations in the tool and with some compilation of different data layers from the regions interested.

A description of this requirements and adaptations is presented below.

9.1 Vessel Information / AIS data

This type of information can be obtained from several different web services. One data provider must be chosen, and then a parser needs to be built and connected to Action Server, in order to allow the automatic download of the information and the subsequent storage in the database. The programming of the parser becomes easier if data is provided in a structured format, like xml or kml (Google Earth) files.

At the moment two different parsers from global data provides are included – AISHub.net and MarineTraffic.

Nevertheless, it is also possible to provide AIS data directly from specific AIS stations, without using any global AIS data provider. This feature was not tested nor implemented, but it is a possibility for future implementations.

9.2 Metocean Data

To apply the DynamicRiskTool (with CoastalRisk + Lagrangian Wizard) to a specific region, metocean numerical model results should be available to download, for the

determination of probability of accidents, and also to feed oil (or HNS) spill modelling system.

Parameters needed are: currents velocity fields and water temperature (hydrodynamic and water properties model in the water column); 10m wind velocity fields, surface air temperature, visibility (meteorological model); significant wave height, and wave period (wave model).

The less common property provided is visibility. If it's not available, the effect of this factor in the probability of an accident will be neglected. If the hydrodynamic and water properties results only provide surface fields, oil spill model will be simulated with the surface velocity only, reducing the liability of the oil spill model results for substances with tendency to entrain in the water column and transport in subsurface layers.

By default, DynamicRiskTool is able to download remote files from the web (ftp protocol), importing files in HDF5 format. However different downloading services were already prepared to download models from THREDDS / OPENDAP or even Copernicus Marine Services.

Anyway, although the inclusion of new types of metocean model data sources can be theoretically accomplished with relative small effort, previous experience has shown that each new data source must be carefully evaluated in order to ensure a seamless automatic download and integration with MOHID oil spill model and risk tool.

9.3 Coastal Vulnerability

The shoreline contamination risk needs an environmental sensitivity index and a socio-economic sensitivity index, in order to adequately quantify the shoreline impacts of potential spills from vessels. Ecological index can also be included, if available. This index was also integrated in the tool, although there is no information on this item for the Portuguese coast (however Galician region has this layer available).

These indexes were obtained for some partners in previous European projects (EROCIPS), and without any quantification of the coastal vulnerability, there is no possibility to understand how serious a potential oil spill can affect the shoreline.

Although the same methodology of quantification of the coastal vulnerability / sensitivity indexes is recommendable, this is not mandatory – however, if a different scale is defined for any index, the risk levels will have a different scale, and the end-user should take that into account. Changes in the coastal vulnerability scale will result in a change on relative weight on this parameter in the shoreline contamination risk. Additionally, these changes will also reduce the possibility of comparing risk levels between different regions.

Since the coastal vulnerability indices obtained for the Portuguese and Galician coastlines are compiled in a kml (Google Earth) files, a parser to import those data was programmed. Different parsers can be developed for different data formats, but if the coastal vulnerability indexes applied in other regions keep the same structure already used in the Portuguese and Galician coastlines, the process of importing this information will be straightforward. The structure used for the coastal vulnerability in the Portuguese coastline can be seen here: http://arcopol.maretec.org/CoastalAtlas/AtlasCosteiro_PORTUGALCONTINENTAL_Netlink.kmz

9.4 Probability of Accidents: Frequency Constants and Multiplying Correction Factors

The quantification of the probability of an accident determined by DynamicRiskTool is based on statistical values and correction factors that derived from previous studies and analysis of ship traffic accidents (most of the values and methodology used was built in EROCIPS project).

The used values can be changed, to reflect regional statistical background of accidents with ships.