Interreg North-West Europe SURICATES

European Regional Development Fund

WP T1 Deliverable 1.1. Sediment management GIS add-on development and testing

Partners Involved in this activity

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SUMMARY

INTRODUCTION

This deliverable T1.1.1 is one of the three reports of activity 1 of work package T1 of the SURICATES project. The objectives of Activity 1 were to develop a method for assessing social risk and prioritising opportunity to increase the acceptability of sediment reuse in projects. This activity was divided into three parts:

- Development and testing of an add-on to the GIS based on the CEAMaS outputs ready for use. This sediment management GIS system will be available for use and application by Port Authorities (Deliverable T1.1.1, this report).
- Implementation of the GIS add-on within ports/waterways using local real field data to identify territories of maximum attractiveness and social acceptability; pilot port sites in North of FR and South of IE, Port of Rotterdam and SC as dissemination sites (Deliverable T1.1.2 not this report).
- 3 locations with potential for new sediment use opportunities will be identified within the four NWE regions (North of France, South of Ireland, Bowling river site in Scotland and Netherlands) using field tested and validated GIS (Deliverable T1.1.3 not this report).

To achieve the objectives set by this activity T1.1.1, it was decided to develop an open source application using QGIS. The aim was to offer a free GIS solution for stakeholders in charge of sediment management. This tool, called RAIES (Repulsion, Attraction, Inclusion, Exclusion, Sanctuarisation), is a complete reworking of the GIS processing method used in the CEAMAS project, for a number of reasons:

- The RAIES GIS application works as an extension to the free GIS software QGIS. In the CEAMAS GIS method, there was no dedicated tool and the GIS software used (i.e. ArcGIS) was not free software, which meant that the end user had to pay a high cost to implement the methodology.
- The RAIES GIS application offers more options for processing territorial constraints than the CEAMAS GIS method. It provides a better description of the spatial constraints influencing the acceptance of local stakeholders and hence decision-making on the implementation of solutions for reusing dredged sediments.
- The RAIES GIS application makes it possible to process all the geographical data selected by a local stakeholder in a single calculation stage. In the CEAMAS GIS methodology, it was necessary to process each layer of geographical data separately and then assemble them manually in ArcGIS software.

In many respects, the RAIES application developed in activity 1 of work package T1 of the Suricates project is a new tool enabling better modelling of territorial constraints and thus contributing to greater acceptability of the reuse of sediments from dredging by locating potential sites which, according to local stakeholders and decision-makers, are most likely to be accepted by the stakeholders and inhabitants of any area of interest.

1 RAIES APPLICATION

1.1 GENERAL DESCRIPTION

- RAIES is an extension planned for version 3.10.9 of QGIS (Long Term Release) and can be downloaded in the repository here. https://download.qgis.org/downloads/
- The RAIES extension is delivered in the form of a .zip file available from the repository: https://github.com/CDI-Tech/QGIS-RAIES.
- The identification and resolution of bugs already identified can be accessed at the following address: https://github.com/CDI-Tech/QGIS-RAIES/issues.
- The RAIES application was developed on a theoretical and conceptual basis as part of Eric Masson's research activities (https://www.researchgate.net/profile/Eric-Masson-2). This work has mainly been carried out since 2008 (ANR SEDIBET 2008-2011) on the location of a treatment plant for polluted sediments from dredging of inland waterways in the Nord-Pas-de-Calais region (Hauts de France region since 2016) and continued on the theme of reuse of sediments from port dredging as part of the Interreg NWE CEAMAS (2013-2015) and SURICATES (2017-2023) projects.
- The RAIES extension coding using python language was developed in Python by Vincent Majorczyk in 2020 (https://www.linkedin.com/in/vincentmajorczyk/?lipi=urn%3Ali%3Apage%3Ad_flagship3_feed%3BcBKV%2FjGxRH%2BBwA8k716Xjw%3D%3D) on behalf of CDI-Technologies (https://www.linkedin.com/company/cdi-technologies).
- The RAIES extension was funded under an external expertise contract of the Suricates NWE Interreg project (2017-2023). https://interreg-suricates.univ-lille.fr/
- This QGIS application was released under the open source license GNU-General Public License 3 (gpl-3.0.md).

1.2 RAIES MODEL PRINCIPLES

- The RAIES model is a spatial decision-making tool that comes with a questionnaire for making a spatial decision about the location of a site or the analysis of spatial constraints. It is a generic tool that does not answer a single decision-making question but allows the spatial dimension of constraints relating to a combination of geographical data parameterised by the end user to be explored with a contribution from a participant.
- We distinguish the user of the RAIES model from the participant in the modelling when the latter does not use the model under QGIS. The participant is therefore an individual who restores a territorial decision rule in response to a question asked by the user about the relevance and importance of geographical data for territorial decision-making.
- The RAIES model is therefore based on a catalogue of GIS data collected by the end user. It is always possible to add or remove data according to each user or participant. The catalogue of geographical data used by the RAIES model is therefore open, which means that as many

territorial responses can be generated as there are individual points of view on a given question.

- The end user can therefore compose his catalogue of geographic data according to the question asked. They can also simply select all or part of their catalogue according to the relevance of the data to the question posed. This selection of data therefore depends on:
- prior knowledge for regional decision-making (experts in the field)
- preparatory work to gather geographical information in conjunction with the various stakeholders in an area, with a view to a participatory approach.
- Dependent on an individual rule to help decision-making. The geographic data catalogue is therefore not limited in number of geographical layers, and can vary from one user/participant to another.
- In the case of a participatory approach (i.e. several participants) several different points of view can be modelled or compared with different selections of geographical data.
- As part of the Suricates project, two questions were asked to help with territorial decision-making:
    - Question 1: In your opinion, what are the geographical constraints on the siting of a dredged material storage site?
    - Question 2: What do you think are the geographical constraints on the reuse of dredged material in applications that comply with environmental regulations?
- The geographic data used by the RAIES model must be exclusively in the shapefile vector format (*.shp) which is a standard format, interoperable with many GIS software and many geographic data infrastructures publishing open data. It is the standard format for the free software QGIS and also for the proprietary software ArcGIS.
- Users wishing to use geographic data in other digital formats (e.g. MIF-MID, GeoJSON, etc.) must first convert them to shapefile format before opening them in QGIS.

2 USING RAIES MODEL IN QGIS

2.1 OPEN THE QGIS EXTENSION AND CREATE A NEW RAIES PROJECT

The RAIES model is a QGIS extension. It must therefore be installed the first time it is used:

- Open QGIS 3.10 then upload the RAIES Model from: Menu Extensions > Install/Manage extensions > then navigate on your computer to the folder where the RAIES model zip file is located. Follow the QGIS instruction to install the extension.
- Once the extension is installed you will need to launch RAIES model at every working session using the following path: Menu > Extensions > RAIES > RAIES (see Figure 1).

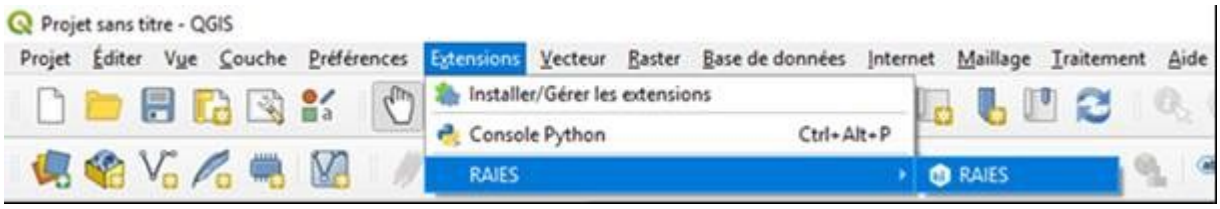

Figure 1: Install/launch RAIES extension in QGIS

- The RAIES extension opens in a settings window on the right (see figure 2)

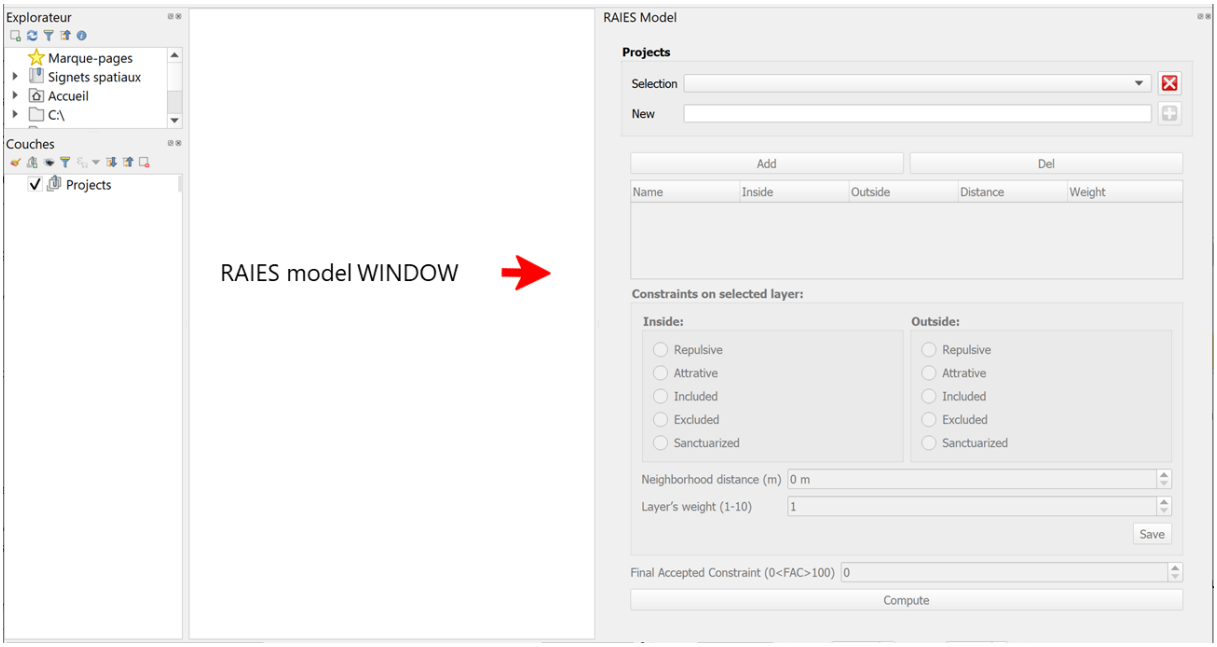

Figure 2: RAIES settings' window

- In this settings window, you first need to create a new project (i.e. "Demo" in this example). To do this, first enter the project name in the "new" dialogue box and then click on the "+" icon. In the QGIS layer explorer, on the left, you will see the "Demo" project and the "project_config" sub-project. The RAIES model dialogue box changes colour to white and the name of the "demo" project appears in the "selection" drop-down menu.

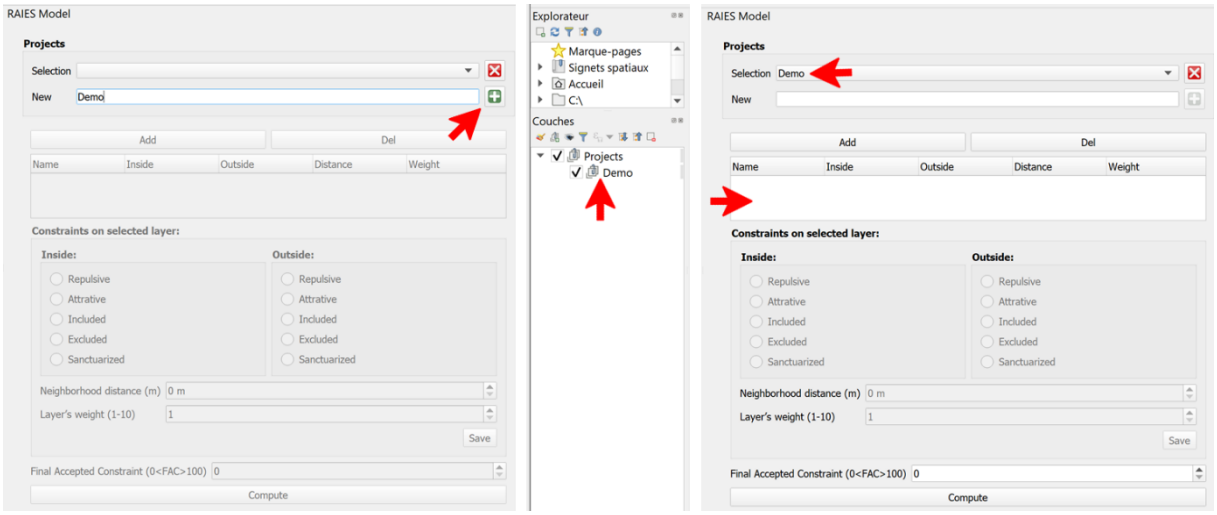

Figure 3: Creating a « Demo » project in the settings' window of RAIES model

2.2 BUILD YOUR GIS DATA CATALOGUE FOR YOUR PROJECT

Once the project has been created, it is necessary to load geographic data in shapefile format into QGIS:

- Use drag and drop from a folder containing all the GIS data. You can also use: Menu > Layer > Add vector layer.

In the explorer, the geographic layers must be placed above the 'Projects' level (see figure 4). Once the data has been selected and loaded into QGIS, it needs to be added individually to the project using the 'Add' button in the RAIES extension.

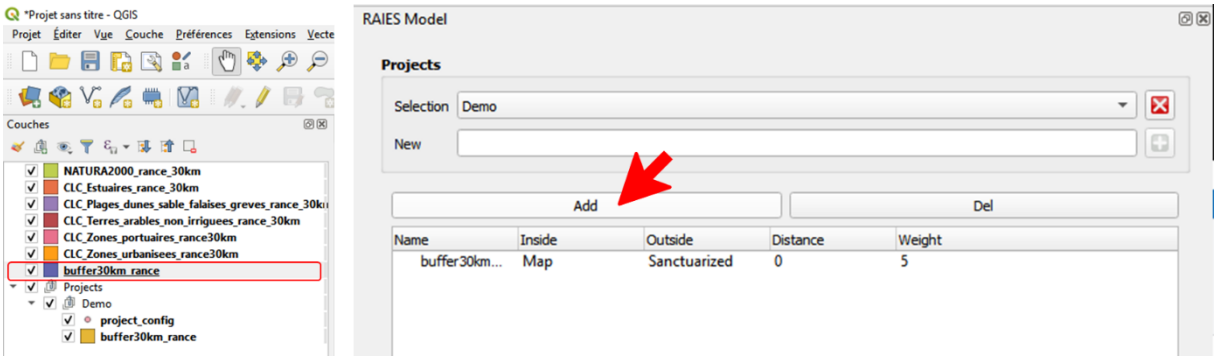

Figure 4: Loading a new geographical layer in the RAIES model

The first layer loaded (buffer or outline or other) must include the word "Map" in the "Inside" attribute (figure 5). It is not possible to modify the parameters, which is normal (see figure 5).

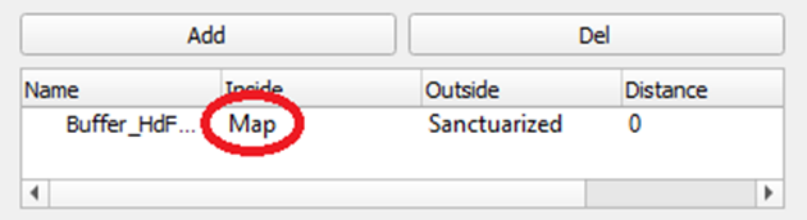

Figure 5: Your first layer is your computational spatial extent. It must be tagged as « Map » in the project layers list.

The other geographic information layers are added in the same way (select the layer in Explorer > Add in the RAIES panel) in the desired order (figure 6). Ideally, you should add only one layer at a time, set its parameters and then move on to the next layer.

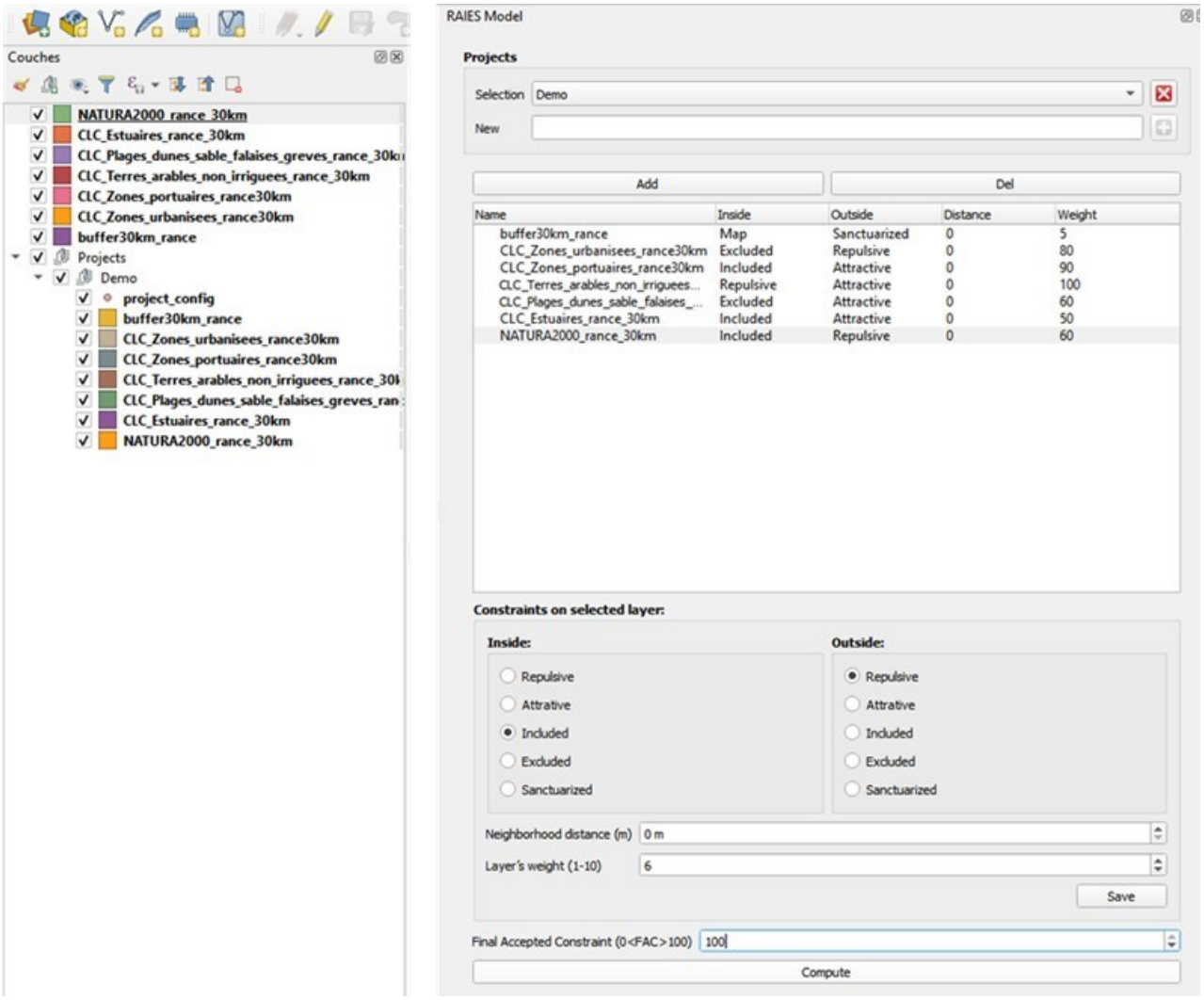

Figure 6: Uploaded layers in the RAIES model. Note that these layers are already setup in this screenshot.

2.3 Selecting spatial constraints in RAIES Model

The RAIES Model is a spatial decision support system based on the principle of weighted sum (1 weight per layer) and standardisation (0-1) of the calculation result to enable comparisons and statistical calculations between several results from several questions or several participants/users on the same territory. Several spatial constraint elements are available for each geographic layer:

- Step 1 Inside: used to set parameters inside a type of geographical space, i.e. inside forest vector objects.
- Step 2 Outside: used to set parameters outside a type of geographic space, i.e. outside forest vector objects

Inside and Outside must be filled in. If a user cannot set a constraint among those proposed (Inside/Outside) for a geographic layer, this is tantamount to considering that the geographic dimension of this layer cannot participate in territorial decision-making.

There are 5 possible options for setting the inside and outside parameters for a geographic layer (see figure 7). Each user of the model can choose one of the 25 possible Inside/Outside combinations (see

figure 7). These combinations can vary from one geographic layer to another and from one user to another according his/her viewpoint.

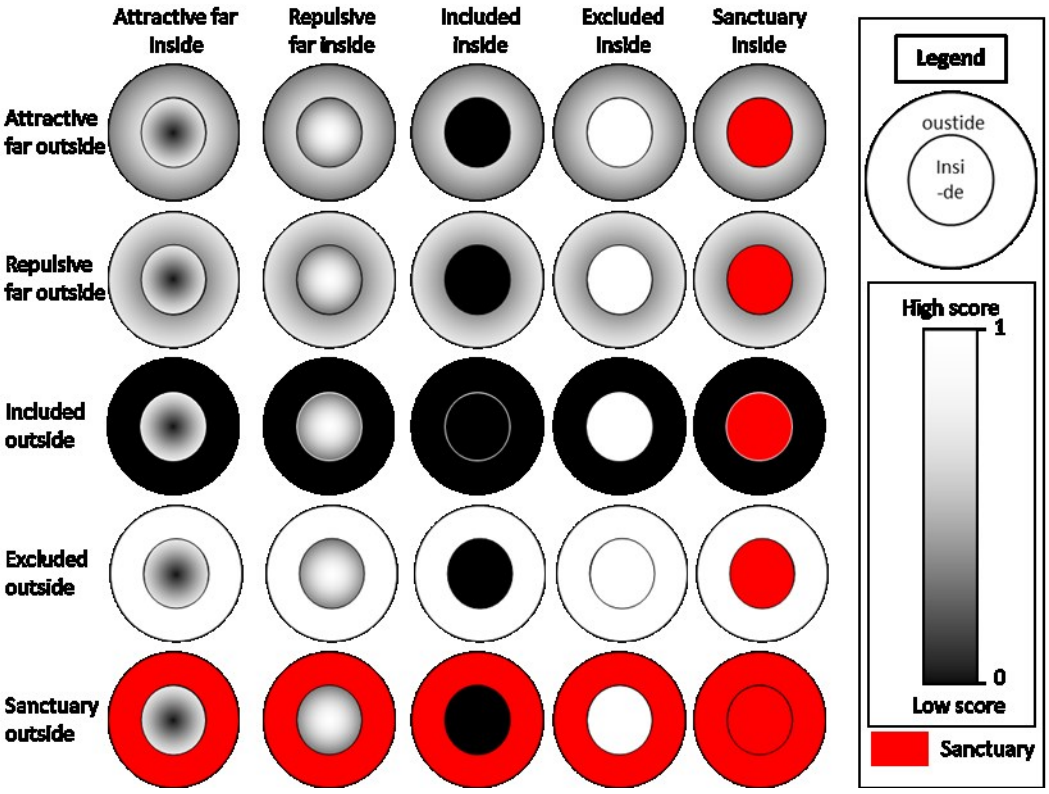

Figure 7: Spatial constraints options for Inside and Outside cases

- Step 3 Neighbourhood distance (m) is an optional layer extent for spatial calculation (see figure 8). When set to zero (default setting) the calculation is limited by the spatial extent given by the first geographical layer loaded in the model (Map value for the Inside and Sanctuarized for the outside see figure 6).

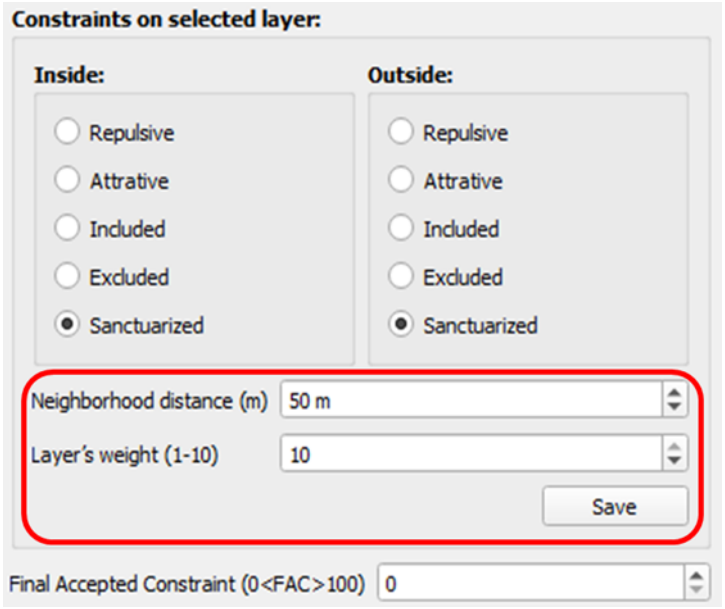

Figure 8: optional steps 3 to 5 for RAIES model calculation

- Step 4 Layer's weight is the relative value (Min = 0 & Max = 10) for the selected geographic layer (see figure 8).
- Step 5 Save button must be clicked to enter each layer's settings in the RAIES model (see figure 8).

Repeat steps 1-5 with each selected layer in order to setup the spatial decision support. When all selected layer settings are saved please proceed to the last steps.

- Step 6 Final Accepted Constraint (0<FAC>100) is an option to extract values under a certain threshold value in the final map (default setting is 100). This parameter act as a lowpass filter. All pixels above the FAC value are rejected. Because final map results are real numbers ranging from 0 to 1: a 1 FAC value = 0.01 lowpass threshold in the map result & a 99 FAC value = a 0.99 lowpass threshold in the map result. If you choose the "100" default value (recommended) you can still manage your map result in a raster calculator tool.
- Step 7 Compute Button is the final step before RAIES model map result. Don't forget to check before computing that all selected layers are properly parametrized (see figure 8).
- Step 8 When calculation is finished a pop-up window is proposing to save temporary files (i.e. one couple of files per geographic layer selected. If you choose « Yes » please make sure your storage capacity is sufficient in case of very large data sets other a vast territory.

The results of the calculation appear in the form of raster files displayed in the QGIS map window. They are also saved by default in the C: Documents folder. The name of the result raster (final weighted sum calculation) begins with the suffix "threshold".

2.4 KNOWN ISSUES

- By necessity, you must have an administrator access to your computer or writing rights to the C: drive which is used by the RAIE extension for model calculations.
- If, after launching the calculation, the operation fails and QGIS indicates Error: Rasters creation failed:
    - Check that a map layer has been loaded into the plugin (contour, buffer etc.).
    - Check that the data added is in the same projection system as the Map layer.
- For any other bugs encountered, please submit an error report to the following address: https://github.com/CDI-Tech/QGIS-RAIES/issues.

CONCLUSION

The RAIES model is an open source spatial decision support system tool aimed at mapping the value of decision makers, experts, stakeholders and citizens when asking them about siting any territorial facility or land application that may involve different level of acceptance. Each single map displays a complex value combined according to one's vision to answer a question of « according to your very own values, where should we place [...] in your area of living/business interests ». [...] remains open to any case if you have at least one geographical information layer within a territorial boundary, both in a shapefile format.

In the Suricates Project the RAIES model has been used with ports/waterways managers/experts, public services experts, local stakeholders, politicians and NGO's mainly in France but also in Ireland, Scotland and The Netherlands. These results are presented in deliverables T1.1.2 and T1.1.3.

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Note that these references are reflecting the evolution of the RAIES model and its thematic applications since its first steps in the National Research project ANR SEDIBET, starting from 2007. Most of these references are in French and are extracted from Eric Masson's ResearchGate profile https://www.researchgate.net/profile/Eric-Masson-2.

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