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1. Location of tool

The toolbox can be downloaded from <https://github.com/MvT19/SPACEA>.

2. Introduction

The SPACEA tool package contains the ArcGIS toolbox called 'SPACEA'. The toolbox can be accessed from ArcMap after download. The toolbox contains the following tools:

- Buffer Marine Uses (Python script 'BufferMarineUses.py'): The tool can be used to create multiple buffer zones around multiple vector layers.
- Raster Creation (Python script 'RasterCreation.py'): Can be used to create raster layers from multiple vector layers based on the presence and absence of features in one area.
- Environmental Thresholds (Python script 'EnvironmentalThresholds.py'): Can be used to analyse raster data with regard to a threshold; it creates output raster with value of zero and one above/below the threshold.
- Suitability Function (Python script 'SuitabilityFunction.py'): Can be used to analyse raster data with regard to a continuous linear suitability function; it creates output raster with values between zero and one.
- Suitability Analysis (Python script 'SuitabilityAnalysis.py'): Can be used to combine multiple raster layer with the geometric mean and creates output raster with values of zero and one or between zero and one, depending on the input raster.

The metadata for the tools is included in each script and can be viewed after download and installation in ArcMap through the tool window and item description.

3. Installing requirements

In order to use the toolbox, ArcMap needs to be installed with a basic and Spatial Analyst licence. The toolbox was developed and tested using ArcMap version 10.5 and Python version 2.7.12.

4. The SPACEA tools – examples with HELCOM data

SPACEA contains 5 different custom-made tools. Each tool comes along with metadata description and script examples using example data from HELCOM. The example data can be found in the Data_examples.zip folder. The zip folder contains a folder HELCOM_data, which offers shapefiles and raster from the HELCOM Map and Data service (<https://maps.helcom.fi/website/mapservice/>). Metadata for each file can be accessed in ArcMap through the files' item description. The results folder contains the results from running each tool on the HELCOM data. The mxd file within the zip can be used as template to open the layer package and view the input data and result files.

BufferMarineUses tool, required input: shapefile(s), buffer distance (in meters)

The Buffer Marine Uses tool was used to create a 500 m buffer around the wind_turbines.shp and a 200 m buffer around the Cables.shp (Figure 1). The results are wind_turbines_500mBuff.shp and Cables_200mBuff.

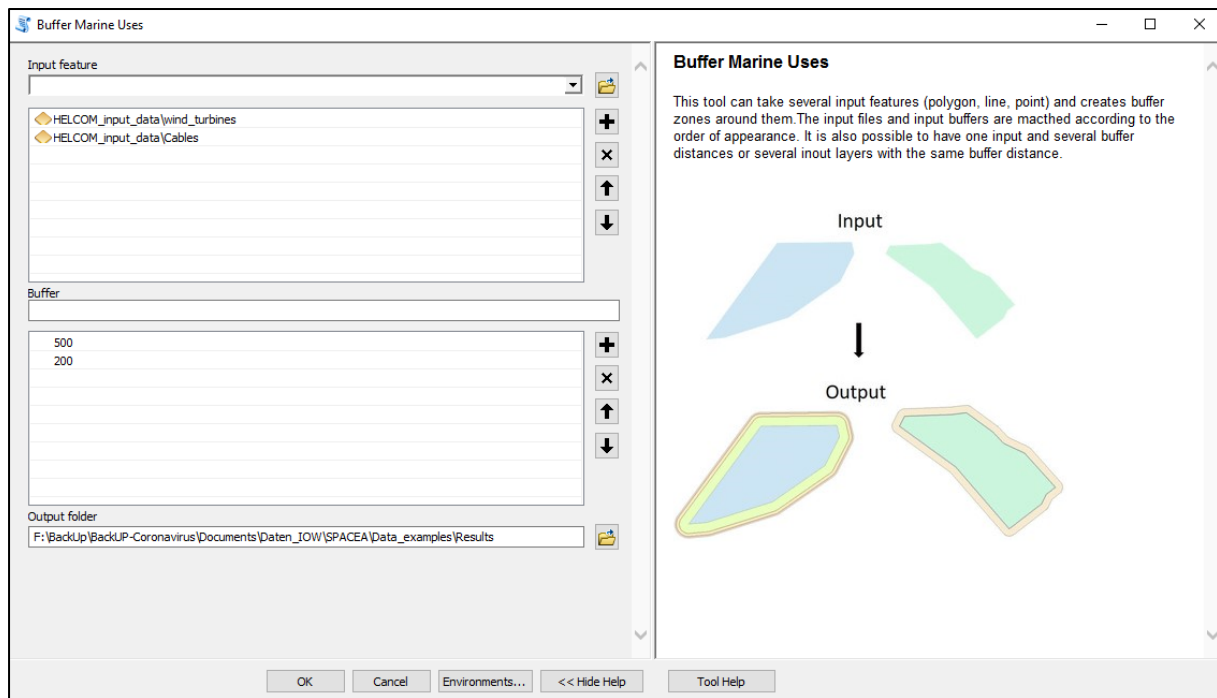


Figure 1: ArcMap tool window of the tool 'Buffer Marine Uses'.

Raster creation tool, required input: shapefile(s), study area polygon, cell size

The Raster Creation tool was used to turn the wind_turbines_500mBuff, Cables_200mBuff, and HELCOM_MPAs into raster layers (Figure 2). The results are RCreawind_tu, RCreacables_, and RCreahelcom_.

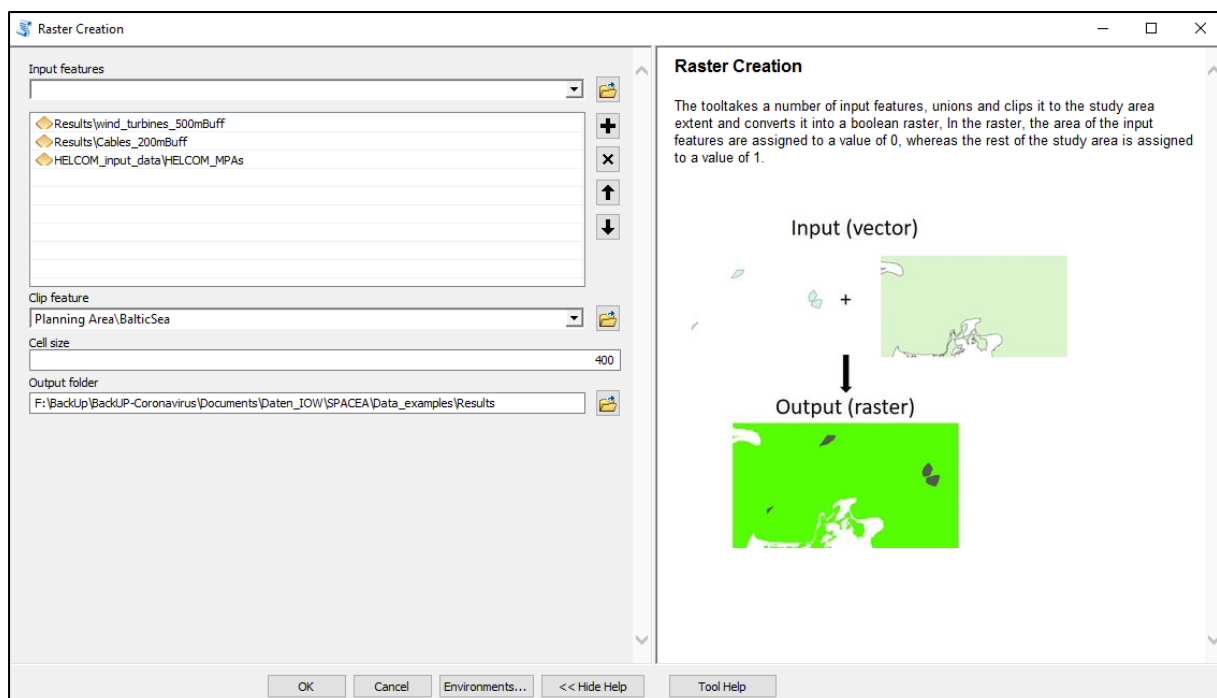


Figure 2: ArcMap tool window of the tool 'Raster Creation'.

Environmental Threshold tool, required input: raster, threshold

The Environmental Thresholds tool was used to define areas below 0.02 m/s bottom current speed as not suitable for certain marine uses (raster input: BottomCurrents.tif) (Figure 3).

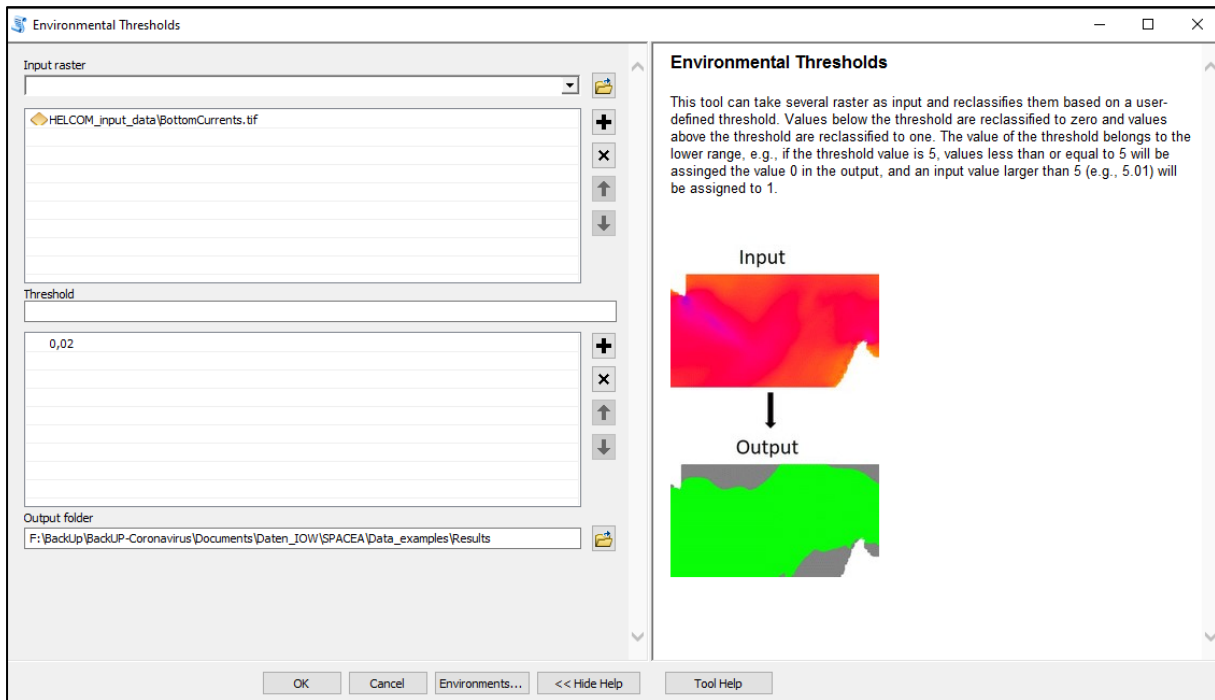


Figure 3: ArcMap tool window of the tool 'Environmental Thresholds'.

Suitability Function tool, required input: raster, suitability range

The suitability Function tool was used to define an increasing suitability with increasing salinity levels in the Baltic Sea (raster layer: Salinity.tif) (Figure 4).

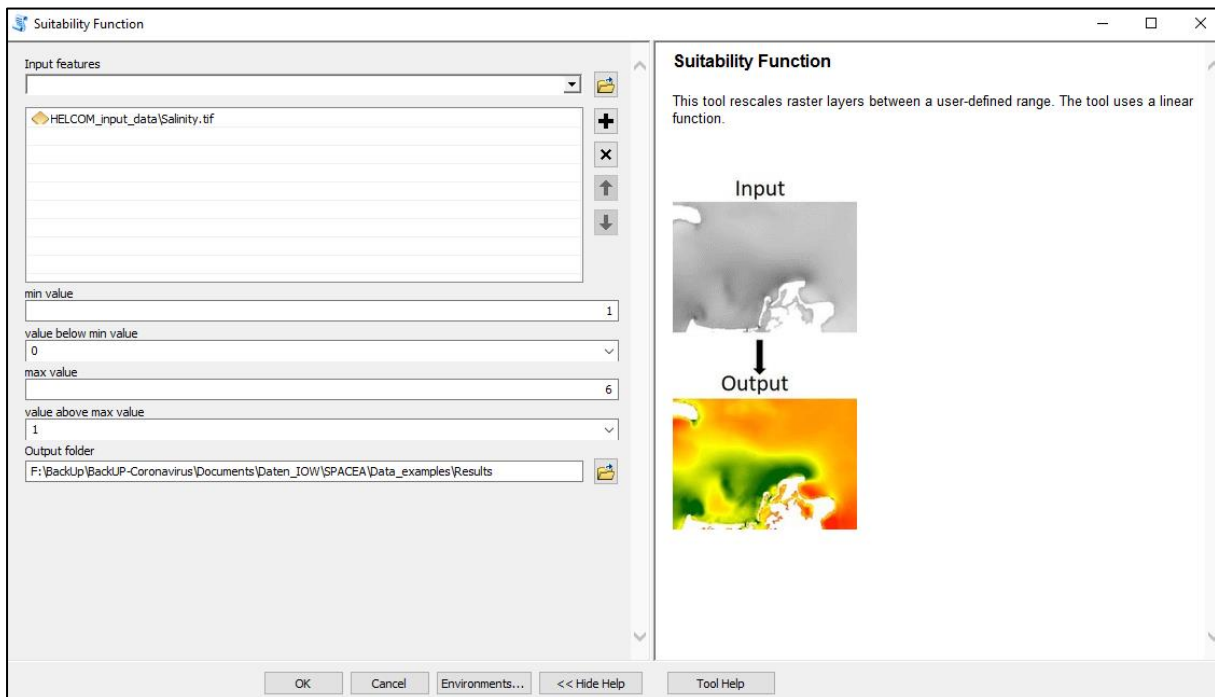


Figure 4: ArcMap tool window of the tool 'Suitability Function'.

Suitability Analysis tool, required input: raster layers

The suitability analysis tool was used to combine the layers Thresh_BottomCurrents_0,02.tif and SuitFunc_Salinity_1_6.tif into the raster SuitAnaly_environment.tif, and the layers RCrea_wind_tu, RCrea_Cables and RCrea_HELCOM_ into the raster SuitAnaly_marineUses.tif, and the raster SuitAnaly_environment.tif and SuitAnaly_marineUses.tif into the raster SuitAnaly_suitability.tif (Figure 5).

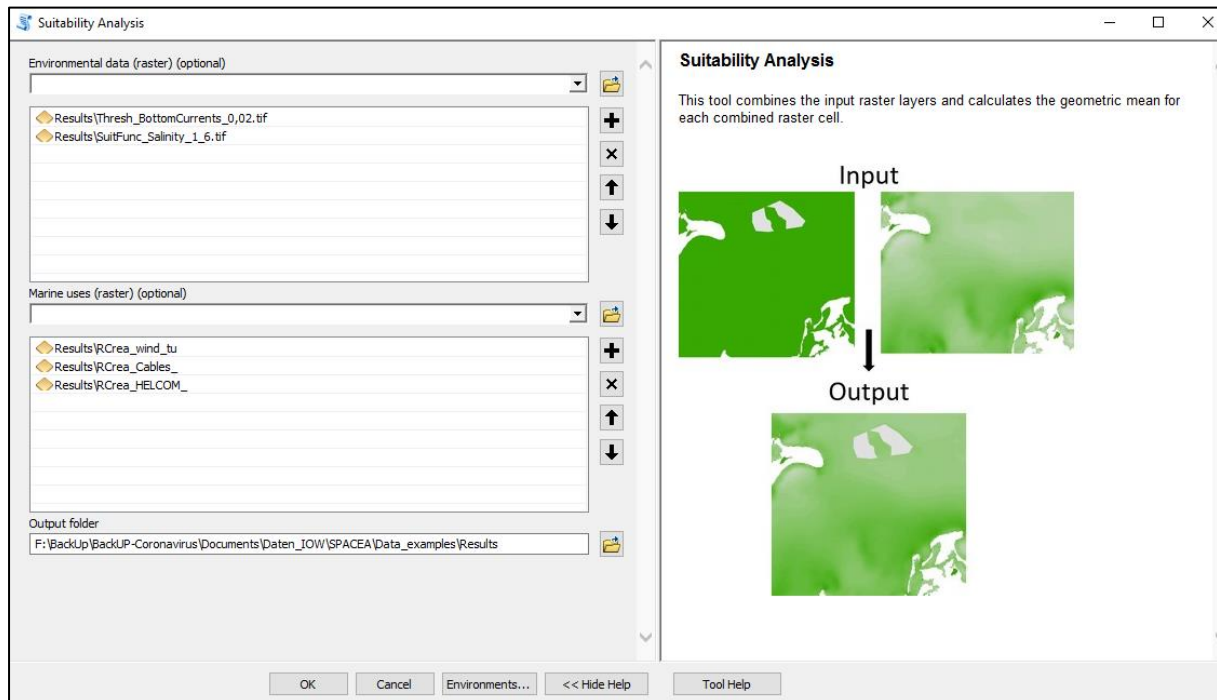


Figure 5: ArcMap tool window of the tool 'Suitability Analysis'.

Symbology

The folder Symbology.zip contains lyr files for each tool's output as well as an xml file that can be used to apply the symbology to all layers in an mxd file. The xml file needs to be opened and the text needs to be copy/pasted in the ArcMap Python window (Figure 6).

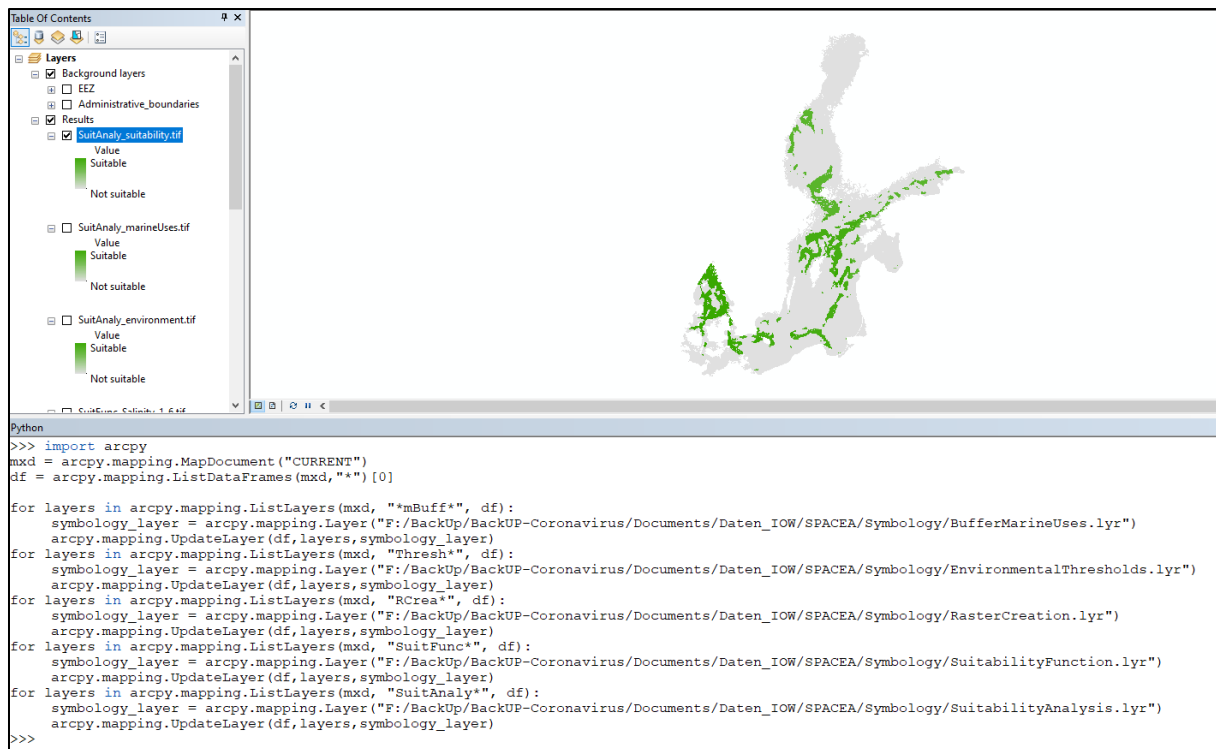
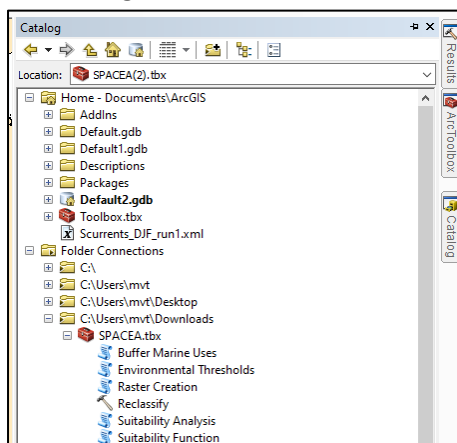


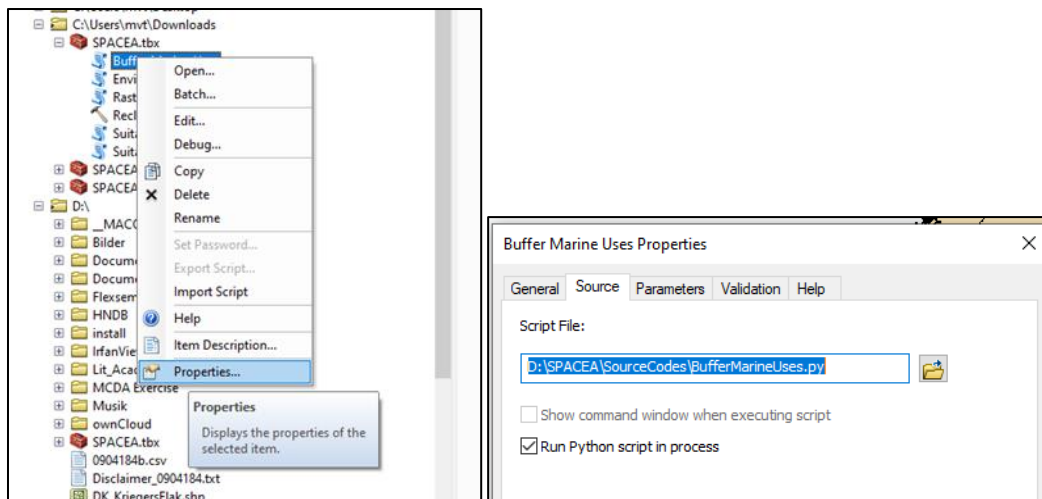
Figure 6: Applying symbology to the results layers from the ArcMap Python window.

5. How to set-up SPACEA

- Download the toolbox from <https://github.com/MvT19/SPACEA> (SPACEA.tbx). Download also the SourceCodes.zip.
- Open an ArcGIS Map document and browse to the location of the SPACEA toolbox in the ArcCatalogue window:



- In order for the tools to work, you need to connect them to the location of the source codes. Right-click on the tools, go to properties, and on the tab "source" browse to the location of the respective source code and click ok:



- If you want to apply symbology to the result, download & unzip the Symbology.zip and change the pathnames in the file AppySymbology.xml to the location of the Layer files (.lyr).
- If you want to run the tools from the command prompt, you need to download & unzip the Stand-alone_Scripts.zip and change the pathnames to the location of the SPACEA.tbx, your workspace (in this case, it needs to be geodatabase), and the folder, where the results should be stored.

6. Recommendation & words of caution

It is recommended to load the layers that should be analysed with the SPACEA tools into an ArcMap document (mxd). If they are not in an mxd, the layers need to be stored in a geodatabase in order for the tools to work.

The output names of the tools are created automatically. For the tools “Buffer Marine Uses”, “Environmental Thresholds”, “Raster Creation”, and “Suitability Function”, the output names are unique (being composed of the input layer name and input parameters). However, when running the tool “Suitability Analysis” the output names are always “SuitAnaly_suitability”, “SuitAnaly_marineUses”, “SuitAnaly_environment”. Therefore, it is recommended to store the results in different folders when you run the tool several times with different inputs (otherwise the results are overridden).