



HUGIN QGIS PLUGIN

HOWTO

Abstract

This is a short document describing how to use the HUGIN QGIS plugin. Please notice that current version is a prototype subject to bugs, errors and change.

Martin Karlsen & Anders L Madsen
mk@hugin.com, alm@hugin.com

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Introduction

This document is a short HOWTO on the HUGIN QGIS BBN plugin. It describes the process of applying the HUGIN QGIS BBN plugin on a set of raster layers by example. The example has kindly been provided by Hans Jørgen Henriksen (GEUS).

The basic principle of the plugin is to apply a Bayesian network to each point in one or more raster layers (must be aligned) and output a new raster layer with the results. For each point potential covering multiple layers, the Bayesian network inserts and propagates the values of the nodes linked to raster layers. The user can select a number of output values: index of state with maximum probability, probability of state with maximum probability, and maximum expected utility. Additional output values are to be included at a later stage.

The document and the HUGIN QGIS BBN are both work in progress.

Mac OS X

Pre-requisites

- QGIS with all its dependencies already installed.
- HUGIN 8.6 dmg image

Install

1. Mount the HUGIN 8.6 dmg image
2. Copy the 'HDE8.6-x64' folder to your Desktop (or some other location on the local disk)
/Users/<YOUR-USER-NAME>/Desktop/HDE8.6-x64
3. Copy the 'HUGIN_belief_update.py' found in 'HDE8.6-x64/tools/QGIS' folder to a place within .qgis2 folder in your home dir:
/Users/<YOUR-USER-NAME>/.qgis2/processing/scripts/HUGIN_belief_update.py

Launch

In a terminal execute:

```
$ export PYTHONPATH=/Users/<YOUR-USER-NAME>/Desktop/HDE8.6-x64/lib64
```

```
$ open -a QGIS
```

Windows

Pre-requisites

- QGIS with all its dependencies already installed.
- HUGIN 8.6 has been installed to <hugin-install>
(e.g. 'C:\Program Files\Hugin Expert\HUGIN 8.6 (x64)')

Install

1. Copy the 'HUGIN_belief_update.py' found in '<hugin-install>\tools\QGIS' folder to a place within .qgis2 folder in your home dir:
C:\Users\<YOUR-USER-NAME>\.qgis2\processing\scripts\HUGIN_belief_update.py

2. Configure PYTHONPATH environment variable:

- Browse through Windows Control Panel -> System and Security -> System
- Click 'Advanced system settings'
- Click 'Environment variables' button
- Under 'System Variables' section, create variable
 - Name: PYTHONPATH
 - Value: <hugin-install>\HDE8.6Python\Lib
 - (e.g. 'C:\Program Files\Hugin Expert\HUGIN 8.6 (x64)\HDE8.6Python\Lib')

Launch

Launch QGIS the regular way

How to Run the Example

The next few sections describe the use of the plugin starting with a set of pre-conditions.

Pre-conditions

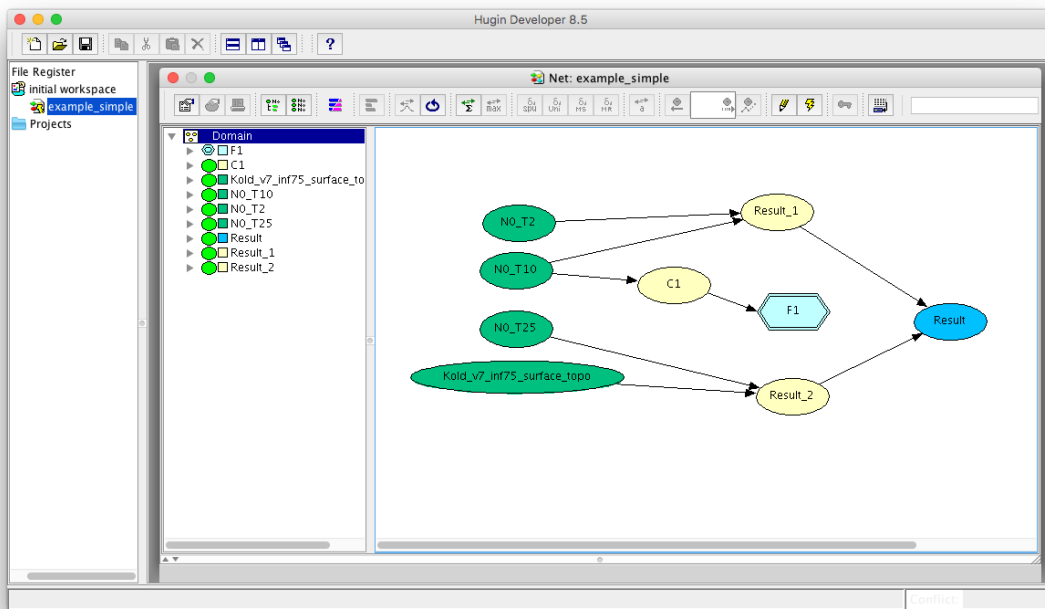
The following pre-conditions are assumed satisfied:

- Model
 - Model is created in HUGIN software in advance. The model used is: simple_example.net
 - Input and output nodes must be of type “interval”. That is, each node in the BBN linked to a value in a raster layer must be of type “interval”.
- Raster layers
 - The HOWTO document uses the non-normalized version of the example consisting of the files:
 - Kold_v7_inf75_surface-topo.asc
 - N-0_T10.asc
 - N-0_T2.asc
 - N-0_T25.asc
- Configuration of HUGIN QGIS BBN plugin
 - HUGIN initialization file: hugin_test.ini

The model is displayed in the HUGIN Graphical User Interface below:

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The content of the hugin_test_ini configuration file is:

```
hugin_test_ini - Notepad
File Edit Format View Help
[hugin]
; Configure which version of the HUGIN Python API to use
pyhugin=pyhugin86

[input]
; NODE=RASTER|BAND
; The input section maps a set of nodes to raster layers.
; Node names must match in verbatim the node in the HUGIN domain.
; RASTER identifies a raster image file by matching a substring of the file name
; BAND indicates band index

NO_T2=N-0_T2|1
NO_T10=N-0_T10|1
NO_T25=N-0_T25|1
Kold_v7_inf75_surface_topo=Kold_v7_inf75_surface-topo|1

[output]
; BANDINDEX=FUNCTION ARGS ...
; The band index must be in correct non-skipping order
;
; functions are:
; MAX NODE
; PMAX NODE
; MEU
; EU NODE STATE
; AVG NODE
; VAR NODE
; QUANTILE NODE PROBABILITY
; SAMPLE NODE ?

1=MAX Result
2=PMAX Result
3=AVG Result
```

Output

The first part “[hugin]” specifies runtime configuration for the HUGIN API.

The second part “[input]” specifies how the nodes of the network are linked to raster layers. The third part “[output]” specifies the output values to be computed. Options marked with “?” are not yet available.

MAX NODE = the state index of the output node with maximum probability

PMAX NODE = the probability of the state index of the output node with maximum probability

MEU = the maximum expected utility computed in the model for the pixel (e.g. as a result of a scaled and weighted overlay of ecosystem service map layers)

EU NODE STATE = the expected utility of the node state

AVG NODE = average value of the node (interval and numerical nodes only)

VAR NODE = variance of the node (interval and numerical nodes only)

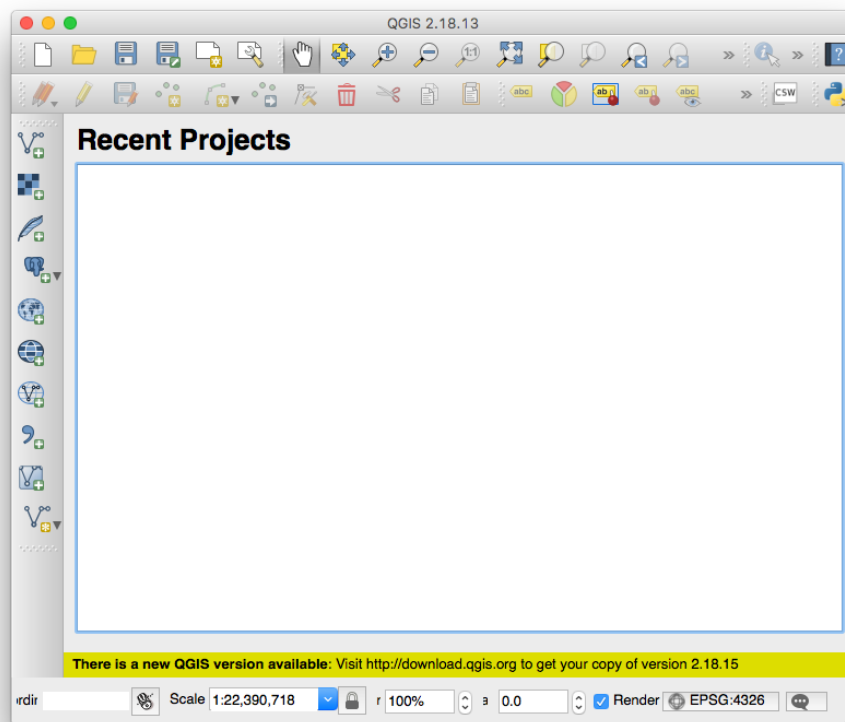
QUANTILE NODE PROBABILITY = the value of the node corresponding to a cumulative probability (one sided confidence bound)

Running the Example

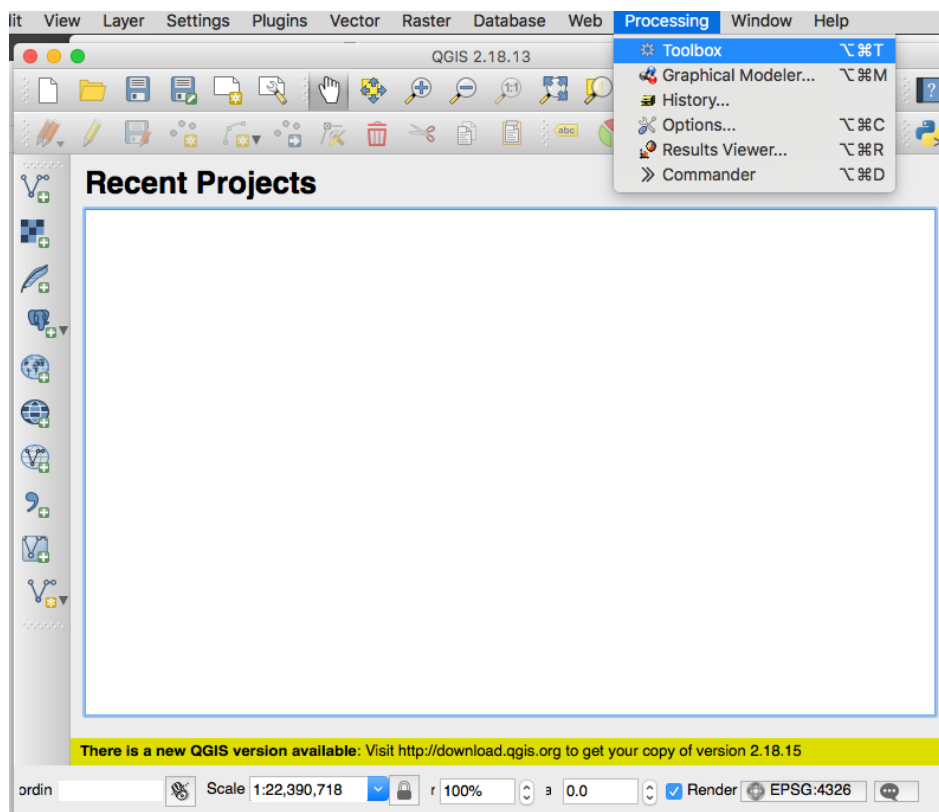
The figure below shows the startup window of QGIS.

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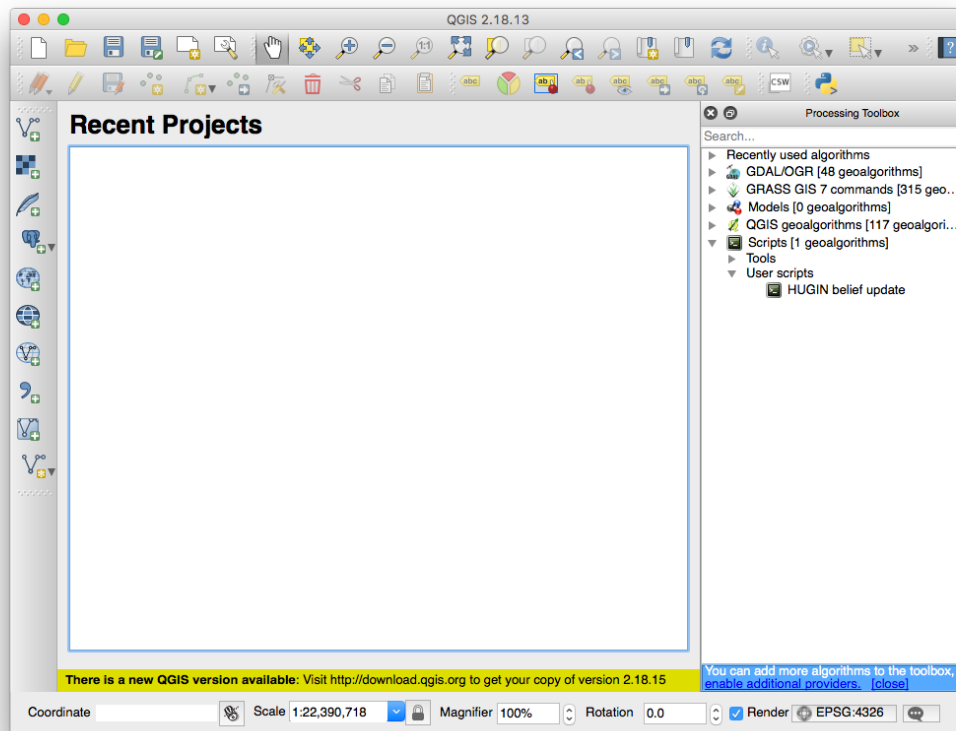
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Select Processing->Toolbox to be able to launch the HUGIN QGIS BBN plugin:



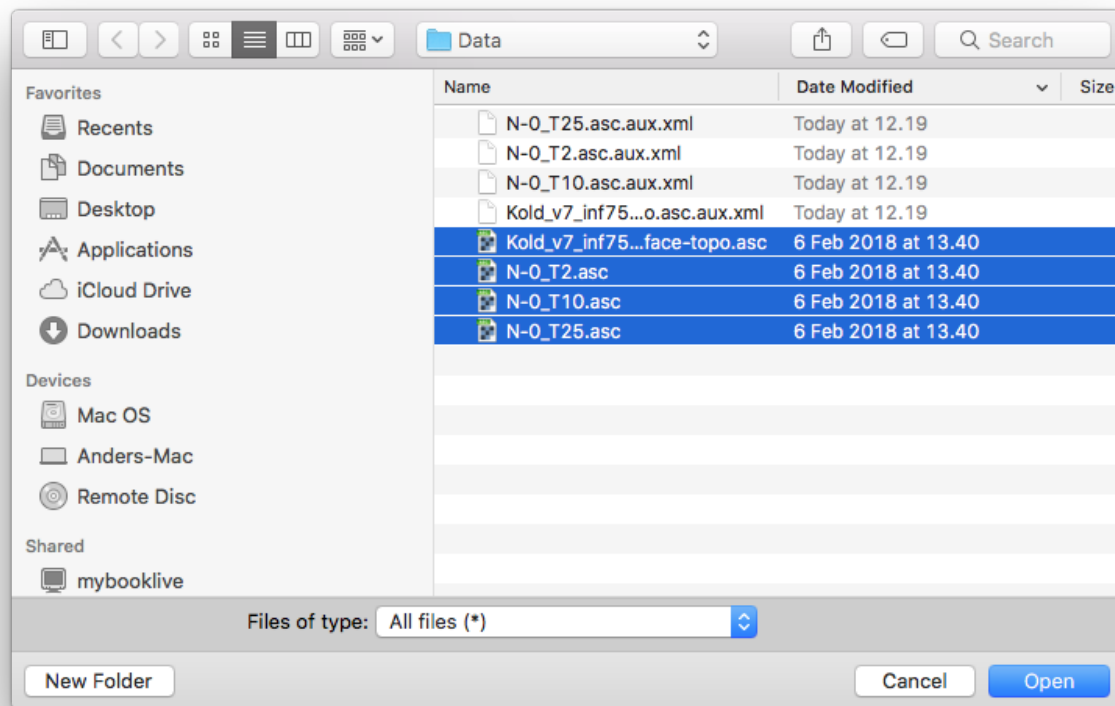
This opens the panel on the right where we notice that the user script HUGIN belief update is now available.



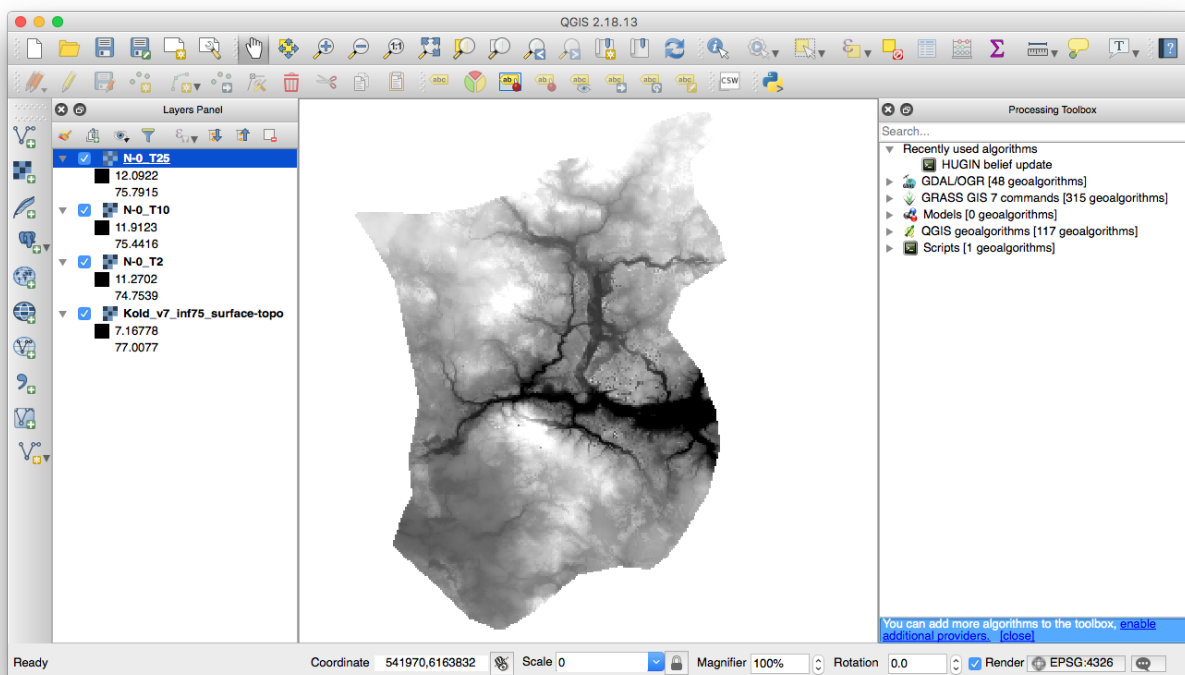
Next, we open the four raster layers of interest by pressing the Add Raster Layer tool on the left:



This opens a file dialog where the raster layers of interest are selected:

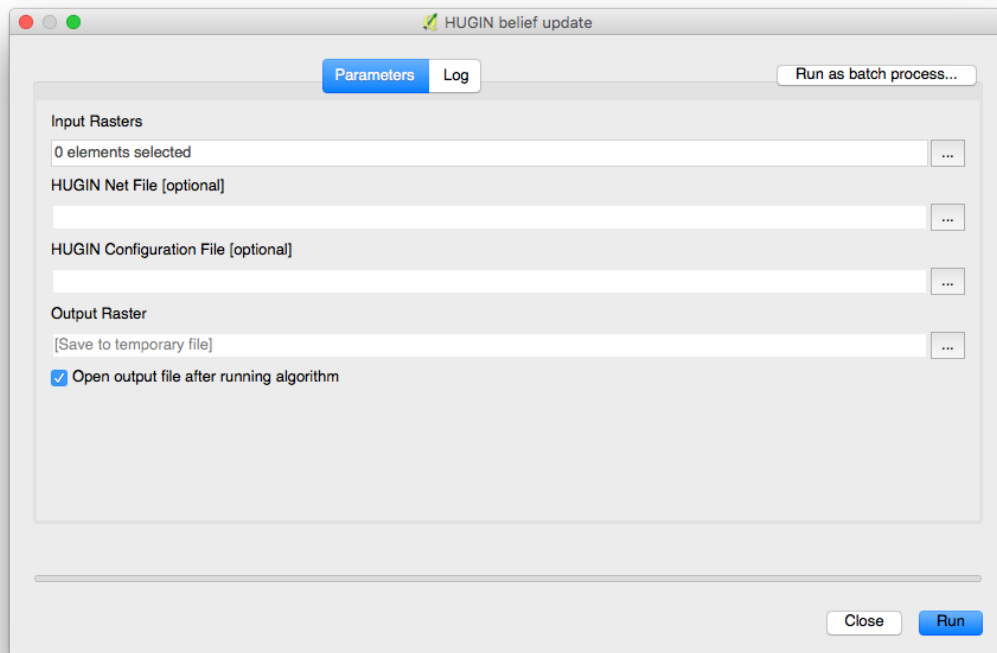


This opens the files and produces this result:



(If the panel on the left with the layers is not shown, then select View->Panels->Layers Panel)

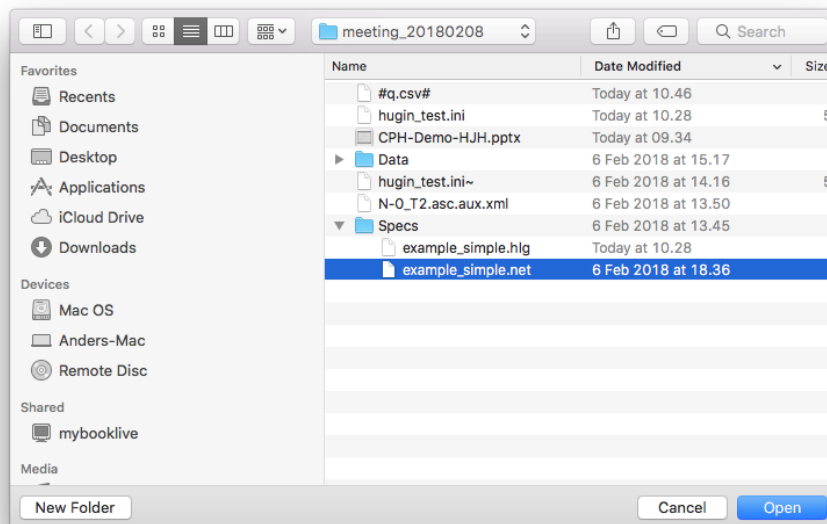
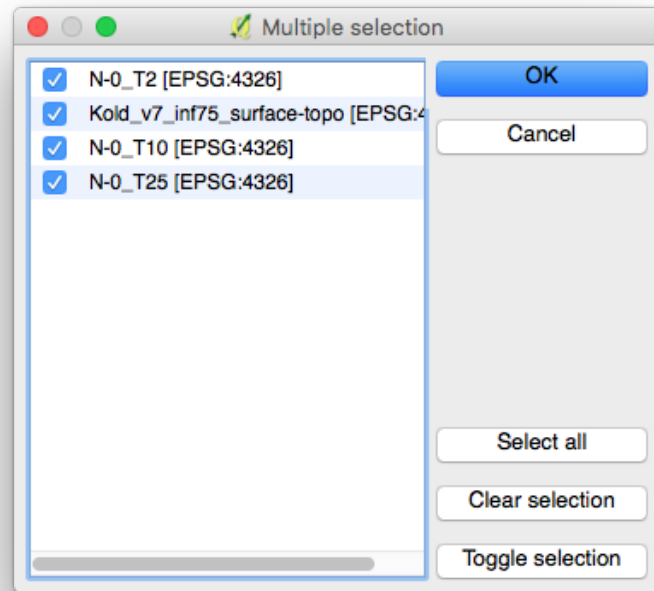
Select Processing Tools->Scripts->User Scripts->HUGIN Belief update in the right panel to open the dialog:

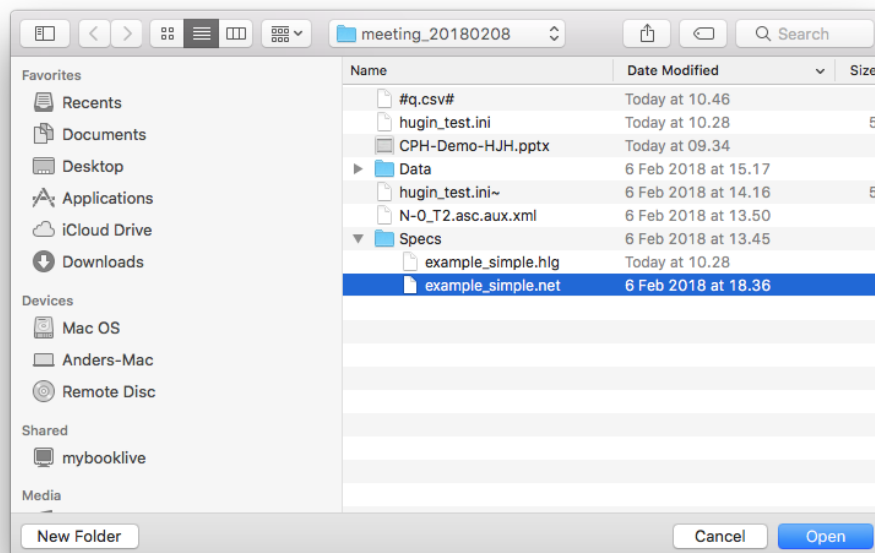


Here the values should be selected for Input raster layers, HUGIN Net File and HUGIN Configuration file through the following sequence of windows:

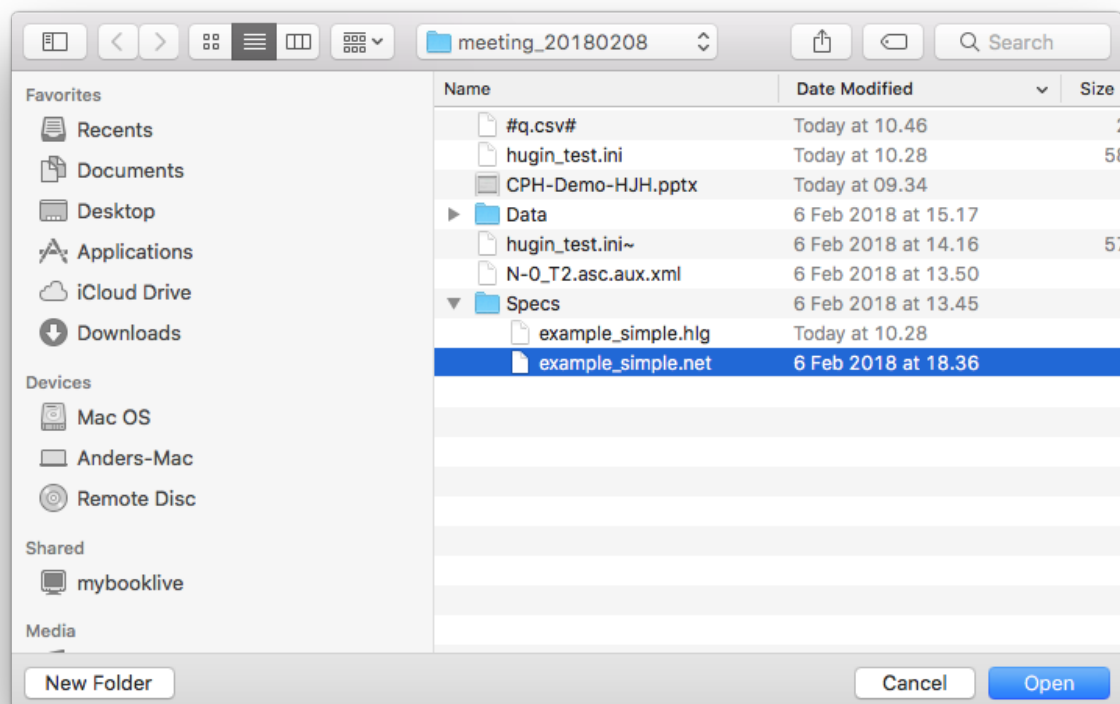
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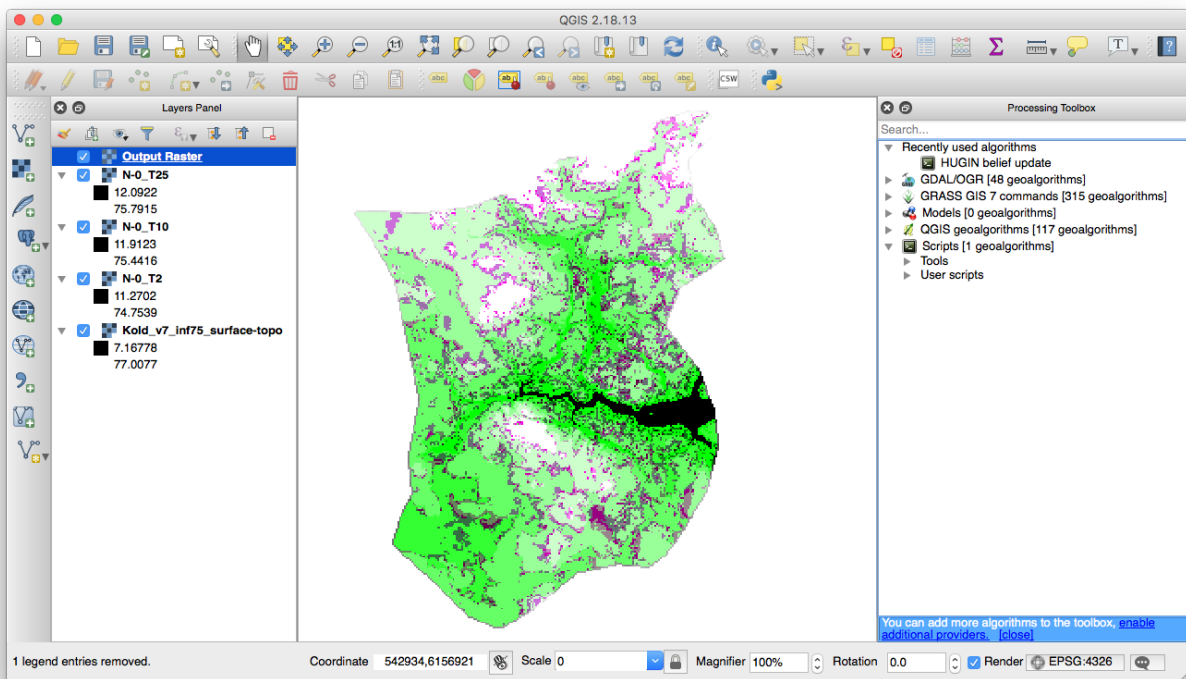
This should produce the window below:



Now press Run to perform the analysis. Information on the analysis is displayed to the user in the window. The result is:

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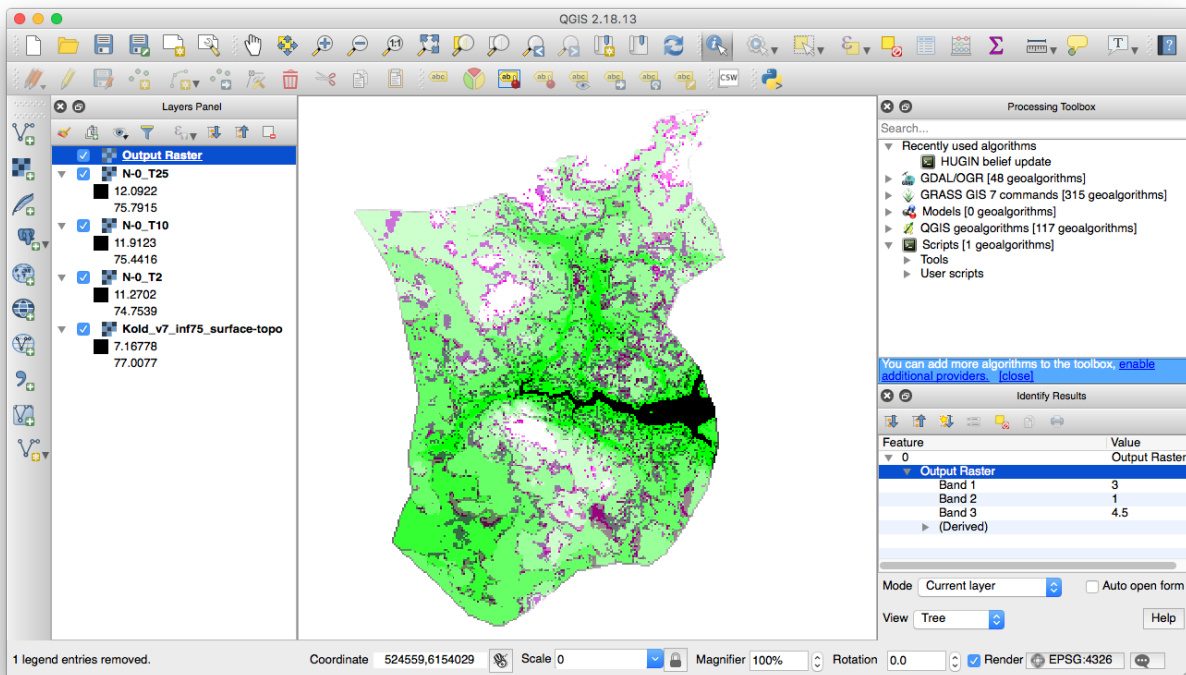
2018-02-09



Select the Identify Features tool in the toolbar:



Press a point on the map and notice the information displayed in the right side of the figure below.

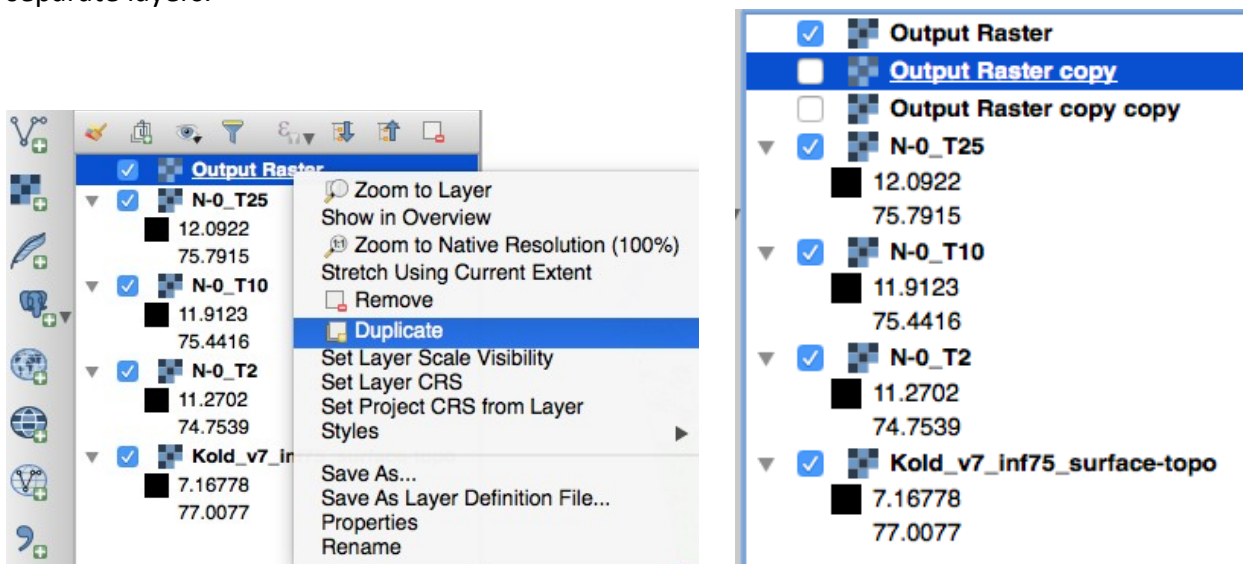


The output of the analysis is displayed in three bands. Band 1 is the index of the state with maximum probability, Band 2 is the probability of the state with maximum probability and Band 3 shows the average.

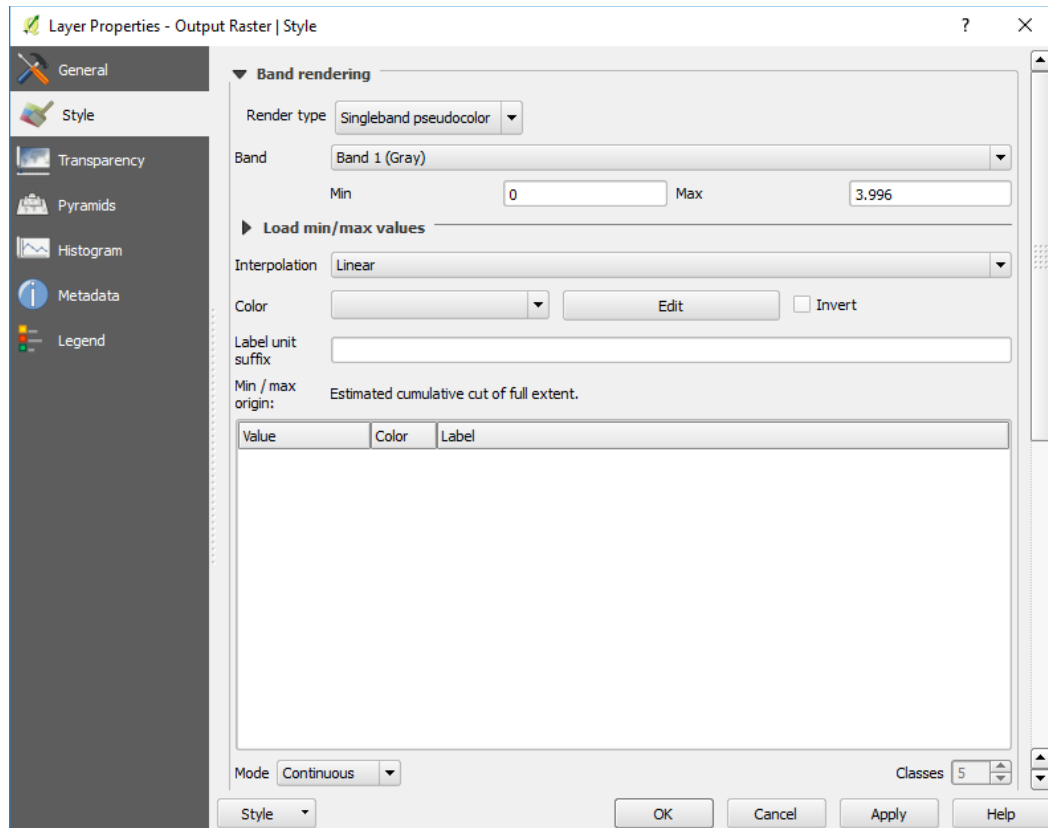
Visualization of the result

For more intuitive interpretation of the results it is useful to visualize the three output layers (the index of the state with maximum probability, the probability of the state with maximum probability and the average) separately.

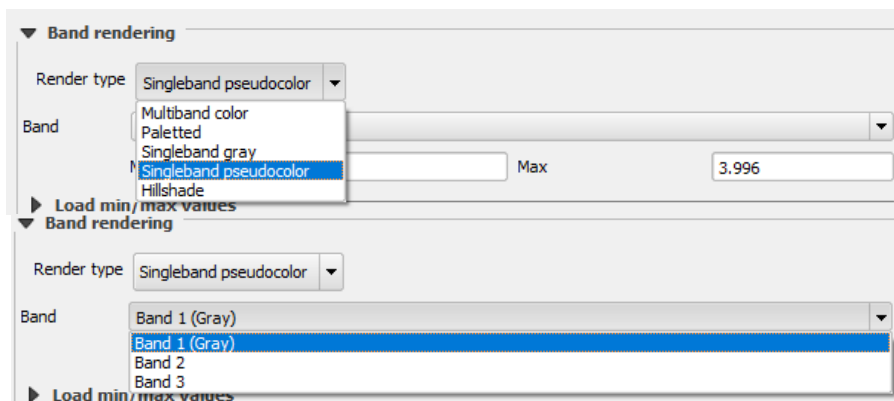
First, right click on the Output Raster, choose Duplicate, and repeat this once more to obtain three separate layers.



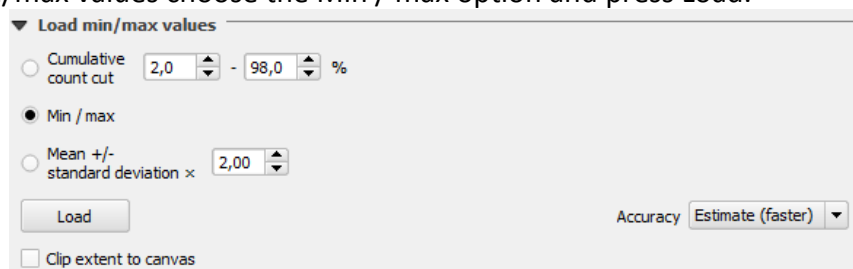
Next, choose the layer properties by right-clicking on one of the three layers and choosing Properties. The Layer Properties window will pop up. Choose the Style tab.



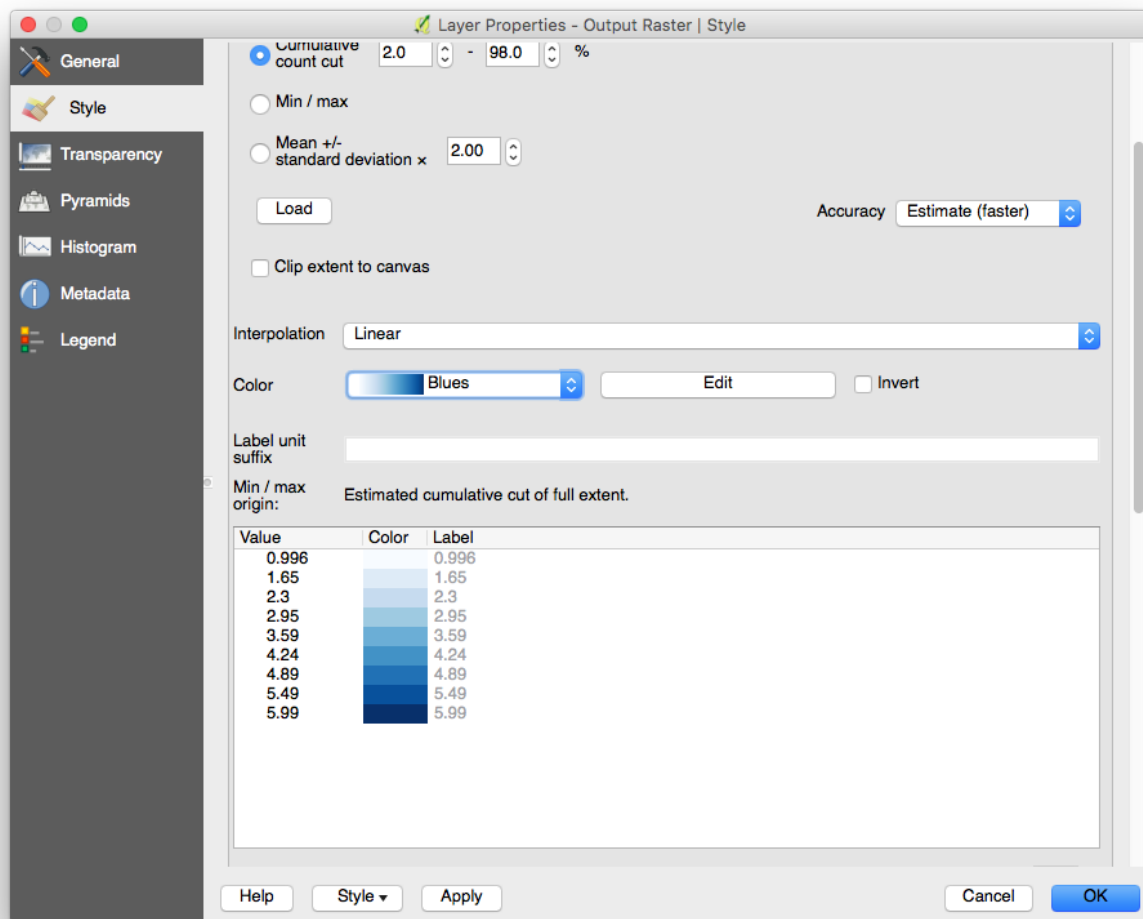
Under Band rendering choose Singleband pseudocolor from the Render type drop-down list, and one of the three bands from the Band drop-down (Band 1 is the index of the state with maximum probability, Band 2 is the probability of the state with maximum probability and Band 3 is the average).



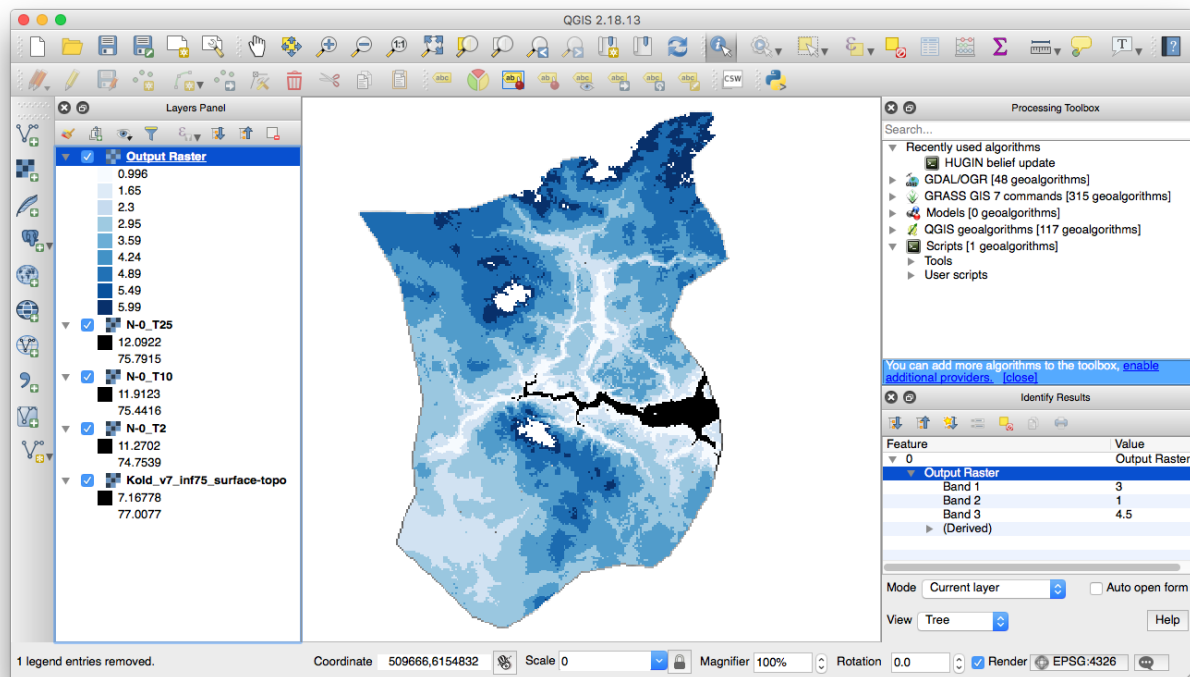
Under Load min/max values choose the Min / max option and press Load.



Finally, choose a color scheme appropriate for the visualized phenomenon from the Color drop-down list, and press OK in the bottom right corner of the Layer properties window.



The first layer will now be visualized in the chosen color scheme.



Visualize the remaining two layers in the same way.

End Note

The plugin does not yet support all operations listed in the configuration file. Operators marked with “?” are not yet implemented.

Have fun!

Acknowledgement

David Barton and Zofie Cimburova (both NINA) made contributions to this document and prepared most parts of the last section.

The example has kindly been provided by Hans Jørgen Henriksen (GEUS).