

PCRaster Tools for Hydrological Applications

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Institute for
Water Education
under the auspices of UNESCO

QWAST



@hansvanderkwast



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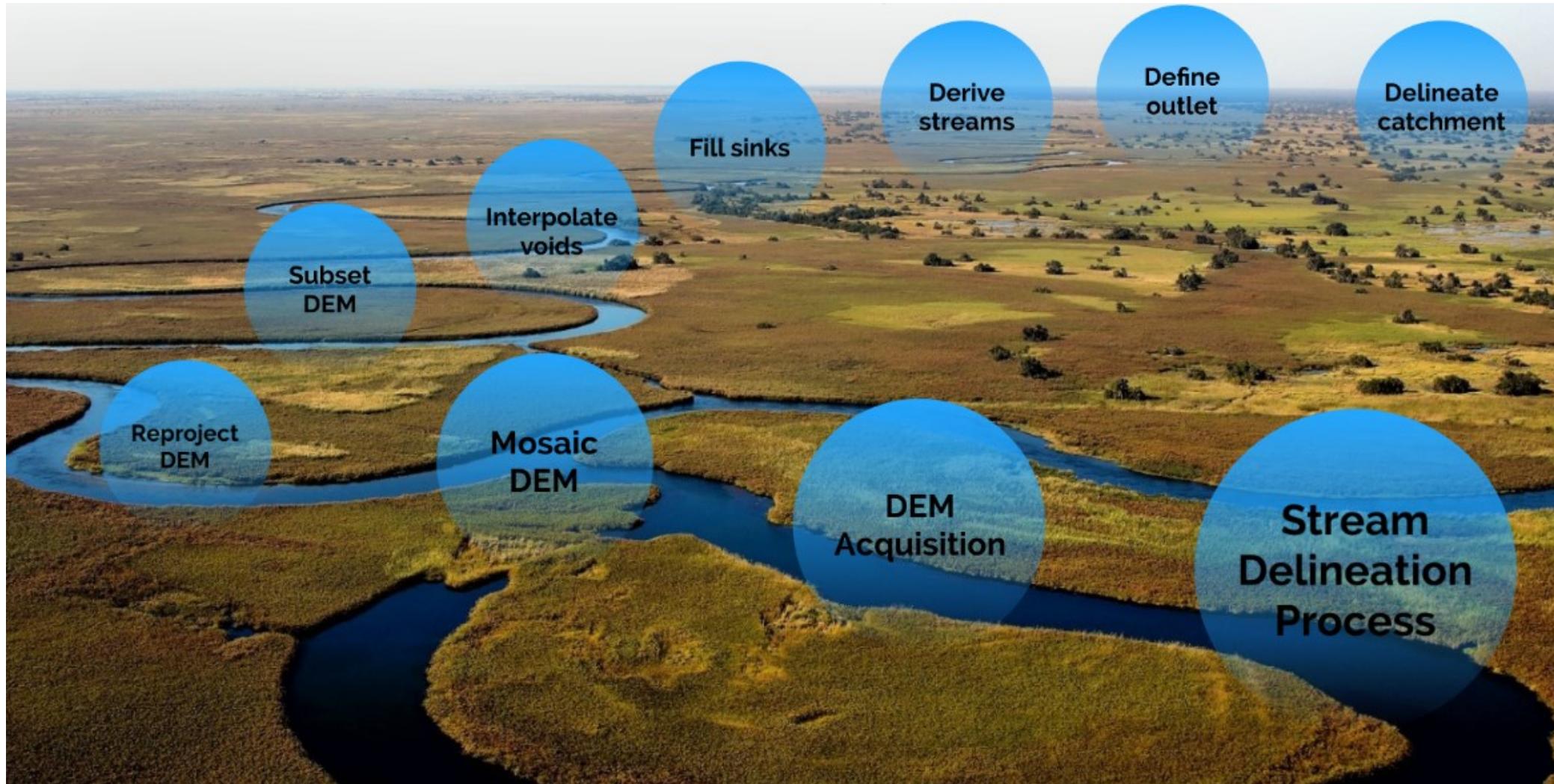


Hans van der Kwast

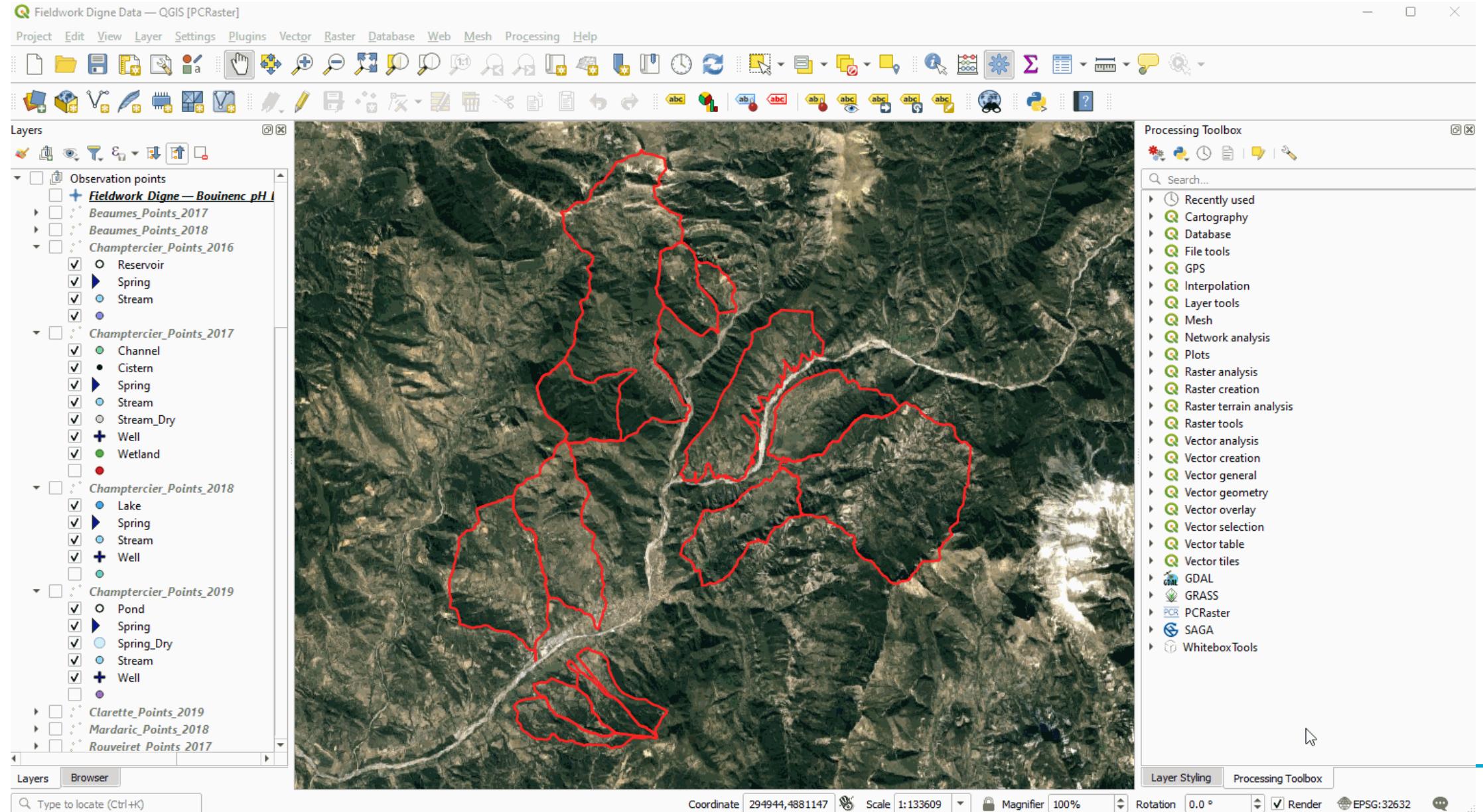
- Physical Geographer, Associate Professor of Open Science and Digital Innovation at IHE Delft
- MSc, PhD at Utrecht University, the Netherlands
- Researcher at the Flemish Institute for Technological Research (VITO, Belgium)
- Board member of Dutch QGIS User Group, OSGeo Charter member
- Owner of QWAST-GIS and member of QCooperative
- Co-author of QGIS for Hydrological Applications with Kurt Menke (Septima)
- GIS OpenCourseWare
- Interests:
 - Open source GIS and modelling (QGIS certified instructor)
 - Remote sensing for hydrology
 - Spatial data infrastructures (SDI) / Open Data
 - Fieldwork



Stream and catchment delineation



QGIS as integrator of tools



Processing provider plugins



PCRaster

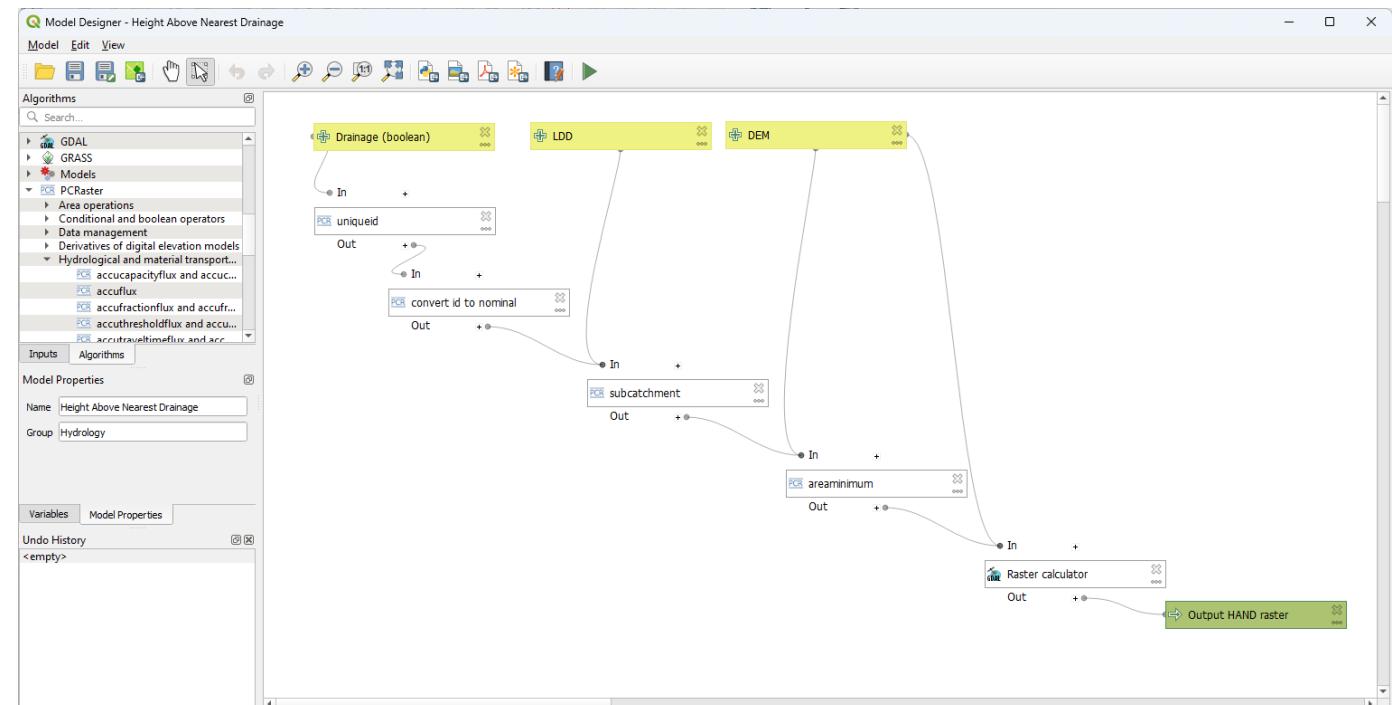


Whitebox GeospatialTM

lasTools®

Processing Provider Plugins

- Add new algorithms (tools) to the Processing Toolbox of QGIS
- Can be used in the model builder (graphical models)
- Batch processing
- Python classes
- Can also add menus



Processing Provider Plugins

QEP #230

Officially drop support for the SAGA provider (without removing it), show warning to all users when running SAGA tools #230

[Open](#) nyaldawson opened this issue on 8 Aug · 7 comments

 nyaldawson commented on 8 Aug · edited ·

QGIS Enhancement: Officially drop support for the SAGA provider (without removing it), show warning to all users when running SAGA tools

Date 2021/08/08

Author Nyall Dawson (@nyaldawson)

Contact nyall dot dawson at gmail dot com

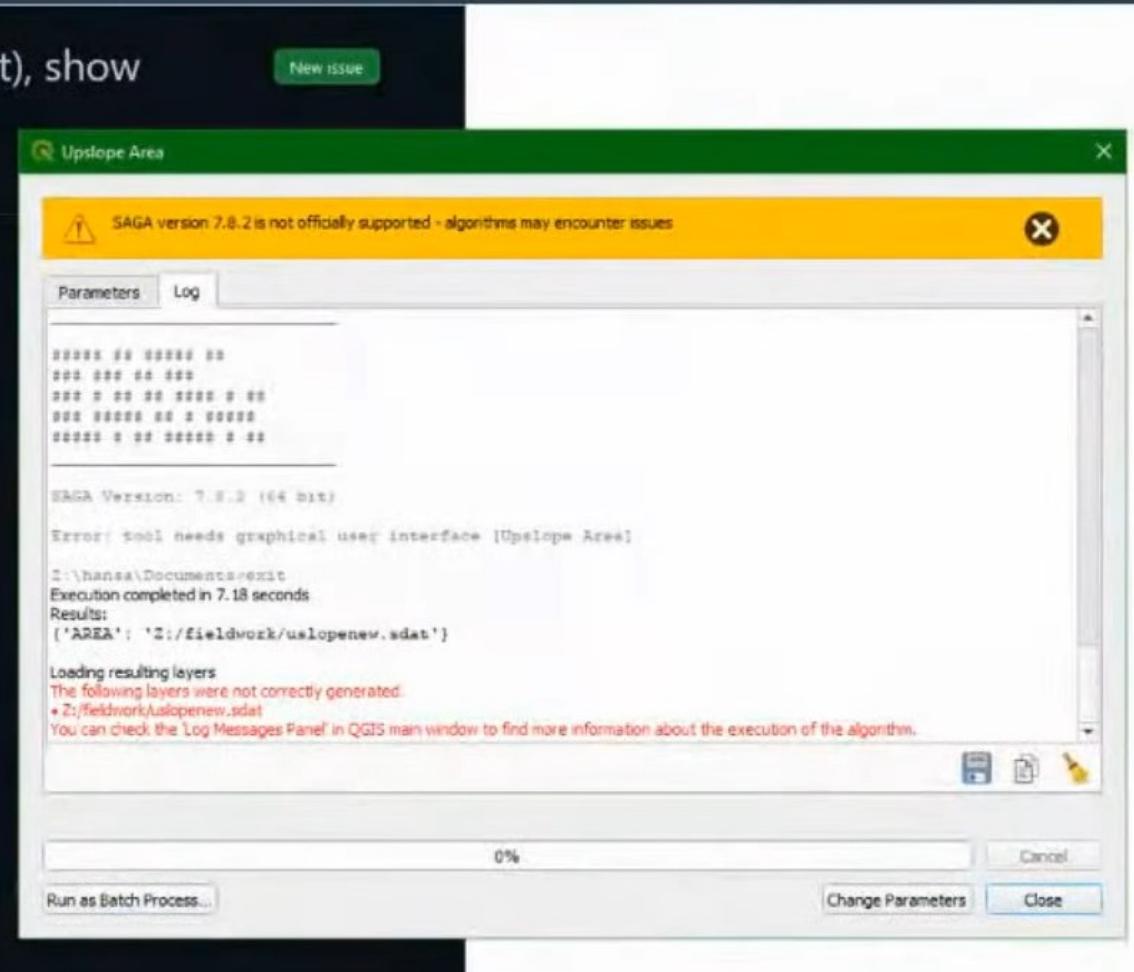
Version QGIS 3.22

Summary

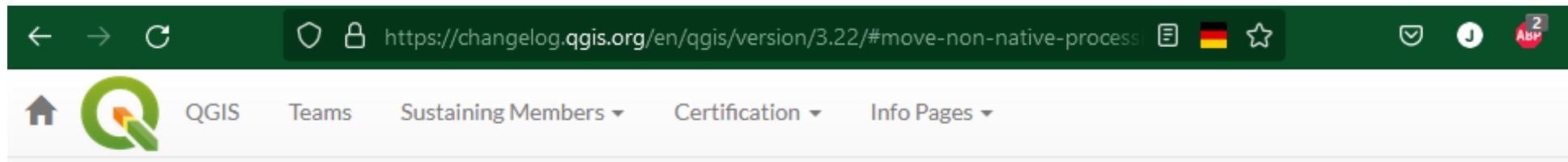
The SAGA Processing provider has been a constant source of conflict since it was introduced in QGIS 2.x. Despite our best efforts, we CAN'T offer users a first class, well supported experience with this provider.

Recent QGIS versions officially support only SAGA 2.3 LTR, and show a user-facing warning whenever users try to run SAGA tools with SAGA 7.

I propose that we extend this warning and show it regardless of the SAGA version, advising users that the provider is now officially unsupported by QGIS and will be moved to a 3rd party plugin in QGIS 4.0.



Processing Provider Plugins

A screenshot of a web browser window displaying a QGIS changelog page. The URL in the address bar is https://changelog.qgis.org/en/qgis/version/3.22/#move-non-native-process. The page header includes the QGIS logo, navigation links for Home, QGIS, Teams, Sustaining Members, Certification, and Info Pages, and various user interface icons like notifications and profile pictures.

Feature: Move non-native processing providers into independent plugins

In line with the discussion in [QEP 226](#), the SAGA, GRASS, and OTB providers have been separated into independent plugins.

This should prevent issues with the loading of the Processing plugin in cases where any one of these providers is broken. It will also make it easier to convert them into third-party plugins in the future.

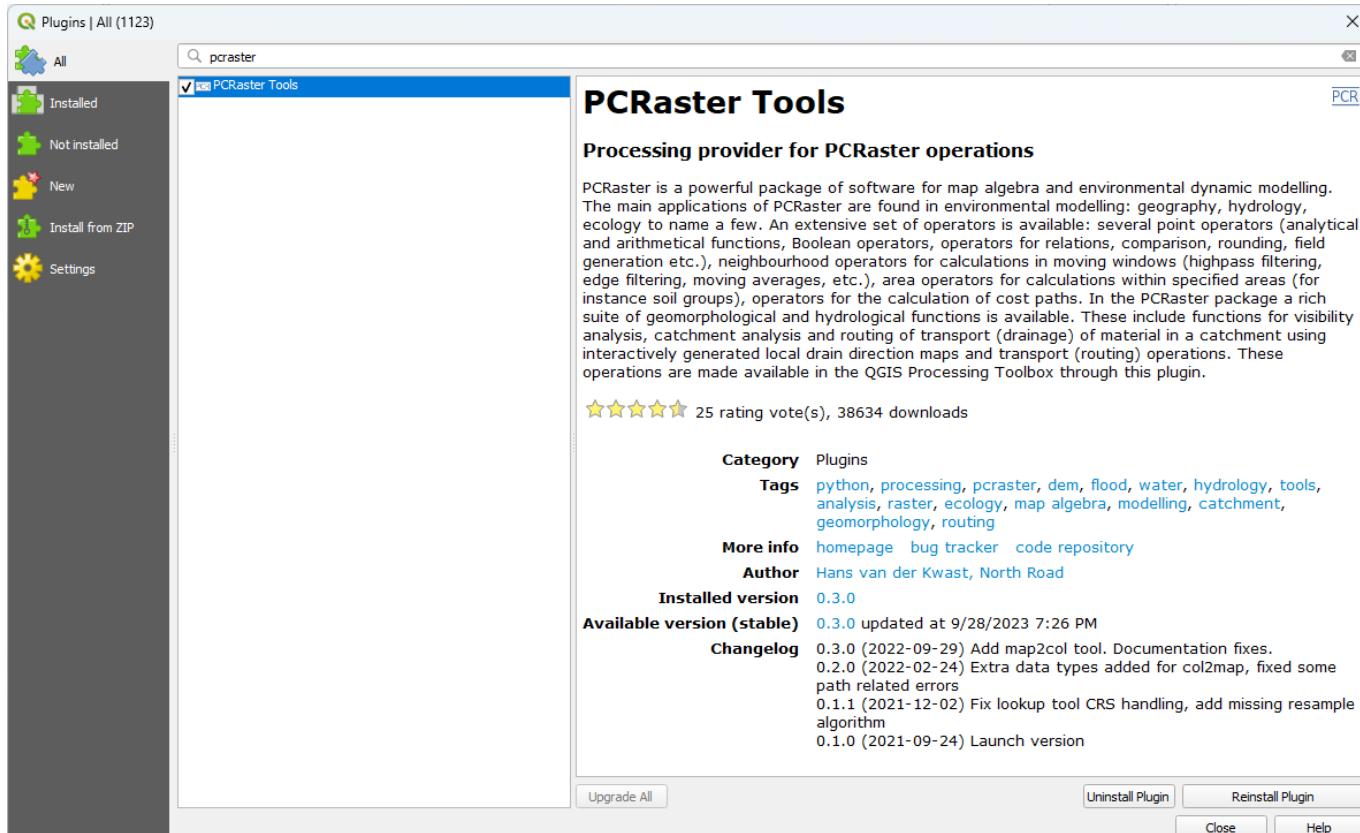
The SAGA and GRASS plugins are enabled by default, leaving the UX unchanged. The OTB provider can be enabled in the Plugin Manager if necessary, however, the enabling or disabling of any of these providers is now performed via the Plugin Manager as with any other plugin.

This is mostly an internal change, with the only visible change on the part of end-users being that the Plugin Manager is used to activate or deactivate the SAGA, GRASS, and OTB providers.

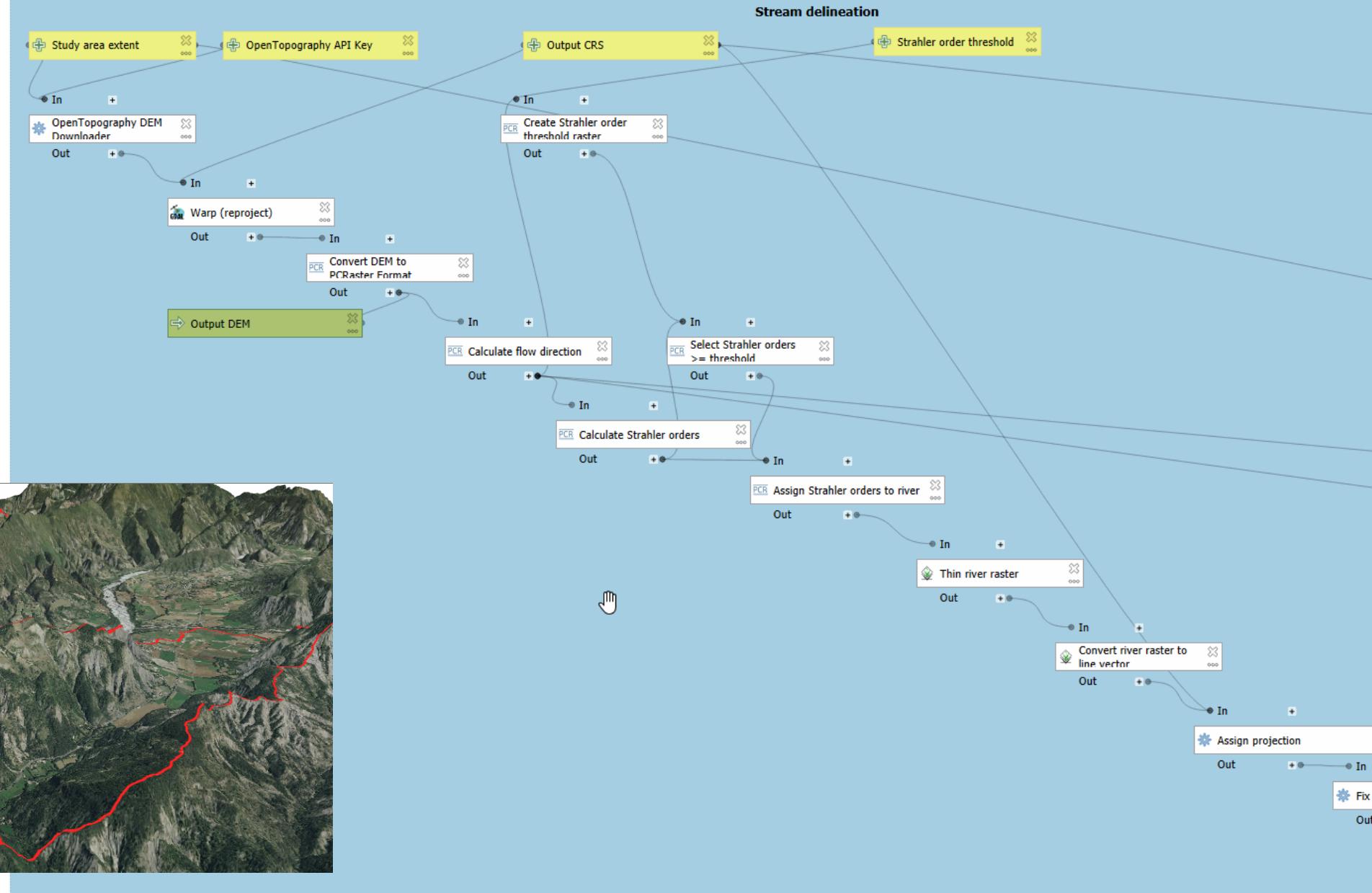
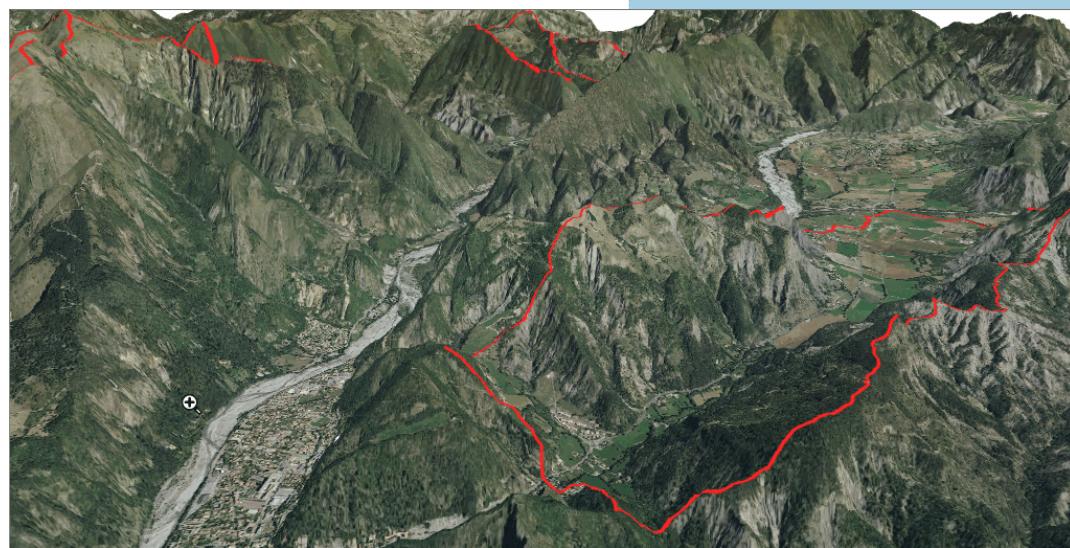
This feature was developed by [Alexander Bruy](#)

The PCRaster Tools plugin

- 2020 – 2021: Prototype with scripts via the Resource Sharing plugin. Worked only in a Conda environment
- Developed as plugin together with Nyall Dawson (North Road)
- 24 September 2021: Launch
- >35k times downloaded
- 2022: used in chapter 4 of the book QGIS for Hydrological Applications – 2nd Edition
- Easy install on windows with the OSGeo4W installer, thanks to Jürgen Fischer
- Works great on Conda for all operating systems



PCRaster tools for water: catchment delineation



Model Designer - Stream and Catchment Delineation

Model Edit View

Algorithms

Search...

- Cartography
- Database
- File tools
- GPS
- Interpolation
- Layer tools
- Mesh
- Modeler tools
- Network analysis
- Plots
- Raster analysis
- Raster creation
- Raster terrain analysis

Inputs Algorithms

Model Properties

Name Stream and Catchment Delineation

Group Hydrology

Stream and Catchment Delineation

Parameters Log

Study area extent

Select outlet point on map

Output CRS

EPSG:3857 - WGS 84 / Pseudo-Mercator

Strahler order threshold

5

OpenTopography API Key

Output catchment polygon

[Create temporary layer]

Open output file after running algorithm

Output streams

[Create temporary layer]

Open output file after running algorithm

Original outlet

0%

Advanced Run as Batch Process... Run Cancel

Stream delineation

```

graph LR
    SA[Study area extent] --> OT[OpenTopography API Key]
    OT --> ODEM[OpenTopography DEM Downloader]
    ODEM --> W[Warp reproj]
    W --> CDT[Convert DEM to PCRaster Format]
    CDT --> ODEM[Output DEM]
    ODEM --> CFD[Calculate flow direction]
    CFD --> SOS[Select Strahler orders > threshold]
    SOS --> COS[Calculate Strahler orders]
    COS --> AOS[Assign Strahler order]
    AOS --> SO[Strahler order threshold]
    SO --> SDS[Create Strahler order raster]
    SDS --> ODS[Output ODS]
    ODS --> SOT[Select Strahler order threshold]
    SOT --> CSD[Create Strahler order raster]
    CSD --> ODS[Output ODS]
  
```

Catchment delineation

```

graph LR
    SOMP[Select outlet point on map] --> CLF[Create layer from point]
    CLF --> RL[Reproject layer]
    RL --> OOL[Original outlet]
    OOL --> SGTL[Snap geometries to layer]
    SGTL --> CSD[Create Strahler order raster]
  
```

***vesdre — QGIS [ClickCatchment]**

Project Edit View Settings Plugins Vector Raster Database Web Mesh Processing Help

Browser

- Favorites
- Spatial Bookmark
- Project Home
- Home
- C:\ (Windows)
- D:\ (HP Port Rep)
- Z:\ (Data)
- GeoPackage
- SpatialLite
- PostgreSQL
- SAP HANA
- MS SQL Server

Layers

- outlet_snap
- streams
- catchment
- outlet_origin
- dem

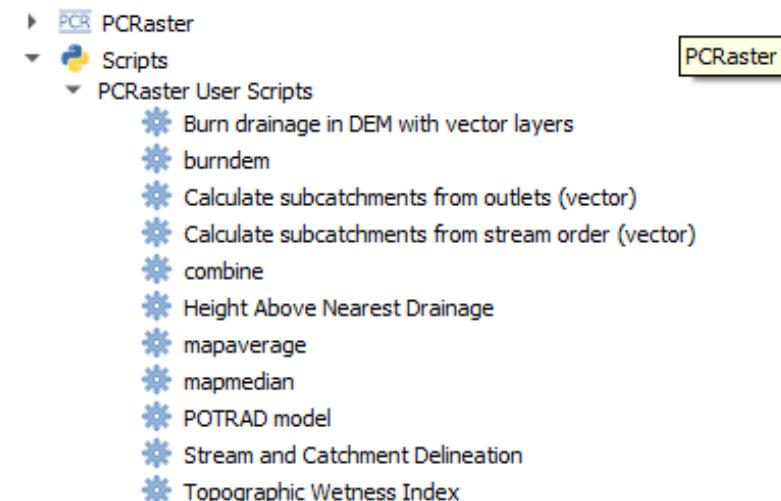
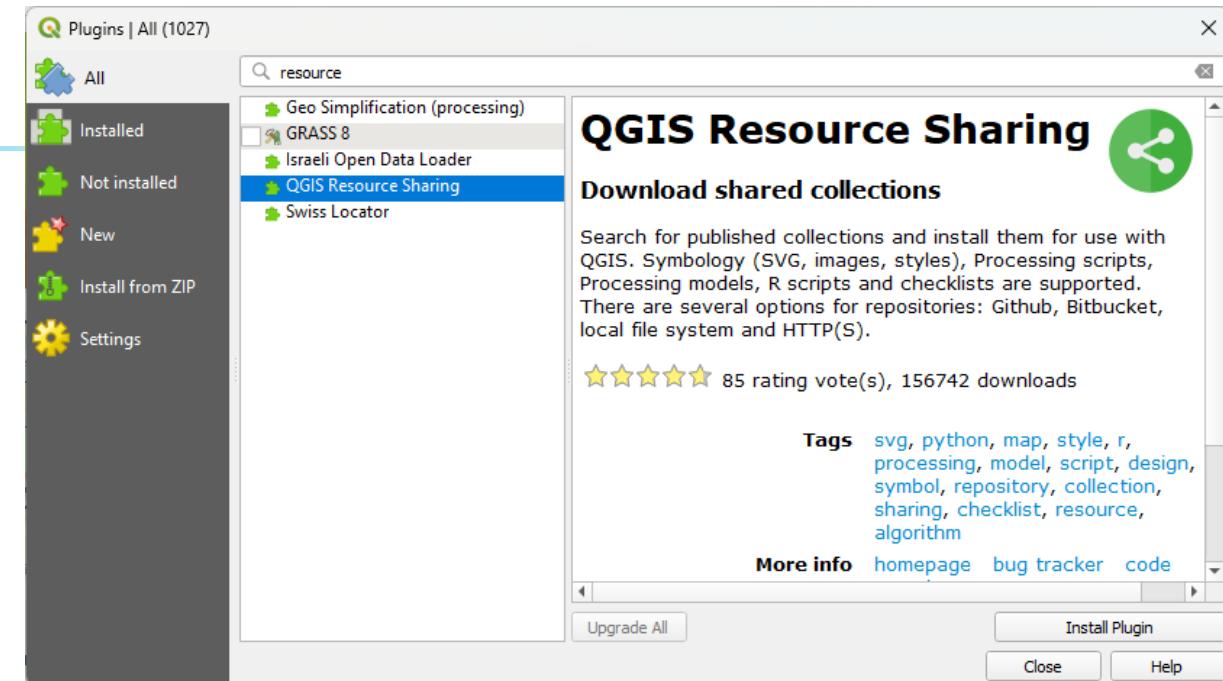
Band 1 (Gray) 700

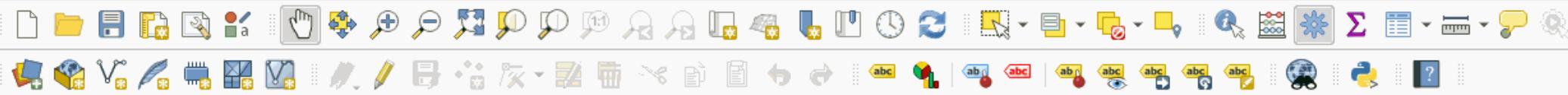
47

Type to locate (Ctrl+K) 1 legend entry Coordinate 637674,6542734 Scale 1:308256 Magnifier 100% Rotation 0.0° Render EPSG:3857

More tools and models

- Resource sharing plugin
- Plan to have an easier repo linked with the plugin
- Add dynamic models to QGIS

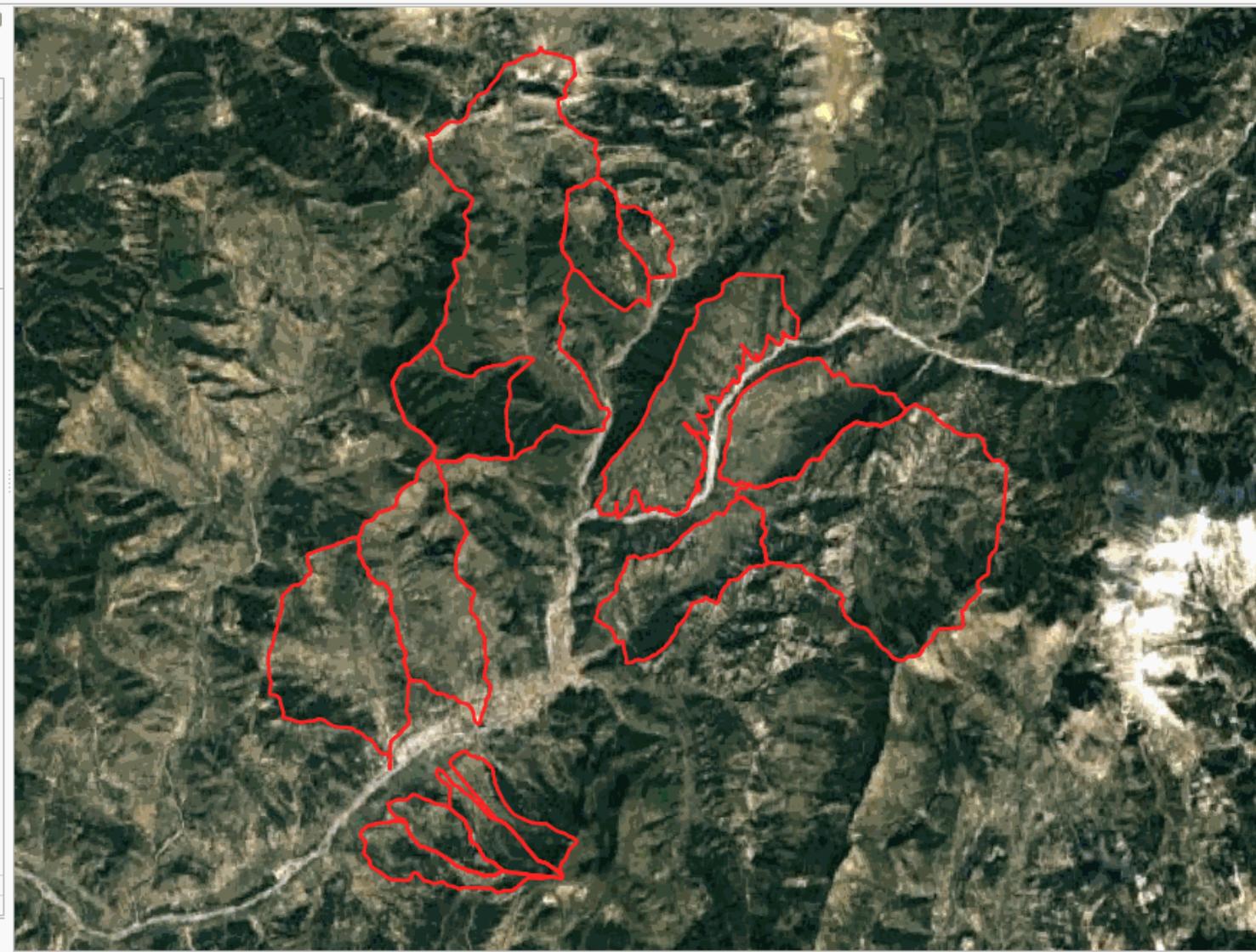




Layers

Observation points

- Fieldwork Digne — Bouinenc pH I**
- Beaumes_Points_2017
- Beaumes_Points_2018
- Champtercier_Points_2016
 - Reservoir
 - Spring
 - Stream
 -
 -
- Champtercier_Points_2017
 - Channel
 - Cistern
 - Spring
 - Stream
 - Stream_Dry
 - Well
 - Wetland
 -
 -
- Champtercier_Points_2018
 - Lake
 - Spring
 - Stream
 - Well
 -
 -
- Champtercier_Points_2019
 - Pond
 - Spring
 - Spring_Dry
 - Stream
 - Well
 -
 -
- Clarette_Points_2010



Processing Toolbox



Search...

- Recently used
- Cartography
- Database
- File tools
- GPS
- Interpolation
- Layer tools
- Mesh
- Network analysis
- Plots
- Raster analysis
- Raster creation
- Raster terrain analysis
- Raster tools
- Vector analysis
- Vector creation
- Vector general
- Vector geometry
- Vector overlay
- Vector selection
- Vector table
- Vector tiles
- GDAL
- GRASS
- Models
- PCRaster
- SAGA
- Scripts
- WhiteboxTools

Layer Styling Processing Toolbox

Type to locate (Ctrl+K)

Coordinate 296351,4881932



Scale 1:141516



Magnifier 100%

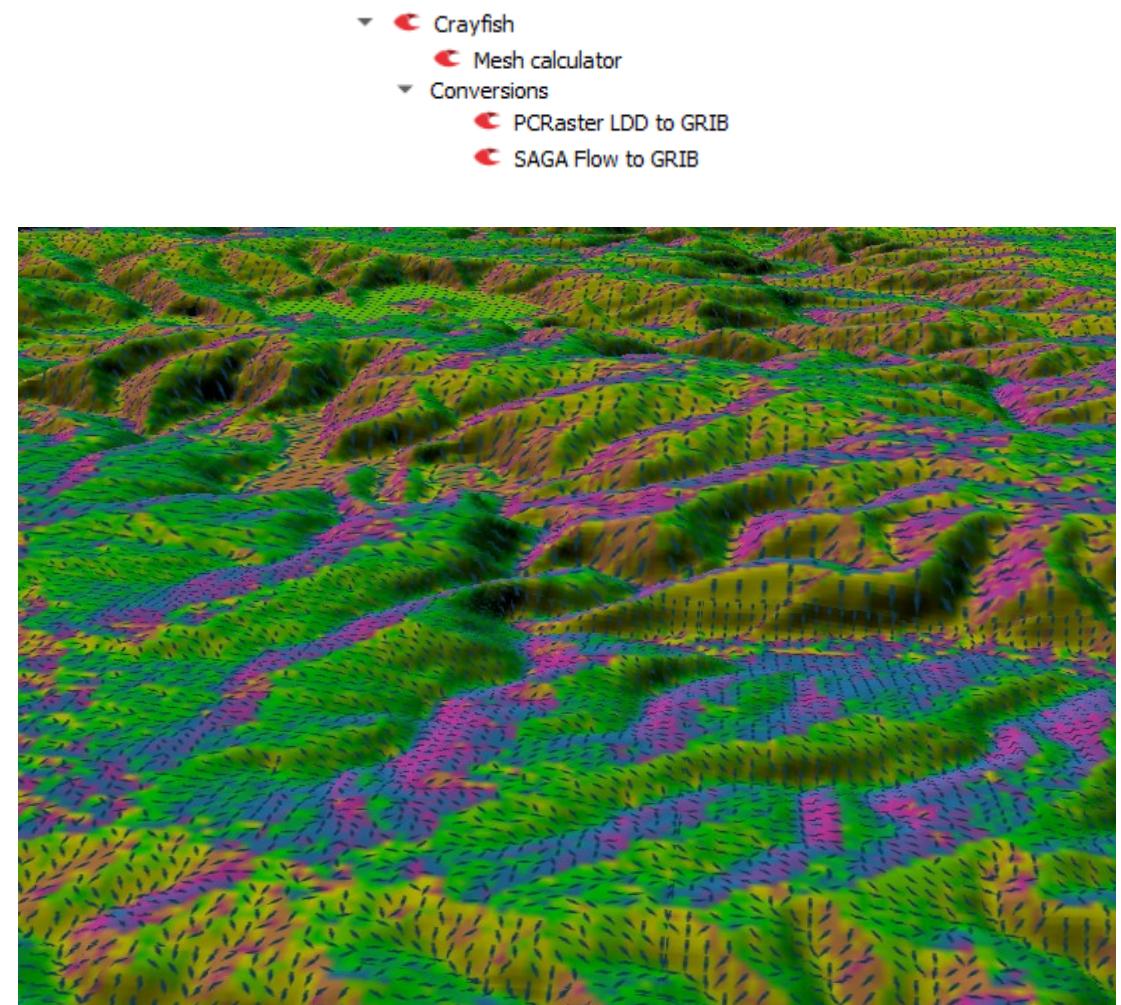
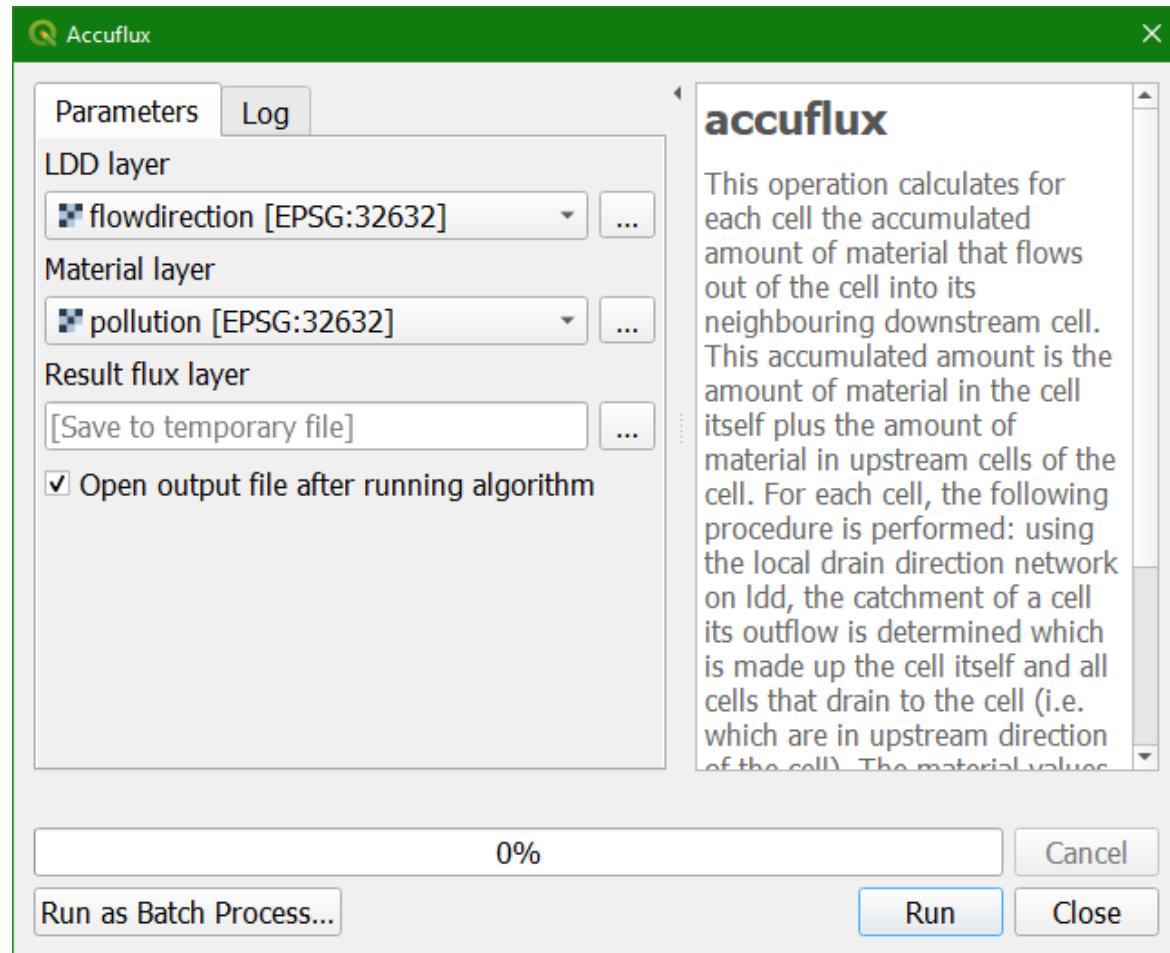


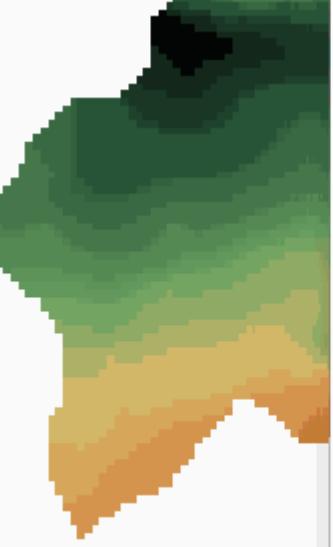
Rotation 0.0°



Render EPSG:32632

Flow accumulation and flow direction





runoff.py X

```

from pcraster import *
from pcraster.framework import *

class RunoffModel(DynamicModel):
    def __init__(self, cloneMap, rainsta
        DynamicModel.__init__(self)
        setclone(cloneMap)
        self.rainstat = rainstationsMap
        self.InfilCapTable = InfilCapTabl
        self.soilMap = soilMap
        self.DEM = DEM
        self.rainTimeSeries = rainTimeSer
        self.rainfallOutput = rainfallOut
        self.runoffOutputStack = runoffOu

    def initial(self):
    
```

Example Runoff Model

Runoff model provided with [PCRaster demo data](#)

Results will be displayed as an animation in with [Aquila](#)

Parameters:

- * **Input clone layer** (required) - raster layer
- * **Input raster with rain gauges** (required) - nominal raster layer
- * **Input rainfall time series** (required) - rainfall table in PCRaster TSS format
- * **Input lookup table with infiltration capacity** (required) - table in PCRaster column format
- * **Input soil raster** (required) - nominal raster with soil classes
- * **Input Digital Elevation Model** (required) - scalar DEM raster
- * **Last time step** (required) - number of last time step (integer)
- * **First time step** (required) - number of first time step (integer)
- * **Output rain mapstack** (required) - PCRaster mapstack format, e.g. Z:/path/p
- * **Output runoff mapstack** (required) - PCRaster mapstack format, e.g. Z:/path/q

0%

Cartography

database

file tools

IPS

Interpolation

layer tools

mesh

network analysis

lots

aster analysis

aster creation

aster terrain analysis

aster tools

ector analysis

ector creation

ector general

ector geometry

ector overlay

ector selection

ector table

ector tiles

IDAL

IRASS

CRaster

DOK Services Plugin

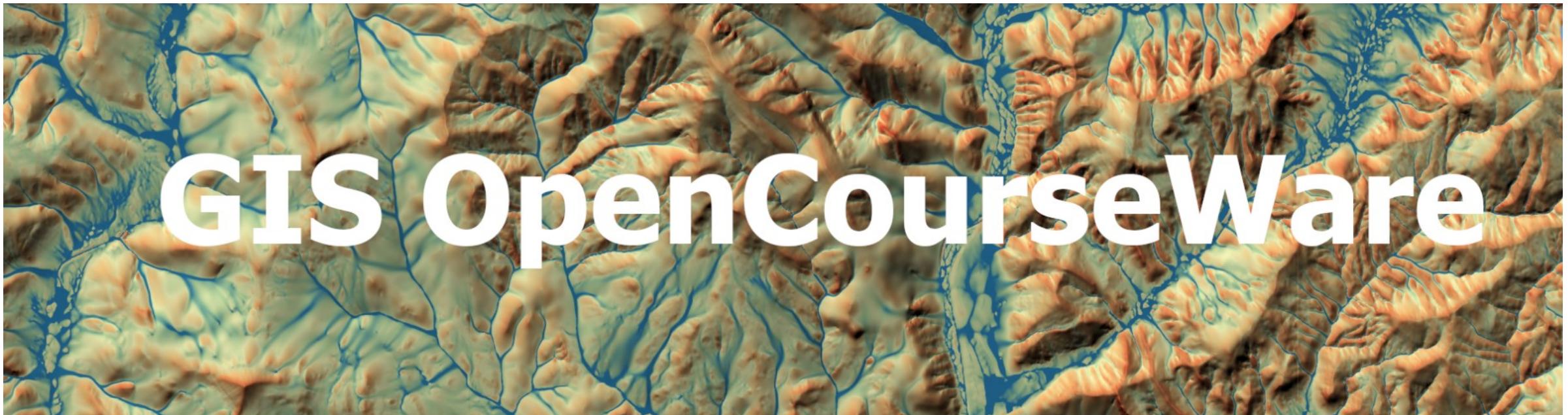
AGA

scripts

CRaster User Scripts

- * Burn drainage in DEM with vector layers
- * burndem
- * Calculate subcatchments from outlets (vector)
- * Calculate subcatchments from stream order (vector)
- * Example Runoff Model
- * Height Above Nearest Drainage
- * mapaverage
- * mapmedian
- * POTRAD model
- * Topographic Wetness Index

Thank you. Questions?



GIS OpenCourseWare

Available courses



Courses in English

QGIS for Precision Agriculture

Prepare precision agriculture projects with QGIS and Mergin Maps.



Courses in English

Looking for support?

IHE Delft offers face-to-face courses, online courses and tailor made advice & trainings.



Courses in English

FOSS4G 2022 Workshop Hydrological analysis with PCRaster in QGIS and...

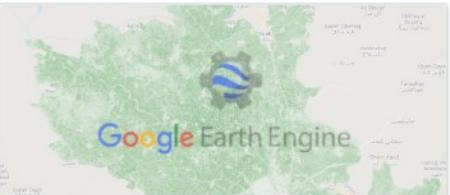
During this workshop you'll learn how to use PCRaster for hydrological analysis and modelling thro...



Courses in English

Creating data visualisations with graphs, maps and animations

In this course you'll learn how to create graphs, maps and animations for posters, slide shows, ...



Courses in English

Google Earth Engine for Agrohydrological Applications

This course will introduce you to Google Earth Engine.

