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enabling delta life

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Demo case Brabant

combined use of iMOD5 and iMOD Suite to set-up a MODFLOW6 model

iMOD User day - November 2021

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Waterschap Brabantse Delta

Topics

- The Brabant ground water model
- Modelling new style
- New coupling method with MODFLOW 6
- Data processing new style
- Viewing in iMOD5 + QGIS plugin + 3D Viewer
- Experiences

Introduction of the Brabant model

Technical details:

- Model area: 110 x 150 km
- Cell size: 100 x 100 m
- Nr of cells: 1.123.896
- Nr of layers: 18, max depth -140 / -800 m.a.s.l.
- Time scale: 8 years daily

Modelling ‘new style’

Model processing

- iMOD5
  - Definition of model input via the iMOD projectfile (*.prj)
  - Batch function: RUNFILE
- iMOD Suite

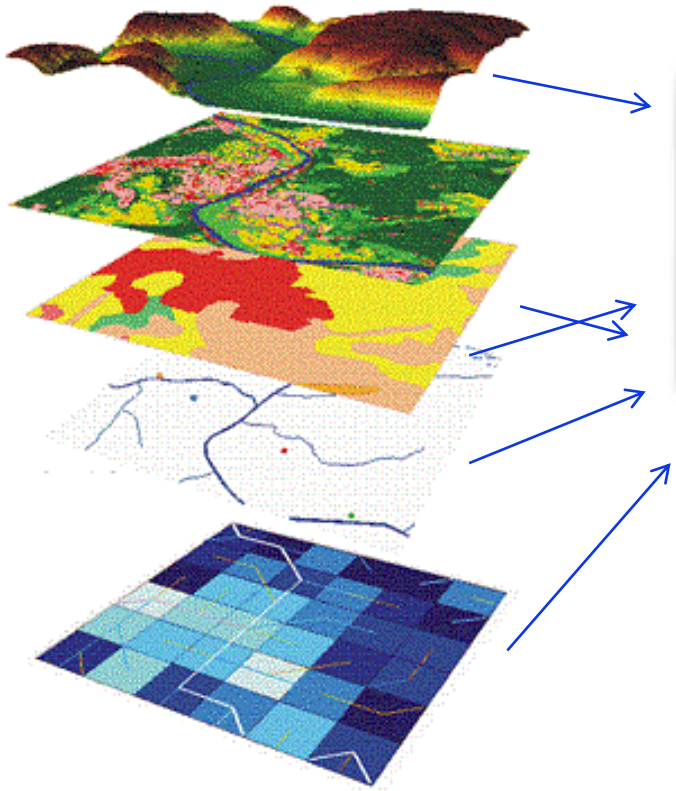
Processing new style

Modeldata
(.IDF, *.IPF, *.GEN)*

Project file
(.PRJ)*

iMOD Batch function: RUNFILE

MODFLOW 2005
MODFLOW 6



Modelrun {i}
- Time period
- Model window
- Cell size
- Scenario
- …

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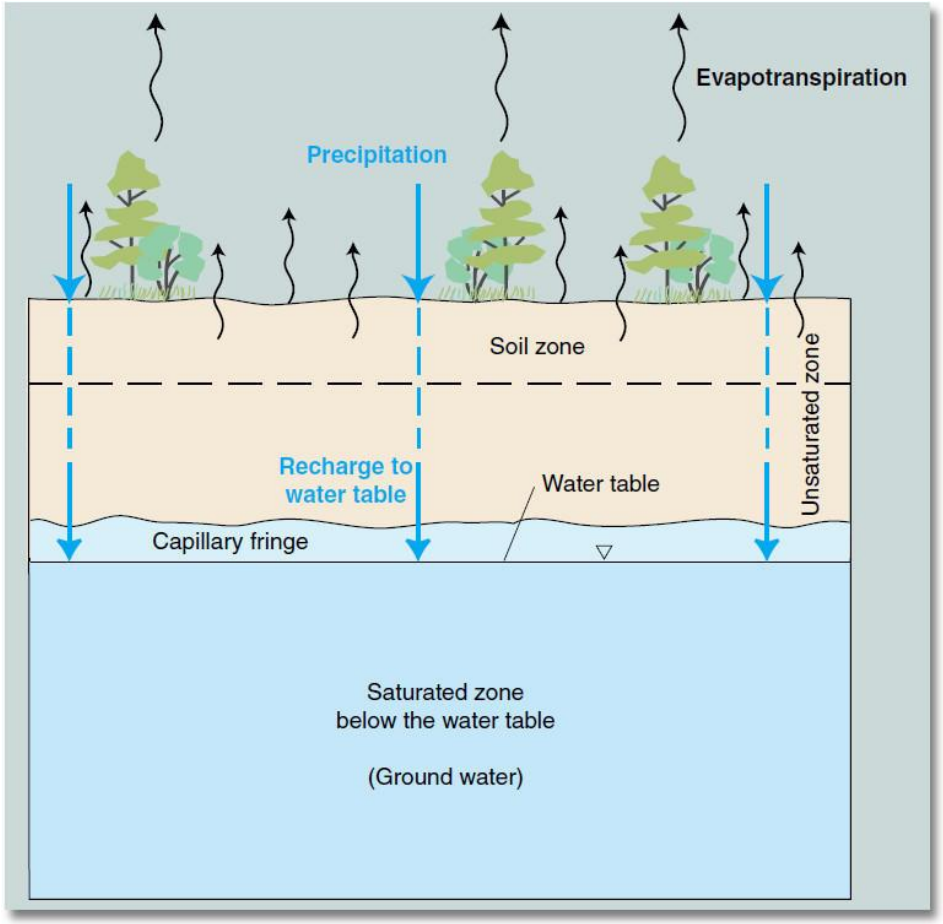
Coupling MetaSWAP to MODFLOW6

- Unsaturated zone model MetaSWAP
- MetaSWAP compared to MODFLOW-UZF
- iMOD Coupler…

```
# This is a configuration file for the imod_coupler
# Relative paths are relative to the configuration file

timing = false
log_level = "INFO"

[kernels]
    [kernels.modflow6]
    dll = 'c:\tools\bin\libmf6.dll'
    model = '.'

    [kernels.metaswap]
    dll = 'c:\tools\bin\MetaSWAP.dll'
    model = '.\GWF_1\MSWAPINPUT'
    dll_dependency = 'c:\tools\bin'


[[exchanges]]
# Two kernels per exchange
kernels = ['modflow6', 'metaswap']
```

[iMOD5 manual. *Appendix A.4 Modflow 6 and MetaSWAP*]



Data processing new style

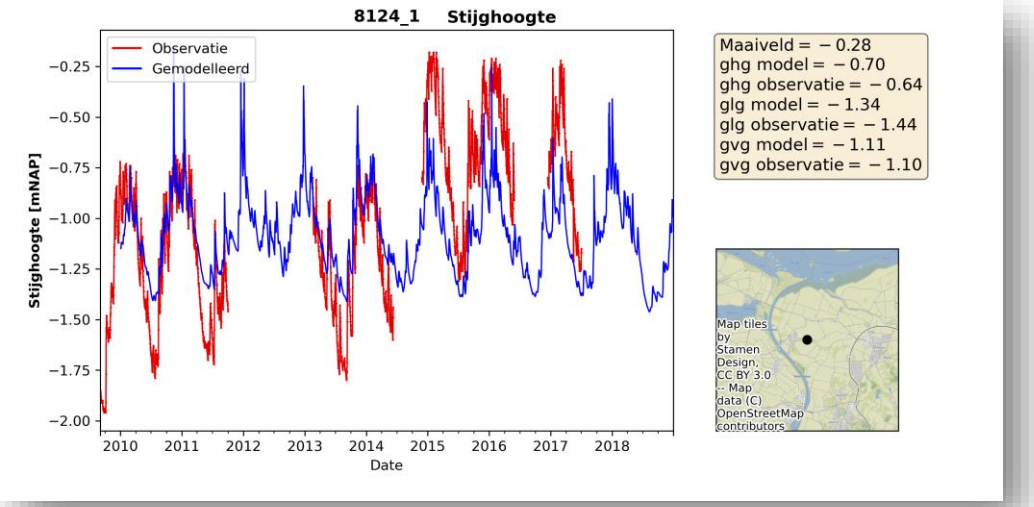
Conversion of data

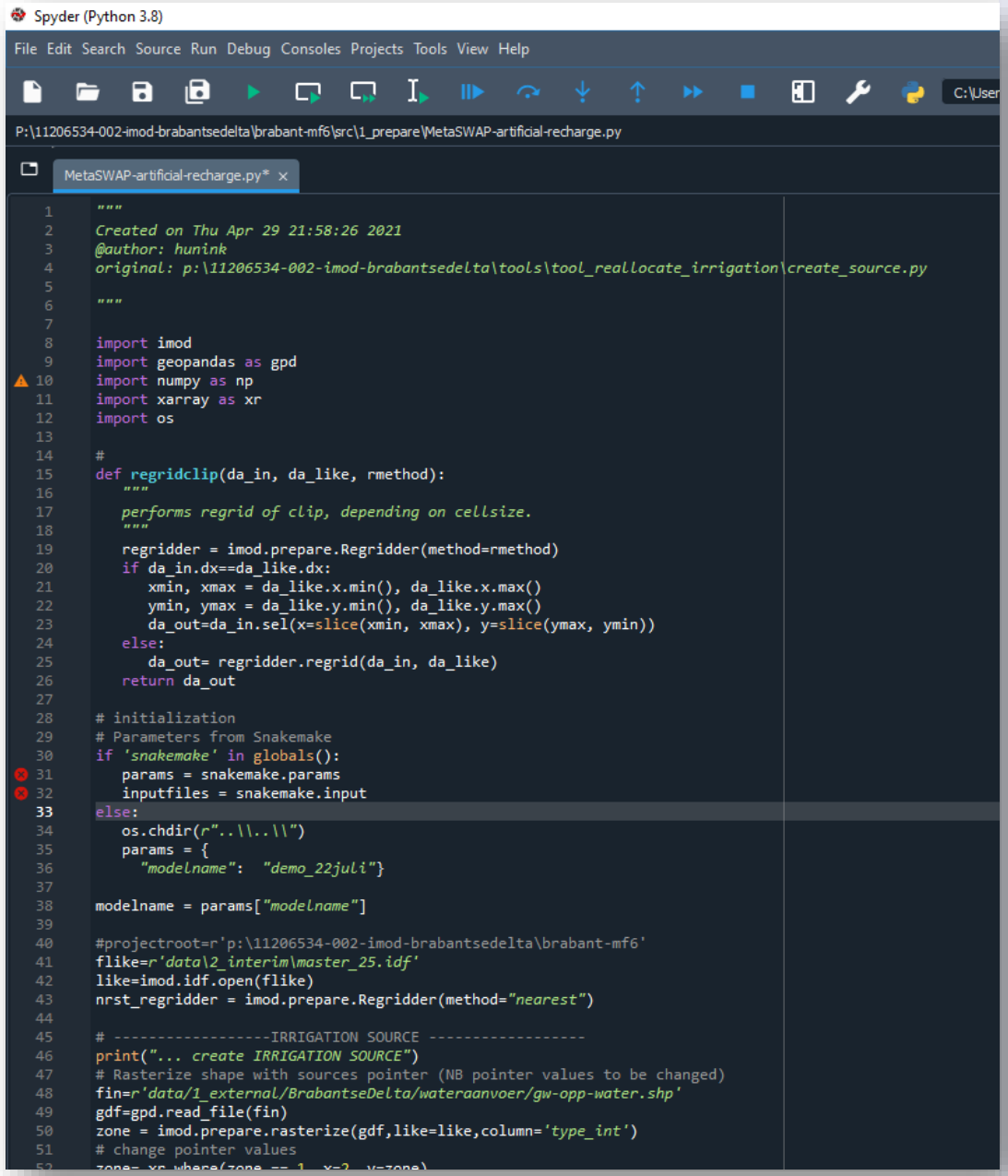
- Conversion geology. Quasi 3D → full 3D
  - *removed artificial thickness, zero thickness possible*
  - *18 layers → 37 layers*
- Import detailed Meteorological data
- Import irrigation data
- Update abstraction rates
- Riverpackage. Split to infiltrating and draining systems
- Add WOFOST parameters (model calculating growth and production of crops)

Data processing new style

Tools for pre/post processing and running the model

- iMOD5 (batch)
- iMOD Python
- Snakemake…






```
"""
Created on Thu Apr 29 21:58:26 2021
@author: hunink
original: p:\11206534-002-imod-brabantsedelta\tools\tool_reallocate_irrigation\create_source.py

"""

import imod
import geopandas as gpd
import numpy as np
import xarray as xr
import os

#
def regridclip(da_in, da_like, rmethod):
    """
    performs regrid of clip, depending on cellsize.
    """
    regridder = imod.prepare.Regridder(method=rmethod)
    if da_in.dx==da_like.dx:
        xmin, xmax = da_like.x.min(), da_like.x.max()
        ymin, ymax = da_like.y.min(), da_like.y.max()
        da_out=da_in.sel(x=slice(xmin, xmax), y=slice(ymax, ymin))
    else:
        da_out= regridder.regrid(da_in, da_like)
    return da_out

# initialization
# Parameters from Snakemake
if 'snakemake' in globals():
    params = snakemake.params
    inputfiles = snakemake.input
else:
    os.chdir(r"..\\..\\")
    params = {
      "modelname":  "demo_22juli"}

modelname = params["modelname"]

#projectroot=r'p:\11206534-002-imod-brabantsedelta\brabant-mf6'
flike=r'data\2_interim\master_25.idf'
like=imod.idf.open(flike)
nrst_regridder = imod.prepare.Regridder(method="nearest")

# -----------------IRRIGATION SOURCE -----------------
print("... create IRRIGATION SOURCE")
# Rasterize shape with sources pointer (NB pointer values to be changed)
fin=r'data/1_external/BrabantseDelta/wateraanvoer/gw-opp-water.shp'
gdf=gpd.read_file(fin)
zone = imod.prepare.rasterize(gdf,like=like,column='type_int')
# change pointer values
```

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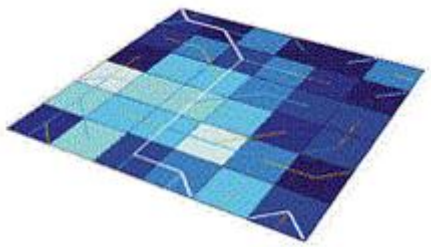
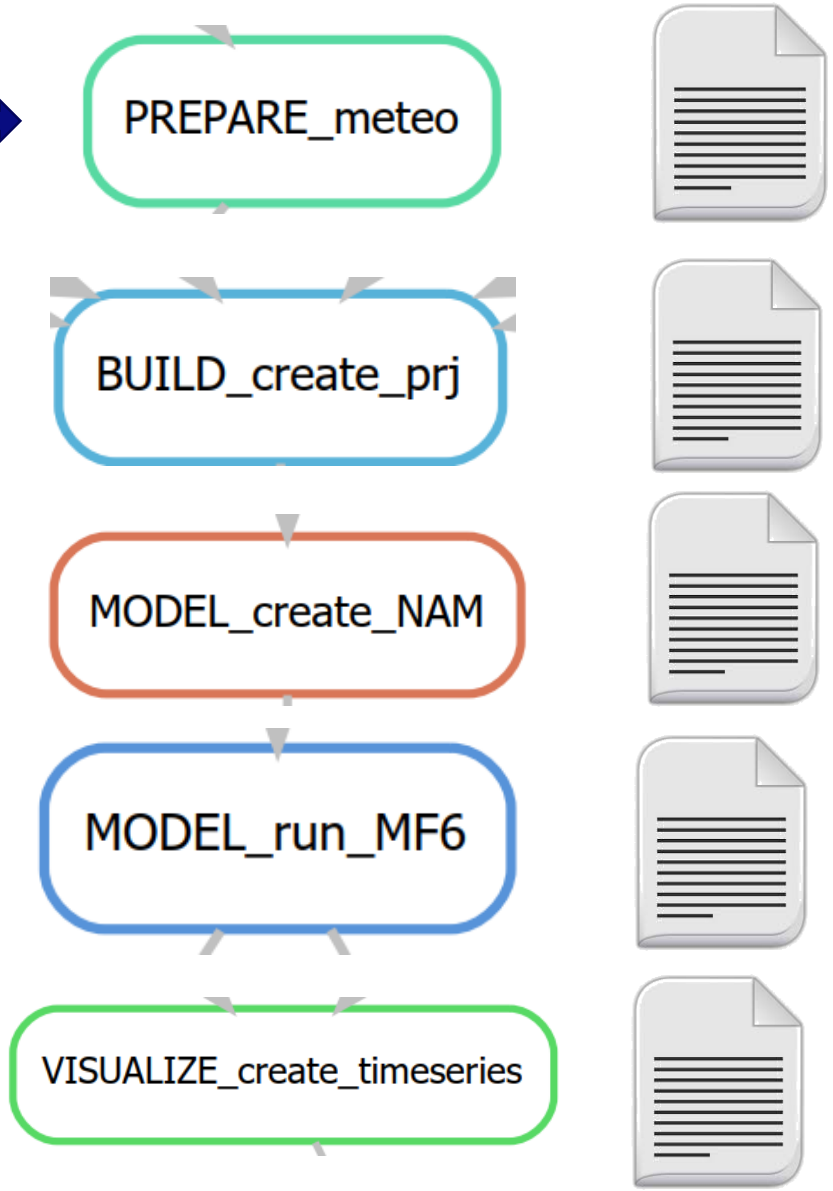
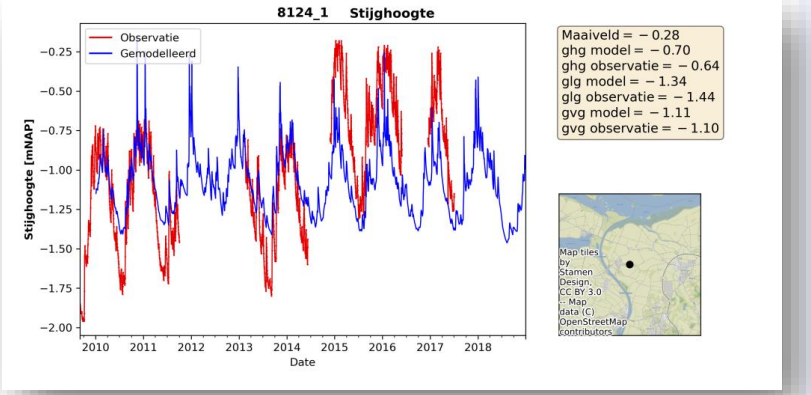
New workflow manager - Snakemake



Example: *Meteo data*





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New workflow manager

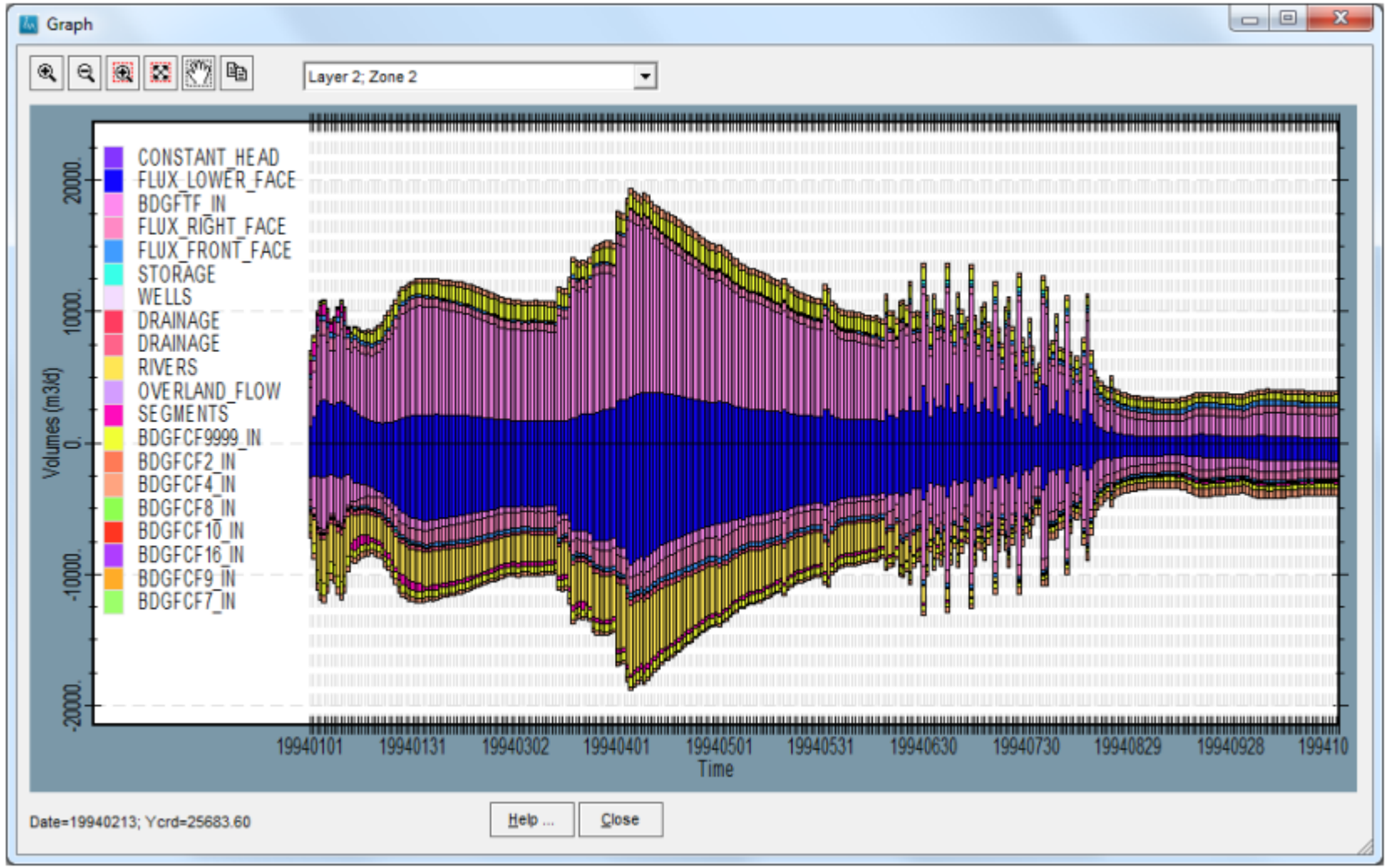
Reproducible workflow

- Data dependence of intermediate steps
- Order of execution
- After changes, only re-run dependent parts
- Transparant process
- Easy to hand over to the Waterboard

MODFLOW 6 – MetaSWAP modelrun

- 55 hours

iMOD 5 - waterbalance



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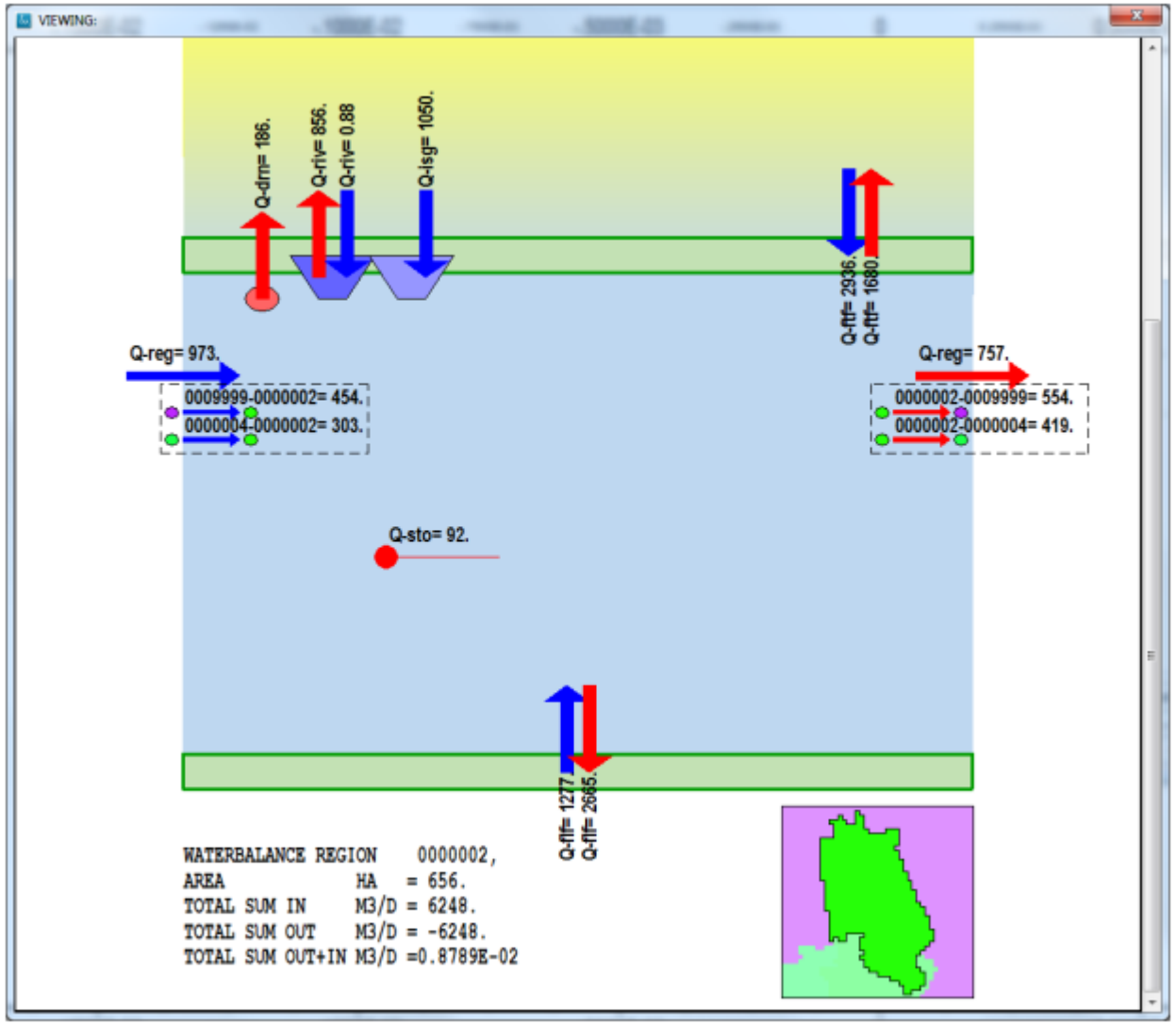
iMOD 5 - waterbalance



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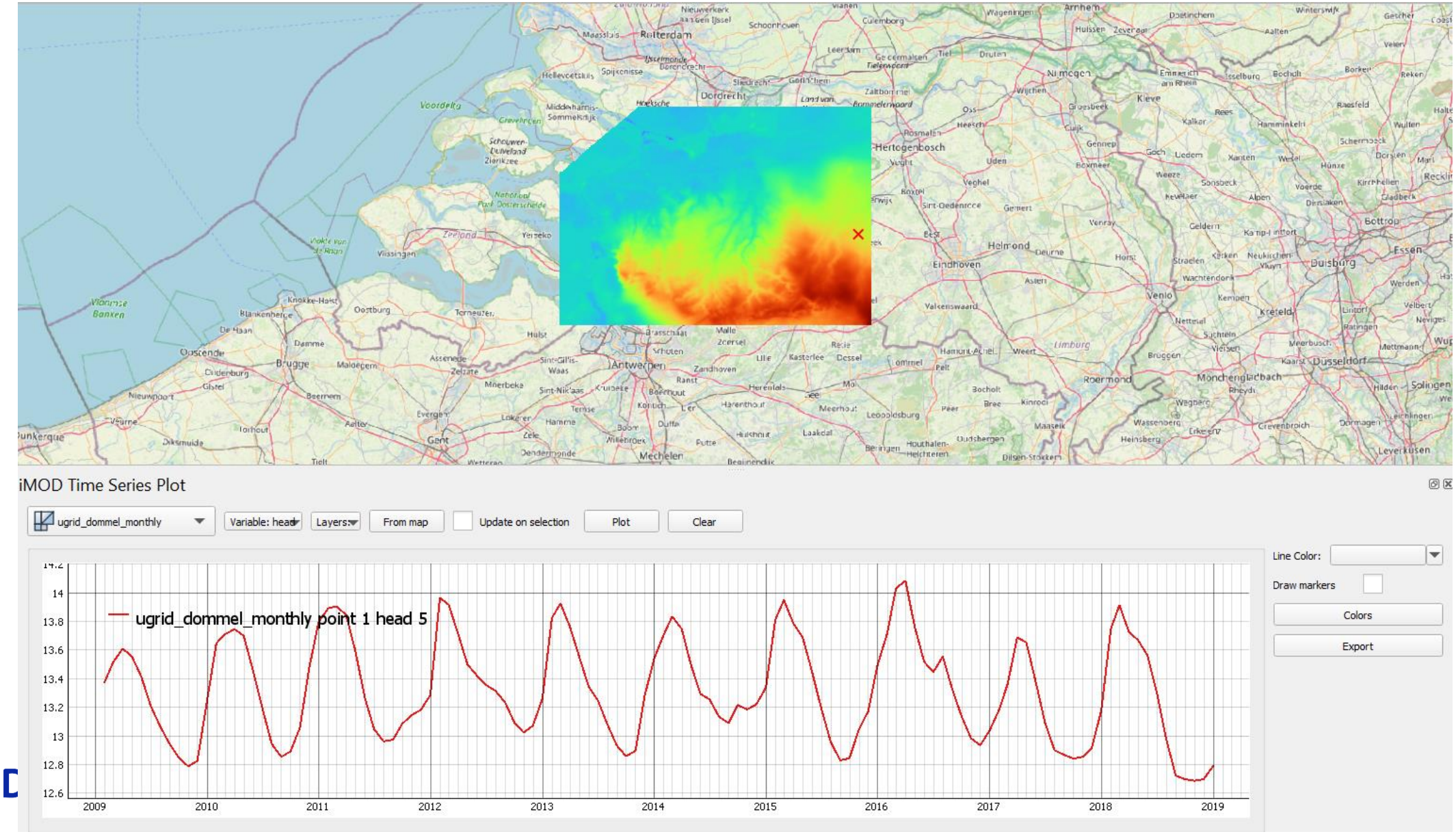
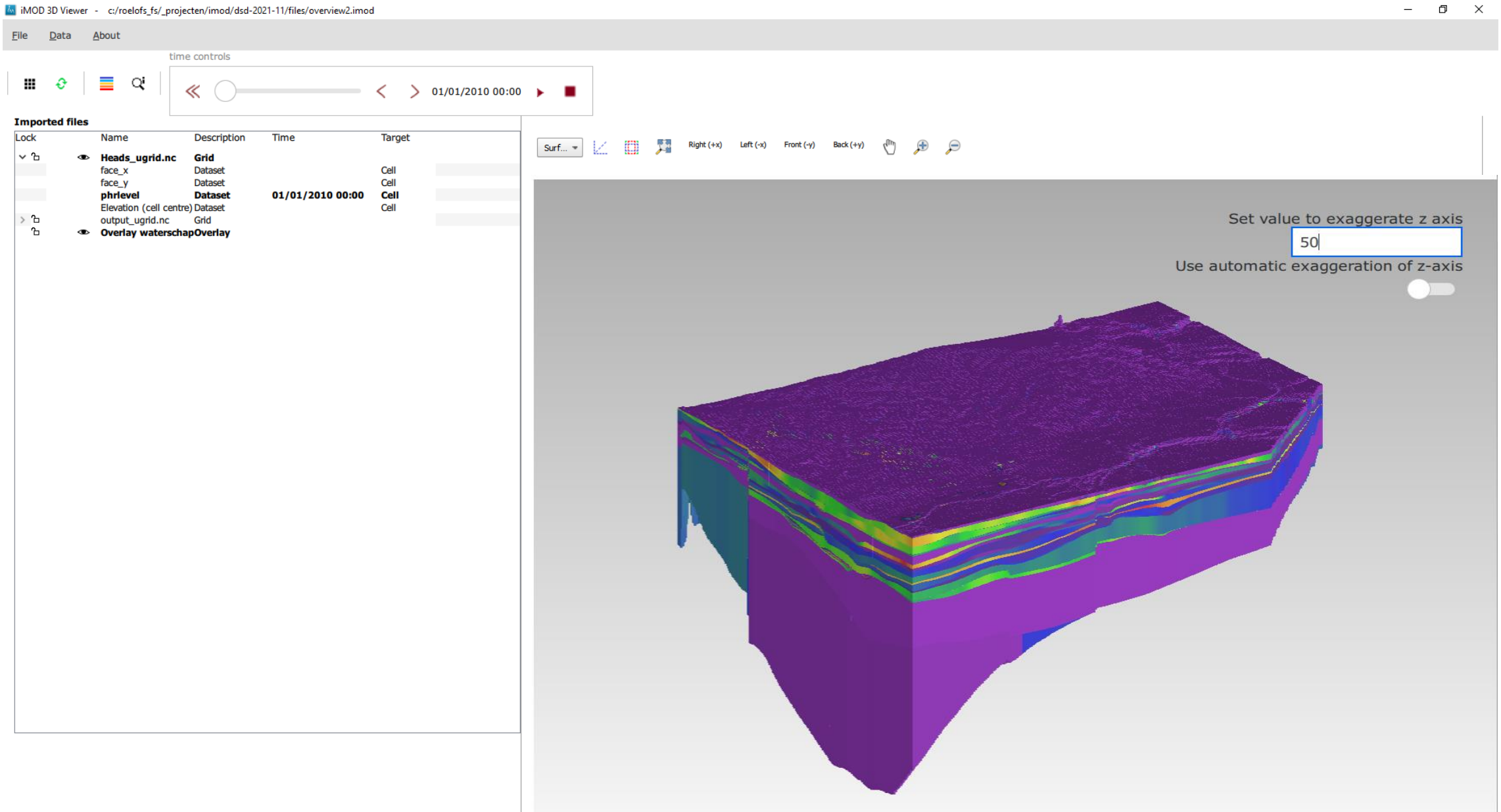
iMOD QGIS plugin



iMOD 3D viewer



Experiences

- Successful transformation MODFLOW2005 → MODFLOW6
- Successfully coupled MetaSWAP to the Brabant model
- iMOD Suite tools helpful in understanding model data (converting, viewing)
- *Snakemake* appears to be a helpful modelling process manager

Questions to Frans Roelofsen

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