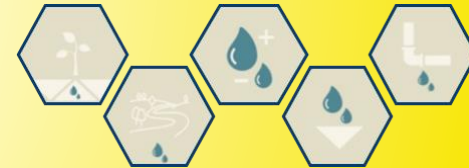


2nd International LIFE REWAT Summer School

Digital water management and water-related agroecosystem services: geostatistics, hydroinformatics and groundwater flow numerical modelling

September 9th—20th, 2019
Scuola Superiore Sant'Anna
Pisa, Italy



2nd FREEWAT International Workshop

FREEWAT Development:
new features, improvements and collaborative
development since the first public release

I. Borsi
TEA SISTEMI S.p.A.

2nd FREEWAT International Workshop –
17th September 2019 (Pisa, Italy)

FREEWAT Development:
new features, improvements and
collaborative development since the first
public release

Iacopo Borsi
TEA SISTEMI S.p.A.

FREEWAT development: Intro

- ❑ So far, **maintenance** of FREEWAT code is guaranteed by (few) persons, basically the ones mostly involved in its first development, plus helpful collaborations coming from others not included in the former Consortium (see later on).
- ❑ **Release Policy:** we are doing our best to ensure **3 releases/year**, organized as follows (policy defined according to the *QGIS-style*):
 - ✓ *Version 1.X.0* (within the end of July) – new reference release
 - ✓ *Version 1.X.1* (within the end of November) – subversion 1 of the 1.X.0
 - ✓ *Version 1.X.2* (within the end of next March) – subversion 2 of the 1.X.0
- ❑ Each version (or subversion) includes updates on the Manuals and new Tutorials (if any).
- ❑ A new release is deployed in:
 - (1) GitLab repository;
 - (2) FREEWAT website;
 - (3) official repository of QGIS plugins

FREEWAT development (since Sept. 2017): a commented Release History

- ☐ We are going to show the main improvements
- ☐ Developer(s) authored the improvements are reported in **[Orange]**
- ☐ Bugs fix is mentioned but not detailed in this presentation
- ☐ The detailed Release History is saved in file *release_history.rst* in freewat plugin folder (you can open it with any text editor)

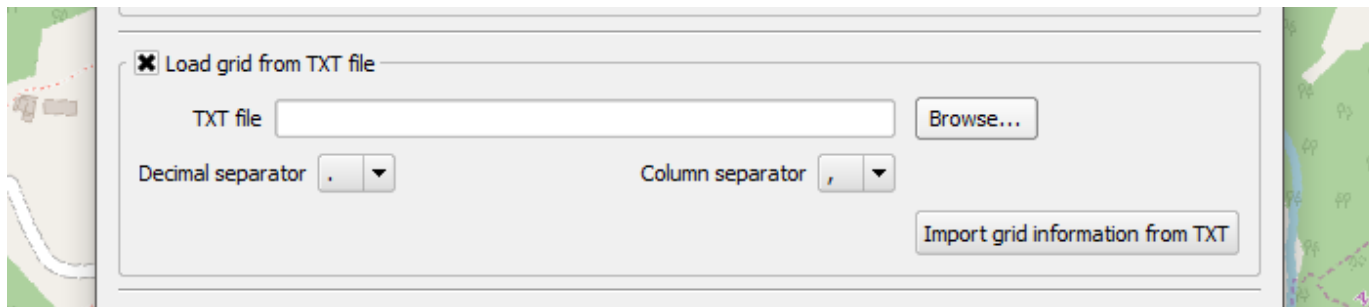
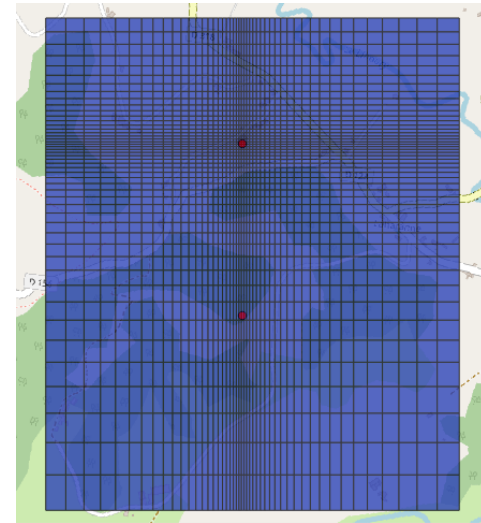
FREEWAT development (since Sept. 2017): a commented Release History

Release v.1.0.2 (March 2018)

Improvements in *Master*

- ✓ Including the possibility to create **non-regular grids** [Oliveira]
- ✓ A new tool to create a **telescopic refinement** of an existing regular grid [Borsi]

Bugs fix in: Copy to Vector, Crop Growth Module, Calibration, OAT



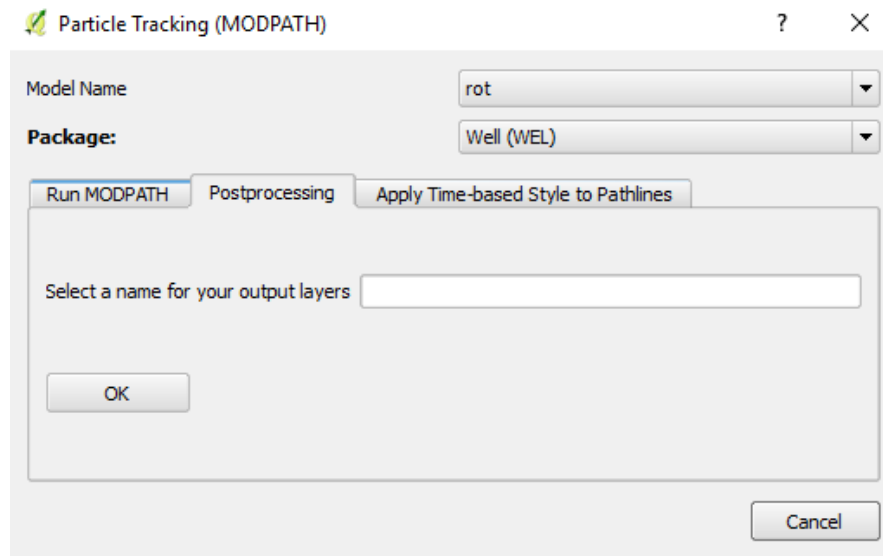
FREEWAT development (since Sept. 2017): a commented Release History

Release v.1.1.0 (July 2018)

Improvements in *Master*

- ✓ Improvement of **Particle Tracking GUI** [Borsi]

Bugs fix in: Post-processing (Plot Model fit)



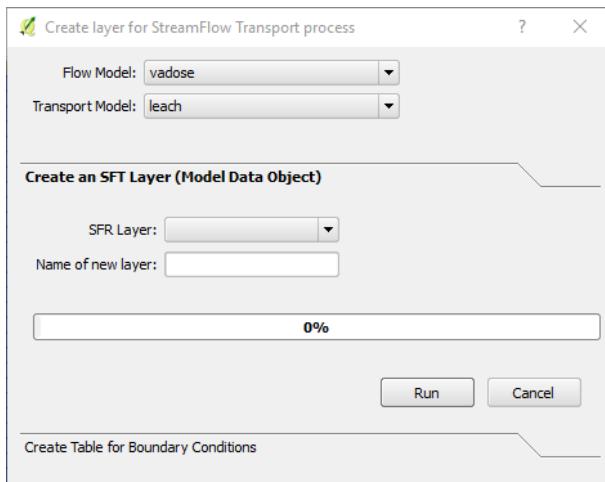
FREEWAT development (since Sept. 2017): a commented Release History

Release v.1.1.1 (November 2018)

Improvements in *Transport*

- ✓ Including two new packages for MT3D-USGS: **Streamflow Transport (SFT)** and **Lake Transport (LKT)** [DeFilippis]

Bugs fix in: Create Grid, MNW2.



Flow Model:

Transport Model:

Create an SFT Layer (Model Data Object)

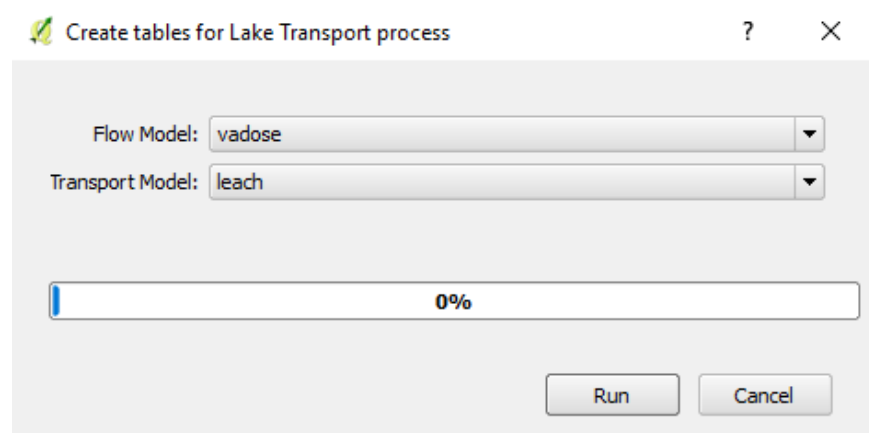
SFR Layer:

Name of new layer:

0%

Run Cancel

Create Table for Boundary Conditions



Flow Model:

Transport Model:

0%

Run Cancel

Release v.1.1.2 (March 2019)

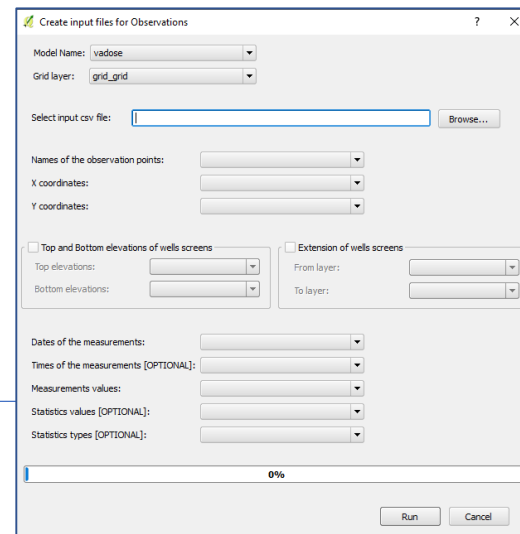
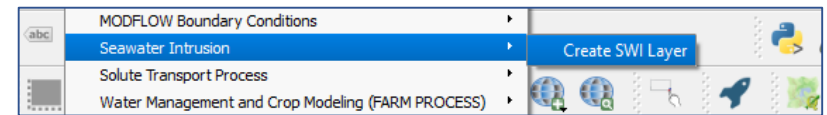
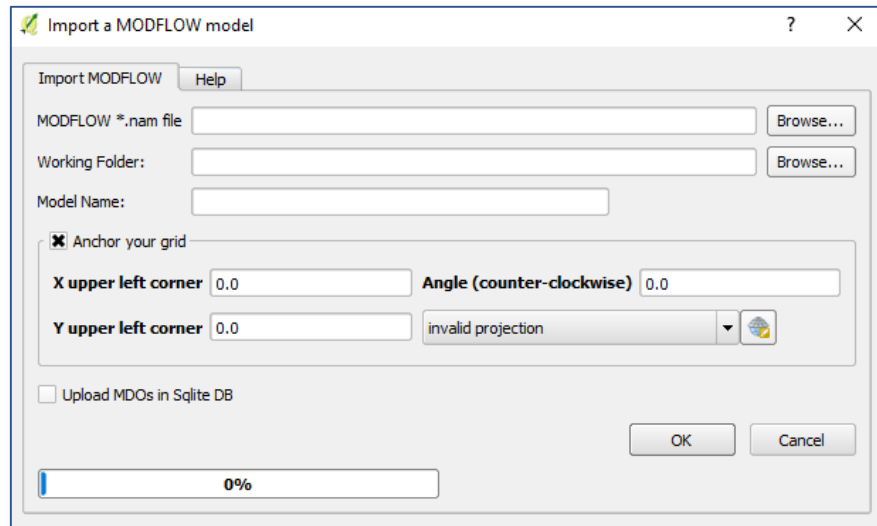
Improvements in *Master*

- ✓ Including capability to **import a MODFLOW model** [Borsi]
- ✓ Including support of **Seawater Intrusion Package (SWI2)** and extract the interface fresh/salt water as raster [Borsi]
- ✓ Improvement of **ParticleTracking** post-processing: **now working also with rotated and/or non-uniform grids** [Oliveira]

Improvements in *Calibration*

- ✓ Added a module to **automatically create input files for head observations** [DeFilippis]

Bugs fix in: Zone Budget, Installer, MNW2, Water Management,



Release v.1.2.0 (*Expected: July 2019; Scheduled: ... in few days...*)

Improvements in *Master*

(1) Including the possibility to use MODFLOW parameter **SS** as **Storage Coefficient** instead of Specific Storage [**Oliveira & Martins**]

...a new check box will appear in *Run Model* GUI

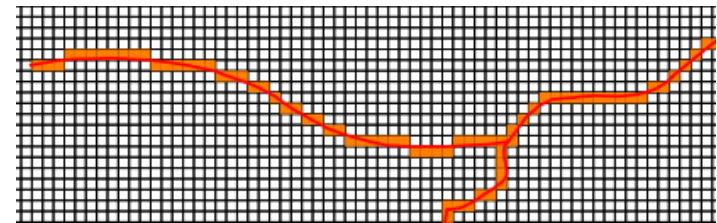
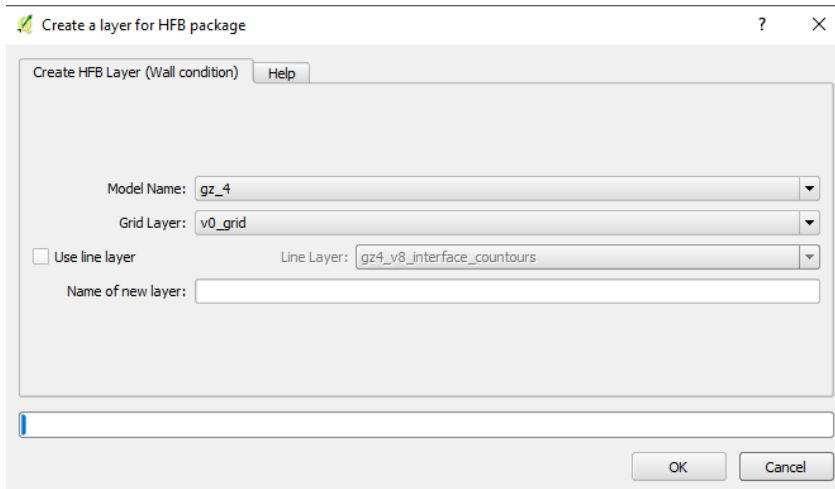
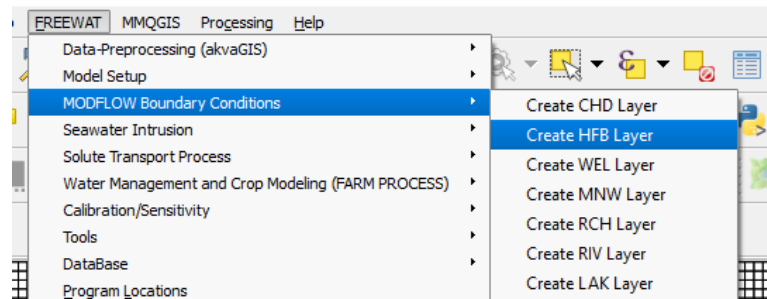
Model Parameters

☒ Column SS in model layer table is read as storage coefficient
[If unselected column SS is read as specific storage]

Release v.1.2.0 (*Expected: July 2019; Scheduled: ... in few days...*)

Improvements in *Master*

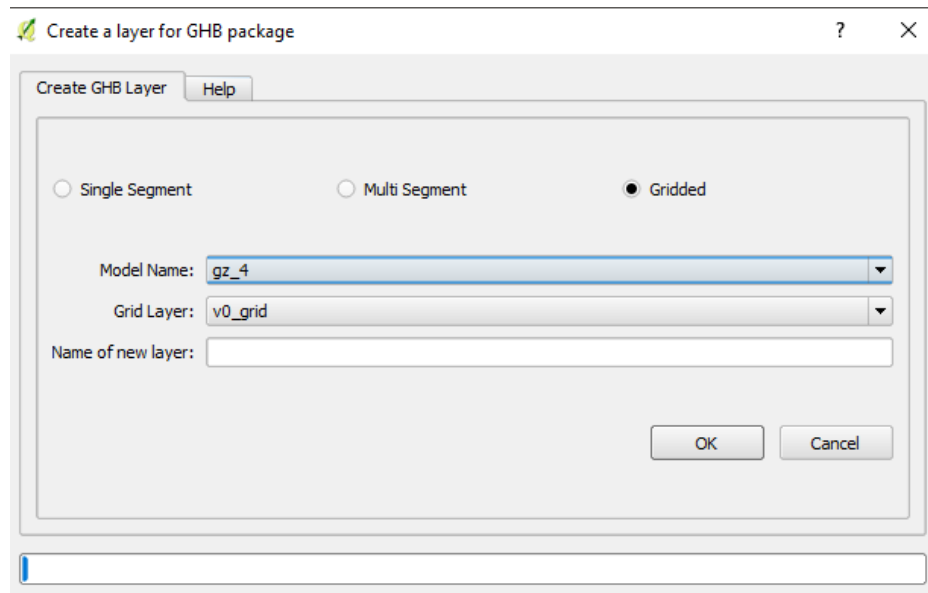
(2) Including support of **Horizontal Flow Barrier (HFB)** [Borsi]



Release v.1.2.0 (*Expected: July 2019; Scheduled: ... in few days...*)

Improvements in *Master*

(3) Option to define **General Head Boundary (GHB)** on a selection of the grid instead of having a linear input **[Borsi]**



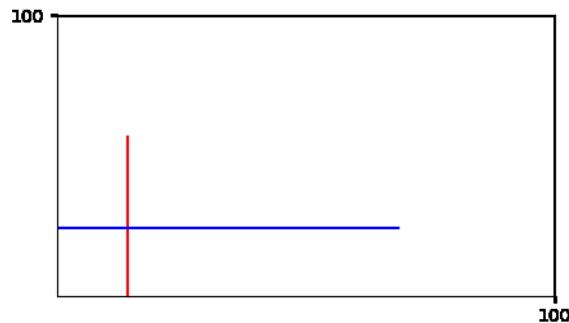
Release v.1.2.0 (*Expected: July 2019; Scheduled: ... in few days...*)

Improvements in *Post-processing*

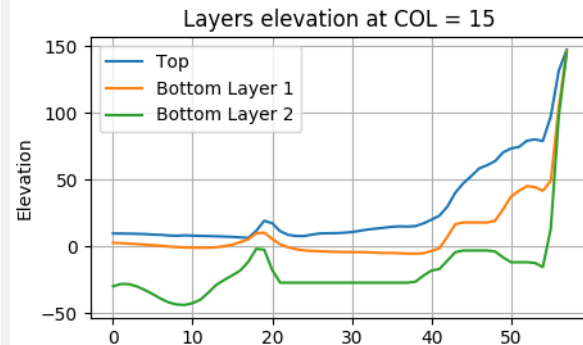
(4) Visualize **top and bottom cross sections of the grid** (even before the model run) **[Borsi]**

Plot Top and Bottom of Model layers

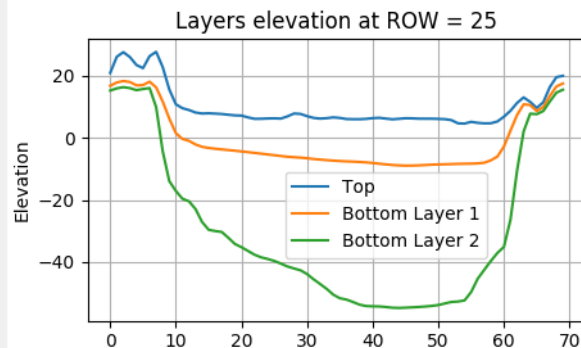
Model Name
Row Column



Navigation icons: Home, Left, Right, Zoom In, Zoom Out, Fit, Save. Coordinates: x=77.8428 y=16.7364



Navigation icons: Home, Left, Right, Zoom In, Zoom Out, Fit, Save

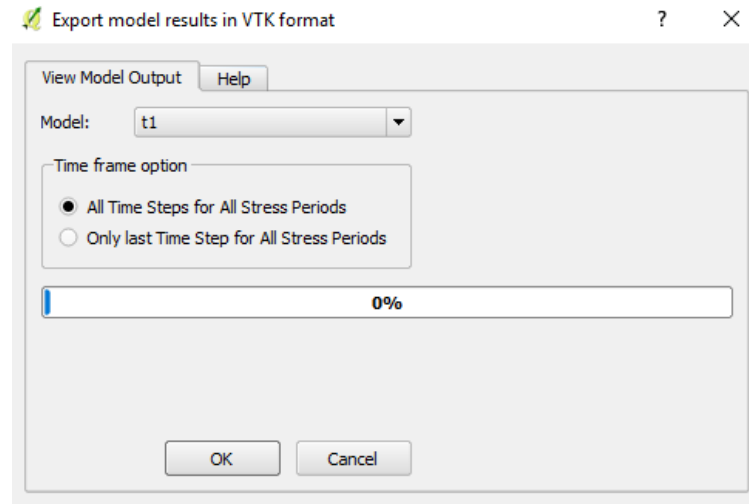


Navigation icons: Home, Left, Right, Zoom In, Zoom Out, Fit, Save

Release v.1.2.0 (*Expected: July 2019; Scheduled: ... in few days...*)

Improvements in *Post-processing*

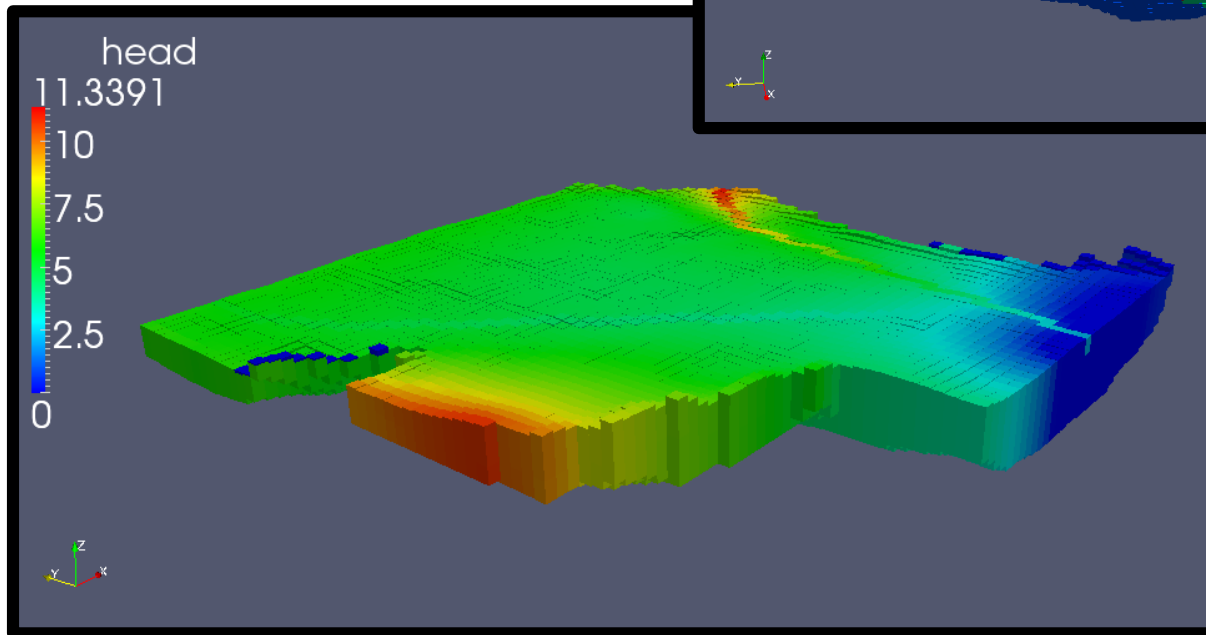
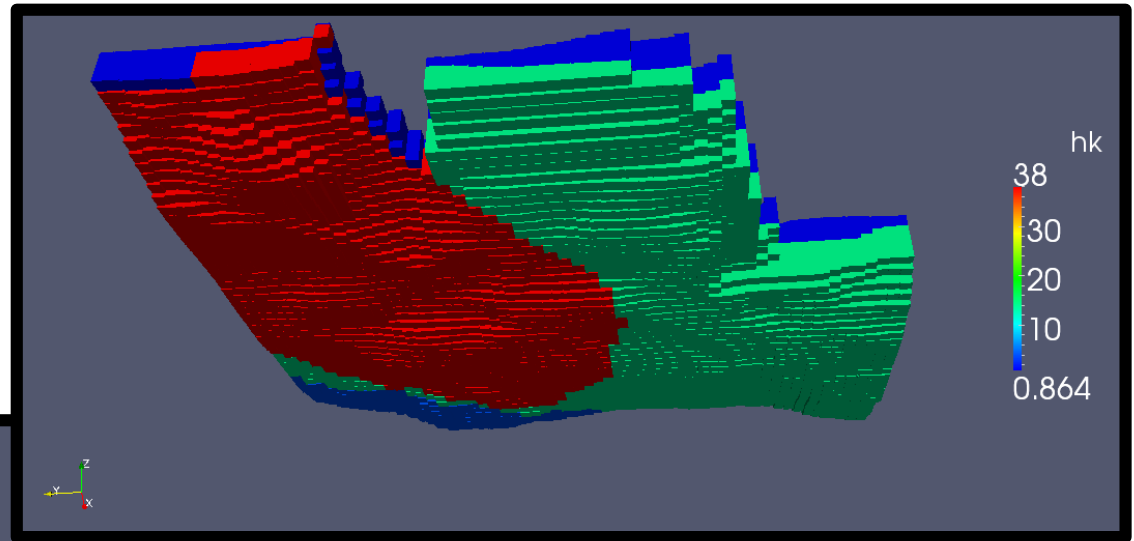
(5) Including capability to **export MODFLOW results in VTK format** [Borsi]



...and use this to get beautiful post-processing images/animations (e.g using **ParaView** free software): 3D visualization, slices, cross-section, cross-section plots, animations, etc.

Release v.1.2.0 (*Expected: July 2019; Scheduled: ... in few days...*)

Examples



Forthcoming improvements/capabilities

- ❑ Several tools to analyze the model results (e.g. maximum head change, balance error, etc.) **[Oliveira & Martins]**
- ❑ Improvements of coupling nitrates leaching through vadose zone and transport simulation in gw **[DeFilippis]**
- ❑ Tools *Open and existing Freewat model and Save as* **[Borsi]**

Interesting synergies on the way ...

- ☐ New sub-plugin to be included for **water management in karst regions**
[Group from Technical University of Munich]
- ☐ Start including support for PEST **[Borsi, Lotti, Doherty]**
- ☐ ... some others ? *If YES, get us informed during the discussion :-)*



FREEWAT

Free and Open Source Software Tools for Water Resource Management
EU HORIZON 2020 Project

SMAQua

Smart ICT tools per l'utilizzo
efficiente dell'AcQua

Interesting synergies on the way ...

SMAQua: smart ICT tools for efficient water use

What?

Contribute to
improving the
*protection of water
quality*



How?

Development and
application of *innovative
software tools* for the
analysis of spatial data (GIS,
numerical modelling)



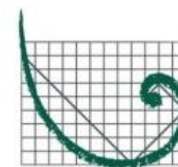
Project partners



REGIONE
TOSCANA



AZIENDA SERVIZI AMBIENTALI SpA

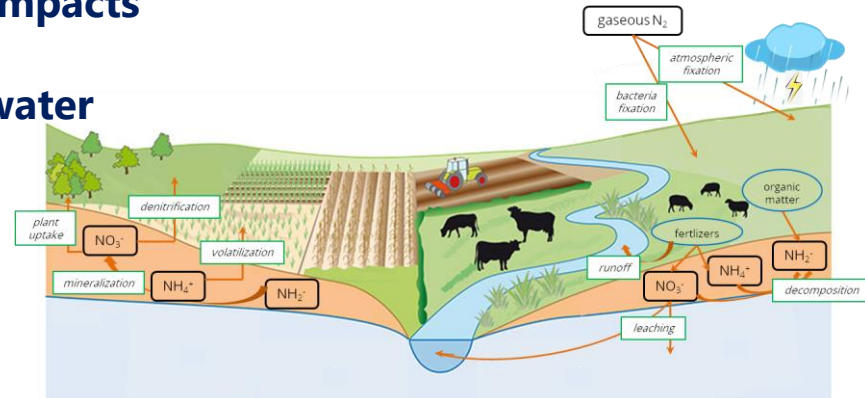


ERM

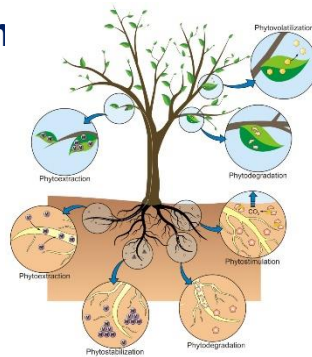
Project duration: 2018-2020

Specific objectives of the SMAQua project

Mitigating the impacts of agricultural production on water resources



Improving reclamation operations in contaminated areas



Reducing consumption in the management and distribution of drinking water

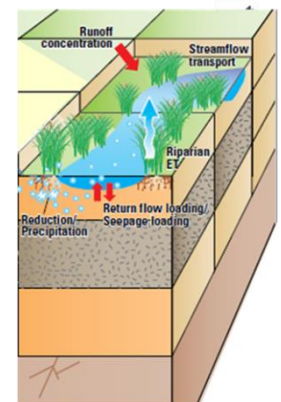


Figure from: Bedekar, V., Morway, E. D., Langevin, C. D., & Tonkin, M. J. (2016). MT3D-USGS version 1: A US Geological Survey release of MT3DMS updated with new and expanded transport capabilities for use with MODFLOW (No. 6-A53). US Geological Survey.

ESR6:

Hydroinformatics and monitoring for investigating groundwater quality changes in Managed Aquifer Recharge (MAR)

Scuola Superiore Sant'anna + TEA spa, Pisa, Italy

Integration (with potential changes) of a reactive transport module in aquifers for investigating changes occurring in the aquifer during managed aquifer recharge, with specific focus on Boron and Arsenic.



FREEWAT
Free and Open Source Software Tools for Water Resource Management
EU HORIZON 2020 Project



... and the Big Deal: Porting in QGIS3 !!

- ☐ We already started discussing this issue last year.
- ☐ Technical work: not so difficult, but it needs **time** (= **resources** = **€**)
- ☐ Estimated costs (as manpower) ~ **30 K€**
- ☐ Let's talk and propose ideas during the discussion ...

FREEWAT Development: get involved!

To support FREEWAT development, we have a Developers Community.

Anyone interested to suggest (and develop!) enhancements and/or new capabilities is welcome!!!

If you want to join us, **subscribe** to the **Developers Group**:


Join the Group!!

<https://groups.google.com/forum/#!forum/freewat-developers-group>

and you'll get involved in FREEWAT future dev.

FREEWAT Development: get involved!

Contributing is simple!

- ☐ Get an account on  GitLab
- ☐ Fork the FREEWAT official repo: <https://gitlab.com/freewat/freewat>
- ☐ Do your changes
- ☐ Submit your **Merge Request**
- ☐ Your contribution will be included in the first available release

Thanks a lot for your attention!

iacopo.borsi@tea-group.com

LIFE REWAT project partners



LIFE REWAT project co-financers



Supported by



University of Applied Sciences and Arts of Southern Switzerland

SUPSI



Patronage

