

EGU 2022 – HS6.3 – Water Level, Storage and Discharge from Remote Sensing and Assimilation in Hydrodynamic Models
Friday, May 27th2022

Estimation of water surface elevation and discharge for rivers with SWOT

Tools4swot: a Python tool dedicated to the generation
of inputs for SWOT simulators from river hydrodynamics
model outputs

Funding from CNES

S. Ricci (CERFACS), C. Emery (CSGROUP-France), A. Piacentini (CERFACS)

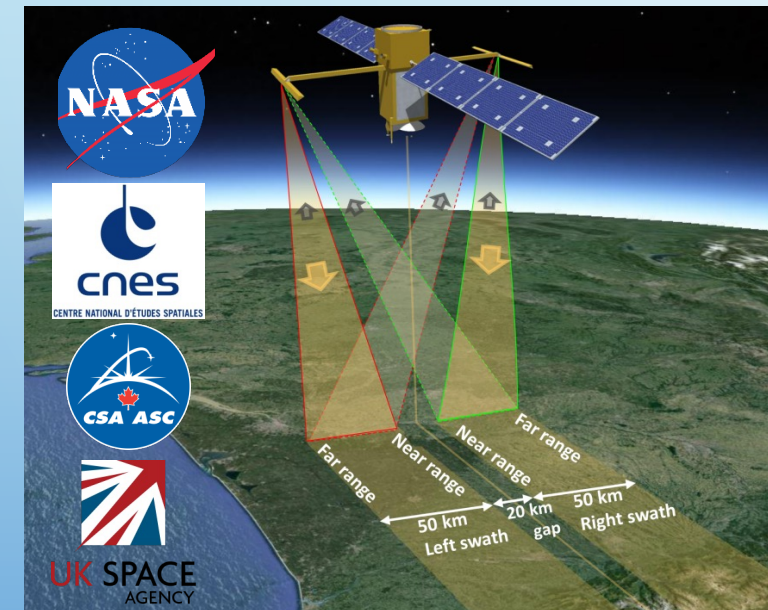
Acknowledgments: I. Dast , D. Desroches, D. Carbone, H. Oubanas, P.-O. Malaterre, K. Larnier, V. Laborie, N. Picot, SWOT Project@CNES (CNES, INRAE, INSA-IMT, CEREMA, LHSV, EDF, ...)

THE SWOT MISSION
WHY TOOLS4SWOTHR ?
PRINCIPLE
HOW TO GET TOOLS4SWOTHR
APPLICATIONS

THE SURFACE WATER AND OCEAN TOPOGRAPHY MISSION 2

The Surface Water and Ocean Topography Mission (SWOT) will observe the elevation of ocean and inland water at an unprecedented resolution, with a global coverage and a 21 day repeat period

The on-board Ka-band Radar Interferometer will measure the radar return signal at near-nadir incidence angles. The SWOT project further estimates river height, width, slope and discharge.



The hydrology community seeks to demonstrate that the predictive capabilities of hydrological models will be greatly improved by the assimilation of SWOT data jointly with other remote sensing and in-situ data.

As of today, pre-launch studies rely on the use of synthetical SWOT-like data produced by SWOT simulators such as SWOT-HR and SWOT-GE.

Objective of SWOTHR: Generate SWOT-like data from hydrodynamics model outputs

SWOT-HR simulates the SWOT observation assuming that the reality is represented by a 2D scene of water level, simulated by a hydrodynamic model.

Objective of Tools4SWOTHR: Provide inputs for SWOT-HR and SWOT-GE simulators

Hyp: The simulated water elevation is either a 1D or 2D field, possibly computed over an unstructured mesh and at each model time step.

What: Post-treat 1D/2D model outputs into expected data format file for the simulators

- Map 1D int-fo into 2D
- Map 2D meshed info to 2D gridded
- Sample model outputs in time according to SWOT pass plan

Tools4SWOTHR is a chain of python scripts that formats hydrodynamic model outputs into a temporal sequence of water elevation raster data files, thus providing inputs for the SWOT-HR/SWOT-GE simulators.

Developments : In the framework of the SWOT project@CNES

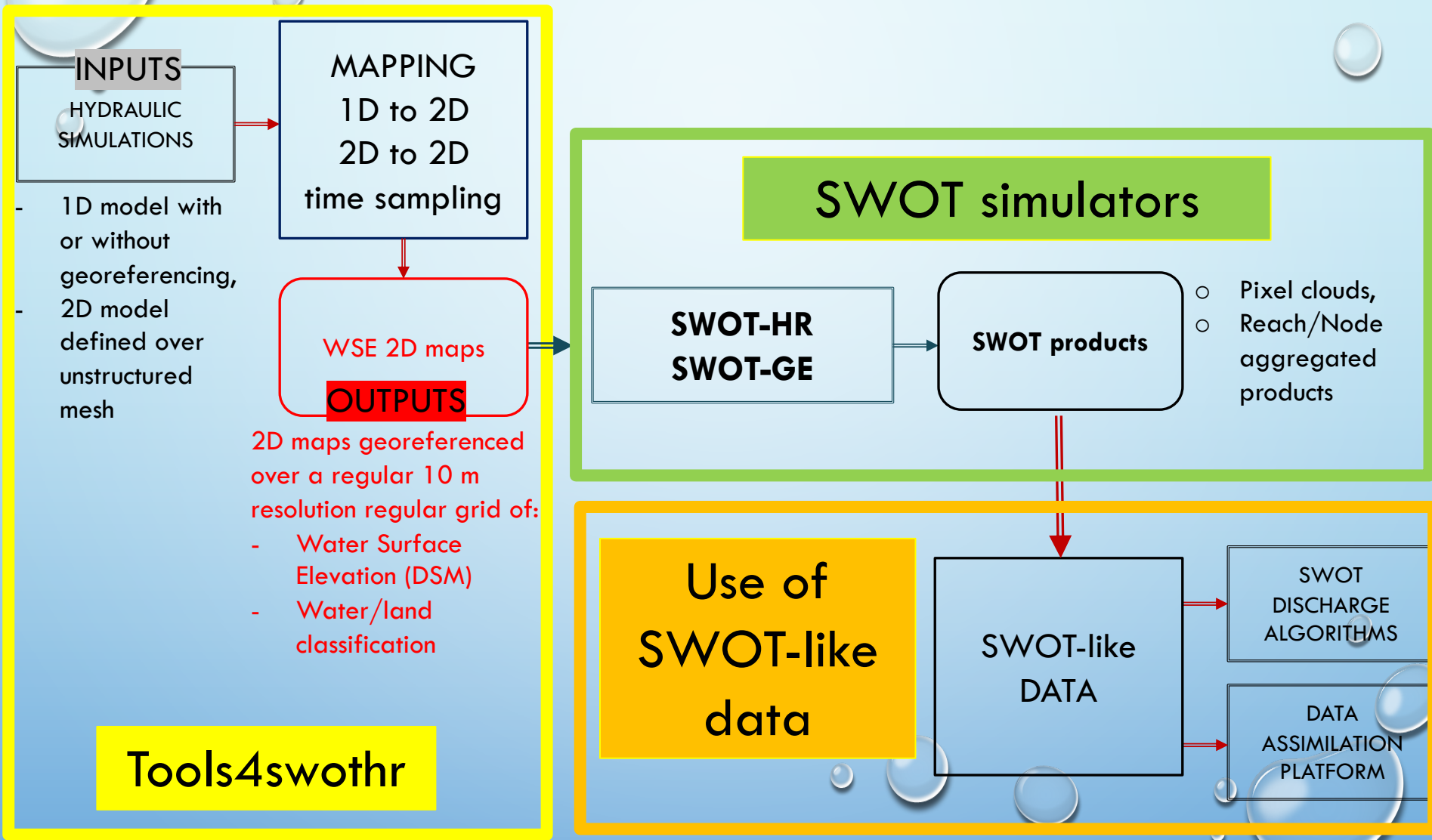
- SWOT-DAHM (PI H. Oubanas, INRAE) on discharge estimation
- SWOT-3MC (PI B. Laignel, Univ. Rouen) on estuaries

Over the past years, we have:

- identified needs from various teams,
- proposed technical solutions,
- validated the proposed strategy.

Today's focus :

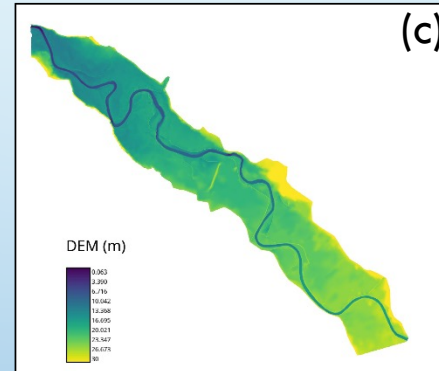
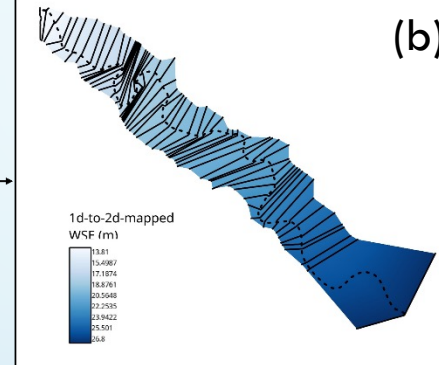
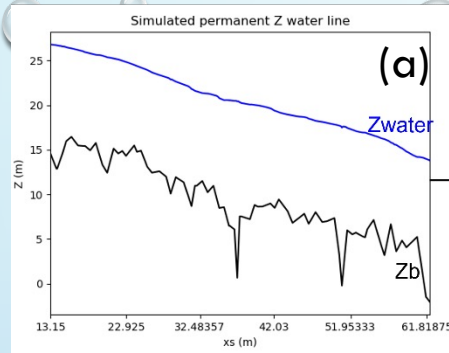
- Make these developments available for users in the SWOT community
- Make the resulting SWOT-like data available for users in the SWOT community



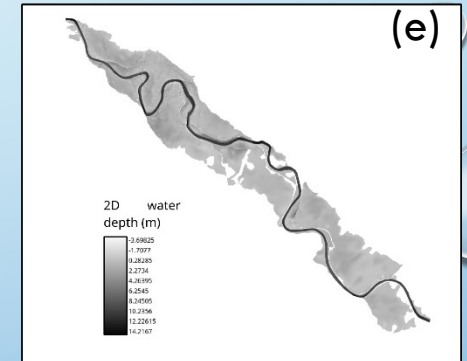
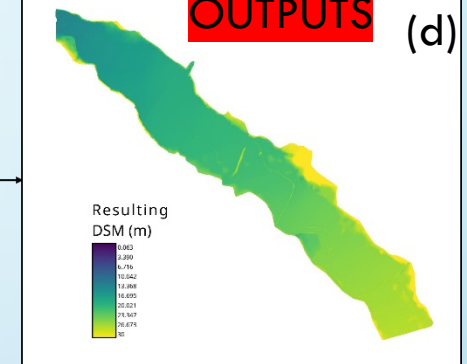
APPLICATIONS: (1) FULLY-KNOWN 1D MODEL

Garonne river in France, 1D Mascaret model @EDF

INPUTS



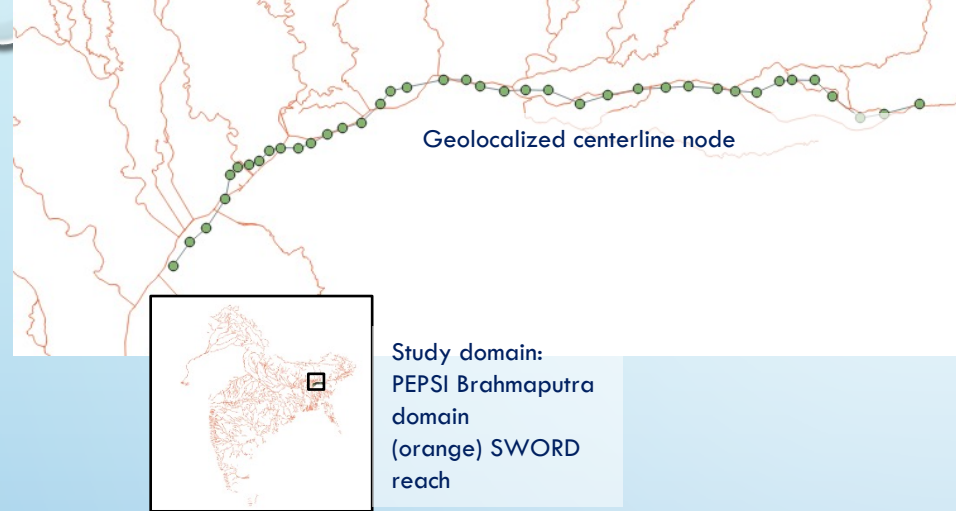
OUTPUTS (d)



Fully-controlled study domain and modeling:

- [in] 1D-model output file (a),
- [in] Geolocalized cross-sectional profiles along 1D centerline (b)
- [in] 2D bathymetry+topography CONSISTENT with 1D-model (c)
- [out] 2D DSM (d)
- [out] 2D maps of water depths (e)

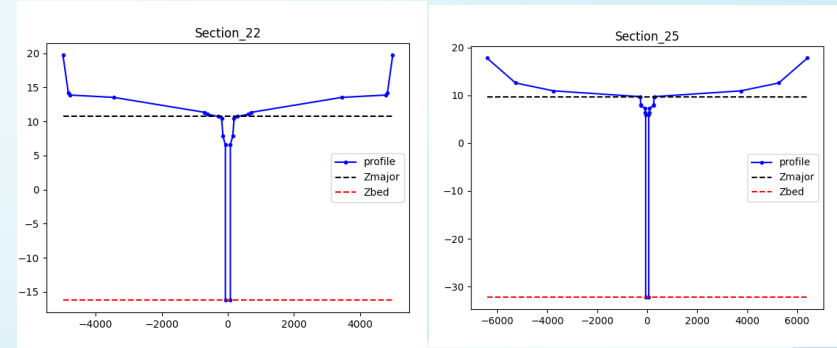
Brahmaputra river in India, 1D SIC model @INRAE



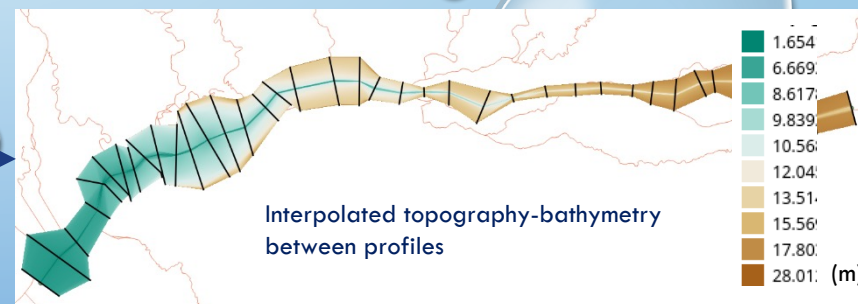
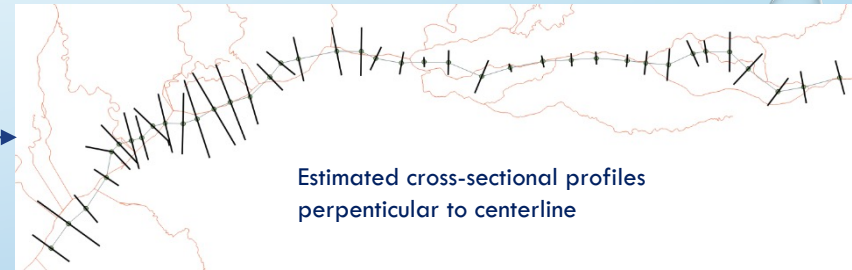
⇒ 1D model with limited
georeferenced info:

- [in] 1D-model output file,
- [in] 1D-model geometry file with limited geolocalization
- NO cross-sectional profiles
- NO 2D bathymetry+topography

+



Shape of cross-sectional profiles



- **Tools4swothr** is a **Python** tool that manipulates hydrodynamic model outputs into inputs for SWOT-HR and generate SWOT-like data
- It is **open source**
<https://gitlab.com/cerfacs/globc/tools4swothr>
- For friendly use, it runs on a **container**
<https://gitlab.com/cerfacs/globc/tools4swothr-singularity>
- Applied for 1D/2D outputs from MASCARET, SIC, DASSFLOW, TELEMAC2D
- It relies on several hypothesis and knowledge that may vary **for known and unknown cathments**
- Applied for Garonne-upstream (**DassFlow-1D**), Garonne-downstream (**Mascaret**), Bramaputra (simplified Pepsi river, **SIC**), Seine (**Telemac2D**), Gironde (**Telemac2D**)

The background features a satellite with large blue solar panels and a gold-colored body, positioned against a grey space backdrop with white stars. Several realistic water droplets of various sizes are scattered across the scene, some appearing to float in the foreground and others near the satellite.

**HAPPY TO SHARE, LEARN AND
COMPLETE FOR GENERAL USE IN THE
SWOT COMMUNITY**

THANK YOU FOR YOUR ATTENTION

ricci@cerfacs.fr

charlotte.emery@csgroup.eu