

Discharge Algorithms Intercomparison

Coming algorithms : Pepsi Challenge 1

Hind Oubanas, Renato Frasson, Kévin Larnier

A black and white photograph of a satellite in orbit above the Earth. The satellite is the central focus, with its solar panels and various instruments visible. The Earth's curved horizon is visible below, showing cloud patterns and the dark space of the atmosphere. The background is a starry field of distant galaxies and stars.

Igor Gejadze, Pierre-Olivier Malaterre, Félix Billaud
S. Ricci, I. Mirouze, N. Goutal, S. El Garroussi, M. De Lozzo
Kostas Andreadis

Coming algorithms

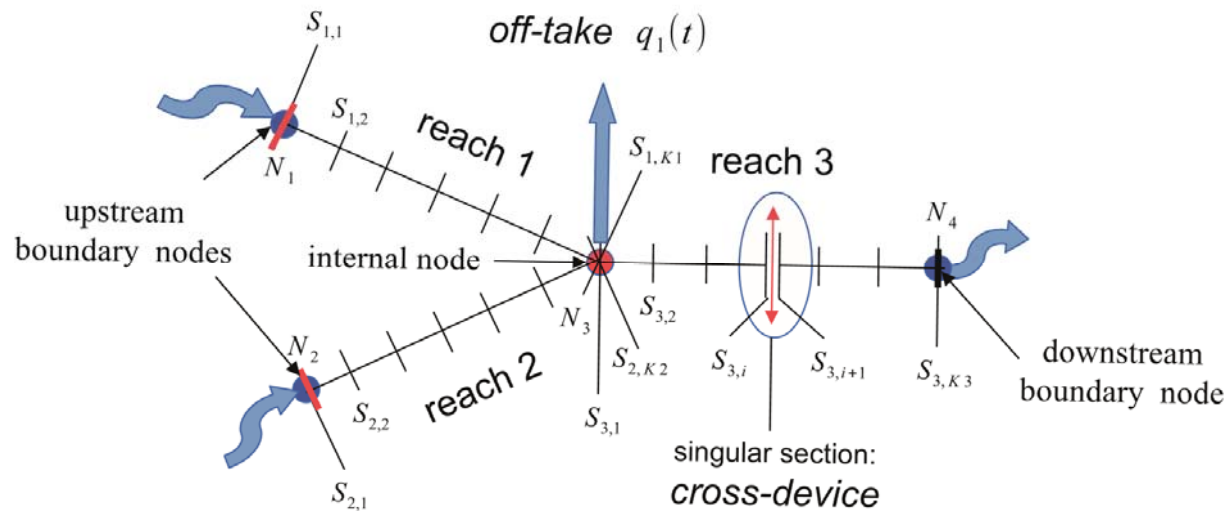
Irstea : **SIC4DVar**

Cerfacs / EDF : **Mascaret + EnKF**

Umass Amherst : **SADS**

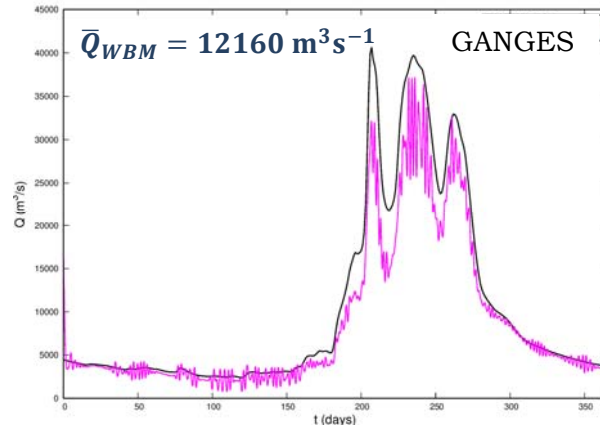
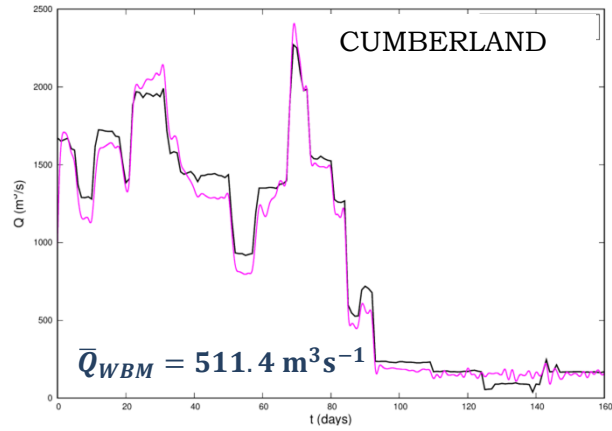
And maybe more ...

SIC4DVAR

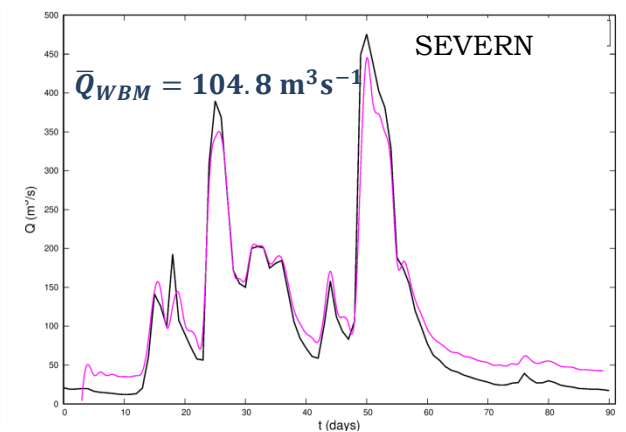
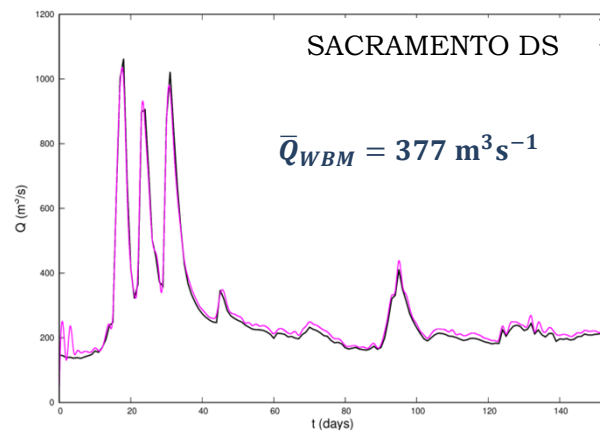
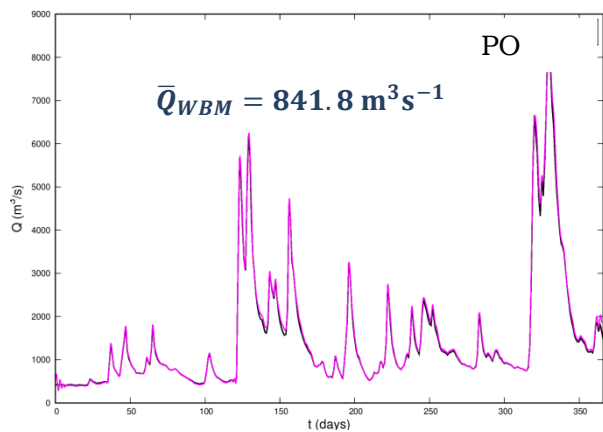
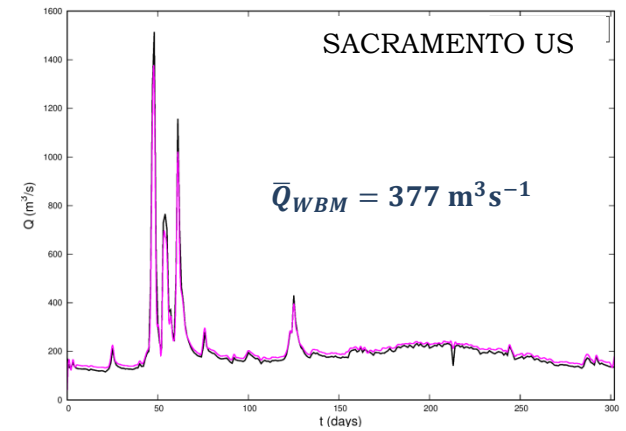
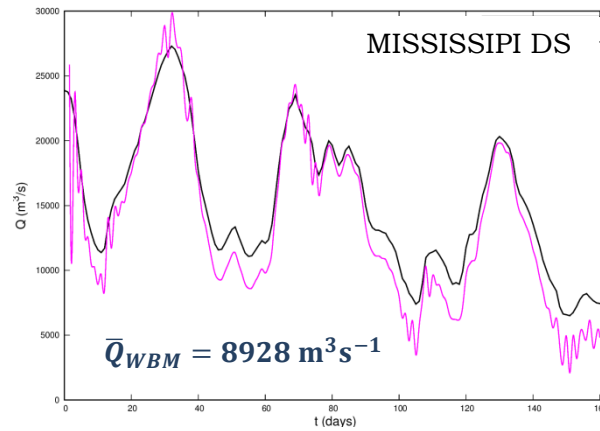
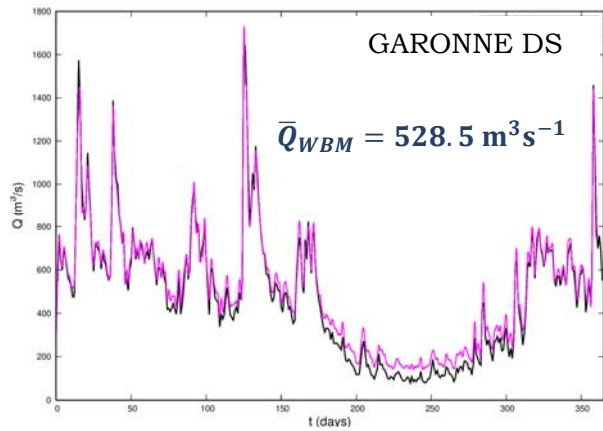


- Simulation and Integration of Controls for Channels: SIC².
- Full Saint-Venant hydraulic model.
- Variational data assimilation : variant of the 4D-Var.
- New version of the algorithm :
 - Improved priors (dry & wet bathymetry).
 - Optimized version (Memory) & Robustness.
 - Weirs, dams, drops, etc.
 - Constrained minimization (double inequality constraint).
- Validation phase : Pepsi challenge 1.
- **CPU TIME ~30 min one-year period.**

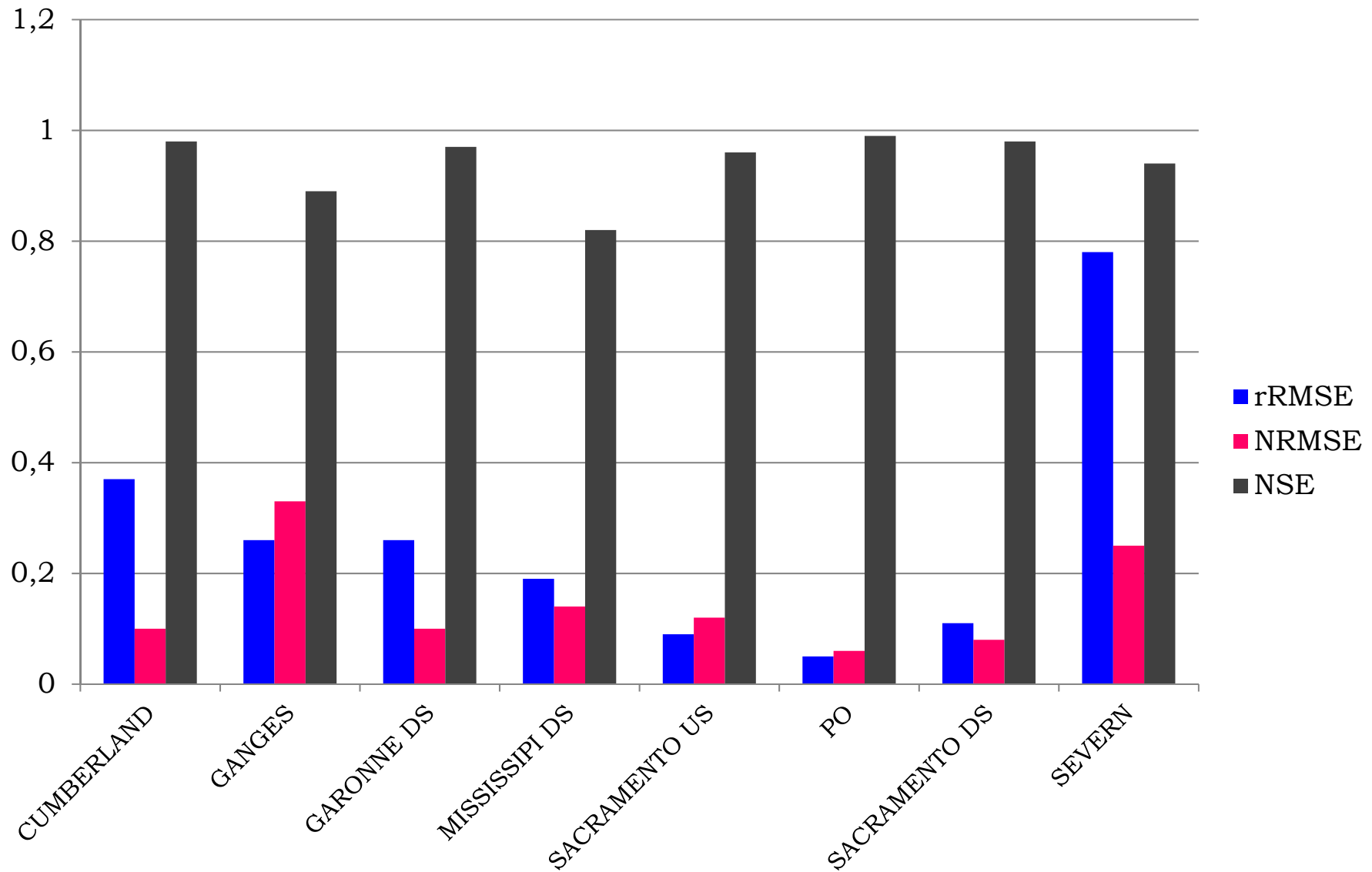




— TRUTH
— ESTIMATE



PRELIMINARLY RESULTS : PEPSI CHALLENGE 1

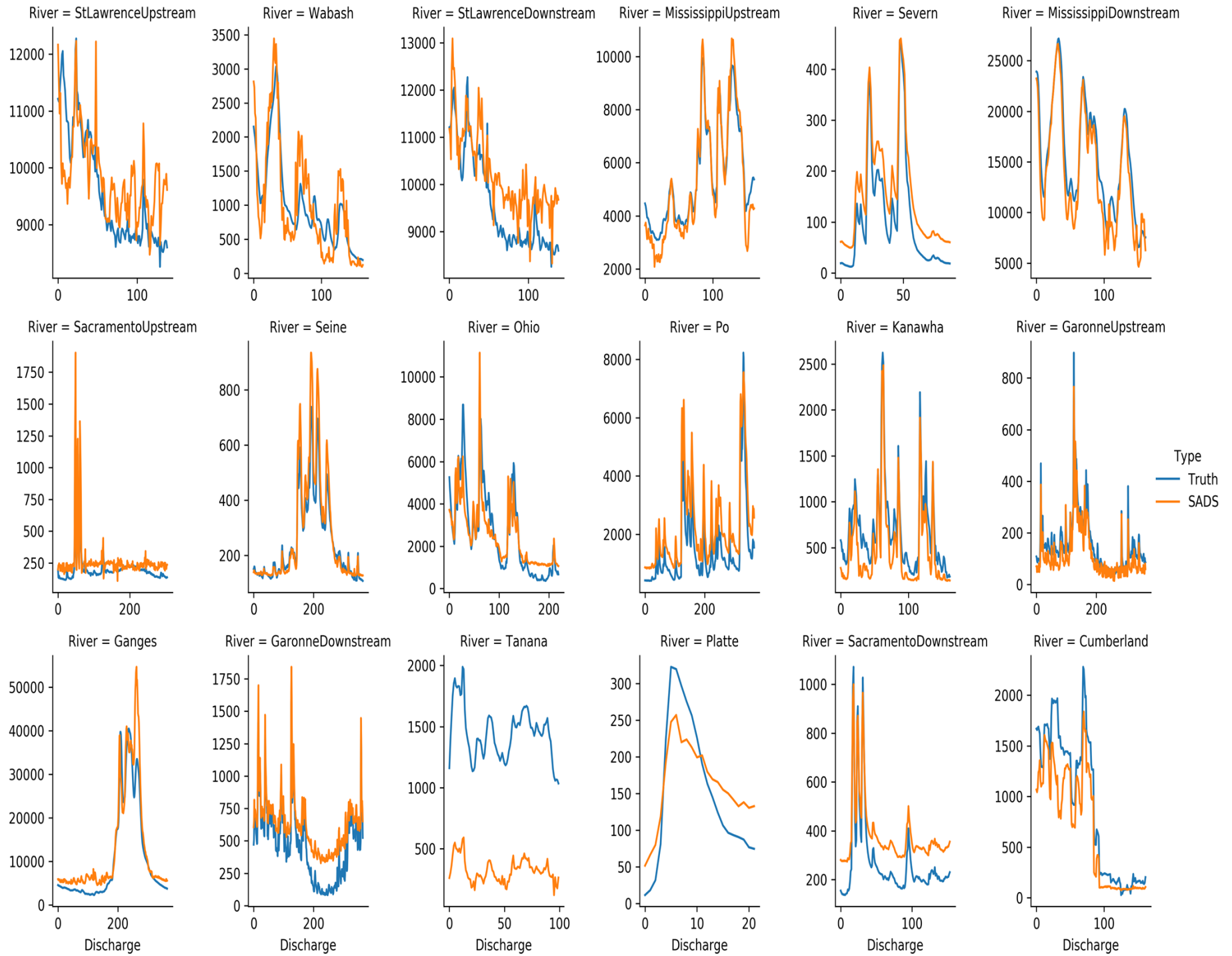


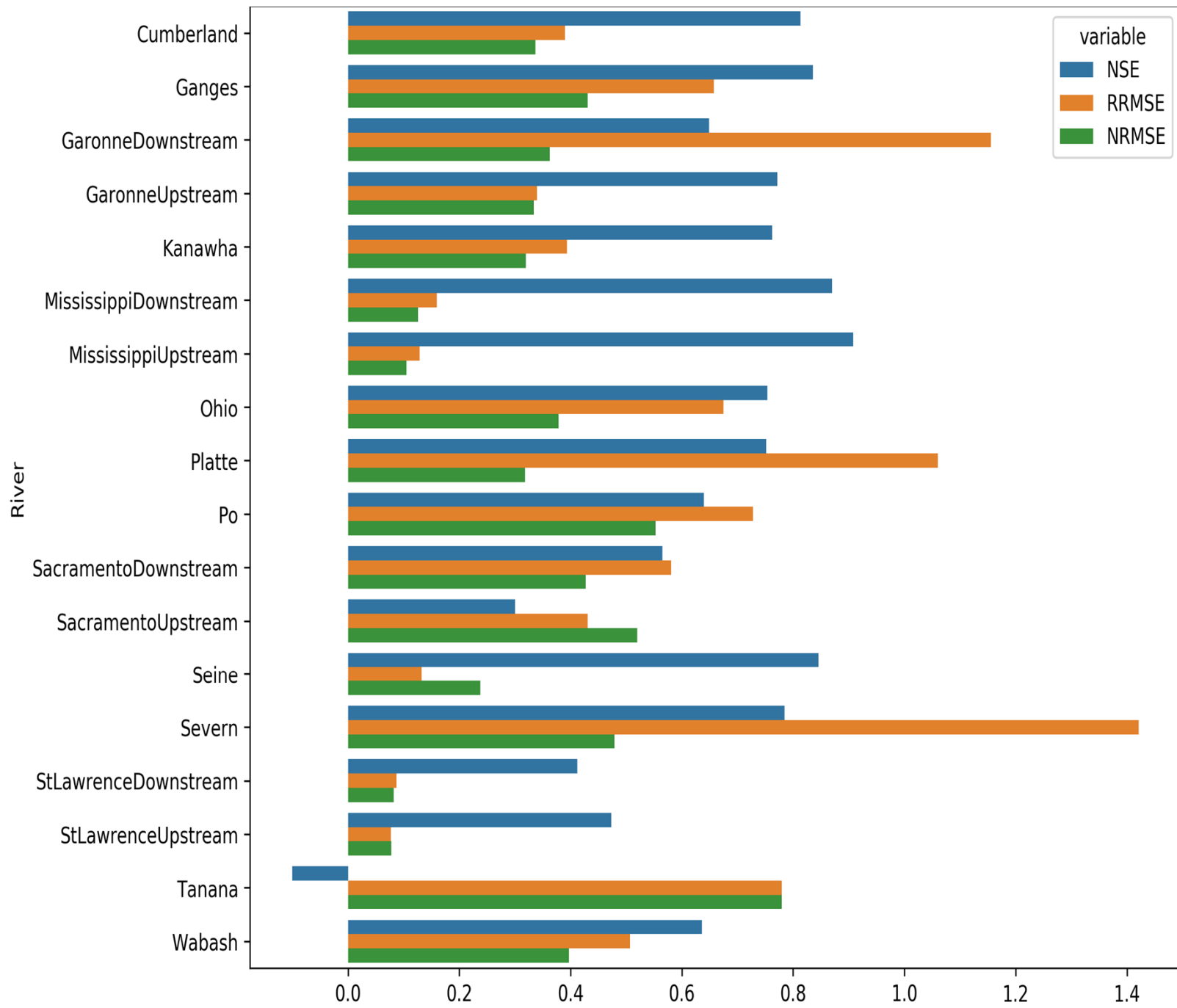
SADS



- SWOT Assimilated DiScharge
- Combines a LETKF assimilation scheme and the 1-D gradually varied flow equation
- Represents river channels using hydraulic geometry formulation.
- Before assimilation it derives prior distributions (bed elevation and discharge) using rejection sampling methods.
- Computational cost and data requirements low enough to allow global implementation.

<https://github.com/kandread/Sads.jl>



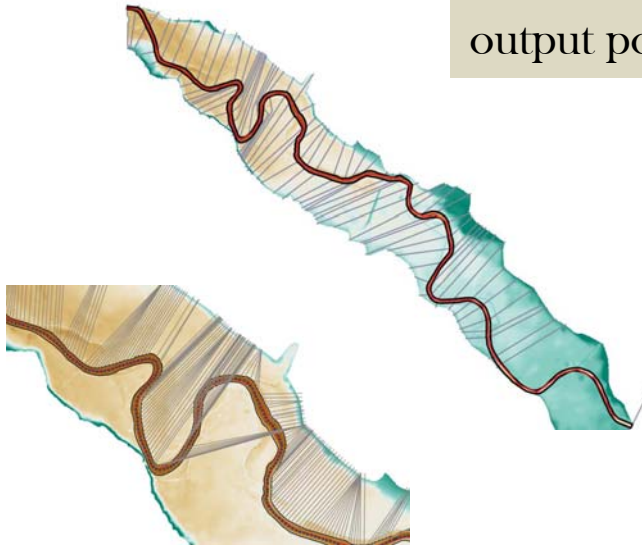


SWOT-like data generation with SWOT-HR

Well known catchment - Garonne downstream river

- Simulated 1D water level output as reference
- 2D mapped water level input to SWOT-HR (water depth +DEM)

Automatic Py script for 1D model
output post-processing



(L. Martin, intern)

Unknown catchment

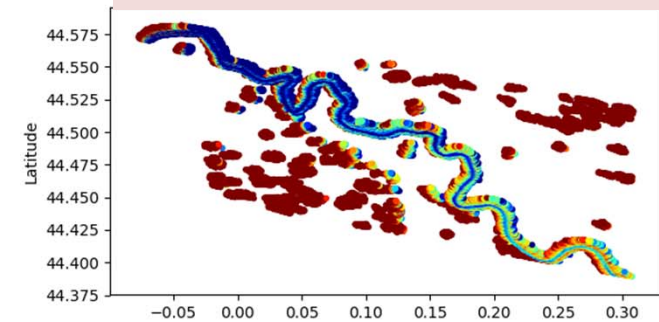
- 2D topography retrieved from SWOT (IRSTEA) or DB.
- Geolocalized river bed and model output
- 2D transects

Observation scenario for SWOT with various

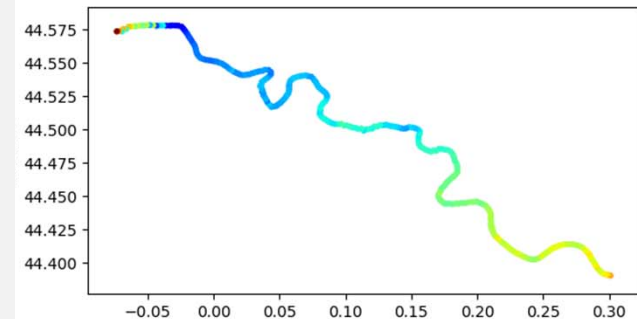
- spatial and temporal resolution
- observation error
- Combine with other observations (in-situ, other missions)



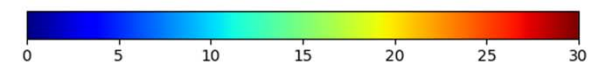
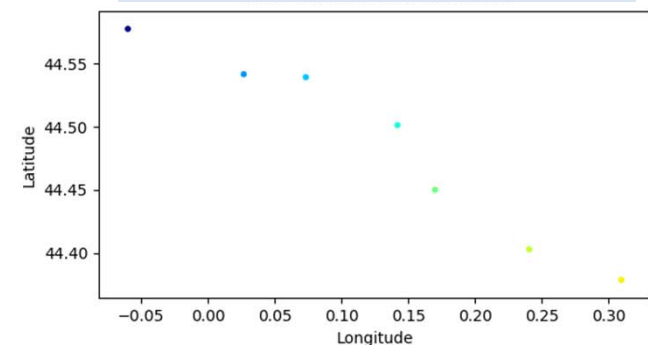
Pixel cloud data



River point data (200m)

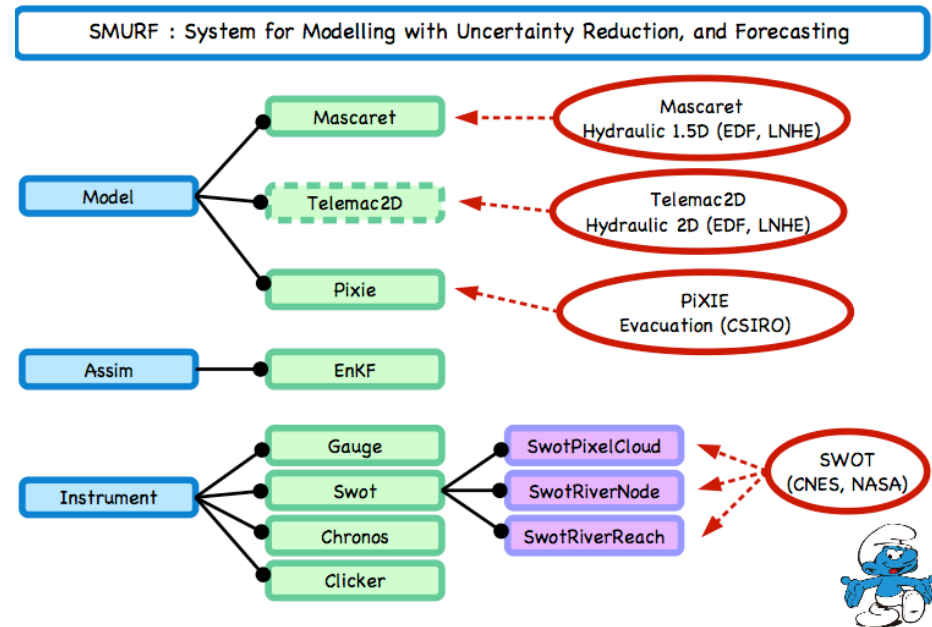
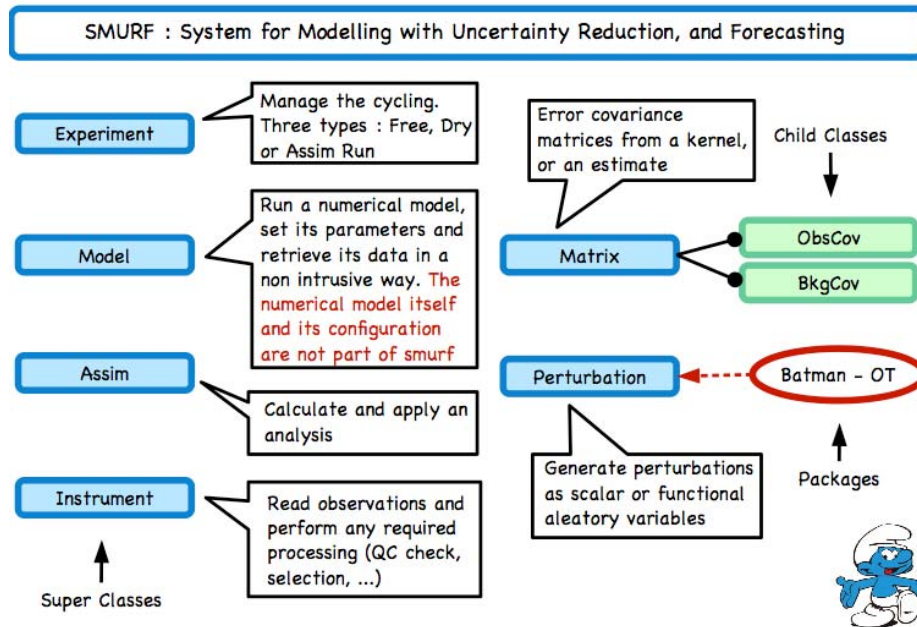


River reach data (10km)



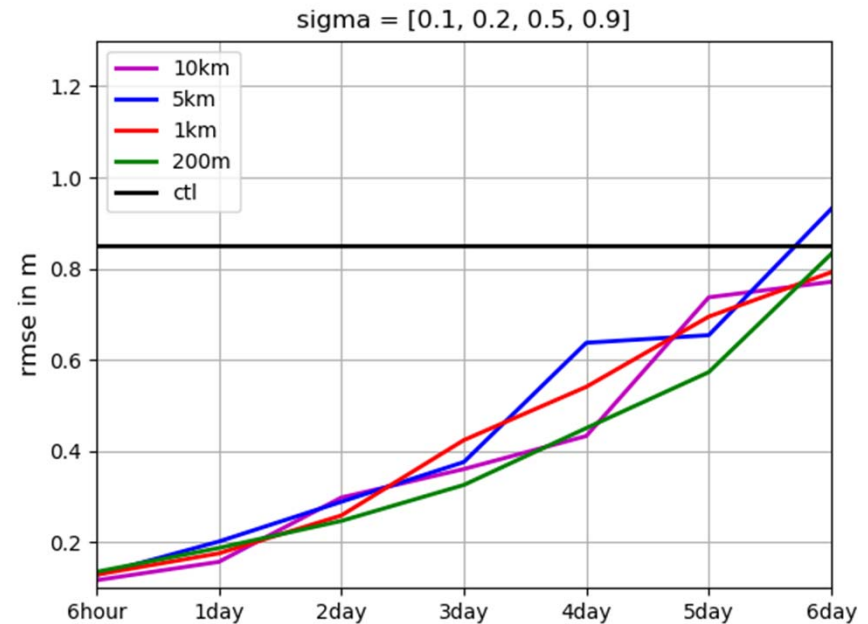
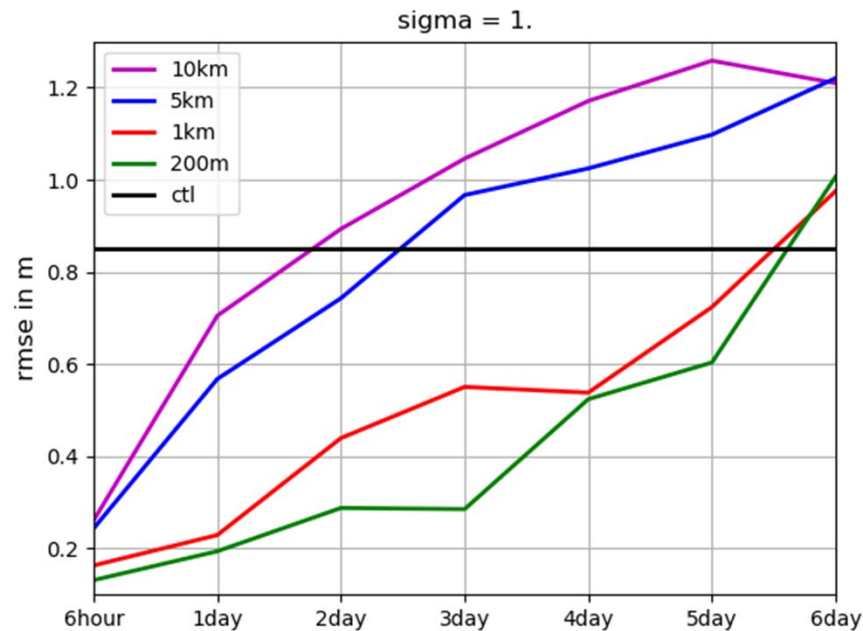
DATA ASSIMILATION SYSTEM

- SMURF library (I. Mirouze, IR TOSCA)
- py library for sequential ensemble data assimilation (EnKF/EnKS)
- OpenSource [git clone git@gitlab.com:mirouze/smurf.git](https://gitlab.com/mirouze/smurf.git)
 - Modularity for models, DA algorithms, observation types
 - Plugged-in diagnosis for SA and DA on ensembles



SWOT-like data assimilation system

Analyzed Water level RMSE for 24-day simulation assimilating increasing spatial and temporal resolution SWOT data with constant or increasing observation error



Perspectives for up-coming TOSCA-ROSES project:

- Ensemble data assimilation with 2D model (M2 internship + I. Mirouze IR, TOSCA)
- Run some of PEPSI 2 test cases using a priori bathy from SWOT (IRSTEA)
- Operational production of analyzed water level and discharge with sequential data assimilation

GLOBAL APPLICABILITY ?

