

# Ocean simulator for science applications

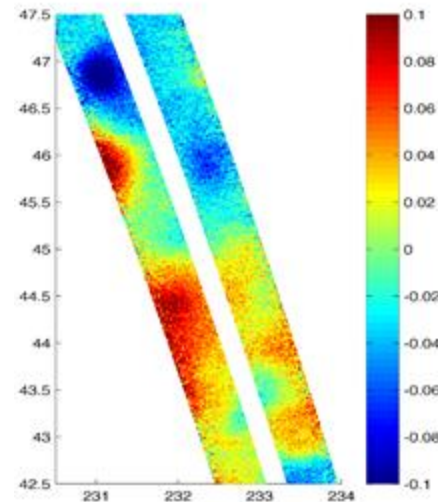
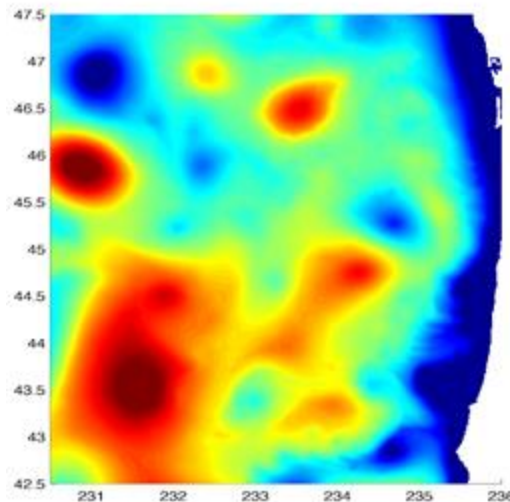
Lucile Gaultier and Clément Ubelmann



# SWOT simulator for Ocean Science

- The needs for a light/portable tool to easily simulate SWOT L2 data with realistic sampling and errors/noise has been pointed by the SDT team.
- **The tool relies on spectral error budget specifications from the project team**  
→ It is **NOT** an instrument simulator.
- Open source, use git version or download tar on the github:  
<https://github.com/SWOTsimulator/swotsimulator.git>

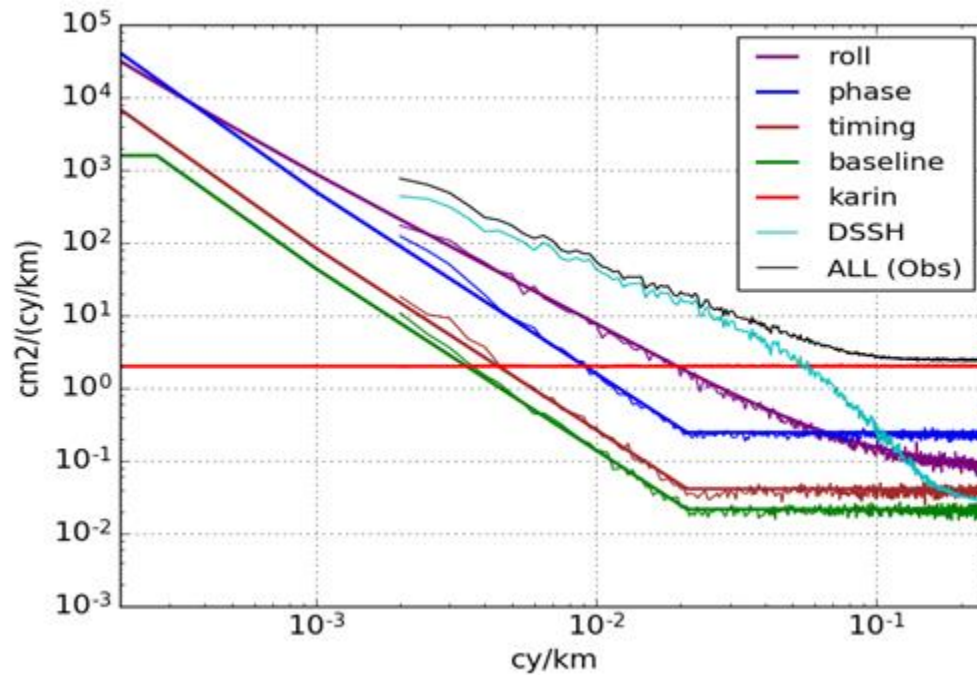
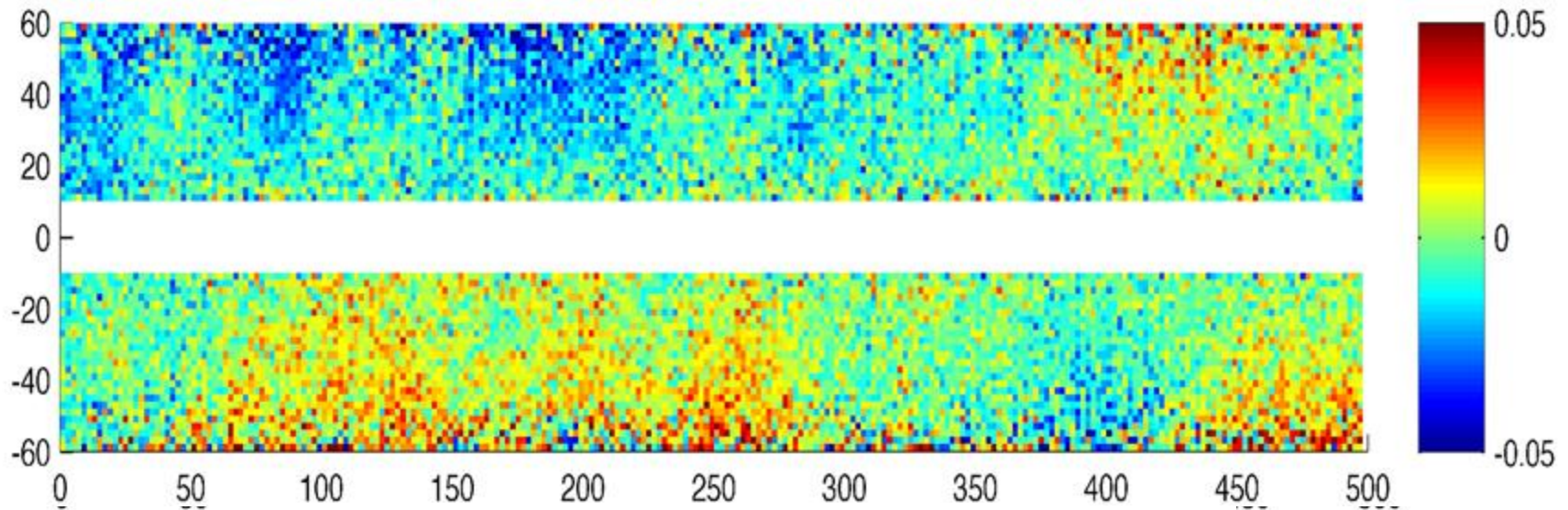
INPUTS: user's  
model Sea  
Surface Height  
Coordinates



OUTPUTS:

SWOT synthetic data  
sampled on a swath  
grid  
Each error is saved  
separately

# Random error realizations



# Playing with the simulator

Fill the parameter file:


```
# -----#
# Files and directories
# -----#
# ----- Directory that contains orbit file:
dir_setup=' [yourpath]/SWOT_simulator/data/'
# ----- Directory that contains your own inputs:
indatadir=' [yourpath_to_yourdata]/'
# ----- Directory that contains your outputs:
outdatadir=' [yourpath_to_outputs]/'
# ----- Orbit file:
filesat=dir_setup+'/orbit292.txt'

# -----#
# SWOT swath parameters
# -----#
# ----- Satellite grid file root name:
#           (Final file name is root_name_[numberofpass].nc)
filesgrid=outdatadir+'/[your_grid_root_name]'
# ----- Force the computation of the satellite grid:
makesgrid=True or False
# ----- Give a subdomain if only part of the model is needed:
#           (modelbox=[lon_min, lon_max, lat_min, lat_max])
#           (If modelbox is None, the whole domain of the model is considered)
modelbox=None or [yourlon_min, yourlon_max, yourlat_min, yourlat_max]
# ----- Distance between the nadir and the end of the swath (in km):
halfswath=60.
# ----- Distance between the nadir and the beginning of the swath (in km):
halfgap=10.
# ----- Along track resolution (in km):
delta_al=1.
# ----- Across track resolution (in km):
```

# A few technical possibilities

- Consider the provided orbits for the two phases of the mission:

Orbit	Repeat cycle (days)	Number of passes
Fast Sampling orbit	0.99349	28
Science orbit	20.8646	584

- Turn on long-wavelength roll errors : remove the 1,500 km cutoff that 'simulate' cross calibrations  
 Changing that cutoff has a significant impact on the level of systematic errors
- Possibility to simulate other altimetric observations (e.g. Jason, AltiKa, Sentinel, ...): OSSEs with a constellation of nadir altimeters

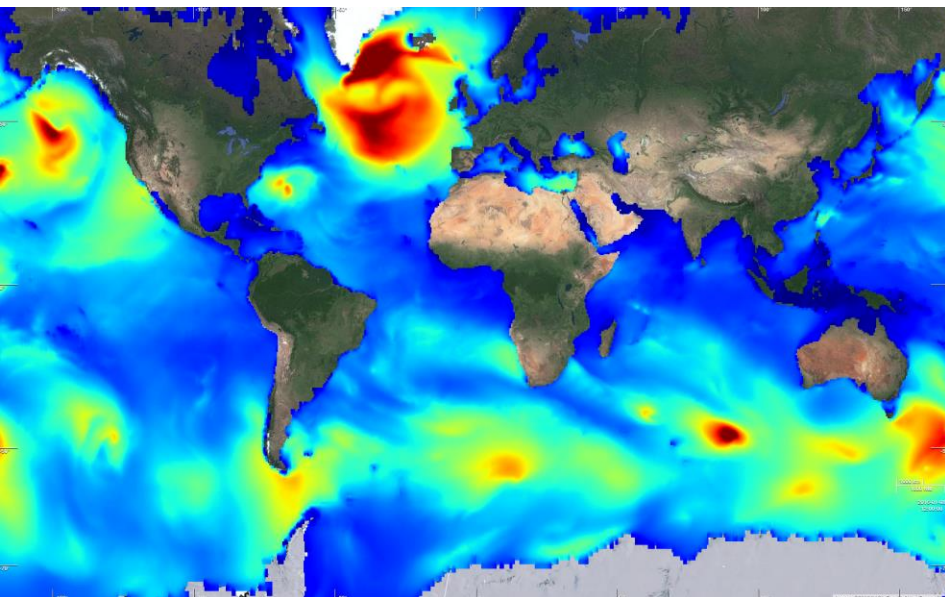
A few updates on scientific aspects

# A few updates on scientific aspects

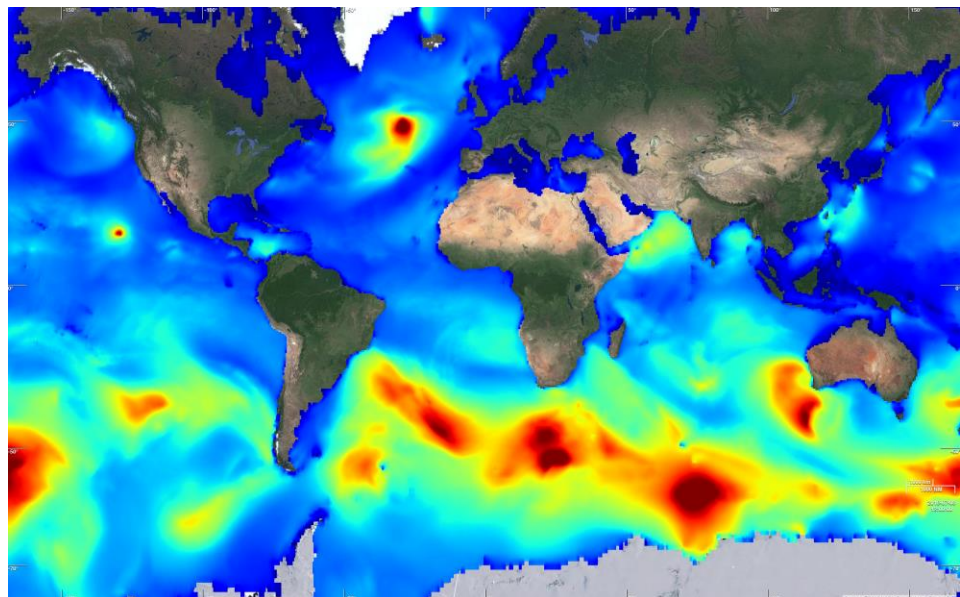
The new release of this month includes:

- SWH variations using a climatology from WW3 model: KaRIN noise is modulated
- Possibility to apply a series of simulated crossover calibration for roll/phase instead of high-pass filtered signal

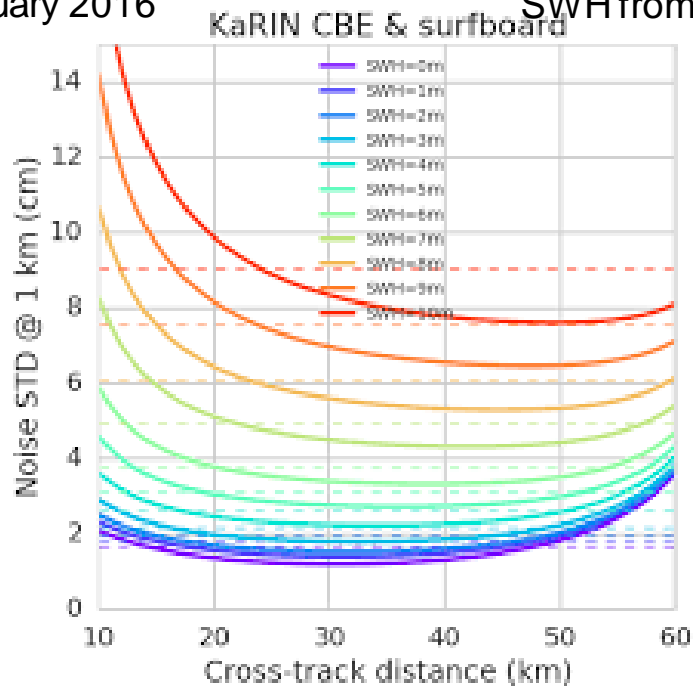
# KaRIn noise modulation with SWH



SWH from WW3, mid-January 2016

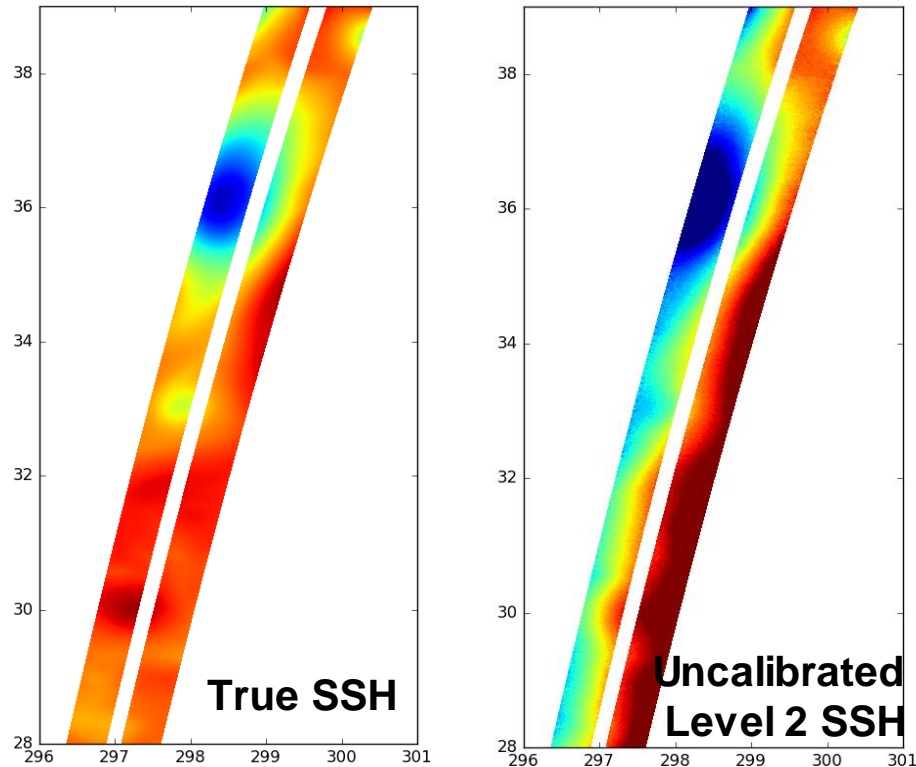


SWH from WW3, mid-July 2016



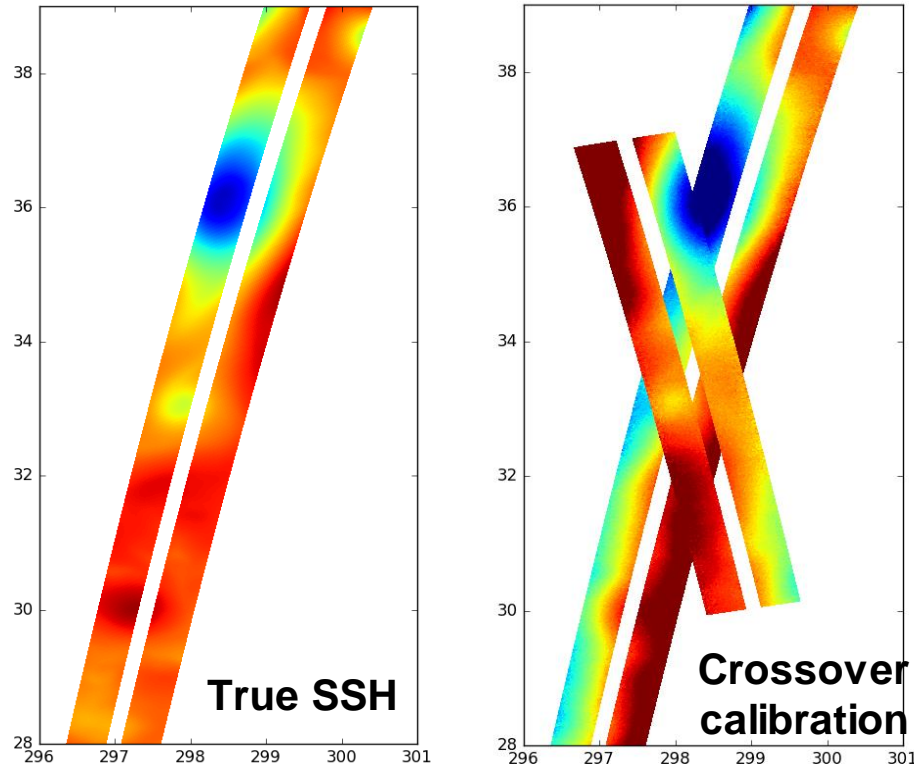


# Simulated crossover calibration



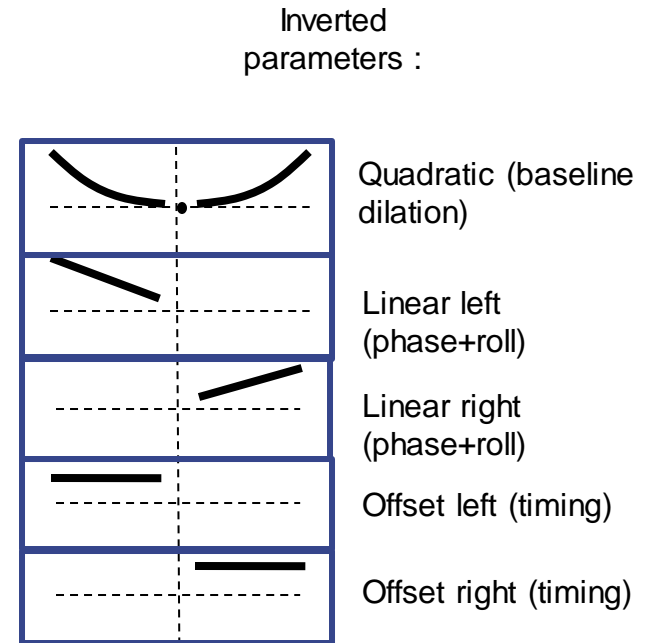
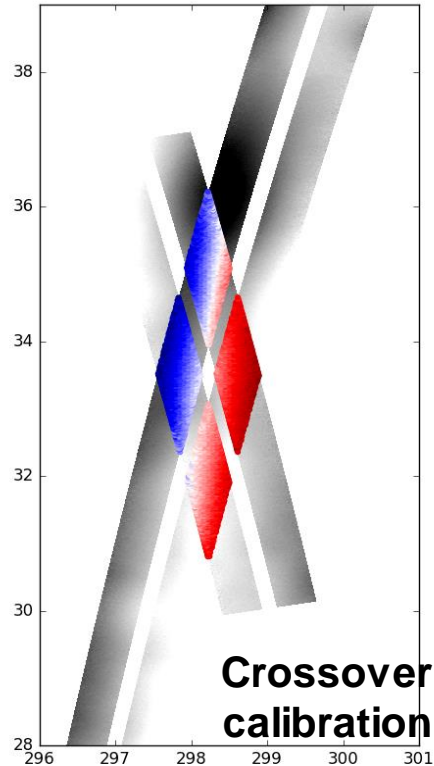
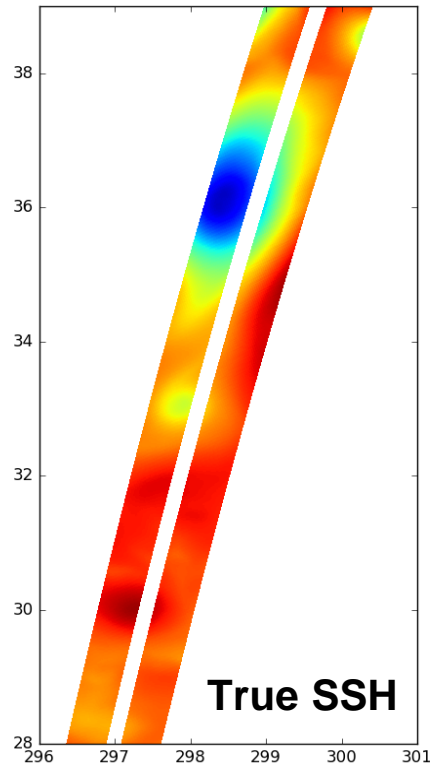
- The systematic errors, roll in particular, feature strong biases (compliant with requirements) presently filtered by default in the simulator (**crude approximation**)
- **Operational crossover calibration** for hydrology can be applied on the Ocean to correct for **long-wavelength error (>2000km)**. More details in Backups.

# Simulated crossover calibration



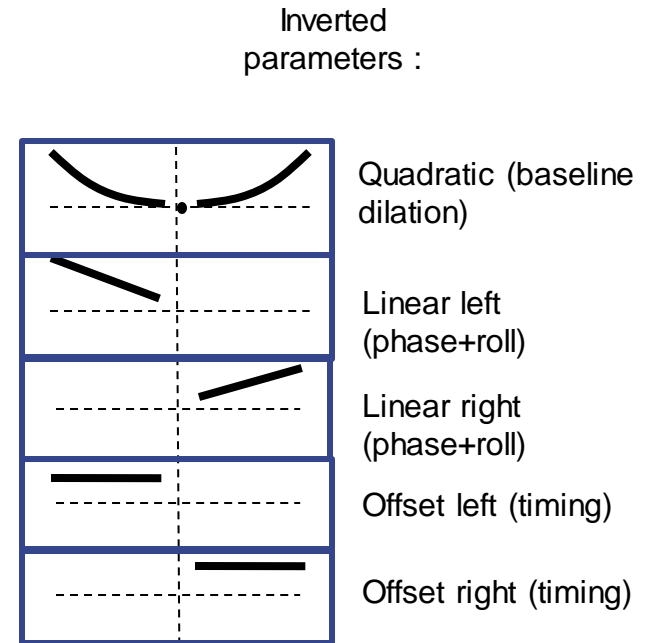
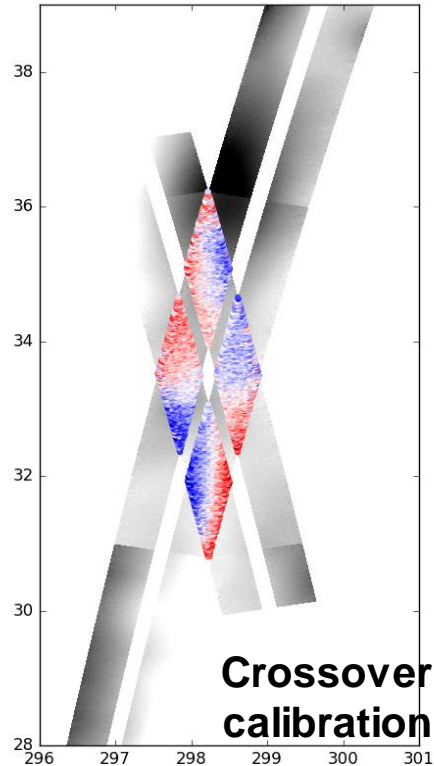
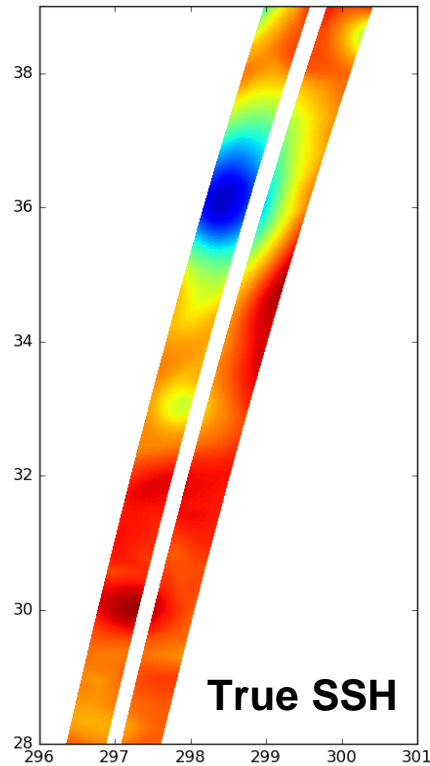
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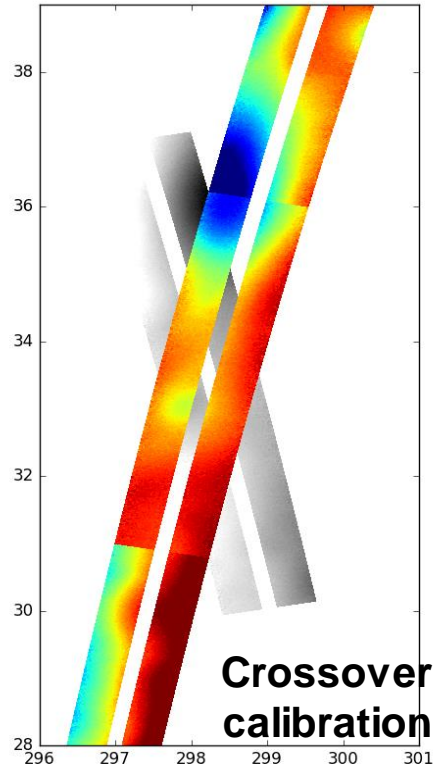
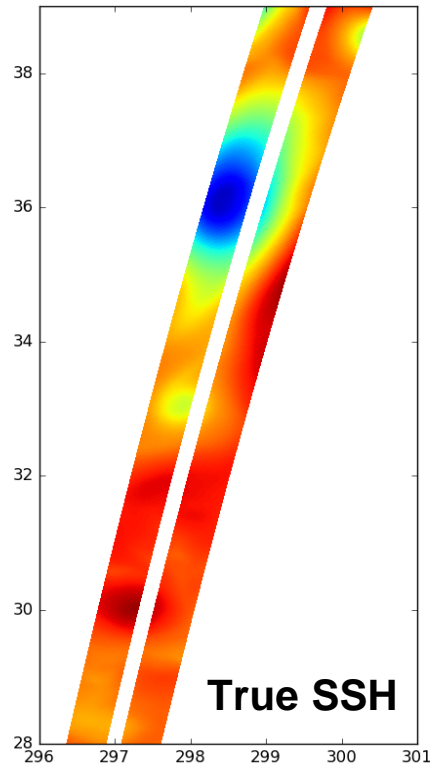
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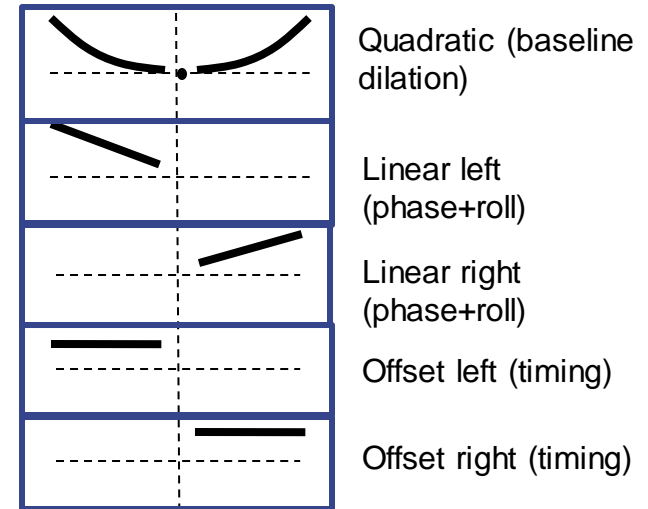


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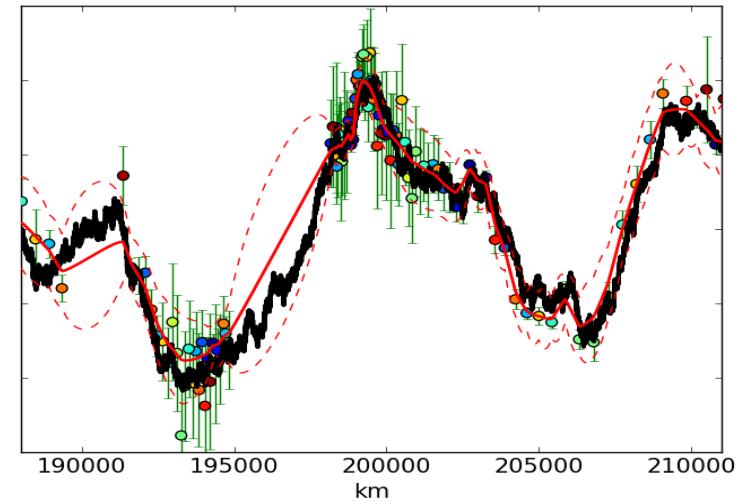
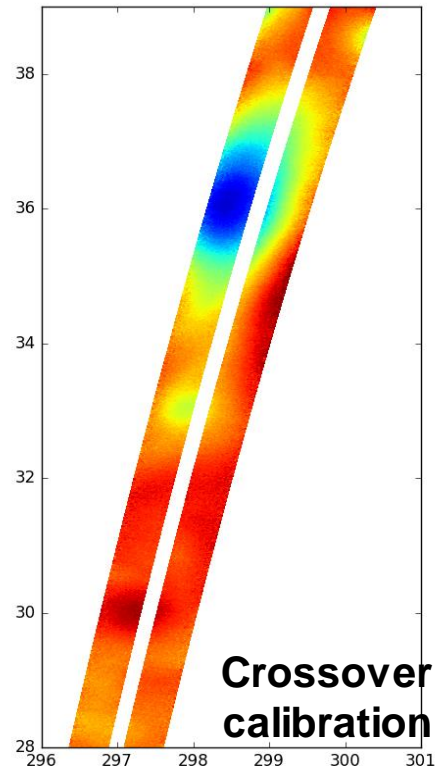
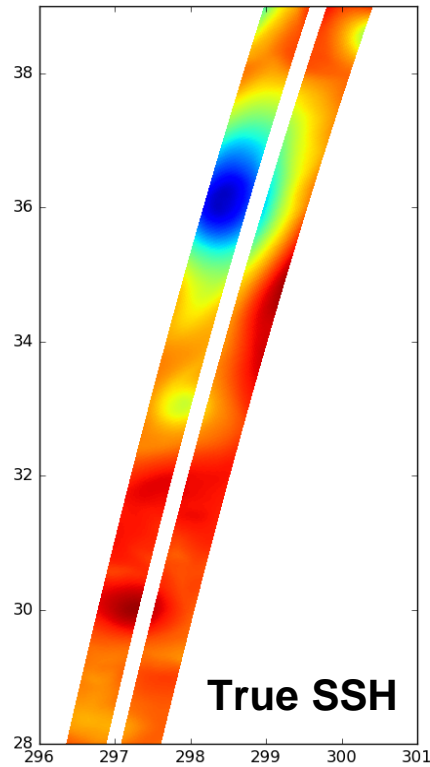


Inverted parameters :



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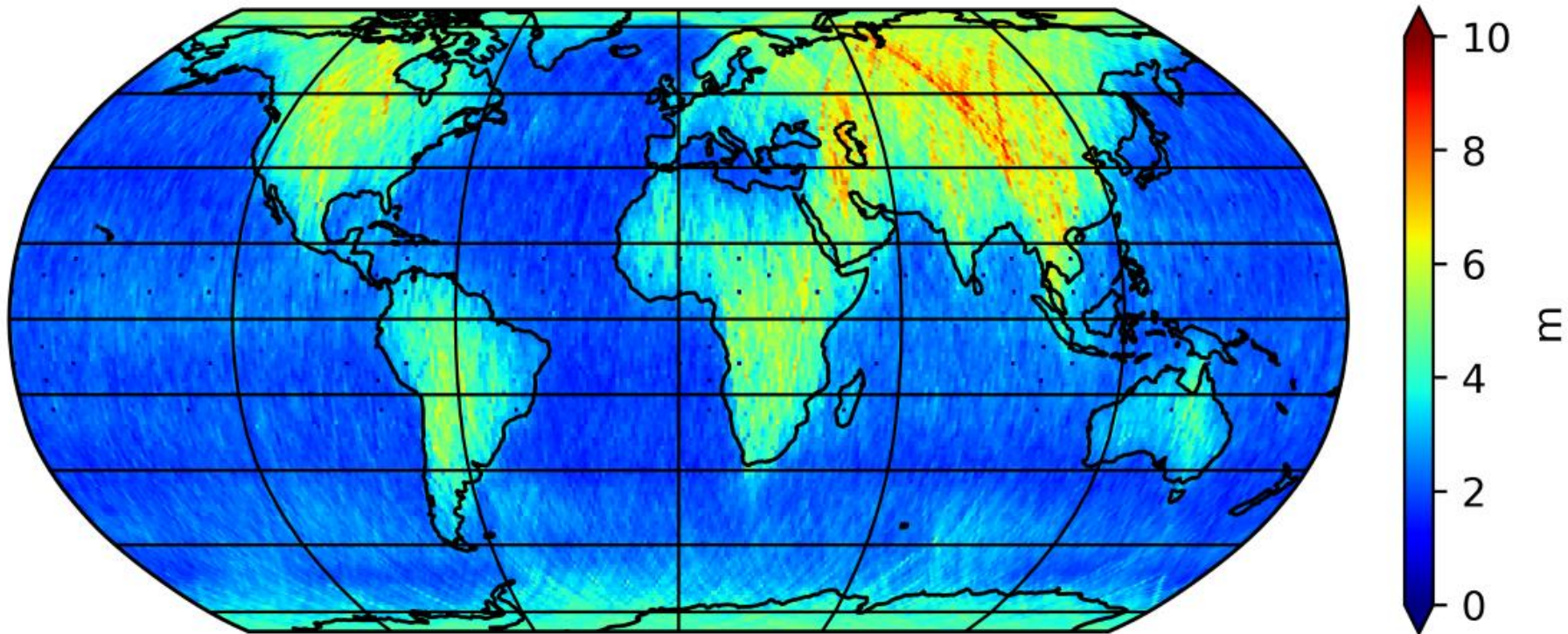
# Simulated crossover calibration



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# Remaining roll error after calibration

Mean RMS over ocean: 2.9 cm



A few updates on technical aspects



# Data format

- **SWOT mockup**

A mockup for future SWOT format has been implemented:

- Name of variables be set to :

  - SSH\_KaRIn\_swath for SSH\_obs

  - SSHA\_uncert for karin\_err

  - time\_day and time\_sec for time

- Flags have been added (KaRIn\_surf\_type and rad\_surf\_type)

- Many other geophysical have been added but set to fill\_value.


**your feedback is important**

- Classic format also the true ssh or any other variable interpolated on the SWOT swath

- Expert mode to save noises (except Karin) in 1D and module to reconstruct noise in 2D

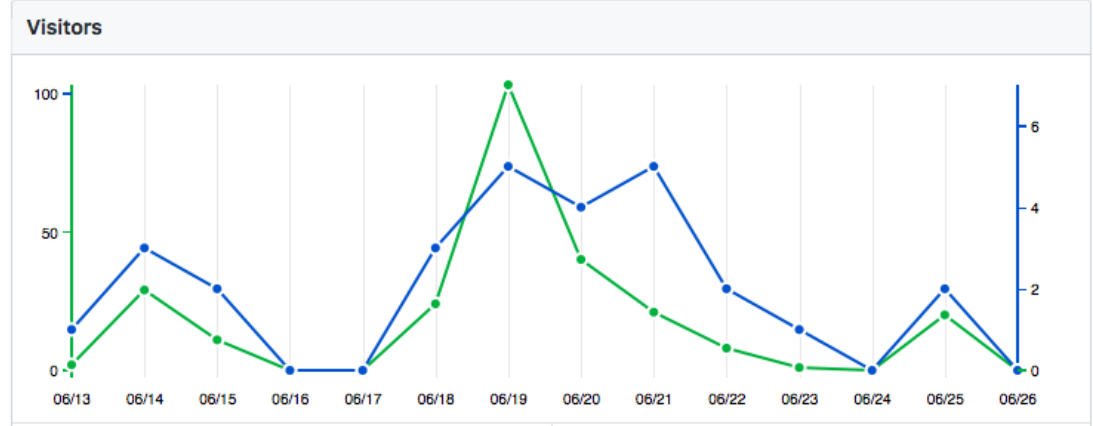
- Soon: IDF format to open with the current SEAScope version

# What has changed

- Parallelization: multiprocessing is improved, errors tracking possible  note that you need enough RAM as every processor will load model data.
- Flexibility in input data: several time in one file, any data can be interpolated on the SWOT swath
- Refactoring of nadir simulator to benefit from swotsimulator upgrades
- User proof (detection of any change in grid)
- **Python 2 is not be supported anymore**
- Compare the 2D signal with what other potential future mission: a similar simulator has been recently coded for the proposed SKIM surface current mission (ESA)

# How it will evolve ?

- ~20 active users



- Many inputs from users have been integrated in the current version. Thank you!
- **Upcoming improvements and possible evolutions:**
  - New interpolation and capability for cluster (ZARR format, faster interpolation)
  - Toward more realistic error simulations. Example: Sea State Bias if some implementation can emerge from the recent studies ?