SKIM Phase A: Simulation/Model synergies

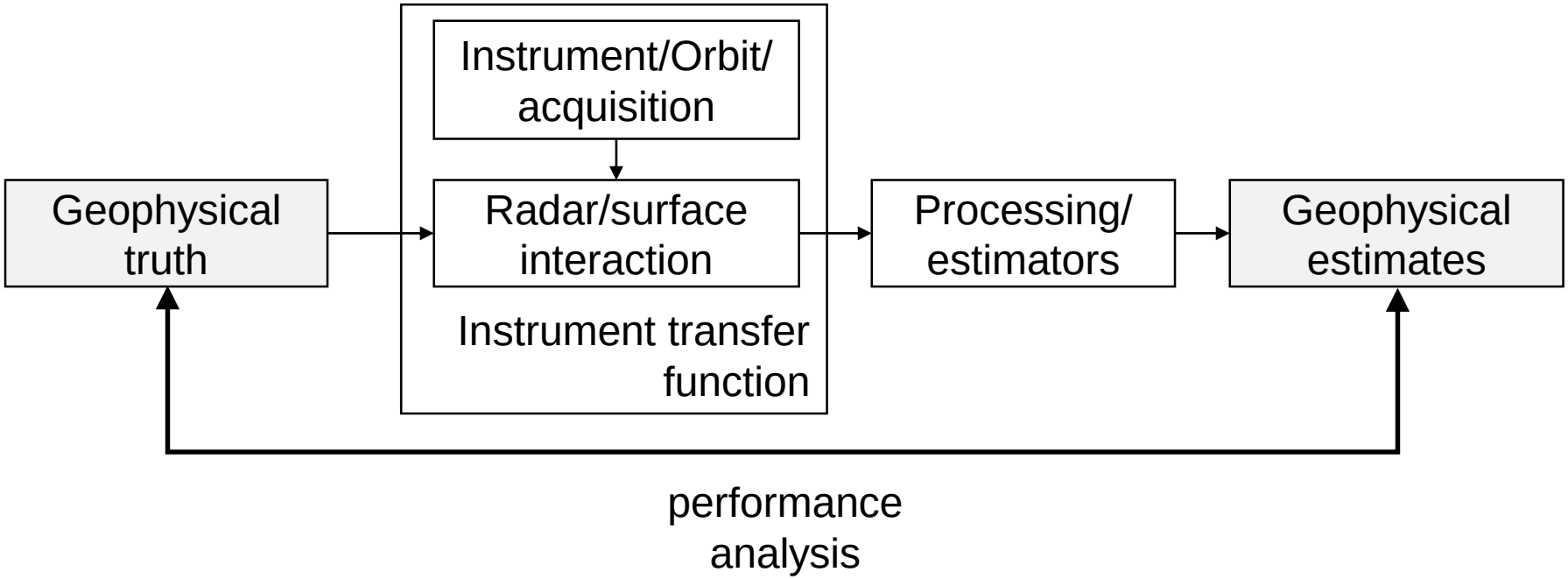
DOFS – October 11, 2018

What kind of simulation are we talking about ?

(1/3)

End-to-end simulator: "deep" simulator meant for performance studies.

SEEPS (ESA) & **RSSS** (IFREMER)

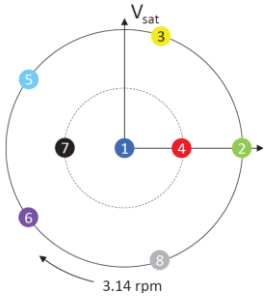


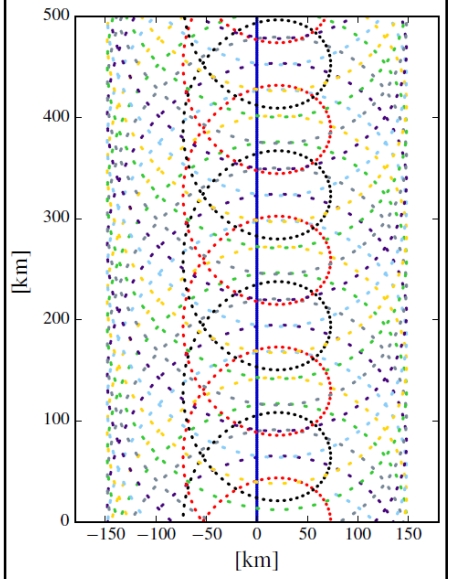
The prototype processing chain is also implemented to assess the full chain

What kind of simulation are we talking about ?

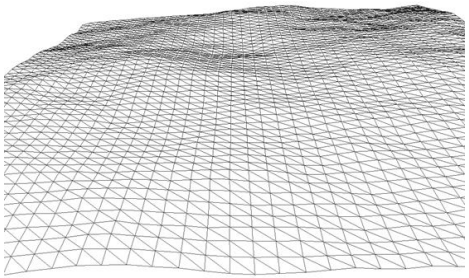
(2/3)

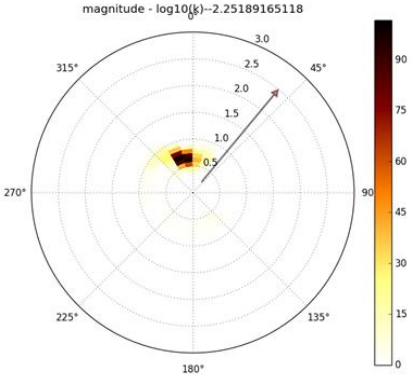
Acquisition/ instrument

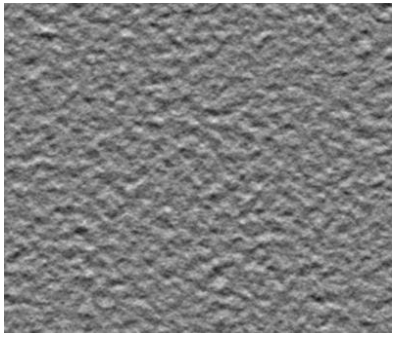




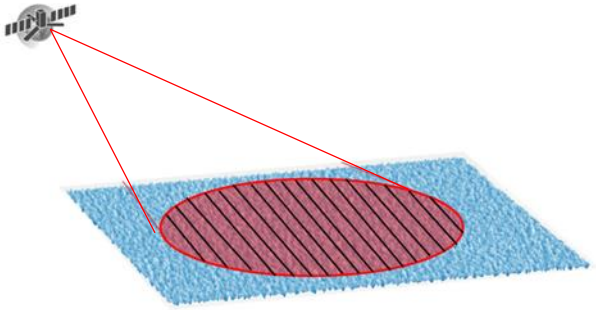
Geophysical truth



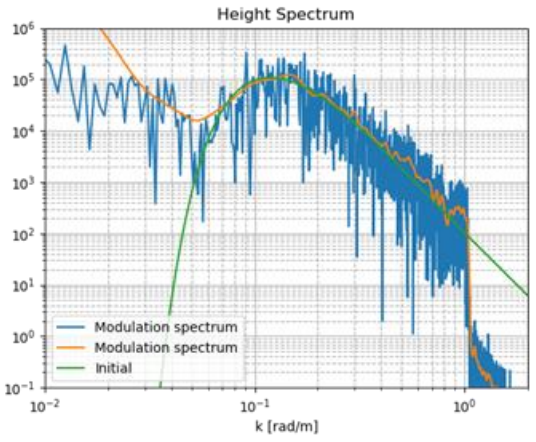




Radar/surface interaction



Geophysical estimate



What kind of simulation are we talking about ? (3/3)

- Need for the highest respresentativity of the instrument + orbit + attitude
- Need for a correct representation of the surface (w.r.t its interaction with the EM radar waves)
- Need to produce raw data (L0) as it is the first input of the processing chains

These combined needs imply **very high computationnal cost.**

SEEPS is not design to produce data on full orbit: simulations are restricted to few ten of seconds of data. Above these times, SKIMulator is the good tool (L. Gaultier)

Link between "deep" and "light" simulators: noise and bias will be derived from SEEPS simulation, if needed the models used in SKIMulator can be updated consequently.

What kind of model are we talking about ?

(1/2)

Basis: Model from Nouguier et al., 2018. "*Sea surface kinematics from near-nadir radar measurements*"

- Assess the concept of the mission
- Gives clues for the best instrument configuration (incidence angle…)
- Gives a bias and noise model given an input directionnal wave spectrum

  → thus deal with what is identified to be the main bias contributor

What kind of model are we talking about ?

(2/2)

The basis is good, still, extra work should be done

- Add the instrument effects (antenna pattern, satelllite velocity, …)
  - Merge the "scientific" error model and the "engineer" error model (provided by the instrument designer, TAS)
  - Special care of the radar slant-range sampling*: yet not caught by the scientific/engineer error models
- Modelize the effects of estimators on errors
  - eg. Zrnic 1977, for the pulse pair estimator
- At best, break the Gaussian assumptions for the surface.

* SAR: range bunching, SWOT: surfboard effect

Simulation/model: different approximations involved

Model/simulation approximation and hypothesis should be chosen independently.

- Simulation: change continuous integrals into finite sums, thus dealing with cut-off issues,
  - driven by the need for reasonable computation time and memory

- Model: approximated instrument and acquisition representation
  - use of an exponential antenna pattern shape and range PTR (e.g. Brown, 1977)
  - driven by the easy use of exponentials in integrals.

Synergies

Comparing the SEEPS simulated data moments with moments from model.

Model → simulation

Validation of the correct representativity of the simulated signal: typical approach for E2E simulator validation during phase A (e.g. S-3, SWOT).

Note that the model has been compared to real data thus linking simulation to real data.

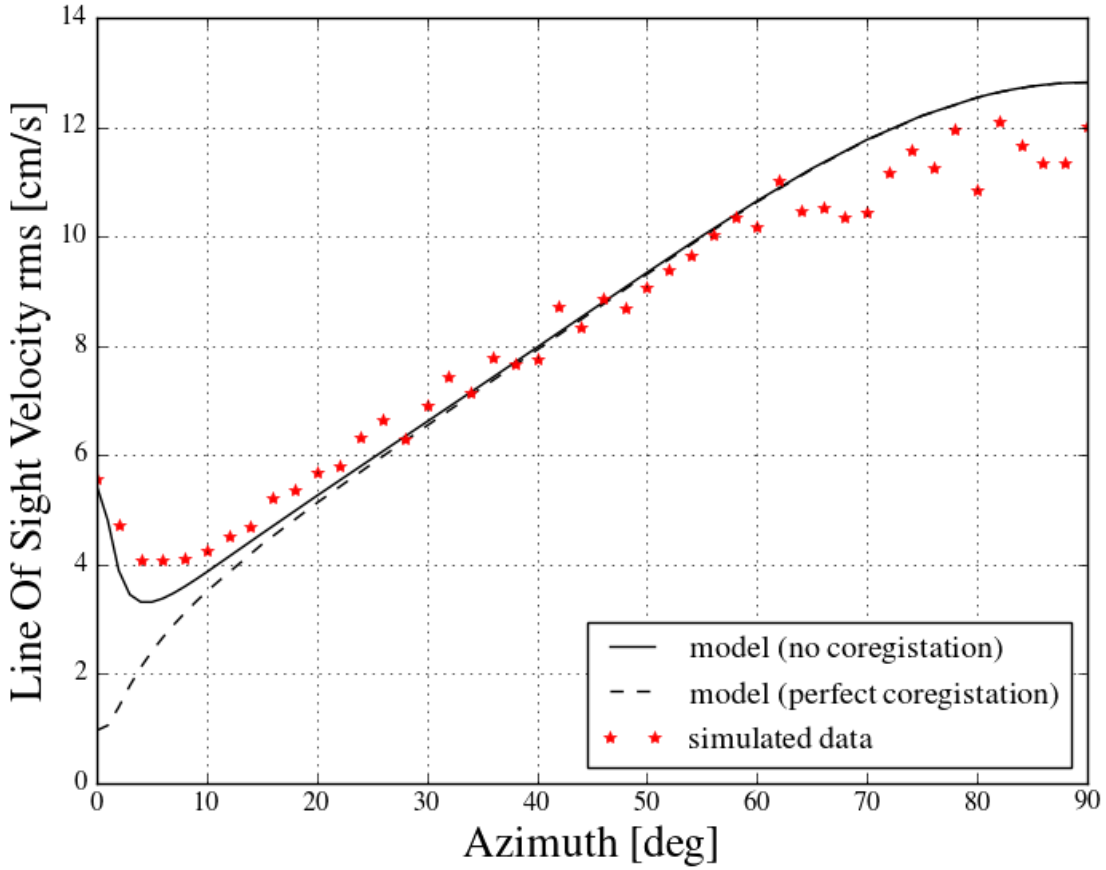
Simulation → Model

Model can be used to design inversion functions.

Some effects are not considered (secondary lobes in PTR,…): quantify what we have missed. Should we fight to add them in the model ?

Alert us on possible omissions in the model.

Synergies: an exemple

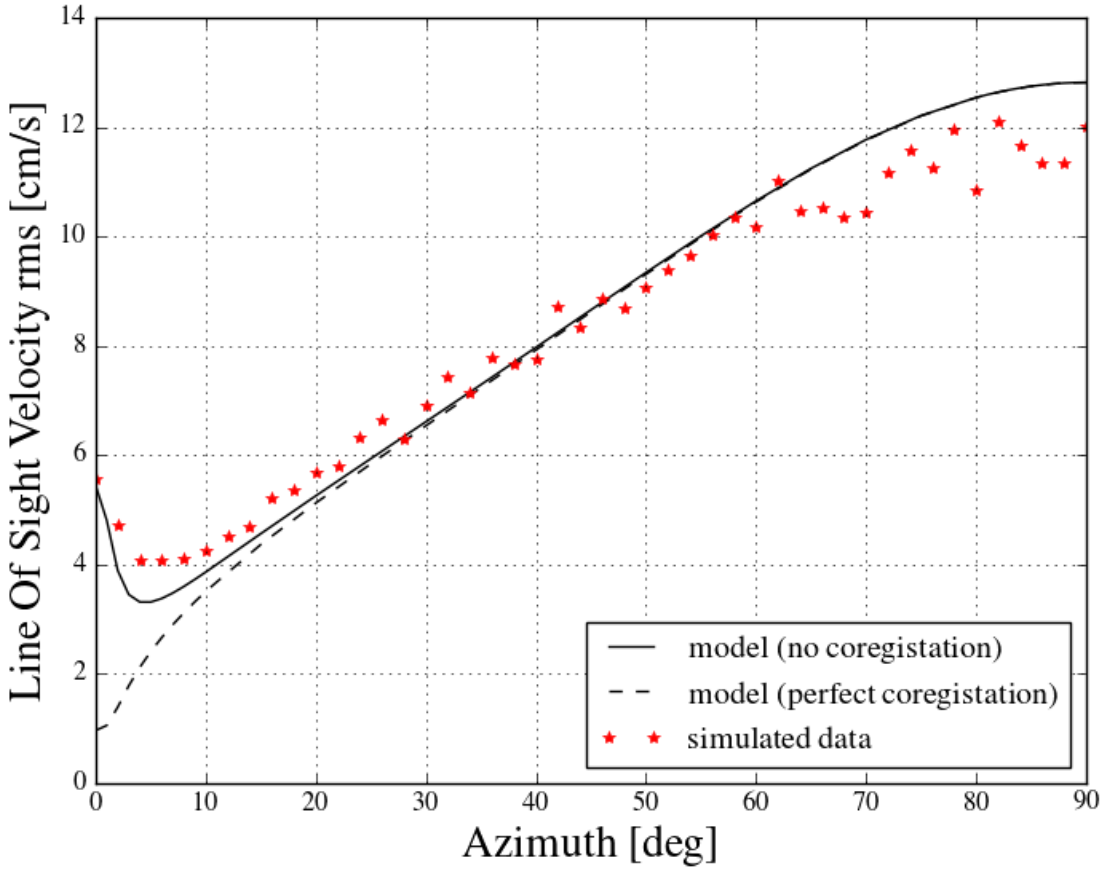


At the time of EE9 proposal

- Red stars : simulation estimates. *(from an early version of SEEPS*)
- **Dotted** black line : Error Model from TAS

At along track: who is wrong ? Are the simulator choices for implementation wrong ?

Synergies: an exemple



- **Solid** black line : error from updated Nouguier Model (*early version*)

Conclusions: model used was uncorrect w.r.t. the simulations frame.

Gain confidence in simulations: important because results shown for EE9 final selection should be trustfull.

Plus, we outline the need for a specific processing