A SAR ALTIMETRY END-TO-END SIMULATION AND PROCESSING CHAIN

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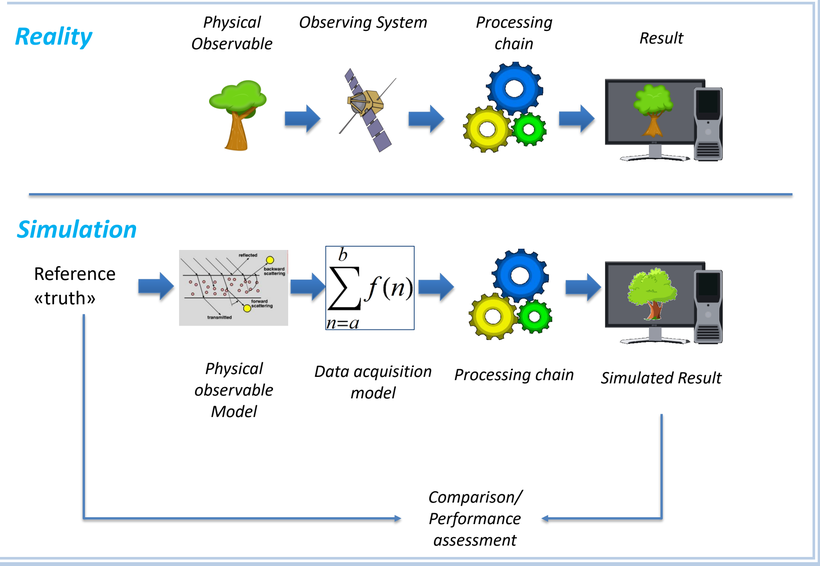
End-to-End Simulation and Processing Concept

Aiming at determining the instrument performance, numerical simulation of the instrument, and the retrieval of the geophysical parameters from its output, is required. To this aim an End-to-End simulation chain is designed and developed.

The physical observable is replaced by a model in the simulation chain, that has a reference ground truth as input

- ❑ The observing system is replaced by a data acquisition mode in the simulation chain
- ❑ The processing chain is fed by the simulated raw data in the simulation chain
- ❑ The simulated results can be compared with the reference ground truth for performance assessment



Aresys SAR Altimetry End-to-End Simulation and Processing Chain

Geophysical params (e.g. SSH, SWH)

ISP/L1A Data Simulator

Scene Generator

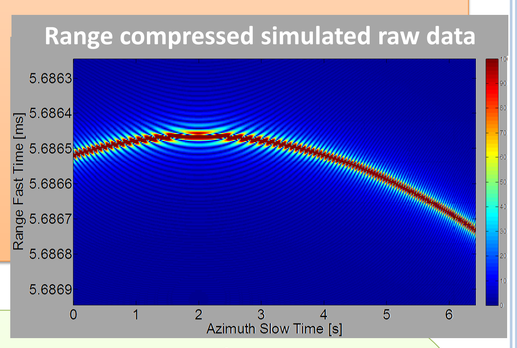
It simulates the ground scene according to the desired scenario
- ❑ Ocean, land ice, sea ice
- ❑ A DEM can be used to define the ground topography

Echo Generator

It accumulates the echoes from each scatterer at PRF rate to obtain the raw data
- ❑ Accounts for the instrument timeline defined by configuration
- ❑ Antenna pattern to be provided as input

Radar Altimeter Instrument Simulator

It models the Rx chain of the instrument
- ❑ Deramping-on-receive or matching-filter-on receive
- ❑ It arranges the output data in the desired format and level (Instrument Source Packets or L1A)



L1A

CryoSat FBR

Generic Altimetric Processor Level1

L1A Importer

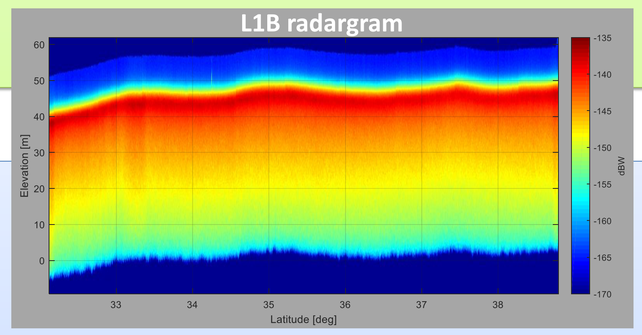
It allows to ingest data from different sources and in different formats, applying calibration corrections if needed

Delay/Doppler Processor

Multilooker

L1B Exporter

Flexible and configurable Delay/Doppler Processing chain.
It allows to select
- ❑ different methods for the Surface Sample placing (i.e. based on fixed angle separation or at nadir of bursts)
- ❑ different methods for the azimuth beamforming (i.e. based on FFT or on DFT or on CZT).
- ❑ different stack weighting methods
- ❑ the output products (L1B and/or L1BS)
- ❑ the format of the L1B product file (NetCDF by default)



L1B

L1BS

CryoSat L1B S6 L1B

Generic Altimetric Processor Level2

L1B Importer

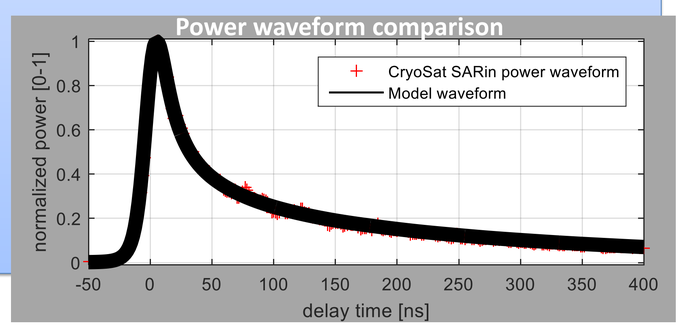
It is in charge of retrieving the geophysical parameters from L1B products.

SAR Ocean retracker

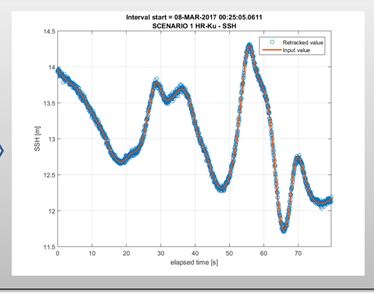
The developed retracker is based on a semi-analytical waveform model [1] that
- ❑ allows for modeling with the same approach LRM, SAR and SARin waveforms
- ❑ allows for modeling of waveforms with bandwidth different from sampling frequency
- ❑ has been verified by comparison with SAMOSA

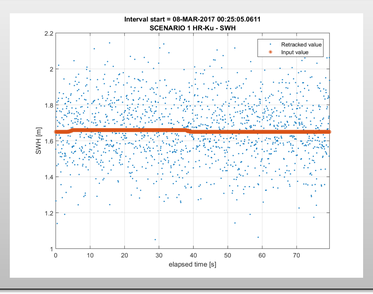
L2 Exporter

[1] L. Recchia, M. Scagliola, D. Giudici and M. Kuschnerus, "An Accurate Semianalytical Waveform Model for Mispointed SAR Interferometric Altimeters," in *IEEE Geoscience and Remote Sensing Letters*, vol. 14, no. 9, pp. 1537-1541, Sept. 2017.



L2





Performance Assessment

It compares the geophysical parameters provided as input to the simulation and the corresponding ones retrieved by L2. The performance of the simulated end-to-end system can be assessed.