Monitoring Water resources in Red River Basin using Microwave Remote Sensing

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Context

The Red River, also known as the Yuan River in Chinese, is a transboundary river basin with its total area of 169,000km2 shared by Vietnam(51%), China (48%) and Laos (1%).

The Red River basin has a tropical or subtropical climate.

The monsoon results in massive flow volume fluctuations.

Flooding is a significant problem during the rainy season, particularly in July and August.

At the same time, large area of karst landform causes the river flow loss and **water shortage**.

One of the greatest challenges for flood prediction and **integrated water management** in the Red River basin is a lack of information on reservoir management as a consequence it is not easy to estimate the water resources.

Since it is a transboundary river, there are difficulties to manage the area as a whole, and the information might not be in time for **flood and drought early warning.**

Objective

The main scientific objective of this project is to develop the algorithms and synergies between different Microwave Remote Sensing sensors to be able to monitoring water resources in the Red River Basin.

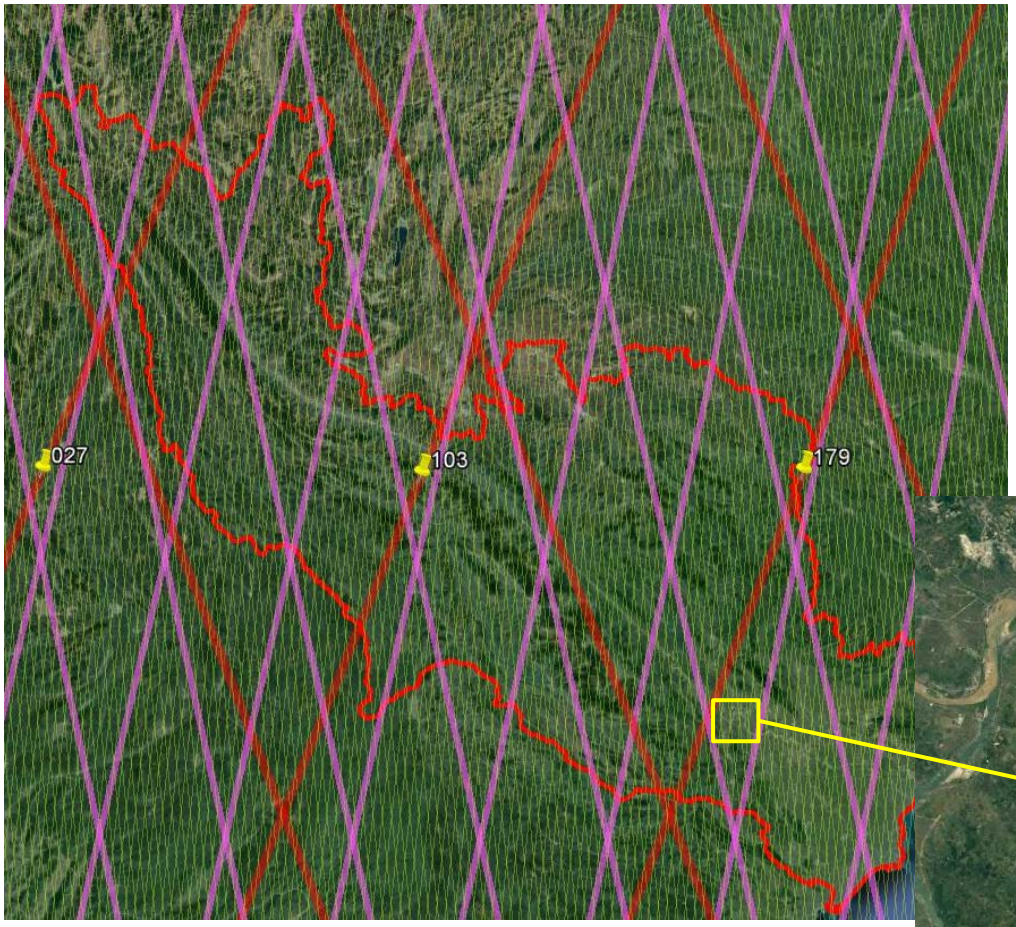
Main expected result of this project improving the knowledge of water stocks and exchanges over wide geographical regions.

Study Area

Red river basin

The Red River, also known as the Yuan River (元江) in Chinese, is a transboundary river basin with its total area of 169,000km2 shared by Vietnam(51%), China (48%) and Laos (1%).

Test Area



JASON2
SENTINEL-3
Cryosat-2

Data Base

Cryosat 2

SIRAL: 3 operation modes: LRM, SAR, SARIN (SAR mode is available from end of 2015 over Redriver basin)

L1 data: waveform, only the enginering and Doppler corrections and centre-of mass offset are applied.

L2 data: Range information; atmospheric and tidal corrections.

Sentinel 3

Sentinel-3A. L1 & L2

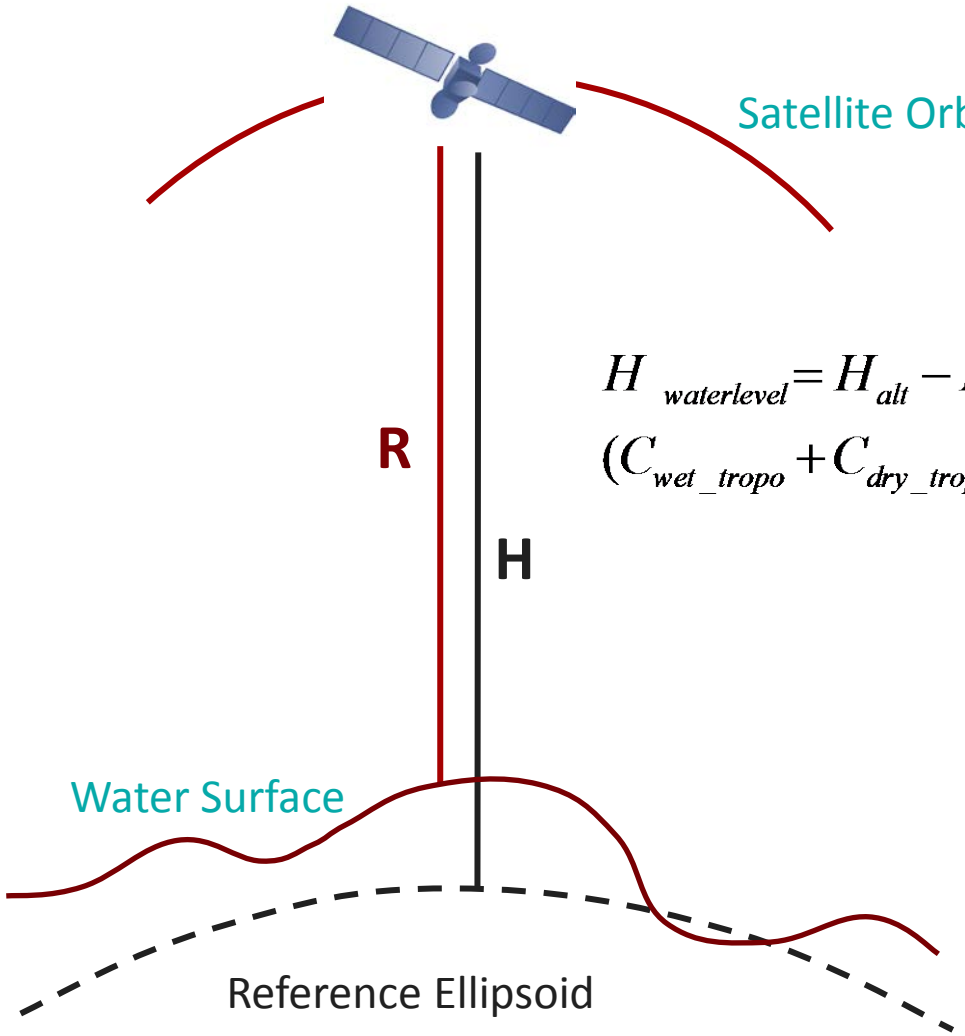
Jason 2

Data available from 2008

Jason PISTACH

Improved Jason-2 altimeter products for coastal areas and inland waters.

Water Level



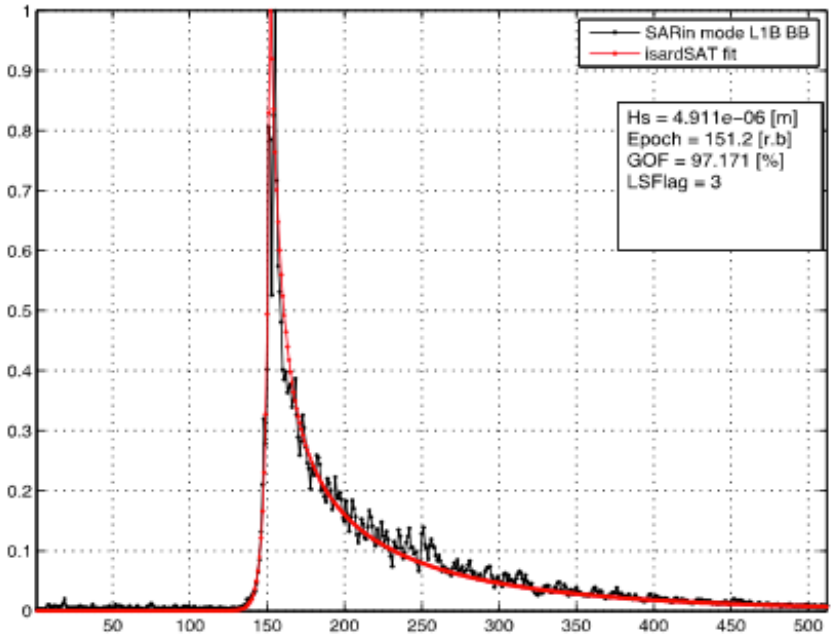
$$H_{waterlevel} = H_{alt} - R + (C_{wet\_tropo} + C_{dry\_tropo} + C_{iono} + C_{solid\_earth\_tide} + C_{pole\_tide}) - Geoid$$

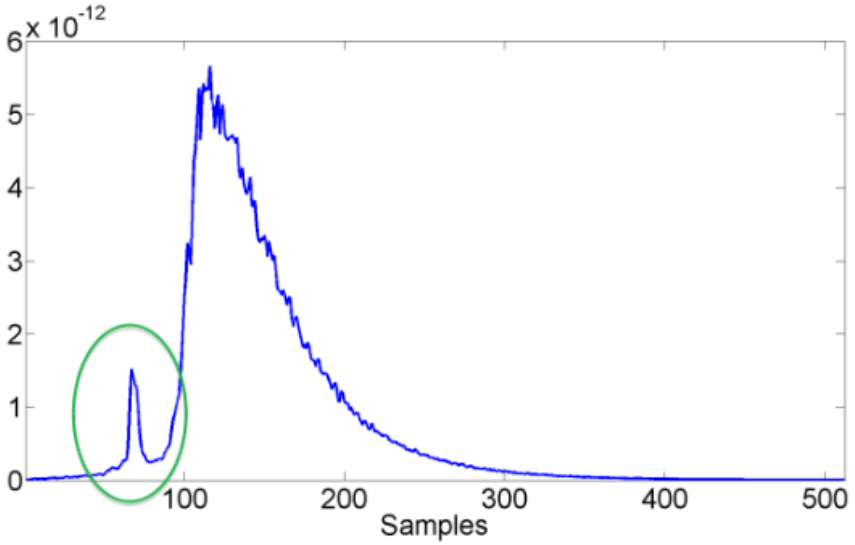
Methodology

The objective is to retrieve the surface height more precisely by own-build retracker in rivers.

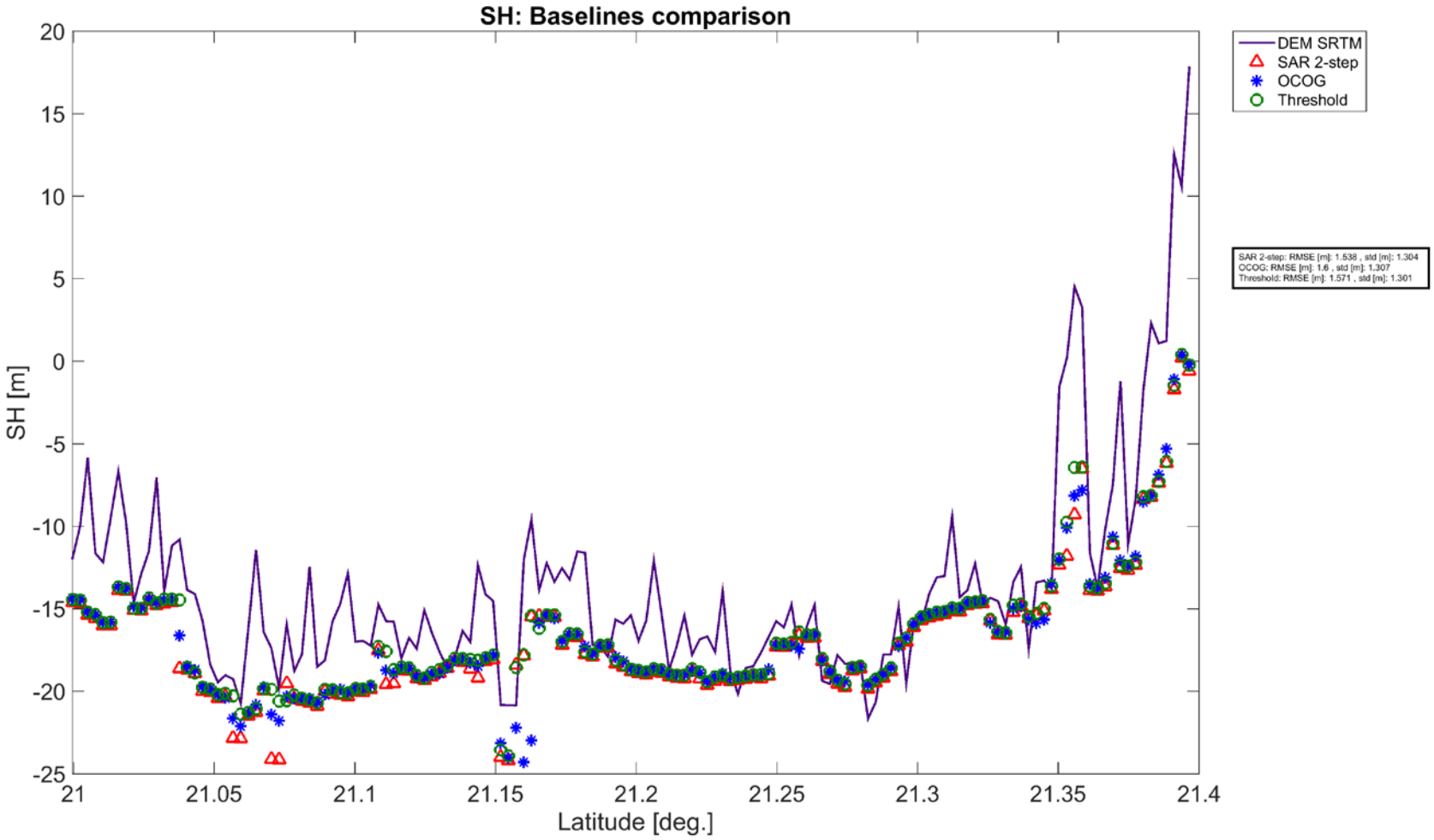
- Analyze the performance of retrackers
  - Analytical retracker
    - The analytical retracker is a physically based model of the SAR altimetric power waveform is used to fit the backscattered signal received by the actual altimetric sensor.
  - OCOG retracker
    - The Offset Center of Gravity (OCOG) is an empirical retracker, the considered implementation uses a combination of OCOG and a threshold retracker to estimate the related epoch (leading edge position).
  - Threshold retracker
    - A simple retracker based on the estimation of the epoch (leading edge position) as a percentatge of the maximum peak
- Retrack surface height directly from L1 waveform data

Methodology



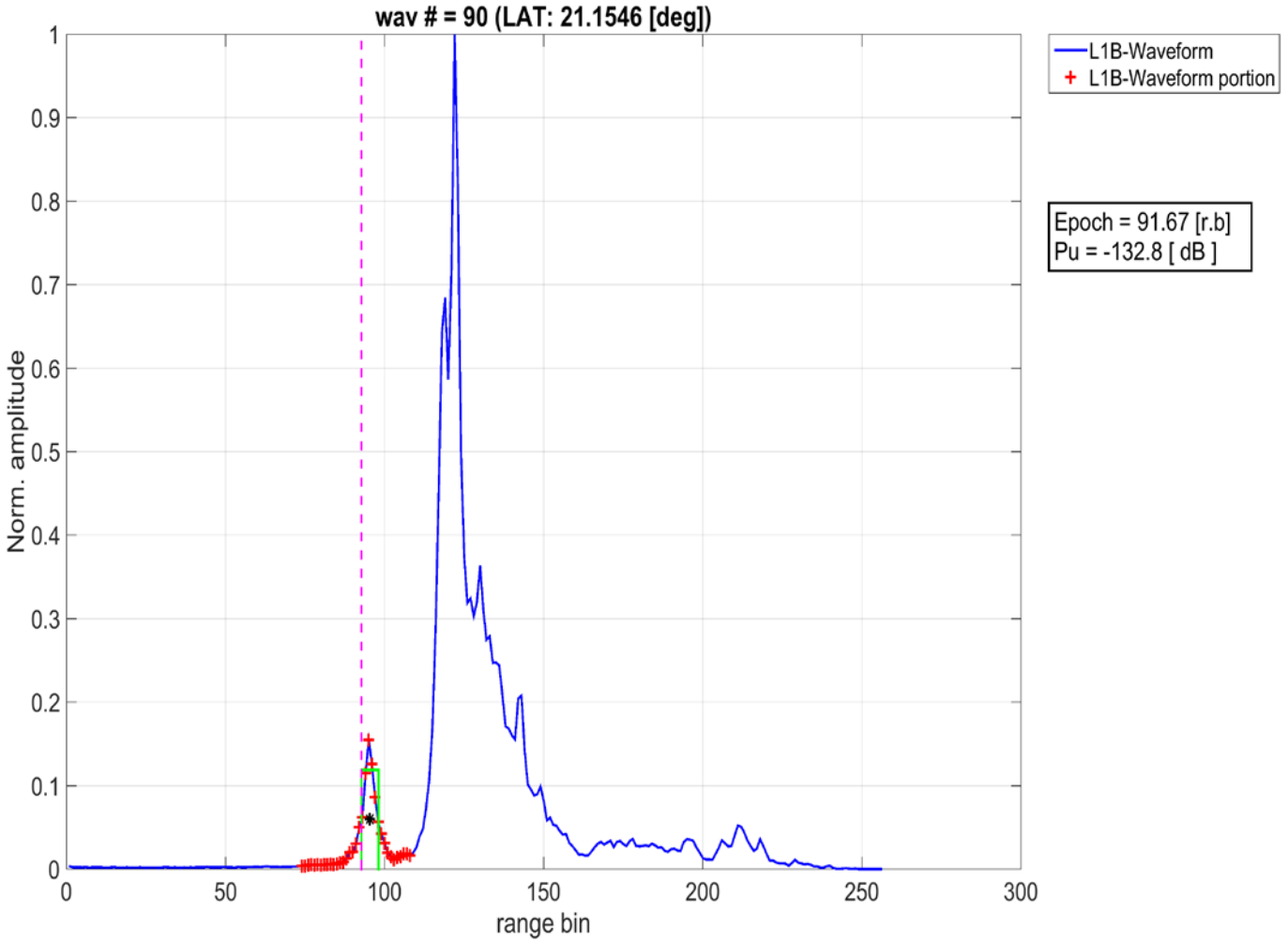


Using the whole waveform



Waveform inside water (Portion selection)

Using the portion of waveform from nadir (fitted better with DEM)



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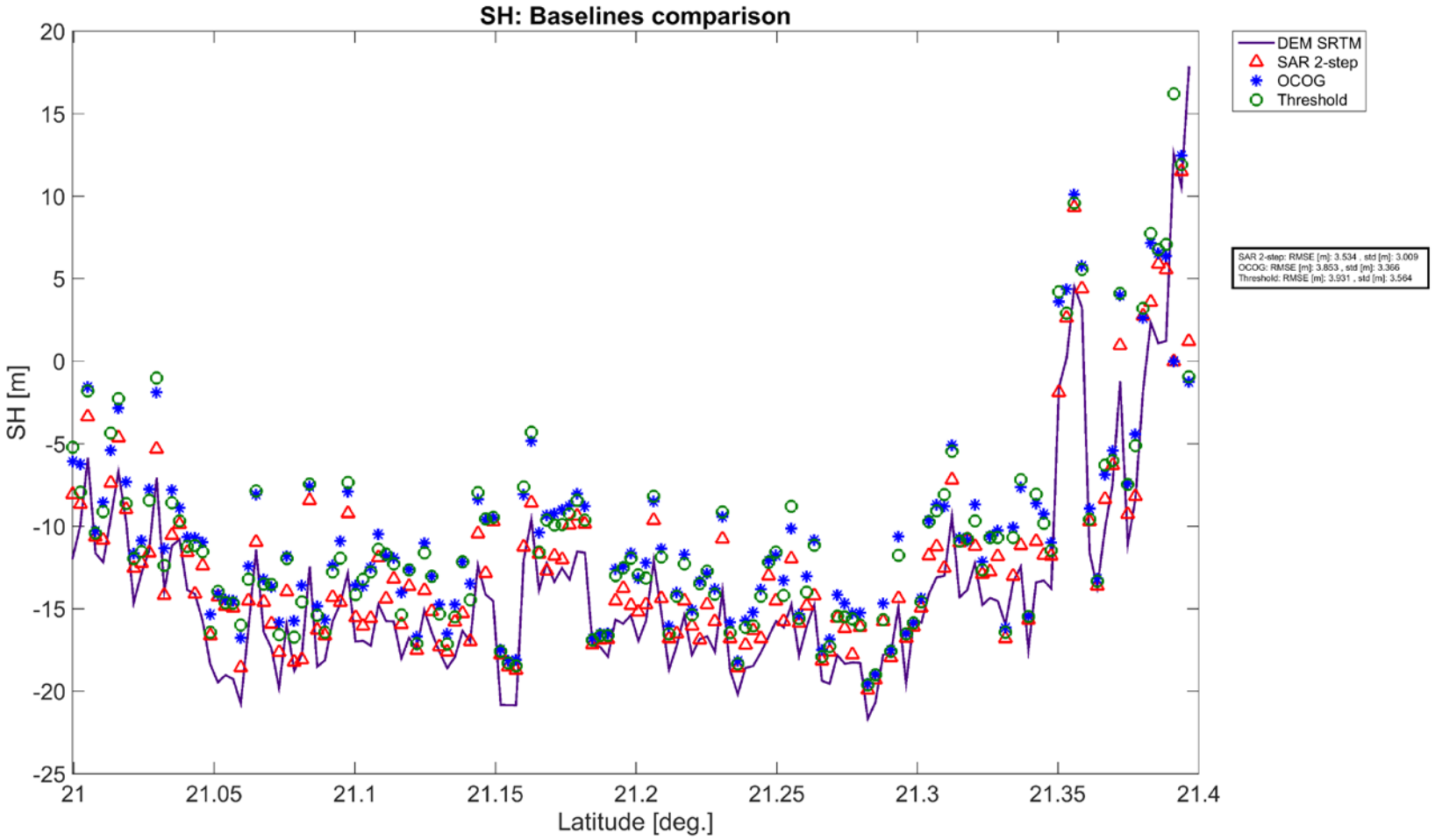

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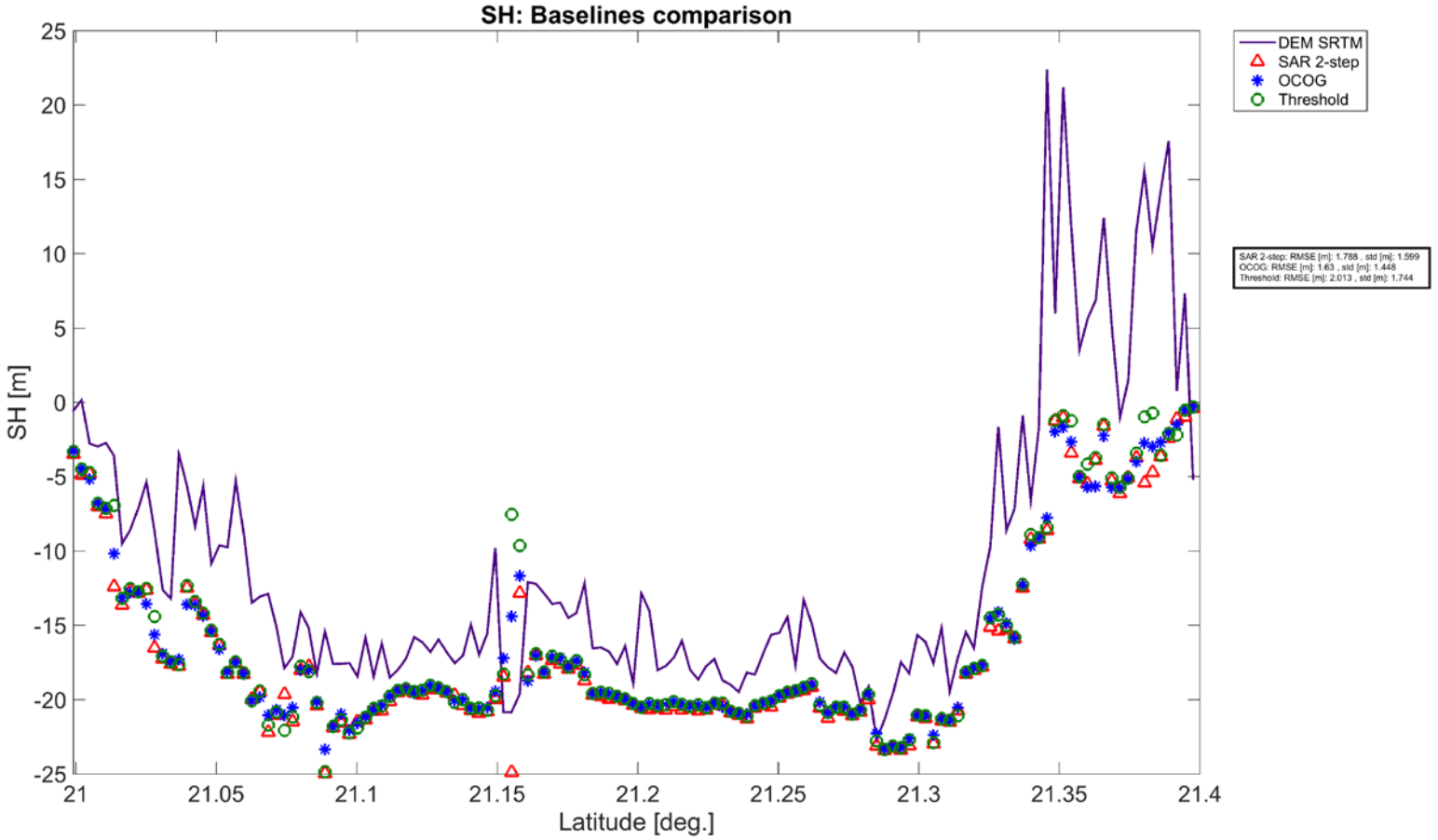

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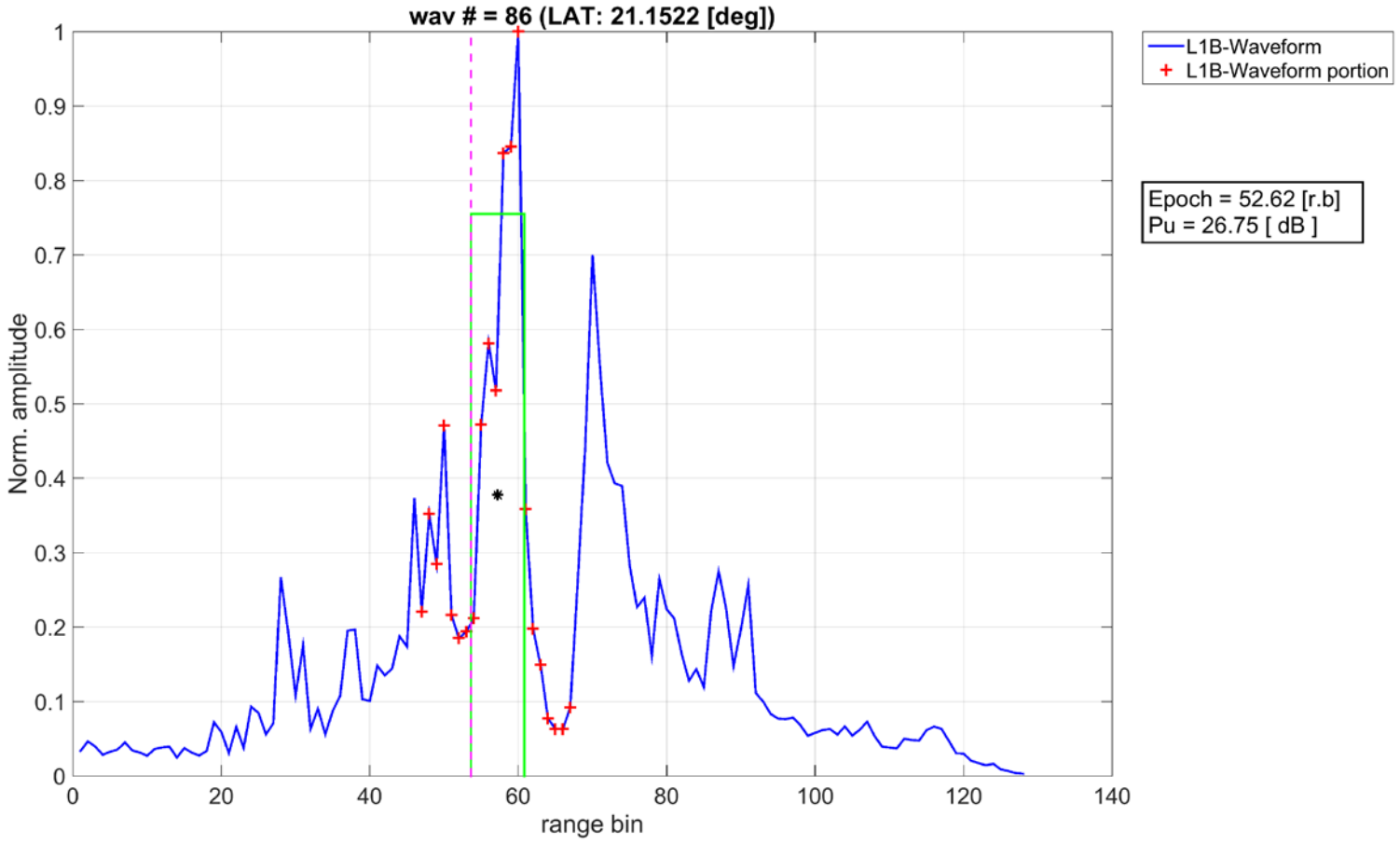

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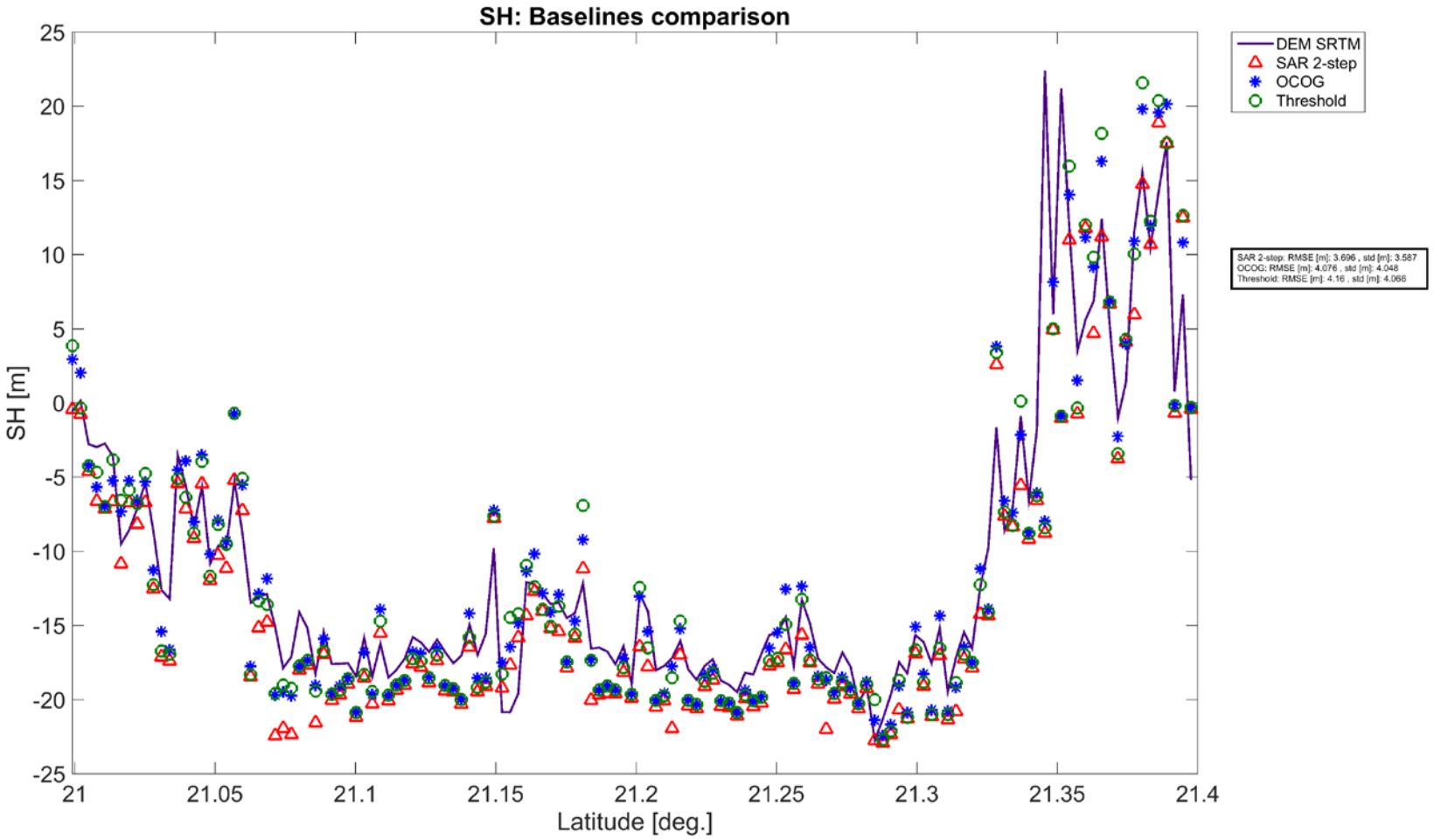
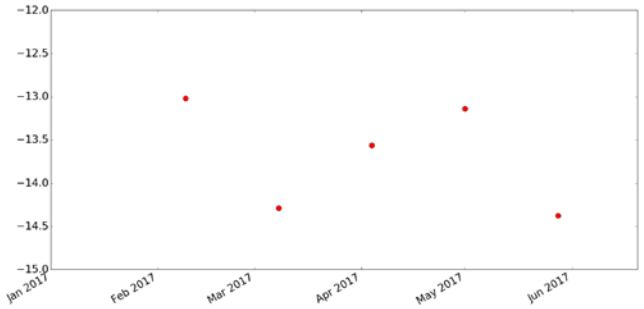
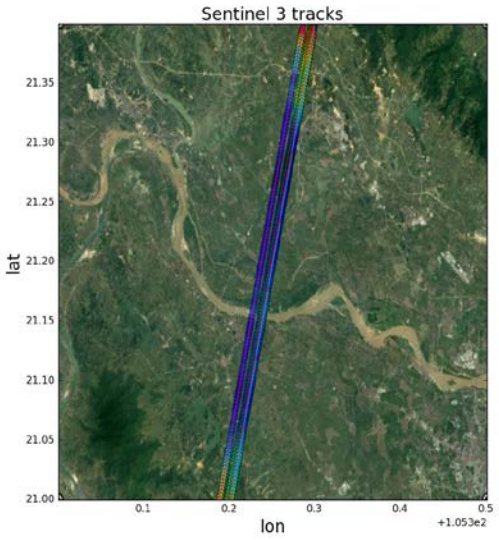
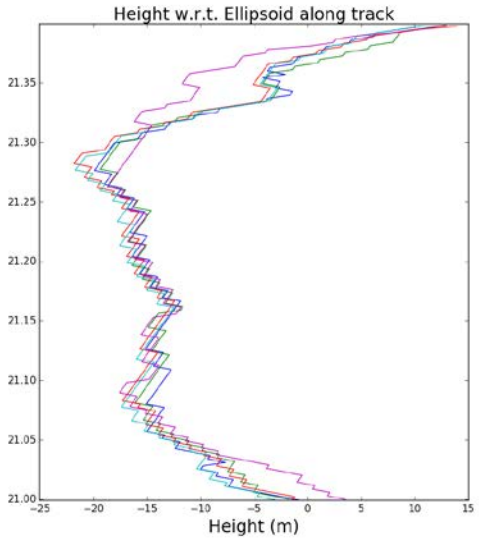


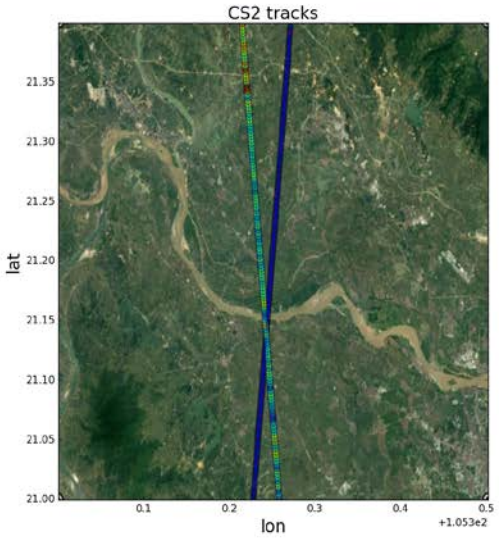
Water Level Preliminary Results

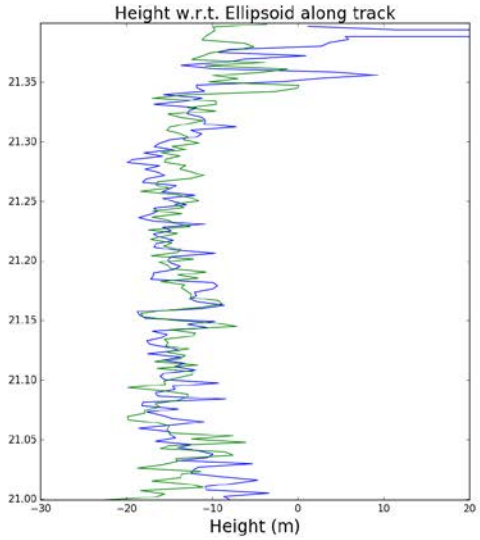


↑ Sentinel-3 retrieved results within using a strict mask drawed manually









Water Level Future Work

- Choose the best retracker and define the input parameters
- Define the waveform within water more automatically instead of manually strict mask
- Validate the accuracy with in-situ data

Approach for High Resolution Soil Moisture

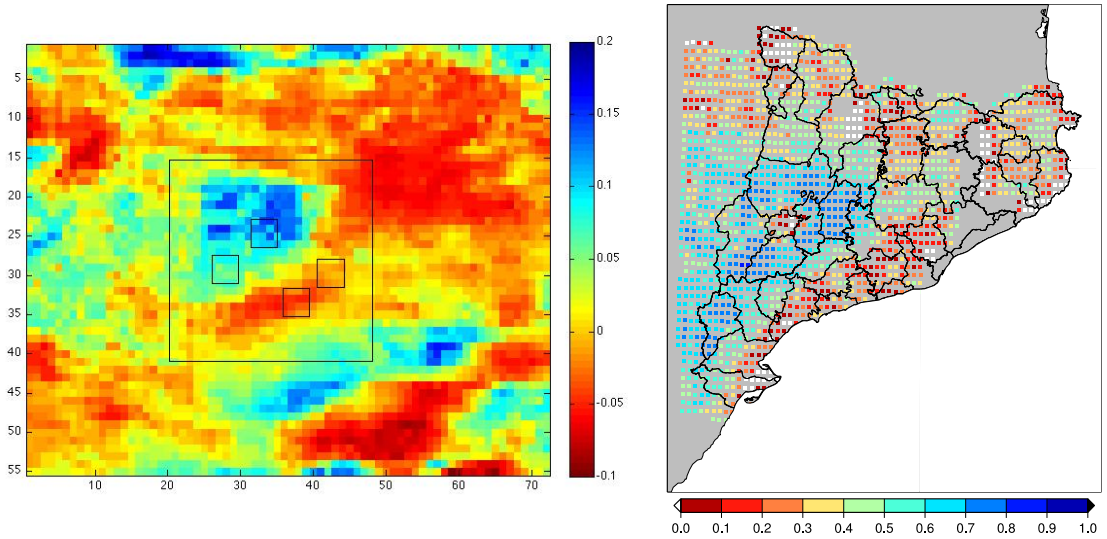
NSSM

L-band Passive MW SMOS/SMAP/WCOM

+

Medium Resolution O/T MODIS (1 km, 1 d)

NSSM (1 km, 2/3 d)



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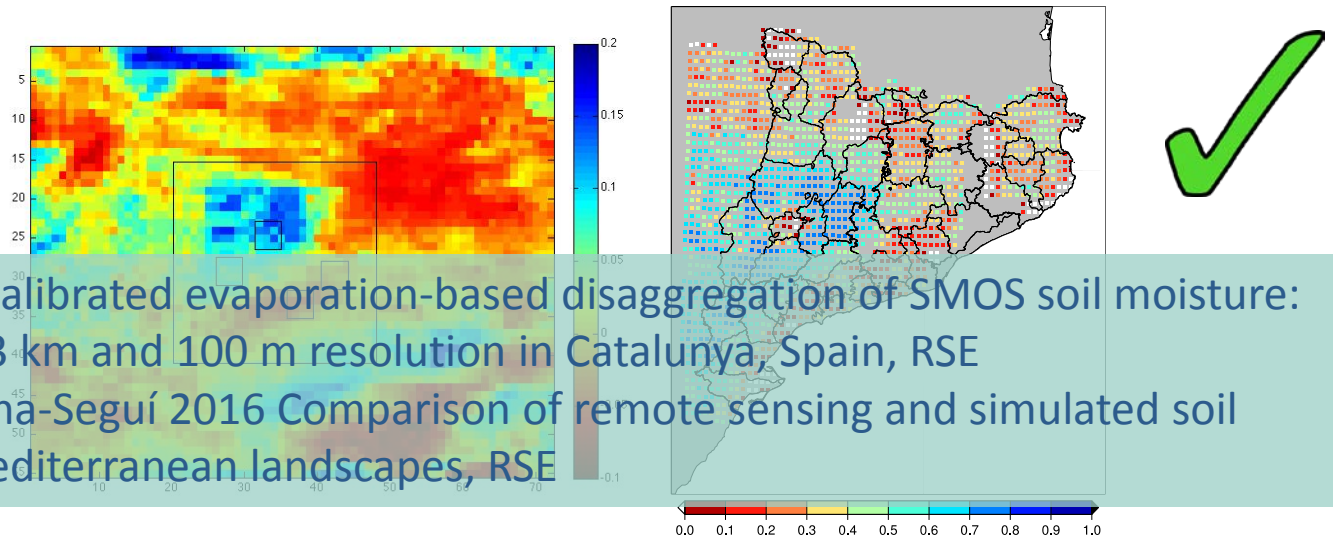
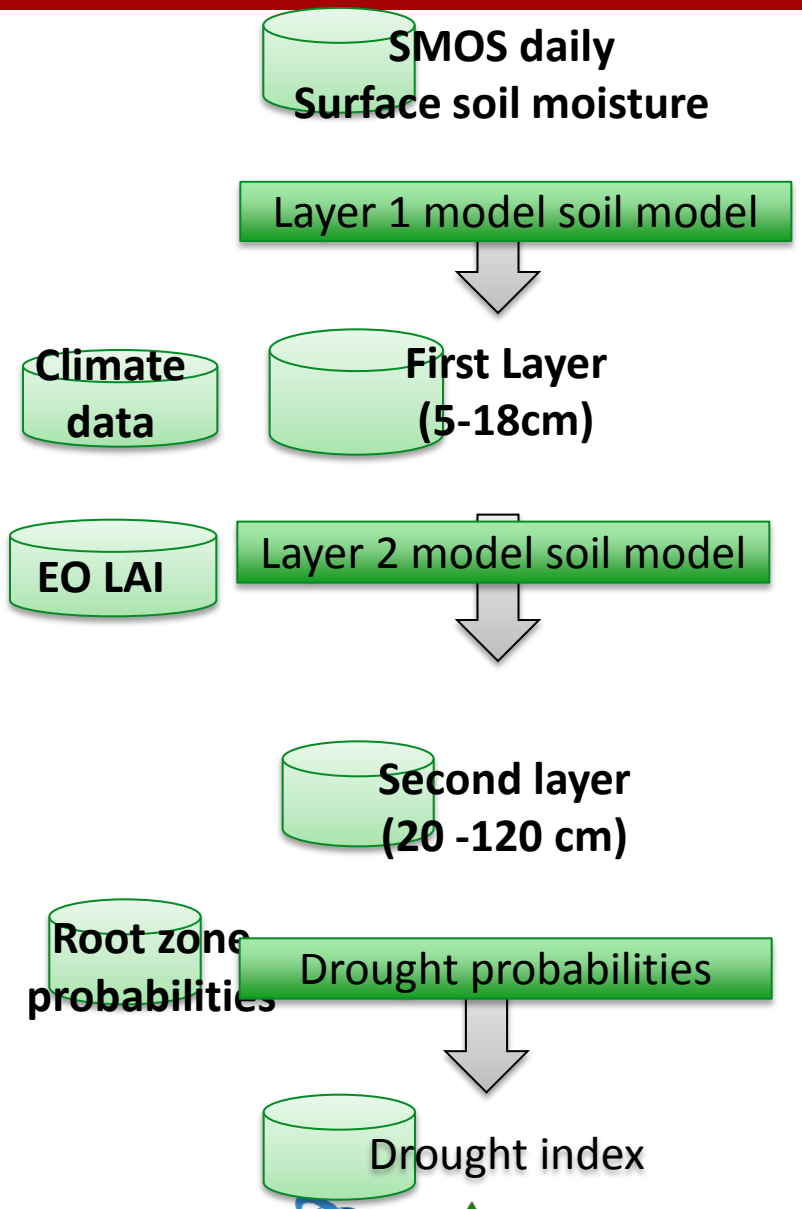


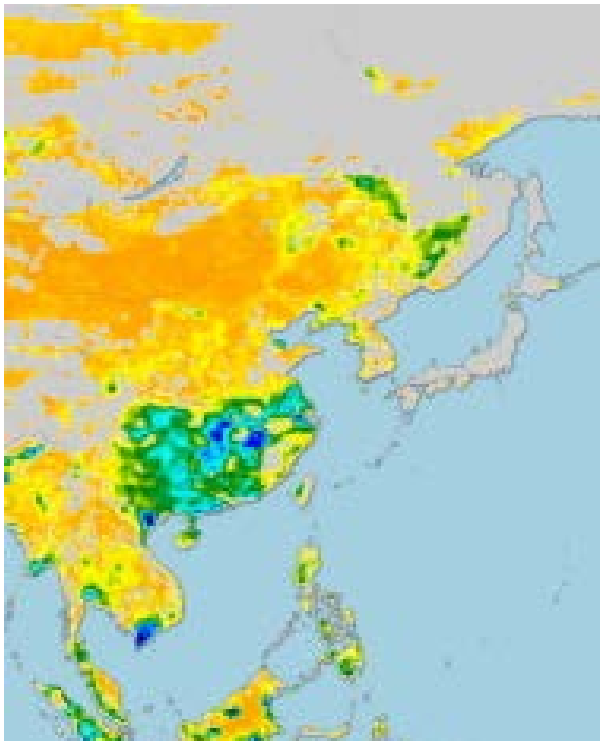
Merlin et al. 2013 Self-calibrated evaporation-based disaggregation of SMOS soil moisture: An evaluation study at 3 km and 100 m resolution in Catalunya, Spain, RSE

Escorihuela and Quintana-Seguí 2016 Comparison of remote sensing and simulated soil moisture datasets in Mediterranean landscapes, RSE

Approach for Drought Monitoring



RZSM – 1st May 2016



Water Balance in Red River Basin

Precipitation P − Evapotranspiration E = Runoff R + Storage ΔS

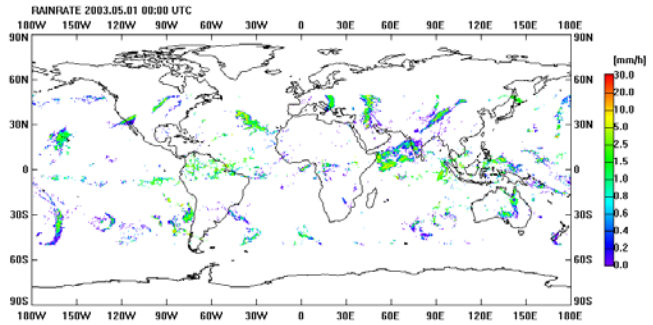
Infiltration

Surface water (water body, reservoir, soil moisture etc.)

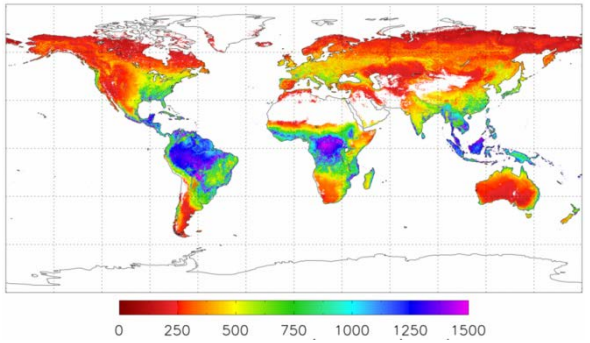
Ground water

Water balance

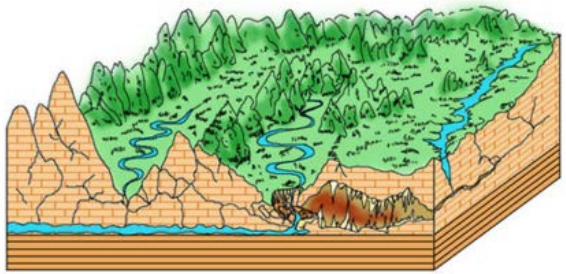
1. Comparison of precipitation, soil moisture, evapotranspiration products (FY-3, SMOS, SMAP and MODIS…)
2. Altimeter based Water body and reservoir product
3. Accuracy Improvement of hydrological process model



TRMM-3B42 3-Hourly RainRate



MOD16 Evapotranspiration



Karst Landform
(high infiltration rate and poor water storage capacity)

Thank you!

Questions?