

isardSAT®



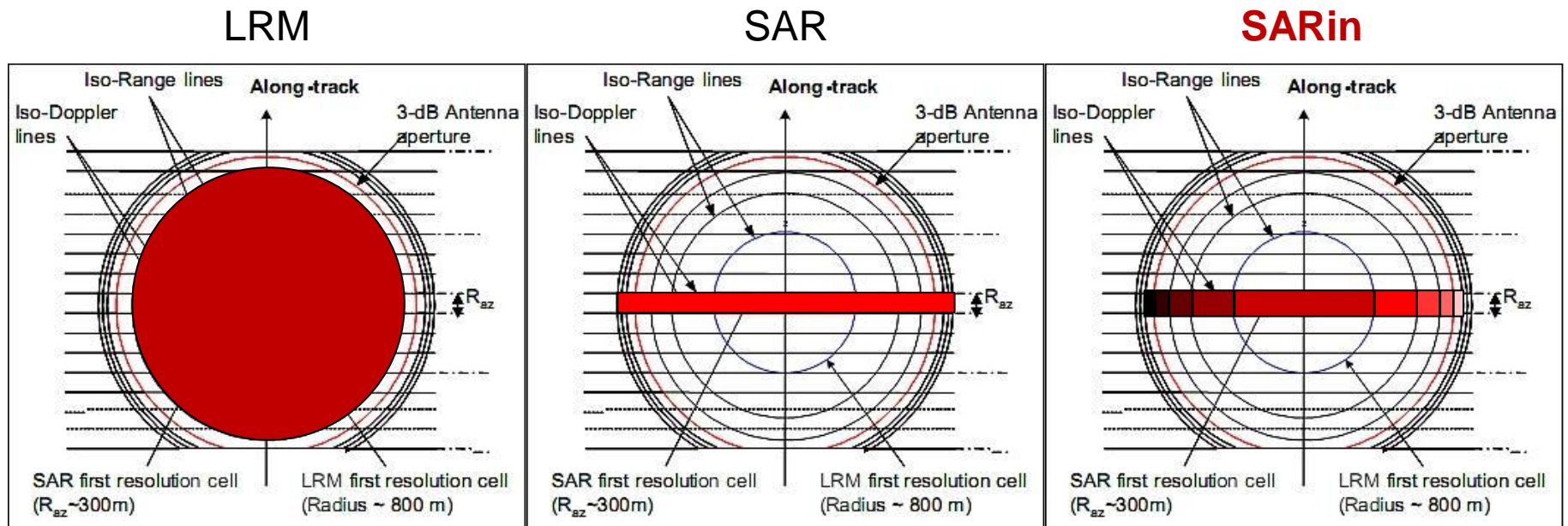
CryoSat-2 SARin Mode for Coastal Altimetry

- Introduction
- CryoSat-2 & Coastal Altimetry
- Proposed solution to coastal Sea Surface Height retrieval
- Area of interest
- Performance of the adopted solution
- Conclusions
- Work to be done & Proposals

CryoSat-2 works in 3 modes

- LRM → Low Resolution (Conventional Altimetry)
- SARM → Better resolution Along track
- **SARinM** → Better resolution Along track & AoA Across track

(Synthetic Aperture, interferometric mode)

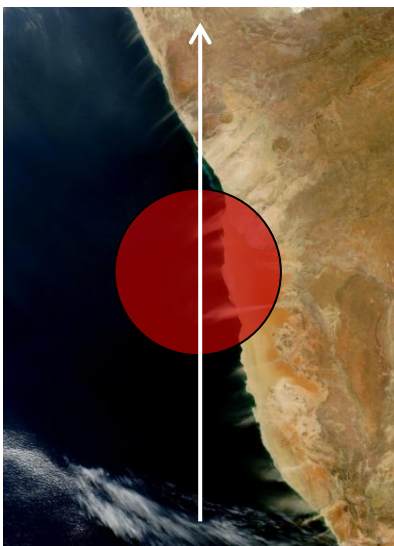


CryoSat-2 works in 3 modes

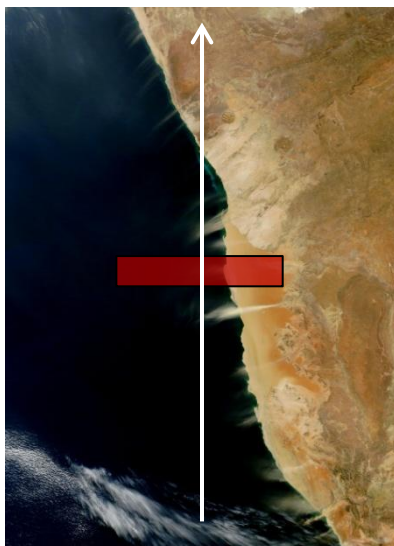
- LRM → Low Resolution (Conventional Altimetry)
- SARM → Better resolution Along track
- **SARinM** → Better resolution Along track & AoA Across track

(Nadir discrimination is possible)

LRM



SAR



SARin

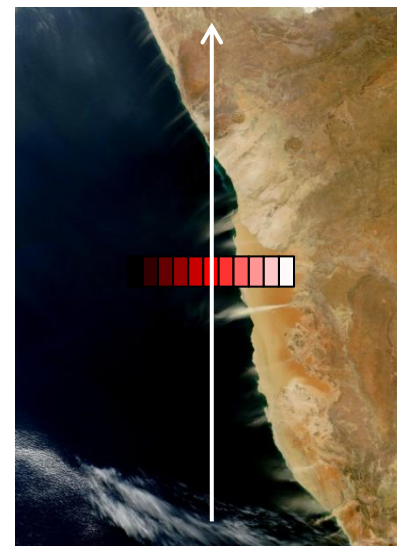
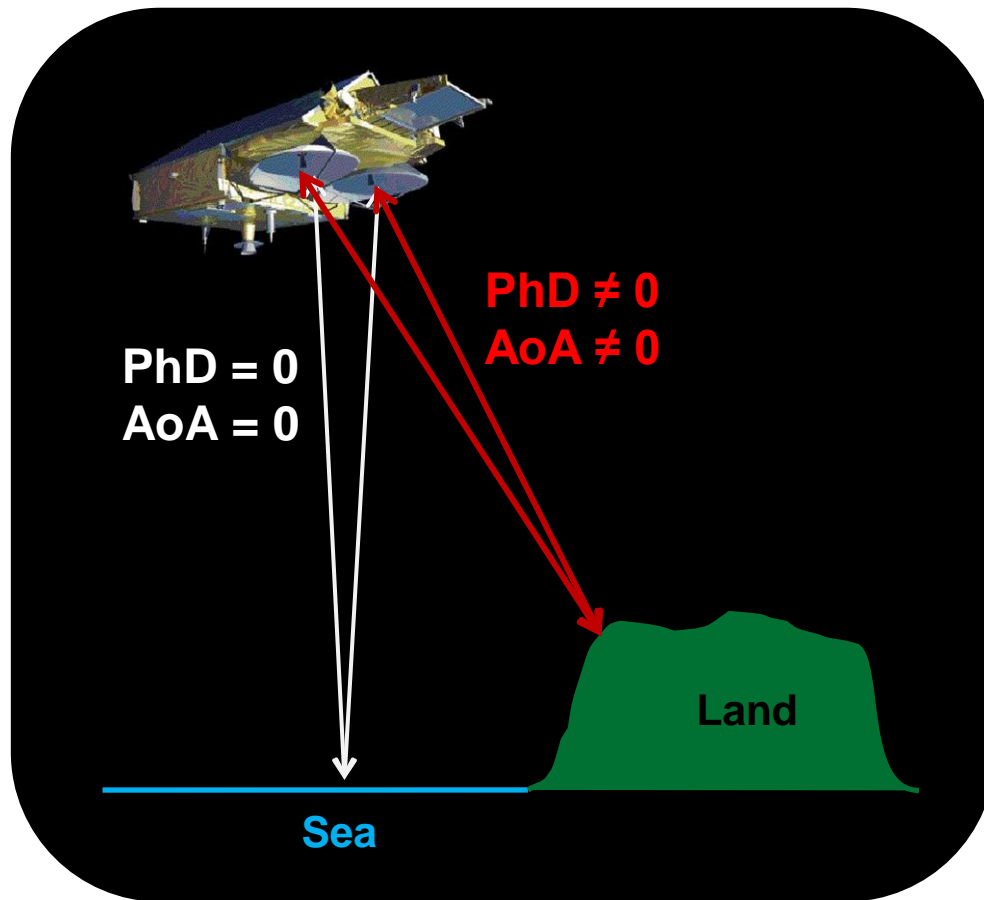
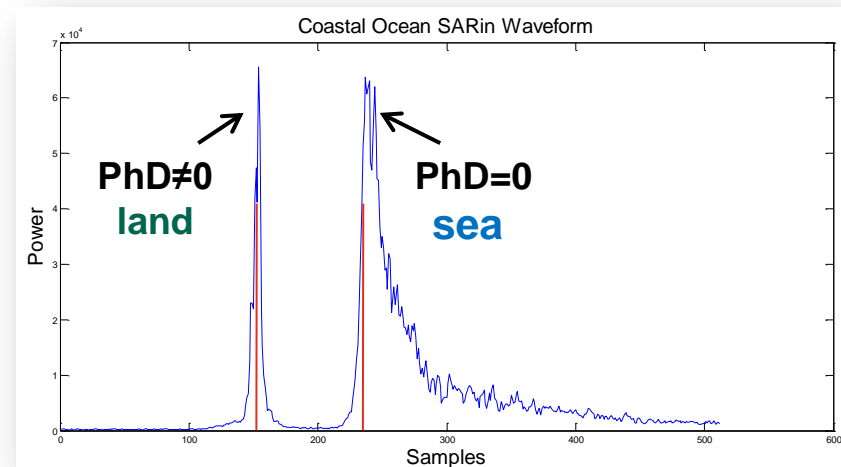


Image: Terra/Modis/Nasa

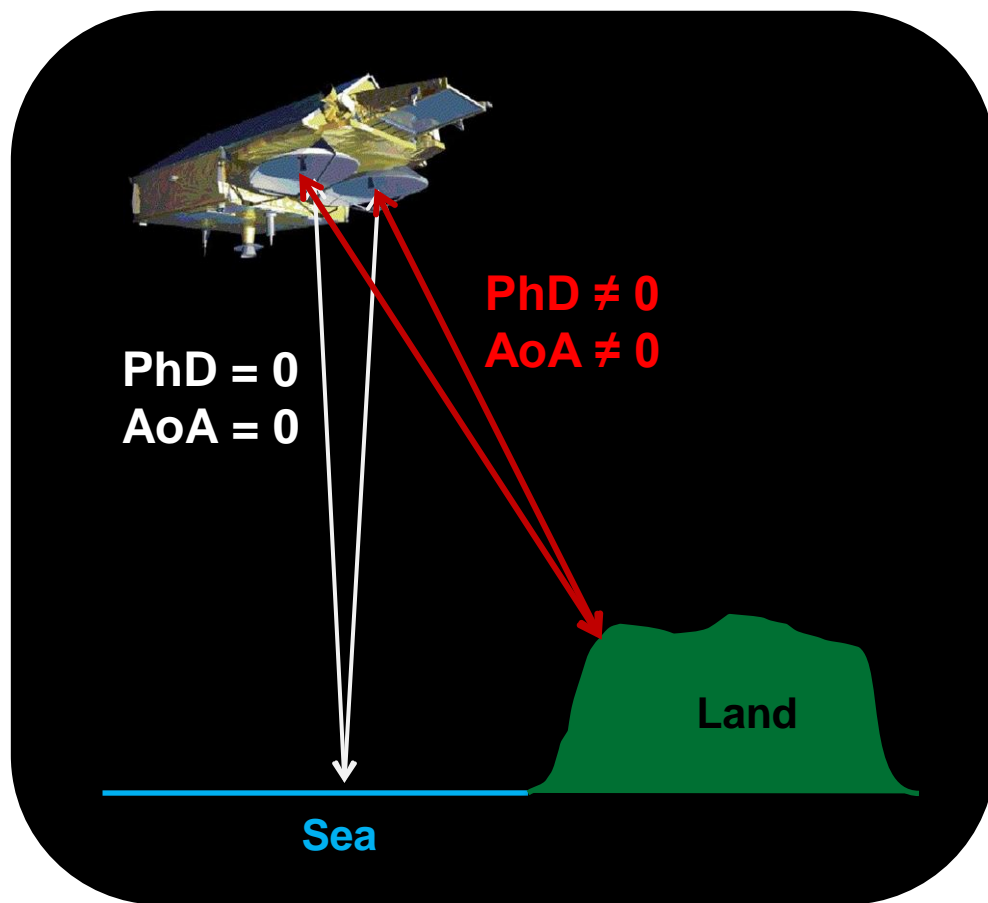
SARinM: The Across-Track discrimination is based in the Phase Difference (PhD) \rightarrow Angle of Arrival (AoA)



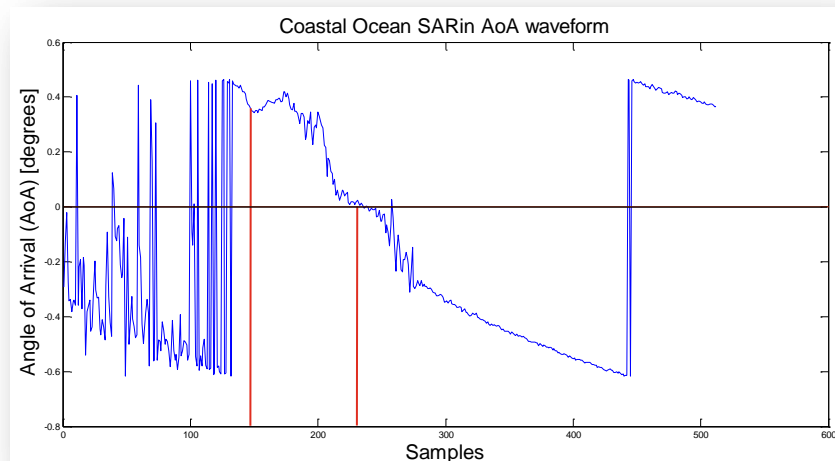
SARin Mode allows discrimination of coastal echoes between **sea** and **land**



SARinM: The Across-Track discrimination is based in the Phase Difference (PhD) → Angle of Arrival (AoA)

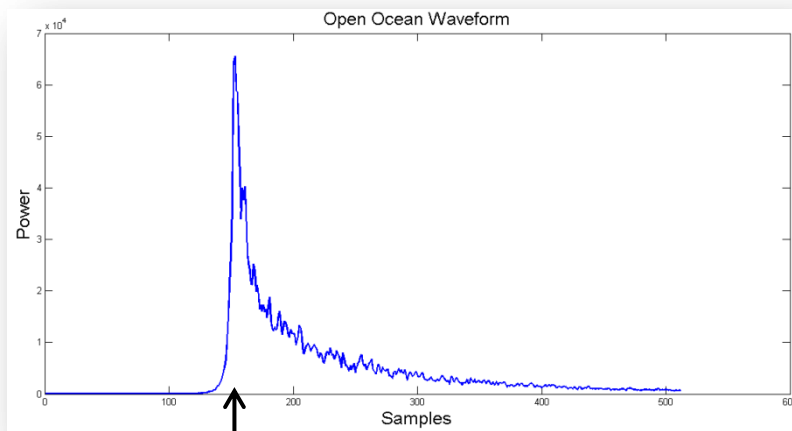


SARin Mode allows discrimination of coastal echoes between **sea** and **land**

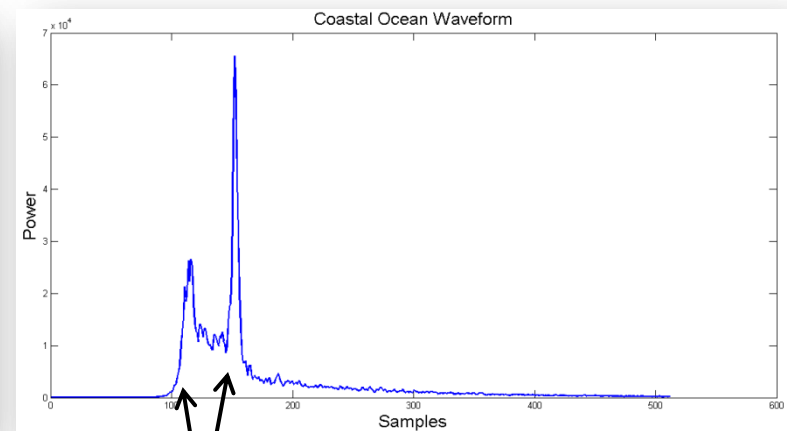


What happens in Altimetry near the coast?

- Coastal signals are not ocean like waveforms, but contaminated by land and calm waters reflections → the retracking processing needs some help.



Retracked
range bin

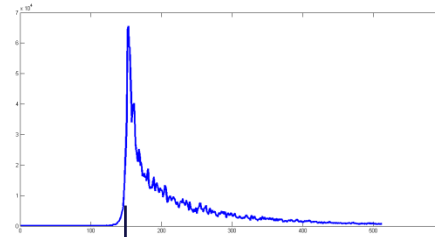


Retracked
range bin?

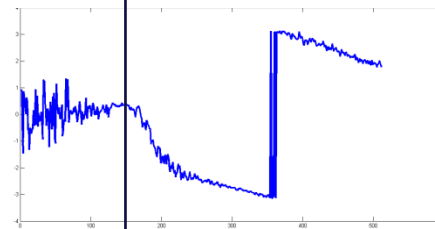
- It is necessary to avoid all the “non ocean” (Off-Nadir) information when retracking.

- Main L1 data selected for the processing:

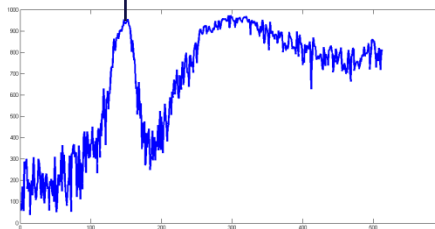
- Power waveforms →



- Phase Difference waveforms →

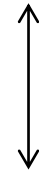


- Coherence waveforms →

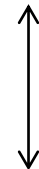


black line:

LEP



AoA = Nadir

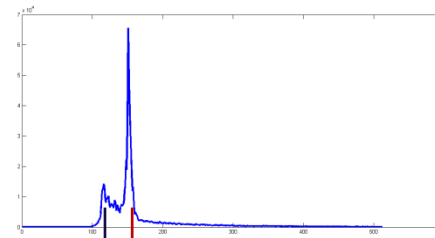


Max Coherence

- Geolocation, Roll, Altitude, Window_delay...

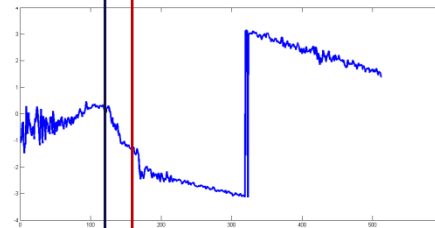
- Main L1 data selected for the processing:

- Power waveforms →



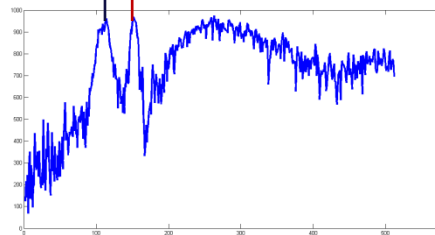
black / red line:
Nadir LEP / flat sea

- Phase Difference waveforms →



Nadir / Off-Nadir

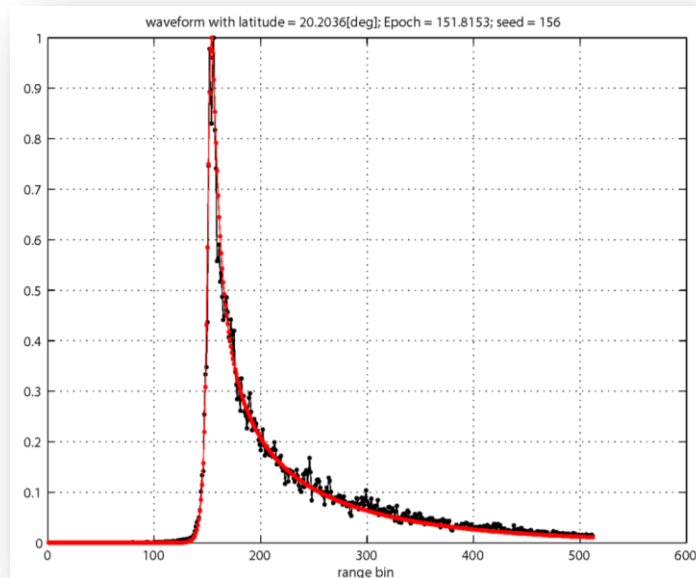
- Coherence waveforms →



High Coherence /
High Coherence

- Geolocation, Roll, Altitude, Window_delay...

- Algorithm developed:
 1. Iterative process to find a seed for the L2 retracker avoiding off-nadir targets.
 2. The L2 processing consists in a retracking method developed by Cristina Martin-Puig (isardSAT), inherited from the SAMOSA model.

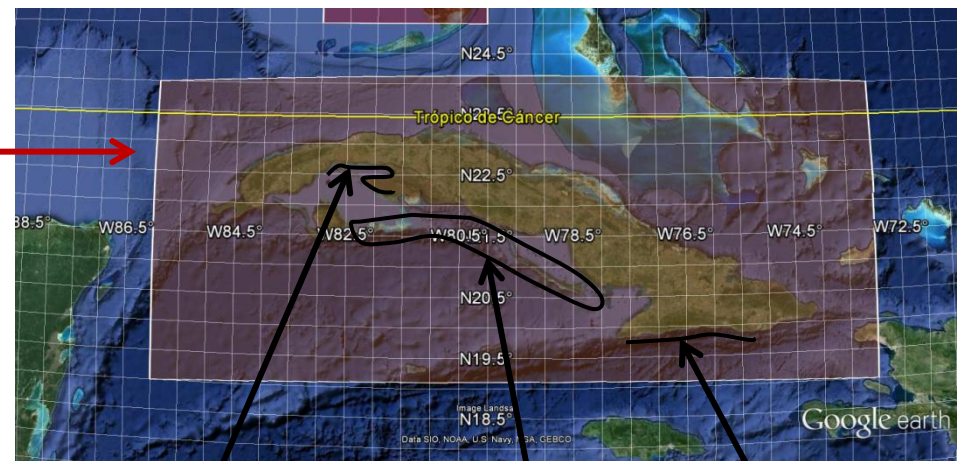


SAMOS A Model Adapted:

- **SARin** Mode
- Baseline B
- Modifications of the model

Zones of interest for this investigation:

- CP40 request for specific SARin mode area: **The Cuban Archipelago**



Lowland coastal zones

Reefs, Cays

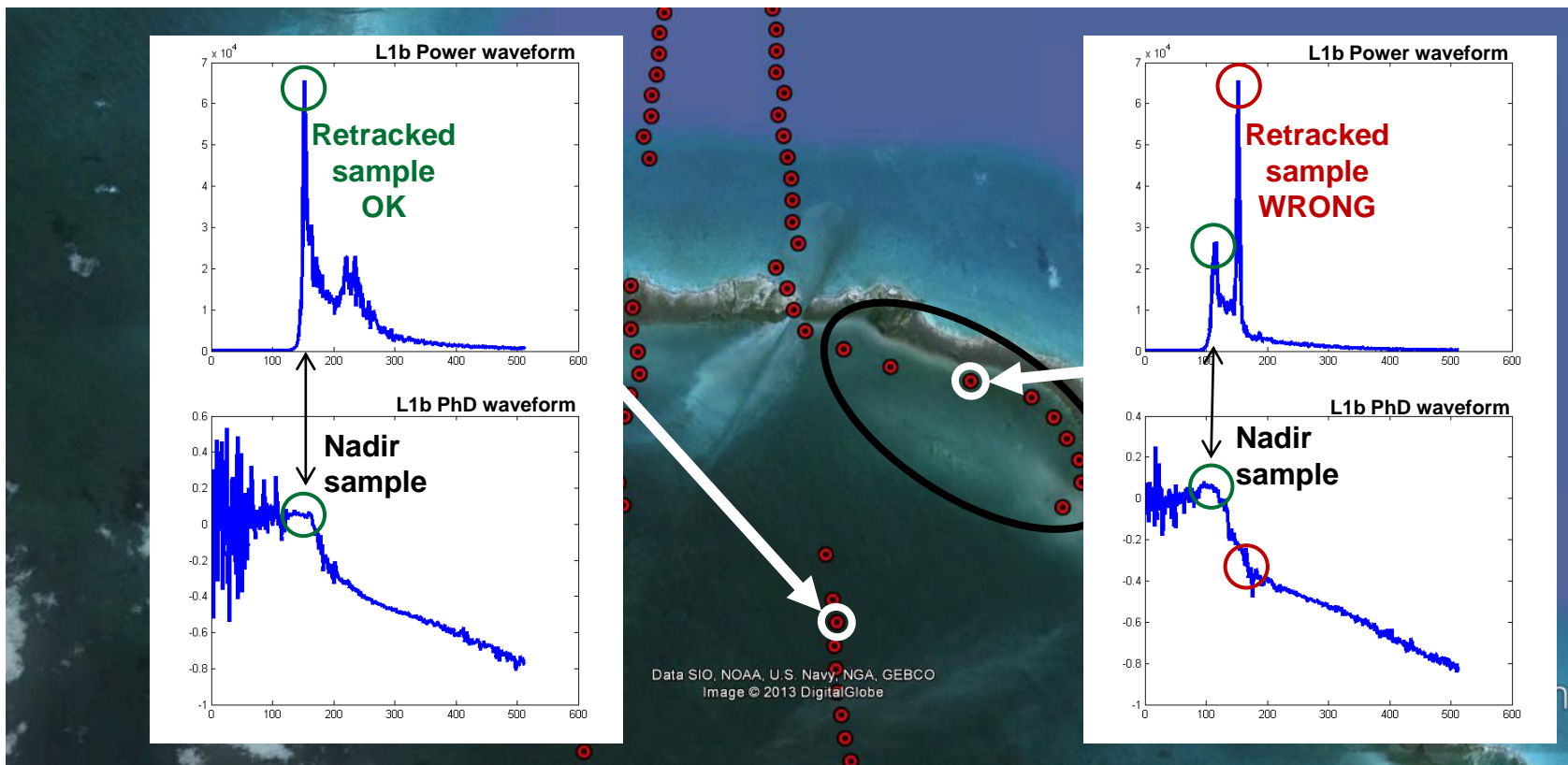
Cliffs

Example of how the current L2 products lose the Nadir signal near the coast.

Geolocations from L2I products corrected based in ESA retracking outputs.

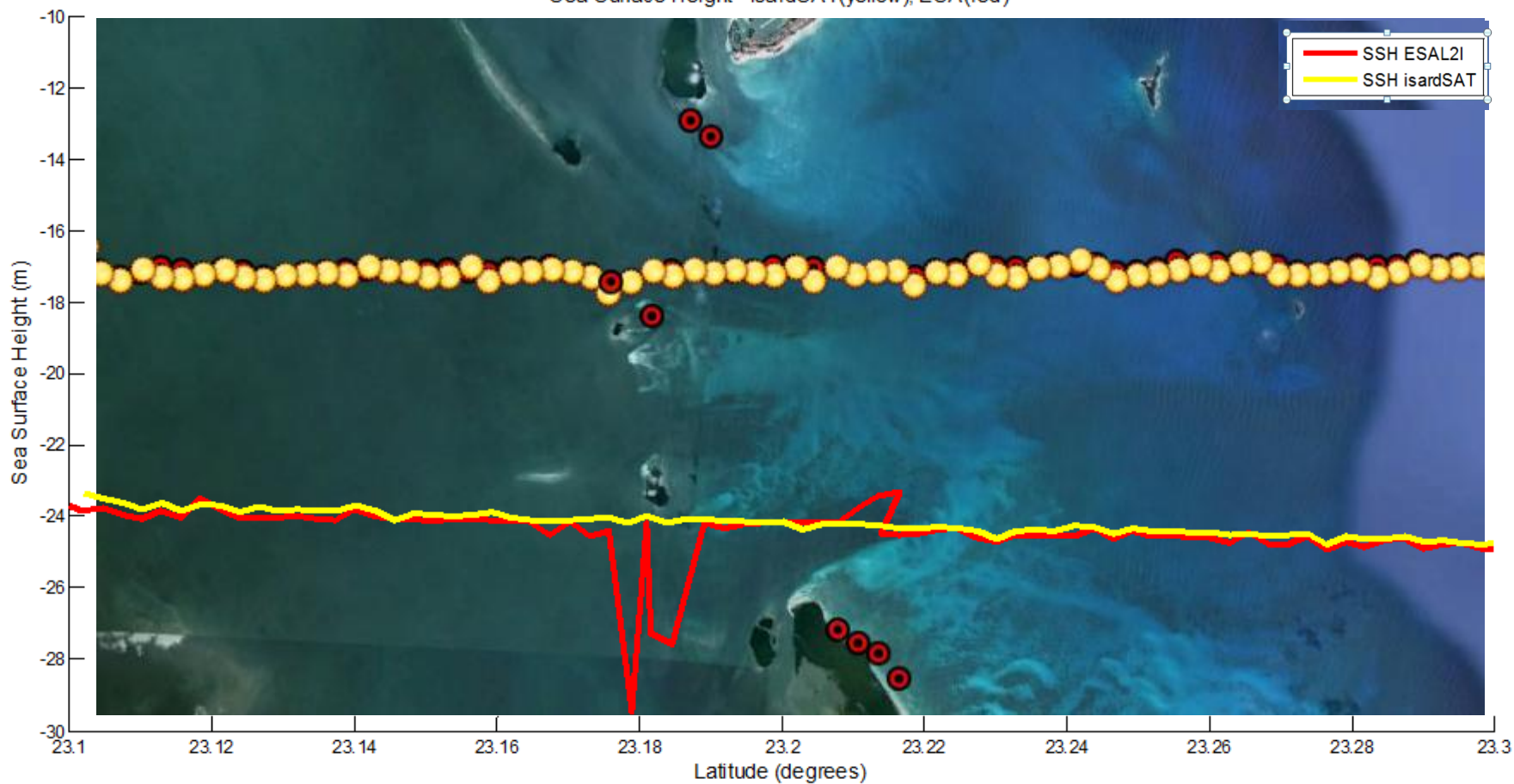


Example of how the current L2 products lose the Nadir signal near the coast.

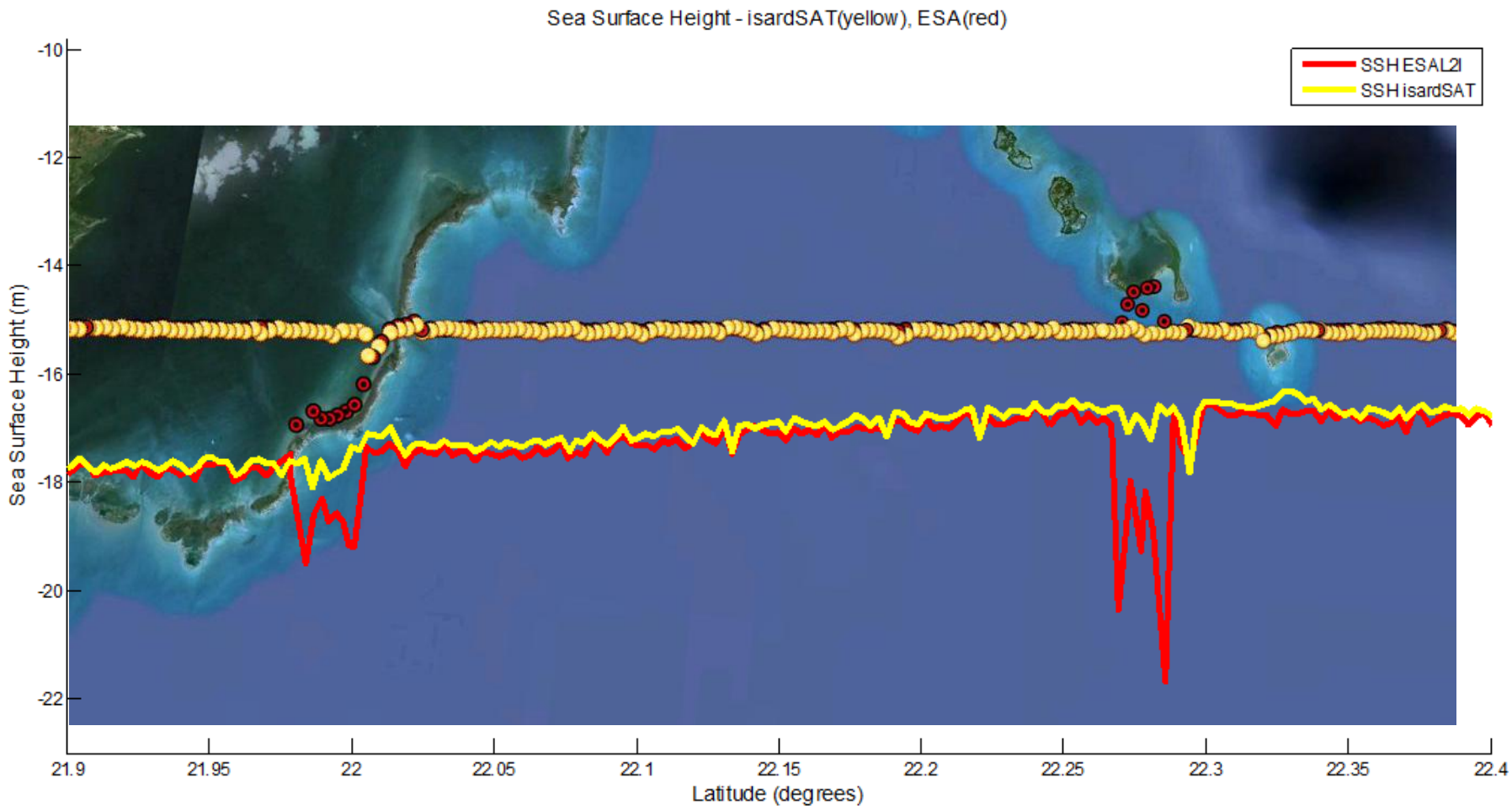


Example 1: CUBA, pass over North cays

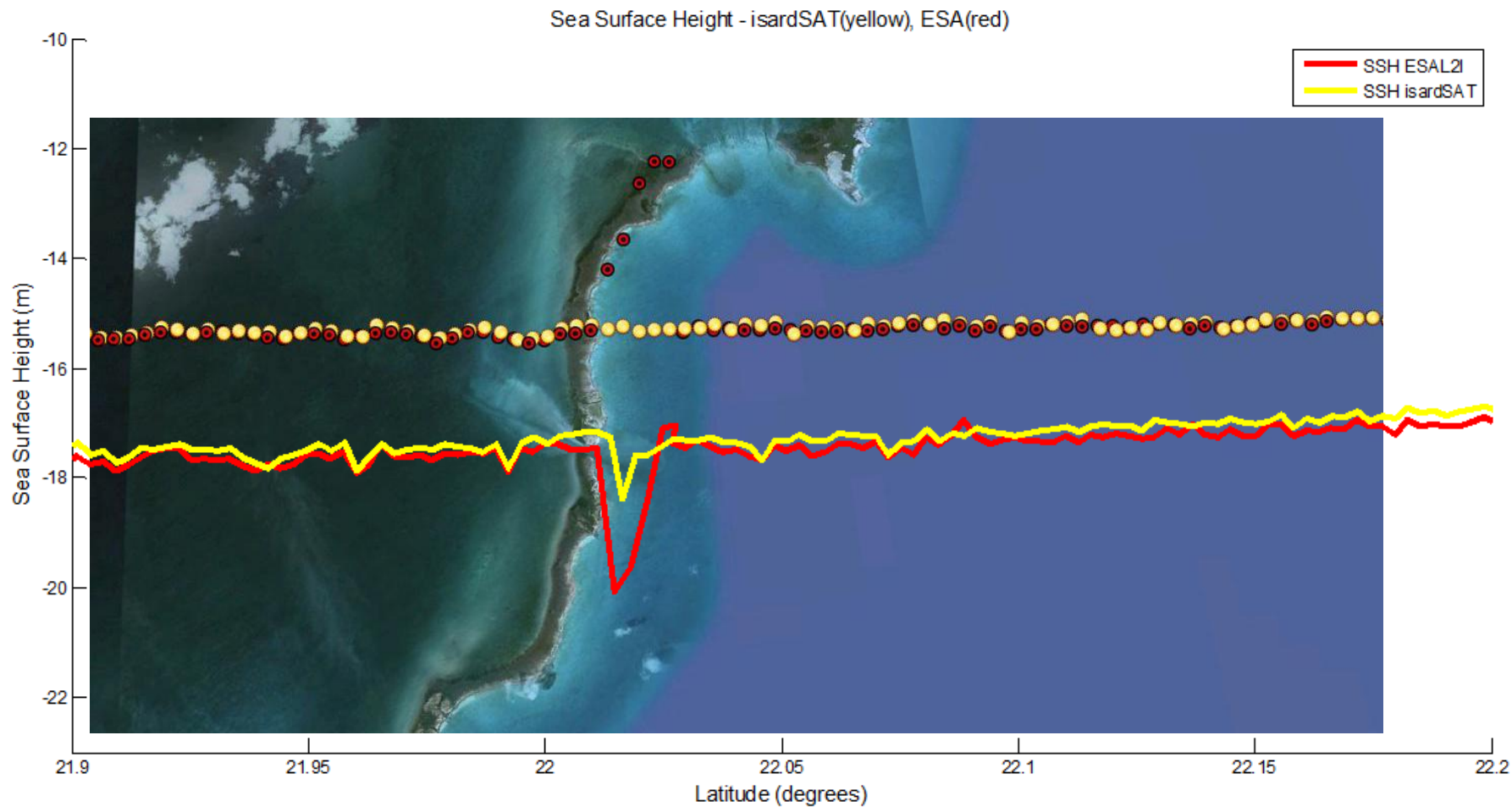
Sea Surface Height - isardSAT(yellow), ESA(red)



Example 2: CUBA, pass over SW cays

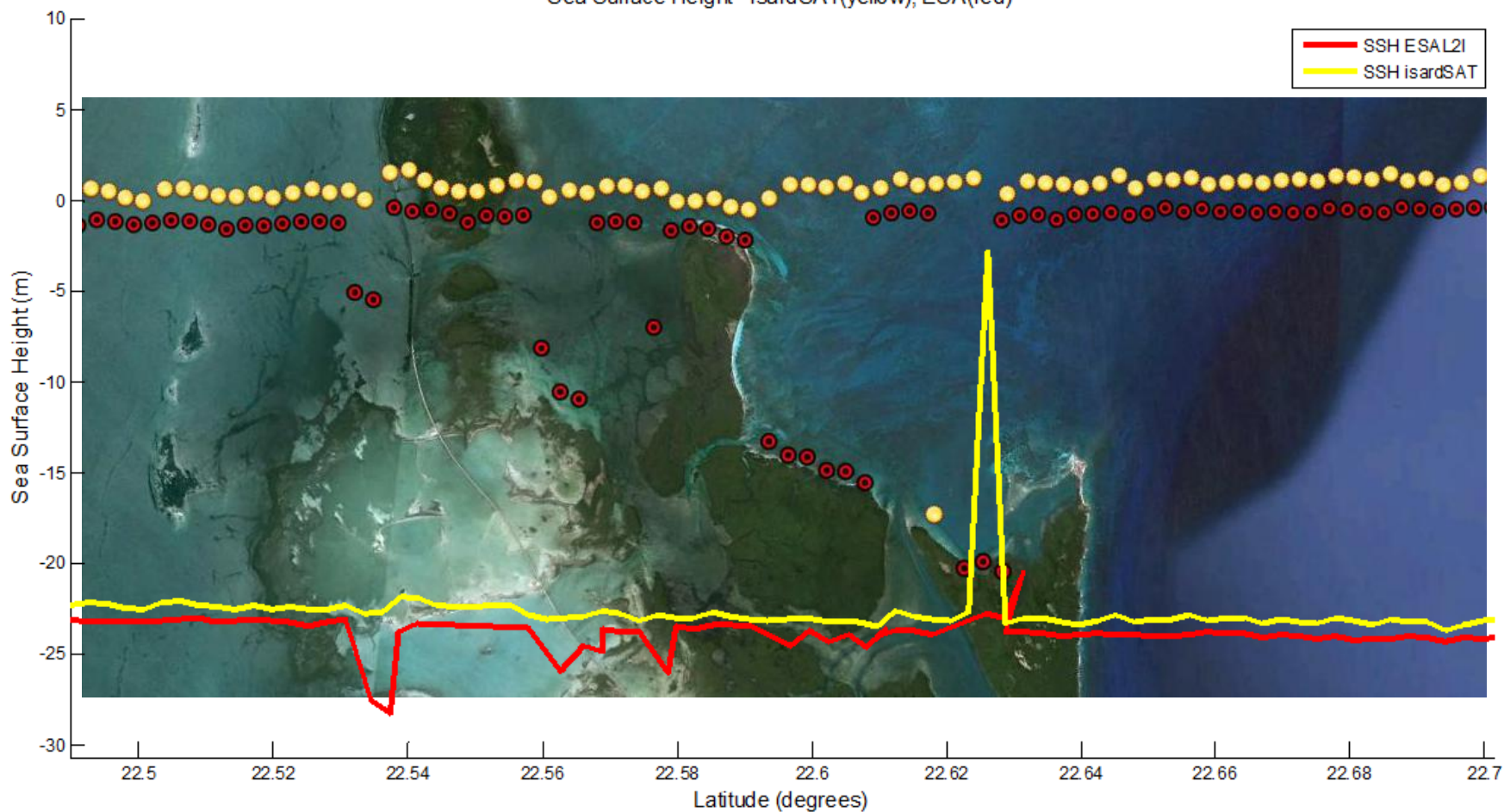


Example 3: CUBA, pass over same SW cays (now descending pass)



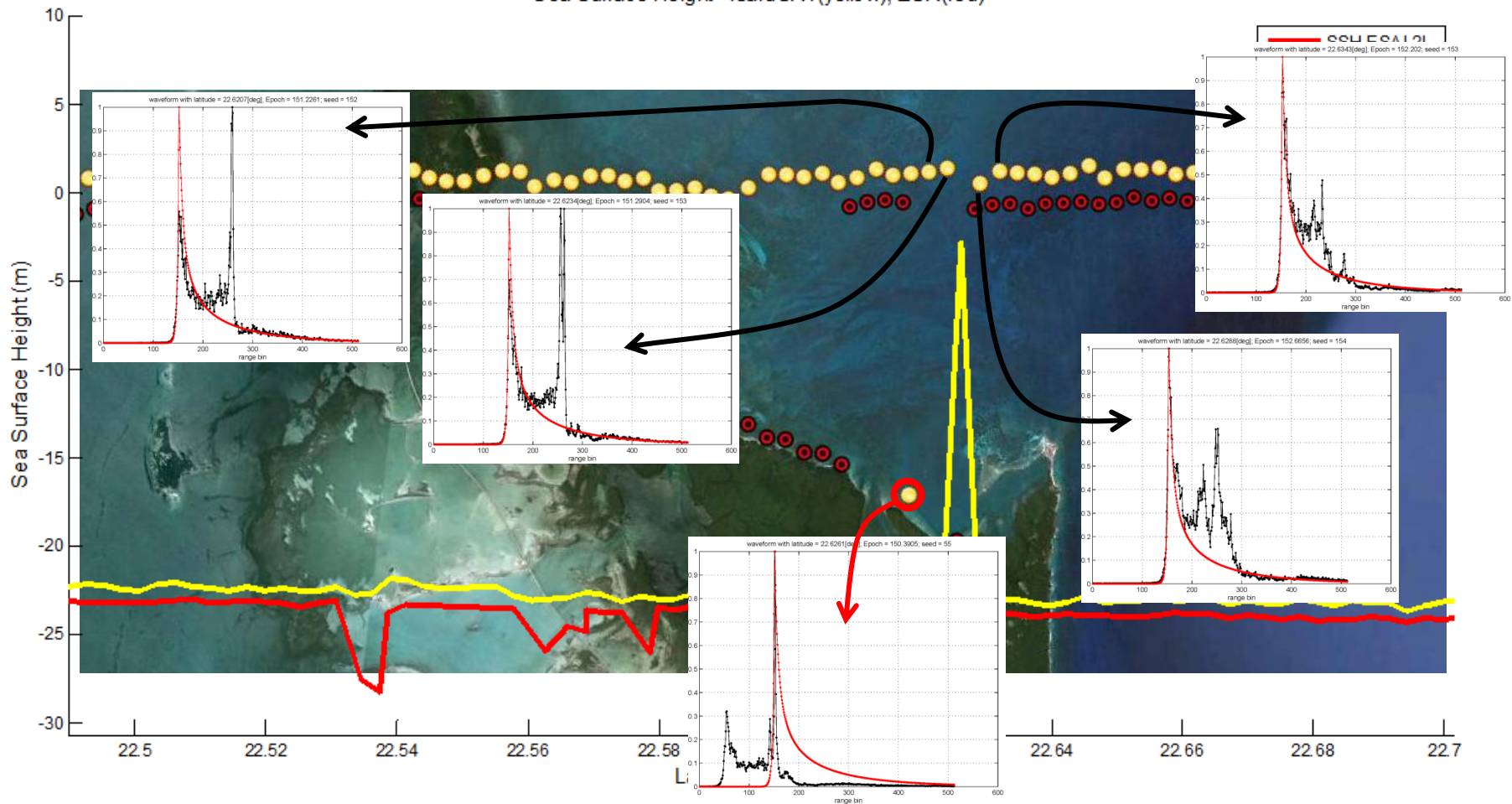
Example 4: CUBA, pass over NE cays

Sea Surface Height - isardSAT(yellow), ESA(red)

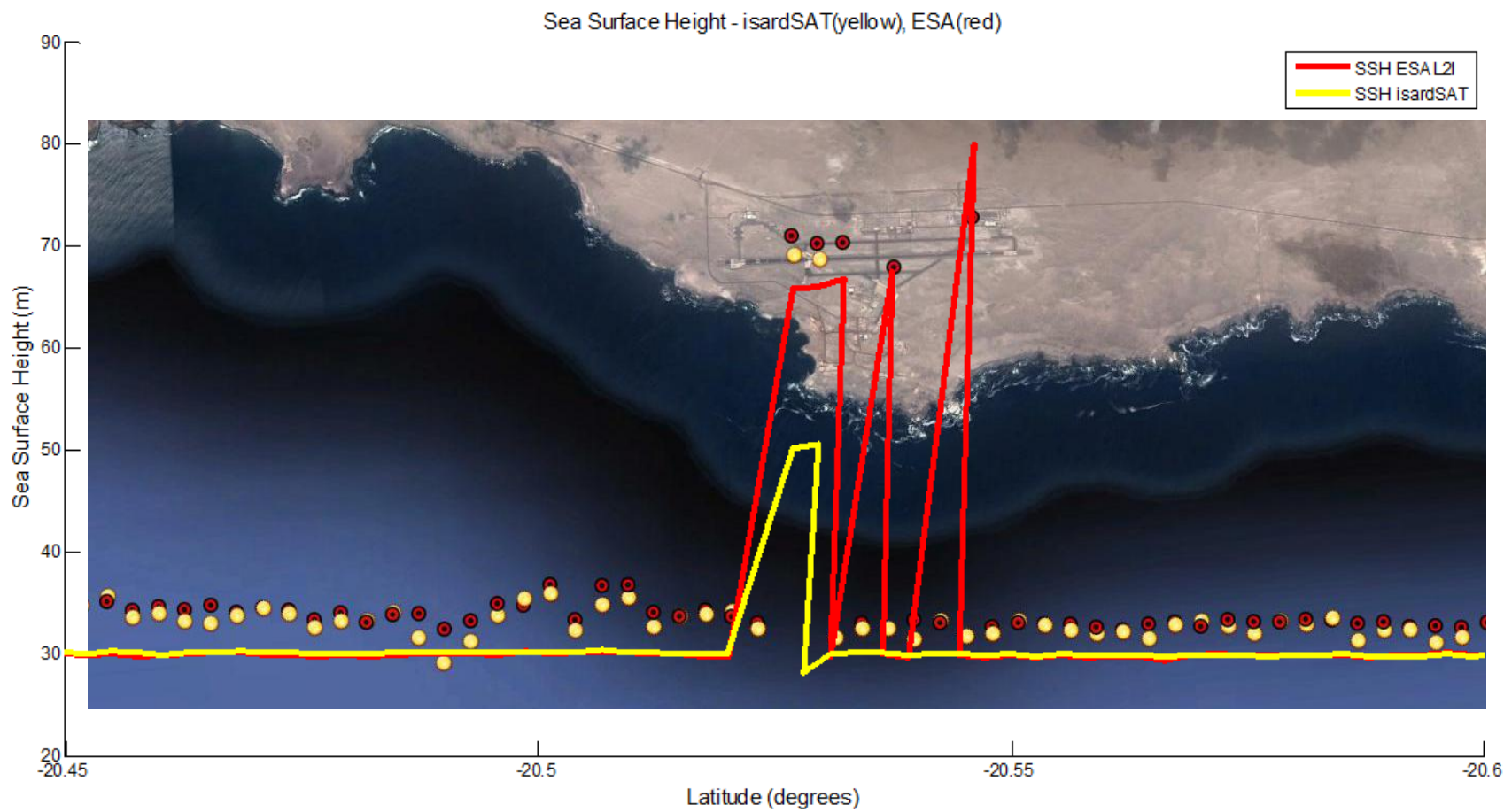


Example 4: CUBA, pass over NE cays

Sea Surface Height - isardSAT(yellow), ESA(red)

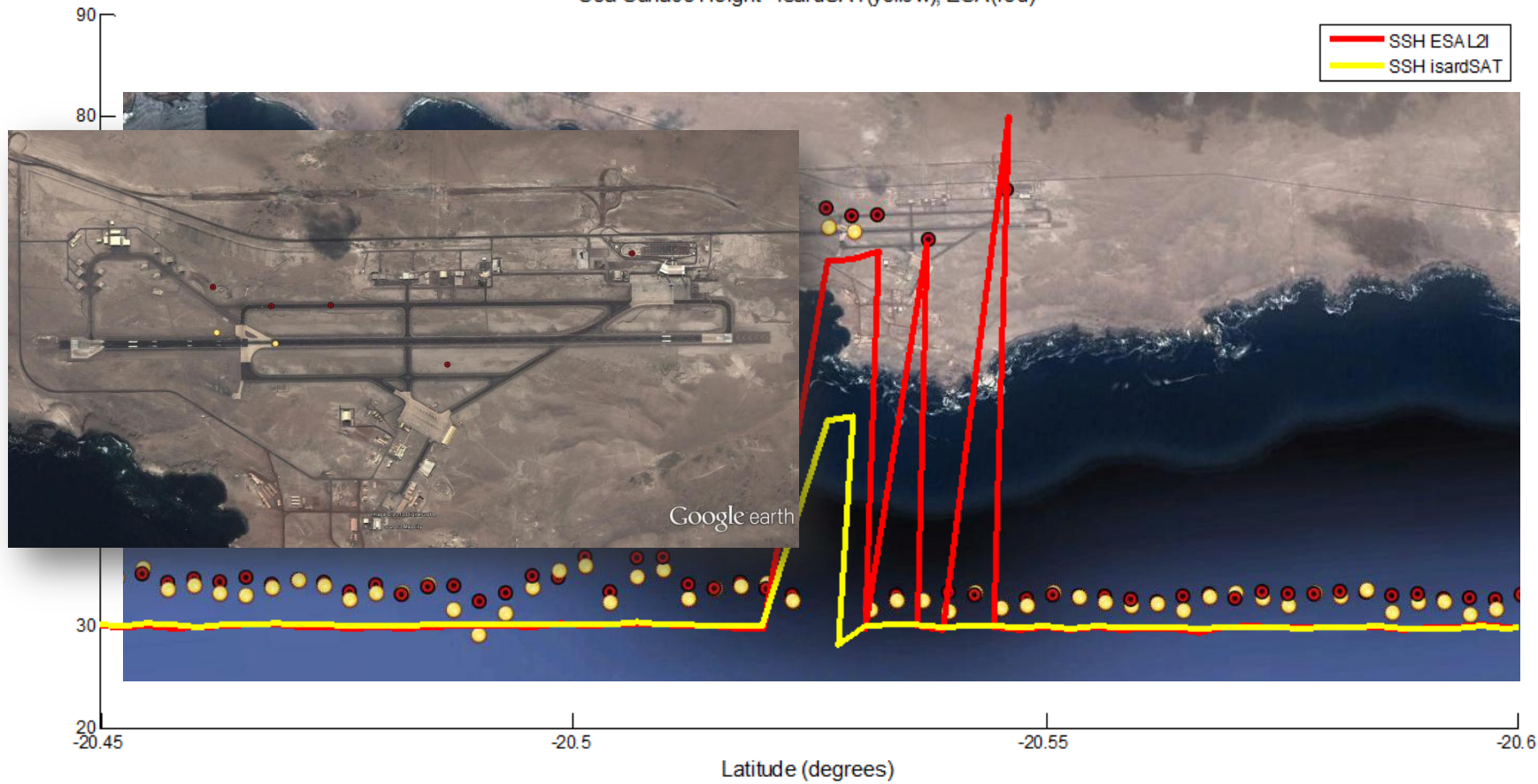


Example 5: CHILE, parallel track wrt to coast line

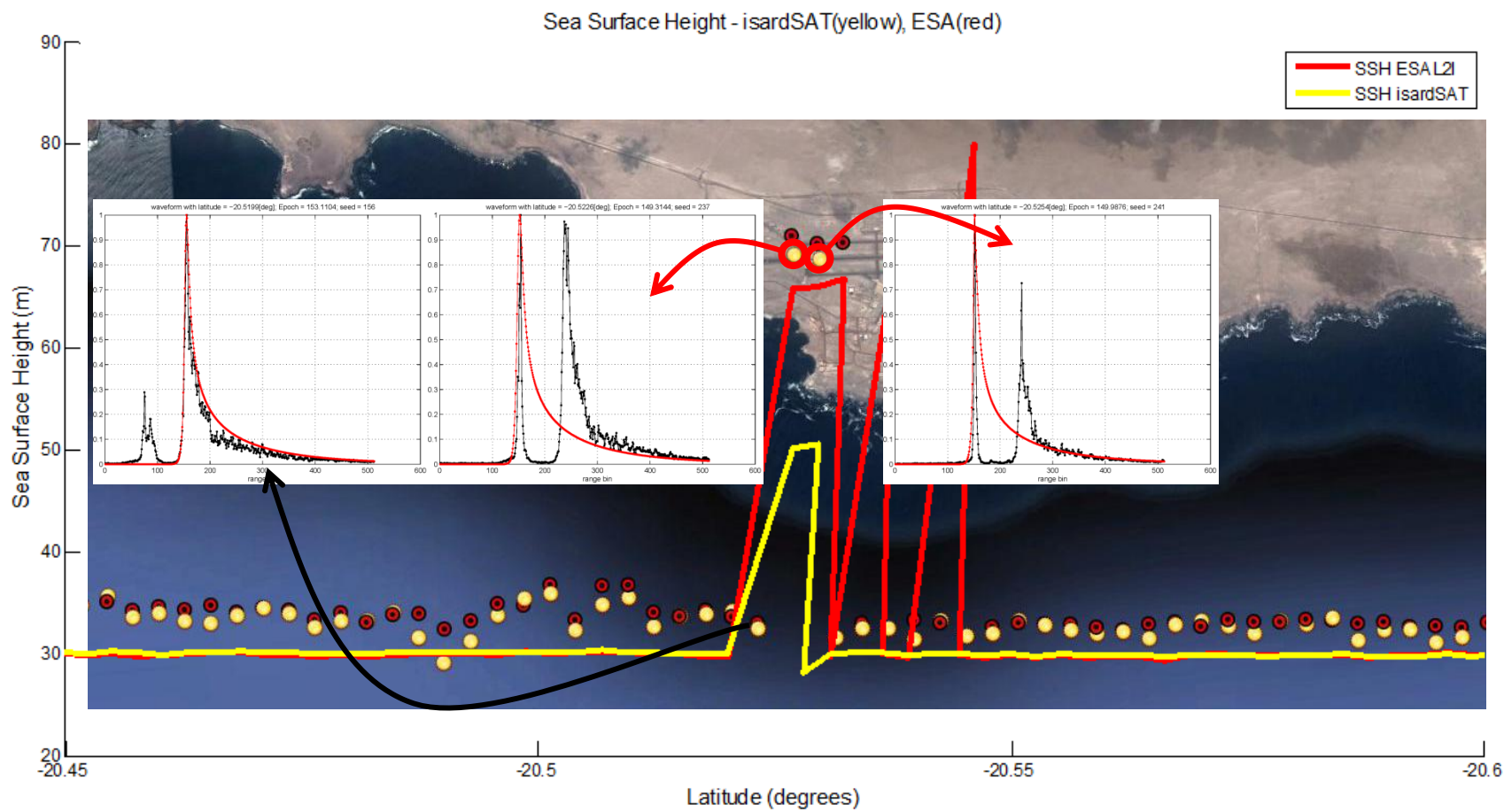


Example 5: CHILE, parallel track wrt to coast line

Sea Surface Height - isardSAT(yellow), ESA(red)



Example 5: CHILE, parallel track wrt to coast line



- Some conclusions:
 - Coastal zones are very likely to produce contaminated waveforms, affecting the SSH retrieval.
 - Nadir determination can be solved from AoA, useful in coastal waveforms.
 - An adapted Retracking method, seeded by a post-L1b dedicated algorithm, improves the SSH results in coastal areas.
 - Coastal Altimetry Community could be highly benefited from this solution, that also can be applied in **inland waters**.
 - **This investigation shows the SARin specific potencial to improve the SSH results in problematic scenarios as coastal zones.**

- Work to be done:
 - **SARin for Coastal Ocean:**
 - Fine tuning of the retracker seed production and the retracking solution.
 - Extensive assessment of the method's results.
 - Produce a test data set to be considered in coastal zones.
 - The improved SSH retrievals could offer a potential validation data set to be used in next missions to come (e.g. **Sentinel-3 CalVal campaign**) in both **coastal regions and inland waters**.
 - Adapt the overall processing to other approaches with the same objective.

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END

Thank You