Onboard Processor

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Outline

• Introduction:
• The OBP and the ATBD: The Basics.
• Testing the Onboard Processor. What extreme conditions does it need to handle?
• Resolution: 250 m vs 1 km. What does the SDT advise?
Introduction: OBP Decisions to be Made in 2015

- Azimuth-range vs geographic grid averaging
- OBP validation (sea state bias)
- Resolution (1 km, 0.5 km at 250 m postings?) trade-offs including synergistic science
Onboard Processor (OBP) Issues

OBP is a **hardware** implementation

- it receives the Karin radar echos
- it produces at 1x1 km resolution & 1 km posting:
  - the complex interferogramme product
  - power SAR images for each of the 2 input channels

An alternate fixed resolution 500mx500m product with 250m posting is also being considered, and additional statistics (power image at 250 m resolution, sum of squares at 250 m resolution, wave mitigation algorithms, ...)

**Workplan to be presented/discussed here, at Jan 2015 SDT meeting**

Results to be presented/discussed at June 2015 SDT meeting

**Decision** to be made **by Oct 2015** for hardware implementation
What everyone needs to know about the OBP and the ATBD (Algorithm Theoretical Basis Document)

• OBP will transmit interferograms---not ssh, and not raw data
• Nadir-altimetry-style reprocessing is not an option.
• Sea ice or land could corrupt full 1-km or 500-m pixel
• JPL technical reports on ATBD cover a broad range of details: surfboard, use of the mean sea surface in OBP, multi-look averaging, wave-mitigation statistics.
Gridding of data

fixed grid

grid aligned with nadir track
Gridding of data

- Convenient for aligning ascending and descending.
- Matches satellite sampling
- If nadir track shifts, can debate whether to use fixed or time-varying reference track.
Gridding of data

- BUT: There is no native grid. OBP output for each of 9 beams is not aligned, so all output interpolated onto final grid.
Some OBP Issues ... 1

Impact of wave field

- workplan underway with ADT & Project, & SDT PIs (eg F. Ardhuin; B. Chapron)
- Testing impact of different sea state (wave, swell) regimes on simulated error
- See following presentation ...

Example: 2 m wave spectra near Hawaii

Fig. 2. Directional spectrum (left) with colors showing the value of $E(f, \theta)/f$ and frequency spectrum (right), with the solid line showing the measurements and the symbols the model. The arrow in the left panel points in the wind direction, taken from ECMWF operational analyses. Plotting convention: energy is in direction from.
Significant wave height

(Project specifications: drafted assuming 2 m average swh and 5.5 m extreme.)
Discussion: Testing the Onboard Processor

- High significant wave scenarios under consideration---what might be missed?
- Sea ice, moving objects, slicks not fully considered yet. What is needed?
- Are additional cases needed?
Resolution: 500 m (with 250 m postings) vs 1 km vs ???

• Oceanographic signals in the 500 m to 5 km range?
• Will 250-m postings actually help us work around ice and coastlines, or ships?
What will SWOT SSH look like?

Rocha et al, in prep for JPO, 2015
Some OBP Issues ... 2

Impact of noise & anomalous points in field (following from HR mask discussion)

These include ....

Permanent structures:
- coasts, fjords, continental ice, oil platforms, wind farms, coral reefs, ...

Moving structures:
- sea-ice, icebergs, ships, tidal sandbars, ...

Analysis SST field – E. Autret, PhD Thesis
(2 lines: FFT & Discrete Cosine Transform)
Inhomogenities also impact on nadir altimeter « noise »

- Jason-class altimeters give average parameters over a large disc (e.g. 7-10km)
- Artifact is caused by approximations in processing algorithms (Brown models)
- Triggered by geophysical causes (e.g. atmosphere and sea state transitions)
- The hump artifact appears when the altimeter footprint repeatedly samples inhomogeneities in sigma0 or SWH
Using KaRIN imagery to understand 1D altimetry

- Karin will provide a 2D image of what traditional altimeters have been integrating in their footprint and waveforms ➔ Higher KaRIN resolution is desirable for such studies

- KaRIN imagery may help investigate what happens in « hump generation events » and improve decades of small scale altimetry records

- Implication: We need to collect reference datasets from KaRIN or AirSWOT with high resolution and nadir overlaps
Hump artifact vs Coverage

- Hump mitigated by 2 to 4 if we sacrifice 5-15% of SSH coverage
- This method edits out major events (e.g. rain cells, $\sigma_0$ blooms)
- Limit: the artifact never disappears even if we discard 50% of data

$\Rightarrow$ SWOT – cannot re-edit/re-process the 1 km OBP data!

[SARAL / AltiKa – SSHA Power Spectrum graph]
Discussion: OBP Resolution

- Having the 250 m image will help us identify noise or anomalous points in the 1 km SSH image; we can’t reprocess the OBP SSH field later, to correct anomalies.

- Can we develop statistical techniques within the OBP to remove / reduce anomalous points in 1 km or 500 m SSH fields?

- Can SDT members provide test cases of images / heights with anomalous points to the Project, to test with their simulator?
Extra Slides
Gridding and image distortion
Noise and spurious pixels

Unfiltered

Filtered: spurious signals can be harder to isolate
Blurring of directional signals
Moiré effects: original data grid not aligned with mapping grid