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Subject: NOAA Climate Data Records Program – Generation of Altimeter Climate Data Records Using Retracking and Updated Corrections – Progress Report

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Report Period: 2013 March 22 to 2013 September 23

Task Objectives for Year 1 (original proposal)

- Develop and validate systematic PTR fitting and retracking procedures.
- Begin investigation of 59-day variation.
- Begin development of data product in consultation with OSTST.
- Begin retracking of TOPEX data.
- Set up quality assurance procedures for retracked data.

Task Objectives for Year 2 (original proposal)

- Complete retracking of TOPEX; retrack selected Jason-1, Jason-2 data.
- Complete investigation, correction of 59-day variation.
- Develop software for fitting for SSB.
- Begin SSB fitting.
- Develop error estimates for inclusion in data products.
- Complete definition of common netCDF data format.

Progress During Reporting Period

As indicated in the Financial section, progress continues to be less than planned because of personnel not being able to spend the planned amount of time on the task. Nonetheless, significant progress has been made. Progress continues to be consistent with expenditures.

Because of previous shortfalls in both personnel and funding, the project has been extended for a year. We are currently finishing the tasks of the first year and working on those of the second year.

- Investigation of the Jensen model for modeling PTR anomalies.

When the anomaly in TOPEX wave height (SWH) was first confirmed in 1998, an engineer at APL (Jensen) began a theoretical investigation of the possible causes. He had previously developed a finite arithmetic model of the onboard software that explained some systematic
waveform features ("teeth") near the top of the leading edge. These features are now corrected by waveform correction factors ("weights").

We did not have either of Jensen’s detailed models, just general description and plots of results, so we derived the full transfer function of the TOPEX receiver chain from an open literature description and block diagram. In particular, we derived a closed form expression for the PTR that results from a phase imbalance between the I/Q channels of the SSB mixer -- Jensen’s basic hypothesis for the changes in the PTR. The resulting expression produced a PTR whose shape varies not only with the phase imbalance, but also with the waveform sample number. In other words, a point target centered at one particular waveform bin would spread energy into the other bins differently than a point target centered at some other bin. As the phase shift increases this approach could produce some of the general features seen in the CalSweep data, but it did not fit the CalSweep well enough to allow a time variable phase difference to produce usable PTRs for processing. The other possible problem shown by this modeling effort was the variation of the PTR with center bin, since the calibrations (CalSweep and Cal-1) have different centers than the nominal track point. PTR fitting from observed data (below) suggests that this effect is not as large as the theoretical model seems to indicate or that the particular bins used have comparable effects.

• Develop and validate systematic PTR fitting procedures – PTR estimation from data.

We developed an approach to estimate the PTR from data over moderate sized lakes, where we know the height and can assume a low SWH. We attempted to apply a similar approach over salt flats, which could be used as a more stable target, but there was significant variation in the waveforms and worse SNR. This approach is promising and can estimate asymmetric PTR properties, but it is difficult to obtain PTR shapes similar to those measured by the CalSweep and Cal-1 data.

Based on the above two findings and as noted in the previous report on the limited range of Cal-1 data that can be used because of instrument leakages, methods to systematically extend the PTR to +/-30 sidelobes with proper behavior as the PTR changes will require additional study over the next approximately 3 months.

• Begin retracking of TOPEX data.

The existing retracking software was run on one pass for each cycle of the mission. The pass chosen crosses the moderate sized Lake Ladoga in western Russia, which can be used as a benchmark to compare trends in the SSH and SWH estimates of the ocean. The lake data were also used in the attempt to deconvolve the PTR from the observed waveforms.

An additional pass of data over salt flats from a number of cycles was processed in an attempt to find a stable target for deconvolving the PTR. As noted above, the results were not stable enough to be usable.