IMPROVEMENT OF TOPEX/POSEIDON ALTIMETER DATA FOR GLOBAL CHANGE STUDIES AND COASTAL APPLICATIONS

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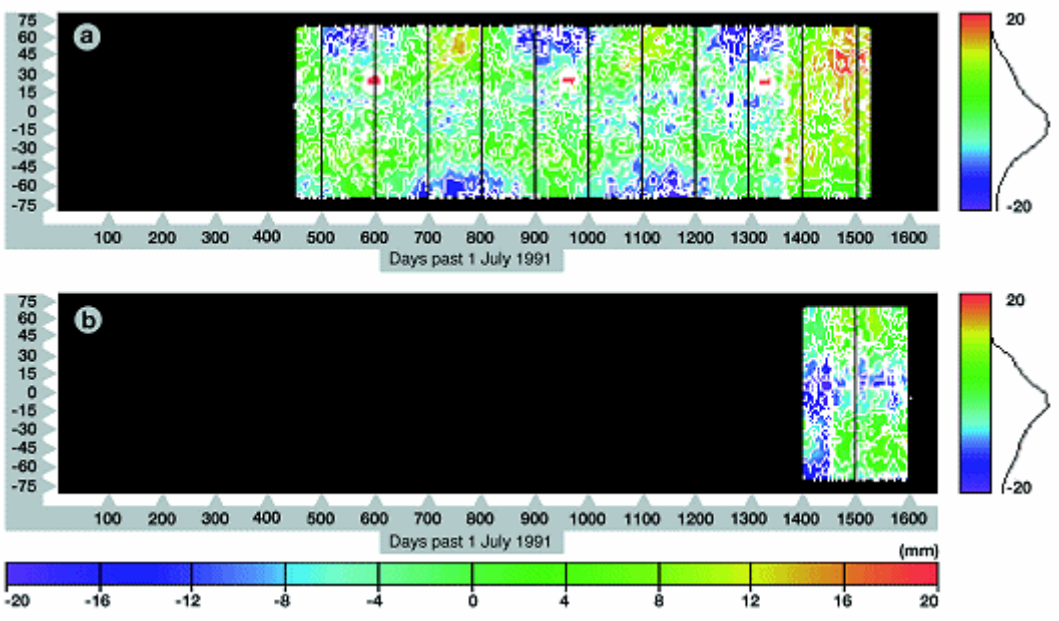
At present, TOPEX/POSEIDON (T/P) has achieved an unprecedented accuracy of sea surface measurements at 4.3 cm rms [Fu et al., 1994]. This error estimate does not include the absolute bias, which is being determined from the Harvest Calibration site currently with an accuracy of 2 cm (4 mm/yr error in bias drift) [Haines, 1997]. The knowledge of the bias and its drift, and the fidelity of the media, geophysical, and instrument corrections for the altimeter data are critical for studies such as global mean sea level variations.

In addition to the enhancement of deep-ocean T/P data, there is a need to improve correction algorithms for data near coastal regions and in semi-enclosed seas. The present stringent requirement for the knowledge of the bias and its drift necessitates efforts to establish additional permanent calibration sites in addition to the Harvest site to achieve enhanced determination of biases of the altimeter systems. This investigation intends to establish a permanent calibration site in the Gulf of Mexico to complement the Harvest effort. Other objectives include the development of techniques and establishment of standards to cross-calibrate T/P with other altimeter systems, and with Jason-1, to provide a long-term observational system for the accurate determination of global mean sea level variations.

Improved and consistent geophysical, media, orbit and instrument corrections were applied to historic and current radar altimeter measurements for the establishment of long-term sea level measurements referenced to T/P. These radar altimeter measurement systems include Geosat, ERS-1, and ERS-2. In particular, improved orbits computed using the TEG-3 gravity field model have been used to infer sea surface measurements from Geosat ERM/GM, ERS-1 and ERS-2 altimeter data. The first validation of concurrently flying nadir-looking radiometers, the 3-channel TOPEX Microwave Radiometer (TMR) and 2-channel radiometers on ERS-1 and ERS-2 (see Figure 1) provides a preliminary finding that the TMR is drifting with respect to the ERS radiometers on the order of 2 mm/yr [Kruizinga, 1997; Urban et al., 1997; Shum, 1997]. The drift has a sense such that, if it could be traced to TMR, it would reduce the differences of the T/P sea level and the sea level inferred from the average of the WOCE tide gauges over the current TOPEX data span. ECMWF fields and TOVS/SSMI wet tropospheric corrections were used to provide media delay corrections for Geosat altimeter measurements. These corrections were validated using both tide gauges and altimeter crossovers. IRI-95

ionospheric models were adopted for Geosat and ERS-1 processing. The improved corrections have enabled two independent efforts to provide consistent determinations of relative bias between the Geosat altimeter and the TOPEX altimeter using tide gauge measurements over the Great Lakes, and tide gauges and primarily over the Pacific [Kruizinga, 1997; Guman, 1997]. The improved corrections provide a preliminary confirmation of consistency between sea level variations inferred from TOPEX, ERS-1, and ERS-2 altimeters and from WOCE tide gauges to within 2 mm/yr over a concurrent data span for two years [Shum et al., 1997]. The resulting link between TOPEX and Geosat enables the determination of relative sea level change during 1986-1996 to be 1 ± 2 mm/yr [Guman, 1997; Guman et al., 1997].



(78 kb)

Figure 1

Wet tropospheric difference (in mm) between (a)ATSR(ERS-1) and TMR (TOPEX/POSEIDON), (b) ATSR(ERS-2) and TMR (TOPEX/POSEIDON) for 1992-1995 [Kruizinga, 1997]

An experimental calibration of TOPEX altimeter was conducted in Galveston Bay [Schutz et al., 1995; Kruizinga, 1997]. GPS buoys operated by the Univ. of Colorado and the Univ. of Texas were used to conduct TOPEX altimeter calibration experiments [Kruizinga, 1997]. Preliminary results indicate that media correction improvement [Kruizinga, 1997] and waveform retracking [Nuth et al., 1997] were found to be necessary to provide TOPEX bias determination with an accuracy of approximately 2 cm rms using the available data.

References :

- Guman, 1997: Determination of global mean sea level variations using multiple satellite altimetry, *PhD Dissertation, Univ. of Texas at Austin*, May, 1997.
- Guman, M., C. Shum, B. Tapley, G. Kruizinga, and J. Ries, 1997: Determination of decadal global mean sea level variations using satellite altimetry, *Spring AGU Meeting*, Baltimore, MD, May, 1997.
- Haines, B., 1997: Harvest Platform T/P calibration status, Jason-1 SWT Meeting, Baltimore, MD, May, 1997.

- Kruizinga, G. , 1997: Validation and application of satellite radar altimetry, *PhD Dissertation, Univ. of Texas at Austin*, December, 1997.
- Nuth, V., G. Kruizinga, C. Wilson, and C. Shum, 1997: Radar altimeter waveform retracking for coastal ocean applications, *Spring AGU Meeting*, Baltimore, MD, May, 1997.
- Schutz, B., Kruizinga, D. Kuang, Abusali, Shum, Guiterritz, S. Nelson, E. Rodriguez, 1995: Galveston Bay experiment for altimeter calibration experiment, *Fall AGU Meeting*, San Francisco, CA, December, 1995.
- Shum, C., J. Bordi, J. Ries, J. Seago, and B. Tapley, 1997: Precision orbit determination and and verification for ERS-1 and ERS-2, *2nd ERS Symposium*, Florence, Italy, 1997.
- Shum, C., 1997: Global verification of altimeter measurements and Gulf of Mexico calibration site planning, *Jason-1 SWT Meeting*, Baltimore, MD, May, 1997.
- Urban, T., G. Kruzinga, T. Pekker, C. Shum, and B. Tapley, 1997: Global verification of wet tropospheric corrections for radar altimeters, *Spring AGU Meeting*, Baltimore, MD, May, 1997.