# Estimation of electromagnetic and tracker bias for Jason

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**The purpose of this investigation is the assessment of various systematic error and biases that will affect the quality of Jason-1 measurements of sea surface height: 1) tracker biases; 2) skewness biases; and the 3) EM bias. We will perform full retracking of the Jason waveforms and independently assess instrument accuracy, as well as provide for an estimate of the sea surface skewness. These estimates will then be used to assess the residual height error dependence on skewness. They will also be used to provide a new non-parametric algorithm for the EM bias which includes sea surface skewness as one of the regression parameters. The proposed EM bias correction will be validated by repeat pass and cross-over analysis, and compared to the TOPEX EM bias performance during the calibration phase of the mission.**

The purpose of this investigation is the assessment of various systematic error and biases which will affect the quality of the Jason-1 measurements of sea surface height. The three main error sources examined will be:
1) tracker biases; 2) skewness biases;
3) EM Bias.

The tracker bias is due to potential errors due to approximations made in the operational retracking of the Jason-1 data. Possible sources of these errors are the look-up table procedure which is made to account for the point target response in the operational retracking. During the validation phase of the Jason-1 mission, we will use optimal retracking algorithms, which, although slower than the operational retracking algorithm, make fewer approximations to obtain statistically "optimal" estimates of sea surface heights, significant wave height and ocean surface skewness.
This procedure will be similar to the one used to validate the TOPEX data and was found to be extremely useful for identifying systematic deviations in the TOPEX waveforms which limited the accuracy of the TOPEX data. During the TOPEX/POSEIDON/Jason-1 cross calibration period, we will retrack waveform data from both instruments and derive the relative calibration of the maximally unbiased estimators for each of the instruments. We will also examine the dependence of the residual differences between the two retracked data sets as a function of significant wave height and wind speed. The result will be an independent assessment of the Jason-1 performance and its relation to the simultaneously collected TOPEX/POSEIDON data.

Another source of bias in the sea surface height is due to the fact that the surface height is not normally distributed, but can show a significant skewness. The skewness causes a bias in the sea surface height, and we will assess the level of residual skewness errors by performing the optimal waveform fitting described above.
More importantly, skewness is an indicator of non-linear interactions among surface waves. These non-linear interactions are also responsible for the EM bias, one of the remaining dominant sources of error in the estimation of sea surface height from altimeters. Srokosz and Longuet-Higgins [1986] have shown theoretically that skewness and wave significant slope are related. It has also been show experimentally by Arnold and Melville, and theoretically by Elfouhaly, that the EM bias can depend strongly on significant slope. During the TOPEX mission, it was not possible to estimate sea surface skewness due to systematic distortions of the return waveform. We expect that these effects will not be present for the Jason-1 waveforms, and therefore it will be possible to obtain a regression of the EM bias, which includes sea surface skewness, as well as the traditional sea surface height and wind speed. We will derive a non-parametric model over the three-dimensional space defined by these parameters.
We will then verify the efficiency of the resulting correction by studying the residual error reduction and dependence on geographical location, inverse barometer correction, and fitting parameters.

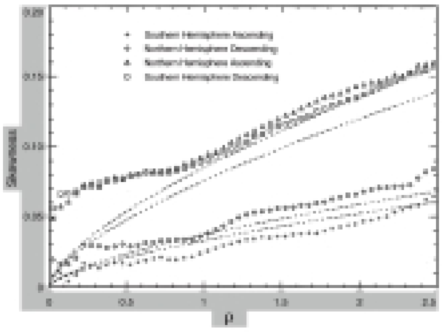

**Figure 1: Ku band skewness estimates for the TOPEX altimeter separated by north/south and ascending/descending passes and binned by the parameter** $\rho = \frac{U}{\sqrt{g.SWH}}$ **,which is an indicator of significant slope [Srokosz and Longuet-Higgins, 1986]. Theoretical bounds for a wave height with power law p=4 (long-dashed curve) and p=3.5 (short-dashed curve) are also shown. There is some consistency between theory and observation for higher values of ρ, but due to distortions in the TOPEX leading edge, significant deviations are observed. Jason-1 waveforms will help in the resolution of the skewness behavior and its relation to theory and the EM bias.**

**References**

**Srokosz M.A., and M. Longuet-Higgins, 1986: On the skewness of the sea surface elevation, *J. Fluid. Mech.*, 164, 487-497.**

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