Extending the TOPEX/Jason Global Mean Sea Level Time Series with GEOSAT Observation

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Abstract
The role of global mean sea level rise over the past 15 years determined from TOPEX/Jason satellite altimeter observations is ~3 mm/yr, more than 50% greater than tide gauge-based estimates of sea level rise over the past century. Determining whether the present higher rate is a long-term change or a temporary one is a major issue. In this paper, past altimeter data, largely TOPEX/Jason and GEOSAT observations, is reported and the new CO2 concentrations in the air are discussed in order to understand global mean sea level change over the last 25 years. It is shown that extending the TOPEX/Jason Global Mean Sea Level Time Series with GEOSAT observations is presented.

1. The Problem:
The Global Geostatistical Mission (GGM) data set has been recently upgraded with new orbits computed by F. Lemoine, NASA/Goddard, reducing the r.m.s. noise in SSH by a factor of 2. The data are recomputed with the newest gravity model and atmospheric forcing. The resulting estimate of global mean sea level from GEOSAT, TOPEX, Jason-1, based on a simultaneous fit to single tide and annual forcings and separate bias estimates for each satellite, is 74 cm/year.

Our approach is to understand the problem in terms of the recent studies of high latitude centered on the gauge. The tide gauge data show a clear drift, with a drift rate of 3.5 cm/year from 1996 to 2006.

We approach the problem of independently estimating a Geosat bias and drift by using tide gauge records that span the period from 1989 to 1994 and the first 3 years of the TOPEX/GM mission to “calculate” the tide series.

A tide of 39 NASGAS, geoid records (Figure 2) were initially selected. Daily means were calculated using an ensemble mean tidal corrected altimetric observations, using the GEOSAT/TOPEX Global Geostatistical Mission (GGM) - all passes falling within ±0.7° latitude centered on gauge site.

Figure 4c shows for each Tide Gauge (TG) stations the TG-GM and TG-ERM mean relative to the TG-TG mean. The GM and ERM means lie within ±0.9 cm of the TG-TG mean. The mean of the TG-GM and TG-ERM mean is almost exactly the same, with a very low value of 3.6 cm/year.

The observed drift is all within the mean estimate (±0.9 cm) for single tide and annual forcings and separate bias estimates for each satellite. The observed trend is 3.6 cm/year with bias values of geosat ~45 cm, e rm ~ 6 cm, jason ~ 14 cm.

2. Methods
Tide Gauge Locations

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3. Correlation vs RMS TG-Alt Difference

4. Estimating Geosat Bias Relative to TOPEX

5. Estimating Geosat Drift Relative to Tide Gauges

6. Global Mean Sea Level with Drift Corrected Geosat

Summary
- The GM and ERM bias estimates (~4 cm) are much lower than the standard error for single tide and annual forcings and separate bias estimates for each satellite.
- The observed drift is almost exactly the same, with a very low value of 3.6 cm/year.
- The results indicate a tendency of drift in the TOPEX/GM data.
- The observed drift is 3.6 cm/year with bias values of geosat ~45 cm, e rm ~ 6 cm, jason ~ 14 cm.
- This is a very preliminary analysis.

Although much more work needs to be done. If it is found that the global mean sea level time series is not a direct input to the problem of global mean sea level change or to the longstanding problem of understanding climate change and its impact, the results could be used to improve our understanding of climate change impacts.

This is a very preliminary analysis.