Coastal Sea Surface Topography from Altimetry, Gravity, and Tide Gauge Data (COSSTAGT)

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Objectives

The absolute sea surface topography (SSTop) and its low frequency variation shall be estimated at selected coastal areas through combination of multi-mission satellite altimetry, tide gauge registrations, terrestrial and marine gravity as well as new satellite-only gravity field models in order to provide information on the absolute velocity field and to allow the unification of national height systems. The poster presents first results.

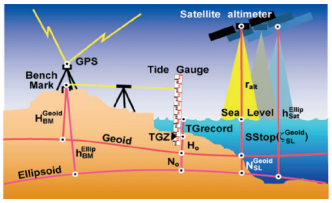
Rationales

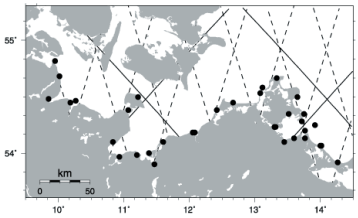
Comparison of sea level time series from tide gauges and satellite altimetry is of great impact for

- investigations on sea level rise,
- the long-term stability of altimeter systems, and
- the unification of national height systems.

Work Packages

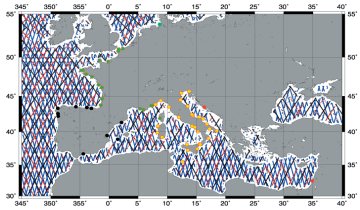
- Selection of sites and areas of interest
- Compilation, enhancement and resampling of altimeter data
- Improvement of (residual) ocean tides
- Cross-calibration of multi-mission altimeter data
- Compilation and analysis of tide gauge data
- Correlation between tide gauge records and altimetric sea level time series
- GPS analysis to estimate vertical tectonic motions
- Compilation of surface gravity data
- Local high resolution geoid computation
- Harmonic and Principal Component Analysis

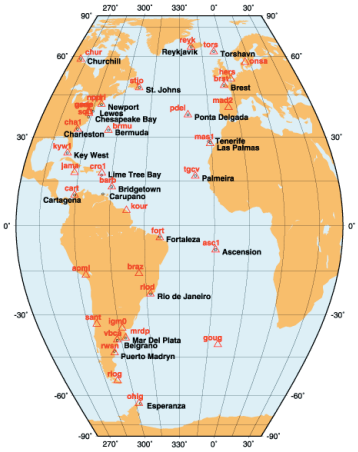




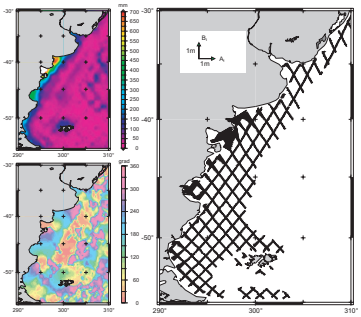
Areas of Interest

According to experiences, cooperations and logistic capabilities of the investigators, a number of sites will be selected within the following areas: The German coast of the North Sea and the Baltic Sea (right), the Mediterranean with the West-European Atlantic Coast (below) and the Caribbean and the South American coast (right).



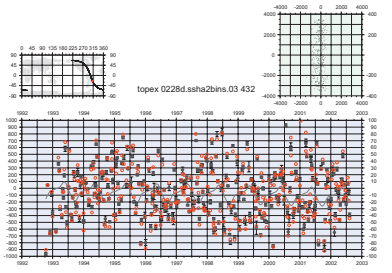


Residual ocean tide analysis



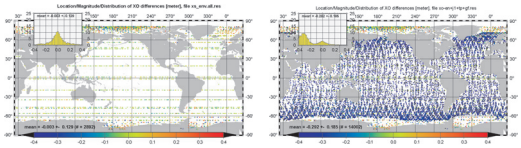
The "response method" is used to estimate residual coastal tides.

- The analysis, performed at complementary tracks of T/P and T/P-EM, show rather consistent results with little track dependent pattern - although the short data period of T/P-EM (61 cycles) does not yet allow to seperate M2 and S2 constituents (Rayleigh criteria requires a period of 1084 days).
- Hamonic analysis of M2 alias period, and analysis of crossover differences demonstrate improvements for T/P, T/P-EM. The analysis even helps to improve the M2 correction for ERS2 although no altimeter data of ERS2 has been included in the analysis.
- Compared to global ocean tide models the spatial resolution was improved by resampling and analysis of altimeter data into small along-track bins of the nominal ground track (see right) and a direct interpolation of the residual tide corrections to the altimeter measurement positions.

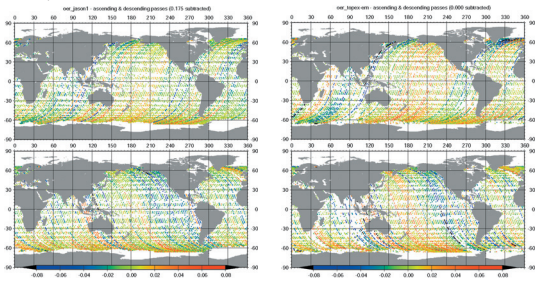


Cross calibration of altimeter systems ...

is performed by a discrete crossover analysis (see poster on Multi-Mission Crossover Analysis by W.Bosch). A large number of nearly simultaneous dual-satellite crossover events ($\Delta t < 2$days) is derived by combination of four contemporary altimeter missions. Nearly simultaneous dual-satellite crossovers provide a considerable better spatial and temporal distribution than single-satellite crossovers which are concentrated at high latitude. (see the example below)

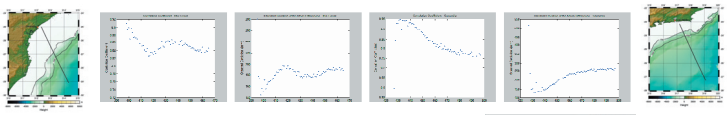


For a ten day period and a two day overlap to neigbouring periods there are typically about 45000 crossovers. The analysis consists in a weighted least squares minimization of both, crossover and consecutive differences. These crossovers perform a dense network with high redundancy which allows a reliable estimate of the radial errors of all altimeter systems and automatically captures the range biases, relative to one altimeter mission taken as reference .



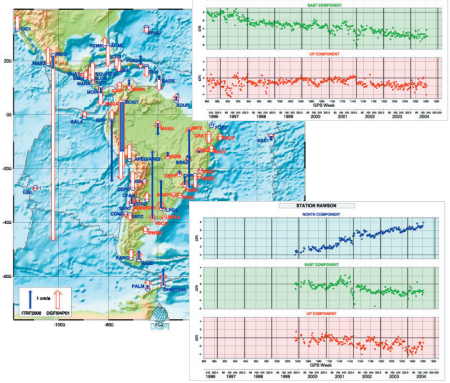
Correlation of tide gauge and altimeter sea level time series

Hourly registrations of two Brasilian tide gauges (see below) were resampled to the epochs of altimeter events by cubic interpolation. For time series analysis sea surface height anomalies for Topex-Poseidon (cycles 1 to 364) were resampled to small bins located along the mean ground track (see above). Ocean tide and inverse barometer corrections were removed from the altimeter data. To account for local sea level variations, a differential tide corrections was derived by tidal analysis for both, the tide gauge registrations and the time series of ssha at every bin.



GPS estimates of vertical tectonic motions

DGFI is acting as an IGS Regional Network Associate Analysis Centre for South America (IGS RNAAC SIR). Since 1996 weekly coordinate solutions are generated and delivered to the IGS global data centres (see right). The network includes continuously operating GPS sites with a large number of them located close to tide gauges. For the period July 1996 to July 2004 a new accumulated solution, DGFI04P01, has been computed and gives the most reliable estimates of vertical velocities (see right).



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