Geophysical Research Abstracts
Vol. 20, EGU2018-18922-3, 2018
EGU General Assembly 2018

A new empirical tidal model for the Great Barrier Reef, Australia

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The Great Barrier Reef (GBR) is the world's greatest reef system. Stretching more than 2 km along Queensland's north-east coasts, it is one of the most biologically diverse systems on earth. Resonant and near-resonant responses of the tidal waves and the non-linearity in dynamic equations promote the complexity of tidal analysis over coastal zones. In comparison to the non-reef zones, reefs can exert a noticeable effect on the tides and other large-scale flows in certain parts of GBR which leads tidal behavior in the region to be even more complicated. To develop a new empirical tidal model for this region a base model, recent FES2014, will be used in a Remove and Restore process. The Sea Level Anomaly of altimetry satellites namely Topex/Poseidon, Jason1&2, Jason-1 interleaved orbit, Envisat and ERS-2 are used. As the target is to model tides therefore the tidal height and ocean loading are returned to the extracted SLA. Firstly the tidal constants of 34 constituents are interpolated over mentioned altimetry along track locations. Then the SLAs are detided using the tidal height predicted by FES2014.
The estimated SLA residuals are firstly analyzed to extract the tidal constants for MK3 using harmonic method. Then response method is used to extract the tidal constants for 8 major components, including K1, O1, P1, Q1, M2, S2, N2 and K2, and applied to the interpolated quantities from FES2014. The new estimated tidal components are interpolated over a regular grid of resolution 15[U+02C8]*15[U+02C8] using two distinct methods, mean weighted distance and depth dependent least squares collocation (LSC). Sentinel 3A is an independent data source that is considered to examine the efficiency of the new developed model in comparison to FES2014. The Sentinel 3A extracted SLA (That includes both ocean and loading tide) is detided using the new model and FES2014.
According to the numerical results the average root mean square (RMS) of the tidal residuals over coastal zone, area with depth from 1 to 40 m, when new model is used is 5 cm better than when FES2014 is used. The geographical coverage of the RMSs show a significant improvement in tidal height prediction over highly depth varying zones of GBR especially when a depth dependent LSC is used to expand the results over a regular grid.