Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2017-51-RC1, 2017

Ocean Science
Discussions

Interactive comment on "Orbit related sea level errors for TOPEX altimetry at seasonal to decadal time scales" *by* Saskia Esselborn et al.

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Received and published: 11 August 2017

Referee comments Orbit related sea level errors for TOPEX altimetry at seasonal to decadal time scales os-2017-51a

I read the paper with interest. It is well written and should offer useful TOPEX altimeter satellite orbit error analysis to the altimeter/oceanographic community. I have few questions and comments, and recommend publication after these are addressed. My comments are intended to possibly help clarify and improve some aspects of an already good paper.

General Comments

* The orbit error analysis is based on orbit differences, which exclude any error common

to the orbits. This should be explicitly mentioned in the paper as well as the authors' assumptions in using orbit differences as an error estimate.

* It seems the large and very similar REF-GRGS and REF-GSFC differences shown in Fig 5 could be better explained. Although similar in structure, the REF-Geoid plot features are so much smaller that one may exclude these gravity model differences as the primary cause of the REF-GRGS plot features. I suggest the authors include the GRGS-GSFC plot in the paper for which the orbits have much greater gravity model differences . I suspect much of the annual variability now shown is due to non-tidal station loading for the REF orbit. This contribution is not tested, but the GRGS-GSFC plot may help better identify the source of the annual variations.

* I also suggest running a spectral analysis on all the orbit differences to better identify all periodic signals; even if they are not evaluated they can be noted in the paper.

* The orbit trend differences are very small (Table 4), however Table 1 indicates substantial differences in the time variable gravity models. I suggest the authors describe/compare which gravity coefficient rates are used over the TOPEX period for all models, and which are defined by SLR.

* This my main comment. The conclusion ends with a recommendation to try to better determine low-order gravity time-varying terms past the 5x5 field employed by the GSFC orbits using improved techniques with SLR/DORIS. The recommendation is not phrased clearly since the GSFC orbits show the lowest crossover residuals compared to the other test orbits which employ 50x50 and 80x80 time varying terms (Table 1). The problem for improving time variable gravity modeling over the TOEPX period should be an issue for all the orbits tested. The authors should mention this and clarify which time-varying terms are determined with SLR for the EIGEN-6S2 and EIGEN-6S4 fields over the TOPEX period and indicate the origin of the other terms. Furthermore the GSFC and Geoid orbit slightly improved performances over the REF orbit could suggest extrapolation of the higher order GRACE-defined seasonal terms to the

TOPEX era may even be harmful. For example is the 5mm REF-Geoid annual signal (Fig 3) due to error in the REF orbit? The authors should clarify the conclusion in consideration of these remarks.

Specific Comments

* Any explanation why the DORIS residuals are slightly higher for the DORIS-only orbit? One would expect a decrease in the DORIS residuals compared to the DORIS+SLR orbit DORIS residuals.

* p7 l191 “The annual component of the global mean orbit differences is not included in Table 4, since it is not significant.” Insignificant in amplitude, or is the formal error larger than the estimate?

* p7 l212-216 non-tidal station loading for the REF orbits can also be included as a “plausible source” for annual orbit difference variations.

* It is not clear what the REF-DORIS plot in Figure 5 is intended to show?

* It is interesting that the Figure 9 REF-DORIS plots show substantial trend differences for the ascending/descending passes. How is the considerable DORIS TOPEX network time bias treated for the various orbits? The SLR network should not have any significant time bias. It has been shown to be closely aligned with GPS time over the Jason-1 period (Zelensky et al. 2006, “DORIS time bias estimated using Jason-1”)

* p9 l264 “The most striking feature is that the ascending trends are opposite to the descending trends.” Say one orbit is always ahead of the other and will reach the North pole region (+Z) first, and the trend is positive. After reaching the North pole, the orbits will race South (-Z), and now will not the trend be negative?

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