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Discussions

Interactive comment on "A new assimilation tidal model for the Mediterranean Sea" *by* D. N. Arabelos et al.

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1. We have no tide-gauge data available for Marmara and Black Sea, so we have nothing new to add about the tides in this area. Furthermore, we agree with other authors (e.g. Tsimplis et al., 1995) that the opening of the Mediterranean to the Bosporus is negligible for tidal propagation.

2. The representers outside the Mediterranean (in the Atlantic) were collected during the compilation of altimetry and tide-gauge data. They were not used for the computation of the model (removed from the input files).

3. The short description of the method (section 2) is identical to the word by G. Egbert & S. Erofeeva, 2002 and it is cited properly. The reason of this repetition is simply to

help the reader, not to replace the authentic. We intent to keep this section.

4. This paper was a first attempt for the computation of a model for practical geodetic applications such as the tidal correction of altimeter data using a regional model instead of global models provided by the geophysical data records or for the computation of the loading effect useful for the comparison of Earth-tide parameters, etc. In this attempt, we have used the "default" parameters listed in section 5 (see Egbert & Erofeeva, 2009), but these parameters were used without any evaluation. For this reason, we have reviewed our investigation. Numerical experiments were carried out in order to define the optimal friction velocity and the optimal correlation length in our test area. The experiments related to the friction velocity showed that the use of spatially varying velocity, estimated as a function of position in the model domain, gives better results than a constant value of 1 or 2 m/s. On the other hand, the experiments related to the estimation of the decorrelation length suggest that the results are not so sensitive for lengths between 10 x s +/- 10 km, where s is the side length of the grid cell.

5. The vectorial comparison between the observed constituents and corresponding from the global model TPXO7.2 is shown in Table 1 below. Large vectorial differences between the tide-gauge of Tarifa and the rest stations are observed, especially for the constituents M2, S2, N2 and K2.

Table 1. Vectorial differences between TPXO7.2 and observed amplitudes and phases. Unit is cm. Site M2 S2 K1 O1 N2 P1 K2 Q1 3 Algeciras 5.82 1.80 0.88 0.96 1.29 0.27 0.34 0.12 13 Ceuta 4.77 1.05 1.70 1.47 0.93 0.60 0.09 0.16 20 Gibraltar 4.12 0.13 0.65 0.49 0.15 0.20 0.16 0.09 53 Tarifa 15.13 4.51 1.45 1.27 2.91 0.51 1.39 0.29

Table 2 shows the phases of the tide-gauge observations. The phases of Tarifa are systematically smaller than the rest, except of O1 (Ceuta) and Q1, while more or less random could characterized the behavior of changes in Ceuta.

Table 2. Phase lags of tide-gauge observations close to Strait of Gibraltar Site M2 S2 K1 O1 N2 P1 K2 Q1 3 Algeciras 47.8 74.5 130.6 169.9 34.5 128.2 66.2 195.8 13 Ceuta

48.8 76.1 142.8 102.4 34.7 140.4 67.8 152.5 20 Gibraltar 49.6 76.6 133.8 174.7 36.2 131.4 68.3 174.7 53 Tarifa 41.0 68.5 128.2 121.1 26.0 125.8 60.2 216.8

Based on these comparisons the observations the Tarifa and Ceuta were excluded from the data set used.

In the revised version instead of ETOPO2 the recent "TOPO 13.1" bathymetry data (Smith and Sandwell, 2010) was used. (see ftp://topex.ucsd/edu/pub/global_topo_1min , file name topo_13.1.img)

6. According to your suggestion, 10 tide-gauge stations were selected as control stations, similar to 102 gauges always be used to evaluate tide models. Unfortunately, none of these 102 stations lie in the Mediterranean. The control stations were selected to be homogeneously distributed and possibly to not disturb the distribution of the rest stations be used for assimilation. RMS and RSS differences between these 10 control data and corresponding data extracted from the contemporary global models EOT10a, FES2004, GOT4.7, NAO99b, TPXO7.2 and from our MEDI10 showed better results in the case of MEDI10. The similar comparison between the 10 control data with MEDI10 and the regional model MED2008 (Egbert and Erofeeva) showed better results for the latter. From this result, it might be supposed that MED2008 is better than MEDI10, or that some or all of the control data have been assimilated in MED2008. Changing the control data set by other set of 10 different tide-gauges selected with the same criteria and computing a new solution, with all other parameters the same, better results were yielded for MEDI10. From this result, it could be supposed that MEDI10 is better than MEDI2008, or some or none of the new control data were assimilated in MED2008. Actually, we don't know which tide-gauge data have been assimilated in MED2008, neither we can decide which model is better among them. Our conclusion is that the data play a very critical role for the quality of a model and thus we suggest a model which uses all available data (except the rejected tide-gauges), and the parameters estimated experimentally.

7. You are right that the evaluation with JASON-1 is not really an independent validation. For this reason, in section 6 of the first version, we had used the terms "external" assessment and "heterogeneous" data. On the other hand, all models using altimeter data are based on representers placed on the crossovers and all satellites of this type have crossovers placed at the same positions. As it is described in (4) above for the tide correction of altimeter data it is necessary to use the better tide model. The decision on this is based on the statistics of the crossover analysis before and after the tidal correction. Since almost all contemporary models are using the same altimeter data, it makes sense such assessment and was used from other researchers (e.g. Andersen et al, 1995), even if it is not exactly independent. However, the assessment of our model in the revised version is based on control data as you suggested and therefore the comparison based on JASON-1 was cancelled. It is apparent that all comparisons were carried out with the same number of constituents.

Reference: Andersen, O. B., Woodworth, P. L. and Flather, R. A. (1995): Intercomparison of recent ocean tide models. J. Geophys. Res., 100 (C12), 25,261-25,282.

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