Ocean Sci. Discuss., 7, C642–C646, 2011
www.ocean-sci-discuss.net/7/C642/2011/

Ocean Science Discussions

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

D. N. Arabelos et al.

arab@eng.auth.gr

Received and published: 3 January 2011

Over-all comments:

In this first attempt "default" parameters listed in "OSU Tidal Inversion Software documentation" have been used. In the revised version, numerical experiments are carried out for the estimation of optimum friction velocity and the model forcing error correlation scale. The assessment is now based on the comparisons with tide-gauges not used in the assimilation. TOPO-13.1 was used in the new version, instead of ETOPO2.

Some examples:

1. Numerical experiments were carried out in order to define the optimal friction velocity in our test area. The experiments 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 equal to 1 or 2 m/s.

2. For the estimation of the optimum correlation scale numerical, experiments using values between 10 and 40 km showed 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. 3. In the first version, of the paper, 74 tide-gauge stations were assimilated: 54 from our data set and 20 from Tsimplis et al (1995), i.e., we have rejected 5 tide-gauge from our data set and we have used all the stations by Tsimplis which are not identical with ours. As it is written in section 3 (Data) of the first version, the data by Tsimplis include only 4 constituents (M2, S2, K1, O1). In Figure 2 these stations are shown in blue, in order to be discriminated from the rest, including 8 constituents.

4. In the new version the assessment is based on comparisons with data not used for assimilation. For this reason ten, not assimilated, stations were selected as control stations. RMS and RSS differences between constituents from our solutions and from other contemporary global and regional models were computed and compared for the evaluation.

Specific suggestions and comments:

1 If we add the place names on Figure 1, then the features of the figure will not be visible. The numbers of tide-gauge stations in Figure 2 correspond to the numbers of Table 1, so the sites can be connected with the names. A new table was added in the new version for the stations taken from Tsimplis.

2 The reference was changed. The text was modified to: "If the dynamical equations (1) are linear, the representer approach (Egbert et al 1994), can be used to minimize (3) according ...".

3 In the current version (OTIS object oriented) "mkSpeed" has been substituted by "mkFrv" which is more flexible and compatible with the overall changes. The tuning

experiments are described in the new version of the paper.

4 In order to compile Table 2, we have used the analysis results of all (59) available tide gauge stations, using the program "versatile_tidana", kindly provided by Foreman and Cherniawsky (personal communication). The results for each station has the following output:

THE ANALYSIS PERIOD IS FROM 26/ 3/2008 TO 14/ 3/2010 IN THE TIME ZONE PST USING SVD TO SOLVE THE OVERDETERMINED SYSTEM STATION # 32 , motril2 LATITUDE 36 43, LONGITUDE -3 31 NUMBER OF POINTS IN THE ANALYSIS = 13247 nin= 2 max, min eigenvalues = 115.1604 74.40578 LARGEST RESIDUAL MAGNITUDE & RESIDUAL SUM OF SQUARES: 0.43061E+00 0.10964E+03 ST. DEV. OF RIGHT HAND SIDES OF ORIGINAL OVERDETERMINED SYSTEM: 0.15158E+00 AND THE ROOT MEAN SQUARE RESIDUAL ERROR: 0.91077E-01 rms residual: brute force = 9.107661154952466E-002 max residual: 0.4306052 12753 HARMONIC ANALYSIS RESULTS: AMPLITUDES, PHASE LAGS, C, S, & amp SD estimates, t-test value Z0 0.000000000 0.56853 0.000 0.001 0.000 0.000 0.000 MM 0.001512152 0.00895 293.160 0.001 0.001 0.001 7.964 MF 0.003050092 0.01135 73.789 0.001 0.001 0.001 10.129 Q1 0.037218504 0.00340 145.871 0.001 0.001 0.001 3.463 O1 0.038730655 0.01771 124.020 0.001 0.001 0.001 17.824 K1 0.041780747 0.03331 155.048 0.001 0.001 0.001 33.599 MU2 0.077689469 0.00448 356.165 0.001 0.001 0.001 3.972 N2 0.078999251 0.03083 35.622 0.001 0.001 0.001 26.891 M2 0.080511399 0.15378 48.574 0.001 0.001 0.001 134.375 S2 0.083333336 0.05764 72.736 0.001 0.001 0.001 53.601 MK3 0.122292146 0.00080 177.591 0.001 0.001 0.001 0.750 SK3 0.125114083 0.00133 96.103 0.001 0.001 0.001 1.279 S4 0.166666672 0.00199 135.987 0.001 0.001 0.001 1.784 2SM6 0.247178063 0.00022 225.389 0.001 0.001 0.001 0.192 M8 0.322045594 0.00054 51.994 0.001 0.001 0.001 0.446 INFERENCE RESULTS P1 0.041552588 0.0106 152.6476 K2 0.083561495 0.0159 64.4363 1 largest correlation coefficient is 0.049 at (i,j)= 4 3 for constituents MF and MM 2 largest correlation coefficient is 0.036 at (i,j)= 5 3 for constituents MF

and MM 3 largest correlation coefficient is 0.025 at (i,j)= 10 6 for constituents K1 and Q1 4 largest correlation coefficient is 0.024 at (i,j)= 11 7 for constituents K1 and Q1 5 largest correlation coefficient is 0.023 at (i,j)= 3 2 for constituents MM and MM 6 largest correlation coefficient is 0.023 at (i,j)= 3 1 for constituents MM and Z0 7 largest correlation coefficient is 0.019 at (i,j)= 9 6 for constituents O1 and Q1 8 largest correlation coefficient is 0.019 at (i,j)= 19 14 for constituents S2 and N2 9 largest correlation coefficient is 0.018 at (i,j)= 18 15 for constituents S2 and N2 10 largest correlation coefficient is 0.017 at (i,j)= 17 14 for constituents M2 and N2 11 largest correlation coefficient is 0.015 at (i,j)= 5 4 for constituents MF and MF 12 largest correlation coefficient is 0.014 at (i,j)= 16 15 for constituents M2 and N2 13 largest correlation coefficient is 0.013 at (i,j)= 8 7 for constituents O1 and Q1 14 largest correlation coefficient is 0.012 at (i,j)= 18 12 for constituents S2 and MU2 15 largest correlation coefficient is 0.012 at (i,j)= 19 13 for constituents S2 and MU2 16 largest correlation coefficient is 0.011 at (i,j)= 22 21 for constituents SK3 and MK3 17 largest correlation coefficient is 0.011 at (i,j)= 18 17 for constituents S2 and M2 18 largest correlation coefficient is 0.011 at (i,j)= 17 12 for constituents M2 and MU2 19 largest correlation coefficient is 0.011 at (i,j)= 10 9 for constituents K1 and O1 20 largest correlation coefficient is 0.010 at (i,j)= 11 6 for constituents K1 and Q1 N,m,LAT,LON,SDEV0,SDEV: 13247 29 36.7167 -2.4833 0.15 0.09 ROOT MEAN SQUARE RESIDUAL ERROR AFTER INFERENCE IS 0.910766E-01

The second part of the table is related to largest correlation coefficients for pairs of constituents at a specific position (i, j). It is reasonable to assume that these numbers are computed using the well known formula (16) which is the formula used by Cherniawsky et al (2001), (please see at the end of page 653 of this paper), although we are not able to confirm this nor to see the structure of the covariance matrix because we have available only the executable of the program. You are right that diagonal elements should be equal to 1, but as you can see at line 5 of the second part of the table, MM and MM are in position (3,2) not on the diagonal. Looking at Figures 5a,b of Cherniawsky et al, there is the explanation that diagonal elements represent covariance and off-diagonal elements represent correlation but in this case we don't speak about diagonal elements. On the other hand, it is reasonable that the combination MM, MM should be on the diagonal. In order to avoid the argument we have removed from Table 2 (Table 3 in the revised version) the diagonal elements.

5. In the new version of the paper we have computed vectorial differences between the global TPXO7.2 and our observed amplitudes and phases. Based on this statistics and taking into account the behavior of the phases of the stations near Gibraltar, the stations Tarifa and Ceuta were rejected from the data set. The description of inference for P1 and K2 is improved in the new version.

6. The geographic coordinates are listed in Table 1 of the new version. Similar table is added for the data taken from Tsimplis.

7. Data from Tsimplis have been used in the old and in the revised version of the paper, as in paragraph 3 above.

8. This assessment has been cancelled in the new version.

9. You are right. The problem is that the values of the transports in specific places of Mediterranean (like near Gibraltar, Sicilian Channel, etc.) differ considerably from the values at the main part of the basin. For this reason colored maps failed to be illuminating. Following your suggestion, we have computed current ellipses but the situation is even more difficult since the values to be plotted are by far different. For this reason we have plotted transport ellipses (see e.g. Ray, 1999: A global Tide Model from TOPEX/POSEIDON Altimetry: GOT99.2, NASA/TM-1999-209478).

Interactive comment on Ocean Sci. Discuss., 7, 1703, 2010.