

Interactive comment on “Sensitivity of the Mediterranean sea level to atmospheric pressure and free surface elevation numerical formulation in NEMO” by P. Oddo et al.

Anonymous Referee #1

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The manuscript aims to investigate whether inclusion of air pressure as a force at the surface boundary may alter sea level solutions by the NEMO model in the Mediterranean at different frequency bands. The paper is nicely written and for sure deserves the publication, but after solving a major methodology problem and some small issues.

The major problem with the methodology is that the authors analyse modelled high-frequency sea level oscillations (on hourly timescale), while all model runs are forced by 6-h ECMWF operational fields, including the winds and air pressure which are dominantly driving sea level oscillations on these frequencies. First, I wonder how the forcing fields are interpolated from 6-h resolution to the model resolution – linear, quadratic or else? Whatever method of interpolation is used, it cannot properly describe the pro-

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cesses visible in air pressure and wind series that are occurring on the periods below a day (and there are a lot of them visible in air pressure and wind measurements, like rapidly moving frontal zones and cyclones, convective systems, gravity waves, squall lines, etc.), resulting in aliased forcing and therefore in aliased modelled hourly sea level series. For that reason a number of conclusions (e.g., regarding the Adriatic seiche at 21-h period, see below) in the manuscript are wrong. Therefore, the analysis in frequency domain should be cut down not at 2 h period, but on at least 24-h period.

Minor to moderate suggestions:

- Page 3897/3898. There is newer literature on the inverse barometric effects in the Mediterranean, like Le Traon and Gauzelin (1997), Pasaric et al. (2000), Raicich (2003), Vilibic (2006), Pasqual et al. (2008) – the authors limit their literature mostly to a 30 of more years old papers (which should be mentioned, but not limited to). Generally, the references about IB effect in the World Ocean and the Mediterranean are pretty old and should be accompanied with some of fresh research and findings.

LeTraon, P.Y., Gauzelin, P., 1997. Response of the Mediterranean mean sea level to atmospheric pressure forcing. *J. Geophys. Res.*, 102, 973-984, doi: 10.1029/96JC02777.

Pasaric, M., Pasaric, Z., Orlic, M., 2000. Response of the Adriatic sea level to the air pressure and wind forcing at low frequencies (0.01 – 0.1 cpd). *J. Geophys. Res.*, 105, 11423-11439.

Raicich, F., 2003. Recent evolution of sea-level extremes at Trieste (Northern Adriatic). *Cont. Shelf. Res.*, 23, 225–235.

Vilibic, I., 2006. Seasonal sea level variations in the Adriatic. *Acta Adriatica*, 41(2), 141-158.

Pascual, A., Marcos, M., Gomis, D., 2008. Comparing the sea level response to pressure and wind forcing of two barotropic models: Validation with tide gauge and altimetry

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data. *J. Geophys. Res.*, 113, C07011, doi: 10.1029/2007JC004459.

- Page 3989. What is r.h.s?

- Page 3990, lines 5-15. They belong to introduction.

- Page 3994, lines 12-13. "... and the structures are more realistic in the atmospheric forcing cases". Please proof this statement with the reference!

- Page 3999, line 15. "sea level" not "seal level".

- Page 4000, lines 16-17. 21 h-1 is not inertial frequency of the Adriatic Sea (it is seiche frequency), but 17 h-1.

- Page 4000, lines 17-22. The existence of seiches on the Venice measured series is reproduced by the model when introducing air pressure forcing, but in my opinion not because of realistic forcing but because of introduction of aliased air pressure high-frequency energy due to 6-h forcing resolution. The Adriatic seiches are normally generated by rapid changes in winds (from sirocco towards lebicchio and tramontana/bora) after pronounced pushing up of waters in the northern Adriatic by strong and long-lasting sirocco wind (e.g., Cerovečki et al. 1997; Raicich et al., 1999), and air pressure is of minor importance for the process – this is also wrongly stated in page 4003, lines 15-19. Again, the effects of 6-h forcing to the modelling of 21-h process should be carefully assessed. As suggested above, it would be wise to rise the lower period of analysis to 24 h (and not to only Nyquist's 12 h), to avoid these problems and not to discuss the frequency range which is affected with aliasing problems.

Cerovečki, I., Orlić, M., Hendershott, M.C., 1997. Adriatic seiche decay and energy loss to the Mediterranean. *Deep-Sea Res. I*, 44, 2007-2029.

Raicich, F., Orlić, M., Vilibić, I., Malačić, V., 1999. A case study of the Adriatic seiches (December 1997), *Il Nuovo Cimento C*, 22, 715-726.

Interactive comment on *Geosci. Model Dev. Discuss.*, 7, 3985, 2014.

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