Ocean Sci. Discuss., 11, C1031–C1034, 2014
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Interactive Comment

Interactive comment on "A wind-driven nonseasonal barotropic fluctuation of the Canadian Inland Seas" *by* C. G. Piecuch and R. M. Ponte

Anonymous Referee #1

Received and published: 12 November 2014

SUMMARY OF MANUSCRIPT

Piecuch and Ponte investigate nonseasonal oscillations of the surface of the Canadian Inland Seas (CIS) using a combination of satellite data, records from a tide gauge, and a barotropic numerical model. They specifically focus on oscillations of spatial scales O(200km) and timescales O(month) that are resolved by the satellite data. The low-pass filtering discards the influence of eddies, tides and other coastal waves. Other signals from the inverse barometer effect and seasonal processes are removed from the data prior to the analyses. The satellite-derived bottom pressure data averaged over the CIS is correlated with a coastal tide gauge, suggesting the existence of a spatially coherent (i.e. bay-wide) oscillation of the surface. The authors further examine

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this coherent oscillation with the help of a quasi-global prognostic model forced with realistic wind stress. The model accurately reproduces the variability from the satellite and tide gauge, and an EOF analysis confirms the existence of a spatially-coherent mode. Correlation analyses and sensitivity experiments suggest that the mode is primarily driven by wind stress over Hudson Strait, with modifications by local wind stress and topography.

GENERAL COMMENTS

The manuscript is well written and represents a good account of the analyses and their key results. The manuscript convincingly shows that the coarse GRACE data can be useful in regional studies of marginal seas, something I have not seen before. The study highlights a spatially-coherent oscillation driven by remote winds and modified by local winds and topography. Such an oscillation was suggested by the same authors in an earlier article (Piecuch and Conte GRL 2014, see "References" below) but the present article provides a dynamical explanation for the oscillation. I do not have any particular concern regarding the manuscript but I suggest below minor modifications that should improve the manuscript.

RECOMMENDATION

I recommend the acceptation of the manuscript after minor revision (see "Specific Comments" below).

SPECIFIC COMMENTS

Section 2.1.1 (Satellite gravimetry): Please state explicitly the spatial resolution of the GRACE data (1 degree?), and how Hudson Bay is represented at this resolution (e.g. 8x8 grid points).

Section 3.1 (Model framework): The authors write "The setup solves the primitive equations on a moderate-resolution (0.5deg x 0.5deg) spherical polar grid". Please replace "moderate" by "coarse" since such resolution barely resolves Hudson Strait (2 grid

OSD
11, C1031–C1034, 2014

points). In fact, it was a surprise to me that the model could reproduce the observed variability (Fig.3) with such a coarse grid.

Section 3.1 (Model framework): The authors write "We use a constant equation of state". It is not clear what the authors mean. Constant and uniform density? Horizontally-varying constant density?

Fig.3a: The authors write "ocean bottom pressure summed over the Canadian Inland Sea from GRACE [...] and the barotropic model". Just to be sure that we are on the same page, you have bottom pressure values varying in space and in time, for both GRACE and for the barotropic model. Let's call them pb_grace(lon,lat,t) and pb_model(lon,lat,t). Then, according to the figure caption, you *sum* pb_grace and pb_model over their respective grid. Well, it makes no sense to *sum* the values if pb_grace(lon,lat,t) and pb_model(lon,lat,t) are on different grids (especially if we are dealing with a spatially-coherent oscillation, i.e. same sign over the domain). Was it really a sum, or was it an average? Or perhaps you interpolated pb_grace and pb_model over a common lon-lat grid prior to the summation?

Fig.4: Is the EOF shown in the figure similar to the Helmholtz mode of an oscillator? (LeBlond and Mysak 1978, Wright et al. JGR 1987). Wright et al. estimate the frequency of this normal mode to be around 3.4 days.

Fig.4 (typo in caption) "The NAO time series is taken" FROM THE "National Oceanic and Atmospheric...".

Section 3.4 (Forcing and dynamics): The authors write "we compute correlations between the expansion coefficients and nonseasonal zonal and meridional wind stress". Have the authors tried to correlate the expansion coefficients and the bottom pressure of the barotropic model? If you tried, did you qualitatively recover the results of Fig.4a,b in Piecuch and Ponte GRL 2014?

REFERENCES

OSD

11, C1031–C1034, 2014

LeBlond, P.H. and L.A. Mysak, Waves in the Ocean, 1978, Elsevier. Piecuch, C.G. and R.M. Ponte, GRL, 2014, doi:10.1002/2014GL060248. Wrigth, D.G. and D.A. Greenberg and F.G. Majaess, JGR, 1987, vol.92, no.C13.

Interactive comment on Ocean Sci. Discuss., 11, 2337, 2014.