Review of GMD-2018-5, “A new tool for model assessment in the frequency domain - Spectral Taylor Diagram: application to a global ocean general circulation model with tides,” by Calim et al.

General remarks:

The authors of this manuscript develop a new model evaluation technique that uses the basic concept of an information-dense diagram of summary statistics that was developed for the time series domain and applies it in the spectral domain. The effort is a worthwhile one, but little detail is given about how they arrived at the spectral domain form of the law of cosines, few caveats are given about how to apply the technique, and the conclusions they can draw from the model comparisons they perform seem ambiguous. Accept subject to major revisions.

- It is not clear whether assessing models at particular frequency bands in the spectral Taylor diagram framework the authors put forward in this study is a better method of assessing the performance of models, including the ocean general circulation models with tides that are presented here. Presumably, the full astronomical forcing is a more realistic representation of the tidal forcing than the first eight tidal constituents, yet sometimes one outperforms the other. As is the case with all model evaluation techniques, it’s difficult to tell which model is outperforming the other because each of them could be outperforming the other by chance.

- One application that the spectral Taylor diagram can be used for, but wouldn’t be useful for, is to investigate the truncation of the higher frequencies in both the tide gauge observations and snapshot model output saved over time intervals not quite short enough. I would expect both the spectral coherence and standard deviation of power to go down to nearly zero to both such datasets. Another application that the spectral Taylor diagram could be used for that needs to be interpreted with caution is a scenario where the time series are non-stationary in a statistical sense. The user should, in theory, know when to use spectral analysis and when not to use it, but I’m wondering if the authors could construct an artificial example of what might happen if one tried to interpret a spectral Taylor diagram for a frequency band of two time series, at least one of which is a non-stationary process (so that its standard deviation varies over time, as is the case with internal waves when Parametric Subharmonic Instability occurs and in many turbulent scenarios). Lastly, the same concept of a spectral Taylor diagram could be applied over the wavenumber domain instead of frequency domain. I’m wondering whether the authors could comment on the potential for such a technique to be used in performing model evaluation of an eddy-resolving model.

- It is much appreciated that the authors made their code open-source and freely available

Specific comments:

- Lines 59-60: Add “inaccurate representation of bottom flow-topography interaction” to this list, although inaccurate estimation of internal tides is related to every factor to listed and this new one. I say this because bottom friction isn’t the only bottom flow-topography interaction
- Lines 63-64: You mention the findings of Lee et al. (2006) on lines 52-53 and say that you’re using MOM5, so it would be good to check on whether your version of the code includes the bug that was present in the Lee et al scheme.
- Lines 88-90: The reader would appreciate more mathematical detail regarding how you can just replace the correlation by the spectral coherence and replace the standard deviation of the time series with the standard deviation of the power. The way that you have defined the root-mean-square error is according to the law of cosines using the information from the spectral coherence and standard deviation of the power. It is unclear to the reader whether the resulting root-mean-square error is what you want to minimize. The artificial example shown in Figures 2-3 isn’t quite enough.
- Line 104: Please describe how you compute the standard deviation of power and the spectral coherence.
- Lines 158-160: I don’t understand: are you using both the Lee et al scheme and Simmons et al scheme, or what do you mean “… to prepare the model… for future studies”?
- Line 206: It would sound better and more clear to say “… remains almost unchanged.” Instead of “… keeps almost unchanged.”
- Line 207: Instead of saying “… it is well stated in Figure…,” say “… it is shown in Figure…”
- Line 221: Instead of saying “superestimates,” say “overestimates”
- Line 243: Say “In contrast to the Taylor diagram…” (need the word “the” in there)