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Geoscientific Model Development Discussions

Interactive comment on "A new tool for model assessment in the frequency domain – Spectral Taylor Diagram : application to a global ocean general circulation model with tides" *by* Mabel Costa Calim et al.

Anonymous Referee #1

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In this paper a variant of the Taylor diagram is proposed which purportedly recasts it to show squared coherence, standard deviation of power (or is it square root of power??), and a quantity described as the "centered RMS difference" (between what and what?). As you can see, I was immediately confused. There needs to be a much clearer definition of the terms being shown in the diagram. In particular, when describing power spectra, "standard deviation" doesn't seem apply (unless one wanted to consider the standard deviation of the power density with respect to frequency, I suppose). More troubling is the claim that the distance from the reference point on the diagram should

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represent some measure of RMS error, since by definition the coherence is, as the authors say, a measure "of the linear relationship between two time series," and can't distinguish between phases that differ by 180 degrees. This means that two time series that are perfectly correlated or perfectly anti-correlated must have the same coherence, yet we know the RMS difference between the two time series will be 0 in the first case and large in the second case. Given this example, I can't see how the distance between the reference point on the diagram and the test points can be a measure of RMS difference.

A second major problem is that the application of this diagram is not for an analysis that relies on Fourier transforms and power spectra, but rather for an analysis based on Fourier series. With discrete Fourier coefficients (like diurnal and semi-diurnal cycle), the natural way to assess how well a model performs is simply to plot the regular Taylor diagram for each Fourier harmonic. One could also plot three points – the first two harmonics plus the sum of the rest of the harmonics – to completely characterize the similarity of the simulated and observed time-series. For each harmonic on a normalized Taylor diagram, the radial distance gives the ratio of amplitudes of the simulated and observed Fourier harmonics and the azimuthal angle is directly related to the phase difference. The RMS difference between the observed and simulated harmonic of interest is proportional to the distance from the reference point on the abscissa. Given this very straight-forward application of the Taylor diagram, why is there a need to invent a variant where the quantities are not clearly defined?

When considering an analysis based on Fourier transforms (as opposed to Fourier series), one might consider displaying coherence and power (for some frequency band) in a 2-d plot with power on one axis and coherence on the other. If in fact there exists a third quantity of interest that is related geometrically to these two, then one could construct a diagram that would include that information (perhaps similar to what proposed in this manuscript), but it would be important to clearly define what that third quantity represents and why it is a useful measure of discrepancy between simulated and observed fields.

Given the fundamental problems with the current manuscript, I recommend that it be withdrawn and rethought.

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