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Geoscientific Model Development Discussions

Interactive comment on "System identification techniques for detection of teleconnections within climate models" *by* Bethany Sutherland et al.

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According to the latest research on climate indices such as ENSO, the transfer function approach is becoming increasingly useful. Either frequency-domain or time-domain transfer functions can be applied. The key premise is to pick a good forcing function, and the best indicator is that the forcing function is the same function that is used to model the length-of-day (LOD) variations in the earth's rotation rate. This is a lunar tidal forcing that is applied to a solution of Laplace's Tidal Equations such that the response matches an ENSO time-series such as NINO34 or SOI. The steps in the time domain transfer function is shown in Fig 1 attached. The initial step is to input the tidal forcing and create a stepped response that duplicates an annual "spring-barrier" lagged response. From there, the LTE transfer function is applied to match the selected ENSO

time-series. Fig 2 attached shows the modulation applied. This actually illustrates two wavenumber modulations, a longer modulation corresponding to the well-known Pacific Ocean ENSO dipole, and a faster modulation corresponding to what is likely related to tropical instability waves. In the frequency-domain, which is the focus of your paper (i.e. the system identification approach), this would show up predominately as two delta-function spikes at a low and high wavenumber.

I hope to see your paper published rather quickly as it will greatly advance the techniques used to characterize ENSO and other climate index behaviors. It is just a matter of time until machine learning algorithms will also discover these patterns after the appropriate time and frequency-domain transfer functions are supplied to the network algorithms.

I don't expect for you to change your paper's organization, as the approach I described is already reported in the monograph titled Mathematical Geoenergy, Wiley/AGU (2018) https://agupubs.onlinelibrary.wiley.com/doi/10.1002/9781119434351.ch12

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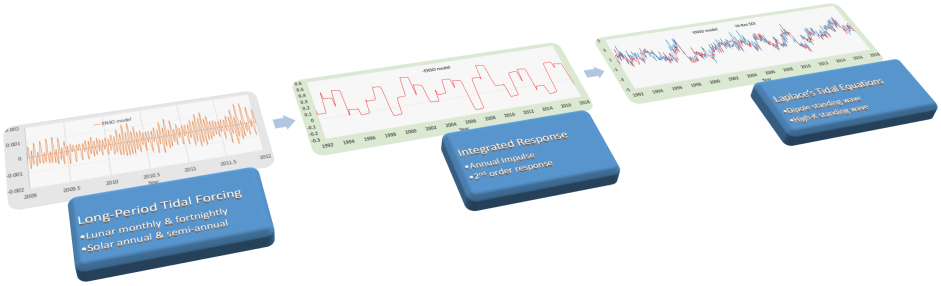

Fig. 1.

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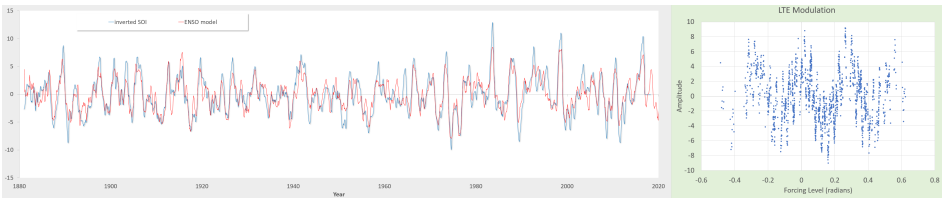

Fig. 2.

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