Notes

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Contents

1 An et al. (2017)

- Used SVD (Singular Value Decomposition) together with the Mixed Layer Heat Budget Analysis to look at which feedbacks contributed most to ENSO's variation between models
- Influence of thermocline feedback is determined by how strongly equatorial horizontal winds affect the slope of the thermocline.

2 BJERKNES (1969)

- First big paper on ENSO having a big impact
- connected changes in ocean currents to Walker Circulation
- ENSO phase affects behavior of the Indian Ocean monsoon.

3 TODO Boer et al. (2000)

4 Cai et al. (2018)

- Increased ENSO variance in most CMIP5 models in EP ENSO center.
- Likely caused by greenhouse gases
- Higher ocean stratification allows for stronger communication between atmospheric and oceanic temperatures.
- Used EOF analysis.

5 TODO Chen et al. (2015)

6 Chen et al. (2017)

- Models are disagreeing on ENSO in the future because they have different representations of the mechanics and mean state of the Pacific subtropical cell

7 TODO Deser et al. (2020)

- Main documentation for CESM1 Single Forcing Ensemble

8 TODO Dewitte et al. (2012)

9 Emile-Geay et al. (2007)

- Analyzed wavelet power spectrum of ENSO variability in models forced by sunspot and orbital changes
- Orbital changes increase long-term ENSO variability
- It is possible that ENSO was the mechanic that allowed prehistoric solar/orbital changes to control the earth's climate

10 Graham et al. (2014)

- tested how accurate the Bjerknes Stability Index is at measuring the mechanics of ENSO in a couple models
- BJ index overestimates the importance of the Thermocline feedback.
- BJ index assumes that terms should be linear when combined, but they actually aren't.

11 Hu and Fedorov (2018)

12 Jia et al. (2019)

13 TODO Jiménez-Muñoz et al. (2016)

14 Kay et al. (2015)

15 Kestin et al. (1998)

16 TODO Kim et al. (2014)

17 TODO Kohyama et al. (2018)

18 Levine et al. (2017)

19 Lorenz (1963)

20 TODO Liu and Alexander (2007)

21 Lübbecke and McPhaden (2014)

22 Maher et al. (2018)

23 Nowack et al. (2017)

24 Phillips et al. (2014)

25 TODO Rashid et al. (2016)

26 TODO Ropelewski and Halpert (1987)

27 TODO Son et al. (2010)

28 TODO Stevenson et al. (2010)

29 TODO Stevenson et al. (2012)

30 Stevenson (2012)

31 Stevenson et al. (2017)

32 Torrence and Compo (1998)

- How to use wavelets to estimate power spectrum in timeseries.
- Uses ENSO data *very niiceee*
- Windowed Fourier Transform sucks butt because it is dependent on a time step parameter that can muck with the results depending on which value you choose.
- A wavelet is a short ***blirp*** of a wave with a mean of zero and finite amplitude/frequency and limited time domain.
- To get an ex. Morlet Wavelet take a regular wave and multiply it by a Gaussian (normal bell curve) so that it drops off over time.
- Will be using continuous methods, but discrete also works.

- Use mathematical transforms to vary scale and translation of wavelet as it slides across the time series.
- Integrate wavelet multiplied by the timeseries while varying scale and shift to generate a power spectrum.
- Applied wavelet spectrum analysis to Nino 3 timeseries
- strong variance in 2-8 year frequency area, but with slight changes between 1900 and 1990
- However, results are highly dependent on which mother wavelet you choose because they all have quite different properties.
- Trying power spectrum from a DOG (Mexican Hat) wavelet gives overall similar answer as Morelett wavelet, but it is slightly different (more detailed in time, less detailed in frequency.)
- Use formula to pick scale limits
- Add zeroes around the timeseries so that the wavelet equation does not misunderstand the data by thinking it is cyclical
- Create a cone of influence to mark where the edge confusion is able to interfere with the results.
- Make sure you convert between the wavelet scale to the Fourier period when you make your axes
- You can also reverse the wavelet transform to get back the timeseries from the power chart if you really want to (I dont think I will).
- Time for significance analysis!
- take a background spectrum that serves as the null hypothesis: all spikes in the power spectrum are due to chance, the underlying signal is really random.
- Comparing to red noise shows that the peaks of ENSO in 2-8 years are statistically significant
- Calculate 95% confidence interval by taking 95% confidence χ^2 statistic and multiplying by red noise spectrum.
- Nino3 SST wavelet power from 2-8year frequency is sometimes significantly different from red noise expectations.
- "The confidence interval is defined as the probability that the true wavelet power at a certain time and scale lies within a certain interval about the estimated wavelet power."
- χ^2 test is advantageous because it applies to a lot of situations in wavelet analysis.
- Averaging the wavelet spectrum across the whole time range gives the overall power spectrum which can be significance tested and approximates the Fourier spectrum.
- Smoothing/averaging increases DOF, allowing to greater significance

for the peaks

- After that, only main ENSO frequency band is shown to be statistically significant.
- Similar to time averaging, scale averaging is sometimes a good idea
- Wavelet analysis can be used to denoise an image/timeseries by throwing away the zones who's amplitude does not meet a certain level of significance.
- Wavelet analysis across spatial and temporal domains when squashed by frequency allows for a great analysis of spatial and temporal variability.

33 TODO Vecchi et al. (2006)

34 Vega-Westhoff and Sriver (2017)

35 TODO Wang et al. (2016)

36 TODO Yeo et al. (2016)

37 TODO Zhang et al. (2019)

38 TODO Zheng et al. (2016)

39 Zheng et al. (2017)

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