

ECS323 EOF Assignment

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September 2020

In this assignment, you will use EOF analysis to explore the way global sea-surface temperature (SST) has varied over the past century and a half.

You are free to use the language of your choice – Python, MATLAB or R. I will provide you with an example notebook in Python, which you could also use as an excuse to learn Python!

The emphasis will not be on how to calculate EOFs – this is not a computational linear algebra course. The emphasis will be on obtaining the results and trying to interpret them physically using what you already know about earth science from your previous courses and some literature review.

The data consists of monthly "anomalies" of SST, and we will talk a little about the data during this week's lecture.

Here are a few questions to get you started.

- Perform EOF analysis for the entire time period of the data.
 - Note down the variance fraction associated with each EOF/PC.
 - Plot the first three EOFs and their corresponding principal components (PCs). Ask others and/or surf the web to see if you can identify some patterns in the EOFs.
 - You will notice that there are some very high/low values for the PCs. What do these correspond to?
 - Use the PCs to see how these EOFs vary over time.
 - What do the PCs and EOFs tell you about the how the different ocean basins have evolved over the past century?
- Use the first 1000 and final 1000 months for EOF analysis. Is there any difference between the first two EOFs and PCs? If yes, can you interpret the EOFs and PCs to explain the difference? How does the variance associated with each EOF change?
- calculate the power spectrum of the PCs and see what time periods dominate the individual EOFs. This gives you an idea about the variety of patterns and the time scale at which they operate in the global ocean.
- Reconstruct the SST using only N EOFs, and subtract it from the full SST. What variability remains once you subtract the dominant variability?
- Combine any two EOFs \mathbf{x}, \mathbf{y} by performing the operation $(\mathbf{x} - \mathbf{y})/\sqrt{2}, (\mathbf{x} + \mathbf{y})/\sqrt{2}$. See if you can amplify any particular patterns you see in individual EOFs.