EAPS 53600: Introduction to General Circulation of the Atmosphere HW 02: Observed large-scale circulations

Reminder for quantitative problem-solving (when applicable): 1) manipulate equations first, plug in numbers last. 2) Double-check units.

This homework asks you to use historical atmospheric data from the ERA5 reanalysis dataset to test a hypothesis about how the general circulation of the atmosphere may be changing with climate change.

For plotting data, you are welcome to use any coding language you like so long as you can answer the question. The recommended coding option is python using Jupyter Notebooks.

A basic introduction to working with NetCDF data on the Purdue Brown supercomputer was shared with the class.

Reanalysis: Reanalysis is a computer model simulation of the atmosphere over the past several decades that also tries to match all available *observational* data as closely possible ("data assimilation"). Hence, it combines both the physics (encoded in the model equations) and observational data. In doing so, it attempts to provide a best estimate of the temporal evolution of the full three-dimensional state of the atmosphere over the period of interest.

Hypothesis: As global mean surface temperature increases, the jet stream shifts poleward.

Using ERA5 reanalysis data, quantitatively evaluate this hypothesis.

Files with monthly-mean ERA5 data for each year during the period 1979-2018 are available on Brown at this path: /depot/eapsdept/data/53600/. Each file contains a single variable of data either on pressure levels (velocity components u, v, w; geopotential height z), or at the surface (sea-surface temperature *sstk*; mean sea-level pressure *msl*; land-sea mask lsm).

For your answer: 1) succinctly state your methodology for testing the hypothesis and explain why you chose this method, 2) make a plot of your quantitative results accompanied by a concise explanation, 3) state your conclusions in the context of your hypothesis, and 4) describe key assumptions in, or limitations of, your analysis and what methods could be used to more robustly test your hypothesis.