Topic #1

- **Topic**: The Global Warming *"Hiatus"*
- **Datasets**: ARGO ocean temperature, AMSRE sea surface temperature, ECMWF Reanalysis surface winds, TOA shortwave and longwave
- **Geographic foci**: mid latitudes (+-60-30), low latitudes (+-30-0)
- **Introduction:** Over the past 15 years the global-mean surface air temperature (GMSAT) has risen slower than predicted by many climate models. Described as a 'hiatus' in global warming, much effort has been spent to understand the failure to predict this apparent 'warming slowdown'. However, while GMSAT is an important variable for many obvious reasons, it is not a robust measure of global net heat flux convergence. Because the heat capacity of the atmosphere is quite small compared to the ocean, much of the year-to-year GMSAT temperature variability simply reflects ocean surface temperature variability. Thus, to answer whether warming has slowed during the 'hiatus' period requires quantifying changes in the energy storage in Earth's largest thermal reservoir: the ocean.
- **Questions:**
  1. Global warming is a consequence of an energy imbalance: more shortwave radiation absorbed at the top of the atmosphere (TOA) than re-emitted longwave and reflected shortwave. Calculate the global net radiative flux imbalance at the top of the atmosphere (TOA). How does this compare with published estimates? How has this number changed through time?
  2. If Earth's radiative flux imbalance was entirely absorbed in the troposphere (assume the lower 10 km of atmosphere), what would be the average annual change in tropospheric temperature? How does your predicted temperature change compare to the actual change through time?
  3. Repeat all parts of question (2) but instead consider that the entire radiative flux imbalance warms the upper 10 m, 100 m, 700 m, and 2000 m of the global ocean, respectively. Compare the predicted temperature changes against observations by using AMSRE SST data as a proxy for the upper 10 m ocean temperature, and ARGO data for the upper 100, 700 and 2000 m. How do the actual warming trends of each of these depth categories compare against predictions?
  4. Divide the ocean into 6 basins: Southern Ocean, N. Pacific, S. Pacific, Indian, N. Atlantic, and S. Atlantic. Which basins and which depth account for the greatest observed warming?
  5. Calculate the surface wind field anomaly over the hiatus period from the long-term mean. Are there any patterns or correlation the between surface wind field anomaly and your answer for (4)?
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