The Competing Forces of Hurricane-Induced Ocean Cooling

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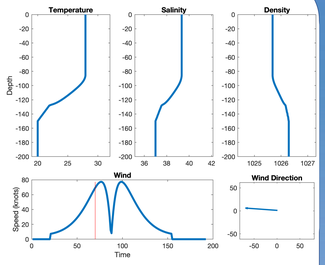
Introduction:

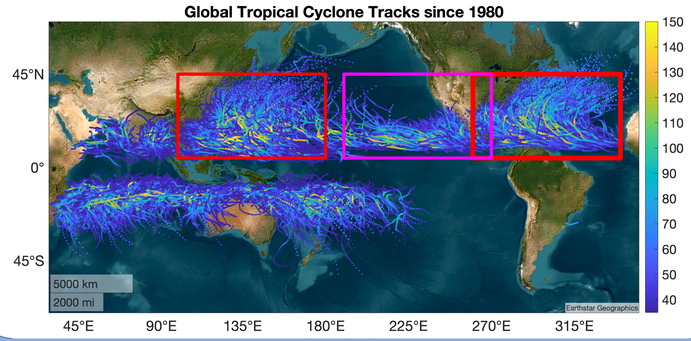
- Heat transfer at the air-sea interface provides the energy for tropical cyclones
- Tropical cyclones induce mixing into the ocean, creating a negative feedback loop with sea surface temperature (SST)

- Subsurface oceanic conditions are known to have substantial impacts on the amount of surface cooling
- There is a lack of quantification of exactly which factors are the most important

Methods:

- PWP 1-D mixed layer model
- Quantify mixing/thermodynamic effects
- Partial regression, isolating variables
- Repeat for real-world "observations"
  - SODA Reanalysis, HURDAT/IBTrACS, Satellite SST
  - Repeat partial regression
  - Compare ocean basins

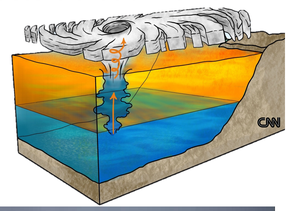




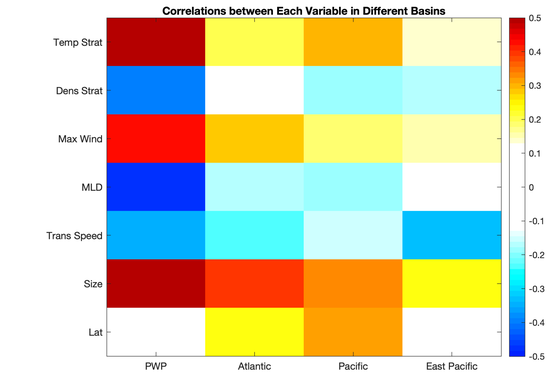
Question:

What are the most important factors that drive TC induced SST cooling?

- Density Stratification
- Temperature Stratification
  - Associated density stratification
    - *Mixing Effect*
  - Cooler water near the surface
    - *Thermodynamic Effect*
- Mixed Layer Depth
- Max Wind Speed
- Translation Speed
- Storm Size
- Latitude



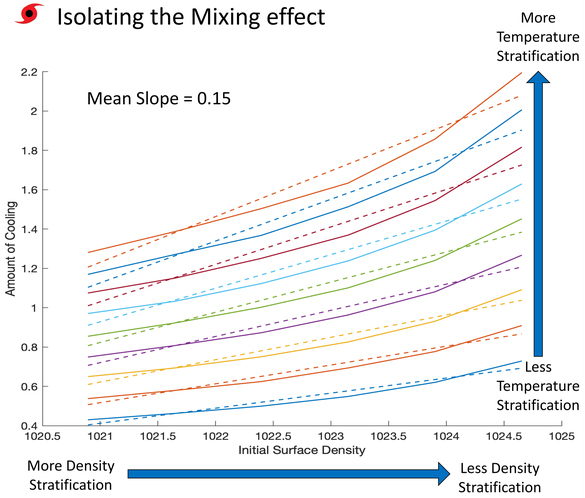
Raw Correlations Across Basins:



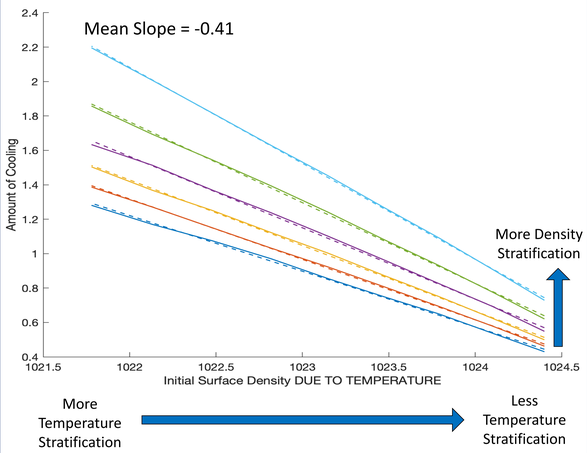
- Raw correlation between each variable (y-axis) and OISST cooling (PWP cooling)

Mixing vs Thermodynamic Effects:

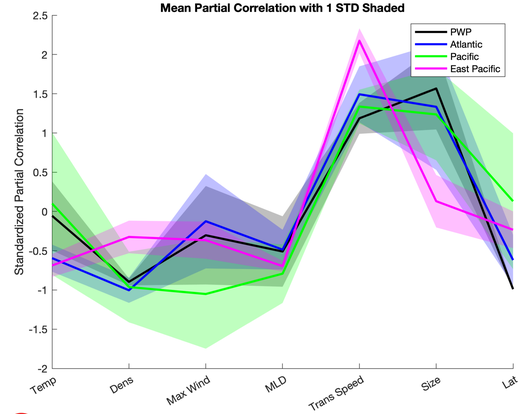
- Isolating the Mixing effect



- Isolating the Thermodynamic Effect



Normalized Partial Correlation:



- Normalized partial correlations for each basin with 1 standard deviation shaded
  - Standard deviation calculated by removing each variable, the recalculating partial correlations

What did we learn:

- Size and translation speed are the two most important factors to consider in SST cooling
- Temperature stratification, wind speed, and mixed layer depth follow in importance
- Temperature stratification (*thermodynamic effect*) is 2-3 times more important to consider than density stratification (*mixing effect*)
- Different basins/regions may differ in order

Where next?:

- Looney et al (in prep)
- Expand model range to encompass more temperature stratification cases
- Create simple statistical model to aid tropical cyclone intensity guidance
- Open to ideas/suggestions!