This research experience is funded by the NSF.

Meteorological and Oceanic Impacts of a Hurricane

By:
Paulina, Lydia, and Alison

Thanks to Sage Lichtenwalner for extensive Python and data help and Josh Kohut for being a great mentor.

A NASA astronaut's picture of a 2003 hurricane, taken from the ISS.

Hurricanes impact us

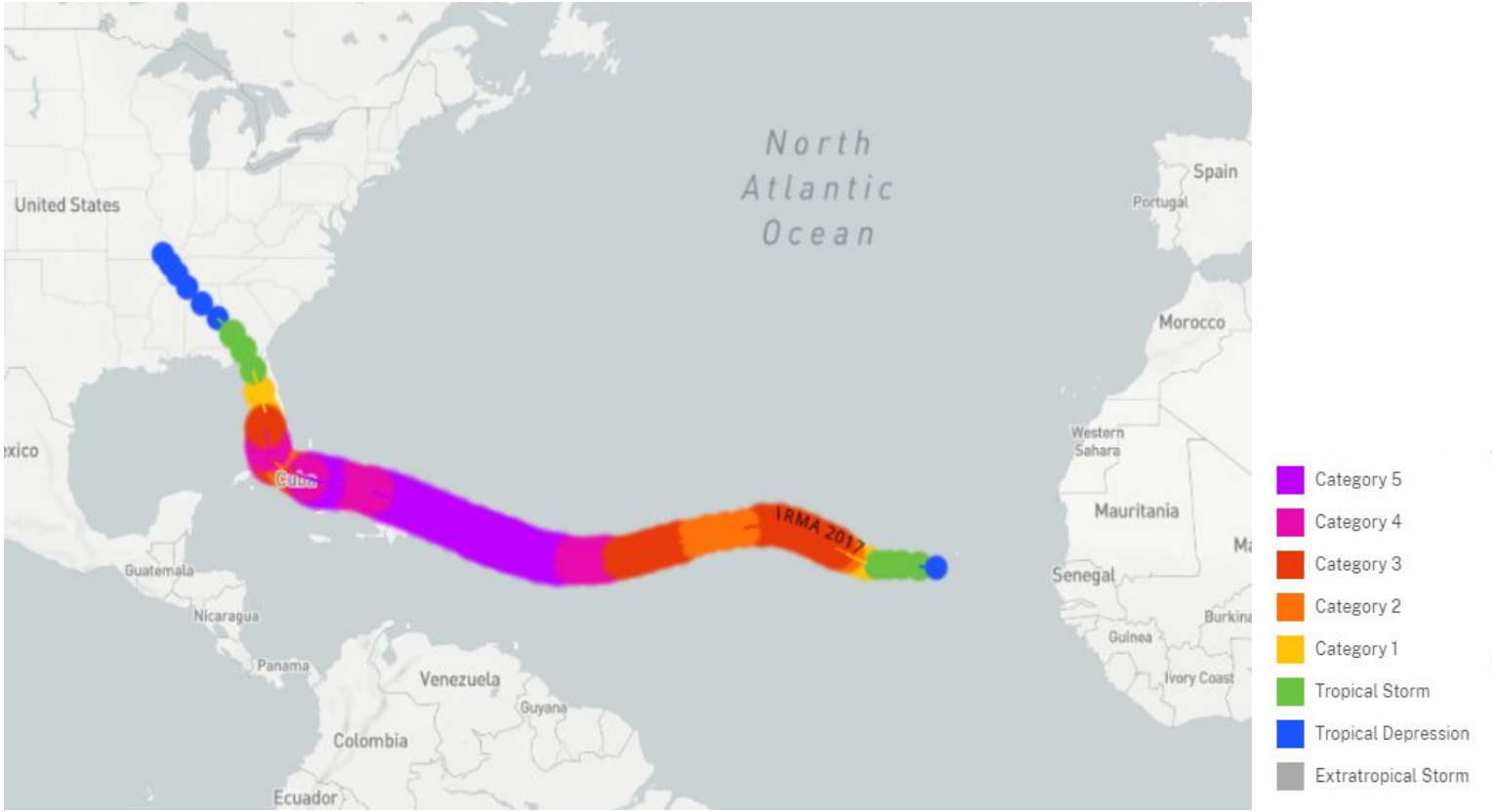
Martin Bureau/AFP/Getty Images

- Hurricanes impact our homes, the economy, and our lives
- Irma-Category 5, August 30th - September 13th 2017 (NOAA 2020)
- Irma took the lives of 129 people

Ian Brown/AP

NY Times

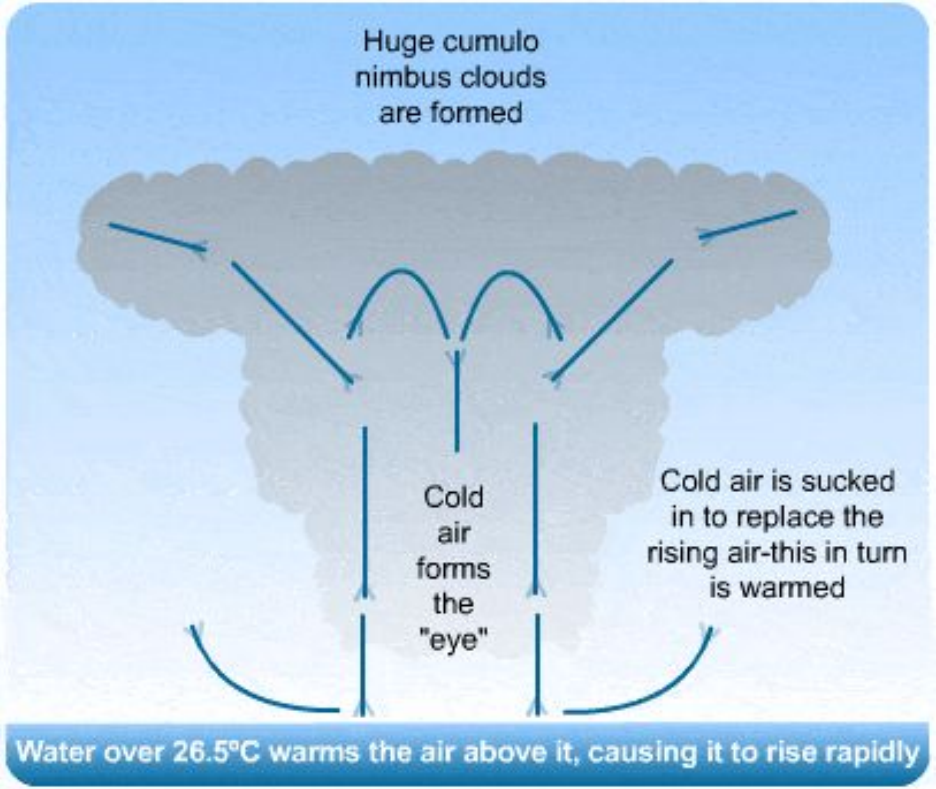
Hurricane Irma (2017) Path



Data from NOAA Historical Hurricane Tracks

How do Hurricanes Form?

- Warm water evaporates and rises away from the surface of the water
- As the warm air rises, the area closest to the water has low air pressure
- Air with high pressure moves into low pressure spaces and warms up, starting the cycle again



Global Weather Climate Center

https://spaceplace.nasa.gov/hurricanes/en/

Q: How broadly can the effect of Hurricane Irma in 2017 on the ocean be seen?

Atmospheric	
Air Pressure	↓
Wind Speed	↑
Oceanic	
Surface Sea Temperature	↓
Wave Height	↑

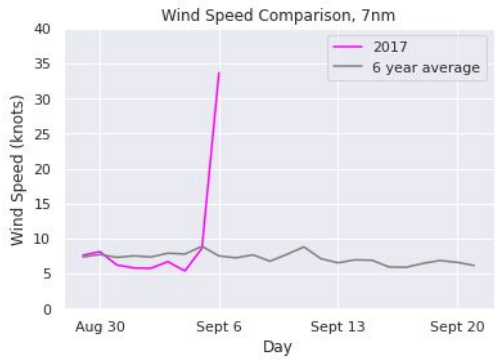
- Our predictions:
  - **Prediction 1:** We expect atmospheric and oceanic variables to look much different in 2017 when Irma hit, compared to other years
    - Air pressure and surface sea temperature will decrease
    - Wind speed and wave height will increase
  - **Prediction 2:** We expect to see a broader impact geographically considering atmospheric variables over oceanic

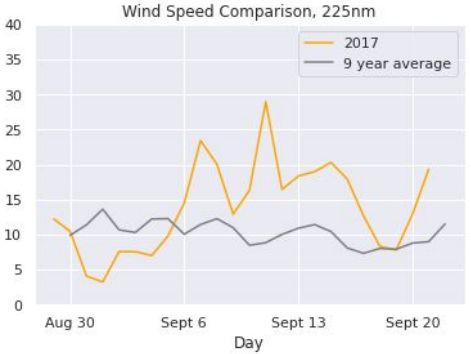
Data from NOAA Historical Hurricane Tracks and NDBC

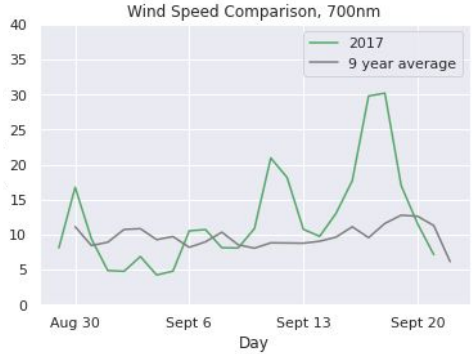
Data

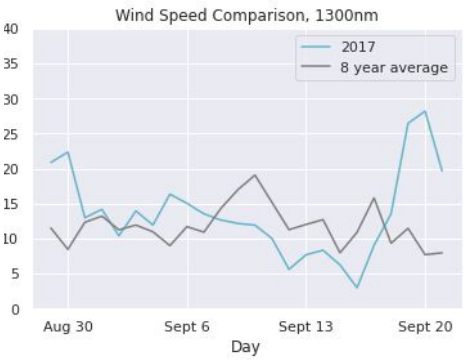
- Analyzed four atmospheric and oceanic variables (air pressure, wind speed, wave height, sea surface temperature)
- September 2017 vs average
  - Which variables show the most extreme impact
  - How these effects change with increasing distance

Wind Speed

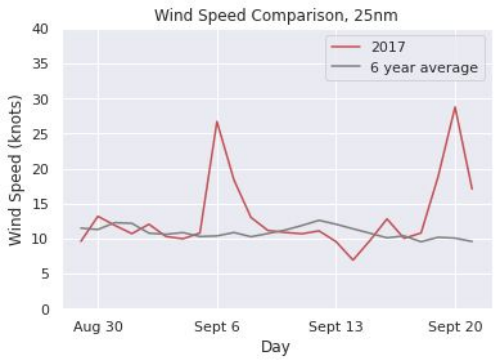

Wind Speed Comparison, 7nm
2017
6 year average
Wind Speed (knots)
Aug 30
Sept 6
Sept 13
Sept 20
Day

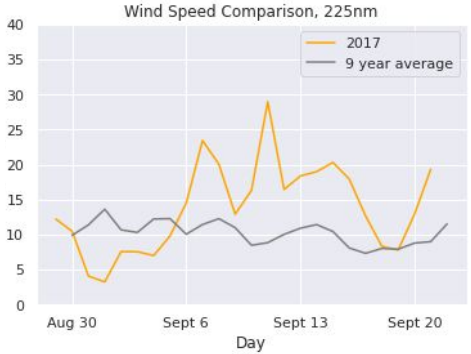

Wind Speed Comparison, 225nm
2017
9 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

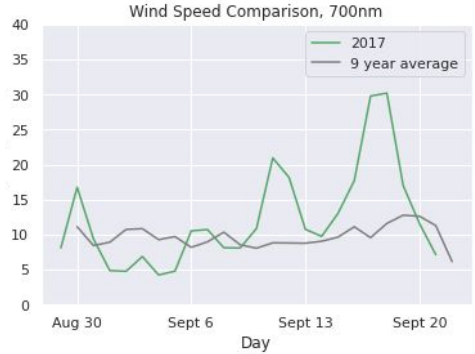

Wind Speed Comparison, 700nm
2017
9 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

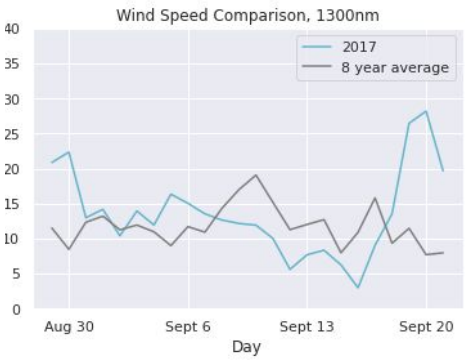

Wind Speed Comparison, 1300nm
2017
8 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

Wind Speed

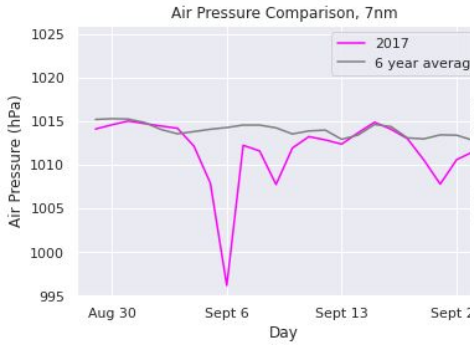

Wind Speed Comparison, 25nm
2017
6 year average
Wind Speed (knots)
Aug 30
Sept 6
Sept 13
Sept 20
Day

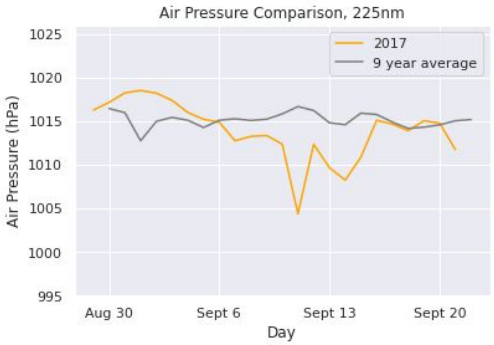

Wind Speed Comparison, 225nm
2017
9 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

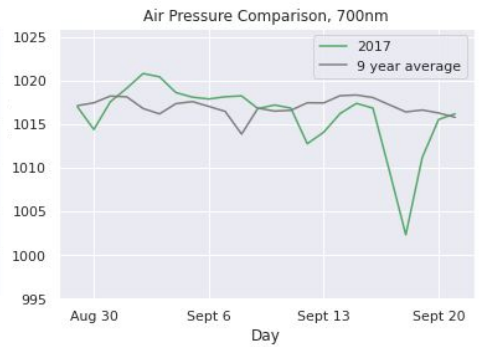

Wind Speed Comparison, 700nm
2017
9 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

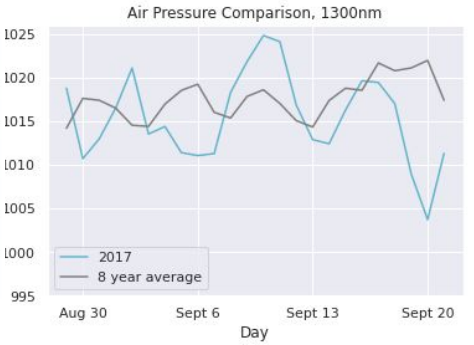

Wind Speed Comparison, 1300nm
2017
8 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

Air Pressure

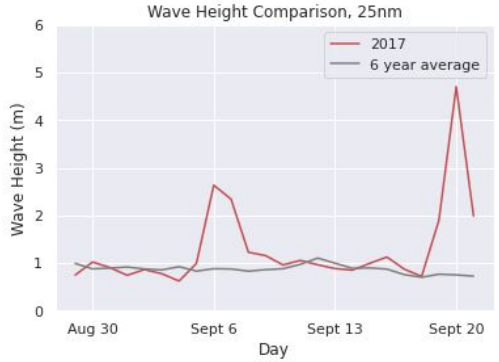


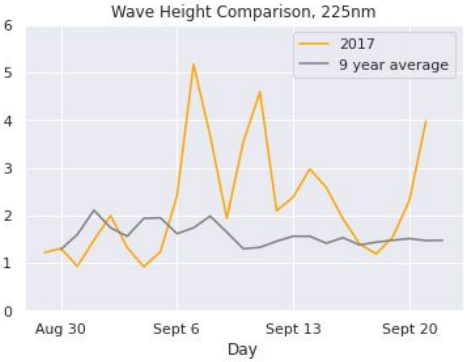


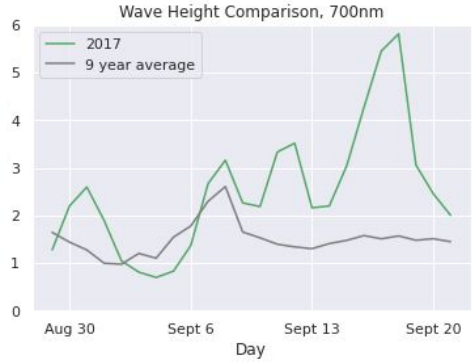


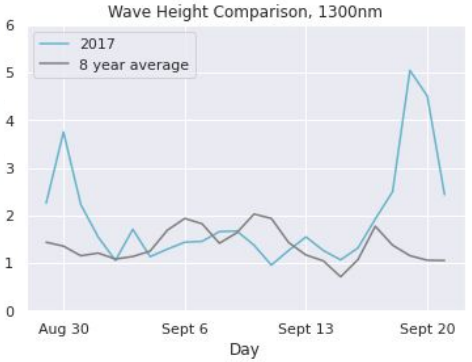


Wave Height

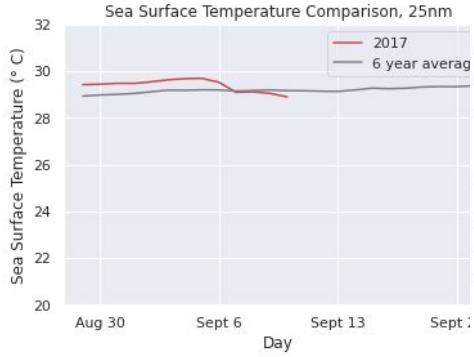

Wave Height Comparison, 25nm
2017
6 year average
Wave Height (m)
Aug 30
Sept 6
Sept 13
Sept 20
Day

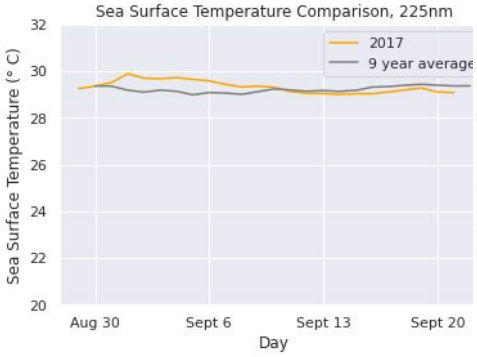

Wave Height Comparison, 225nm
2017
9 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

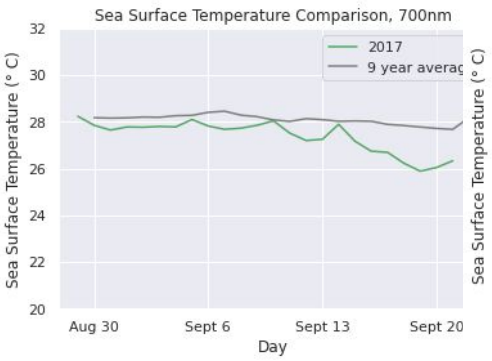

Wave Height Comparison, 700nm
2017
9 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

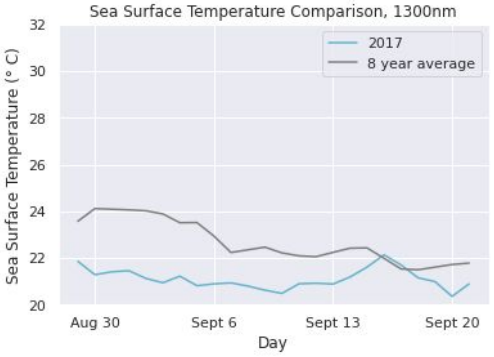

Wave Height Comparison, 1300nm
2017
8 year average
Aug 30
Sept 6
Sept 13
Sept 20
Day

Sea Surface Temperature

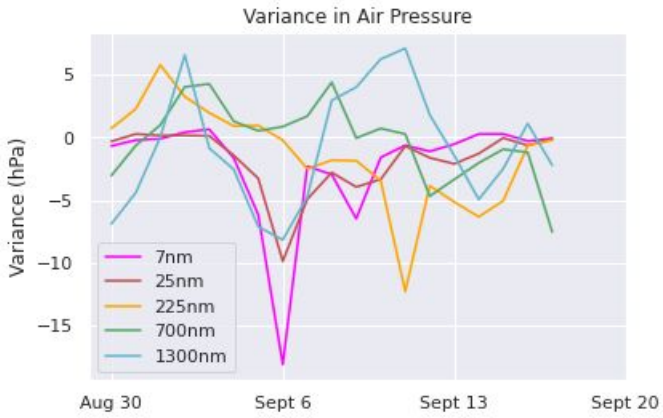


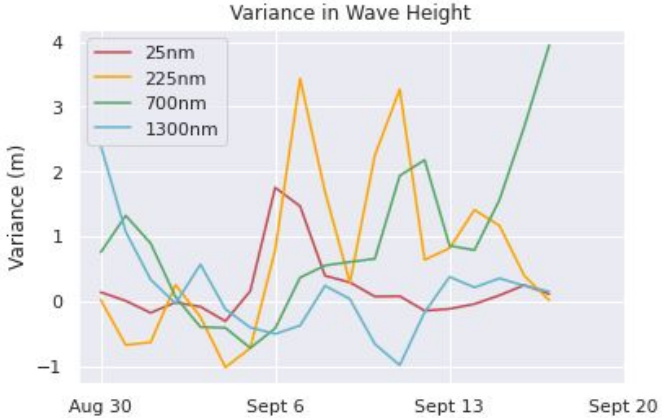


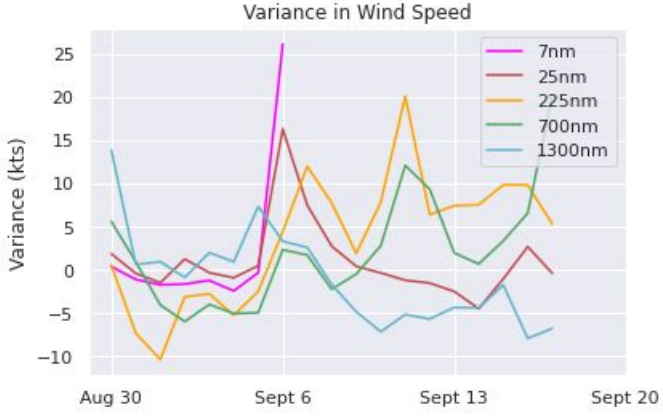


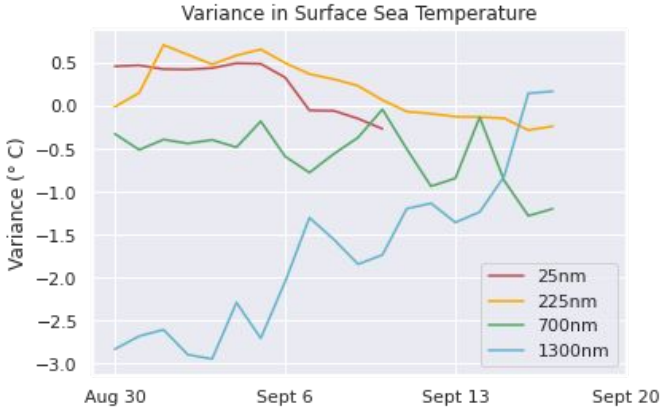


Results


Variance in Air Pressure
Variance (hPa)
5
0
−5
−10
−15
7nm
25nm
225nm
700nm
1300nm
Aug 30
Sept 6
Sept 13
Sept 20


Variance in Wave Height
Variance (m)
4
3
2
1
0
−1
25nm
225nm
700nm
1300nm
Aug 30
Sept 6
Sept 13
Sept 20


Variance in Wind Speed
Variance (kts)
25
20
15
10
5
0
−5
−10
7nm
25nm
225nm
700nm
1300nm
Aug 30
Sept 6
Sept 13
Sept 20


Variance in Surface Sea Temperature
Variance (° C)
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
25nm
225nm
700nm
1300nm
Aug 30
Sept 6
Sept 13
Sept 20

Conclusion

Predictions

Atmospheric	
Air Pressure	↓
Wind Speed	↑
Oceanic	
Surface Sea Temperature	↓
Wave Height	↑

- Predictions correct, surface temperature effect very small
- Oceanic effects were less visible at 1,300nm whereas atmospheric effects were still visible
- Major hurricanes impact huge geographic areas
- At 1,500nm there was no significant observable effect
- Damage extends significantly beyond the radius of the storm

Questions?