S245

Analysis of Upstream Synoptic Conditions for Tropical Cyclones that Pass Near or Over Florida

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Introduction

This project analyzes the synoptic conditions upstream of tropical cyclones (TCs) in the seven days prior to making landfall on Florida's east coast or recurving out to sea. In doing so, we are looking to determine if there is a statistical difference in the 500 hPa heights between landfalling systems and systems that recurve toward the northwest (heading > 315°) and those that recurve toward the east (heading > 0°).

Methods

The National Hurricane Center's best track files (Landsea and Franklin 2013) were obtained for the period 1979-2017. Next, we sorted through the data to find storms that approached Florida from the south and east and passed within the 70°W to 80°W longitude band. We then determined the date in which the TCs recurved (defined at the first time with heading > 315° or the first time with heading > 0°) or made landfall. Those dates were then used to obtain the ERA-Interim (ERAI; Dee et al. 2011) data that went back seven days prior to the cyclones' indicated landfall or recurvature date. Next, we composited the 500 hPa height field for each event type for each day 1-7 days prior to the landfall or recurvature time. A comparison was then done between the landfall and each of the recurving cases by taking the difference between the 500 hPa height fields for landfalling and recurving TCs. Finally, a Mann-Whitney U test was performed at each grid point with p-values < 0.05 contoured in order to show where the statistical differences in the height fields are located.

Conclusion

Based on the evidence gathered, it appears that there are differences in the 500 hPa height patterns of landfalling and recurving TCs as shown in the resultant figures. The locations where the 500 hPa heights are statistically different varies with time before landfall or recurvature.

Results

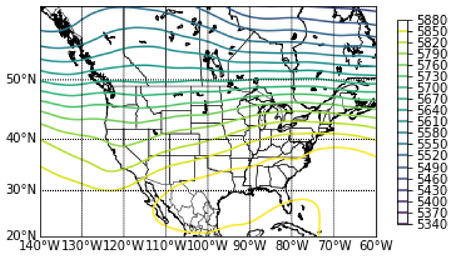

Figure 1: Landfall 500hPa Heights Day-1

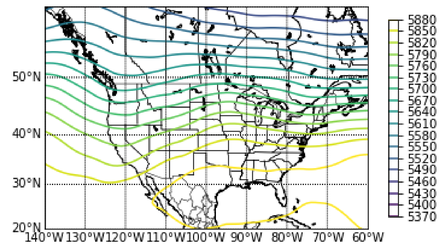

Figure 2: Landfall 500hPa Heights Day-3

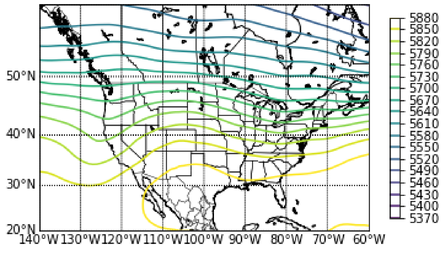

Figure 3: Landfall 500hPa Heights Day-5

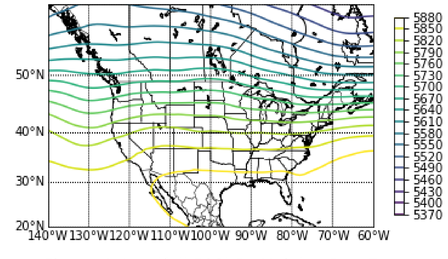

Figure 4: Landfall 500hPa Heights Day-7

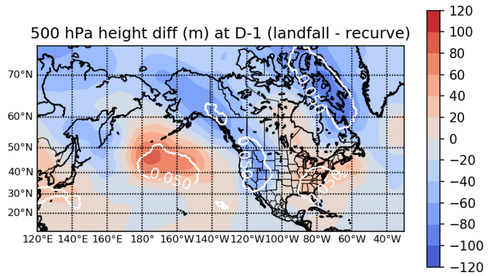

Figure 5: Landfall and Heading > 315° 500hPa Height Differences Day-1

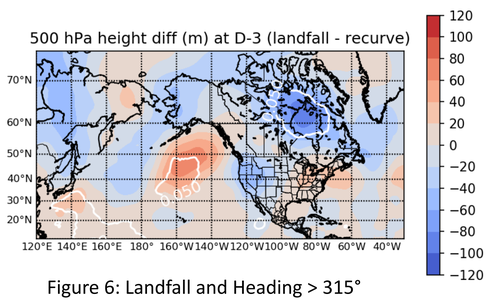

Figure 6: Landfall and Heading > 315° 500hPa Height Differences Day-3

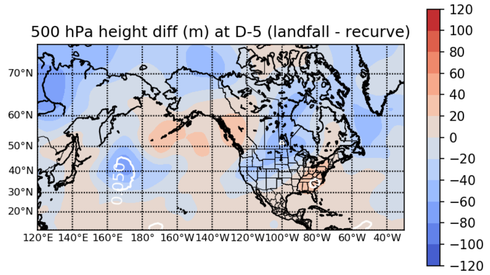

Figure 7: Landfall and Heading > 315° 500hPa Height Differences Day-5

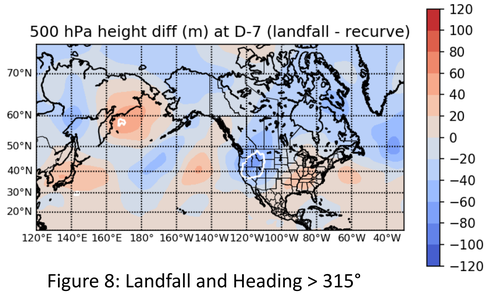

Figure 8: Landfall and Heading > 315° 500hPa Height Differences Day-7

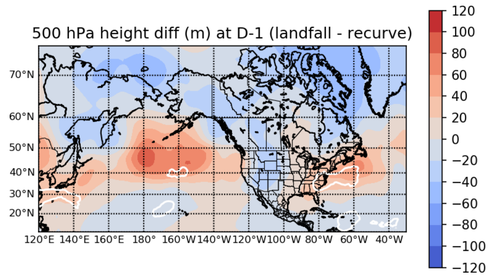

Figure 9: Landfall and Heading > 0° 500hPa Height Differences Day-1

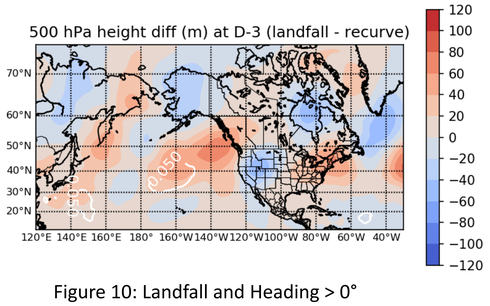

Figure 10: Landfall and Heading > 0° 500hPa Height Differences Day-3

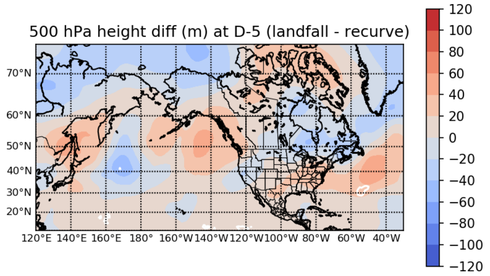

Figure 11: Landfall and Heading > 0° 500hPa Height Differences Day-5

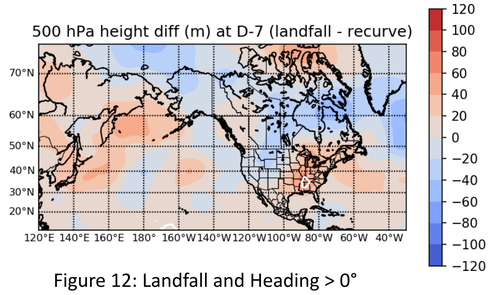

Figure 12: Landfall and Heading > 0° 500hPa Height Differences Day-7

Discussion

The landfalling cases exhibit a 500 hPa height pattern with a ridge over the eastern U.S. and a trough over the western U.S. (Figures 1-4). As the days get closer the date of landfall, the trough and ridge pattern begins to intensify which helps to steer the TCs toward the Florida coast.

With respect to the height differences between the landfalling and heading > 315° cases, we find that the landfalling storms exhibit lower 500 hPa heights over the western U.S. and eastern North Pacific throughout the seven day period as seen in Figures 5-8 (blue shading). These maps also show that the 500 hPa heights for landfalling cases is higher over the eastern U.S. for the same time period (red shading). This indicates that there is a stronger trough pattern over the western U.S. and eastern Pacific when the TCs make landfall in Florida. There also appears to be a stronger ridge present over the eastern U.S. for the landfall cases as well. However, these differences generally are only statistically significant 1 day prior to landfall or recurvature. A statistically stronger ridge over the central North Pacific is also associated with the landfalling cases 1-3 days prior to landfall.

With respect to the height differences between the landfalling and heading > 0° cases, we notice similar patterns to the differences between landfalling and heading > 315° cases, but there are smaller areas of significant differences (Figures 9-12).

References:

Landsea, C. W., & Franklin, J. L. , 2013. Atlantic hurricane database uncertainty and presentation of a new database format. *Monthly Weather Review*, **141 (10)**, 3576-3592.

Dee, D. P., and co-authors, 2011. The ERA-Interim reanalysis: Configuration and performance of the data assimilation system. *QJRMS*, **137 (656)**, 553-597.