5B.1 VARIABILITY OF SEA-AIR INTERACTIONS ASSOCIATED WITH TROPICAL CYCLONE/HURRICANE KATRINA

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1.INTRODUCTION

Previous studies by Reddy et.al (2006) have indicated strong interactions of sea and atmosphere through surface fluxes (heat, momentum and latent heat) associated with the formation and development of tropical cyclone/hurricane activity over the Gulf of Mexico. We extend these investigations to study the variability of sea-air interactions to the hurricane Katrina, which began to strengthen reaching Category 5 strength on 28th August, 2005 about 250 miles South-Southeast of the mouth of Mississippi river and made land fall on the Miami-Dade/Broward county line. Katrina's winds reached their peak intensity of 175 mph and the pressure fell to 902 MB, the fourth lowest pressure on record. Later Katrina turned to the Northwest and then north, making landfall in Plaquemines Parish, Louisiana just South of Buras on 29th August 2005. NOAA GOES satellite, NDBC Buoy and NHC dropsonde data for sea surface temperature and meteorological variables including air temperature, wind speed and sea level pressure were used for computing surface fluxes. Weather Research Forecast (WRF) mesoscale model simulations are used for better understanding of the structure and dynamics of hurricane Katrina activity and compared model output with observations. The model is run on a doubly nested domain centered over the central Gulf of Mexico, with grid spacing of 90 km and 30 km for 6 hr periods, from August 28th to August 30th. The model is capable of simulating the surface features, intensity change and track associated with hurricane Katrina. The study suggested strong heat and latent heat fluxes with heaviest rainfalls as Katrina changes its intensity while making landfall.

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2. KATRINA HISTORY

Katrina was an extraordinarily powerful and deadly hurricane that carved a wide swath of catastrophic damage and inflicted large losses of life. It was the costliest and one of the five deadliest hurricanes to ever strike the United States. Katrina first caused fatalities and damage in southern FL as a Category (CAT) 1 Hurricane on the Saffir-Simpson Hurricane Scale. After reaching

CAT 5 intensity over the central Gulf of Mexico, Katrina weakened to CAT 3 before making landfall on the northern Gulf coast. Even so, the damage and loss of life inflicted by this massive hurricane in LA and MS were staggering, with significant effects extending into the FL panhandle, AL and GA. Considering the scope of its impacts, Katrina was one of the most devastating natural disasters in United States history.

3. WRF MODELING SYSTEM CAPABILITIES

- Globally re-locatable.
- Flexible and multiple nesting capabilities.
- Real-data inputs.
- Non-hydrostatic.
- Terrain-following vertical coordinates.
- Choices of advanced physical parameterization.
- Four-dimensional data assimilation.
- WRF modeling software runs on various computer platforms.
- Parallelization.

4. MODEL CONFIGURATION

- The model was run for a period of three days – August 28th – 30th , 2005.
- Two domains of dimensions 81 x 47 and 100 x 67 are used for simulation over the Gulf of Mexico.
- Horizontal grid spacing of 90 km and 30km fixed over the Gulf of Mexico and FL.
- Central latitude of 30.2N and longitude of 89.6W.
- Real Data was taken from UCAR's NCEP Global Analysis.

Physics options include:

- Simple ice mixing. (Microphysics)
- Blackadar planetary boundary layer parameterization.
- Cloud-resolving radiation.
- Grell cumulus parameterization.

5. RESULTS AND CONCLUSION

- WRF Model for Hurricane Katrina was capable of producing both track and intensity changes close to the observational data recorded by NOAA National Hurricane Center, (Table 1).
- Sea Level Pressure (930 mb) and Wind Speed (115 kt/59 ms-1/132 mph) data outputs were in good agreement with observational data.
- Predicted Precipitation (9.9 in/253 mm) was within the range of the rainfall forecast.
- Max Heat Flux of 310 watts/square meter and Latent Heat Flux of 1549 watts/square meter were accurately predicted in the system's southern sector during intensification.
- Variability of sea-air interactions associated with tropical cyclone was observed while hurricane Katrina making landfall.

6. ACKNOWLEDGEMENTS

NOAA Educational Partnership with Minority Serving Institutions (EPP/MSI) Grant through National Center for Atmospheric Science (NCAS) Howard University.

7. REFERENCES

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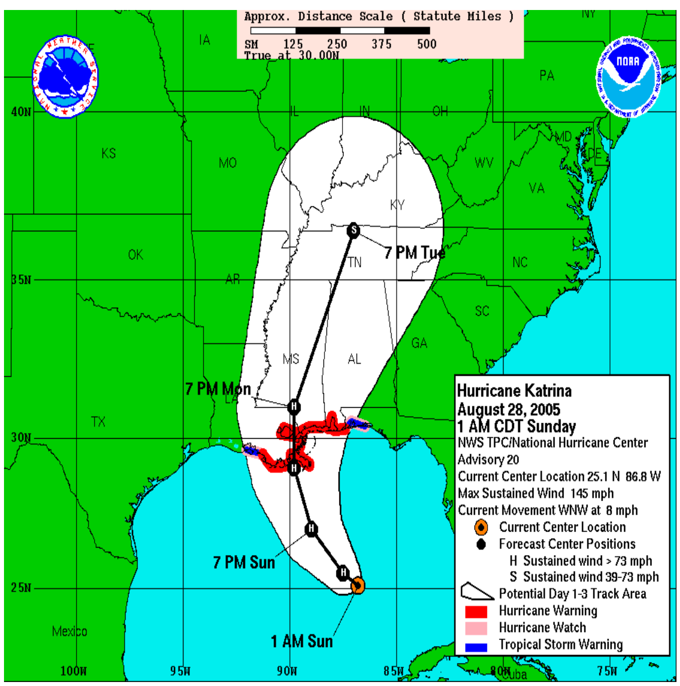

Figure 1. Track of Hurricane Katrina

Figure 2. Satellite Image – Hurricane Katrina

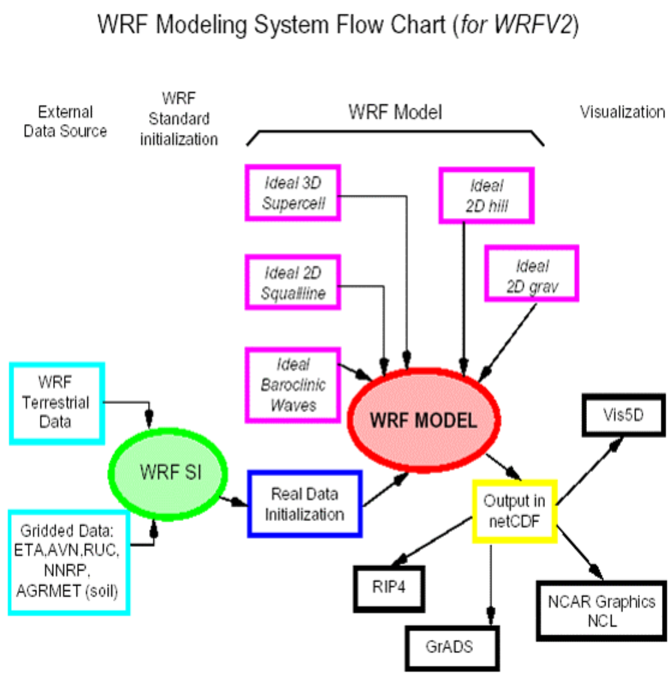

Figure 3.

Table 1. Simulated and Observed Results – At The Time of Landfall

Hurricane Katrina	Simulated (WRF)	Observed (NOAA)
Sea Level Pressure (mb)	930	927
Precipitation(inches)	9.89	10.0
Wind Speed (ms-1)	59.25	55.8

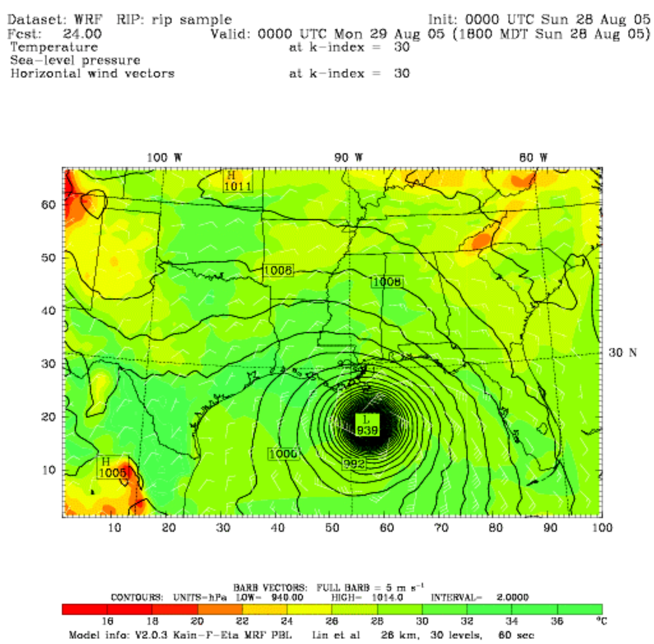

Figure 4. Sea Level Pressure – Before Landfall

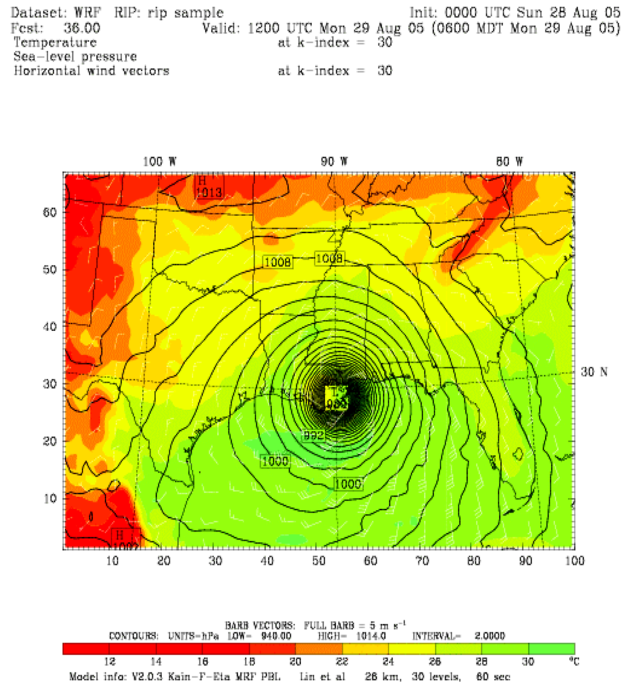

Figure 5. Sea Level Pressure – At the Time of Landfall

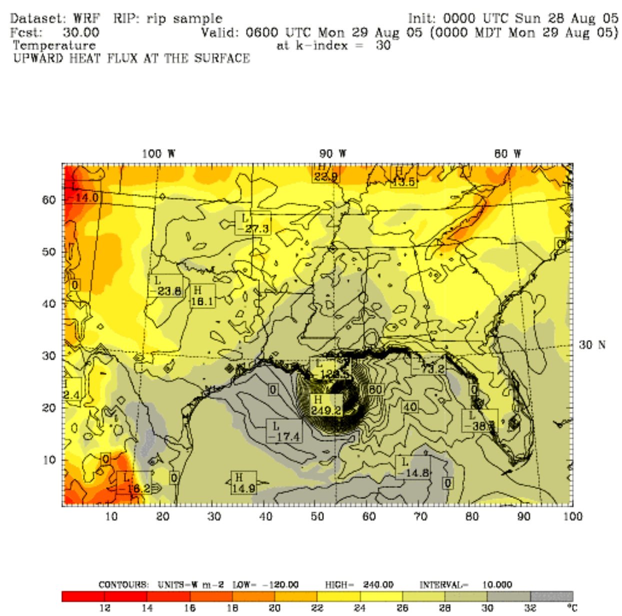

Figure 6. Heat Flux – At the Time of Landfall

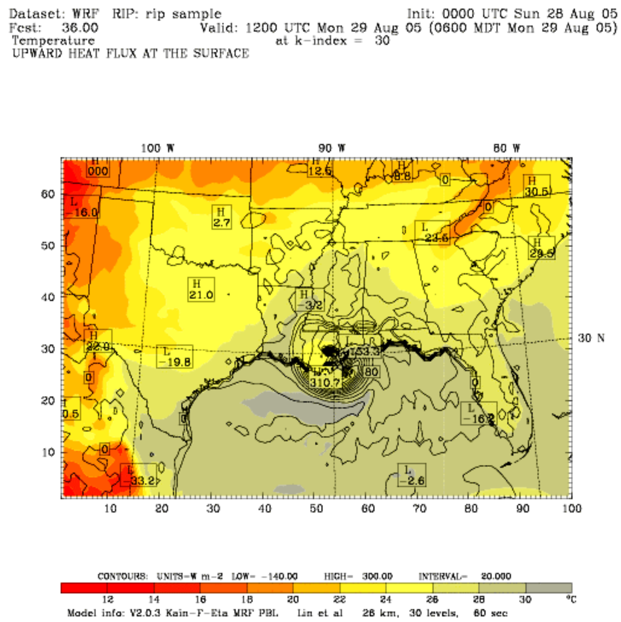

Figure 7. Heat Flux – Before Landfall

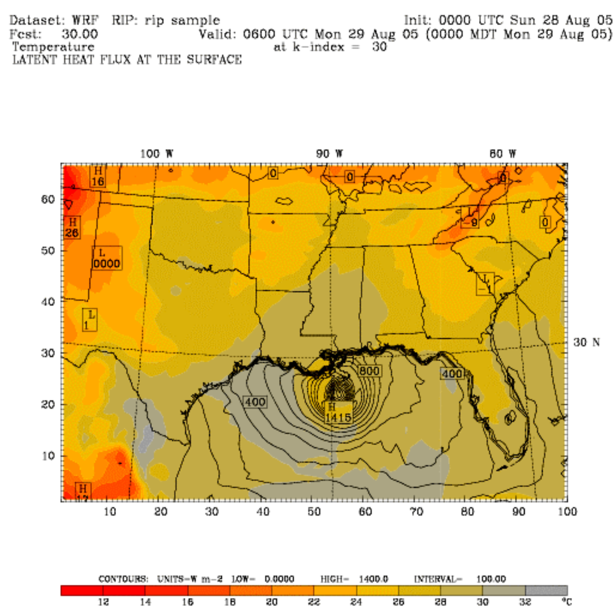

Figure 8. Latent Heat Flux – Before Landfall

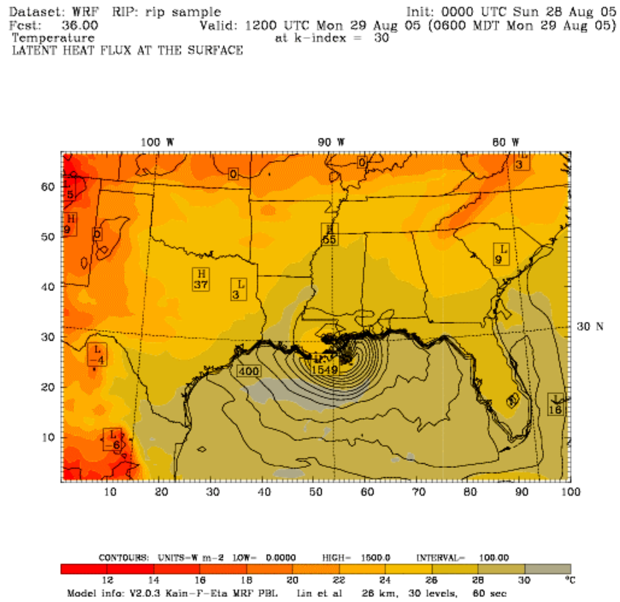

Figure 9. Latent Heat Flux – At the Time of Landfall