P1.88 A SIMULATION OF HURRICANE ISIDORE (2002) USING MM5

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1. INTRODUCTION

Tropical storms and hurricanes that reach the Caribbean and Gulf of Mexico can cause severe problems to the population when they make landfall. It is of great interest to be able to forecast the intensification of such storms as well as the time when they reach the coast.

Four hurricanes developed in the 2002 season out of 14 named storms, and only 2 of them, Isidore and Lili, made landfall as hurricanes. In particular, on 17 September 2002 tropical depression Isidore affected Jamaica and continued intensifying as it proceeded to affect western Cuba, Mexico and the US, where it arrived on 26 September 2002.

We present here preliminary results obtained from a simulation of 2 days in the evolution of hurricane Isidore with a mesoscale model.

2. BACKGROUND ON STORM

The storm developed from a easterly wave and could be traced back to the western coast of Africa. As the wave reached about 50W, the convective activity started to increase and to become more organized, and by 14 September due to the convection and associated cyclonic vorticity the system was classified as a tropical depression. In the western Caribbean Sea it affected Jamaica on 17 September. Figure 1 shows the best track position, obtained from the web page of the Tropical Prediction Center of the National Weather Service (www.nhc.noaa.gov). Isidore became a tropical storm on 18 September and moved slowly toward the northwest, becoming a hurricane at 18 UTC on 19 September. It continued slowly moving towards the northwest and made landfall in western Cuba at 21 UTC 21 September, where it remained for about 12 hours. The track changed after this period and became due west, heading for the Yucatan peninsula. It was in this region of ocean of about 500km that Isidore intensified rapidly reaching the coast as a category III hurricane, with a minimum pressure of 934 hPa just before landfall. The hurricane remained in he area for almost 36 hours causing severe damage to crops and cattle, widespread flooding and loss of life. The region was affected by a massive power outage, that lasted for about 1 week.

At about 13UTC on 24 September, Isidore headed north and crossed the Gulf of Mexico to reach Louisiana at 06 UTC on 26 September. Upon leaving Mexico, Isidore regained strength, but not a very coherent central core of strong winds. At landfall, its miminum pressure was 984 hPa.

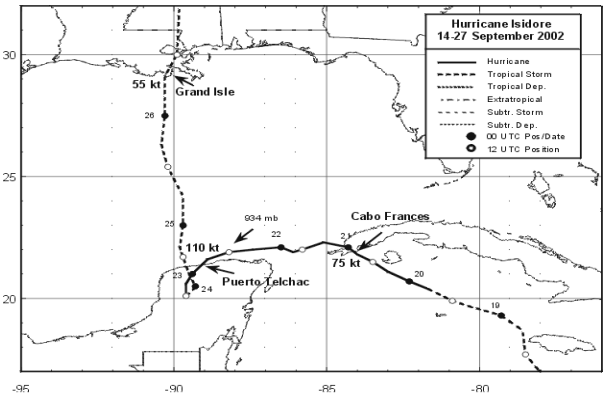

Figure 1. Best track for Isidore, downloaded form the Tropical Prediction Center web page (www.nhc.noaa.gov)

Figure 2 shows the infrared imaged from GOES 8 for 22 September, before landfall in the northern coast of the Yucatan peninsula in Mexico. The eye is clearly seen in the picture, as well as the bands of convection, particularly a band to the east of the center. Figure 3 shows the corresponding image from the radar at Cancun.

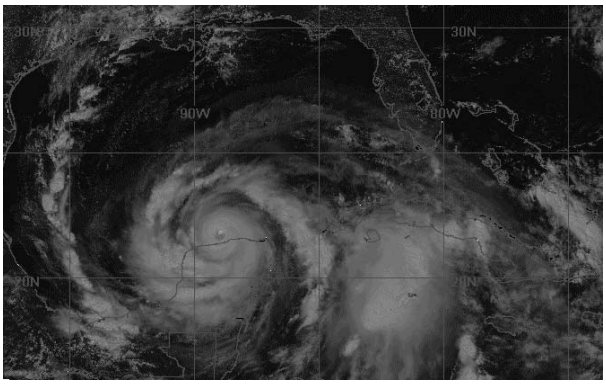

Figure 2. Infrared image from GOES-8 for 22 September 2002

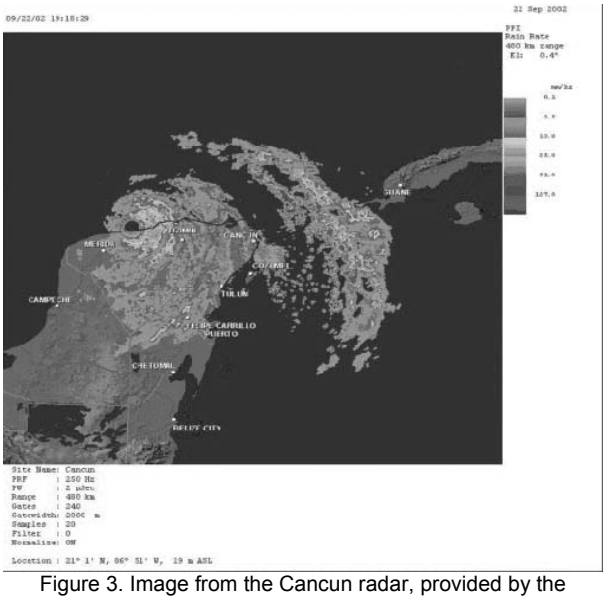

Figure 3. Image from the Cancun radar, provided by the Mexican Weather Service, at time of landfall

3. MESOSCALE MODEL

The fifth generation of the mesoscale meteorological model (MM5), developed initially by Pennsylvania State University and currently available through the National Center for Atmospheric Research was used to simulate the system, as it intensified from category I to III in the region between western Cuba and the Yucatan peninsula.

Three domains were used for the simulations, with maximum resolution of 10 km in the innermost domain. The sea surface temperature was taken from average values for the week when the hurricane was in the region.

The simulations were initialized at 00 UTC on 21 September, utilizing the results from the Aviation Model (AVN). The model was run for 48 hours, with data assimilation performed every 6 hrs.

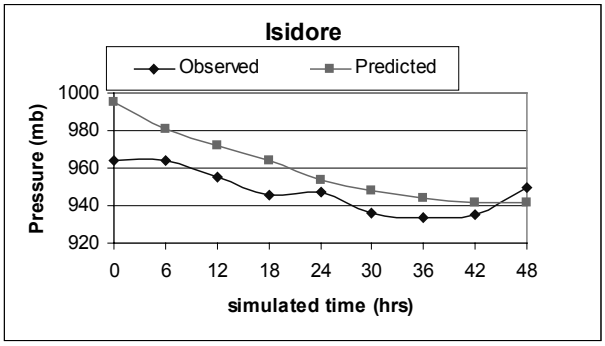

Figure 4. Time evolution of observed and predicted minimum pressure.

It is worth mentioning that the minimum pressure of the AVN data at the initial time was significantly larger than the observed one, given by reports of the Tropical Prediction Center. Figure 4 presents the minimum pressures reported and those predicted by our simulations. The initial difference is slowly decreased, given the larger resolution of the MM5 model, as can be seen in Figure 4.

4. RESULTS

The results of the innermost domain captured the main physical characteristics of Isidore, particularly, the strong band of convection seen in the radar image (Fig. 3). It is surprising that even though the initial pressure was about 30hPa higher than the observed one at the center of the storm, MM5 was able to capture the decrease in pressure to reach a minimum one only 8hPa higher than observed at landfall.

The simulated storm followed a westward trajectory upon leaving Cuba, consistent with observations, but it was systematically to the east of the real storm, as can be seen in Figure 5.

Also interesting is the fact that landfall in the model occurred only 1.5 hours after the actual landfall.

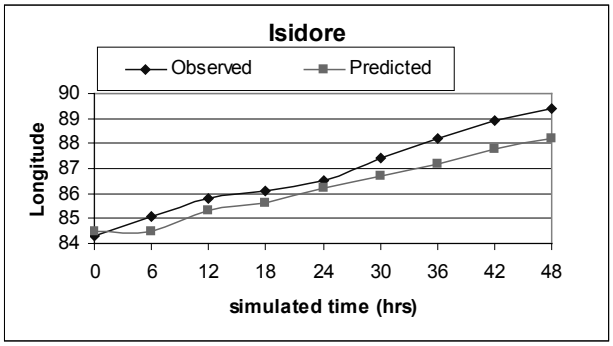

Figure 5. Time evolution of observed and predicted longitude.

It has been proposed (Emanuel, 1991) that the parameterizations of surface fluxes in conditions of hurricane-force horizontal winds may not be adequate. We are currently investigating the sensitivity of the minimum pressure to a modified parameterization of the latent heat flux at the ocean surface and will report these results at the conference.

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