Comparing Rainfall Observations in Hurricanes
Mobile County Health Department
Earthzine/DEVELOP Virtual Poster Session, Summer 2011
Video Transcript

"Hey, my name is Walt Clark, I'm Nathan Owen, I'm Cynthia Erhardt, I'm Vandana, and for the next few minutes, the NASA Develop team in Mobile, Alabama will explain to you how crucial it is for weather forecasters and emergency planning to have accurate precipitation observations. But first, a bit of background, NASA Develop is a student led student run research program that falls under NASA's Earth Science Directorate and Applied Sciences Program. Develop conducts short term research projects that utilize Earth Observations in order to provide data and decision support tools directly to the community. While there are 9 different locations, we are located here at the Mobile County Health Department."

"As tropical cyclones are an annual threat to life and property on the Gulf Coast, our DEVELOP team is continuing the investigation into these systems. While the aspect of storm surge has been heavily studied both from an oceanographic and meteorological standpoint, freshwater flooding from tropical systems is still given minimal attention and can occur unexpectedly. A FEMA study from 1970 to 1999 found that tropical cyclone induced freshwater flooding is responsible for approximately 59% of tropical cyclone related deaths. Since freshwater flooding is still a major concern, the team has partnered with the Center for Hurricane Intensity and Landfall Investigation (CHILI) and the University of South Alabama (USA) Geology Department to compare three precipitation datasets during tropical storm events."

"CHILI is the curator of the University of South Alabama Mesonet, a network of real time weather observation stations that currently stands at 26. The primary purpose of the mesonet is for tropical cyclone landfall monitoring, however, its applications range from agriculture to education. The mesonet utilizes rain gauges to measure precipitation. These measurements were compared to observations from radar and the TRMM satellite. We will discuss the strengths and weaknesses of each dataset as well as our results in the next few minutes."

"Radar, which stands for Radio Detection and Ranging, is commonly used in broadcasting. Radar works by sending out electromagnetic pulses and then waiting for the pulse to be reflected back. A variety of products are created using different algorithms from this basic data collection method. We used the one hour accumulated rainfall product in this study. This product is updated in each radar scan, which is approximately every 4-6 minutes, and gives the estimated rainfall accumulation. Radar has almost continuous coverage, which leaves few gaps in the data."

"Some of the limitations of radar are beam spreading, beam folding, attenuation, and curvature of the earth. For example, beam spreading is caused by the radial nature of the scan. As the

distance from the radar sight increases, the beams become further apart, like the spokes on a bicycle wheel."

"The Tropical Rainfall Measuring Mission or TRMM is a joint mission between NASA and the Japan Aerospace Exploration Agency. The 3B42 V6 product was used for this project which gives a single precipitation rate valid anytime during the given 3 hour period. This product is a combination of the three sensors found on board TRMM as well as sensors from different satellites and gives the precipitation rate based on cloud top measurements."

"Rain gauges are a common way of measuring rainfall. Different types of rain gauges exist, but the type used in this study is the tipping bucket rain gauge. This gauge gathers rain and funnels the water into a small container that tips back and forth like a see-saw. The container holds a predefined amount of water. This allows each tip to be added up to give the rainfall measurement."

"Limitations however, do exist in rain gauges. Some limitations are concerned with accuracy, while others focus on the spatial coverage. Rain gauges are known to underestimate rainfall during strong wind events, such as hurricanes and tropical storms. This is because the wind will actually blow the rain across the top of the rain gauge preventing rain from being measured. With concern to spatial coverage, rain gauges only measure the rainfall at a particular spot. With rainfall being localized, it is impossible to measure rainfall over a large area. Increasing the number of rain gauges helps increase the accuracy, but comes at greater cost."

"I am going to talk about the results and conclusions. The plots generated from the random points on the interpolated maps and the time series plots from individual stations all reveal that precipitation from the rain gauge data is much higher than that of the radar and TRMM, which is not a big surprise as mesonet is a point data. TRMM underestimates rainfall in case of Tropical storm Claudette due to the fact that it was stratiform precipitation characterized by shallow and low clouds which made it hard to measure. Hurricane Gustav was mostly convective precipitation characterized by tall cumulus clouds which is an advantage for TRMM but the reason for underestimation is the spatial resolution. Hurricane Gustav had a single rain band that went across Alabama. TRMM averages the rainfall over a3136 square kilometers that had zero values as well, thereby decreasing the total rainfall. Hurricane Ida was a mixture of both the stratiform and convective precipitation, the issue with this was also spatial resolution of TRMM."

"The mesonet data had the best temporal resolution of 1min but poor spatial resolution as they are few and not well distributed. During high rainfall events with high wind speed the rain could be blown over the top of the rain gauge which will result in underestimation."

"The RADAR data has a good spatial and temporal resolution but it is not accurate over the radar location and its accuracy decreases beyond 40 kilometers. This greatly skews the data."

“These precipitation datasets could be plugged into a flood model to map the flooded areas. Using the RADAR data, the flooding could be predicted even before the storm makes landfall. This has been proposed as a future project.”