Sensitivity of G-IV Dropsonde Configuration on Tropical Cyclone Prediction using a Regional OSSE Framework

Kelly Ryan[1,2], Lisa Bucci[1,2], Javier Delgado[1,2], Robert Atlas[3], Shirley Murillo[2]

[1]Univ. of Miami/CIMAS, Miami, FL
[2]NOAA/AOML/Hurricane Research Division, Miami, FL
[3]NOAA/AOML, Miami, FL

612

MOTIVATION

Study the impact of G-IV dropsondes on tropical cyclone analyses and forecasts

DATA DESCRIPTION

Dropsonde deployed via NOAA G-IV aircraft:

- Temperature, moisture, pressure and wind observations
- 100 observations per dropsonde
- Deployed in various configurations relative to TC size

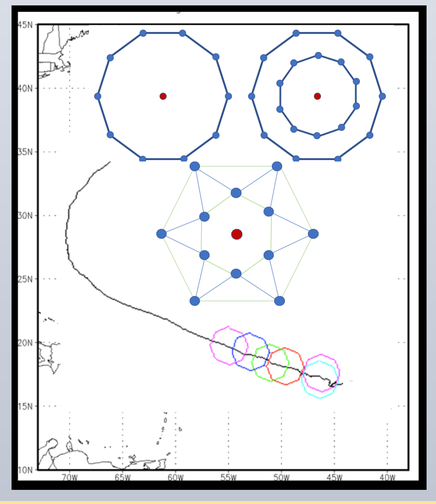


Figure 1. Simulated G-IV locations (6 flights) and dropsonde configurations options

# of observations assimilated

Control: 26000
Circumnavigation: 27000
Concentric: 28000
Star: 27200

OSSEs for Hurricanes

Observing ***S***ystem ***S***imulation ***E***xperiments (OSSEs):

- aim to quantify the potential impact of a proposed observing system on tropical cyclone analyses and forecasts
- can also be used to assess current observing systems and methods for data retrieval

Regional OSSEs for Hurricanes

The regional OSSE system developed at NOAA/AOML and UM/RSMAS uses synthetic observations produced from the Nature Run and assimilates them to create analyses used by a high-resolution regional forecast model

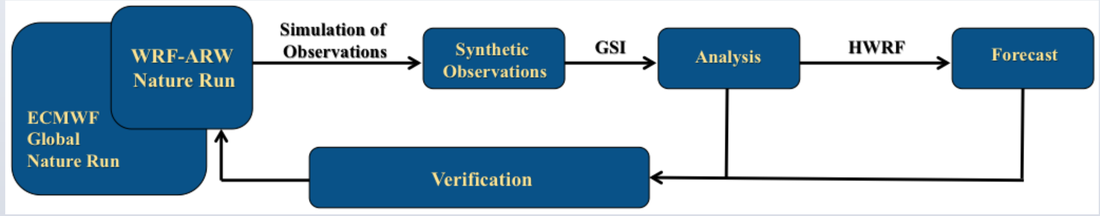


Figure 2. Schematic of NOAA/AOML regional OSSE flowchart

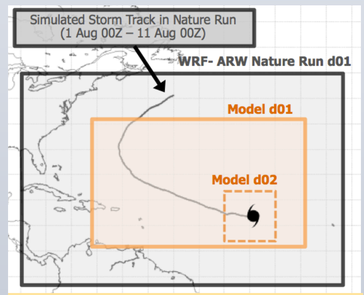


Figure 3. NOAA/AOML regional OSSE system.

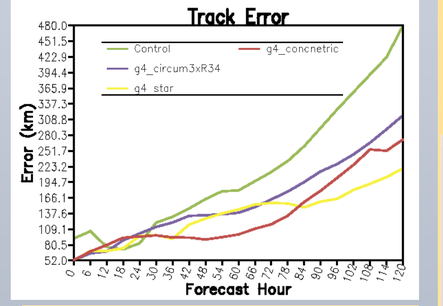


Figure 4. Average absolute track errors over 8 cycles of all 4 experiments

Nature Runs: The 27 km WRF-ARW nature run with storm-following inner nests (9km/3km/1km spatial resolution) is embedded in the T511 ECMWF Global Nature Run.
Data Assimilation: GSI (v3.3) performs 9km analysis over the 9km parent domain (d01).
Regional Forecast Model: Hurricane-WRF model (v3.5) has 9km parent domain and 3km storm-following nest (d02).

EXPERIMENTS AND RESULTS

Each experiment included the assimilation of simulated conventional and satellite data with 120-hour forecasts launched for each analysis. Impact experiments include various configurations of G-IV dropsonde deployments during the 36 hours leading up to rapid intensification.

- **Control**: conventional and satellite observations
- **Circumnavigation**: control plus G-IV dropsondes at a radius of 3 x radius of 34-knot winds
- **Concentric**: control plus G-IV dropsondes at radii of 1.5 and 3 x radius of 34-knot winds
- **Star**: control plus G-IV dropsondes at radii of 1.5 and 3 x radius of 34-knot winds

Positive impact on track forecasts using all configurations

- Analysis track errors improve by about 40 km for all experiments compared to control and are dominated by differences in TC-environment interactions
- Forecast track errors improve significantly for all lead times, with the most significant improvement produced by the concentric circumnavigation configuration
- Experiments adding G-IV dropsonde data capture the strength and western extent of the subtropical ridge, where the control experiment forces the vortex to embed within the ridge

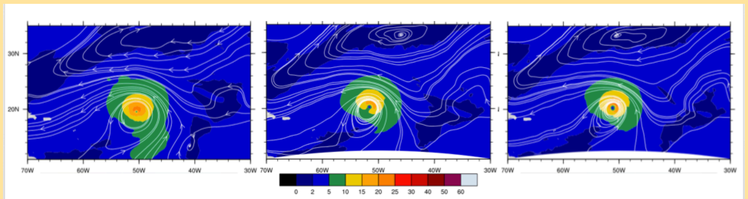
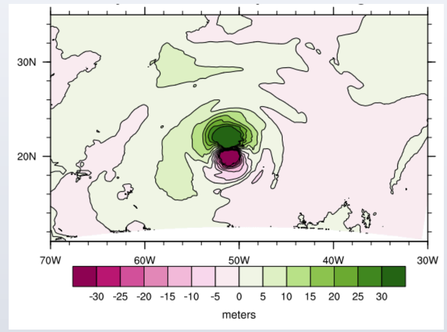


Figure 5. Deep-Layer Mean Wind for the nature run (left), star (middle), and concentric configurations (right).

FURTHER ANALYSIS

Near-storm environment differences



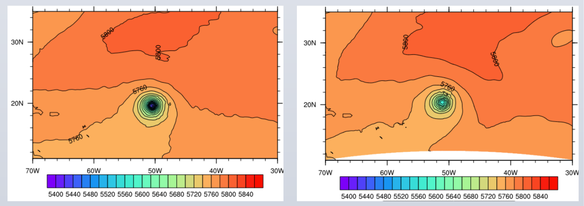


Figure 6. Impact of G-IV dropsonde data from concentric experiment on geopotential height field (top), geopotential height field from nature run (bottom left), and geopotential height from concentric configuration experiment (bottom right).

Future Regional OSSE System Upgrades

New state-of-the-art **Basin-Scale Nature Run**

- Large domain of uniform high-resolution
- Allows for multi-TC interactions

Flexibility

- Use of multiple nature runs
- Implementation of multiple DA systems
- Capability of evaluating model physics/parameterization schemes

Contact:
Kelly.Ryan@noaa.gov