Preliminary Report

NOAA Science Advisory Board

Hurricane Intensity Research Working Group

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Outline

- Motivation
- Charge
- Working Group Membership
- Process
- Hurricane Intensity
- Preliminary Findings
- Six Preliminary Recommendations
- Summary

Motivation

- Continual improvement over the last two decades in forecasting of hurricane track
- **Simultaneously, little improvement in forecasting of intensity – *why*?**
- Recent “surprises”: rapid changes in hurricane intensity, especially just before landfall
  - Charley – 2004 – rapid strengthening just before landfall
  - Katrina – 2005 – rapid weakening just before landfall
  - Wilma – 2005 – rapid strengthening to record central low pressure

Charge

- Independently assess current “state-of-science” and R&D activities in NOAA and elsewhere with respect to hurricane intensity, and then
- Recommend an agenda of R&D activities that will lead to an improved understanding of the processes determining hurricane intensity and the timely transfer of that understanding to operations.

Working Group Membership

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Process

- Meetings
  - Washington, D.C.
  - Miami, FL
  - Boulder, CO
- Teleconferences
- ftp site
- Preliminary Report
- Feedback, and additional teleconferences and meetings
- Coordination with NSB study
- Final Report

Hurricane Intensity

- NHC: Intensity = peak sustained surface winds anywhere in the storm
- **Occurs through a set of poorly understood, complex processes involving both external environmental influences and internal vortex dynamics, e.g.,**
  - Environmental influences, atmosphere and ocean
  - Internal variability (e.g., eyewall replacement cycle)
  - Rapid intensification and weakening
- **Wide range of time and space scales involved**

Preliminary Findings 1: Key National Hurricane Center Guidance Needs

- Formation phase to become named tropical storm
- **Timing and magnitude of rapid intensification**
- **Decay and re-intensification cycles**
- **Timing and magnitude of rapid decay**

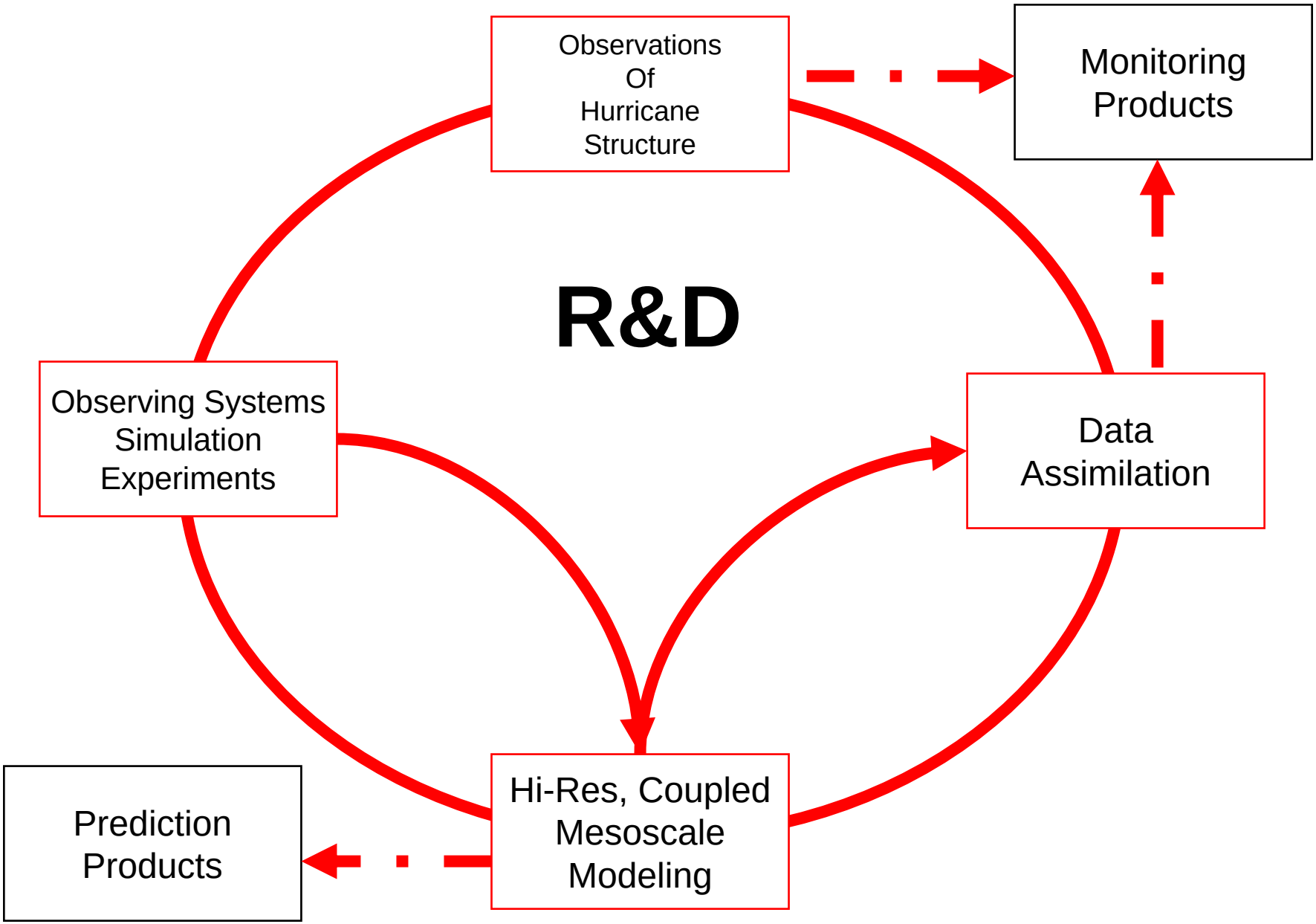
Preliminary Findings 2: Current Situation

- Significant number of activities – observational, R&D, tech transfer, operational -- underway inside (and outside) of NOAA, but no single point of leadership
- Interconnections, coordination, collaboration between activities range from poor to good
- Given complexity of problem to be addressed, “critical mass” is lacking – limited human resources, financial wherewithal, no national focus → progress relatively slow
- **Numerous bright spots on which to build, leverage**

Six Preliminary Recommendations

- Attaining Critical Mass
- Observations of Hurricane Structure
- Data Assimilation
- High Resolution, Coupled Air-Sea-Land Mesoscale Modeling and Analysis
- Operations Research and Socio-Economic Impacts
- Accelerating Transfer from Research to Operations

Point: Recommendations interdependent


Observations
Of
Hurricane
Structure
Monitoring
Products
R&D
Observing Systems
Simulation
Experiments
Data
Assimilation
Prediction
Products
Hi-Res, Coupled
Mesoscale
Modeling

2. Observations of Hurricane Structure

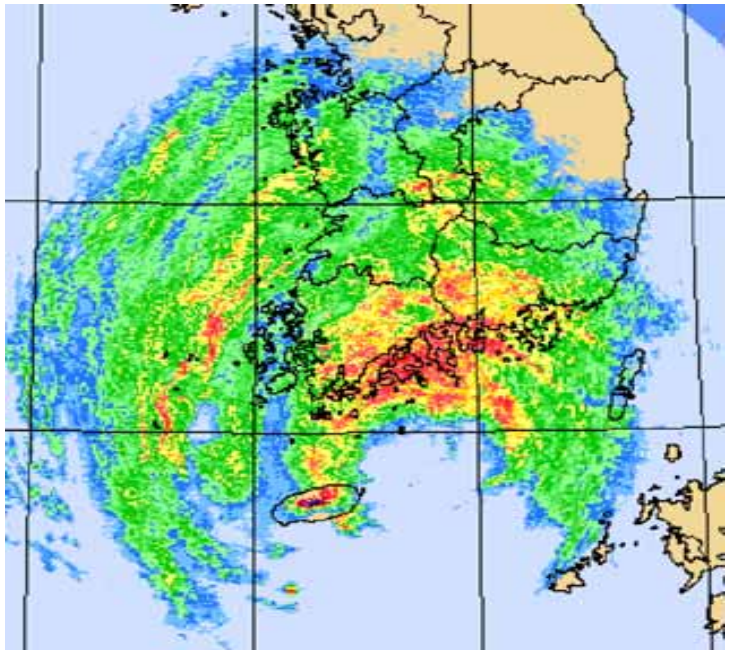
Numerous observing systems provide data on hurricanes (satellites – critical for monitoring, aircraft, buoys, radar) and promising new technology is in-hand (SFMR) or on horizon (UAS, radar on G-4)

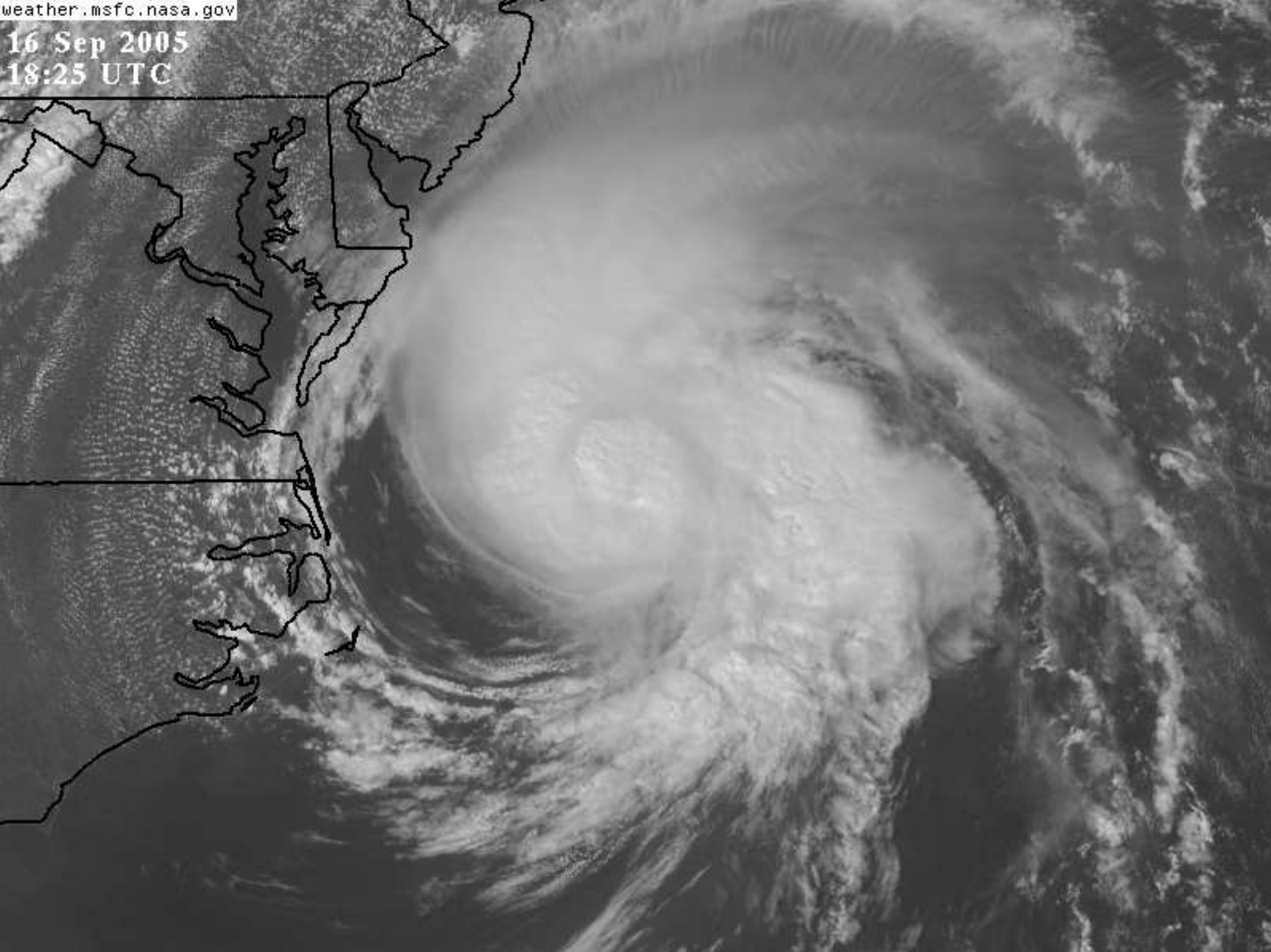
- **Near-term:** Airborne and surface-based radars offer best opportunity to observe mesoscale fields in core region → real time assimilation into models
- **Near-term:** "Low and Slow" Unmanned Aircraft Systems (UAS) demonstrations to assess ability to provide low altitude *in situ* observations, complementing manned aircraft observations
- **Medium-term:** Observing System Simulation Experiments (OSSEs) needed to determine optimal configurations of observing systems for improved forecasts

3. Data Assimilation (DA)

Crucial to obtaining value from nontraditional observations (radar, satellite, dropsonde, etc…) to initialize, update models

- **Near-term:** Explore developing first-guess fields using mesoscale model output as well as global model output
- **Near-term:** 3DVAR DA
- **Medium-term:** 4DDA

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16 Sep 2005
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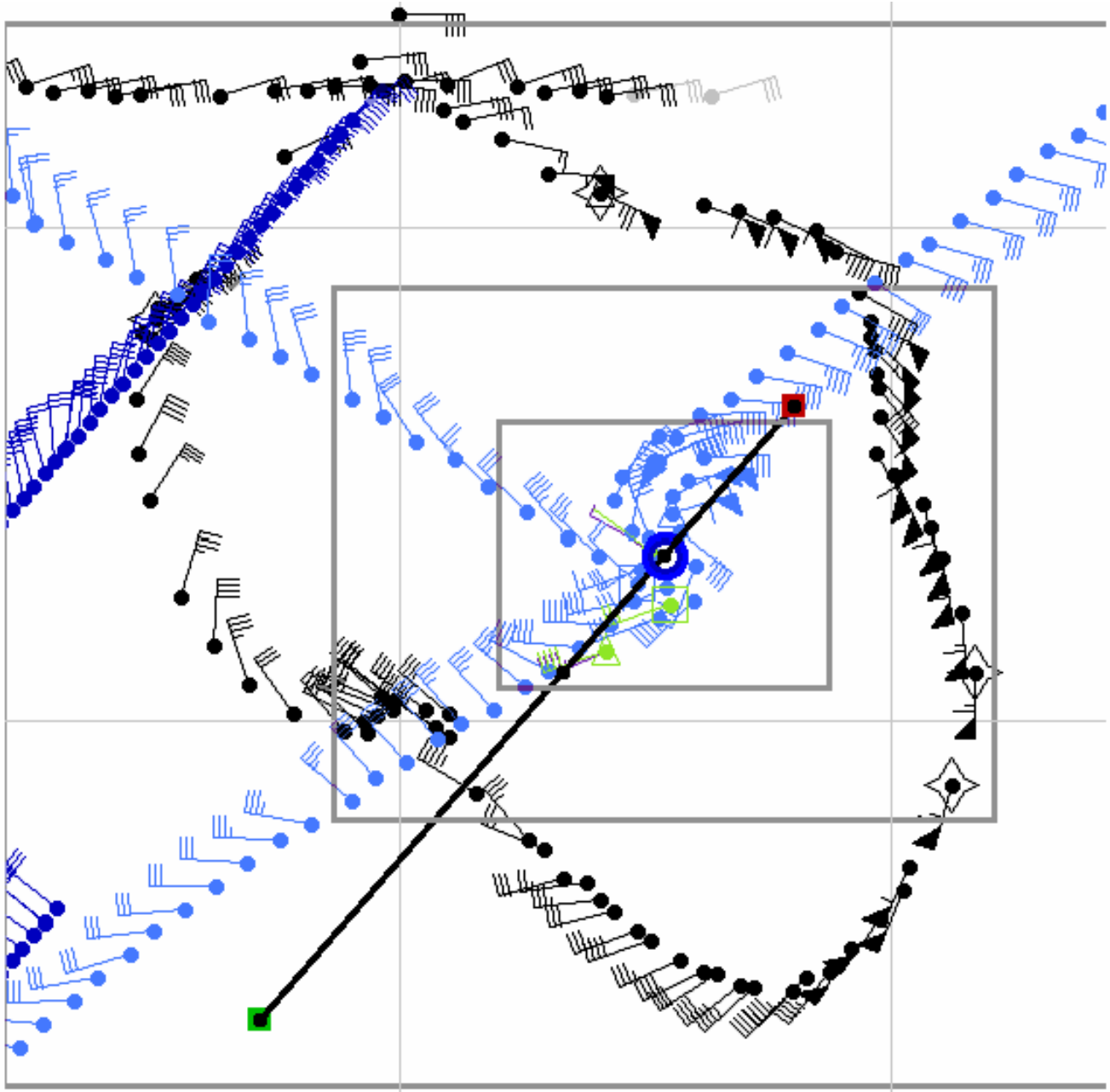
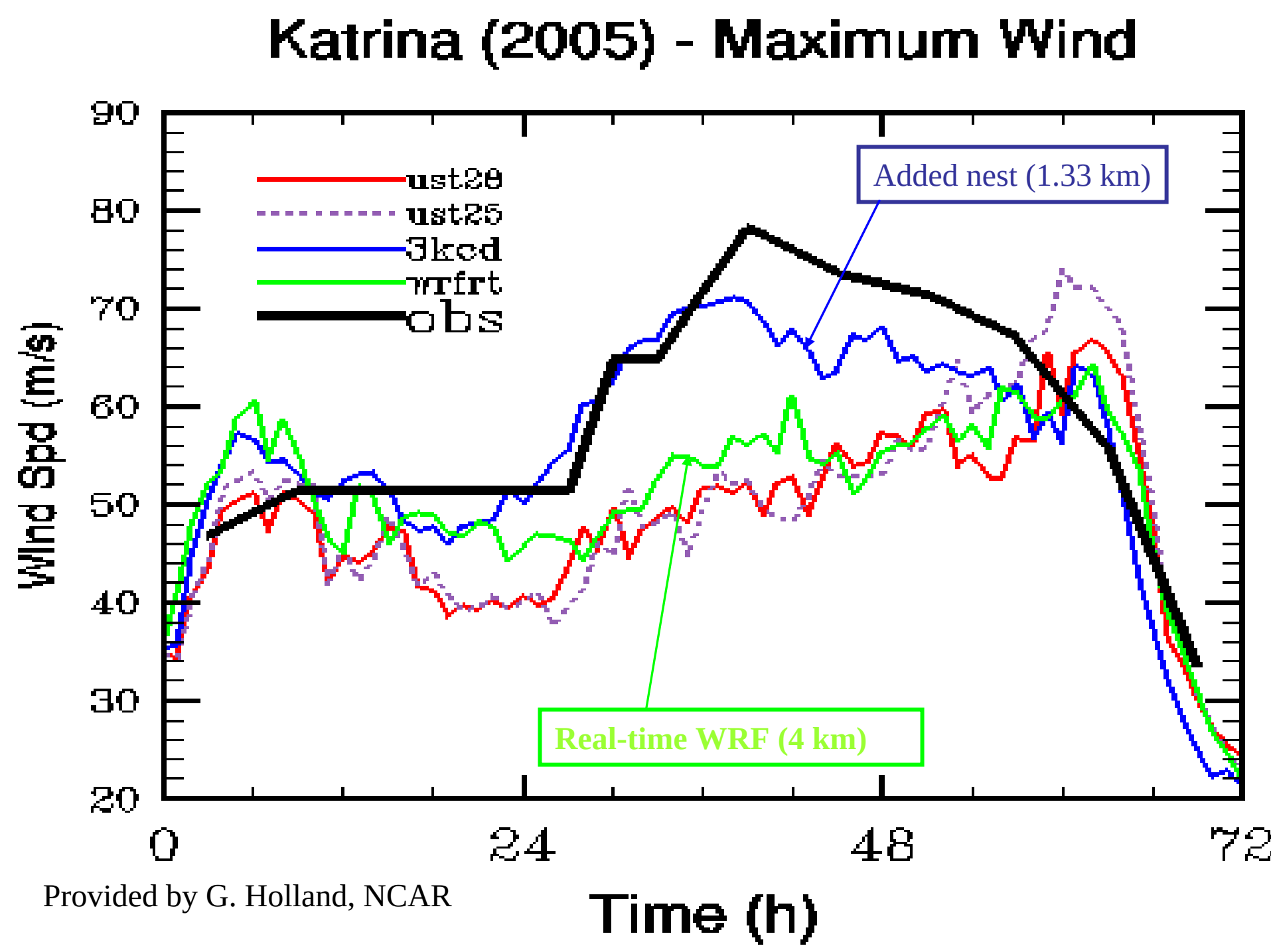


Plot from Peter Black 2005, provided by Greg Holland, 2006

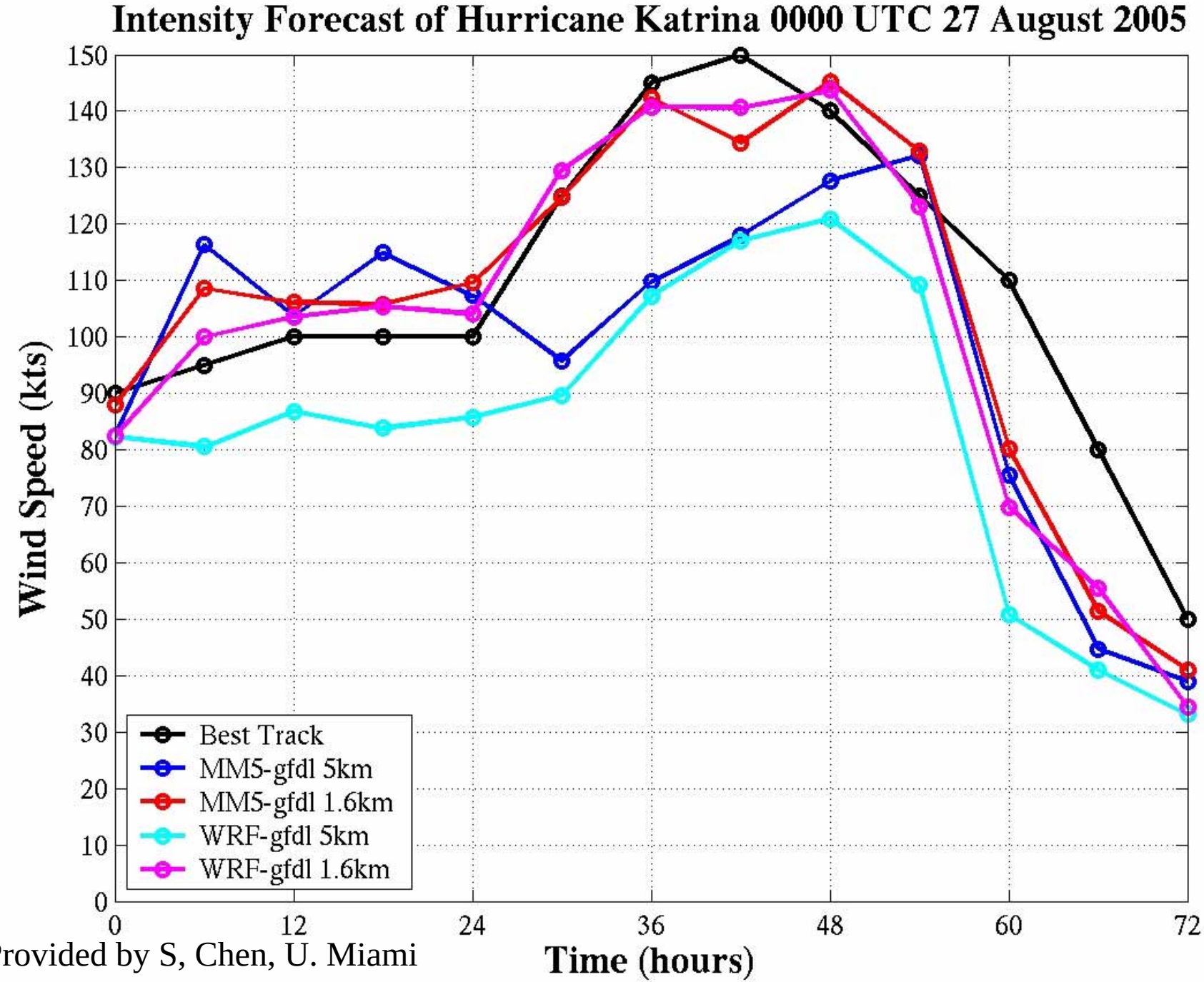
4. High Resolution, Coupled Air-Sea-Land Mesoscale Modeling and Analysis

Many indications that models must have resolution approaching 1 km to capture phenomena in the core region important to accurate prediction of intensity; coupling between ocean surface and atmosphere is also critical

- **Near-term:** Exploit recent field experiments (e.g., CBLAST, RAINEX) for improving models
- **Medium-term:** Additional field experiments to validate high-resolution coupled models
- **Medium-term:** NOAA acquire capability to produce 1 km resolution forecasts



Provided by G. Holland, NCAR



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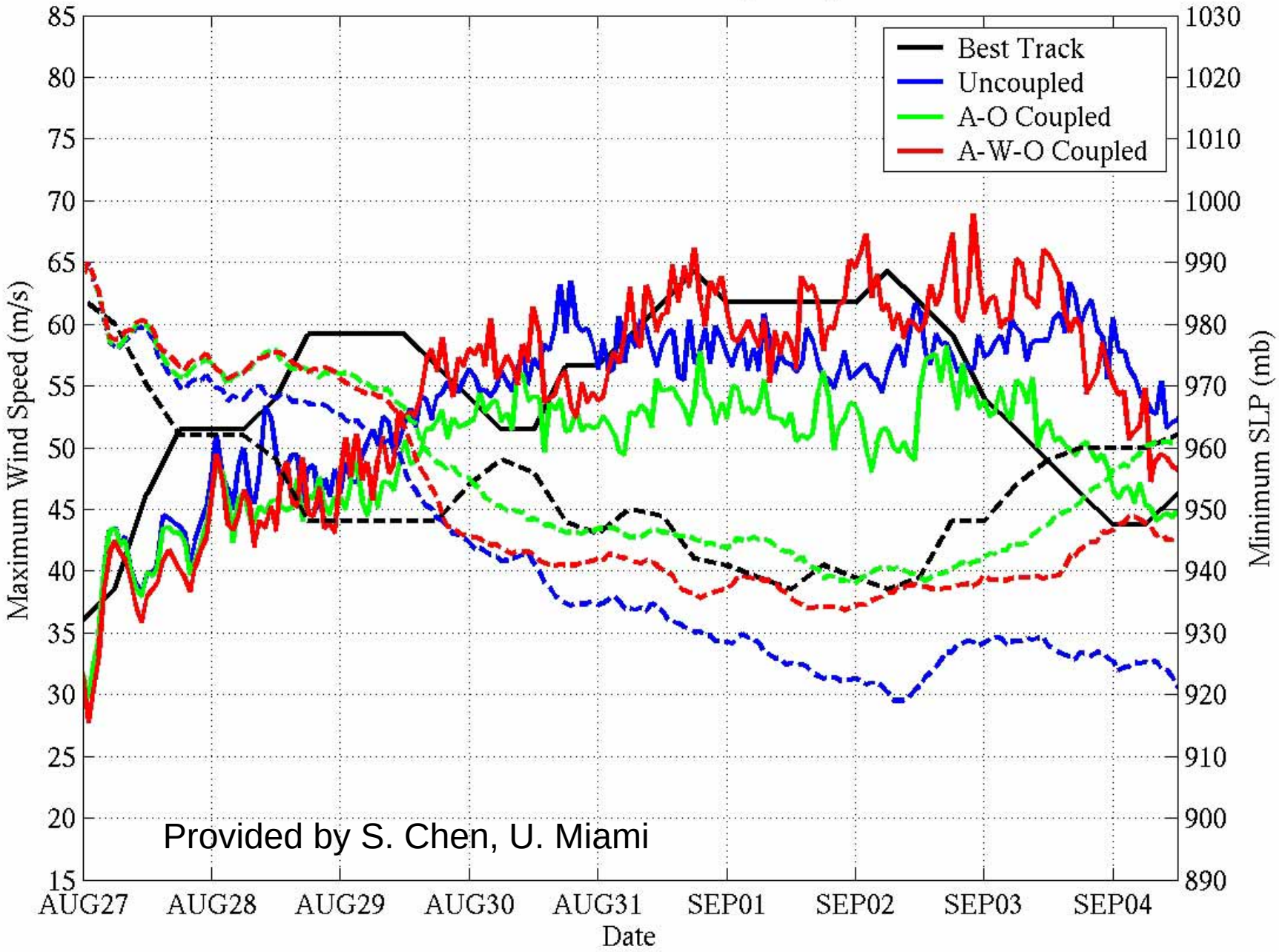
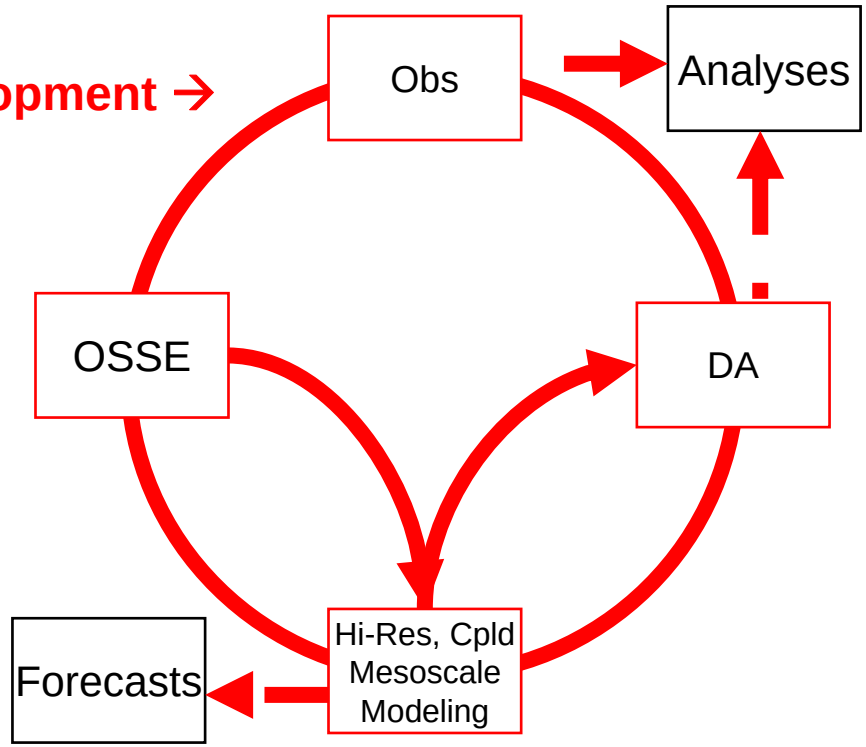

Hurricane Frances (2004)
Best Track
Uncoupled
A-O Coupled
A-W-O Coupled
Maximum Wind Speed (m/s)
Minimum SLP (mb)
Date
AUG27
AUG28
AUG29
AUG30
AUG31
SEP01
SEP02
SEP03
SEP04
Provided by S. Chen, U. Miami

Summary

- **Attaining Critical Mass** → co-locate leadership, resources, organization in Miami to achieve goal
- **Research and Development →**



- **Operations Research and Socio-Economic Impacts** → optimize utilization of enhanced intensity forecasts
- **Accelerating Transfer from Research to Operations** → expedite implementation of research results to operations through programs such as JHT and DTC