

Status of OSSEs GSFC

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Working Group on Space-based Lidar Winds
June 28- July 1, 2005
Welches, Oregon

DWL OSSEs at GSFC

- NOAA Thorpex funded development of an OSSE testbed for mission planning
- IPO funded experiments for adaptive targeting and dual technology DWL for P³I; also WindSat data utility and synergisms with a future DWL.
- NASA funded investigation of DWL impact upon Hurricane prediction
- Generation of new Nature Runs

THORPEX OSSEs to support predictability experiments, mission planning and future observing system design

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E. Kalnay (U of Md)

THORPEX Pacific Predictability Experiment Workshop

June 6,7 2005

Seattle, Washington

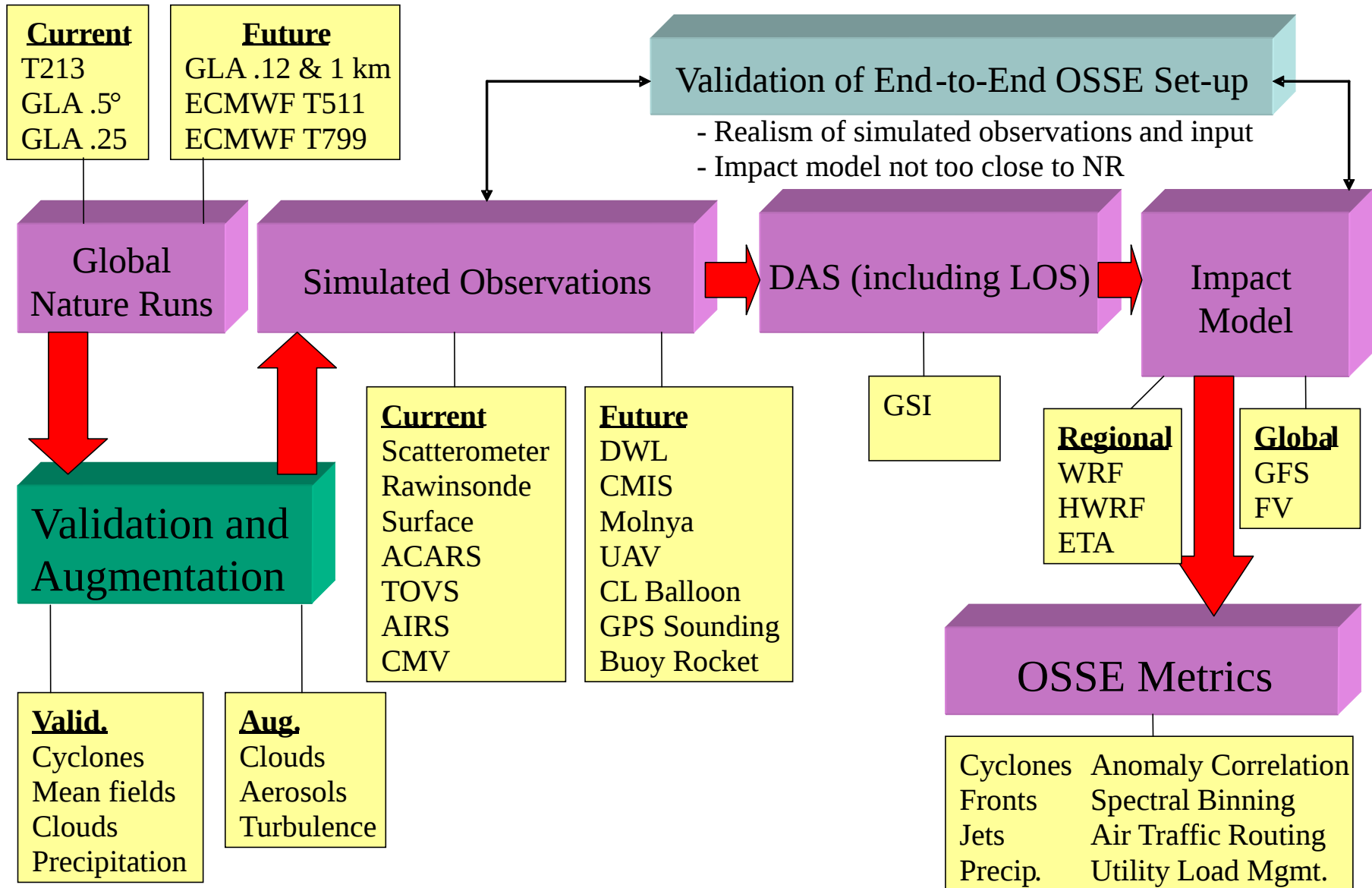
The Role of OSSEs in THORPEX

- NOAA's THORPEX Program Plan calls for cross-cutting OSSE and OSSE-like activities to:
 - a) Assess what data would be most useful for NWP (neutral to obs instruments/platforms)
 - b) Assess what existing or new instruments/platforms can best serve the needs under (a)
 - c) Assess the relative value for USERS from obs system, DA, and modeling/ensemble improvements
 - d) Based on a-c, propose and test a few promising configurations for the new integrated, adaptive, and user controllable NWP system (new NWP paradigm, p. 15); most promising configuration to be tested in THORPEX global demo project, and to become legacy of THORPEX under GIFS
- OSSEs give a quantitative determination of the potential for improvement between
 - new or improved instruments,
 - improved data assimilation systems
 - improved forecast models

The Role of OSSEs in THORPEX (continued)

- The use of OSSEs to conduct predictability experiments using simulated observations enables investigations over broader range of atmospheric conditions and observation platform deployments than possible in actual field experiments
- OSSEs foster broader international academic, operation's centers and research laboratory interaction/investigations than is monetarily possible in focused field campaigns
- OSSEs help design adaptive targeting field experiments; can run simulated experiments for many atmospheric scenarios providing the context for "validation" field campaigns
- The NOAA OSSE Testbed will provide a laboratory for international collaboration in assessing cost-benefits of various observing system/DAS/FM combinations
- OSSEs are of very high value in accelerating the preparedness of the operational centers for the use of new observations; builds upon established collaboration between NASA/GSFC/GLA, NOAA/NCEP, JCSDA, NOAA/NESDIS and academia.

THORPEX OSSE TESTBED



Current plans for THORPEX OSSE testbed (funded)

- Baseline the testbed with current NR/OBSIM/DAS/FM capabilities to enable near term experiments
- Generate new high resolution Nature Runs
 - ECMWF T511 and T799
 - GLA (.25 degree)
 - GLA .12 and 1 km non-hydrostatic
 - ECMWF analyses w/high res rapid update meso model
- Incorporate updated forward models for all observing systems currently used and those being considered (e.g. wind lidars and balloon swarms)
- Operate with a least two DASs
 - NCEP DAS (GSI primary)
 - NASA GFSC DAS (also GSI)

Offer several forecast model options

 - FVGCM
 - NCEP GFS
 - Others

Recent experience with OSSEs at NCEP and GSFC

- Shifting focus to high impact weather forecasts and events for OSSE metrics
 - Precipitation forecasts
 - Hurricane track
 - Jet stream strength and location
 - Air traffic routing
 - Utility load management
- Adaptive targeting (AT) OSSEs in progress at NCEP (follow-on to earlier GSFC ATOSSE)
- Hurricane lifecycle OSSEs in progress at GSFC

A Quick OSSE to Assess the Role of the Divergence Profile in the Prediction of Hurricane Ivan and the Potential Impact of Lidar Winds

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G. D. Emmitt

Simpson Weather Associates

Description of Quick OSSE

Experiments

Nature Run : fvGCM .25 x .36 deg horizontal resolution,
start on Sep. 11, 2004 at 12z

Observations : simulated from the Nature Run
for Sep. 11, 00z – Sep.12, 12z, 2004.

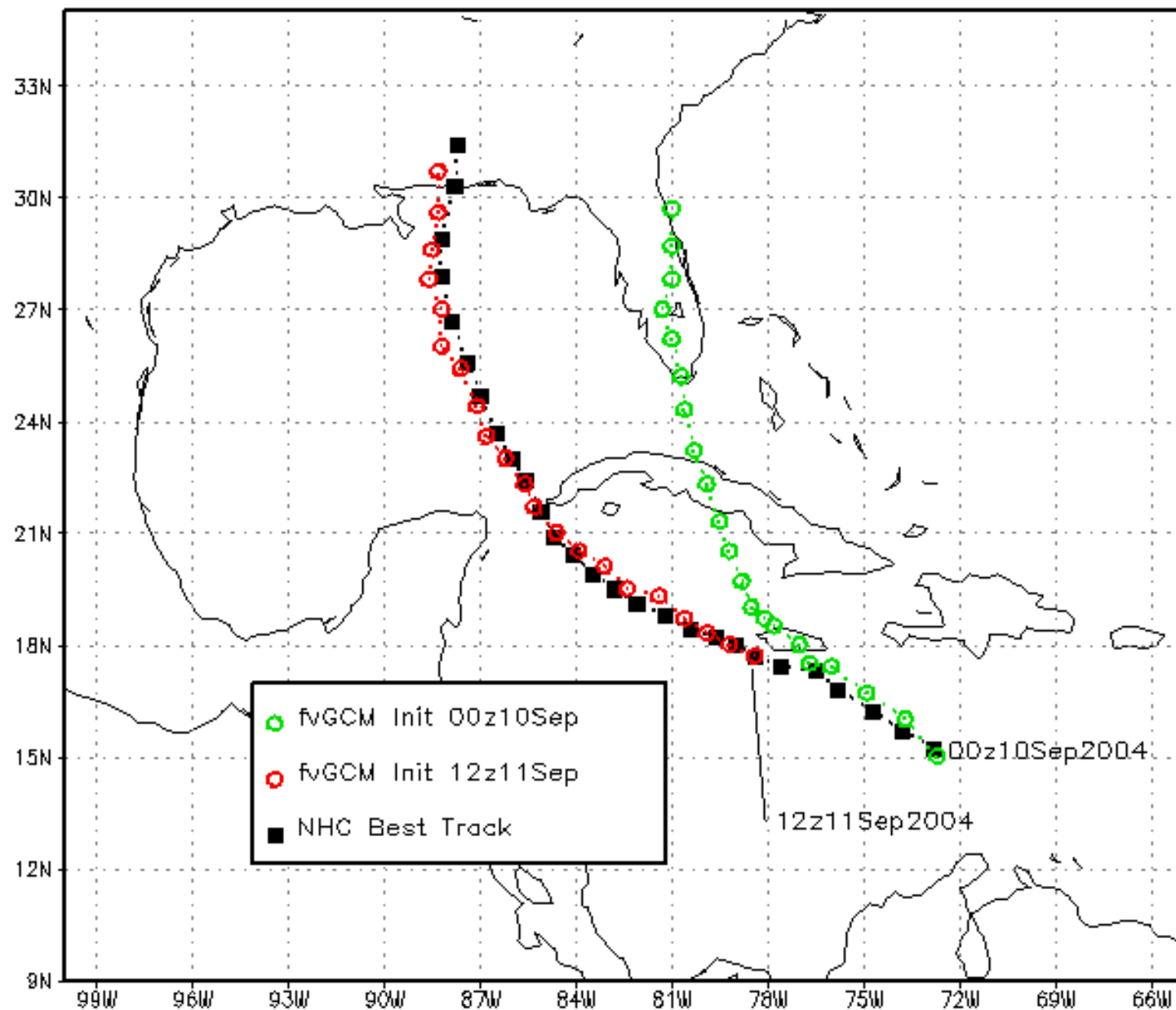
Data Assimilation Experiments : fvSSI , 1 x 1.25 deg resolution,
ran Sep. 11, 00z – Sep.12, 12z, 2004.

Control - compliment of operationally globally observed data,
including satellite temperature profiles

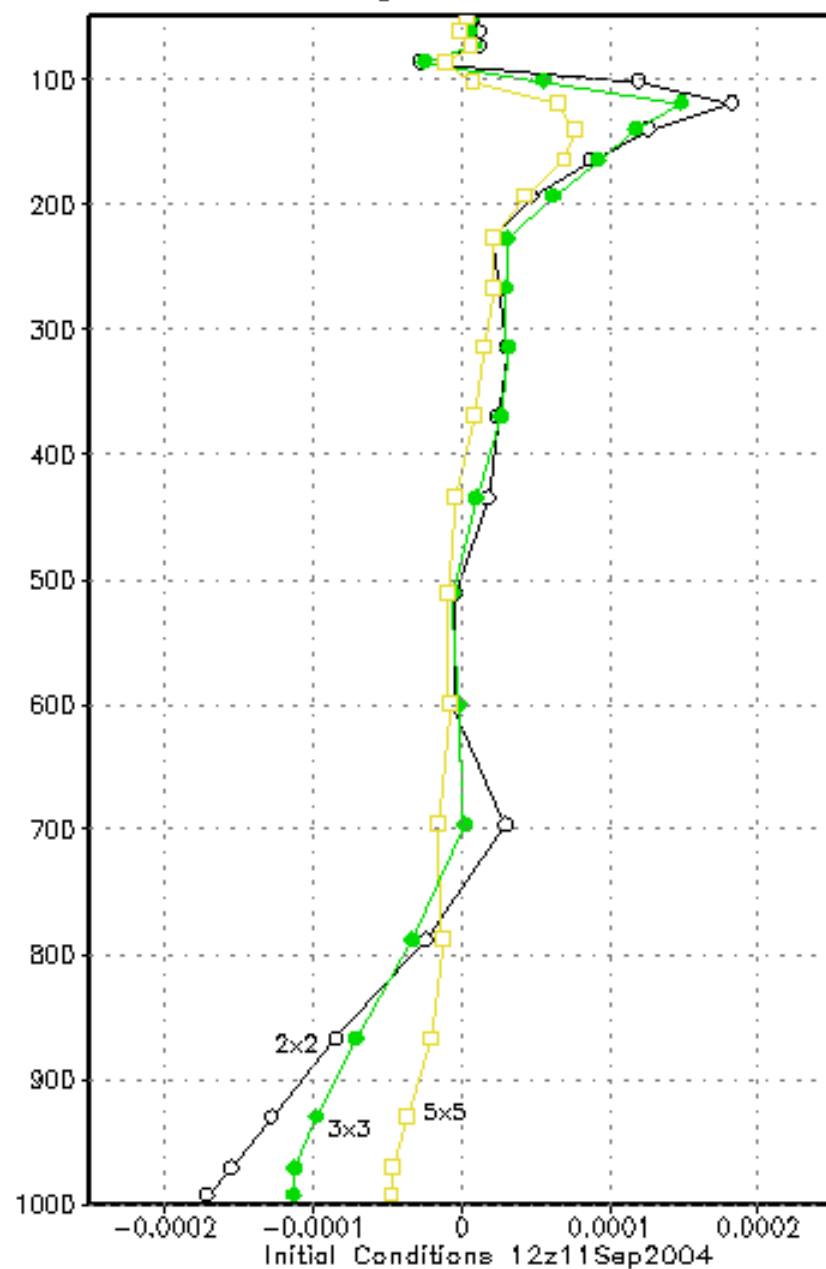
Lidar - Lidar wind profiles added in the vicinity of the hurricane

5 Day Forecasts : Started on Sep.11, 12z, Sep.12, 00z and 12z
ran at both .25 x .36 deg and 1 x 1.25 deg horizontal resolution

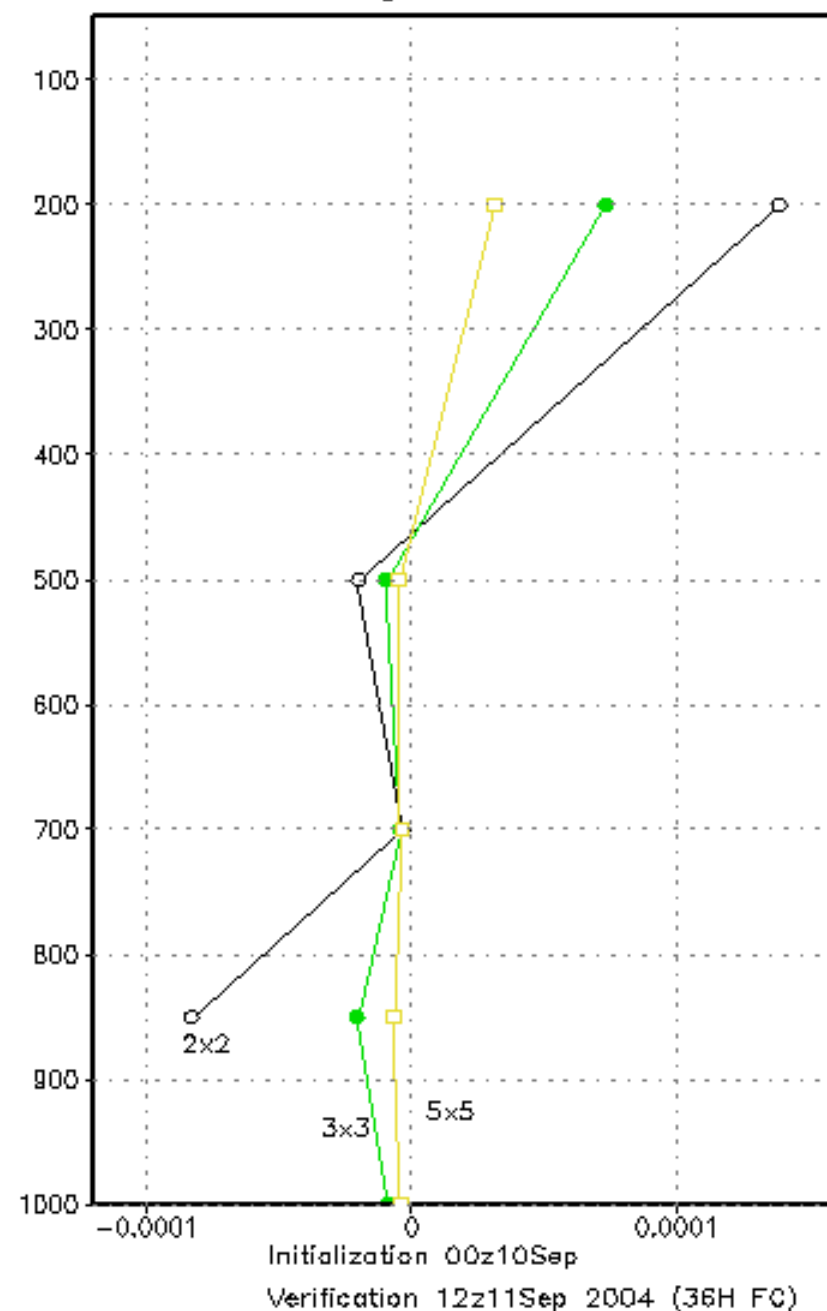
Hurricane Ivan



Area-avgd. Div. Profile

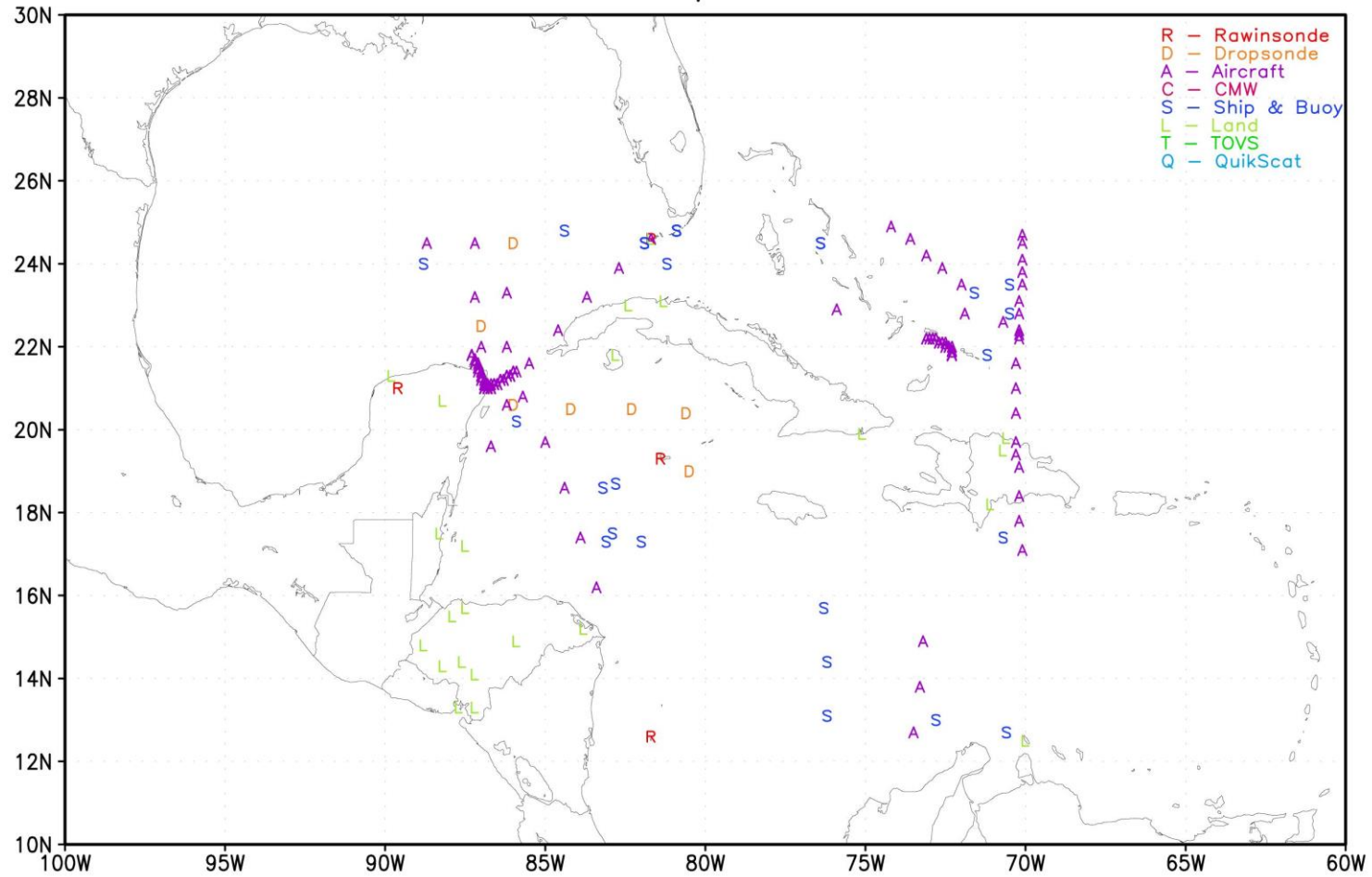


Area-avgd. Div. Profile

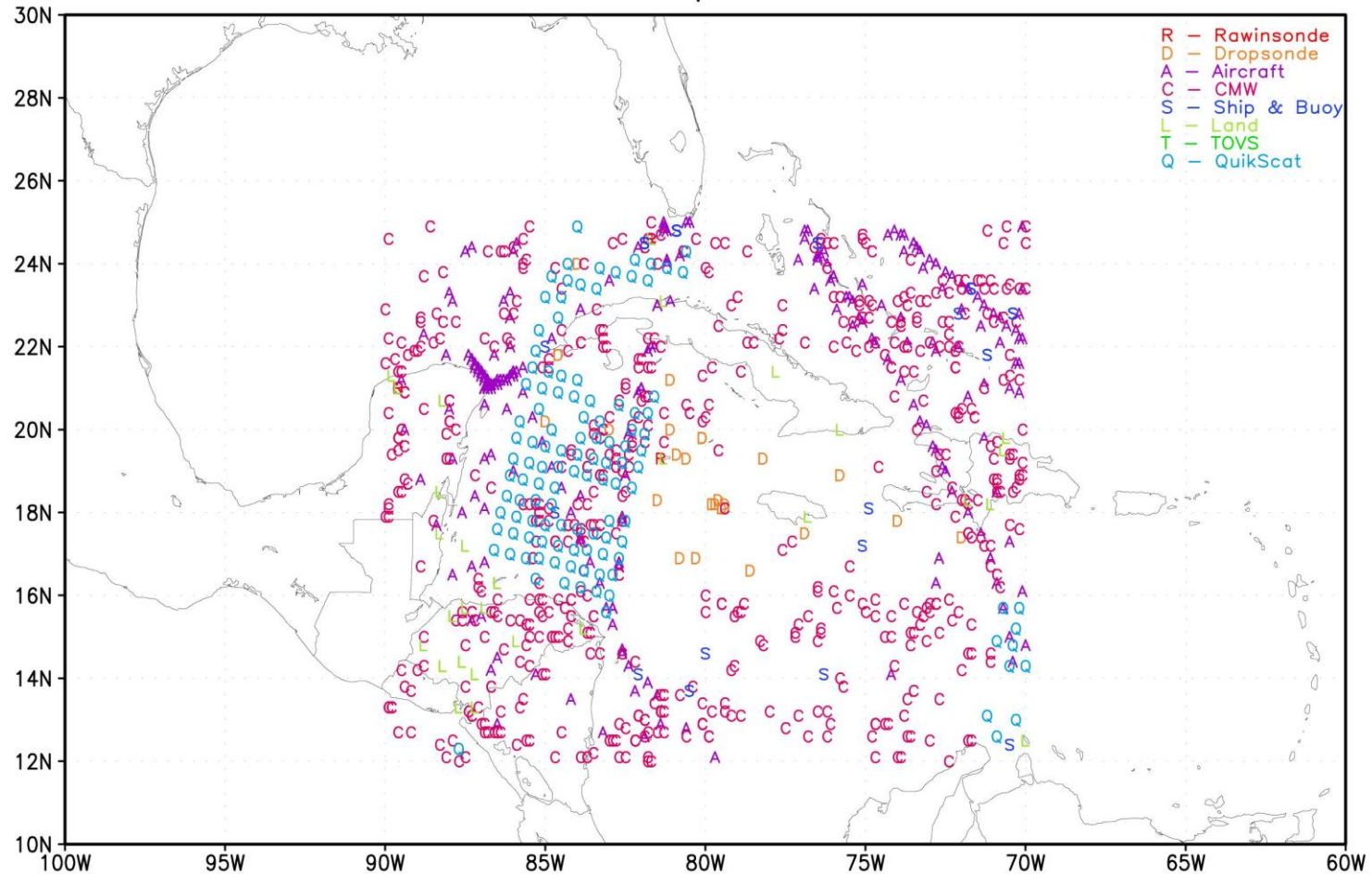


Observing System Wind Coverage for Quick OSSE

2004 Sep 11 12Z

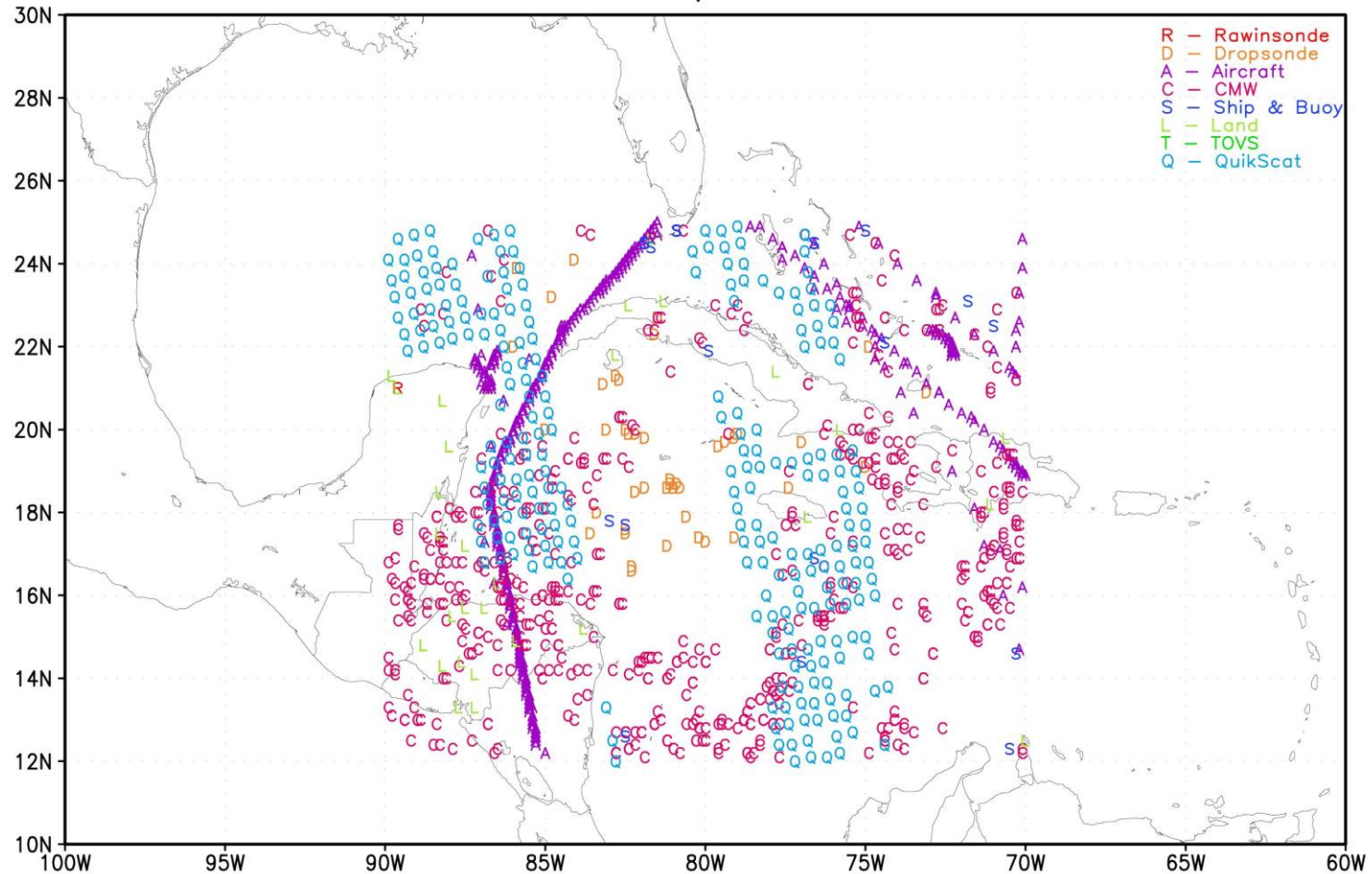


Observing System Wind Coverage for Quick OSSE 2004 Sep 12 00Z

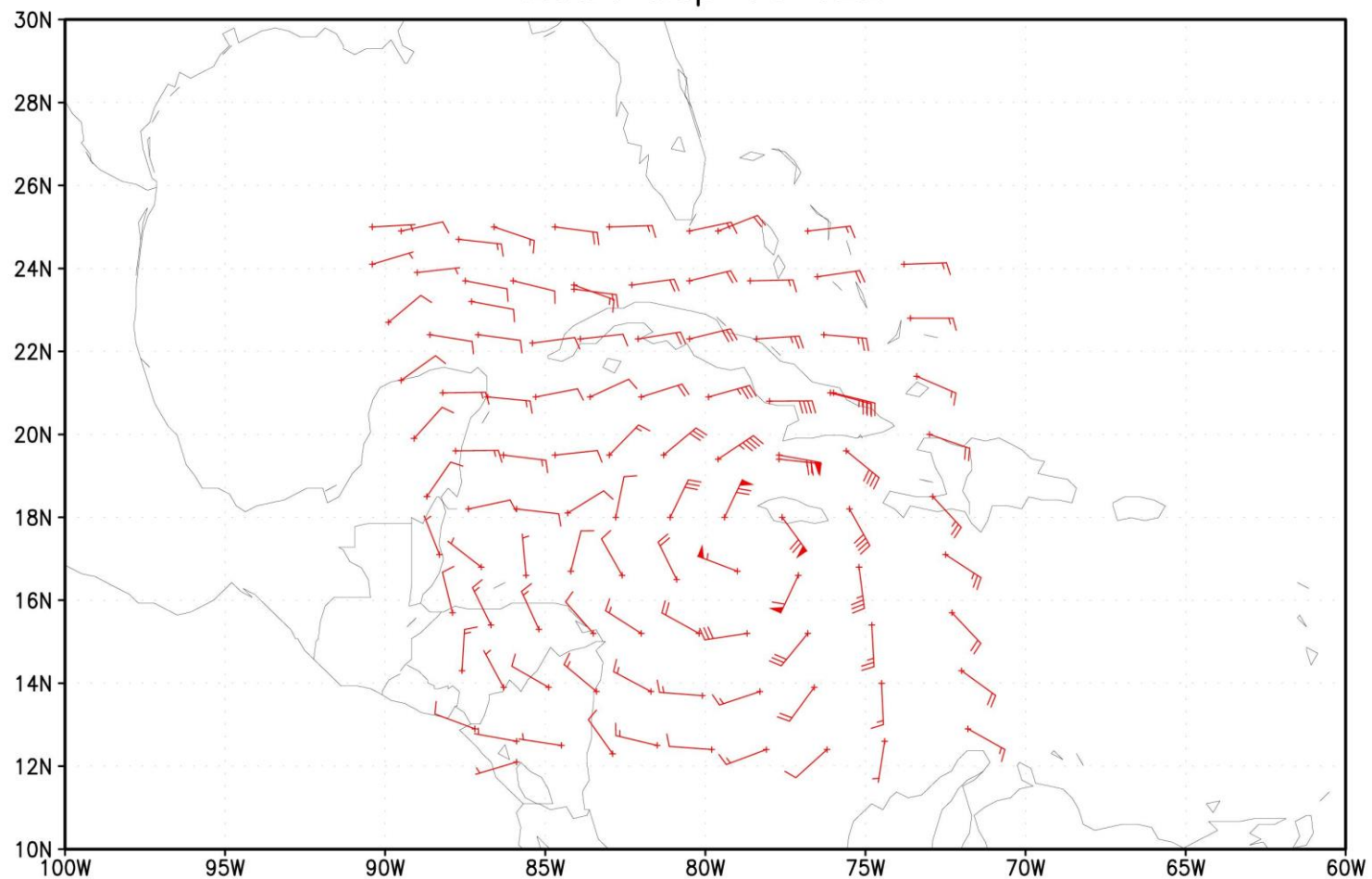


Observing System Wind Coverage for Quick OSSE

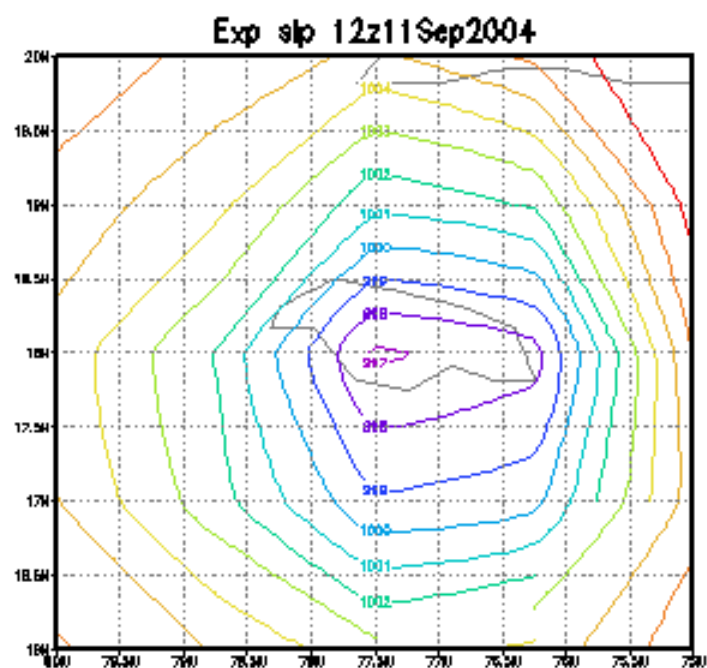
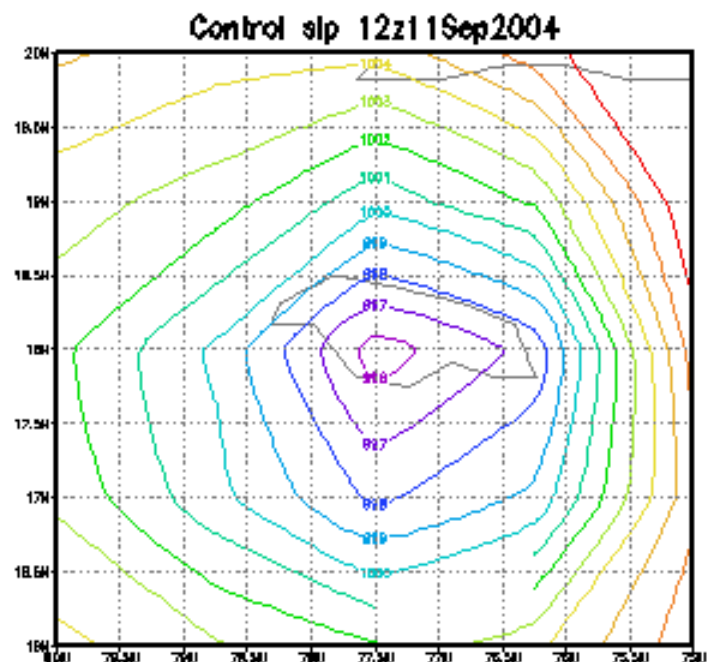
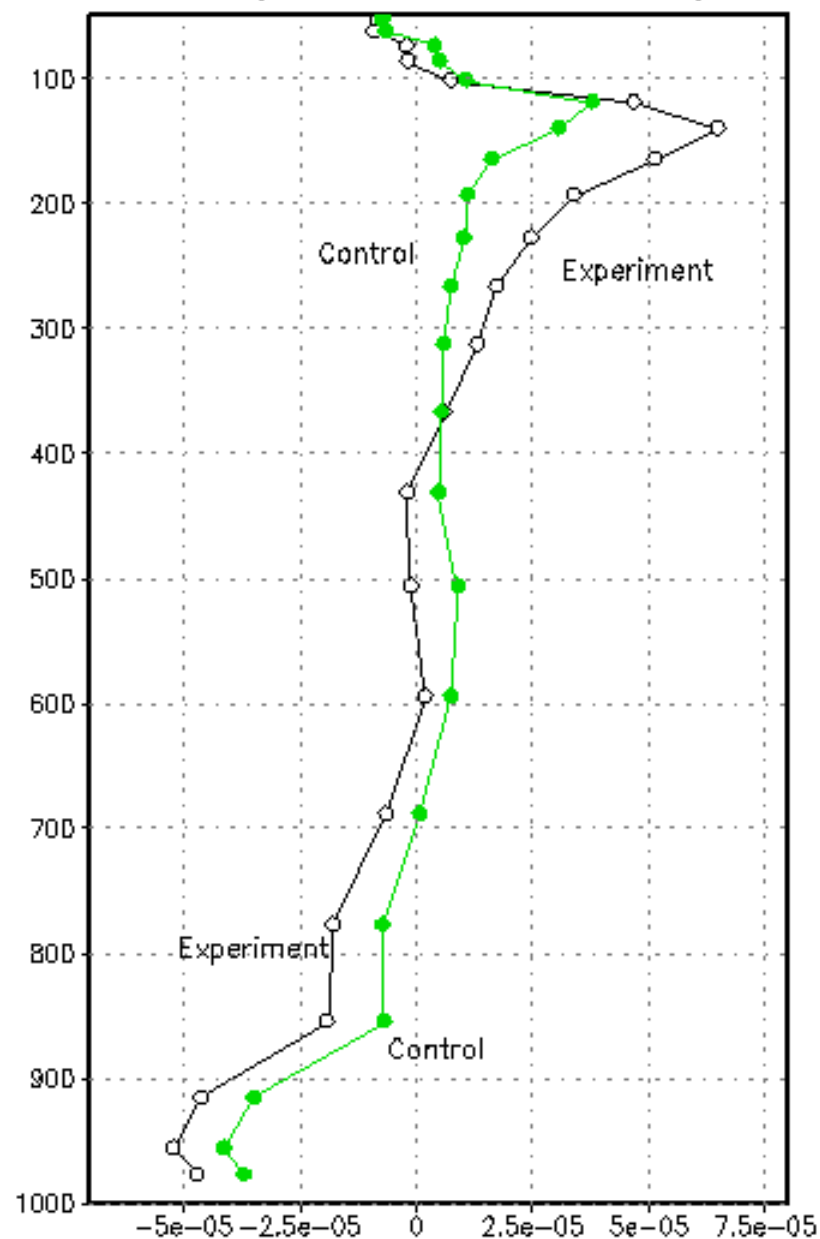
2004 Sep 12 12Z



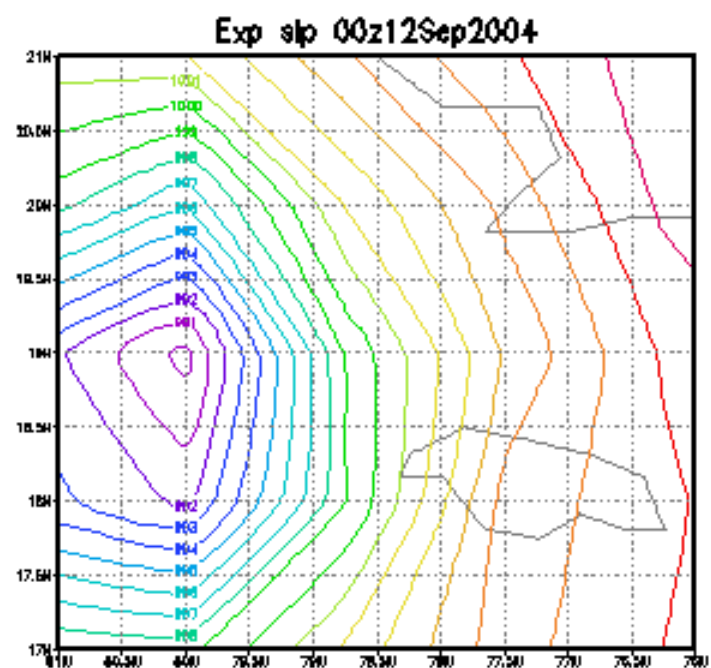
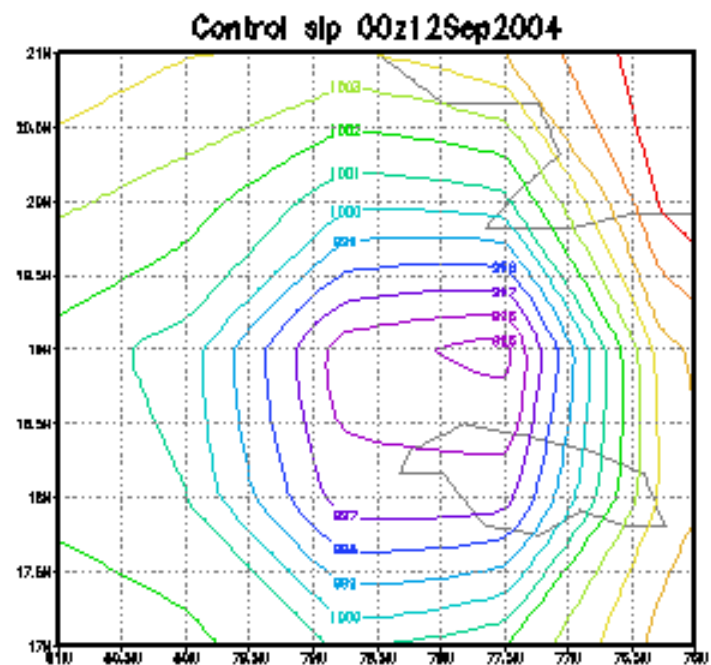
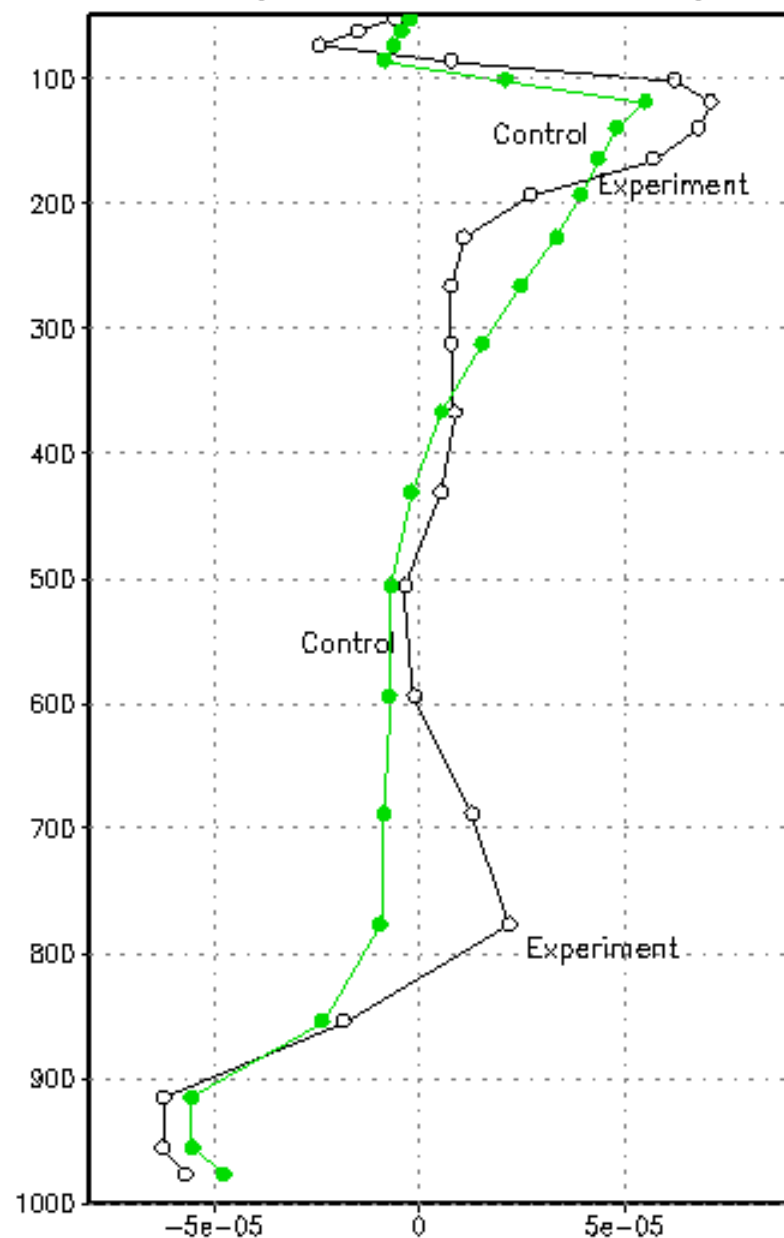
Simulated 850 hPa Idealized Lidar Winds with Errors 2004 Sep 11 12Z



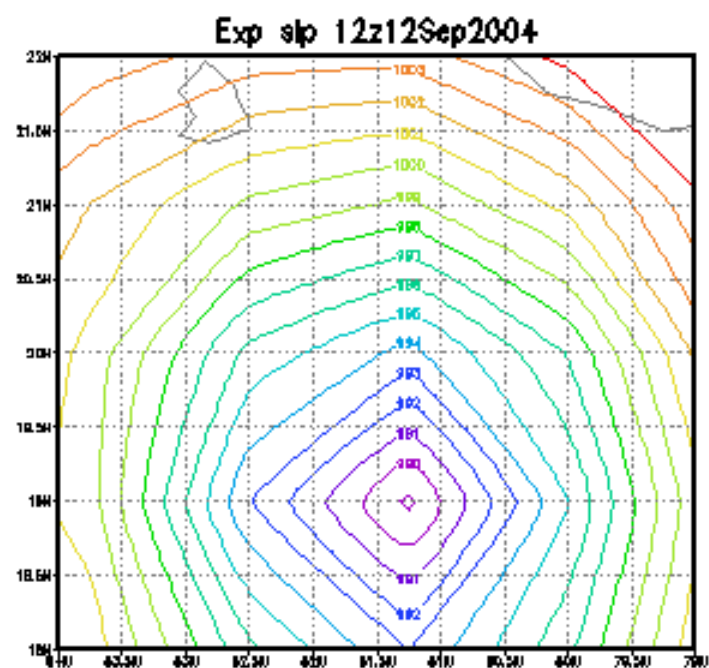
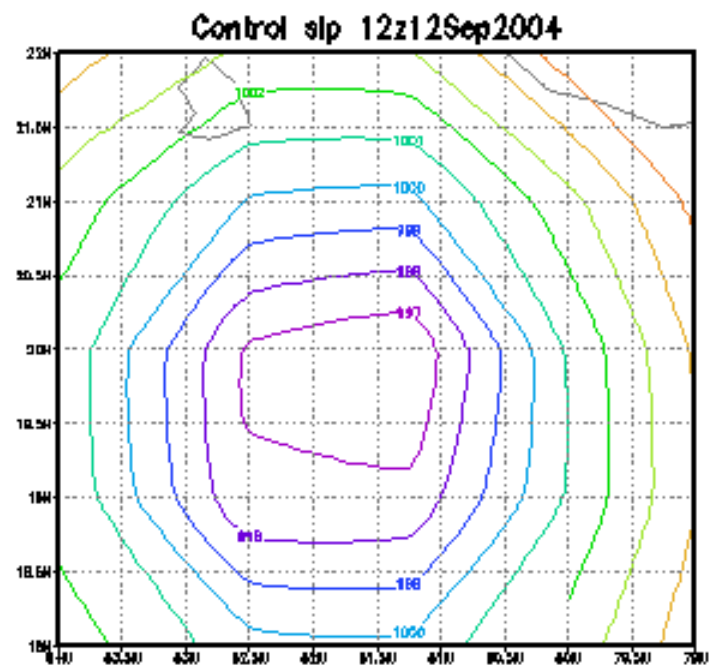
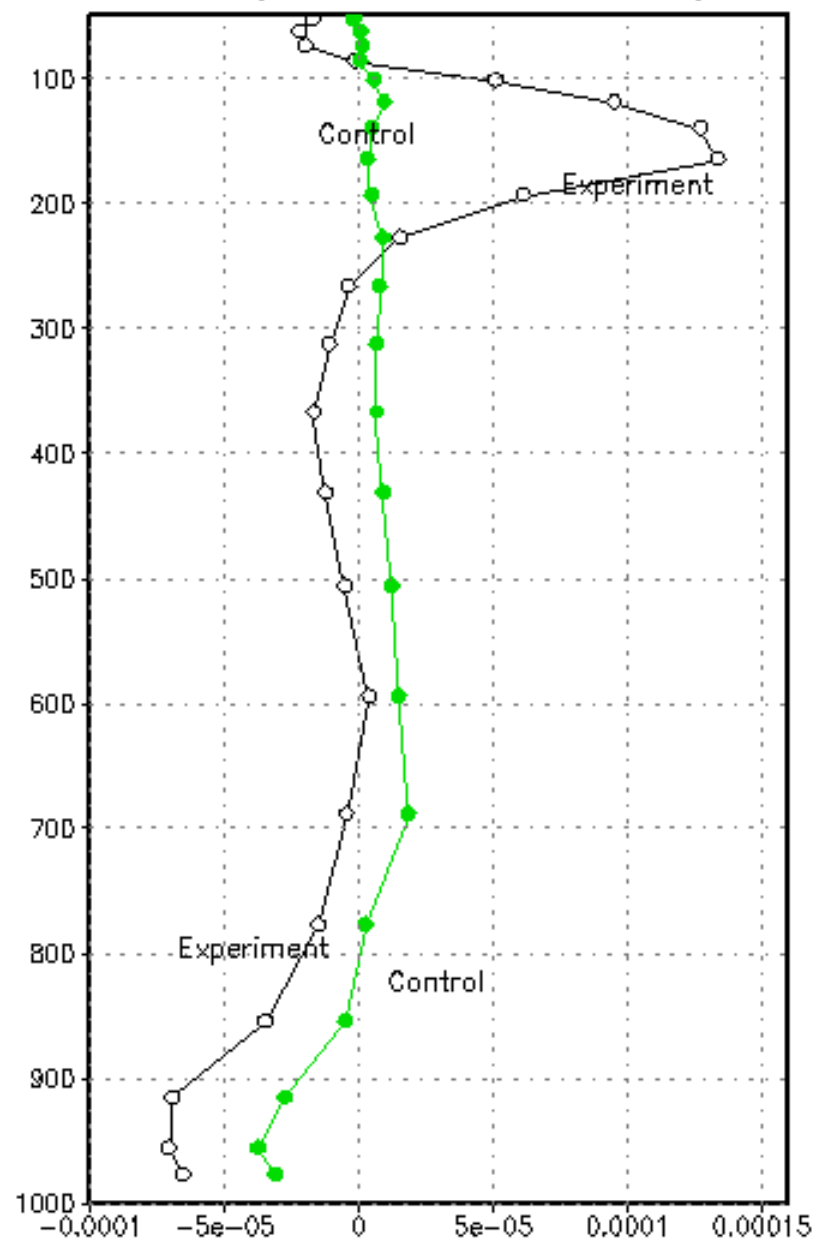
5x5 Div profile 12z11Sep2004



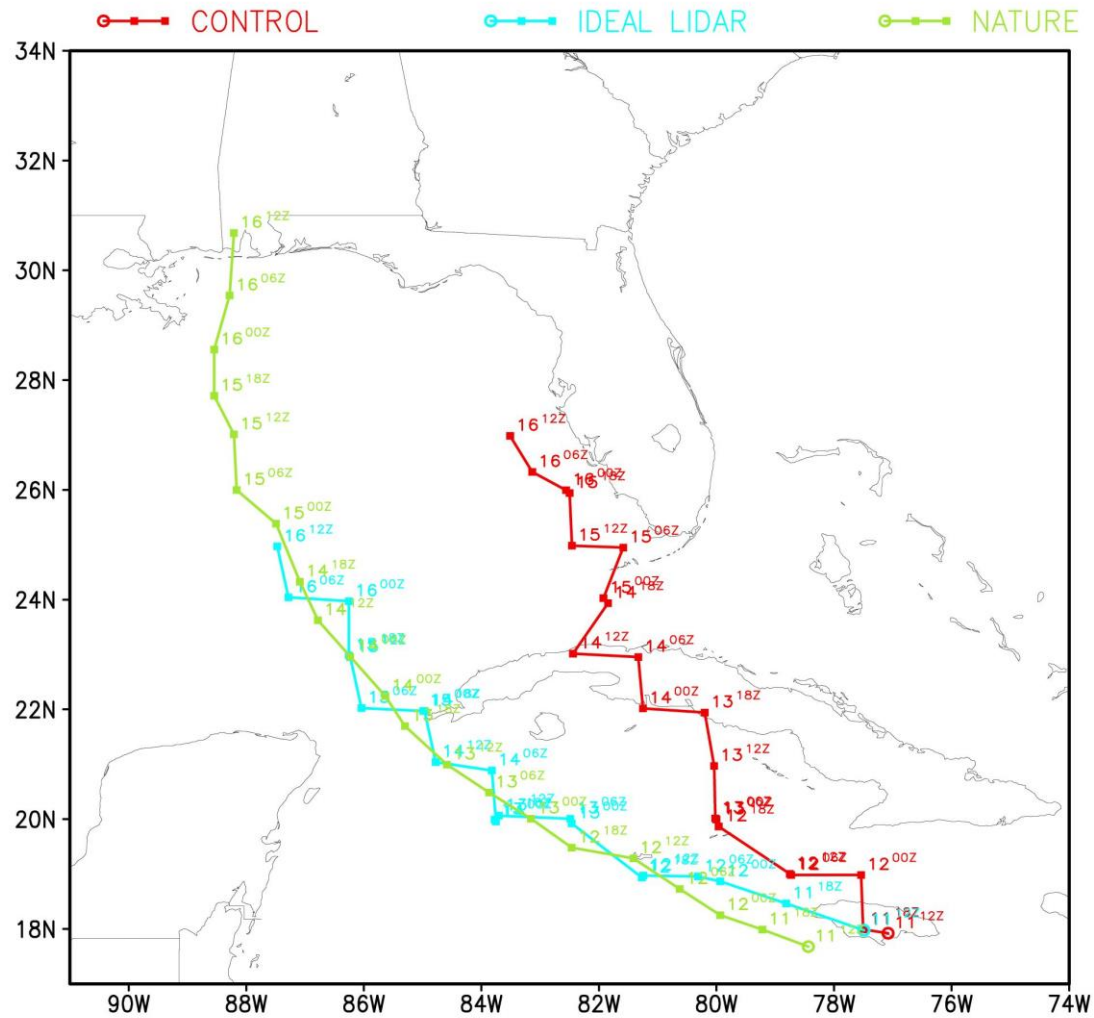
5x5 Div profile 00z12Sep2004



5x5 Div profile 12z12Sep2004



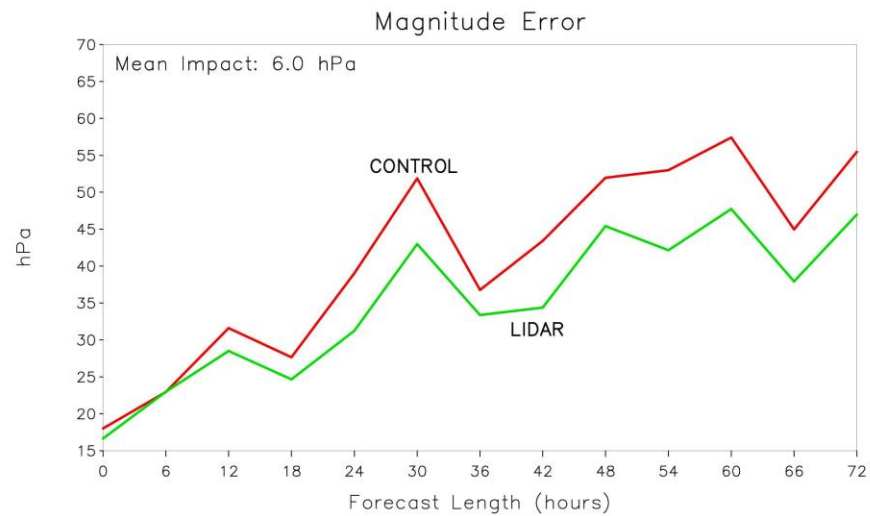
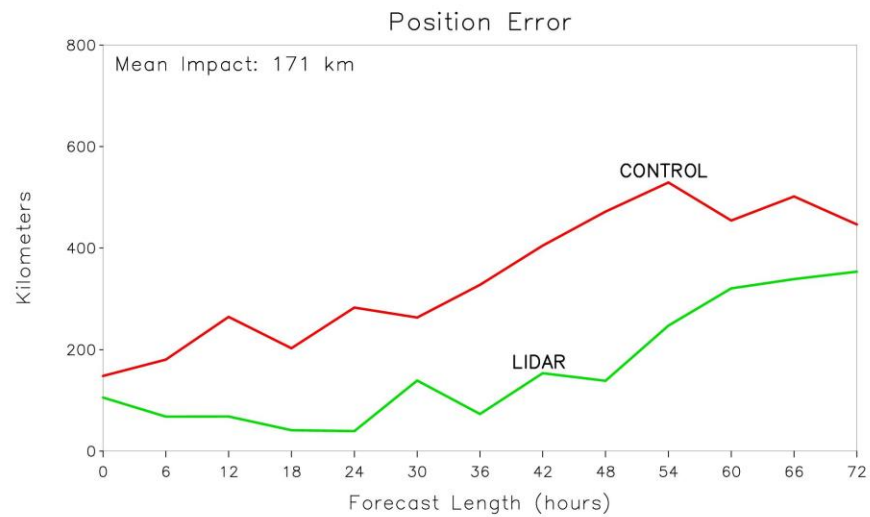
Prediction of Ivan (1° FvGCM Forecasts)



Sep 11, 2004 12Z – Sep 16, 2004 12Z every 6 hrs

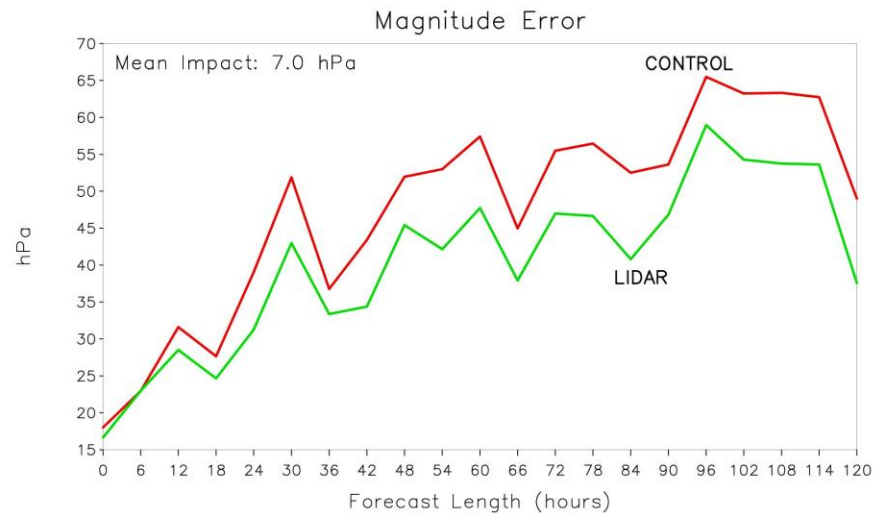
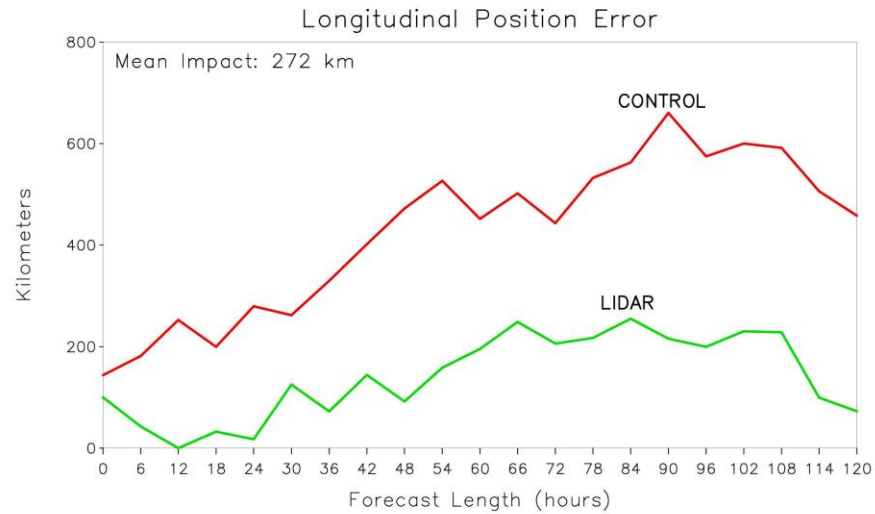
Prediction of Hurricane Ivan in 1° FvGCM

Initial Conditions: 12Z Sep 11, 2004

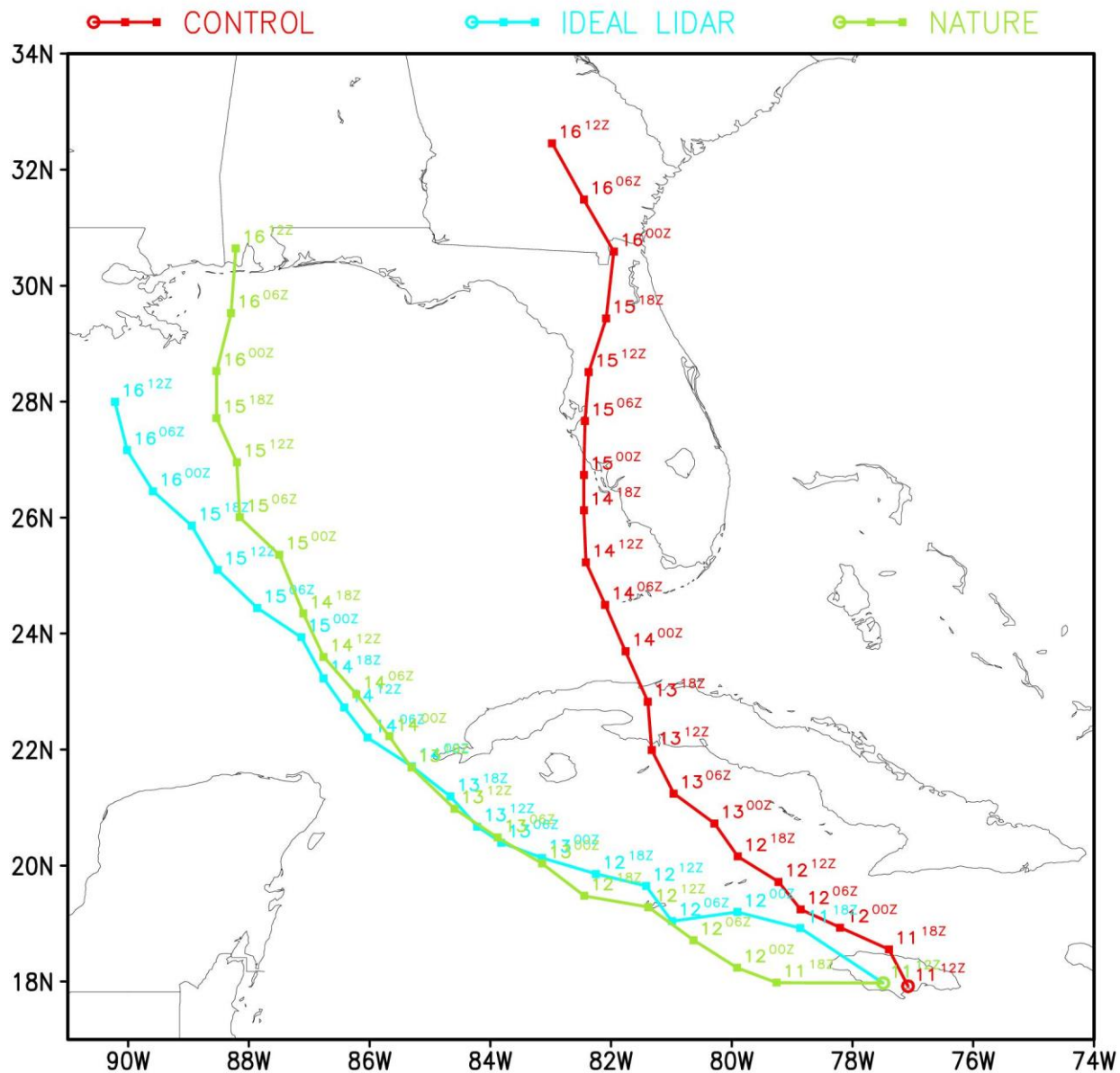


Prediction of Hurricane Ivan in 1° FvGCM

Initial Conditions: 12Z Sep 11, 2004



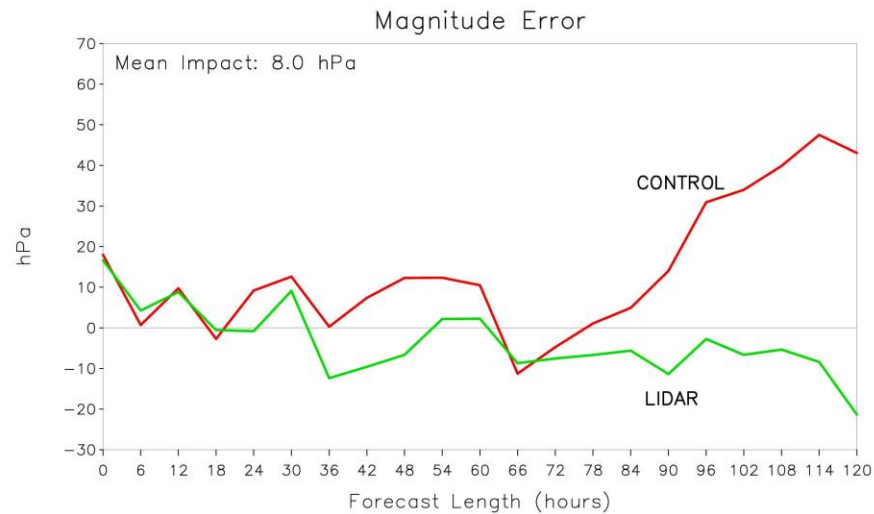
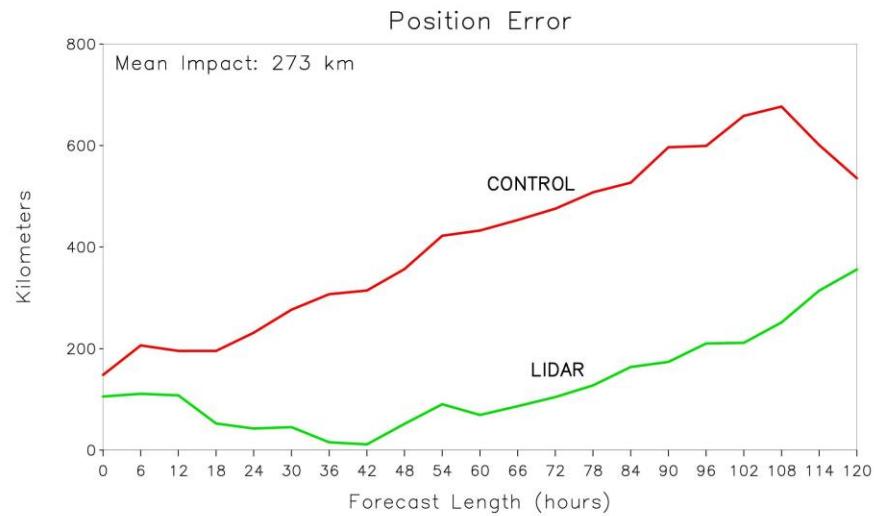
Prediction of Ivan (0.25° FvGCM Forecasts)



Sep 11, 2004 12Z — Sep 16, 2004 12Z every 6 hrs

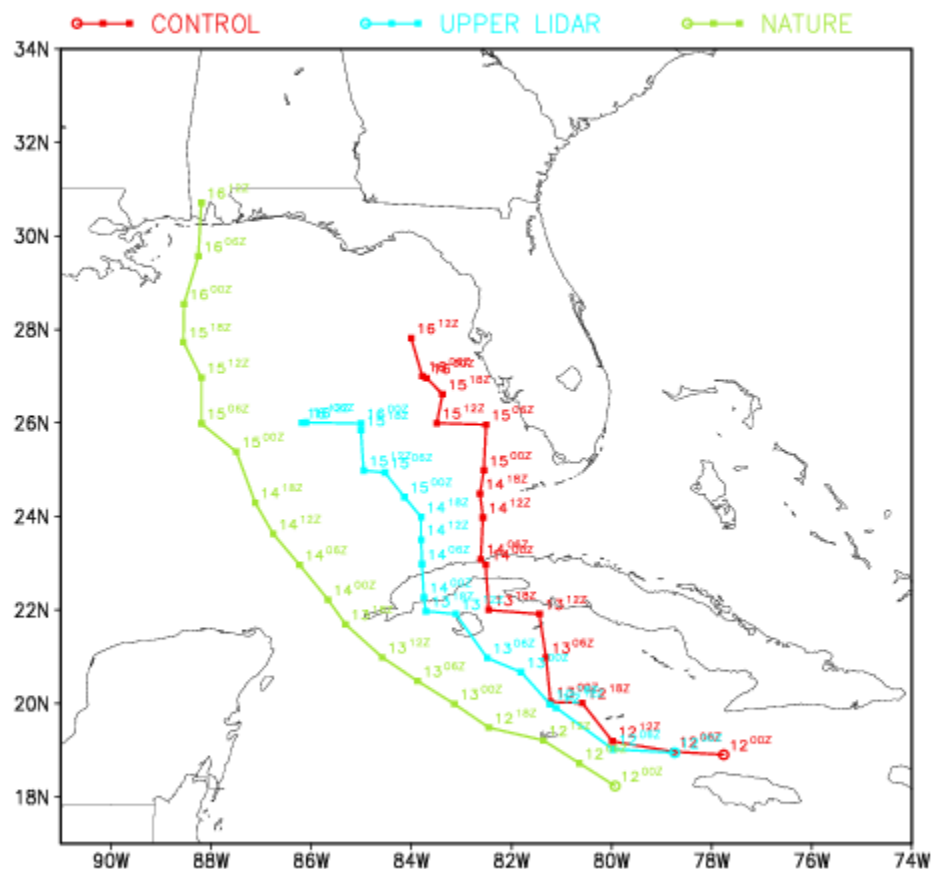
Prediction of Hurricane Ivan in 0.25° FvGCM

Initial Conditions: 12Z Sep 11, 2004



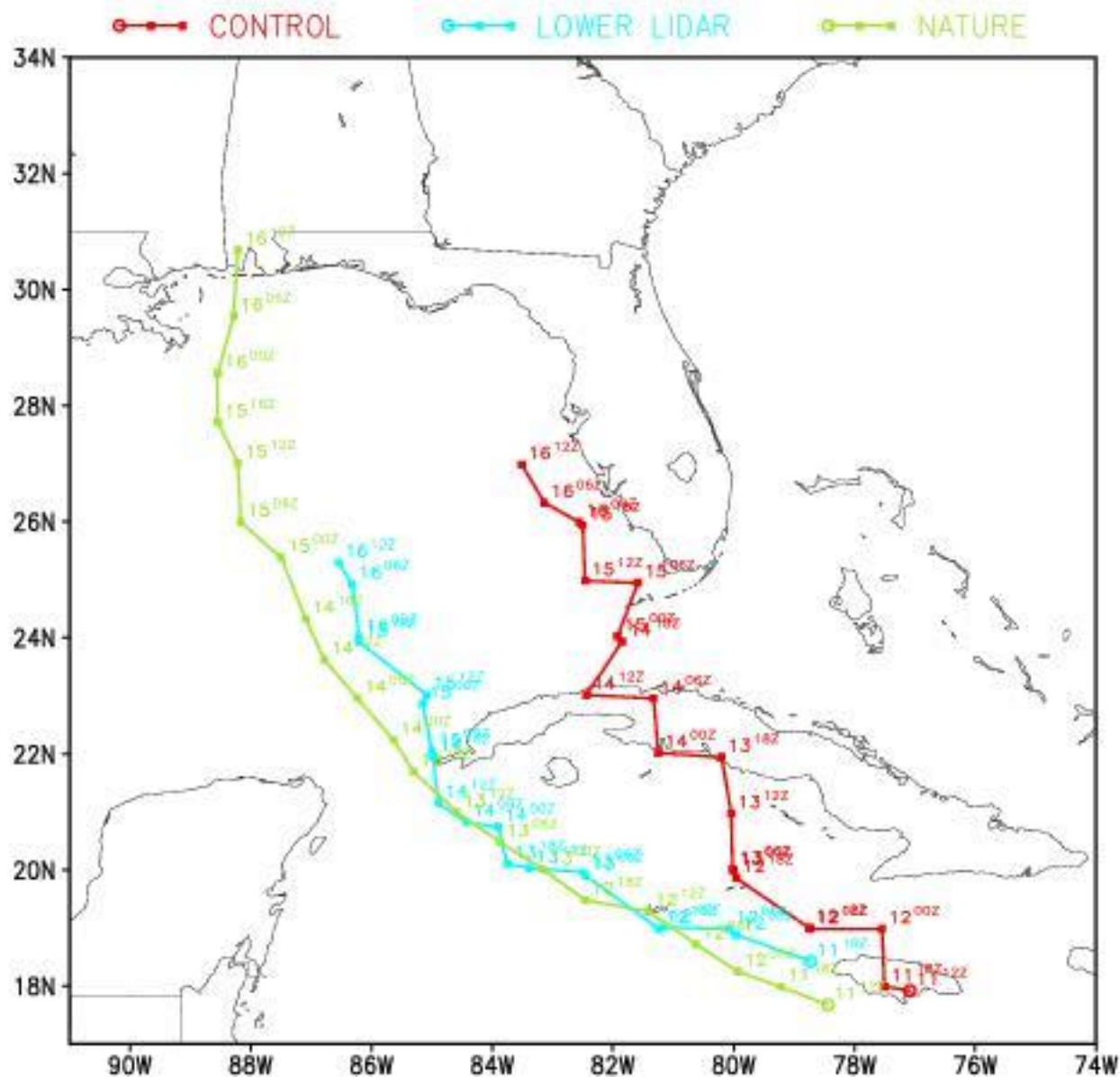
Dual Technology QOSSE

Prediction of Ivan (1° FvGCM Forecasts)



Sep 12, 2004 00Z – Sep 16, 2004 12Z every 6 hrs

Prediction of Ivan (1° FvGCM Forecasts)

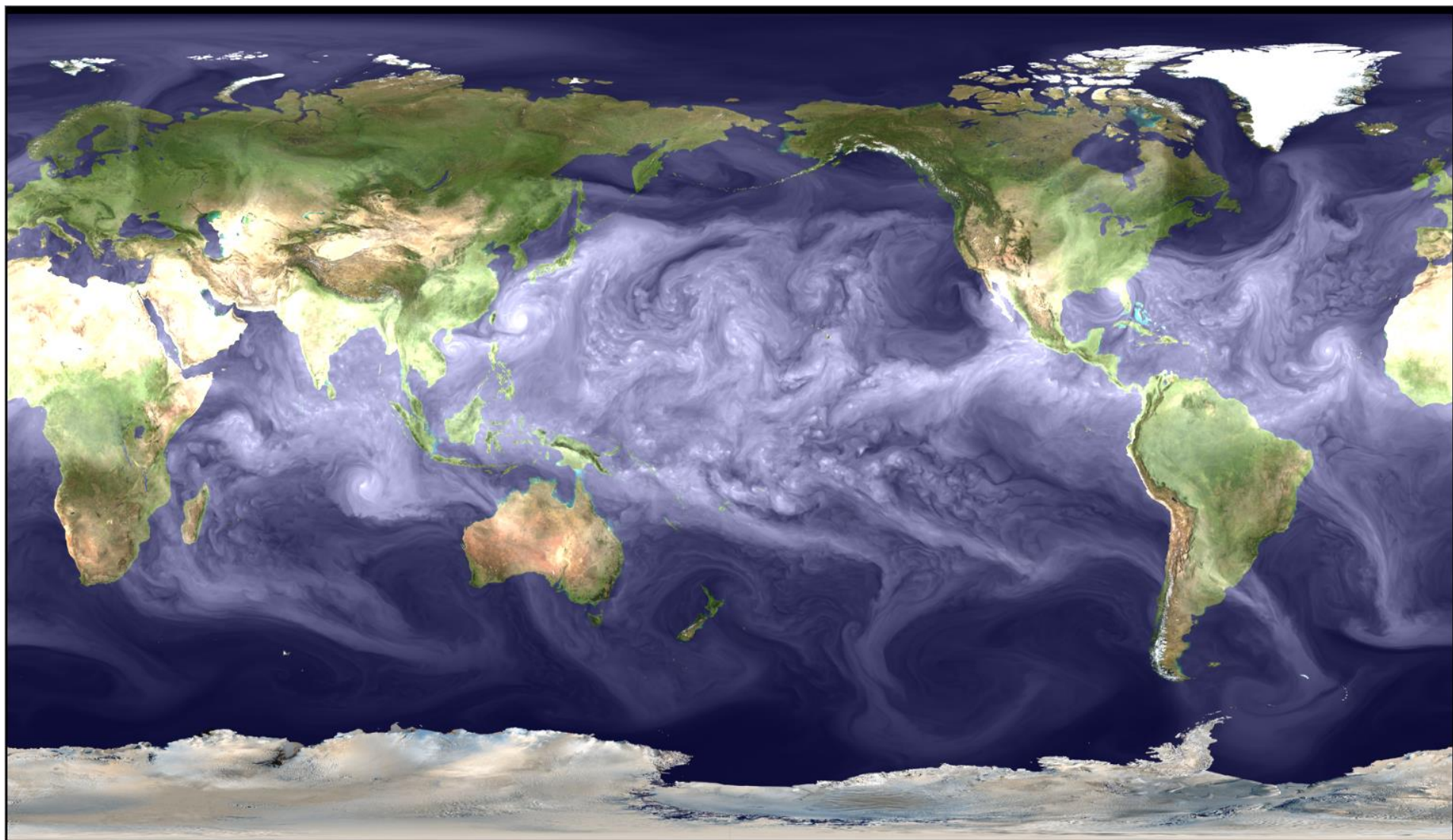


Sep 11, 2004 12Z - Sep 16, 2004 12Z every 6 hrs

In Progress

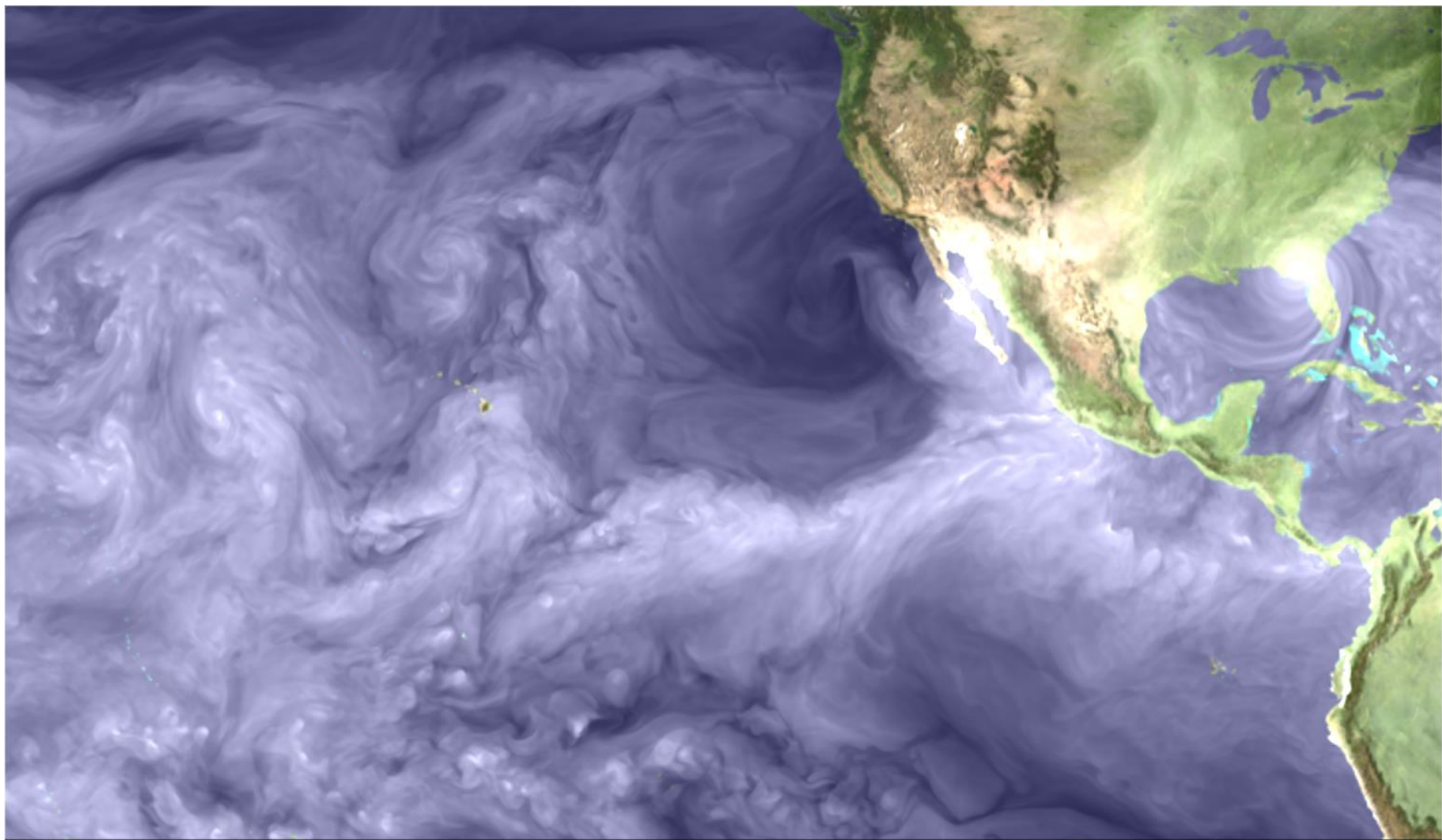
- Thinning the idealized DWL observations to just 2 complete profiles per pass.
- Producing realistic vertical DWL coverage using model and observed clouds.
- Experimenting with degraded accuracy of DD observations above clouds and increased sampling with CD around the hurricane.

.25 Degree Nature Run



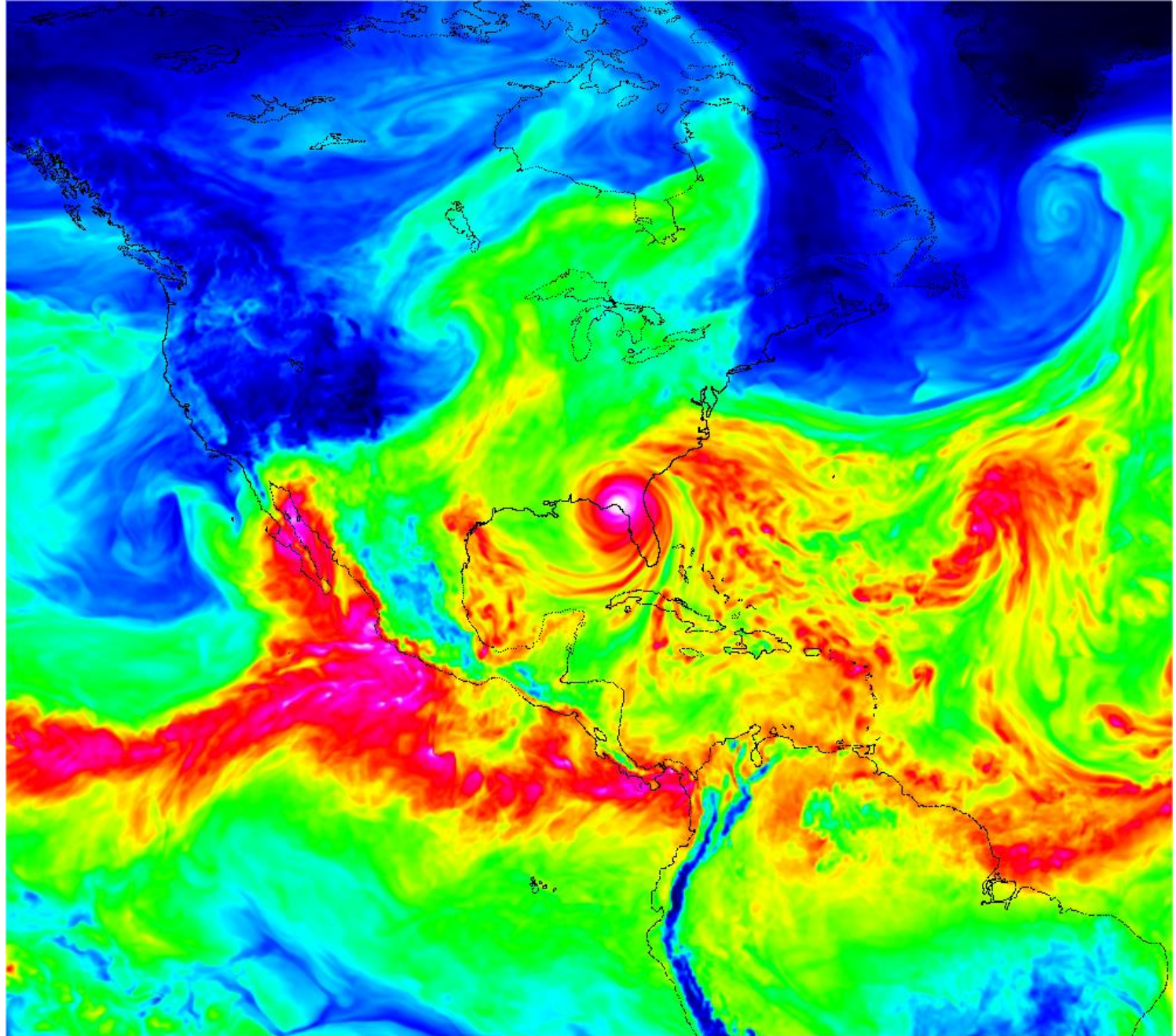
total precipitable water

Mon Sep 6 00:00:00 2004



total precipitable water

Mon Sep 6 00:00:00 2004



total precipitable water

Mon Sep 6 00:00:00 2004

Backup slides

Outline

- The role for OSSEs in THORPEX
 - Major role: OSSEs as cross-cutting investigations before “validation” field experiments
 - “On Par” role: OSSEs and exploratory field experiments together
- The status of the NOAA THORPEX OSSE Testbed
- The status of some recent OSSEs, including targeted observations in high impact weather events such as hurricanes
- The current NOAA THORPEX OSSE plans
 - OSSE Working Group
 - OSSE baseline system using currently available components
 - New instrument simulators (validate with field data)
 - New Nature Runs
 - Include capabilities for RROSSEs, QuickOSSEs, POSSEs, and any other OSSE-like experiments.

What is an OSSE?

- A controlled experiment to provide insight to the potential benefit of new (yet to be realized) observing systems or observational strategies by involving all key components of the forecasting process.
- The NOAA THORPEX OSSE effort recognizes the limitations of any single OSSE and the benefits of conducting several OSSE-like experiments:
 - POSSEs
 - OPREs
 - RROSSEs
 - QuickOSSEs

ATOSSE at NCEP

- Adaptive targeting of future DWL
- Using T213 Nature Run provided by ECMWF
- Using T62 and T170 models for impact assessment
- Will use several target identification schemes
- First series expected to be completed early this summer

Summary (OSSE role)

- OSSEs are the cross-cutting element of the NOAA THORPEX program; bring the four (Obs, DAS, FM and Users) components together in controlled experiments
- OSSEs can help guide the design of field experiments and establish priorities from a quantitative set of OSSE results
- OSSEs permit rapid generalizations from a time/space/situation limited set of field experiment results; allow multi-seasonal and multi situational experiments to be run using the same observation strategies.

Summary (Programmatics)

- Funding from NOAA is now in place to establish an OSSE testbed for THORPEX community access
- Need to assemble an THORPEX OSSE Working Group (International membership is sought, especially academia)
 - Suggest this WG be a sub-group under the International GIFS WG
 - WG would be cross-cutting in its membership to assure an “end-to-end” perspective on OSSE activities
 - Observations, data assimilation, forecast models, users interests
- Updating the instrument forward and performance model library is in progress
- Collaborating with NCEP and international THORPEX partners on planning OSSEs is envisioned
- Seeking funding to conduct OSSEs designed for THORPEX mission planning and assessing economic/societal impacts from improved OBS/DAS/FM products.

Critical need for broad community
input to THORPEX OSSE design,
interpretation and validation

Josh Hacker (NCAR)

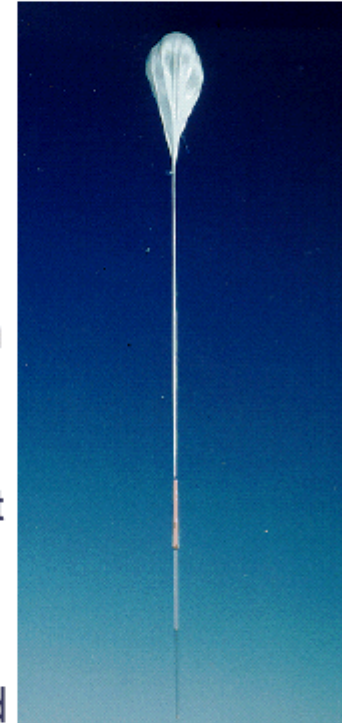
OSSE components

- NR: Nature Run which is considered the “truth” for the OSSEs
- OBSIM: Observation simulators for current and proposed instruments
- DAS: Data Assimilation System
- FM: Forecast model
- IM: Impact Model

OSSEs at the UK Met Office

- Three backup slides were taken from a presentation by Richard Swinbank (UKMO)
- Reported on some OSSE and OSSE-like experiments related to future observing systems (SWIFT and Stratospheric Balloons)
- Use of ECMWF analyses instead of long model integrations for Nature Run

- § Investigation of the impact on analyses and forecasts from assimilating various constellations of long-duration stratospheric balloon data.
- § These balloons are a potential new component of the global observing system
 - § GAINS: Global Air-ocean IN-situ System
 - § THORPEX: The Hemispheric Observing System Research and Predictability Experiment
- § The balloons would carry dropsondes
- § As with SWIFT, this experiment is motivated by the lack of stratospheric wind data



§Partial (or Poor-man's) Observation System
Simulation Experiment

§Hybrid between an OSE and an OSSE

§Simulate balloon data as in an OSSE

§All other observations are real as in an OSE

§ECMWF analysis as the Nature Run

§Similar to OSRE (Observation System
Replacement Experiment, Wergen 2000)

New Dynamics

- § Semi-Lagrangian
- § Semi-implicit (predictor-corrector)
- § Arakawa C-grid
- § Height based: hybrid terrain-following grid
- § Charney-Phillips
- § Full 3D Helmholtz solver

Old Dynamics

- § Explicit Heun
- § Split-explicit (2 time-level)
- § Arakawa B-grid
- § Pressure based: hybrid sigma-pressure grid
- § Lorenz
- § Reference state profile

Description of Quick OSSE Experiments

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start on Sep. 11, 2004 at 12z

Observations : simulated from the Nature Run
for Sep. 11, 12z – Sep.12, 12z, 2004.

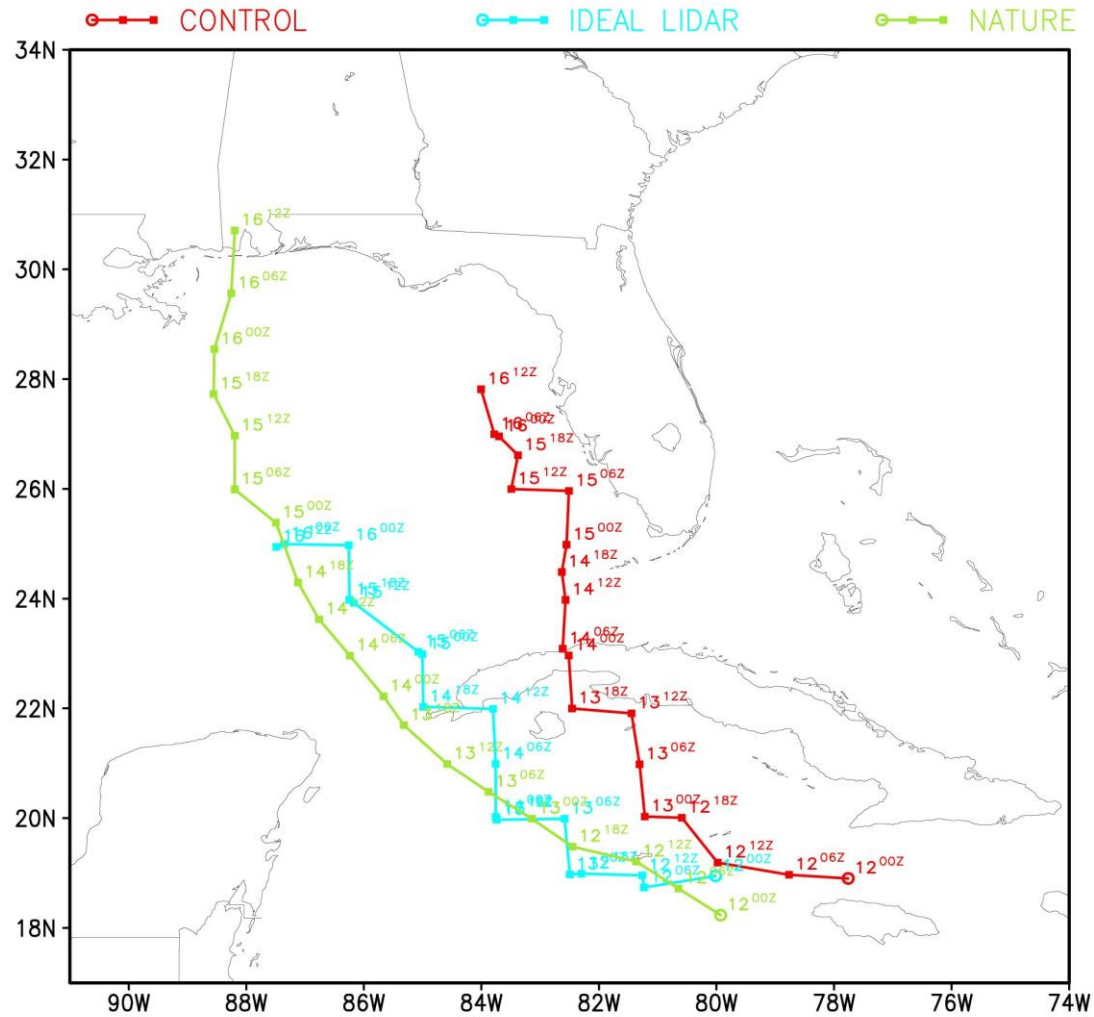
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Control - compliment of operationally globally observed data,
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Lidar - Lidar wind profiles added in the vicinity of the hurricane

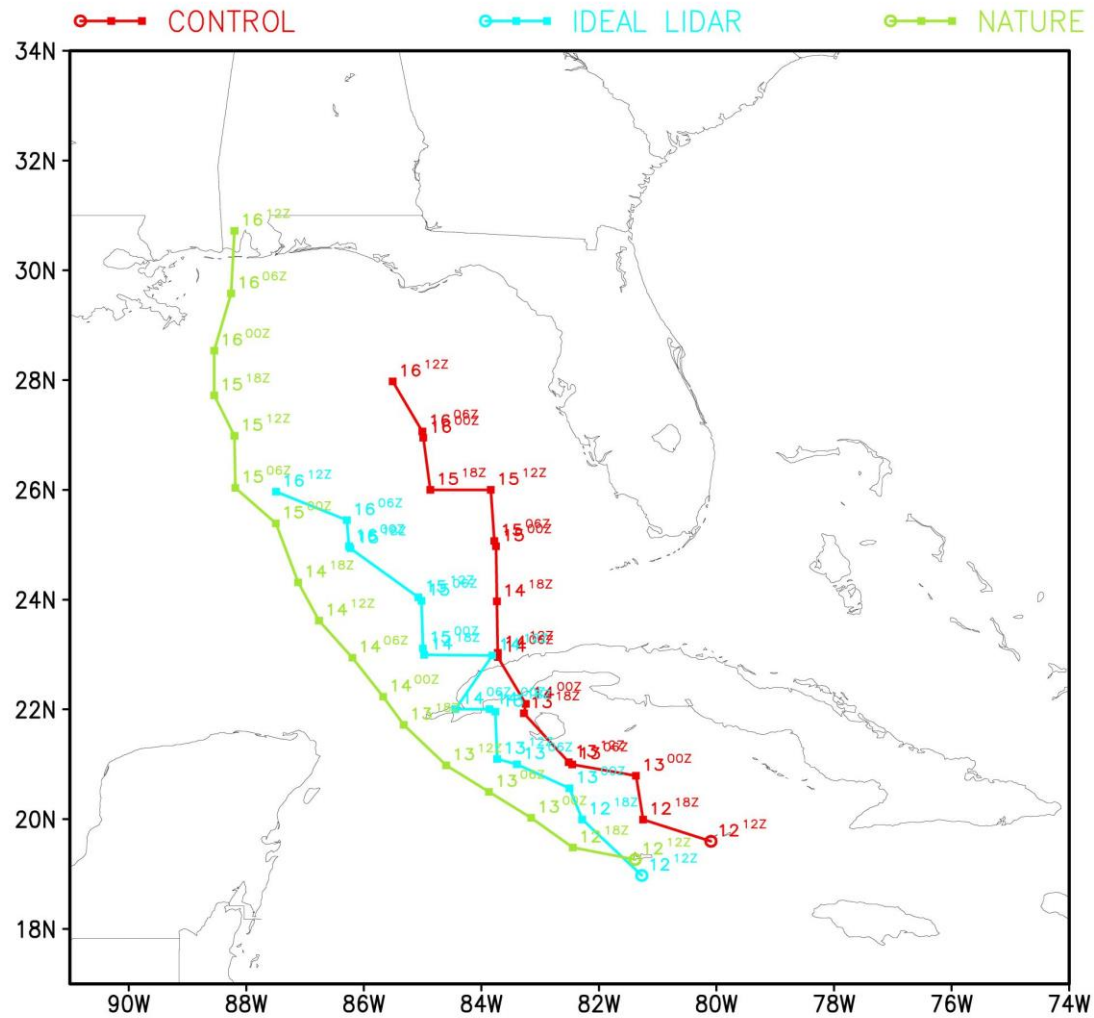
5 Day Forecasts : Started on Sep.11, 12z, Sep.12, 00z and 12z
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Prediction of Ivan (1° FvGCM Forecasts)



Sep 12, 2004 00Z – Sep 16, 2004 12Z every 6 hrs

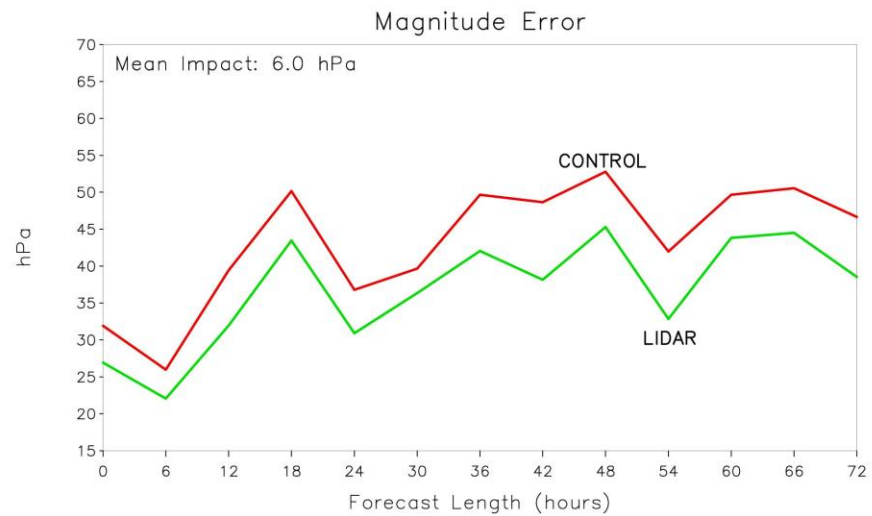
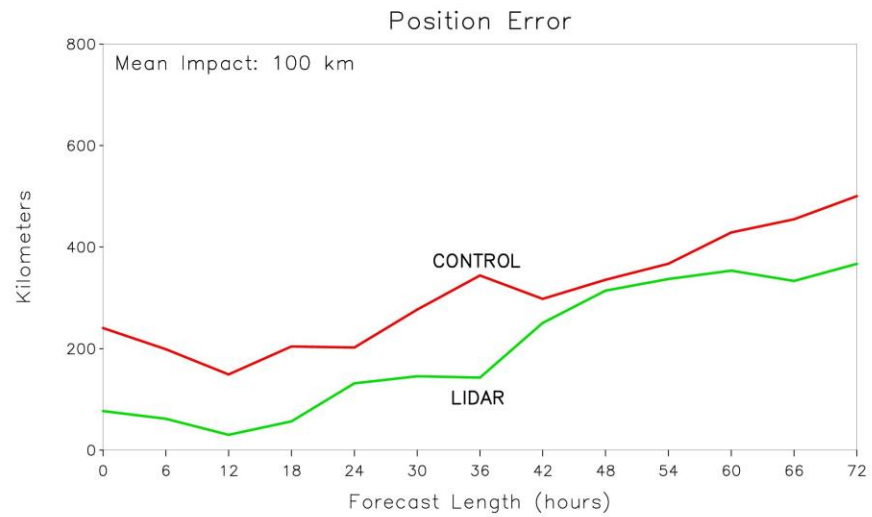
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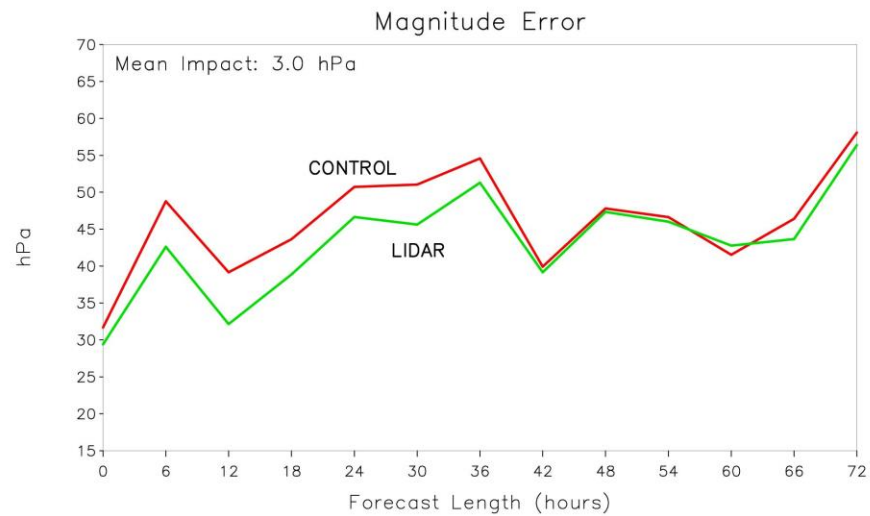
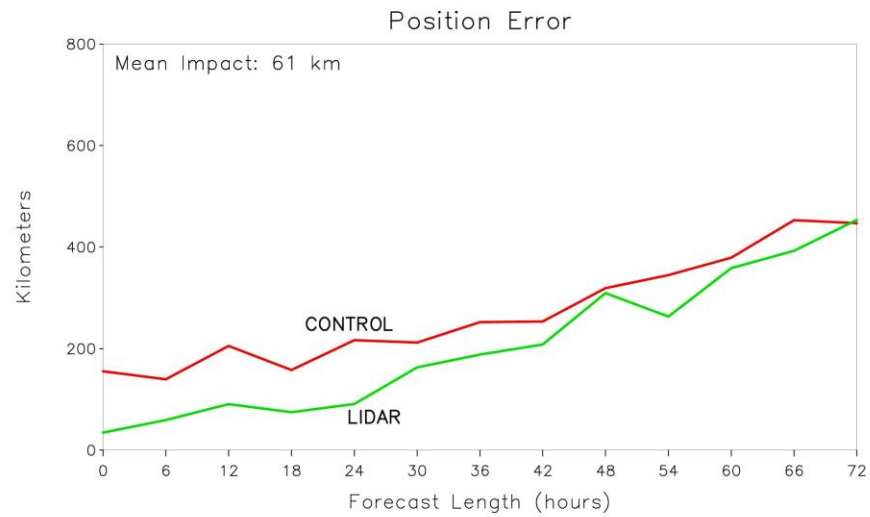
Prediction of Hurricane Ivan in 1° FvGCM

Initial Conditions: 00Z Sep 12, 2004



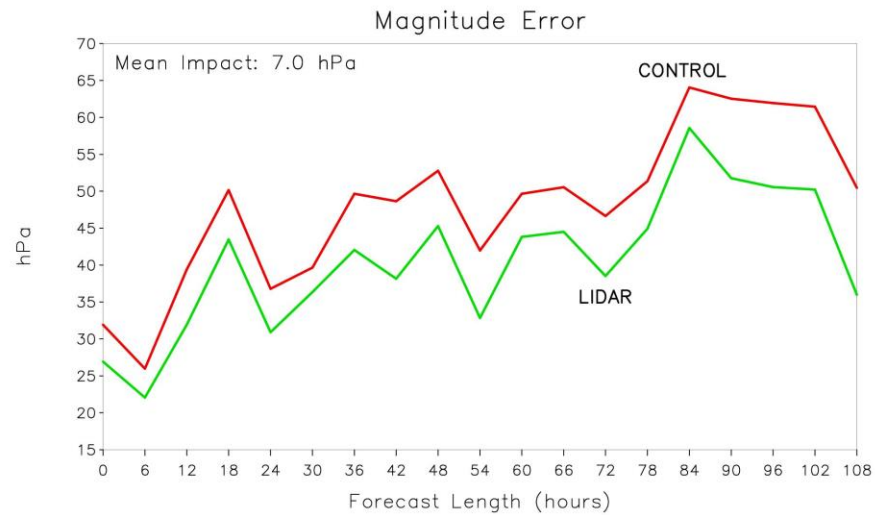
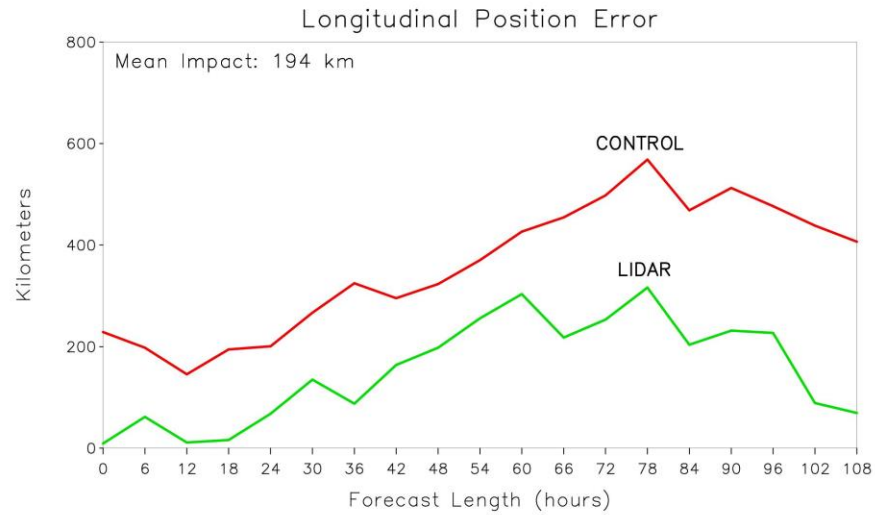
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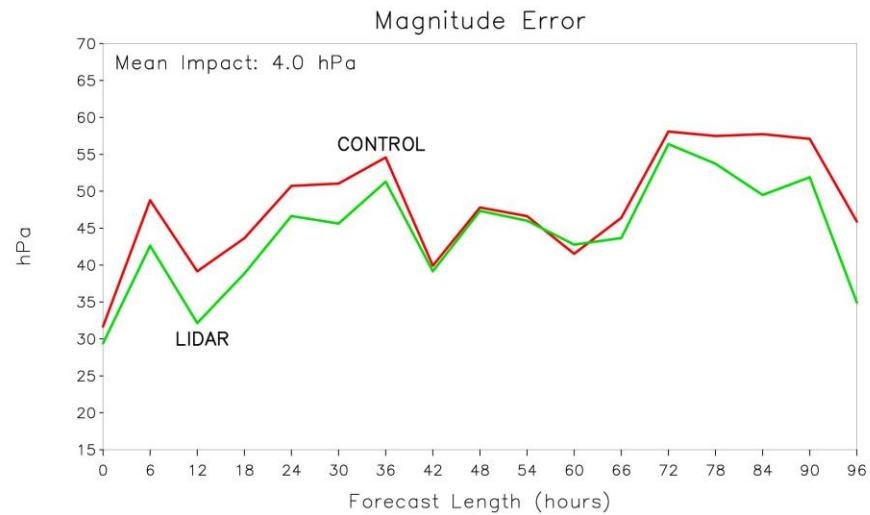
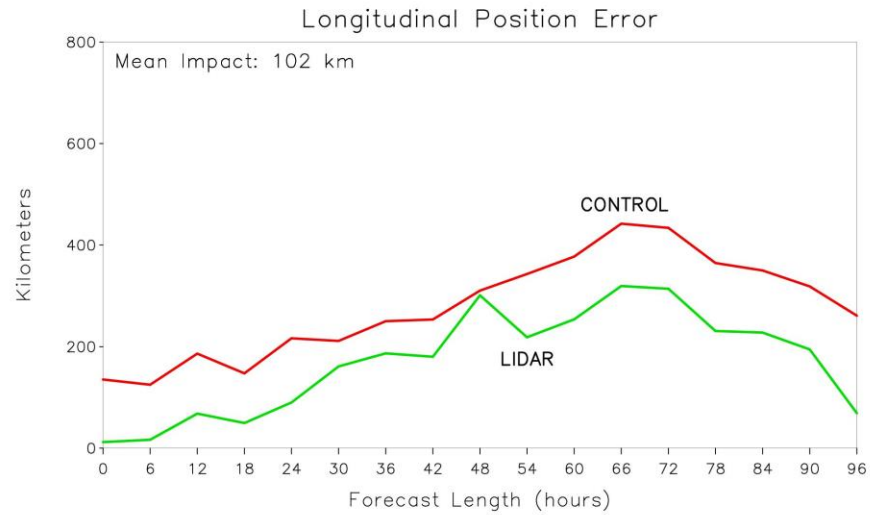
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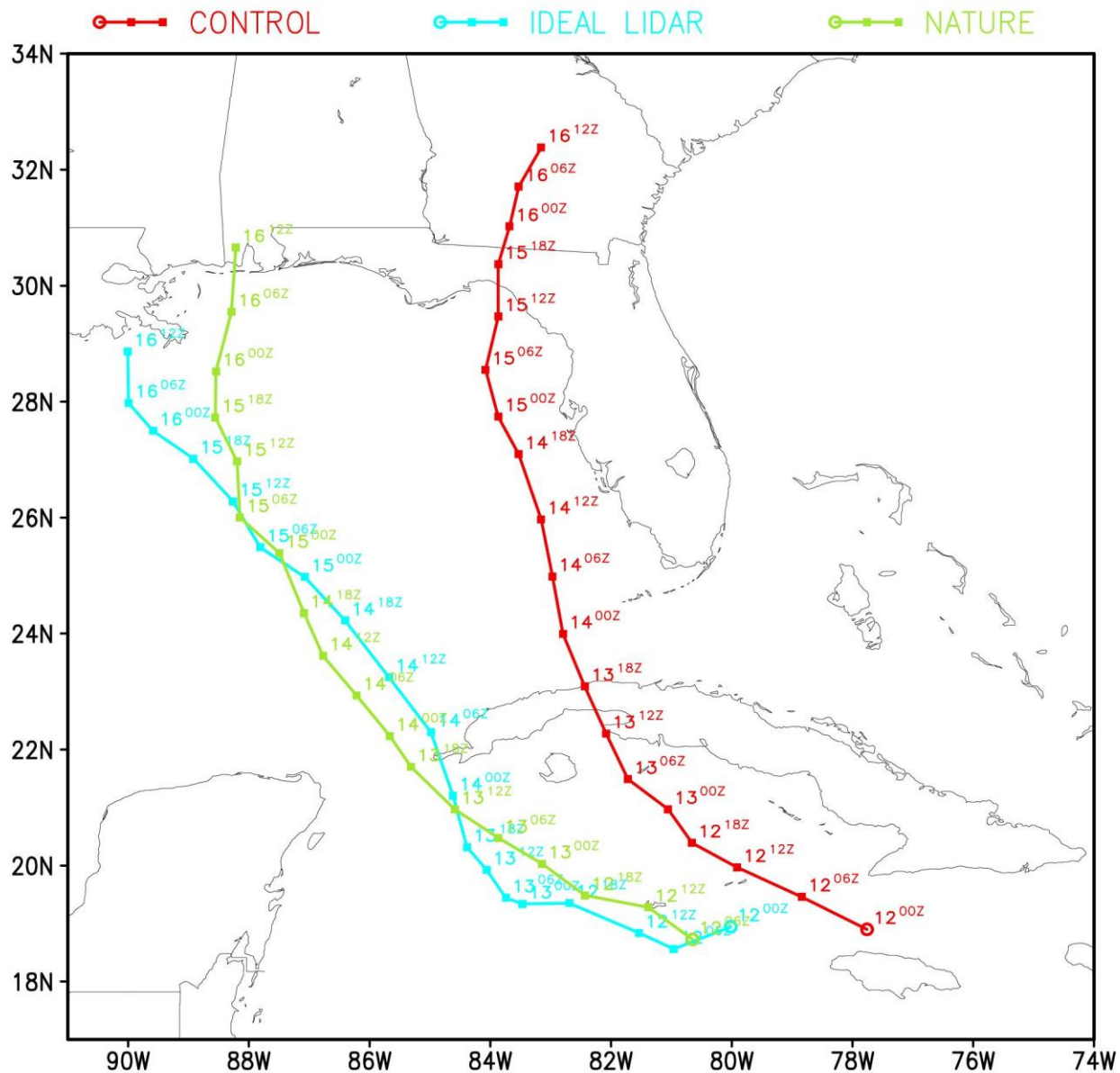


Prediction of Hurricane Ivan in 1° FvGCM

Initial Conditions: 12Z Sep 12, 2004

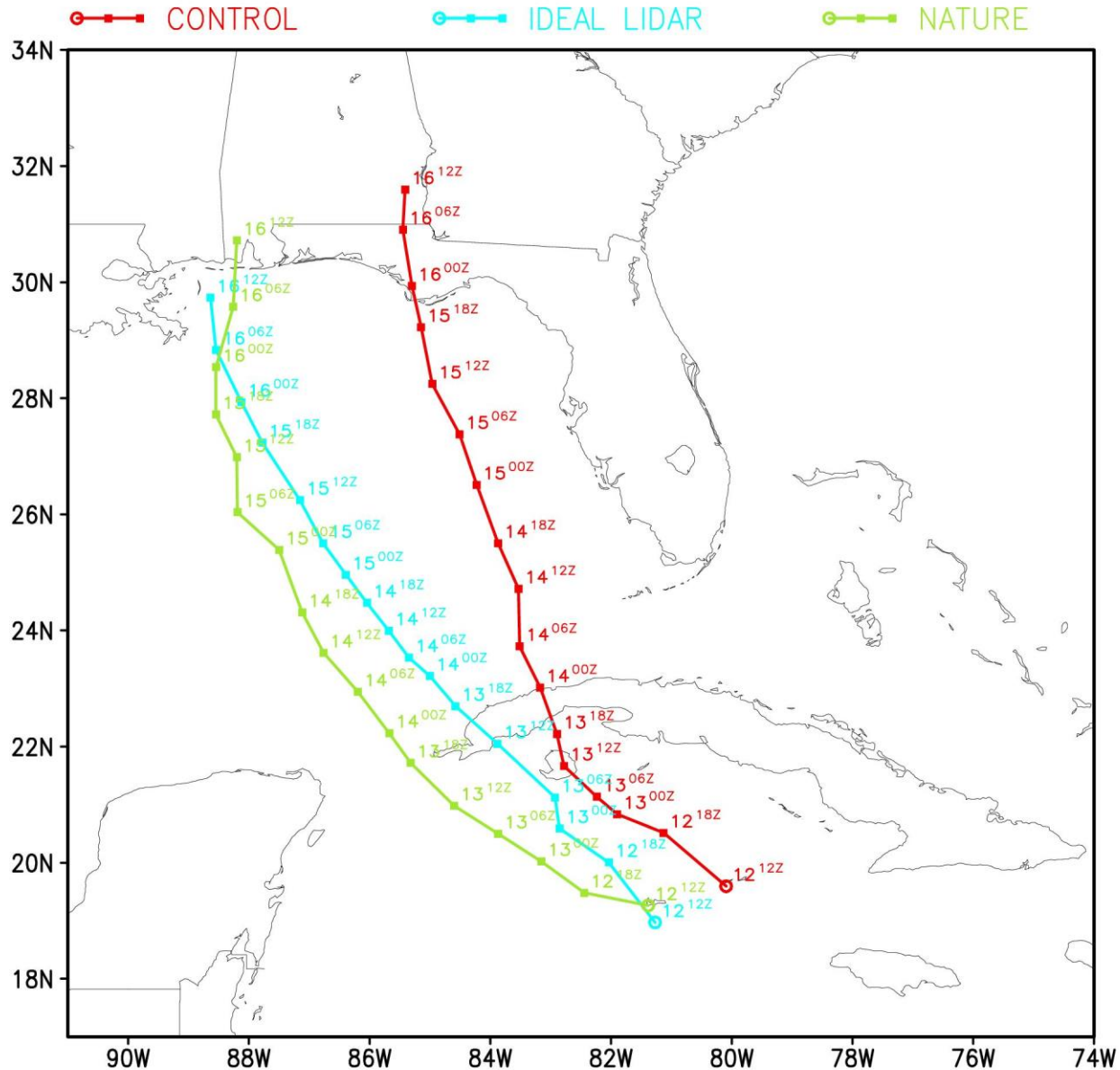


Prediction of Ivan (0.25° FvGCM Forecasts)



Sep 12, 2004 00Z — Sep 16, 2004 12Z every 6 hrs

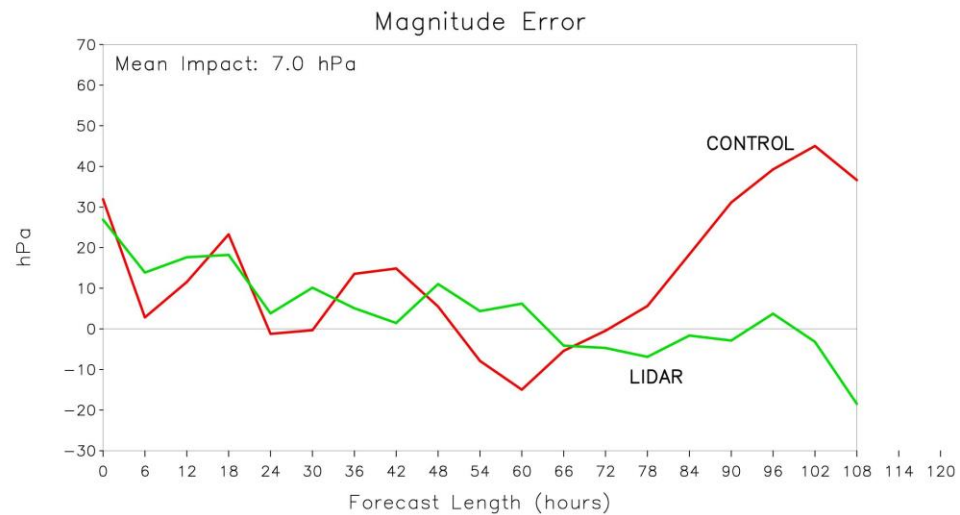
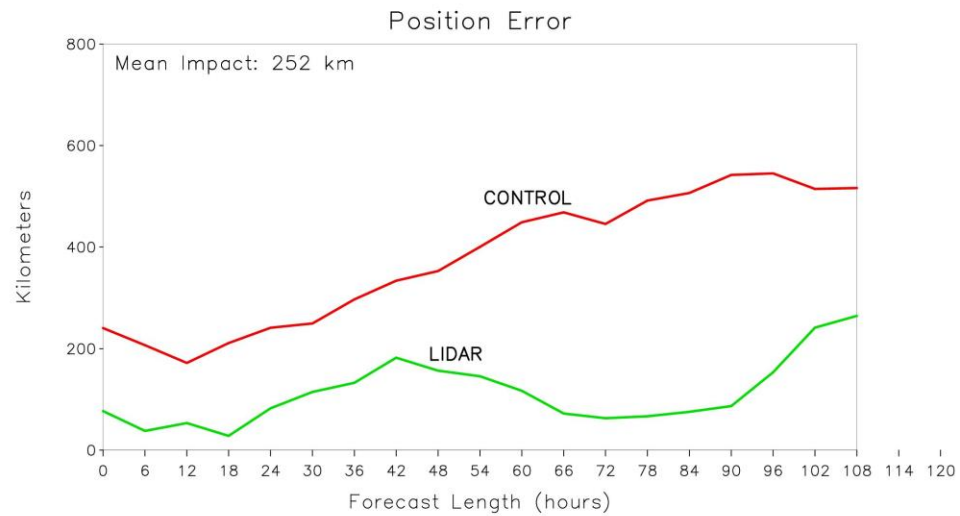
Prediction of Ivan (0.25° FvGCM Forecasts)



Sep 12, 2004 12Z – Sep 16, 2004 12Z every 6 hrs

Prediction of Hurricane Ivan in 0.25° FvGCM

Initial Conditions: 00Z Sep 12, 2004



Prediction of Hurricane Ivan in 0.25° FvGCM

Initial Conditions: 12Z Sep 12, 2004

