Assessing The Forecast Impacts of Simulated GEMS Observations

Joseph Dreher, John Manobianco, Randolph J. Evans, Jonathan L. Case
ENSCO, Inc.

13 January 2005
AMS Annual Meeting (San Diego, CA)

Outline

Concept Description

Deployment Scenario

Regional OSSE

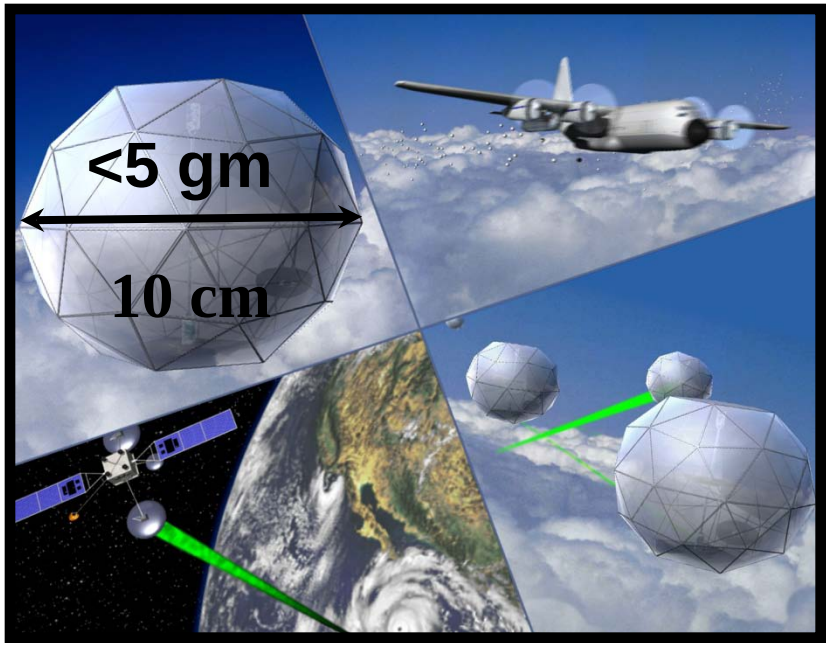
Future Work

Motivation

- Produce observing capabilities commensurate with advances in atmospheric models
- Calibration/ground truth for space based measurement
- Complement remote sensing technology
- Improve density/distribution of in situ observations

Concept Description

- **Global Environmental Micro Sensors (GEMS)**
- **Integrated system of airborne probes**
  - **Mass produced at very low per unit cost**
  - **Disposable**
  - **Suspended in the atmosphere (buoyancy)**
  - **Carried by wind currents**
  - **MicroElectroMechanical System (MEMS) and/or nanotechnology-based sensors (P, T, RH, velocity)**



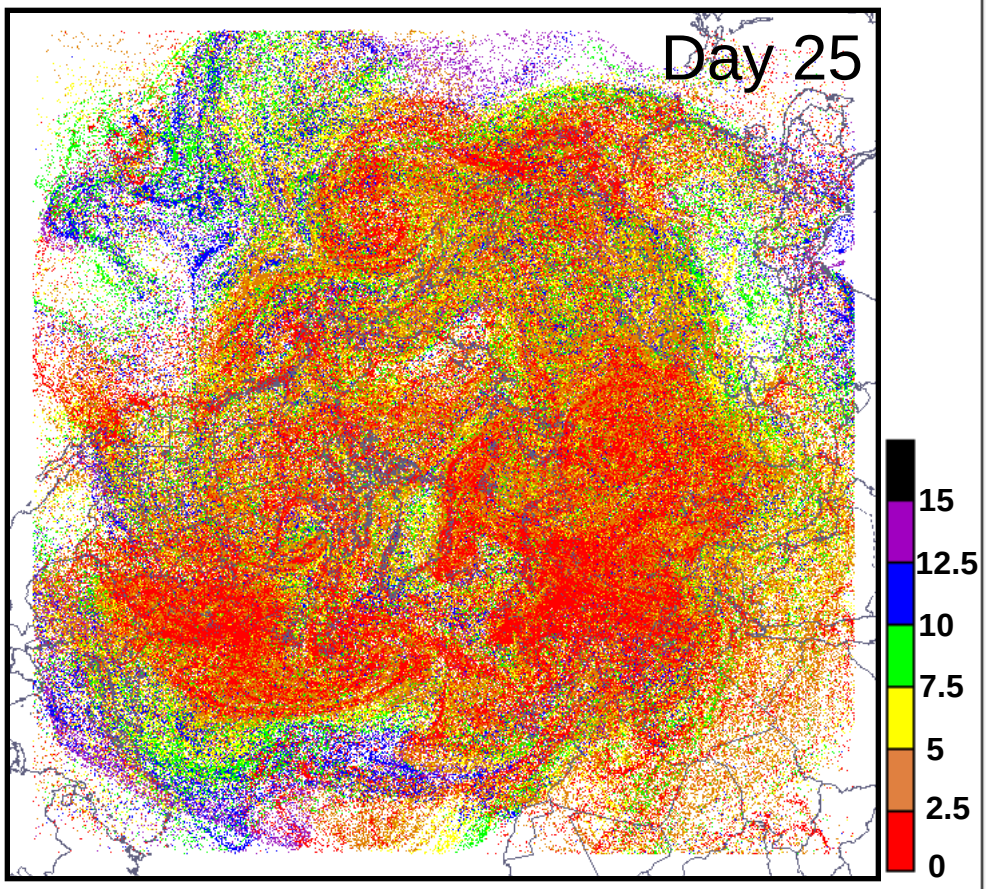
- **Mobile, 3D wireless network with communication among**
  - **Probes**
  - **Intermediate nodes**
  - **Data collectors**
  - **Remote receiving platforms**
- **Self-contained with power source for**
  - **Sensing, geolocation, communication, limited computation**

Potential Deployment Strategies

- Stratospheric balloons
- Rawinsonde
- Surface release w/ positive buoyancy
- Unattended Aerial Vehicles
- Commercial aircraft

Surface Release

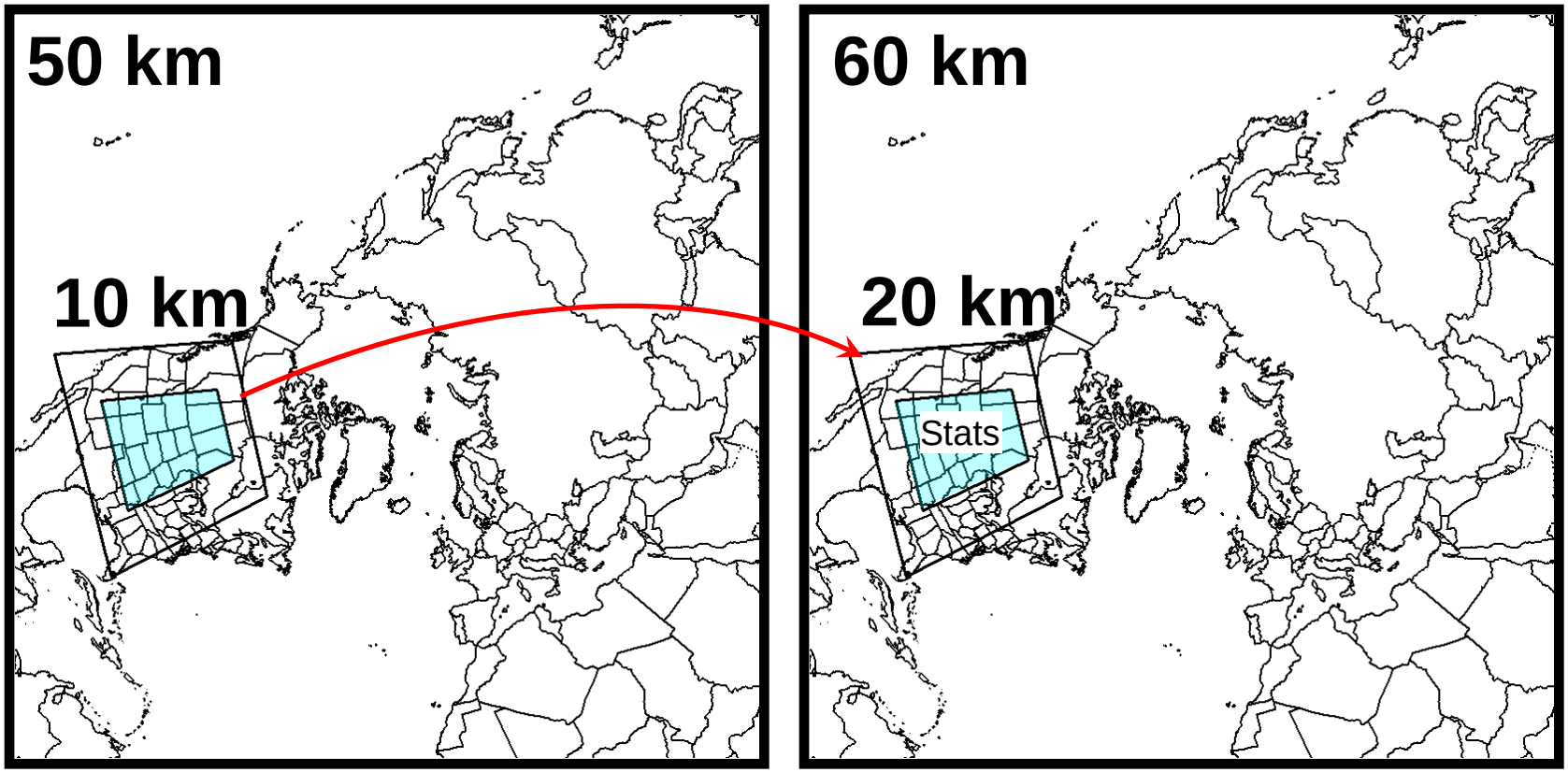
- ~ 4000 @ current METAR Stations (Northern Hemisphere)
- Altitude of 0.03 – 15 km
- 2-h release frequency
- 30-day duration
- 1,335,240 probes released



0000 UTC 1 June 2001 Initialization
Probe altitude (km) given by color scale

Simulation Domains

Same lateral boundary conditions

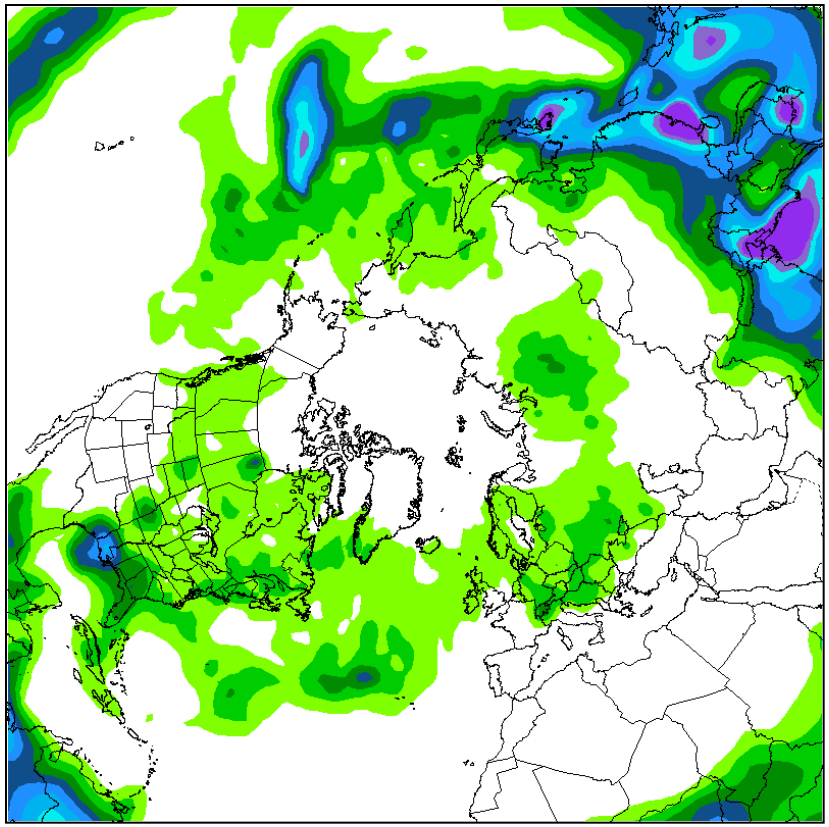


ARPS (“truth”)

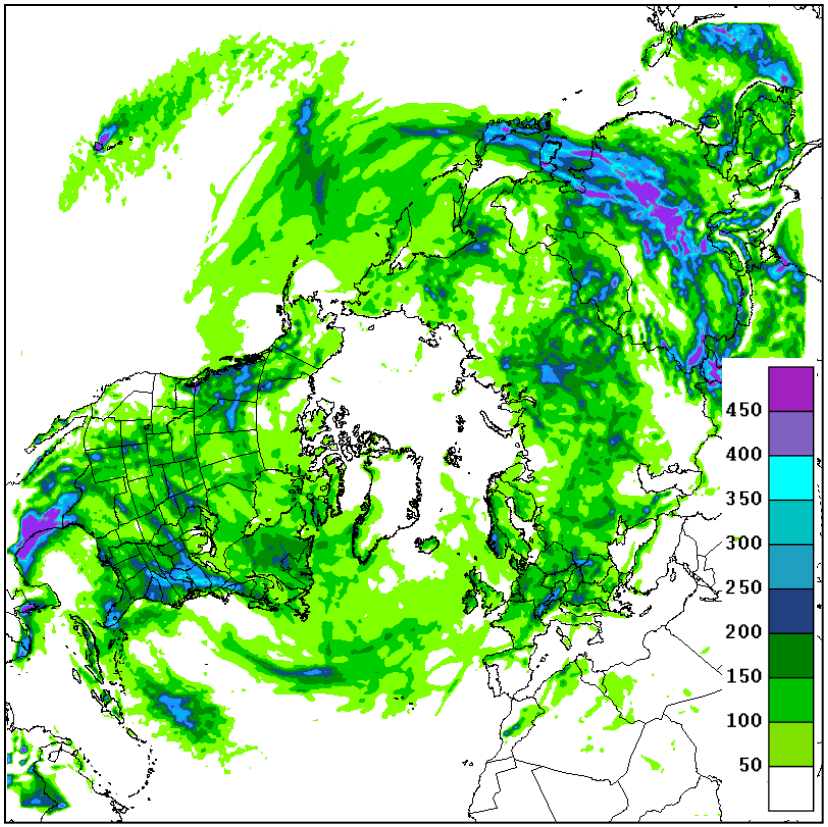
MM5

Climatology

- 30-day accumulated precipitation for June 2001
  Amount (mm) given by color scale



GPCP V2 combined (2.5º)

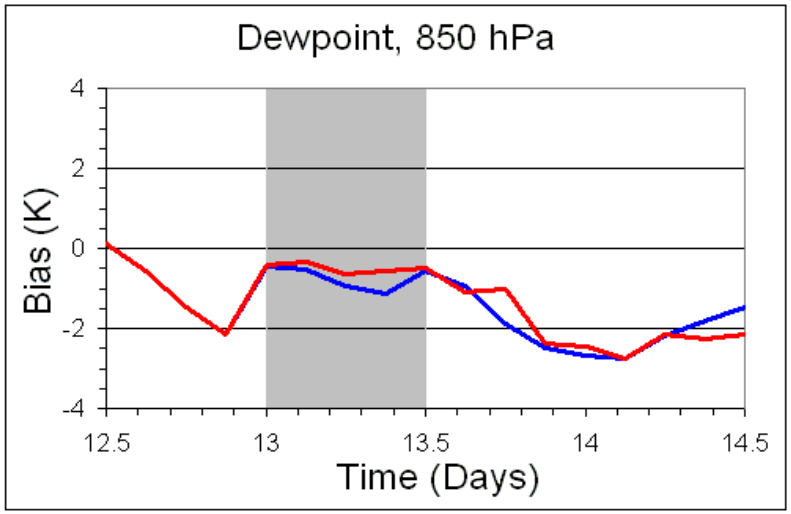


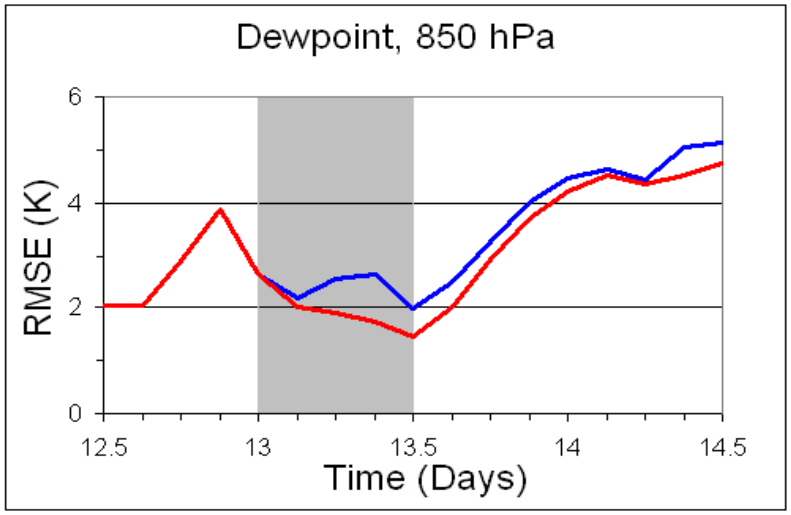
50-km ARPS

Regional Observing System Simulation Experiments (OSSE)

Experiment Name	**OBS assimilated in boundary conditions**	**OBS assimilated in domain**
Conventional	Raob + METAR	Raob + METAR
GEMS + Conventional	Raob + METAR	GEMS from surface deployment + Raob + METAR

Preliminary OSSE Results

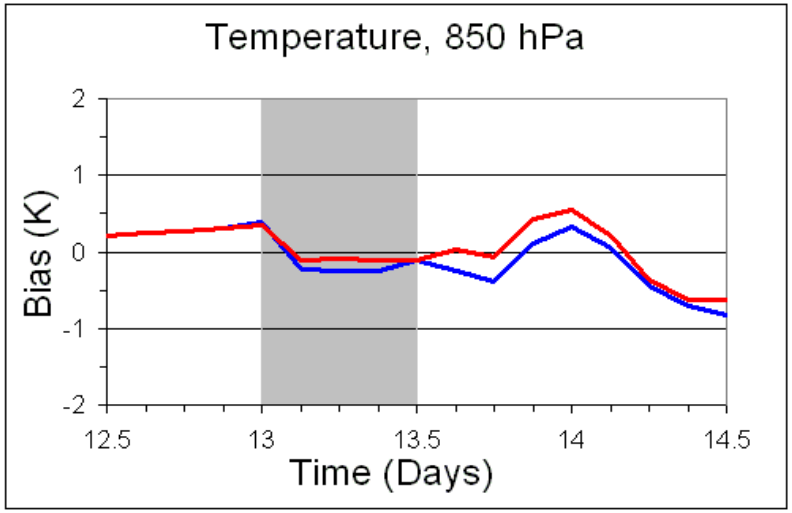


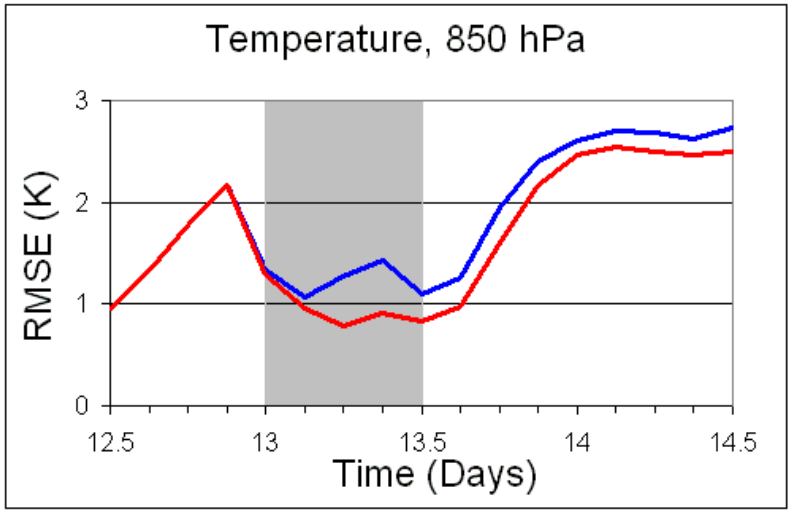


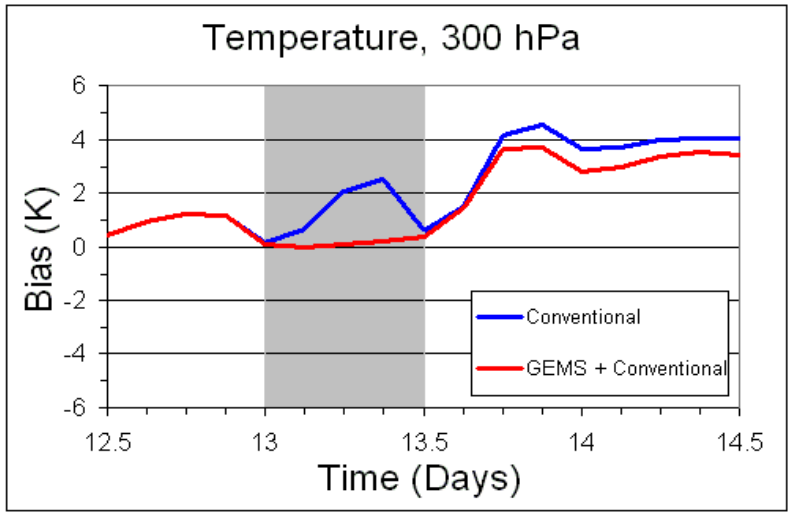
MM5 OSSE
2-day forecasts (1200Z 12 June – 1200Z 14 June 2001)
Data assimilation every 3 h for 12-period (shown by shading)

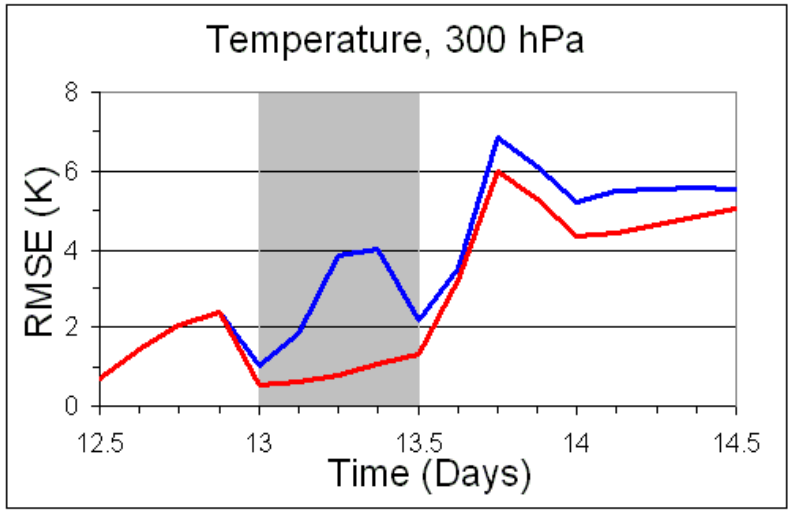
Conventional (surface + upper air measurements)
GEMS + Conventional

Preliminary OSSE Results

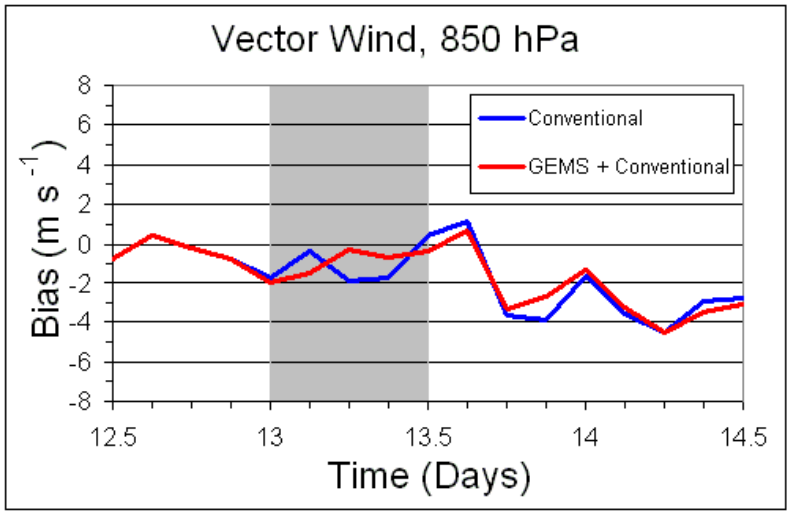


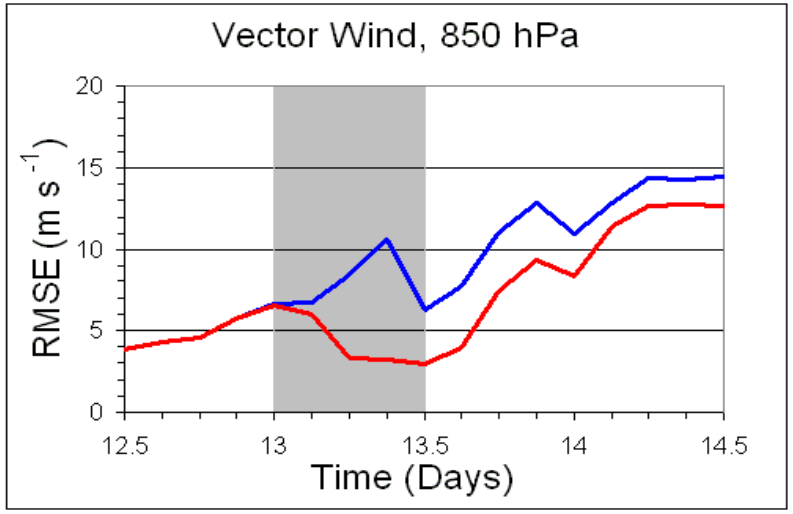


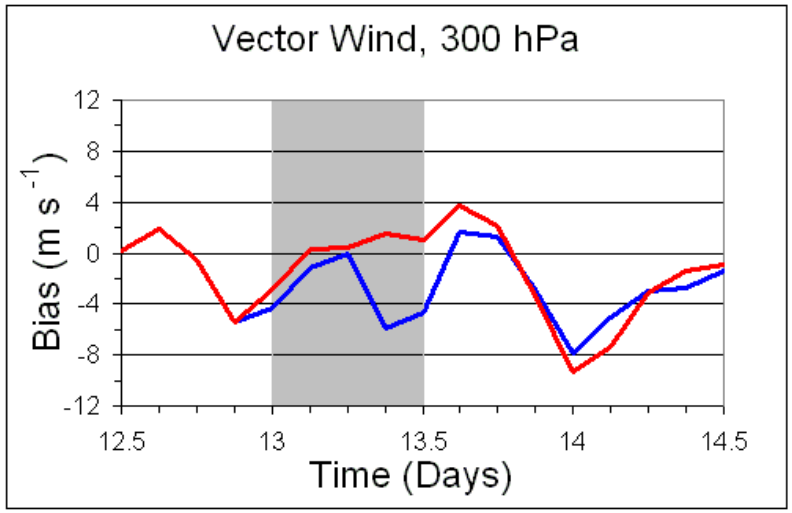


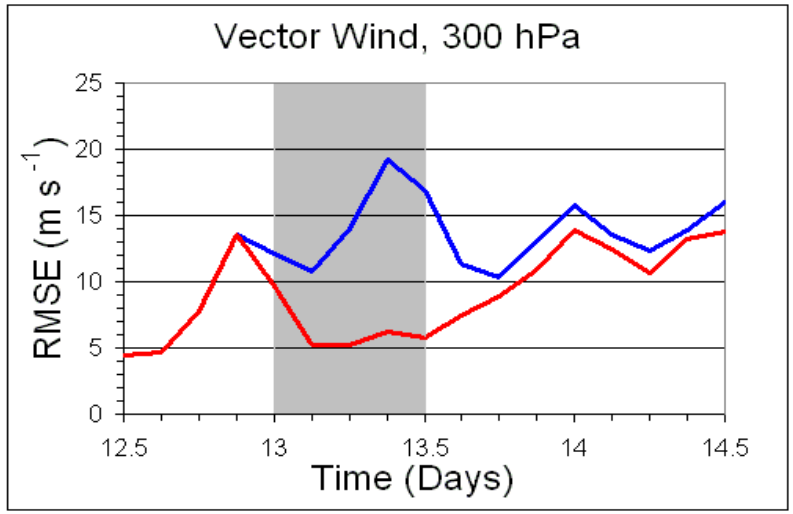


Preliminary OSSE Results









Summary and Future Work

- Motivation
- Concept description
- Preliminary OSSE results
- Sensitivity to deployment scenario, precipitation scavenging, data density, & data assimilation period & frequency
- Add realistic errors to the assimilated meteorological variables
- Regional OSSE calibration
- Include simulated aircraft data in conventional data suite
- Additional OSSE including a winter case
- Run OSSE over longer time periods in order to mimic operational data assimilation forecast cycles

Acknowledgments

- Universities Space Research Association

  NASA Institute for Advanced Concepts
  - Phase I funding
  - Phase II funding