

Evaluation of RAMS in the Eastern Range Dispersion Assessment System

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Presentation Outline

- **Background on ERDAS**
- **Configuration**
- **Methodology**
 - Objective and Subjective Components
- **Objective Results**
 - Surface Temperature, Moisture, and Winds
- **Subjective Results**
 - Sea Breeze Verification
- **Summary**

Background on ERDAS

- **Space Launches → Emergency Response Guidance at Cape Canaveral Air Force Station**

- **Regional Atmospheric Modeling System (RAMS)**

- **AMU evaluated prototype ERDAS RAMS**
 - AMU recommended changes → implemented
 - Replacement ERDAS system includes changes

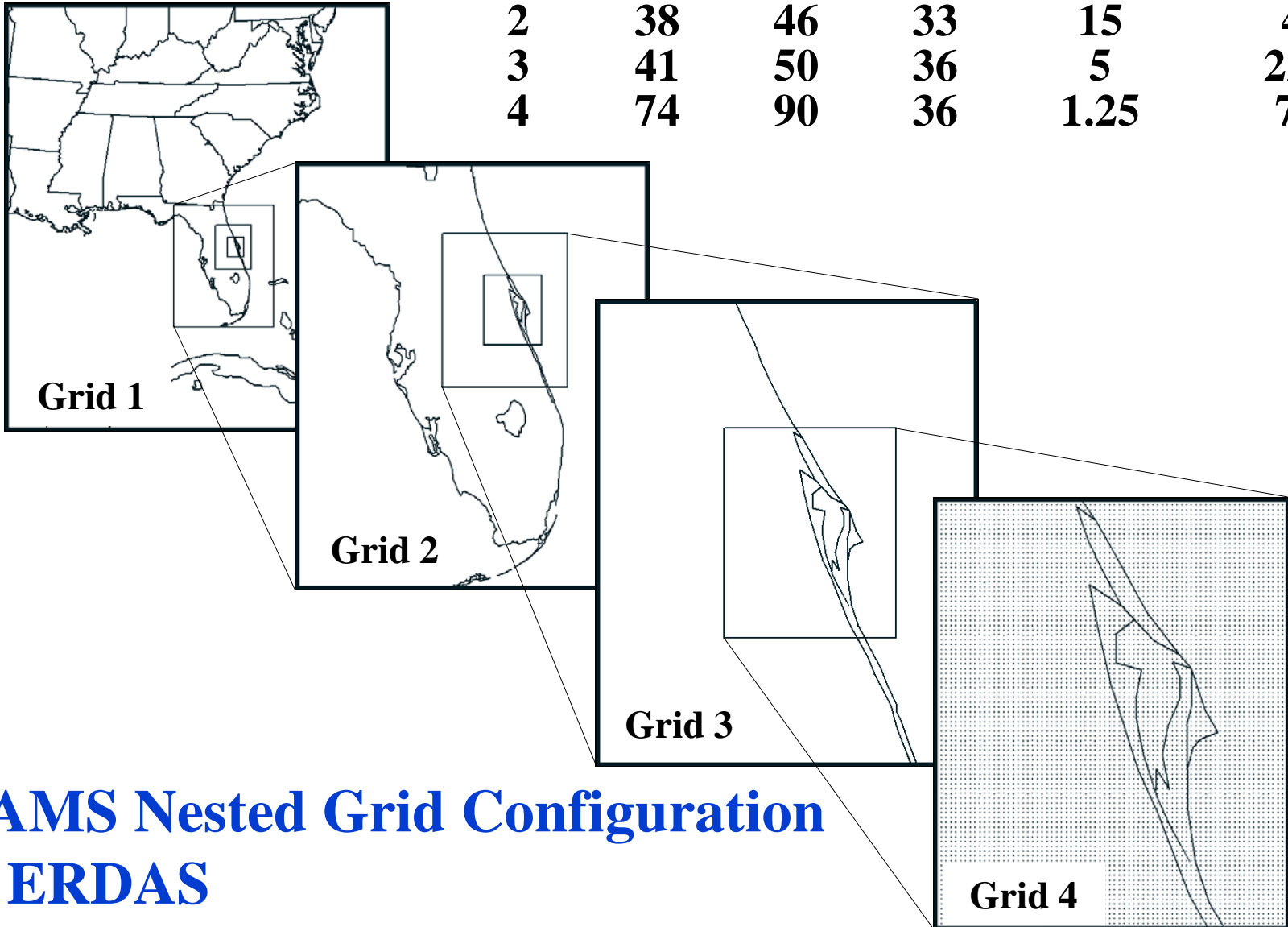
Background on ERDAS

- **Additional ERDAS configuration changes**
 - RAMS model upgrade
 - Finer resolution on inner forecast grid
 - Full cloud microphysics

- **Systematic evaluation of current ERDAS needed to validate new configuration**

- **Forecast tools for 45th Weather Squadron**

Grid	nx	ny	nz	dx (km)	dt (s)
1	36	40	33	60	45
2	38	46	33	15	45
3	41	50	36	5	22.5
4	74	90	36	1.25	7.5



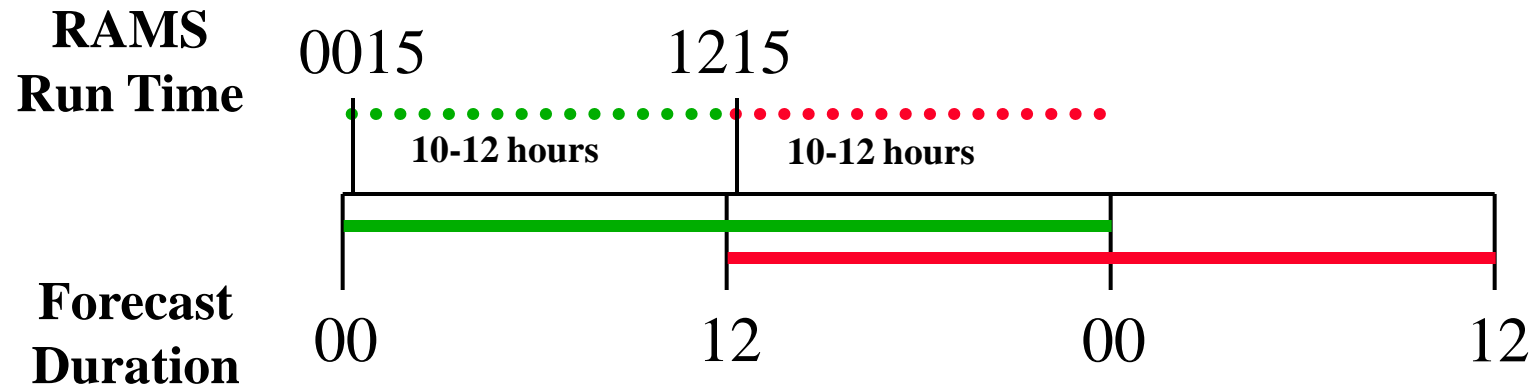
RAMS Nested Grid Configuration in ERDAS

RAMS Initialization and Forecast

- **Data obtained at 0000 and 1200 UTC**
 - 12-h forecast from Eta model
 - Rawinsondes, surface stations & buoys
 - Local wind towers
 - 5 local 915 MHz & 1 local 50 MHz DRWP

- **Isentropic analysis using Barnes scheme**
- **Cold start (no technique to balance data w/ model)**
- **24-h RAMS forecasts generated**
- **Hourly forecast output available**

RAMS Operational Cycle



- Eta 12 to 36-h forecasts as boundary conditions
- Run on (3) HP-K460 (11 processors total)
- Prognostic data still available for 1-cycle failure

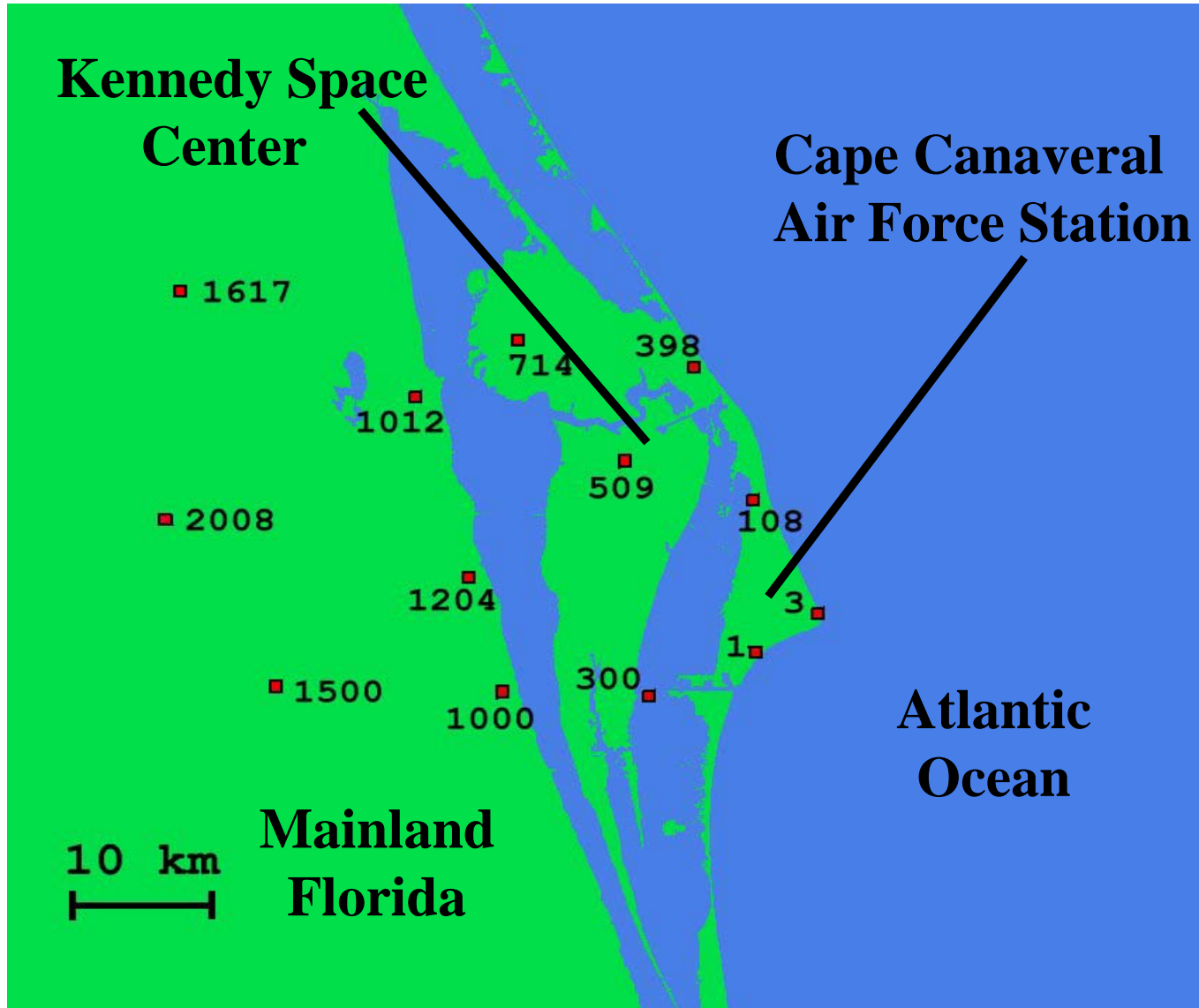
RAMS Evaluation Methodology

- **Objective component (May – August 1999)**
 - **Point verification of 4-grid RAMS configuration**
 - » **Bias, RMS Error, Standard Deviation of error**
 - » **T, T_d, Wind direction & Speed**
 - » **All available observational data on grid 4**
 - » **Surface land, buoy, & weather balloon sites on grids 1-3**
 - **Horizontal resolution experiment**
 - » **Run RAMS with 3-grid configuration (grids 1-3 only)**
 - » **Compare errors to 4-grid configuration**
 - **Eta model benchmark**
 - » **Compare RAMS to national-scale Eta model**

Methodology (cont.)

- **Subjective Component (grid 4 only)**
 - **Central Florida east coast sea breeze (May – Aug 1999)**
 - » **Occurrence (Doppler radar & visible satellite data)**
 - » **Onset & propagation (13 local wind towers)**
 - » **Compare with RAMS forecasts at 13 wind towers**

13 Local Wind Towers used for Sea Breeze Verification



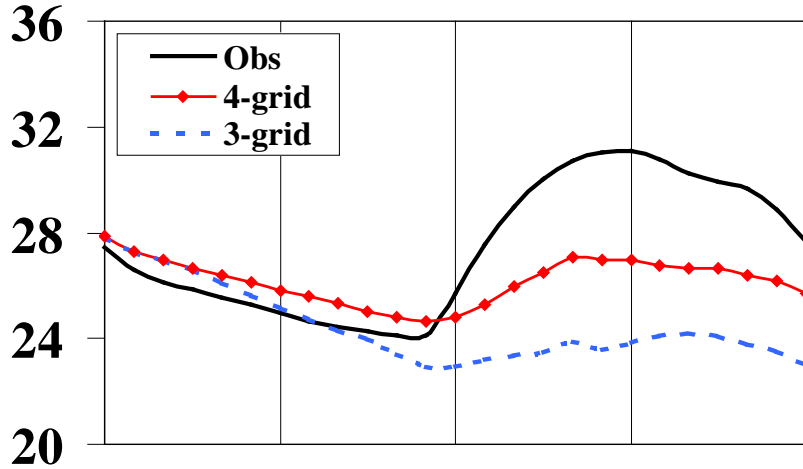
Methodology (cont.)

- **Subjective Component (grid 4 only)**
 - **Precipitation verification**
 - » **Occurrence (Doppler radar 1-h rain rates)**
 - » **Identify forecast rain (any measurable rain in model)**
 - » **6-zone classification scheme on grid 4 (see paper)**

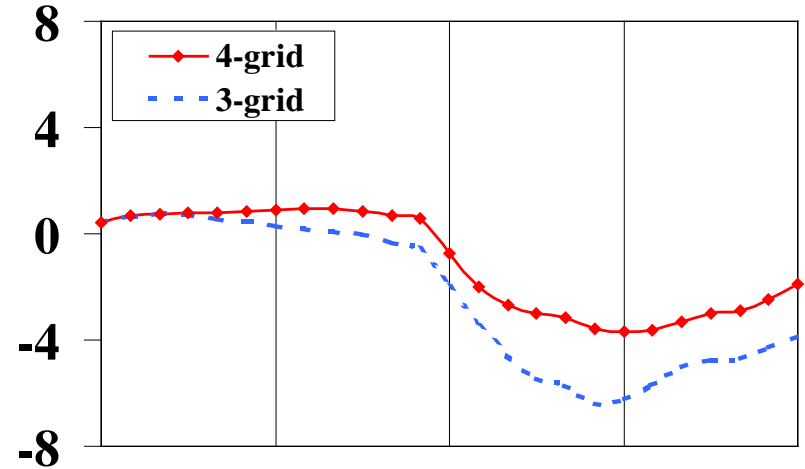
Objective Results: 0000 UTC 4/3-grid Cycle

Temperature ($^{\circ}\text{C}$, wind towers at 1.8 m)

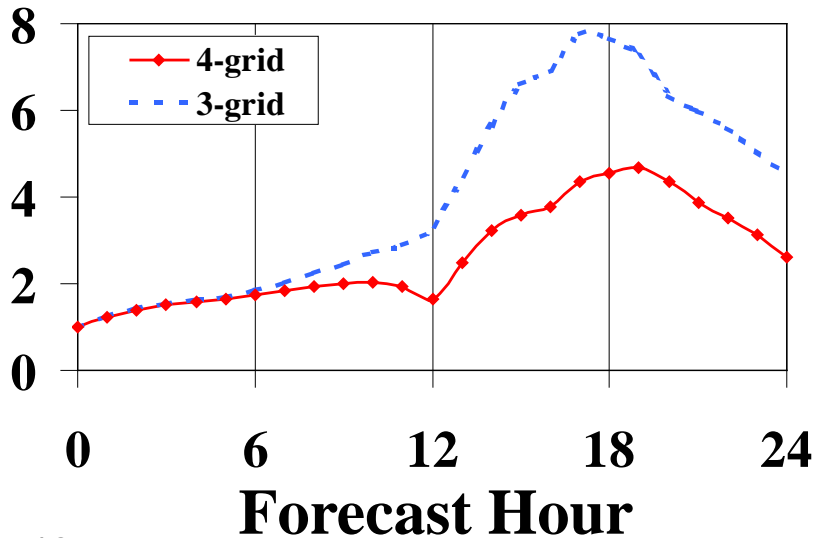
Mean Obs vs. Forecast



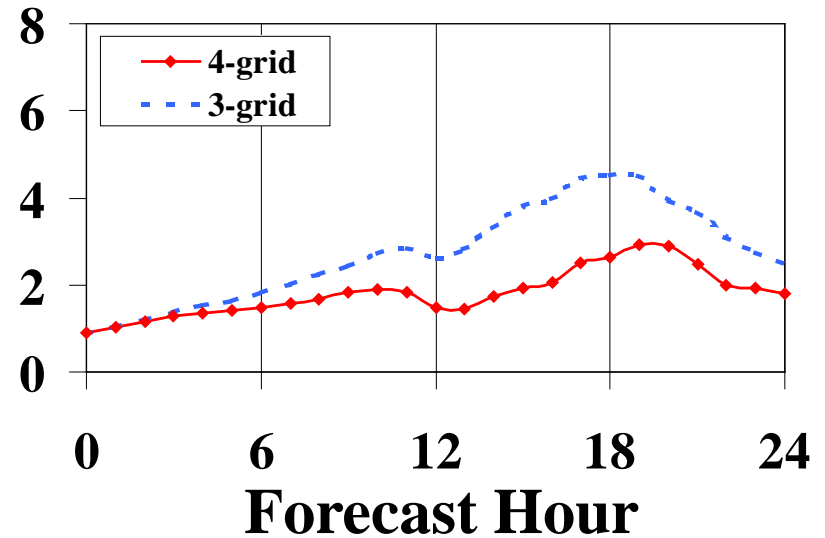
Bias



RMS Error

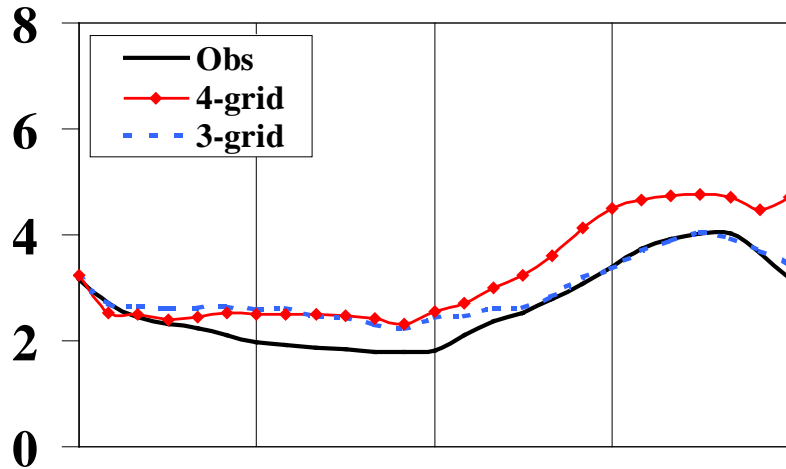


Standard Deviation

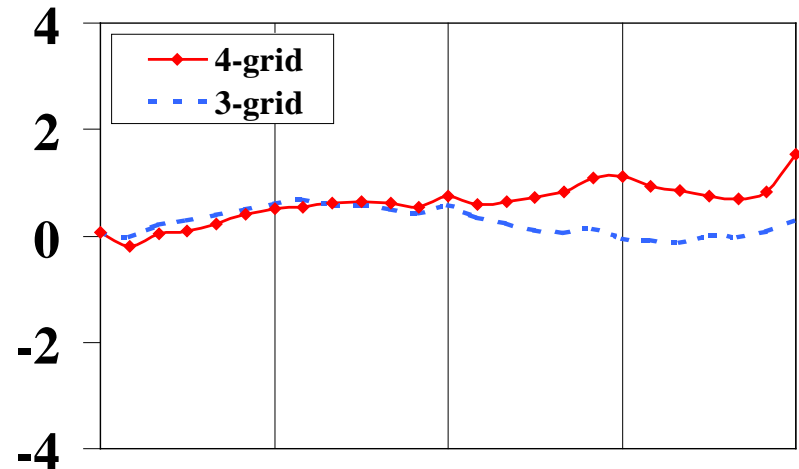


0000 UTC 4/3-grid Cycle: Wind Speed (m s^{-1}) (wind towers at 16.5 m)

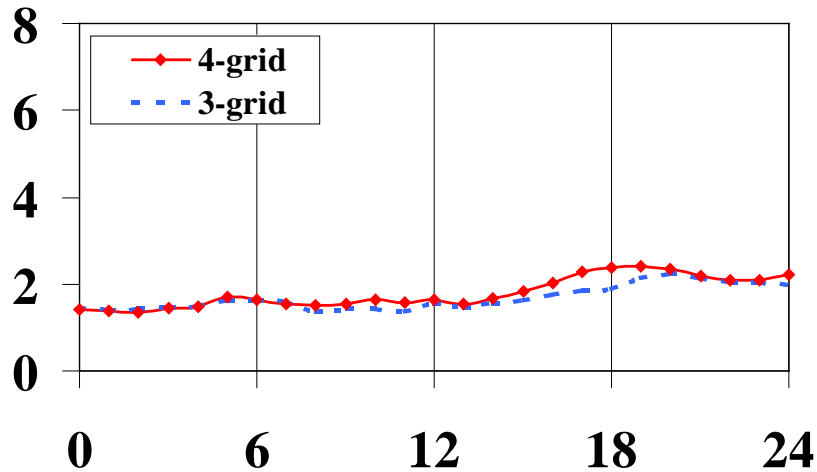
Mean Obs vs. Forecast



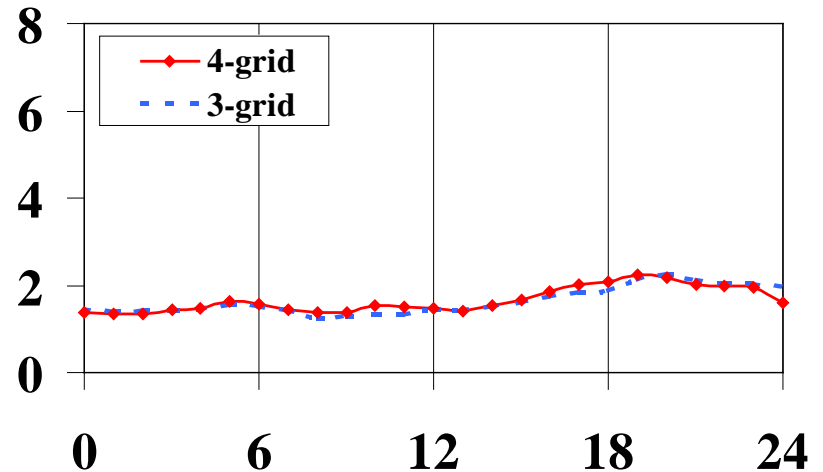
Bias



RMS Error



Standard Deviation

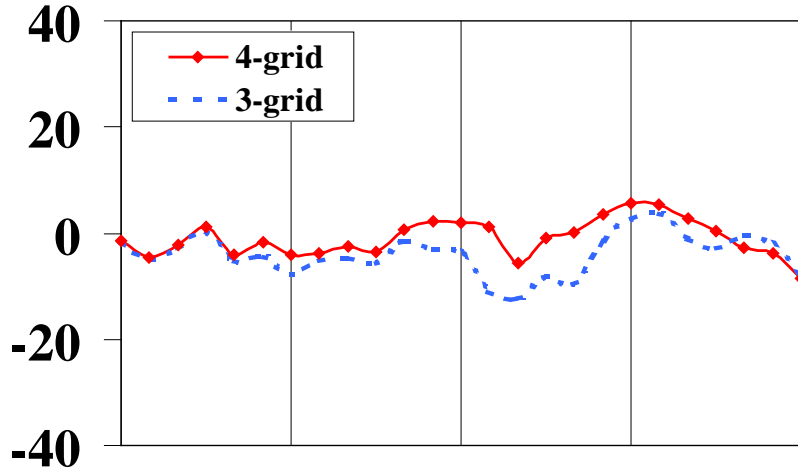


Forecast Hour

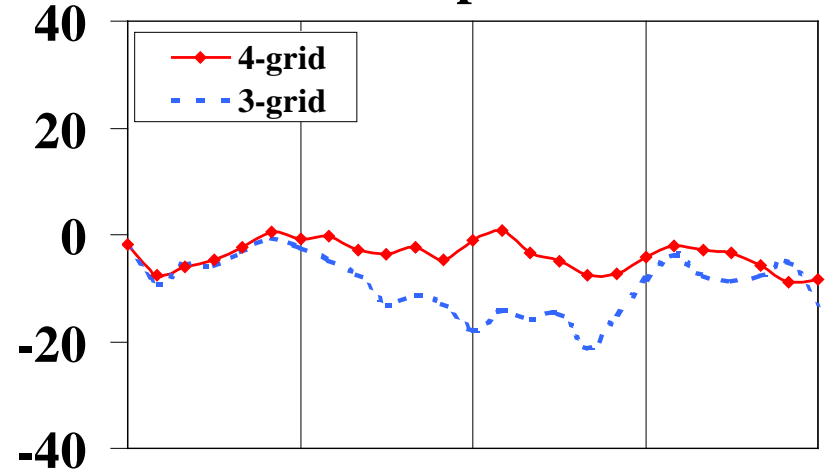
Forecast Hour

0000 UTC 4/3-grid Cycle: Wind Dir (deg) (wind towers at 16.5 m)

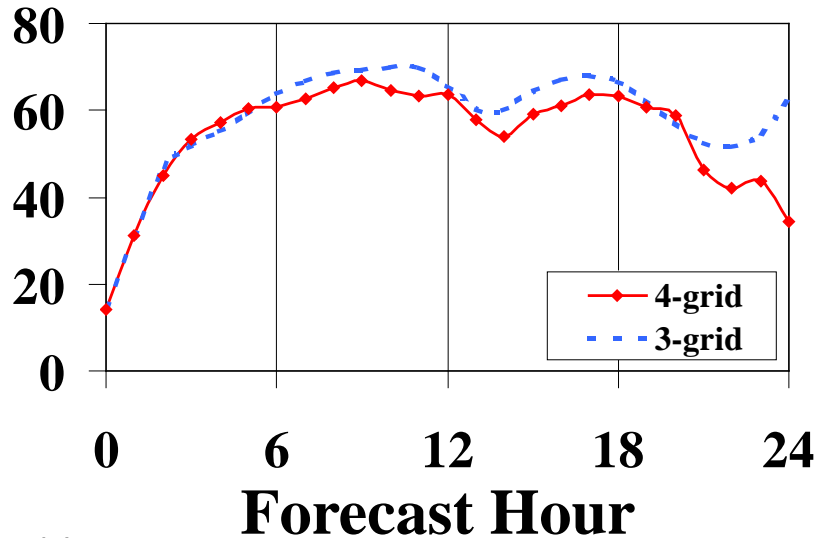
Bias: All Forecasts



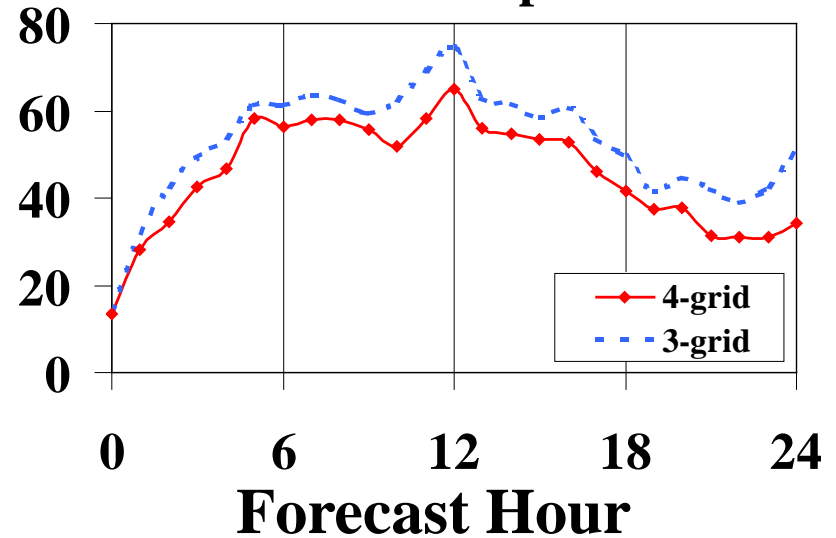
Bias: Completed Runs



RMS Error: All Forecasts



RMS Error: Completed Runs



Subjective Sea Breeze Verification

(May – Aug, 0000 & 1200 UTC)

TABLE 1. Contingency table of sea breeze occurrence.

	Observed Sea Breeze	No Observed Sea Breeze
Forecast Sea Breeze	110	3
Sea Breeze Not Forecast	6	16

Probability of Detection: 0.95

False Alarm Ratio: 0.03

Critical Success Index: 0.92

Heidke Skill Score: 0.74

TABLE 2. Sea breeze timing error statistics.

	0000 UTC	1200 UTC	All
MAE (h)	0.9	0.9	0.9
RMS (h)	1.3	1.3	1.3
SD (h)	1.3	1.3	1.3
Bias (h)	-0.2	0.1	0.0

Summary

- **Temp. & Dew point: Cool, dry daytime bias**
 - RMS Error of 4.5 °C in 4-grid, 8 °C in 3-grid config.
- **Wind Dir: 50-70° RMS error, Unbiased**
 - 15-20° observational variability (Merceret 1995)
 - Largest during nighttime hours (light wind regimes)
 - Smallest error in 4-grid config. during quiescent regimes
 - » Post sea breeze ~ 30°
 - » 10-15° model error
 - Anomalous precipitation forecasts → Large wind errors
- **Wind Speed: Positive bias in 4-grid forecasts**
- **RAMS: Excellent in forecasting onset and movement of central FL ECSB**

Future Work

- **1999-2000 cool-season verification**
 - Cold fronts and associated precipitation
 - Low temperatures and low-level inversions

- **2000 warm-season evaluation**
 - First thunderstorm of the day
 - Additional sea breeze verification
 - Precipitation verification

- **AMU Quarterly reports:**

<http://technology.ksc.nasa.gov/WWWaccess/AMU>