

# An Evaluation of RAMS in the Eastern Range Dispersion Assessment System during the 1999-2000 Florida cool season

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# Presentation Outline

- **Background on ERDAS**
- **RAMS configuration**
- **Methodology**
  - Objective and subjective techniques
  - 1999-2000 cool season
- **Results**
- **Summary**

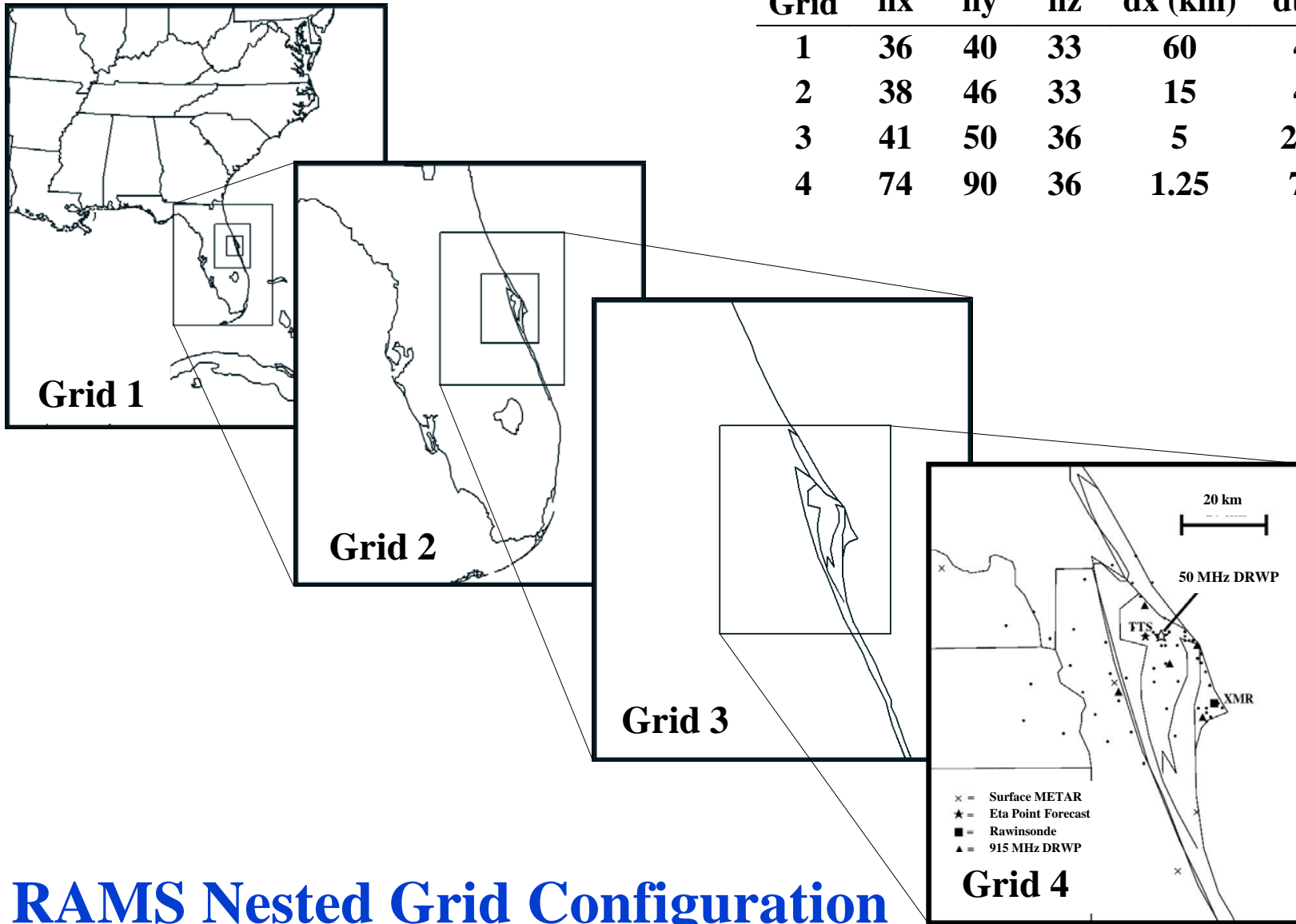
# Background on ERDAS

- **Emergency Response Guidance**
  - Cape Canaveral Air Force Station (CCAFS)
  - Kennedy Space Center (KSC)
- **Regional Atmospheric Modeling System (RAMS)**
- **New version of ERDAS RAMS**
  - AMU recommendations
  - RAMS model upgrade
  - Finer inner-grid resolution, full cloud microphysics
- **Evaluation to validate new configuration**
- **Forecast/Verification tools**

# RAMS Initialization and Forecast

- **Data obtained at 0000 and 1200 UTC**
  - 12-h forecast from NCEP 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 data assimilation scheme)**
- **24-h RAMS forecasts generated**
- **Hourly forecast output available**

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

# RAMS Objective Evaluation

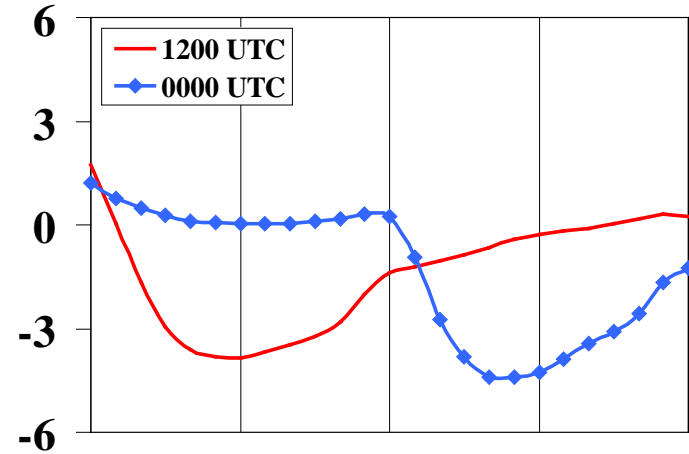
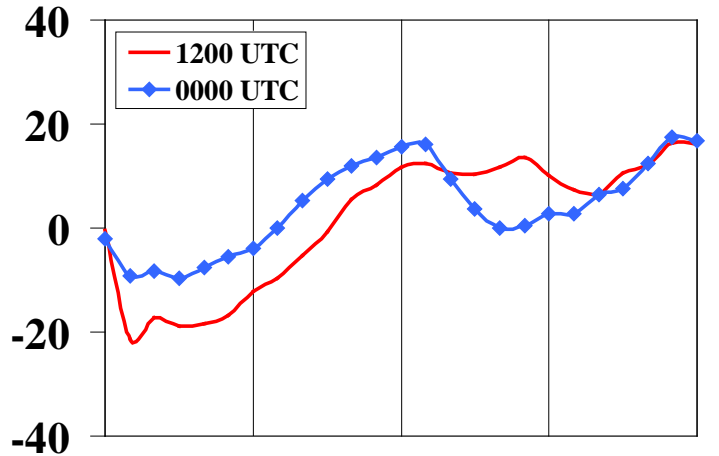
## ■ Point verification

- Nov 1999 – Mar 2000
- Bias, RMS error, standard deviation of error
- All available observational data on grids 1-4
  - » Profilers
  - » Rawinsondes
  - » Surface land, buoy
  - » **KSC/CCAFS towers (grid 4)**
    - Both 0000 and 1200 UTC model cycles
    - T (°C) at 6 ft
    - Wind direction (deg) at 54 ft

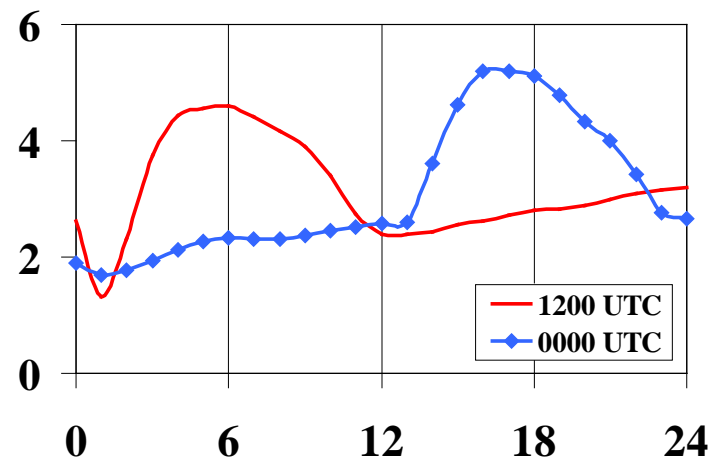
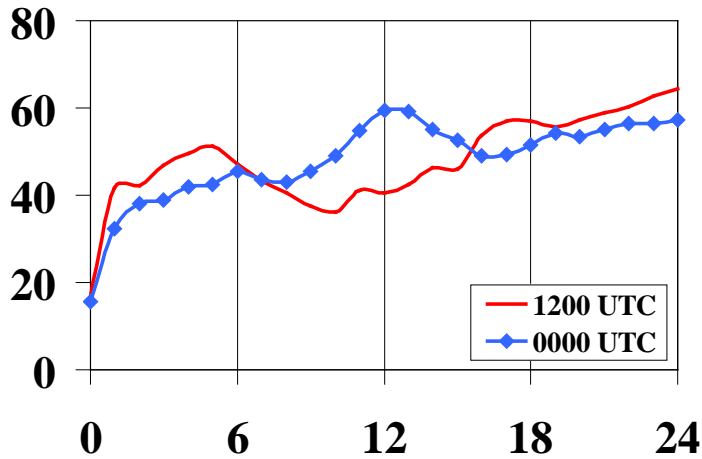
## Wind Direction (deg.)

## Temperature (°C)

Bias



RMS Error



Forecast Hour

Forecast Hour

# RAMS Subjective Evaluation

- **Low-level temperature inversions**
  - Cape rawinsonde
  - Magnitude ( $\Delta T$ ), height, depth ( $\Delta Z$ )
  - 0000 & 1200 UTC forecasts
- **Frontal timing/position**
- **Frontal/pre-frontal precipitation**
- **Low-level minimum temperature**



# Verification of Fronts: Methodology

- **Meteograms of winds, T, & T<sub>d</sub>**
  - 7 stations along Florida east coast (grids 1-4)
  - Analyze variables independently
  - Verify timing at station to nearest hour
  - Examine 3-h changes in each quantity
  - Use RAMS forecast that overlap observed FROPA
- **Error statistics**
  - Pre-frontal conditions (1-h before FROPA)
  - Timing errors
  - Frontal & post-frontal (< 6 h) characteristics
  - N=37 to 100 depending on model run, case & variable

# Verification of Fronts: (Forecast - Observed)

Category	Variable	RMSE	Bias
<b>Pre-frontal Errors</b>	<b>Wind Dirn. (deg)</b>	<b>36.2</b>	<b>-11.8</b>
	<b>T (°C)</b>	<b>3.0</b>	<b>-1.6</b>
	<b>T<sub>d</sub> (°C)</b>	<b>2.6</b>	<b>1.1</b>
<b>Timing Errors</b>	<b>Wind shift (h)</b>	<b>3.7</b>	<b>2.2</b>
	<b>T-change (h)</b>	<b>2.2</b>	<b>0.2</b>
	<b>T<sub>d</sub>-change (h)</b>	<b>3.1</b>	<b>1.2</b>
<b>Frontal Errors</b>	<b>Δ Wind Dirn. (deg)</b>	<b>46.9</b>	<b>1.9</b>
	<b>Δ T (°C)</b>	<b>3.1</b>	<b>-1.9</b>
	<b>Δ T<sub>d</sub> (°C)</b>	<b>6.1</b>	<b>-4.6</b>
<b>Post-frontal Errors</b>	<b>Peak Wind Speed (m s<sup>-1</sup>)</b>	<b>3.2</b>	<b>-2.5</b>

# Verification of Temperature Inversions

	OBS=Y	OBS=N
FCST=Y	86	3
FCST=N	103	15

- **POD: 0.46; FAR: 0.03**
- **CSI: 0.45; Bias: 0.47**

Parameter	RMSE	Bias
Intensity (°C)	4.1	-2.5
Depth (m)	202	59
Height (m)	516	22

## Summary of RAMS Errors

- **Systematic low-level cool bias ( $\sim -4$  to  $-5^{\circ}\text{C}$ )**
- **Non-systematic wind dirn. errors ( $30\text{--}60^{\circ}$ )**
  - Largest at night, smallest during afternoon; small bias
  - Tendency for error growth over 24-h forecast
- **Frontal passages too weak and slightly slow**
  - $T$ ,  $T_d$  changes too small
  - Post-frontal wind speed too weak
- **Under forecasts temperature inversions**
  - Underforecast occurrence
  - Intensity too weak; slightly too deep

# Contacts

- **Publications:**

  - Interim & final report*

  - Weather and Forecasting manuscript*

- **AMU Quarterly reports:**

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

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