Using a Suite of Observational and Forecasting

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Key and Conventions:

• In t-hgt x-sections,

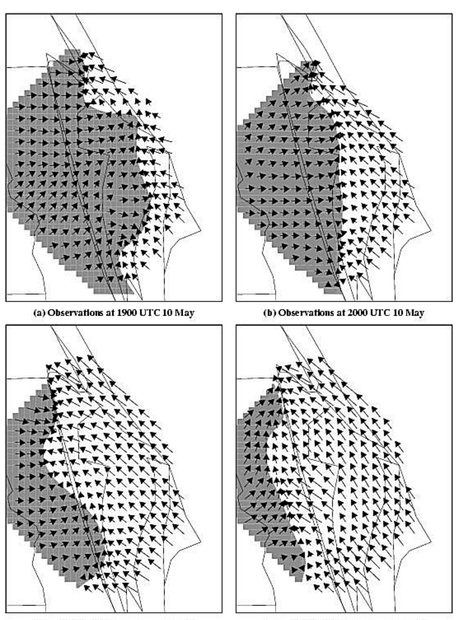
← time increases from right to left.

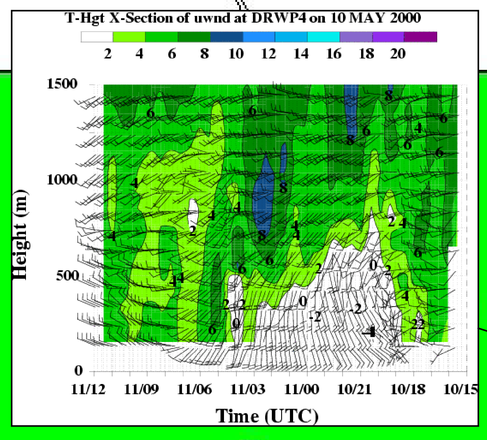
= KSC/CCAFS Towers

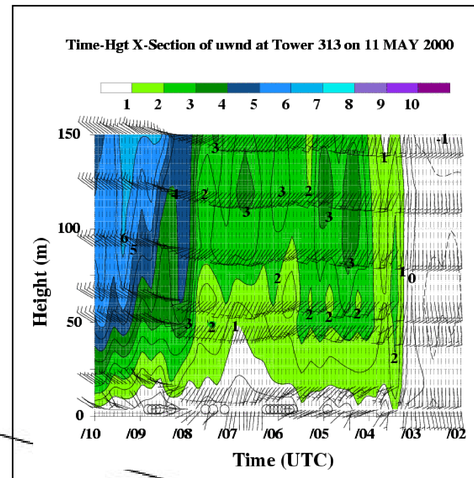
= 915-MHz Doppler Radar Wind Profilers

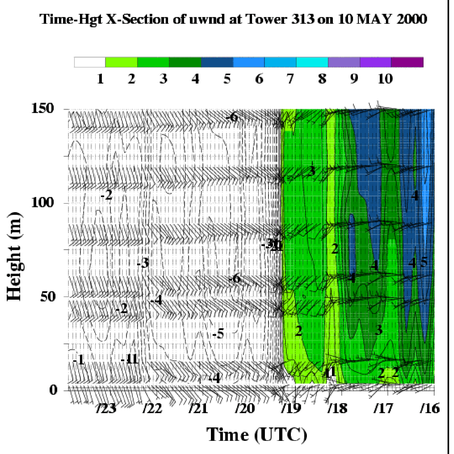
10-13 May 2000 Sea / Land Breeze Events:

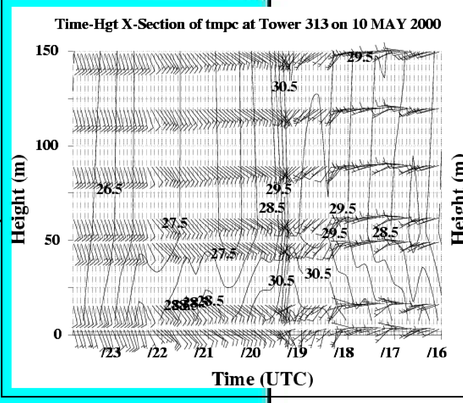
- **Observations from 10th and 11th** (left half)
  - Distinct Sea-Breeze Front
  - Dual Land-Breeze Surge
  - Time-height X-sections
    - 915-MHz profilers
    - Tower 313
- **Sea-Breeze Forecast Verification** (right half)

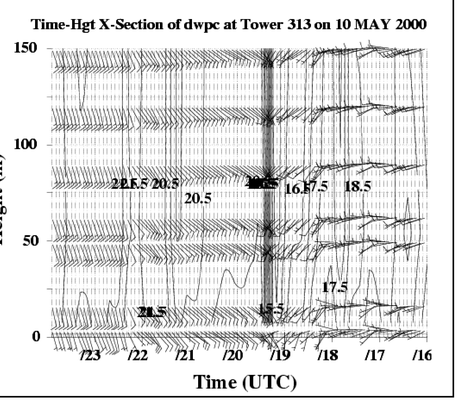


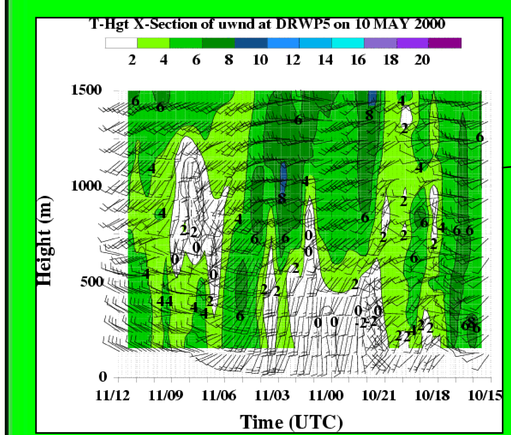


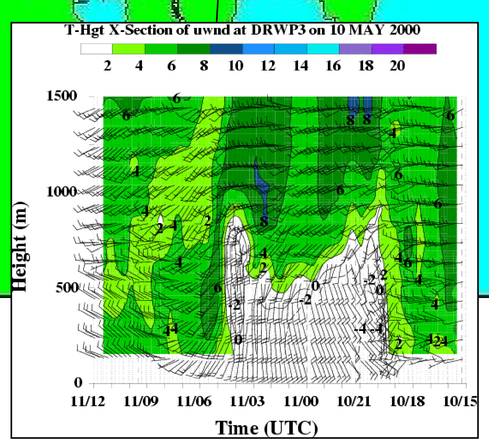


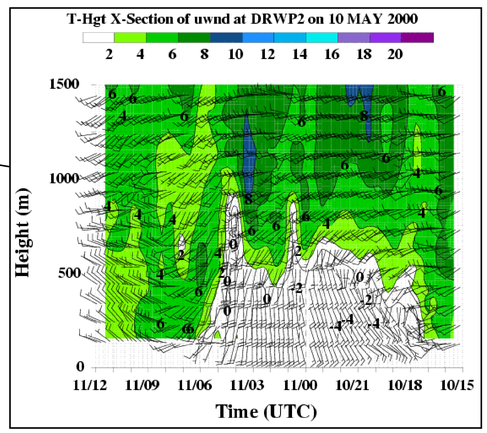


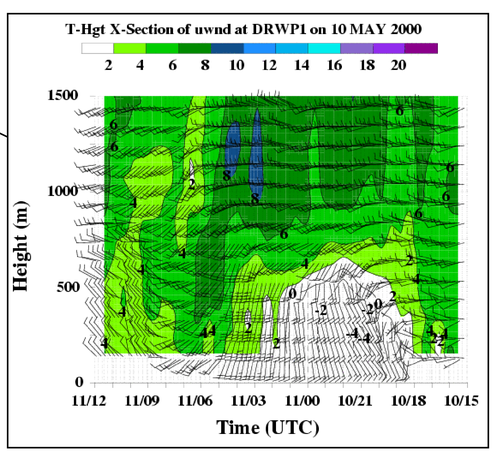












Tools to Study a Sea / Land Breeze Event

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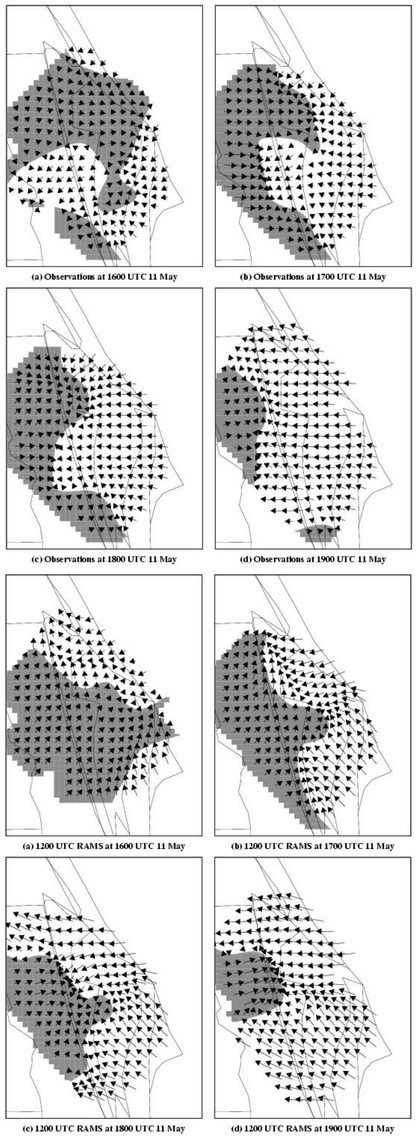
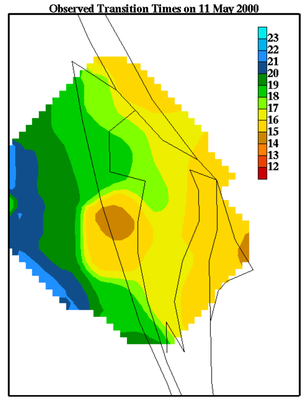
ASRC Aerospace Inc.

Francis J. Merceret / Jennifer G. Ward
NASA Kennedy Space Center

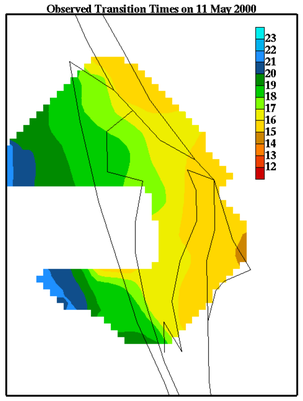


Observed Sea-Breeze Transition Times

(Raw)

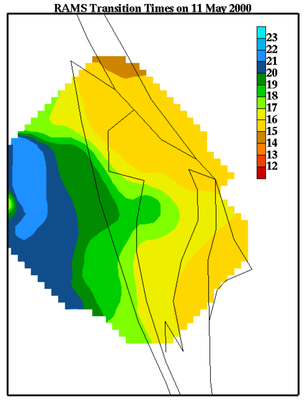


(Eroded)



RAMS Sea-Breeze Transition Times

(Raw)



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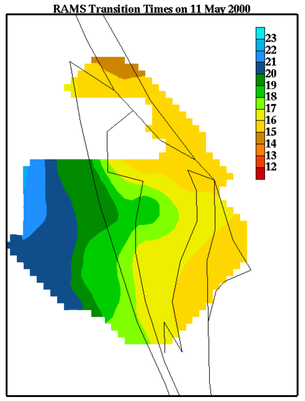
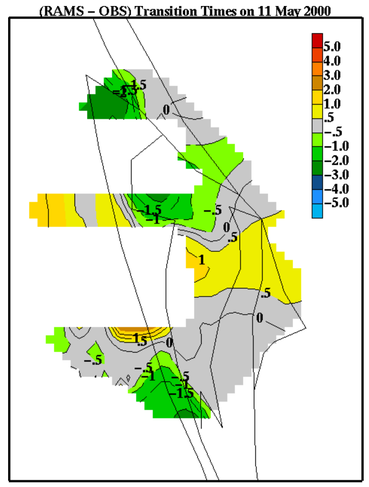
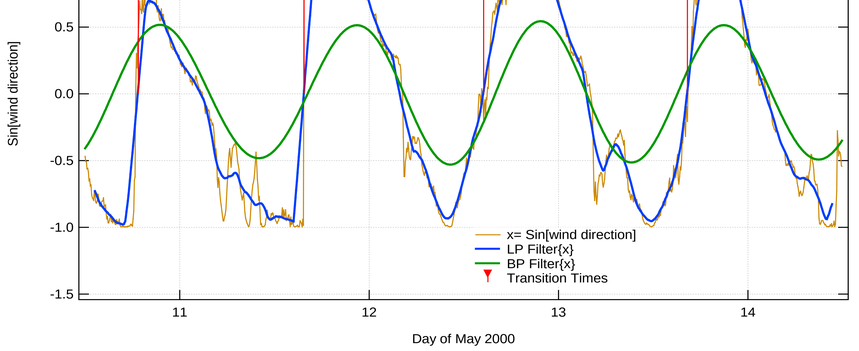




Contour Error Map of Sea-Breeze Transition Times (Eroded)



Sea-breeze transition time filter for 11-13 May at a sample grid point, using combined band-pass and low-pass boxcar filters

Automated Sea-Breeze Verification Technique: Contour Error Map (CEM)

- **Regional Atmospheric Modeling System (RAMS)**
- **Grid point processing**
  - **Barnes objective analysis of 5-min wind tower observations and 5-min RAMS point forecasts**
  - **Compute sin of wind direction at each grid point**
  - **Determine offshore vs. onshore wind**
- **Temporal processing**
  - **Time series filtering at each point**
  - **Best estimate for sea-breeze transition time**
- **Spatial processing**
  - **Compute 2D spatial gradients & combine filtered points into single image**
- **Comparison and Analysis**
  - **Verifies RAMS sea breeze against OBS**
  - **Error distribution fit to Gaussian function**
  - **Mean post-sea breeze wind direction & speed**
- **Image Erosion**
  - **Suppresses contamination by river breezes**
  - **Gradients of sea-breezes transition times computed**
  - **Removed areas with negative gradients (i.e. boundaries moving towards coast, rather than inland)**

Gaussian fit parameters for eroded CEM histograms, subjectively-determined range of observed and RAMS times of the SB transition (in UTC), and the mean post-SB observed and forecast wind directions (WD, degrees) and wind speeds (WS, m s^{-1}) as calculated by CEM.

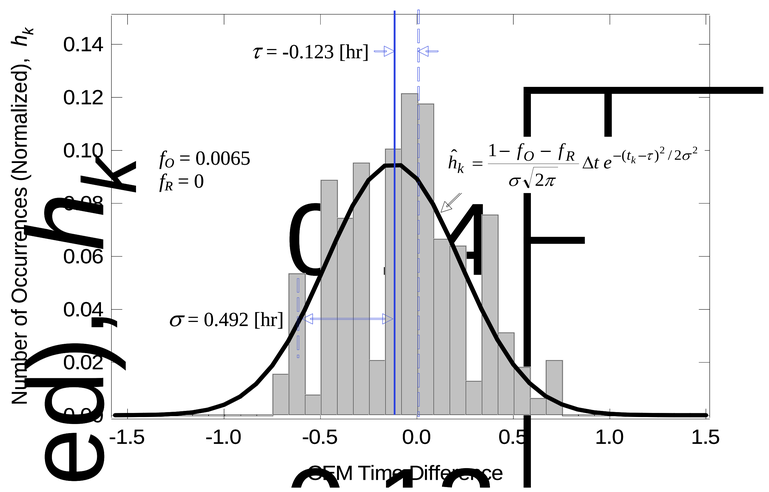
Day	τ (h)	σ (h)	f_O (%)	f_R (%)	Obs Times	RAMS Times	Post-SB Obs WD	Post-SB RAMS WD	Post-SB Obs WS	Post-SB RAMS WS
10	-3.1	1.4	31	8	1715-2230	1530-1815	142°	126°	4.5 m s^{-1}	6.2 m s^{-1}
11	-0.0	0.9	21	26	1445-1945	1515-1915	106°	126°	3.4 m s^{-1}	6.0 m s^{-1}
12	0.0	0.5	8	17	1400-1530	1415-1530	80°	97°	3.0 m s^{-1}	4.9 m s^{-1}
13	-0.6	0.5	2	12	1500-1730	1500-1630	85°	86°	3.3 m s^{-1}	4.2 m s^{-1}

RAMS Attributes:

- **1.25-km grid spacing**
- **East-central FL domain**
- **Cold-start initialization**
- **Output every 5 minutes**
- **Interpolated to tower sites**
- **Refer to paper for details**

Parameter definitions:

τ = mean bias
σ = standard deviation of bias
f_O = fractional grid area with only observed SB transition
f_R = fractional grid area with only RAMS SB transition



Sample SB transition time error distribution and Gaussian function fit for entire analysis grid domain