Characteristics of Nocturnal Land Breezes over the Kennedy Space Center (KSC), Florida

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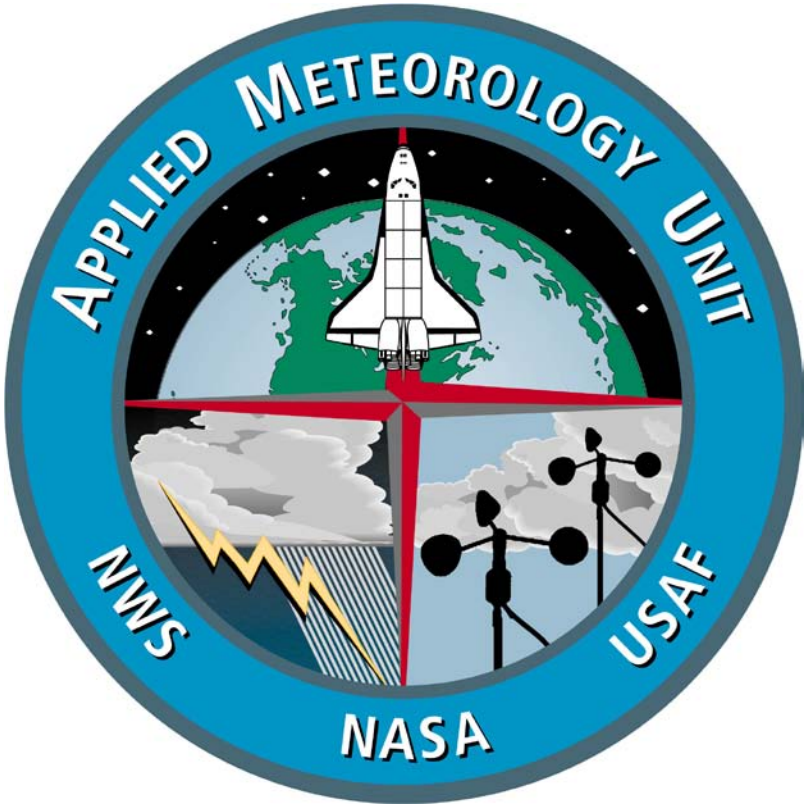
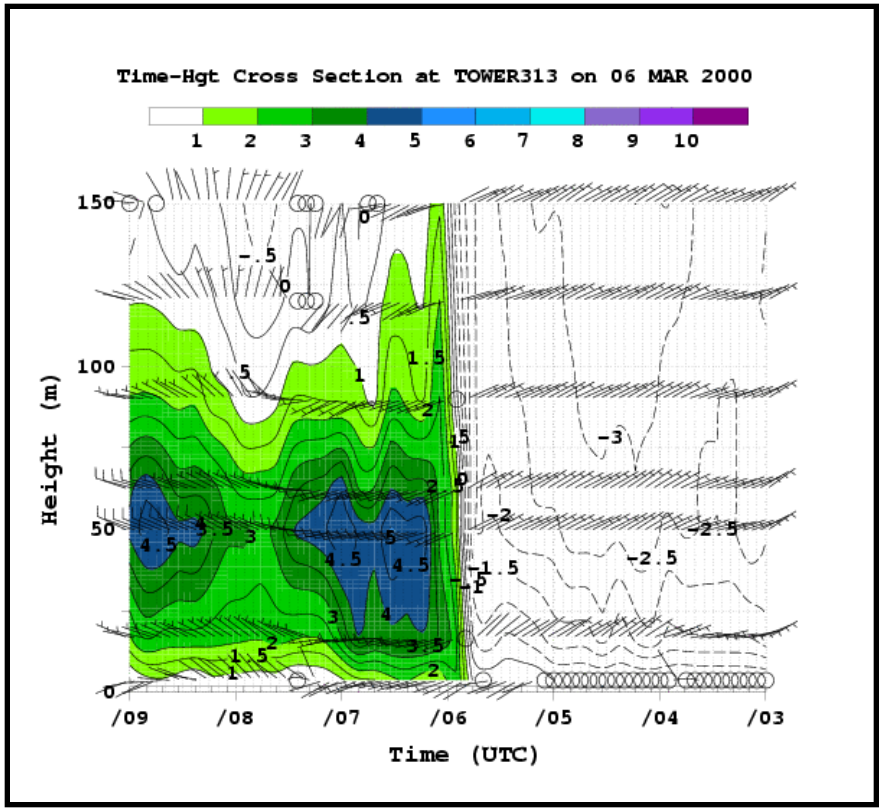


Talk Outline

- **Motivation / Objective for Studying Land Breezes**
- **Analysis Data Set**
- **Sample Events**
  - **6 April 2000**
  - **27 April 2000**
- **Seven-Year Climatology**
- **Summary**



Motivation & Objective

- **Operational Significance of Land Breezes at KSC**
  - **Toxic dispersion forecasts during launch operations**
    - **Influenced by low-level winds and stability**
    - **Critical to safety of Range personnel and public**
  - **Fog development / low cloud ceilings**
  - **Low temperatures**

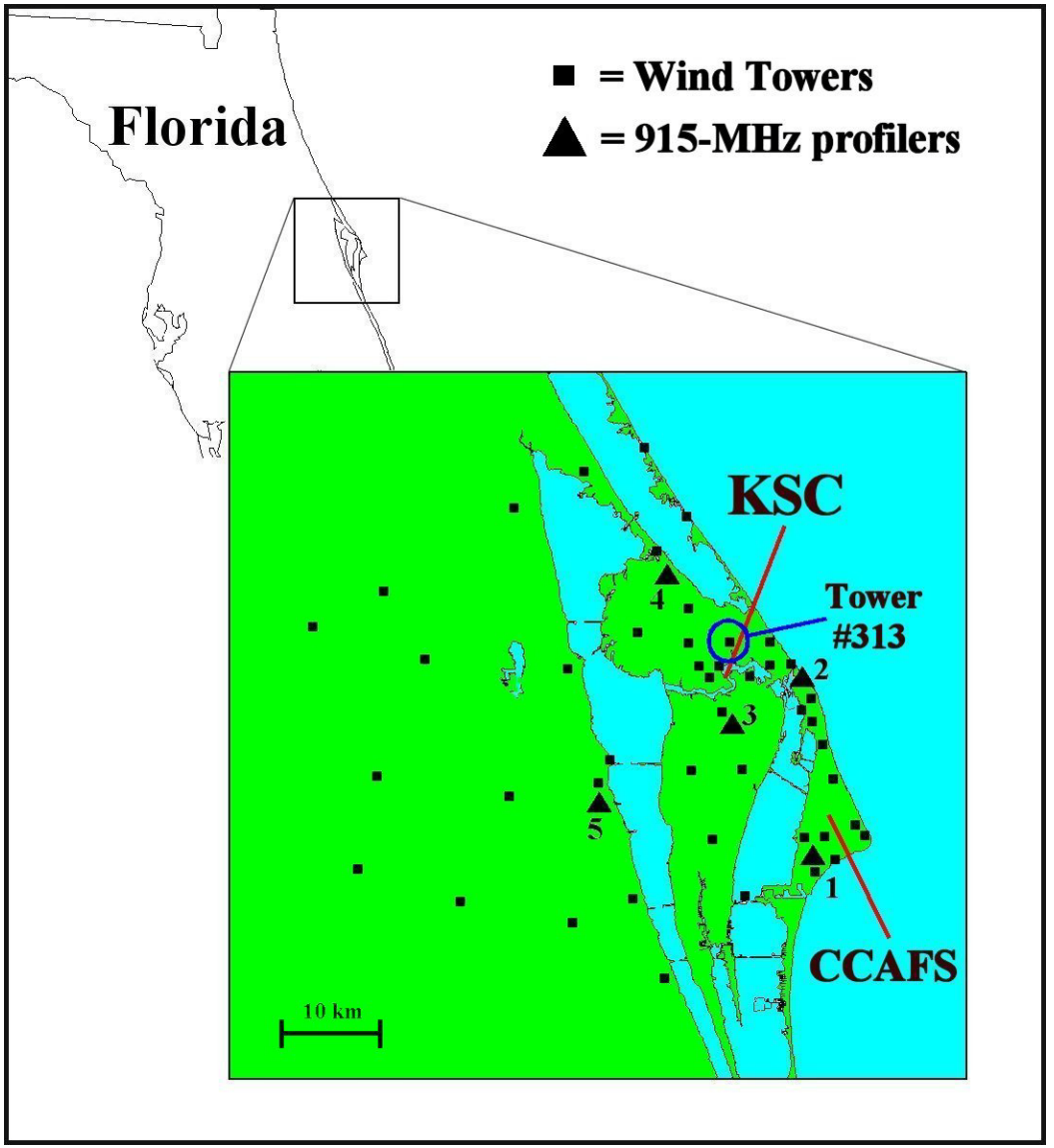
- **Objective is to Develop Forecast Rules that:**
  - **Improve predictions of land-breeze occurrence**
  - **Determine timing, duration, speed, and direction**

Wind Towers and 915-MHz Profilers

- **44 wind towers**
  - **5-km avg. spacing**
  - **6 ft: T, T_d**
  - **54 ft: Wind (all), T (some)**
  - **Tower 313: up to 492 ft over south KSC**

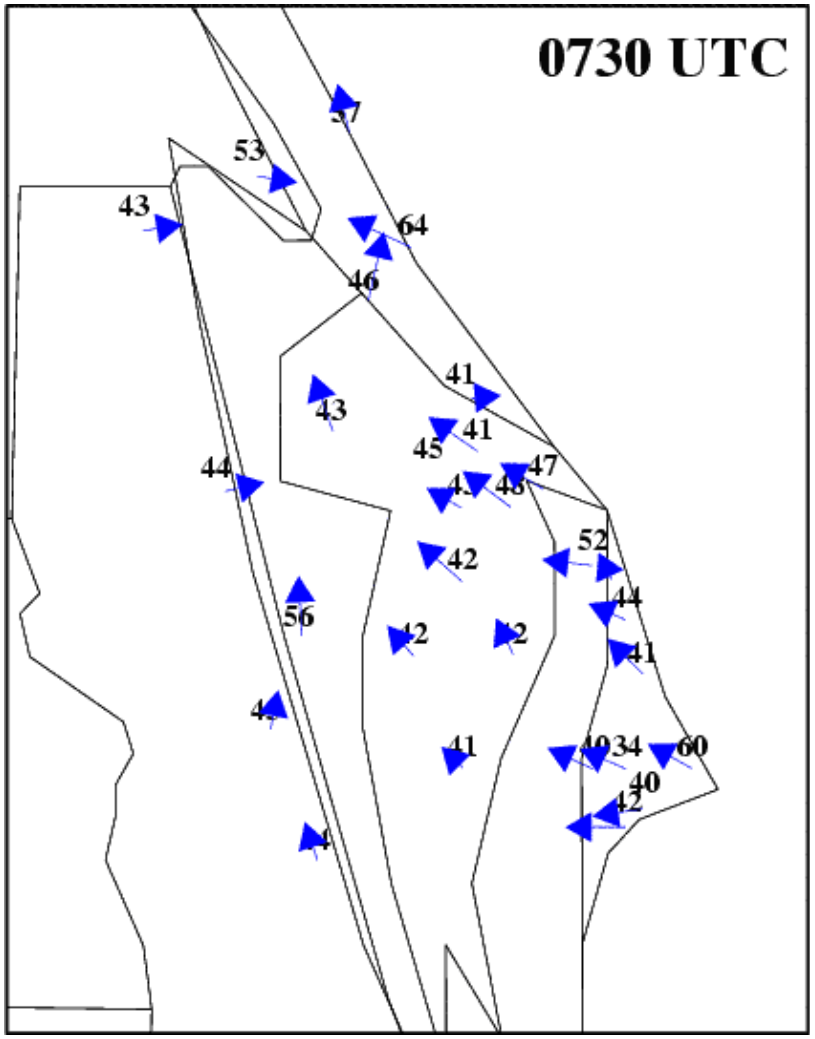
- **915-MHz profilers**
  - **Five across KSC/CCAFS**
  - **Lowest gate: 130 m**
  - **Resolution: 100 m**
  - **Highest gate: up to 6 km***

***depends on meteorological conditions; typically around 3 km.**

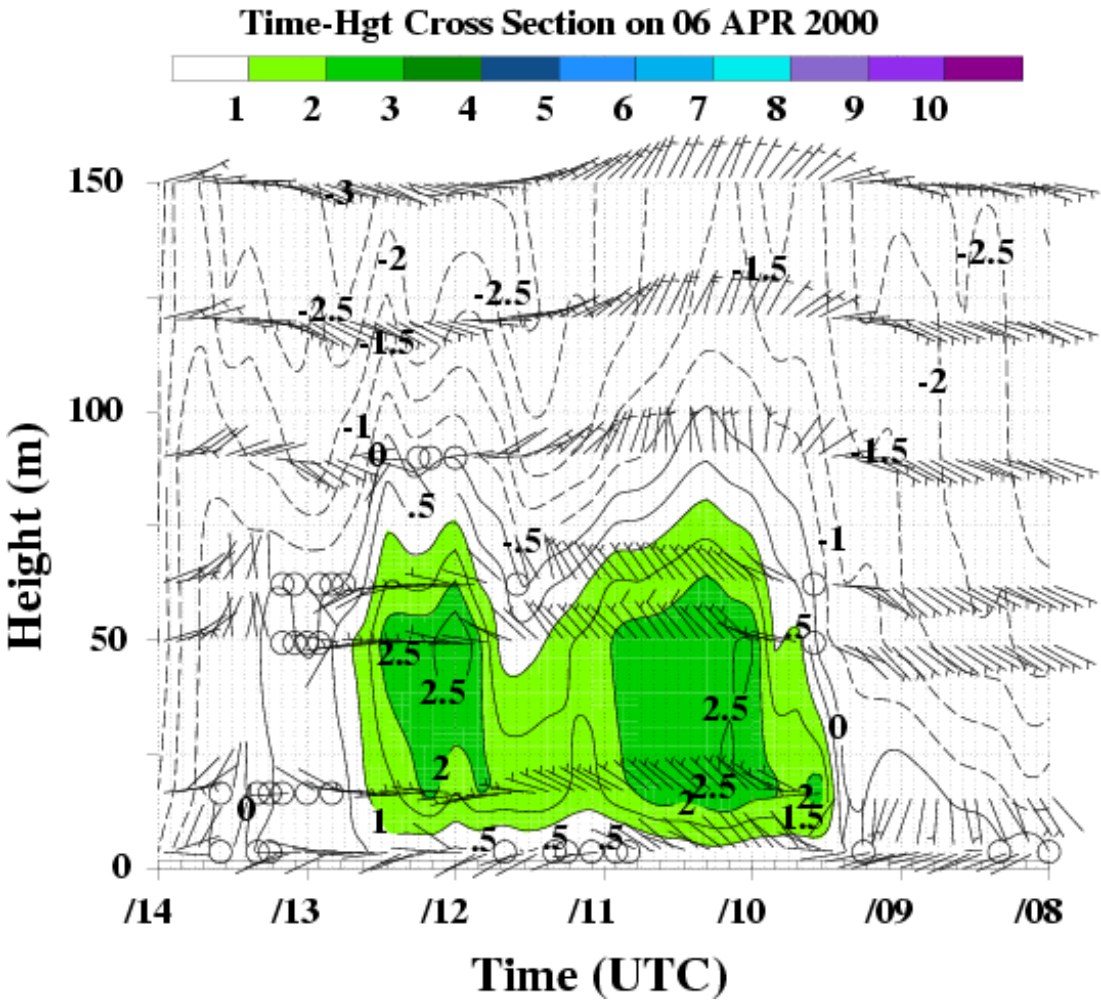


6 Apr 2000: Shallow Event with Cold Temps

6-ft temp; 54-ft winds

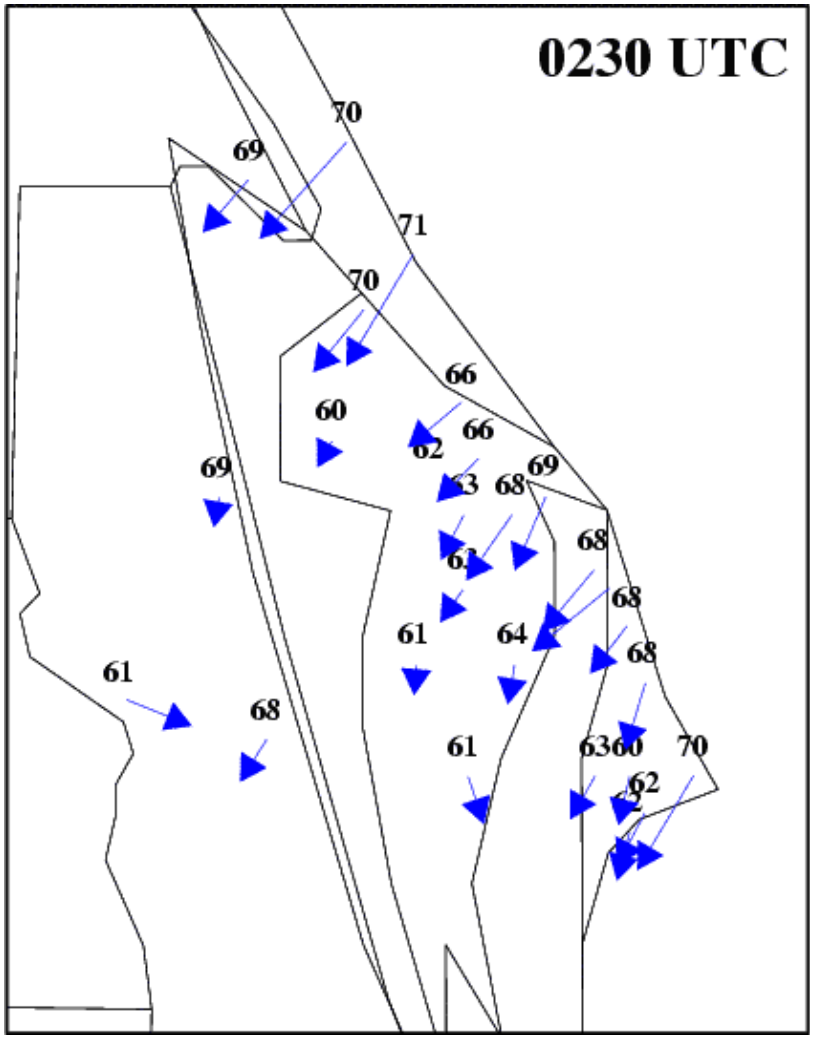


Tower #313 u-wind, wind barbs

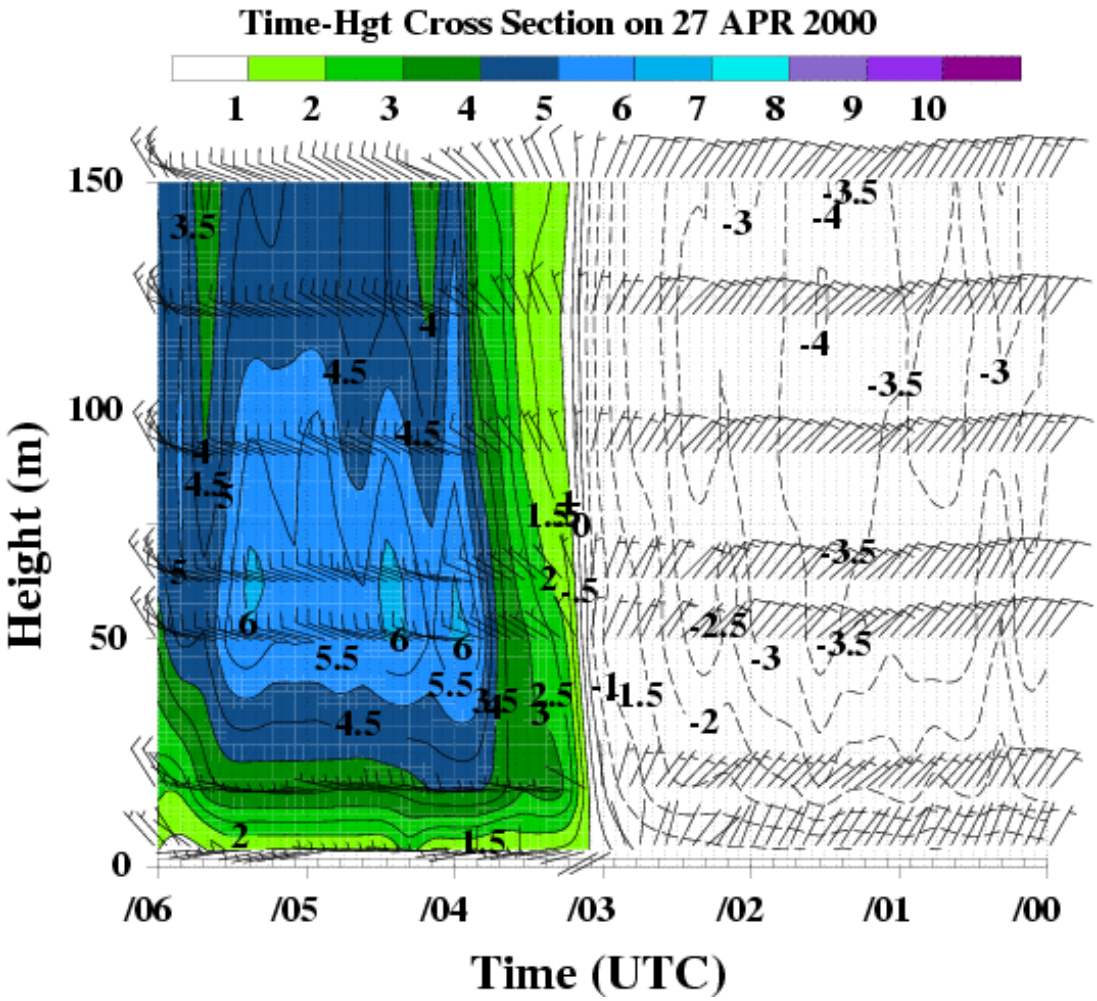


27 Apr 2000: Retreating Sea-Breeze Event

6-ft temp; 54-ft winds



Tower #313 u-wind, wind barbs

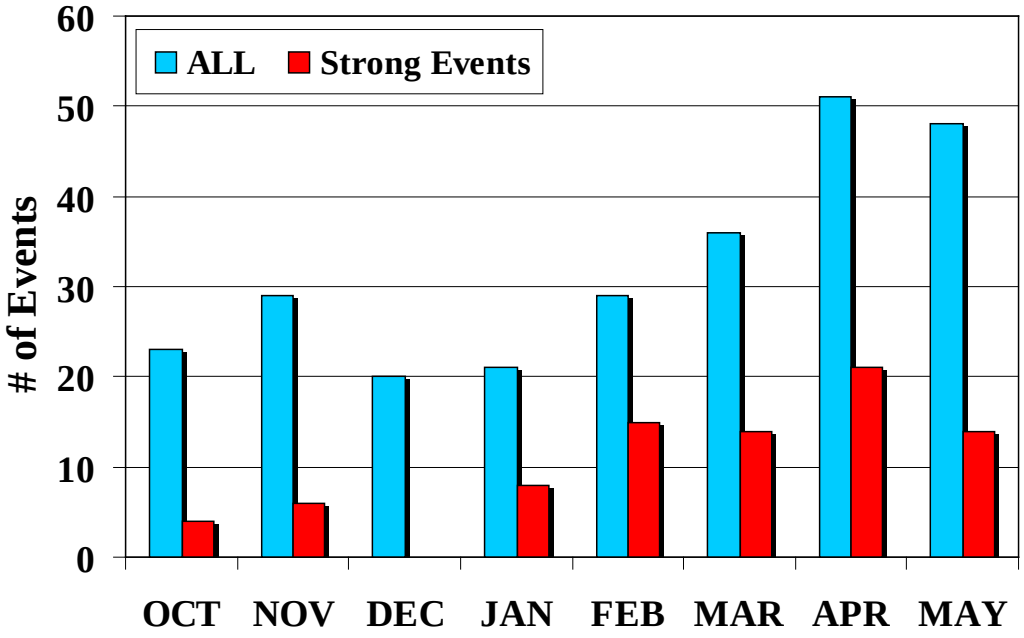


Land-Breeze Climatology at KSC

- **Seven Years: 1995 to 2002**
  - **Non-convective months only: OCT to MAY**
  - **Considered only mostly clear, rain-free nights**
  - **Average winds under 4 m s^{-1}**

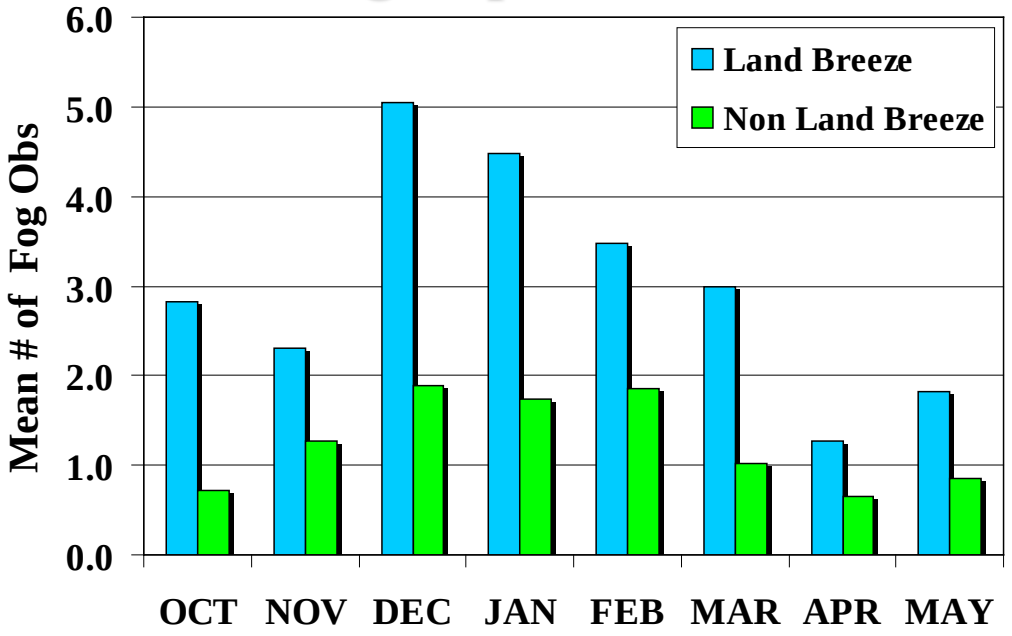
- **Objective boundary identification technique**
  - **Barnes (1964) analysis of wind towers every 5 min**
    - **1.25-km grid spacing**
    - **Temp at 6 & 54 ft; T_d at 6 ft; Wind at 54 ft**
  - **Tracks seaward-moving wind-shift lines**
  - **Refer to conference paper for algorithm details**

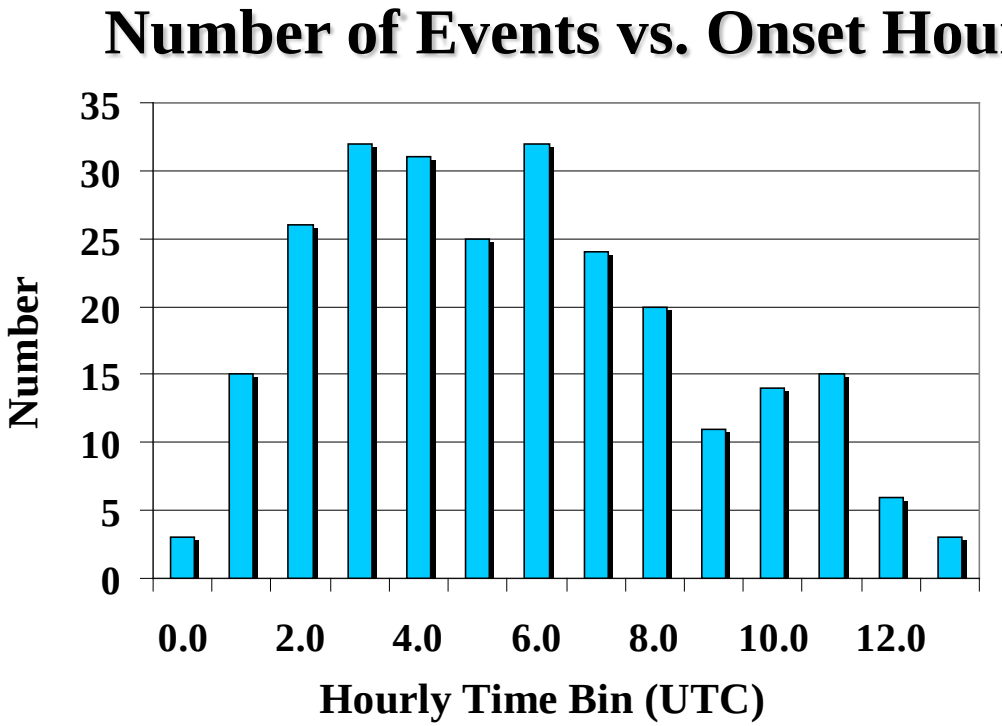
LB Climatology Results: 1995-2002



Number of Events vs. Month

Number of Hourly TTS Fog Reports vs. Month





LB Climatology Results, cont.

Tower 313 Land-Breeze Stats

	Depth			Sea Breeze During PM	
	> 150 m	< 150 m		SB	No SB
# Days	84	78	# Days	90	72
Mean Time	4.13	7.95	Mean Time	5.16	6.98
Median	4.00	8.13	Median	4.75	7.38
% SB	78.6%	30.8%			

Summary and Conclusions

- **Land breezes most frequent in late winter/spring**
  - **End of cool / dry season: Dry air and land mass**
  - **Largest diurnal contrast in temperatures**
- **Two possible types of land breezes over KSC**
  - **Retreating sea breeze**
    - **Early onset time**
    - **Deep column of offshore winds; stronger fronts**
  - **Thermally-driven land breeze**
    - **Late onset time**
    - **Shallow circulation (less than 150 m); weaker fronts**
- **AMU Quarterly Reports**

http://science.ksc.nasa.gov/amu/home.html

27 Apr 2000: 915-MHz Profiler #3