

An analysis of the Northern Gulf of Mexico sea breeze and associated thunderstorms

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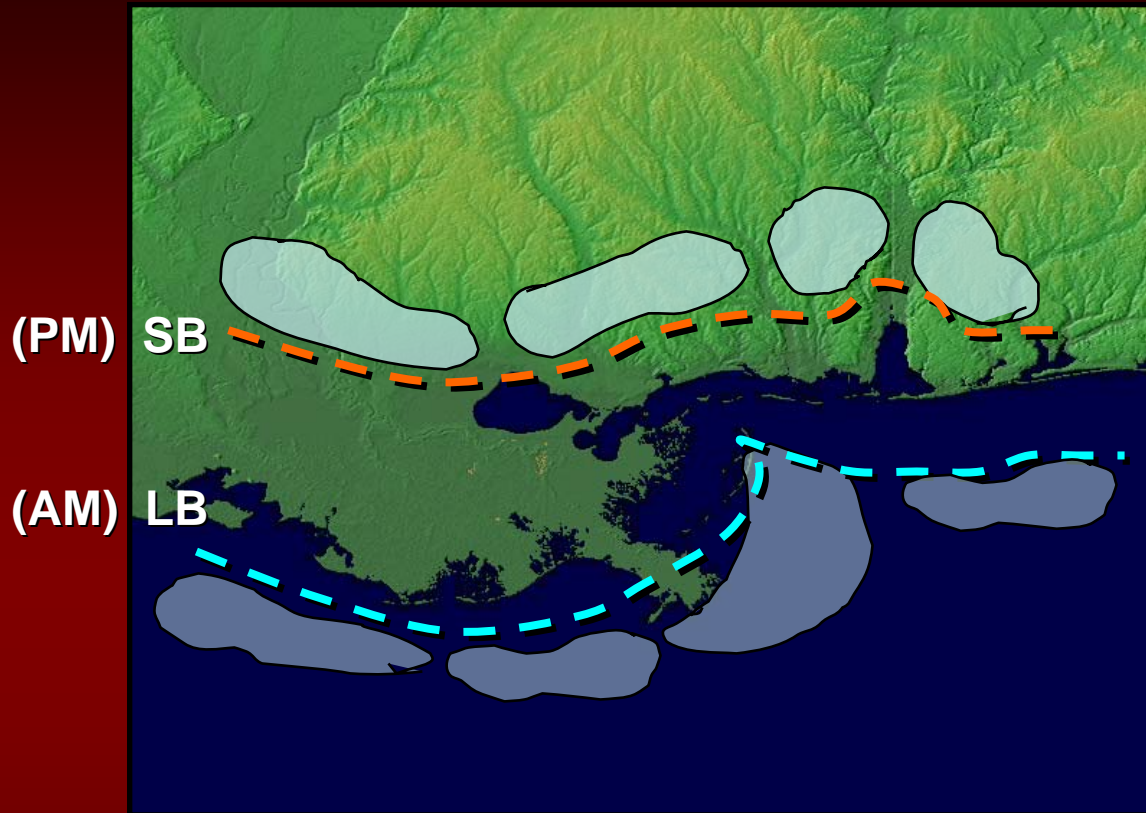
16th Conference on Applied Climatology



Overview



- The sea breeze is commonly observed along the northern Gulf coast during the summer (June, July, August)
- Intersection of a sea breeze front with boundary layer perturbations (i.e. horizontal convective rolls) will trigger convection (Fovell 2005)



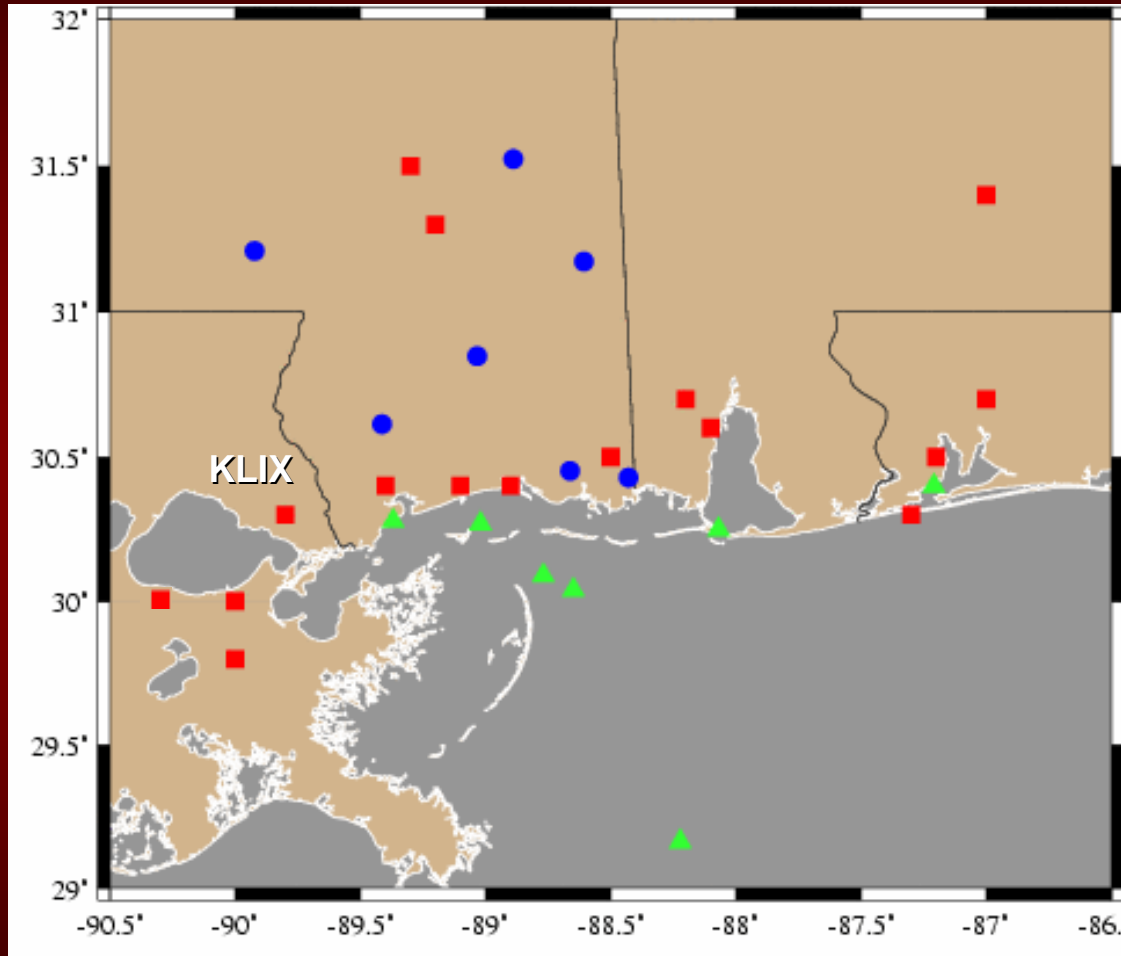
The exact orientation and migration of the sea (land) breeze front, and the focus of associated convection, depends upon:

- the temperature gradient between land and water
- the prevailing boundary layer flow
- land elevation
- shape of the coastline

Methodology

- Surface observations, upper air observations at KLIX, and NEXRAD data at KLIX collected for:
June, July, and August of 2003 – 2005 (276 days)
- Reduced dataset to “sea breeze” days with the following criteria:
 - wind speed at land stations does not exceed 7.5 mph (or 3.4 m s^{-1}) at 00 UTC or 12 UTC
 - no precipitation event generated by a synoptic system or by widespread air mass thunderstorm activity, as discerned from NEXRAD data
- 3-year averages of meteorological quantities computed for remaining days (168) by month

Observing stations



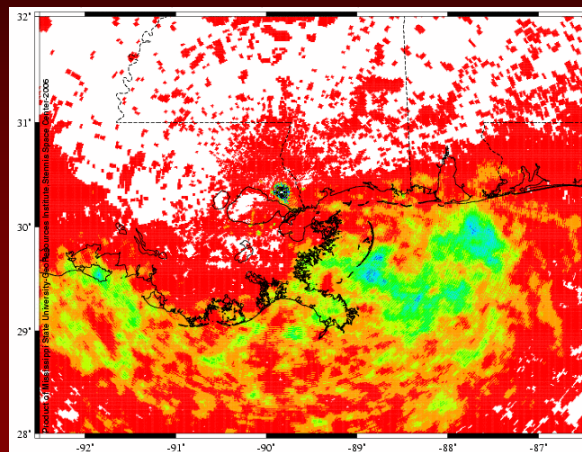
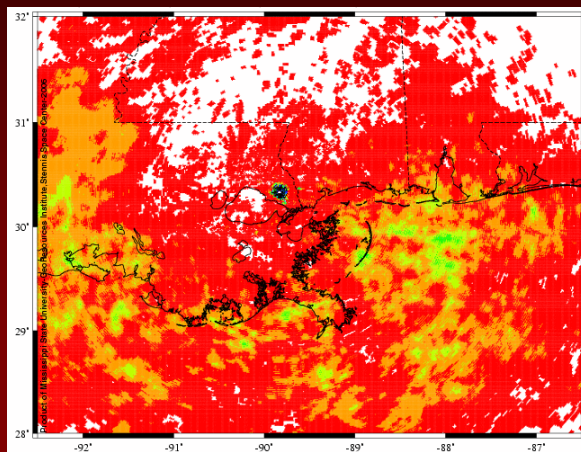
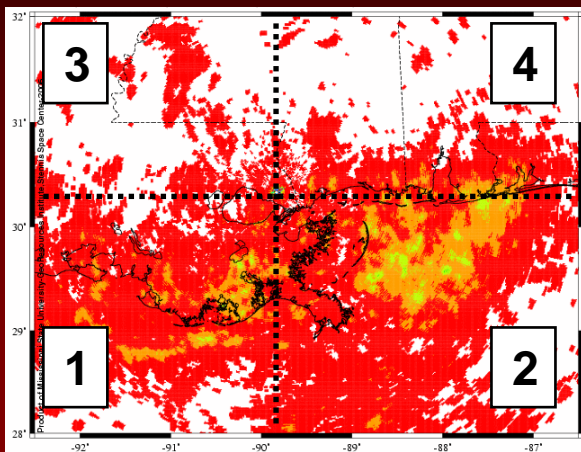
Red squares - NOAA stations

Blue circles - Mississippi RAWS stations

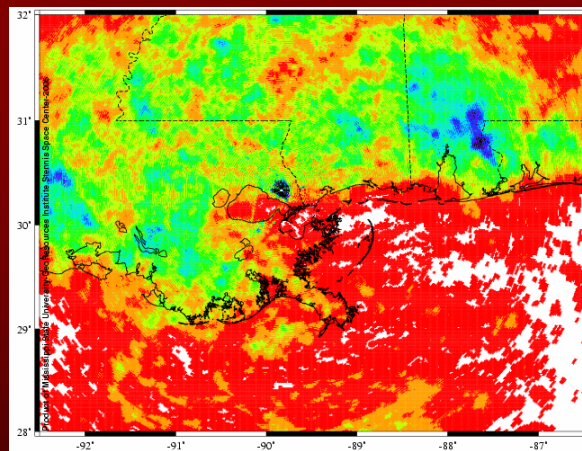
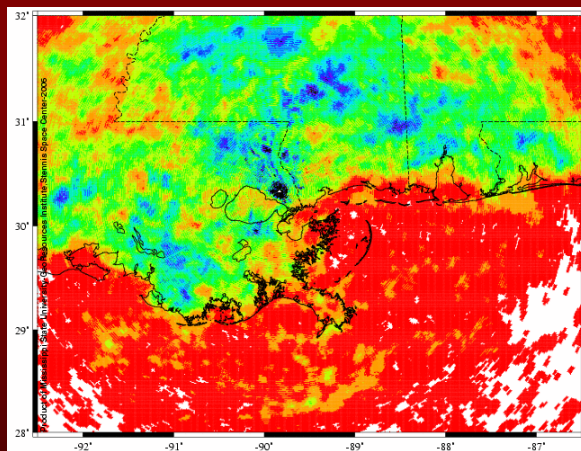
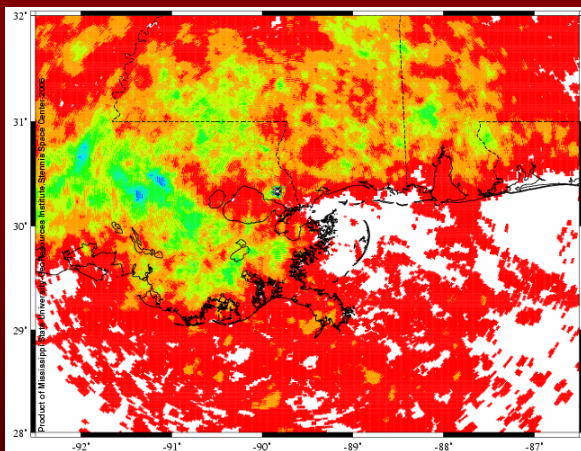
Green triangles - buoys

Monthly composites of convective rain pixels for 2003 – 2005 on “sea breeze” (168 of 276) days

12 - 16 UTC



20 - 00 UTC



JUNE

JULY

AUGUST



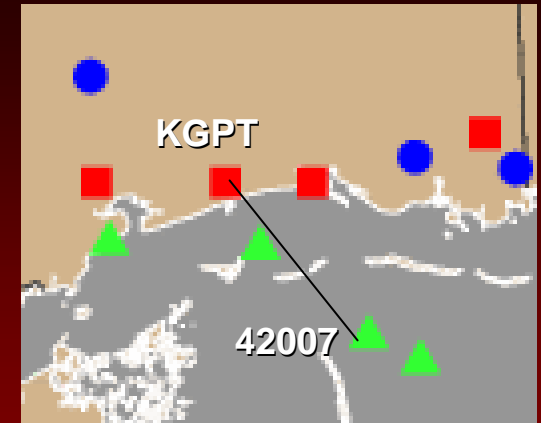
total radar pixels \geq 30 dBZ

Average WIND DIR and SPEED

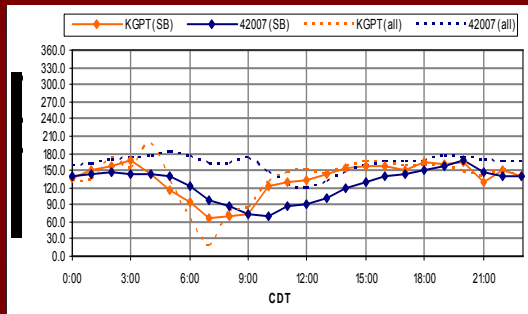
for 2003 – 2005

on “sea breeze” (168 of 276) days

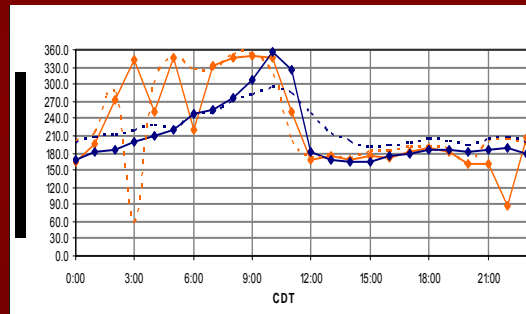
KGPT (orange line), Buoy 42007 (blue line)



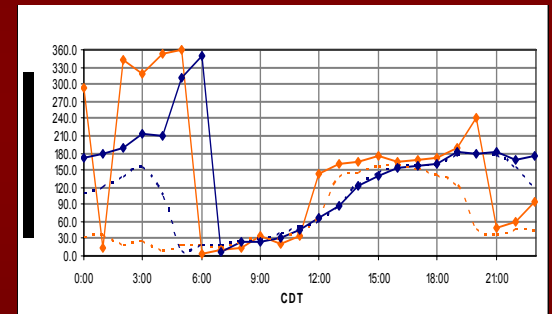
wind dir.



JUNE

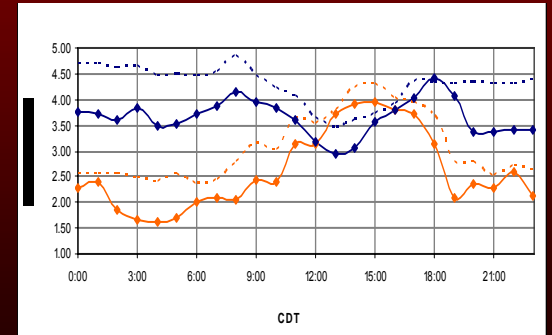
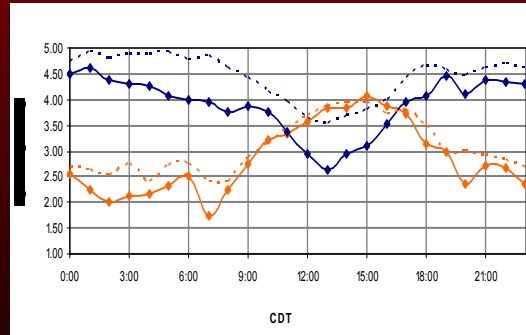
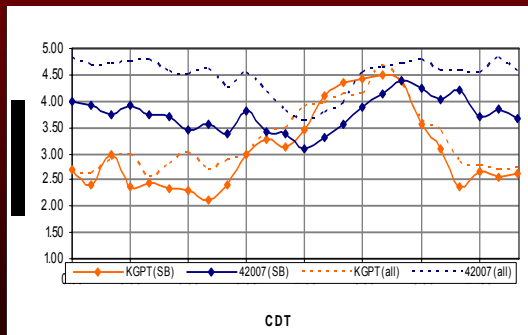


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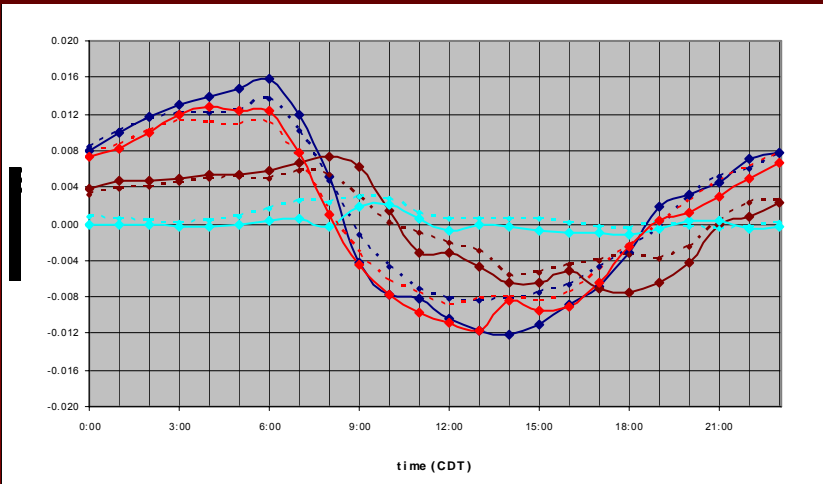
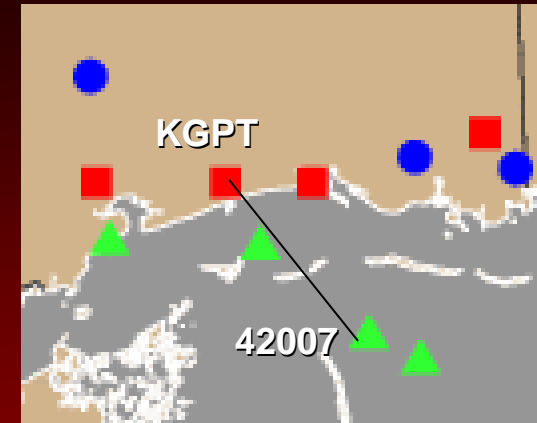


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wind speed



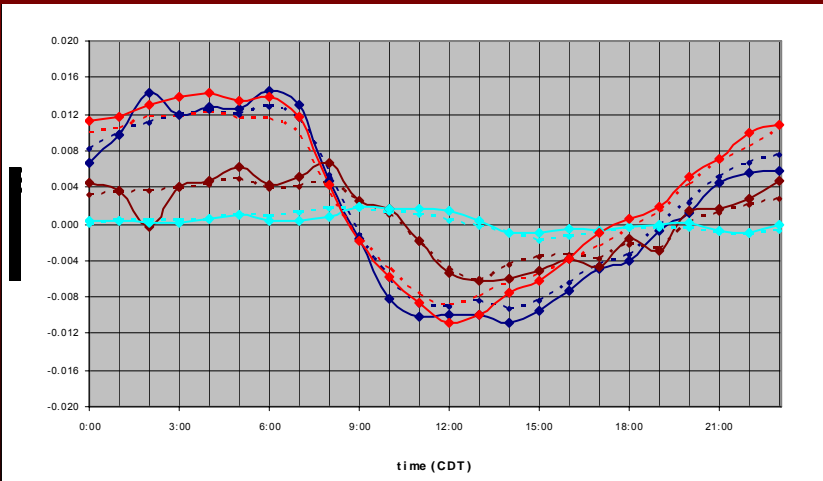
Average AIR DENSITY DIFF. for 2003 – 2005 on “sea breeze” (168 of 276) days



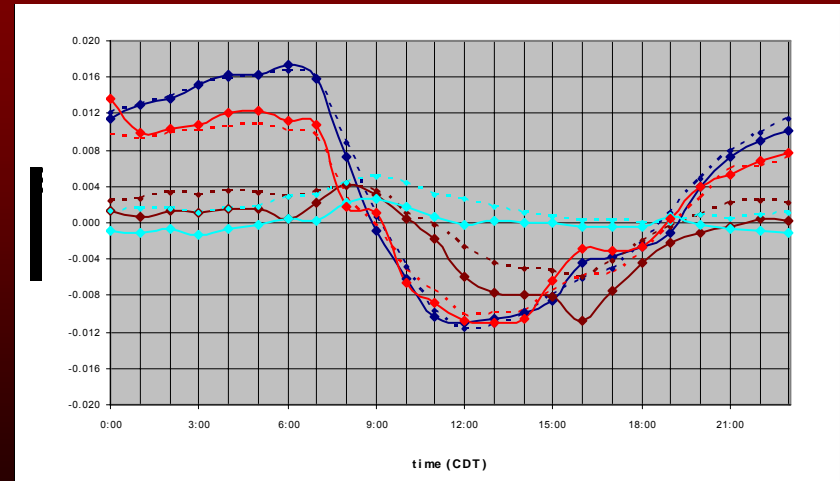
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Dark blue line:
Density difference of KGPT – 42007

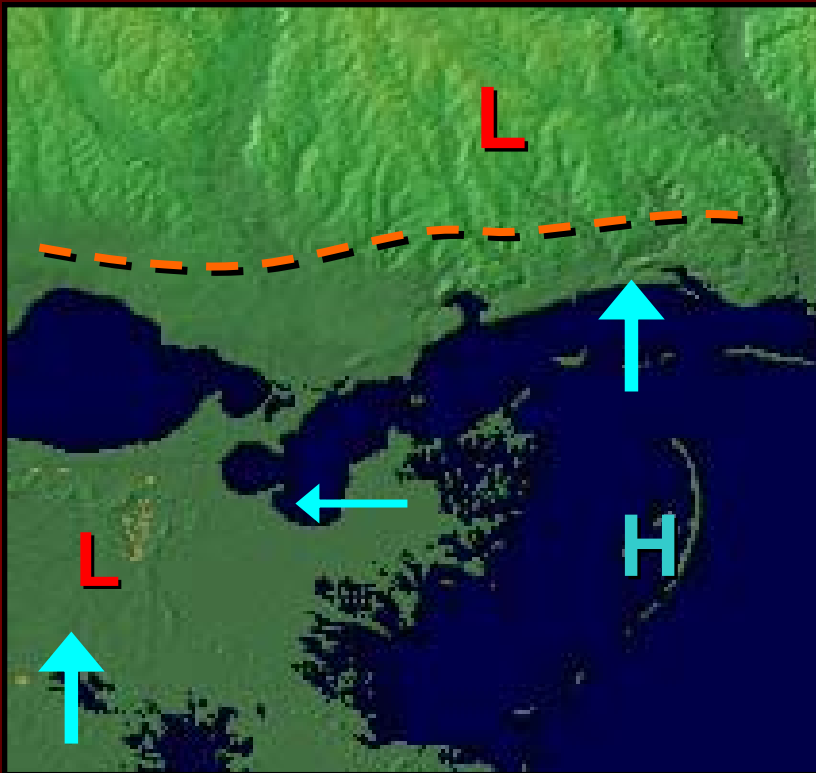
AUGUST



JULY

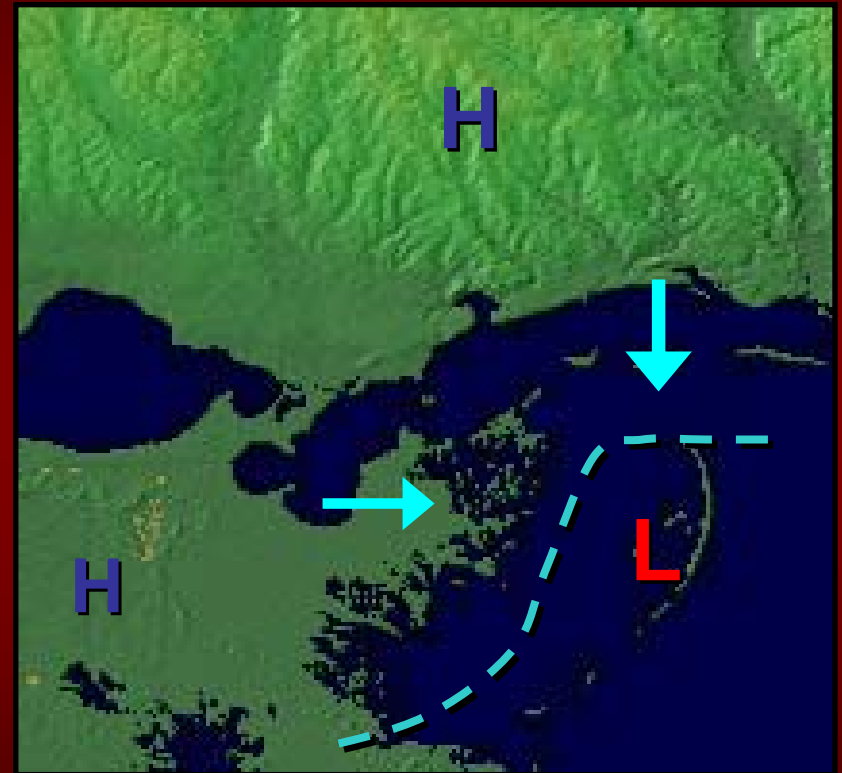


Flow distribution



Afternoon sea breeze

- flow primarily from the south
- resulting front runs west-east



Morning land breeze

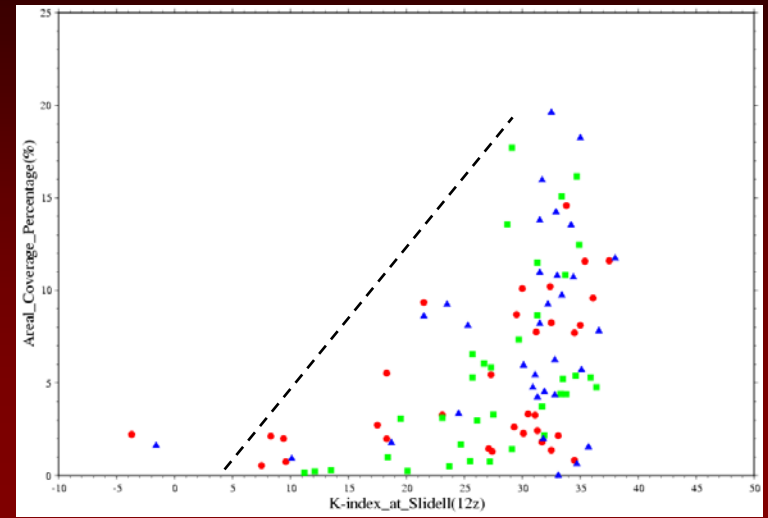
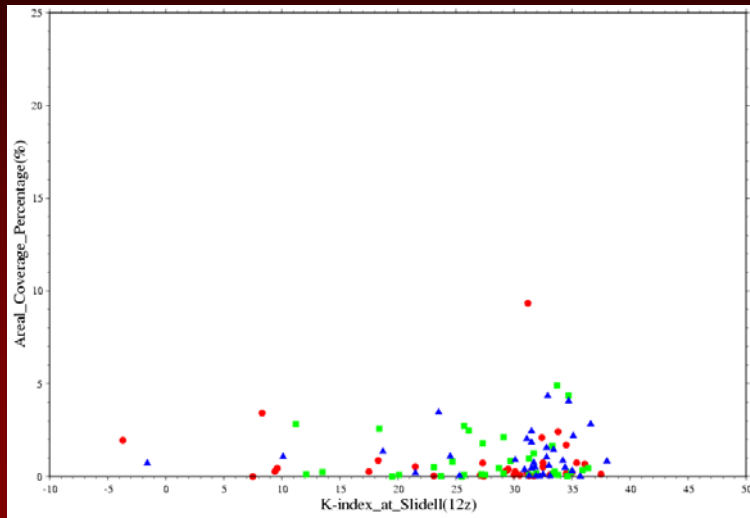
- flow from north and west
- resulting front converges over barrier islands

Methodology, cont.

- Assess predictive capability of upper-air parameters for areal precipitation coverage (APC)
 - Compare 00 UTC and 12 UTC parameters against following 4-hr composites of APC
- **K-index**
 - 700-hPa Dew. Dep.
 - 850 - 500 hPa Γ
- CAPE
- 850-hPa wind dir.
- **PW (1000 - 300 hPa)**

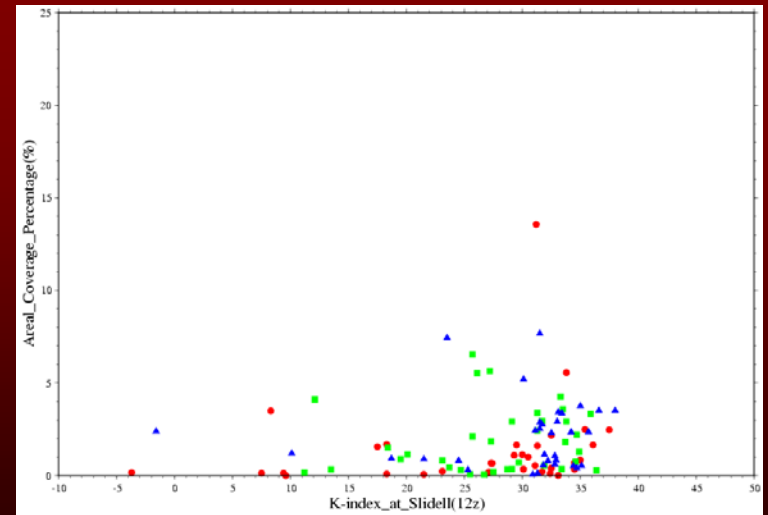
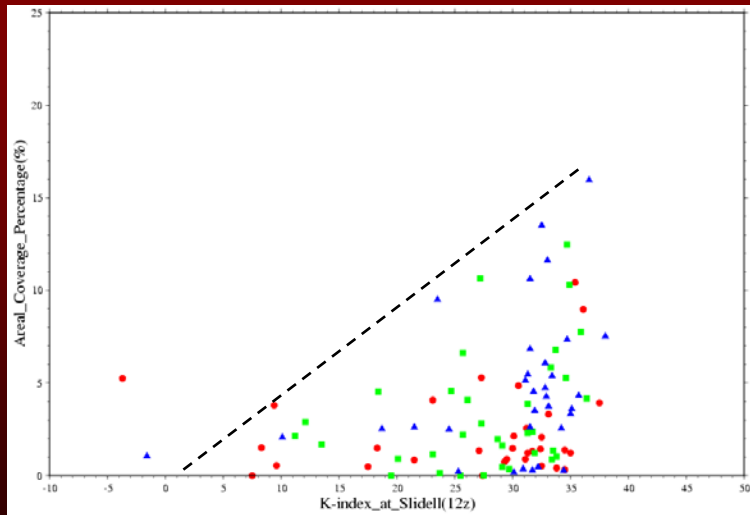
12 UTC K-index versus 4-hr Areal Precipitation Coverage

NE sector (4)



▲ 2003 ■ 2004 ● 2005

SE sector (2)

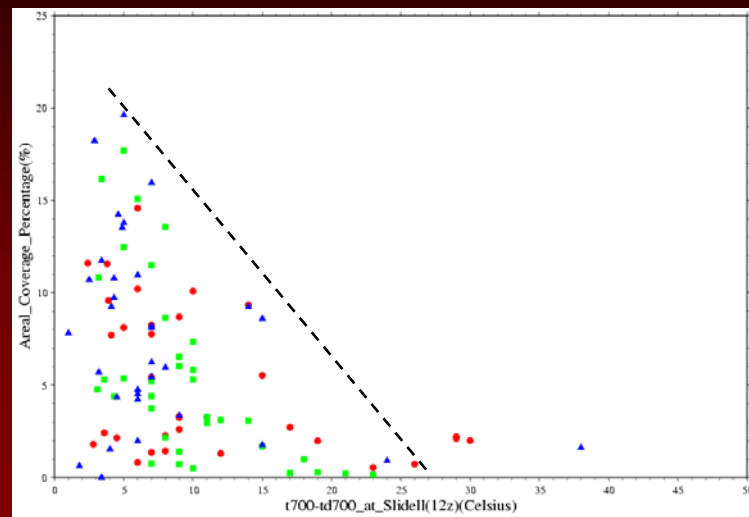
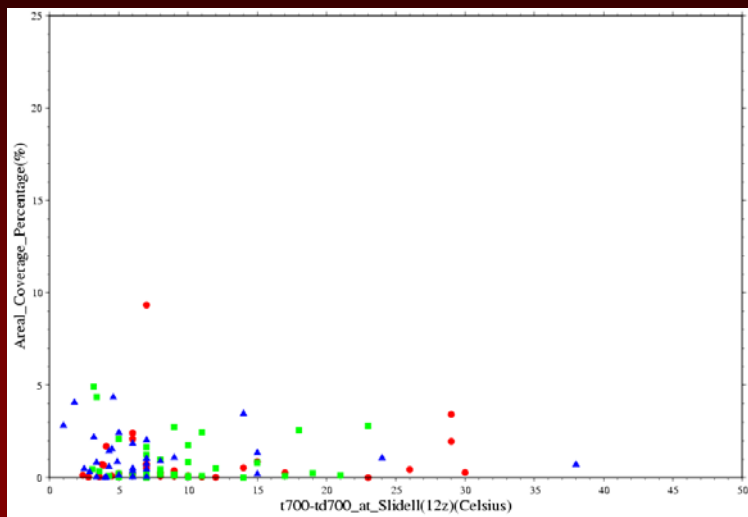


12 - 16 UTC

20 - 00 UTC

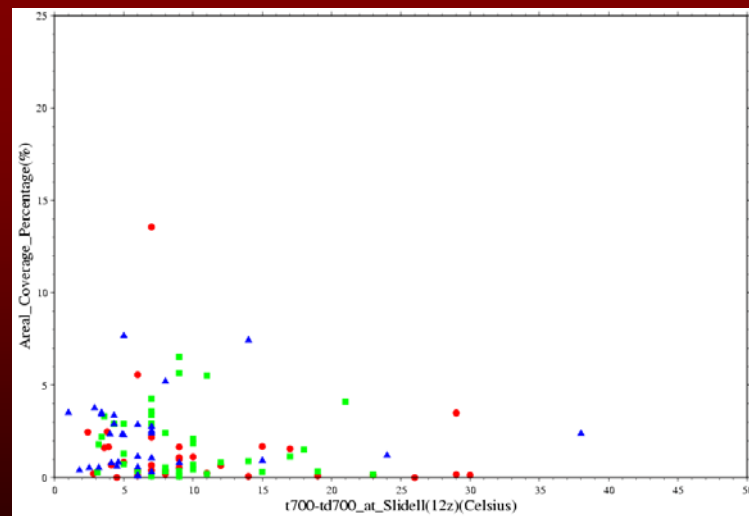
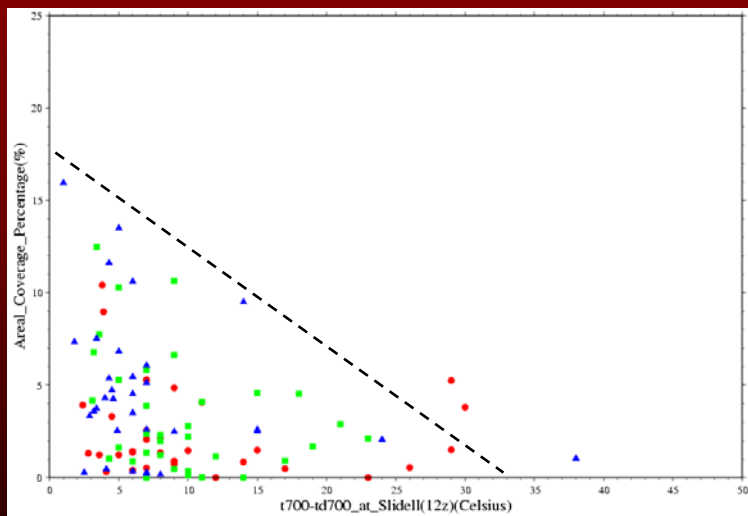
12 UTC Dewpoint Depression at 700 hPa versus 4-hr Areal Precipitation Coverage

NE sector (4)



▲ 2003 ■ 2004 ● 2005

SE sector (2)

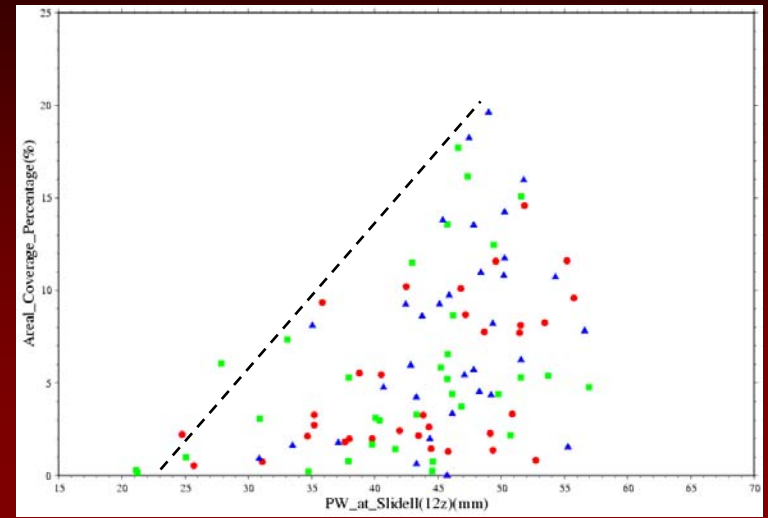
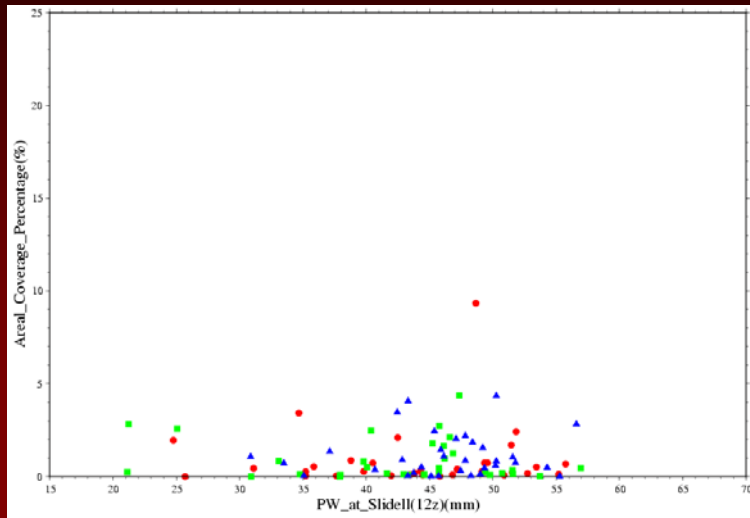


12 - 16 UTC

20 - 00 UTC

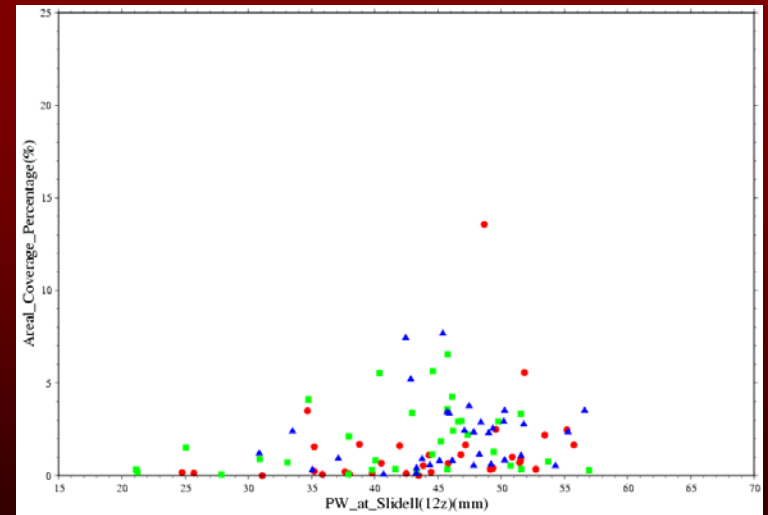
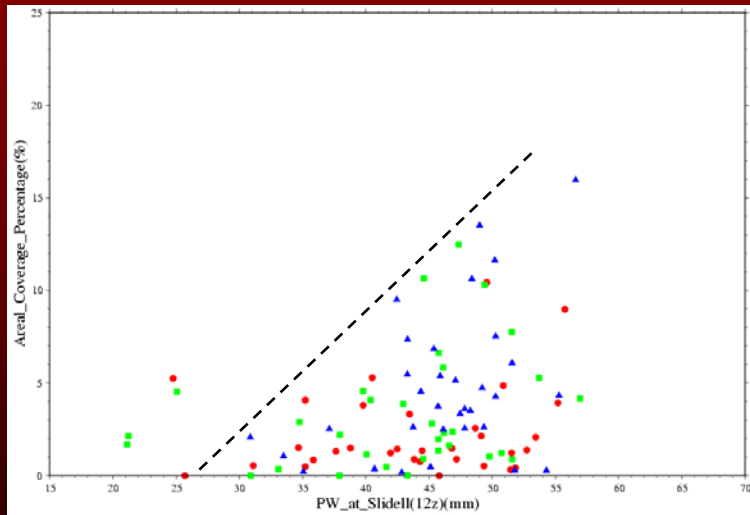
12 UTC Precipitable Water versus 4-hr Areal Precipitation Coverage

NE sector (4)



▲ 2003 ■ 2004 ● 2005

SE sector (2)



12 - 16 UTC

20 - 00 UTC

Conclusions

- As expected, precipitation forms at coast along sea breeze front
- The land breeze front converges near barrier islands, providing focus for precipitation
- Linear trends of 700-hpa dewpoint depression and precipitable water with precipitation coverage