



A Climatological Study Of Nighttime Rapidly Developing Low Cloud Ceilings In A Stable Environment



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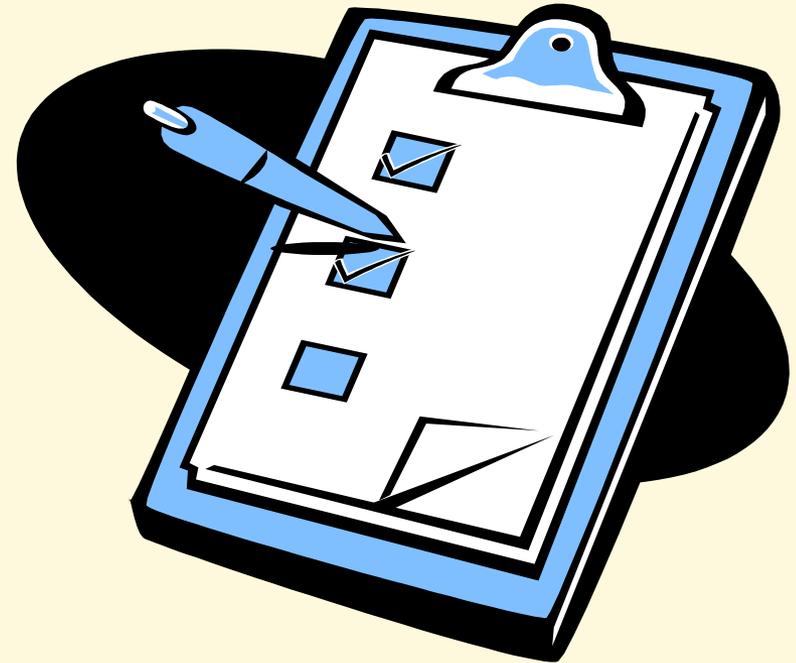
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Outline



- Project objectives
- Data and period of record
- Definitions
- Methodology
- 8 January 2004 Event
- 28 December 2004 Non-Event
- Summary/Results





Project Objectives



- Improve forecast for shuttle de-orbit burn GO/NO GO decision
- Assemble database of nighttime events with rapidly developing ceilings below 8000 ft
- Document the atmospheric regimes favoring the rapid, stable cloud formation
- Identify the onset and dissipation times





Data and Period of Record



- Cape Canaveral (XMR) evening and morning radiosondes
- Hourly surface obs at Kennedy Space Center Shuttle Landing Facility (SLF)
- Infrared satellite imagery
 - Every 15-30 minutes
- Nighttime only
 - 2200 to 1200 UTC
- Florida cool-season months
 - November to March
 - 1994 to 2005 (12 cool seasons)





Definitions



- Rapid development: Ceiling forms in less than 90 minutes
- “Event days”
 - Low ceiling violations at SLF
 - Rapid development confirmed via infrared satellite imagery
- “Non-Event days”
 - Low ceiling violations at SLF
 - Rapid development did NOT occur
 - Low ceilings from other mechanisms
 - Fog
 - Rain
 - Cloud advection



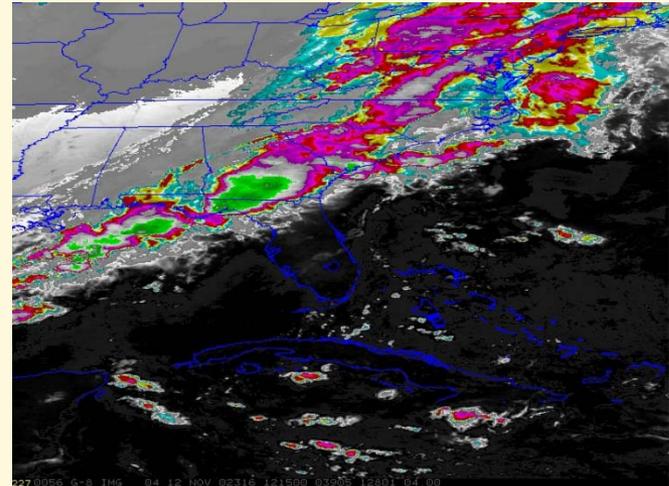
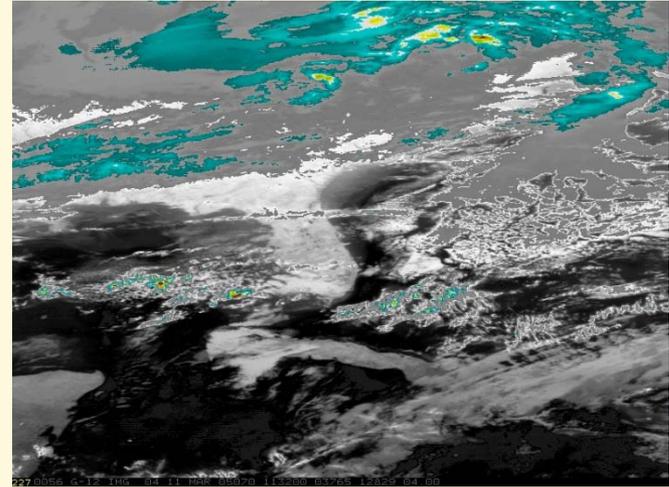
Methodology

- Identified inversions from XMR radiosondes below 8,000 ft
 - Height & strength
 - RH in layer beneath inversion
 - Mean wind & shear to ~ 15,000 ft
- Examined SLF surface obs
 - Identified ceilings below 8000 ft
 - Extracted nighttime hours
 - Eliminated cases with fog burn-off, widespread clouds or precip
 - Kept cases with ceiling development

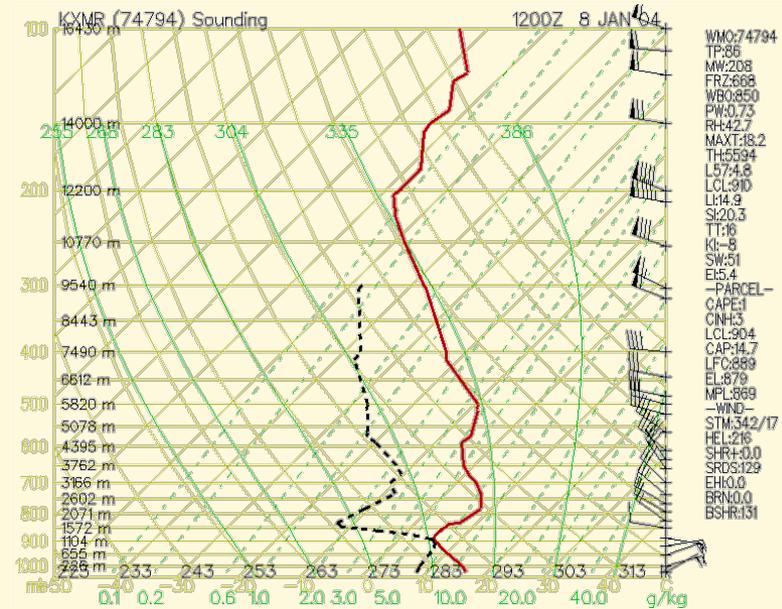
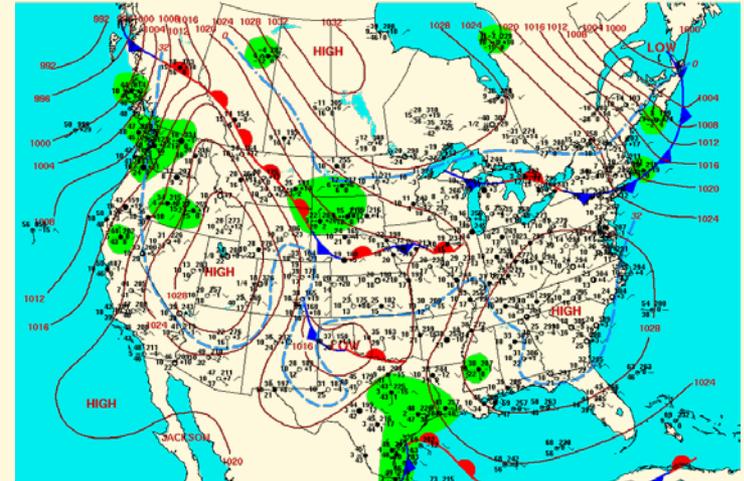
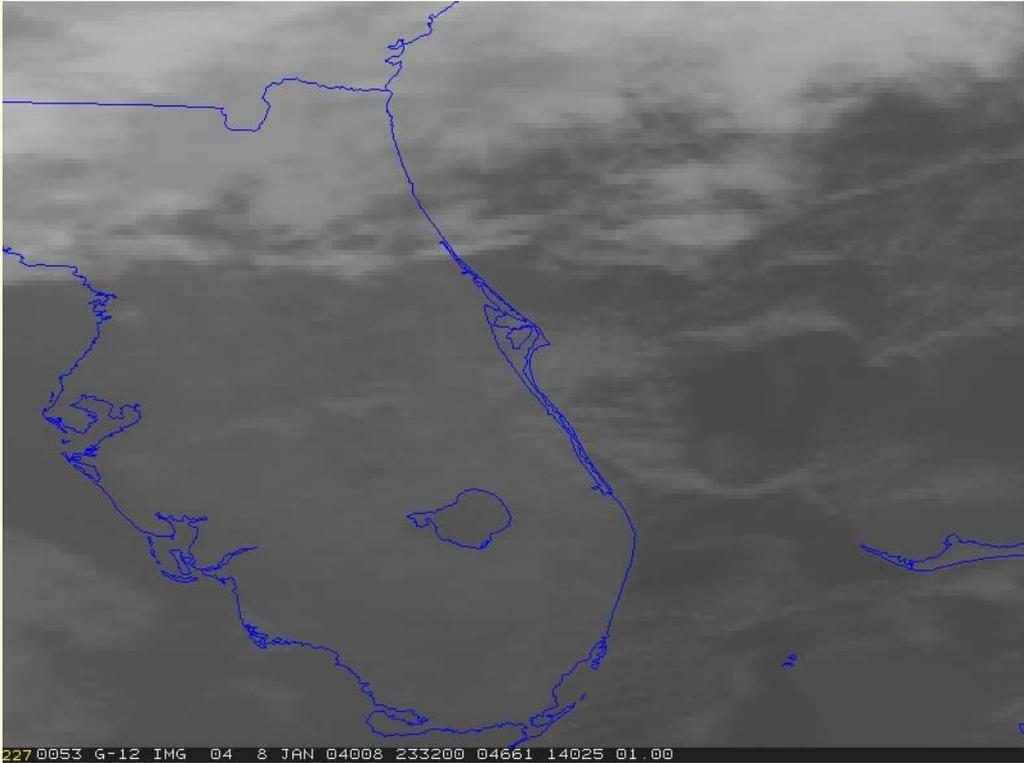


Methodology

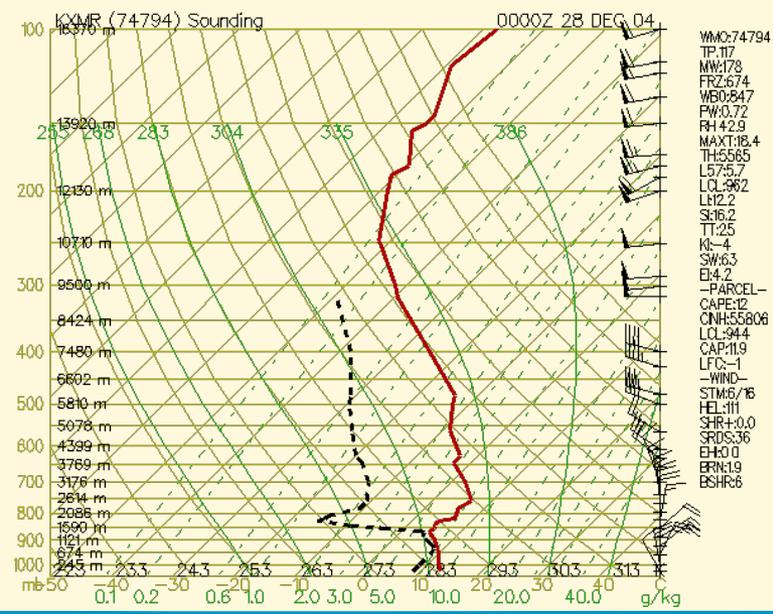
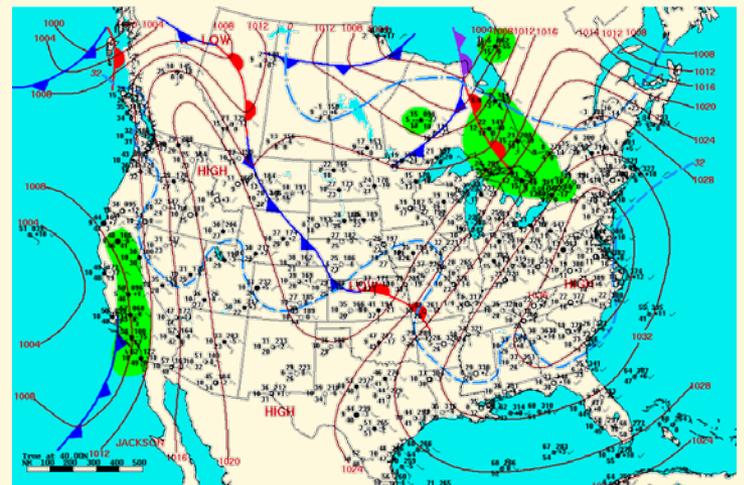
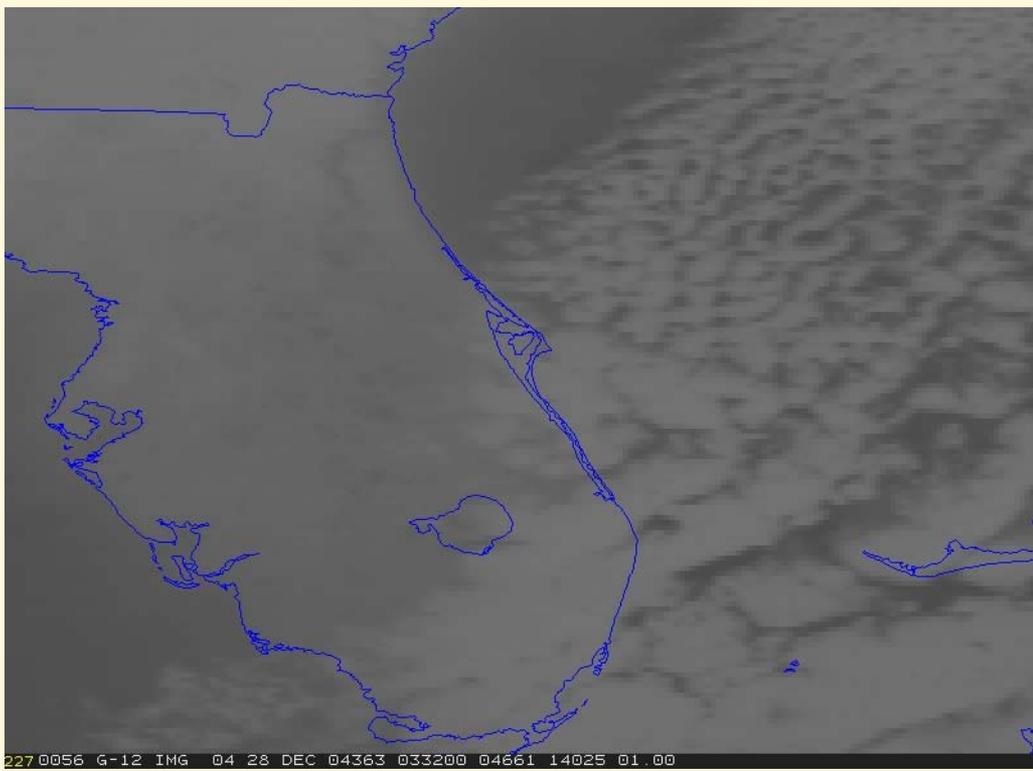
- Combined cases with low ceiling development and low-level inversions
 - Identified 86 possible cases
- Examined infrared satellite imagery for all cases
- Confirmed whether each case was development or advection
 - Very difficult with infrared imagery despite enhancements
- Identified only 6 cases with rapid ceiling formation



8 January 2004 Event



28 December 2004 Non-Event





Summary/Results



Nighttime

- Only nighttime events
- 4 km infrared satellite imagery
- 83% of events had winds veering with height
- Mean inversion strength 2.5 °C
- Average onset time 0511 UTC
- 6 out of 86 cases identified as events
 - Meaningful statistics could not be calculated
 - Nighttime rapid low cloud development not a common occurrence

Daytime

- Only daytime events
- 1 km visible satellite imagery
- 85% of events had winds veering with height
- Mean inversion strength 4.0 °C
- Average onset time 1403 UTC
- 20 out of 48 cases identified as events
- Identified atmospheric regimes favoring rapid, stable cloud formation