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Multi-scale Analysis of Hurricane Earl's (2010) Rapid Intensification

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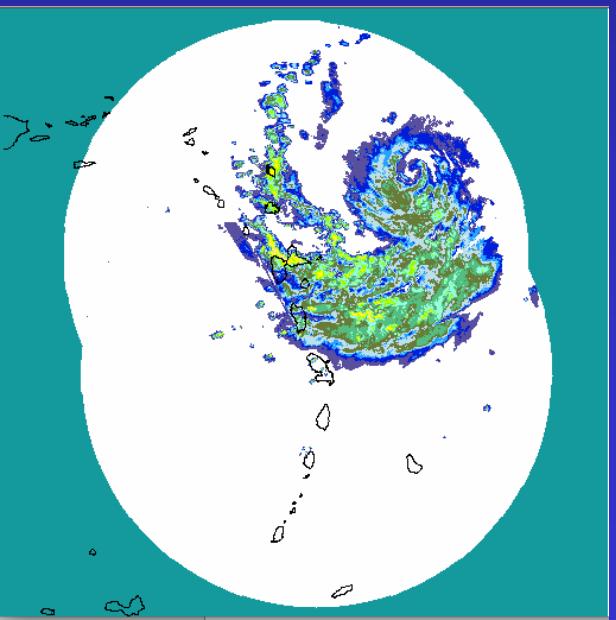
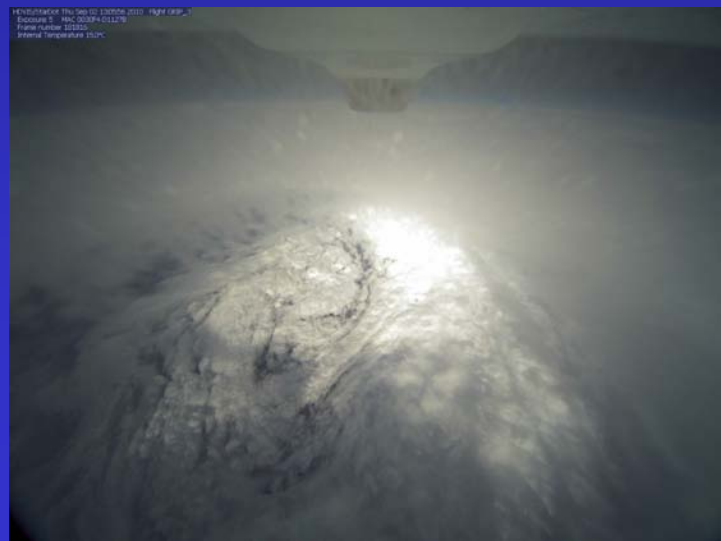


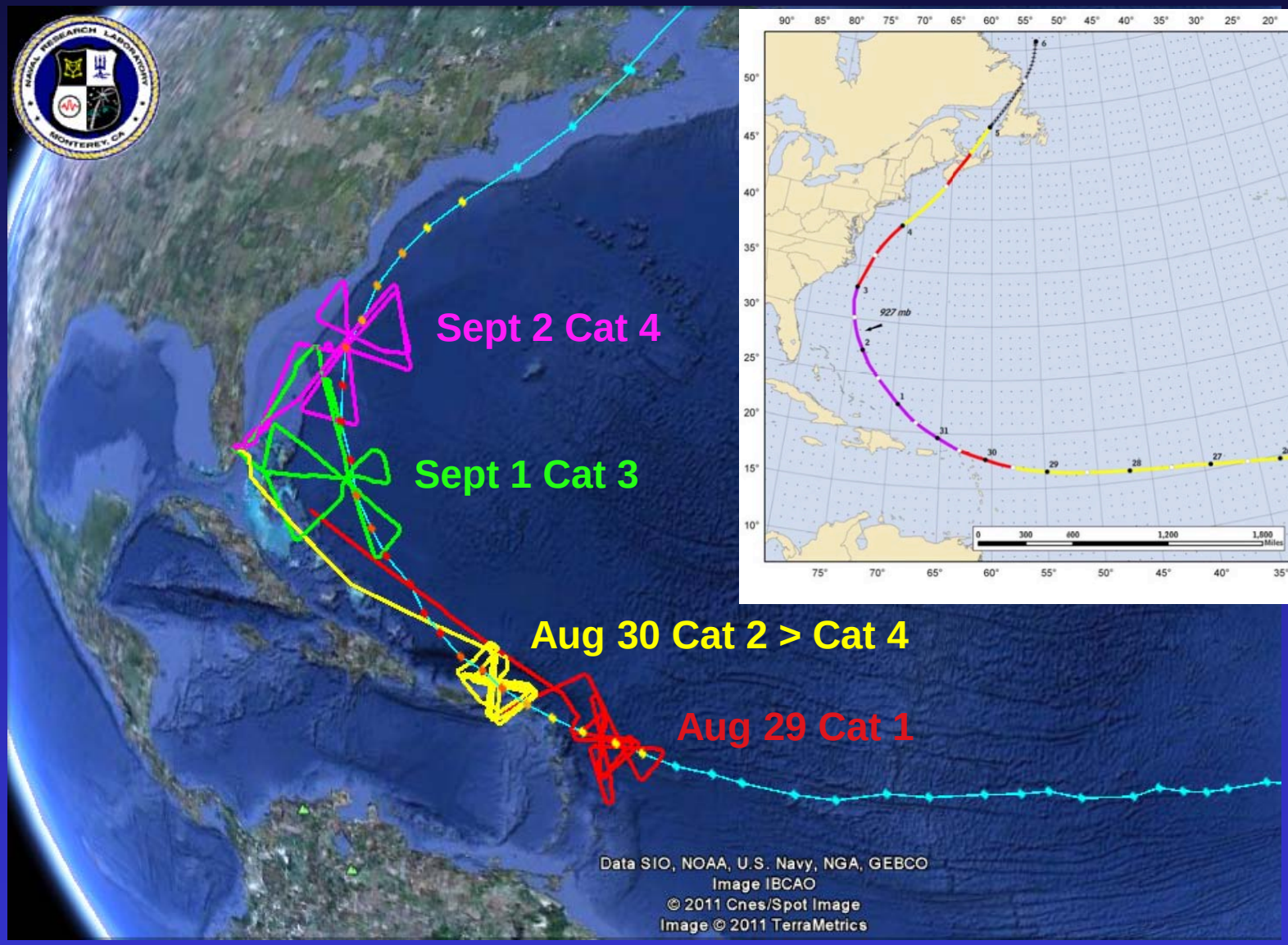


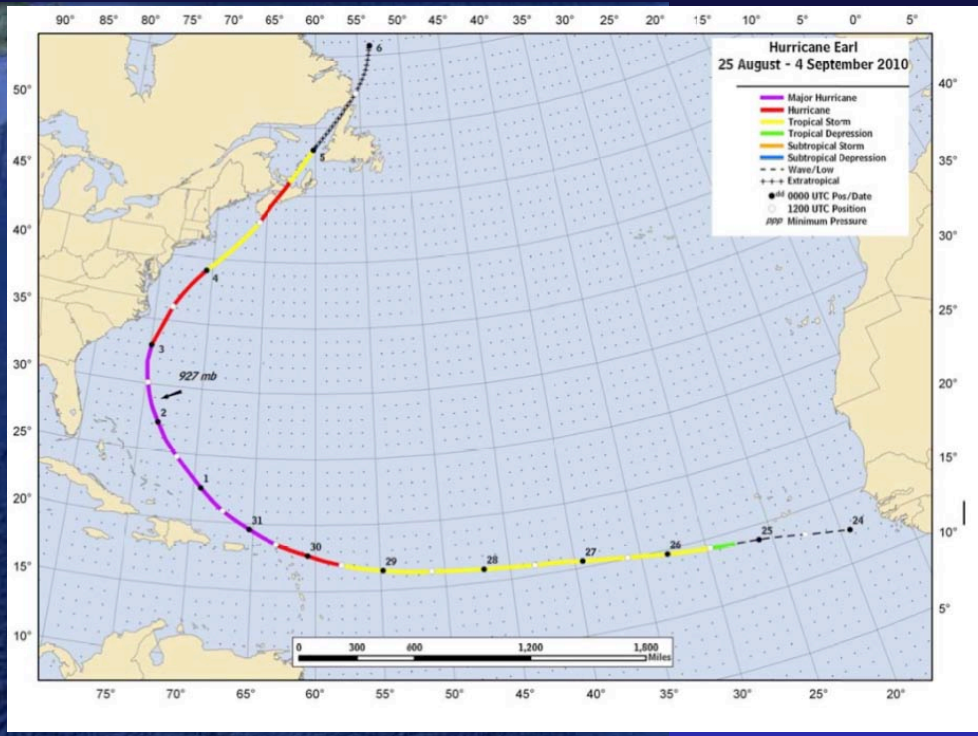
Objectives

Relate the period of Earl's rapid intensification (Aug 28-31, 927 mb) to the following physical processes:

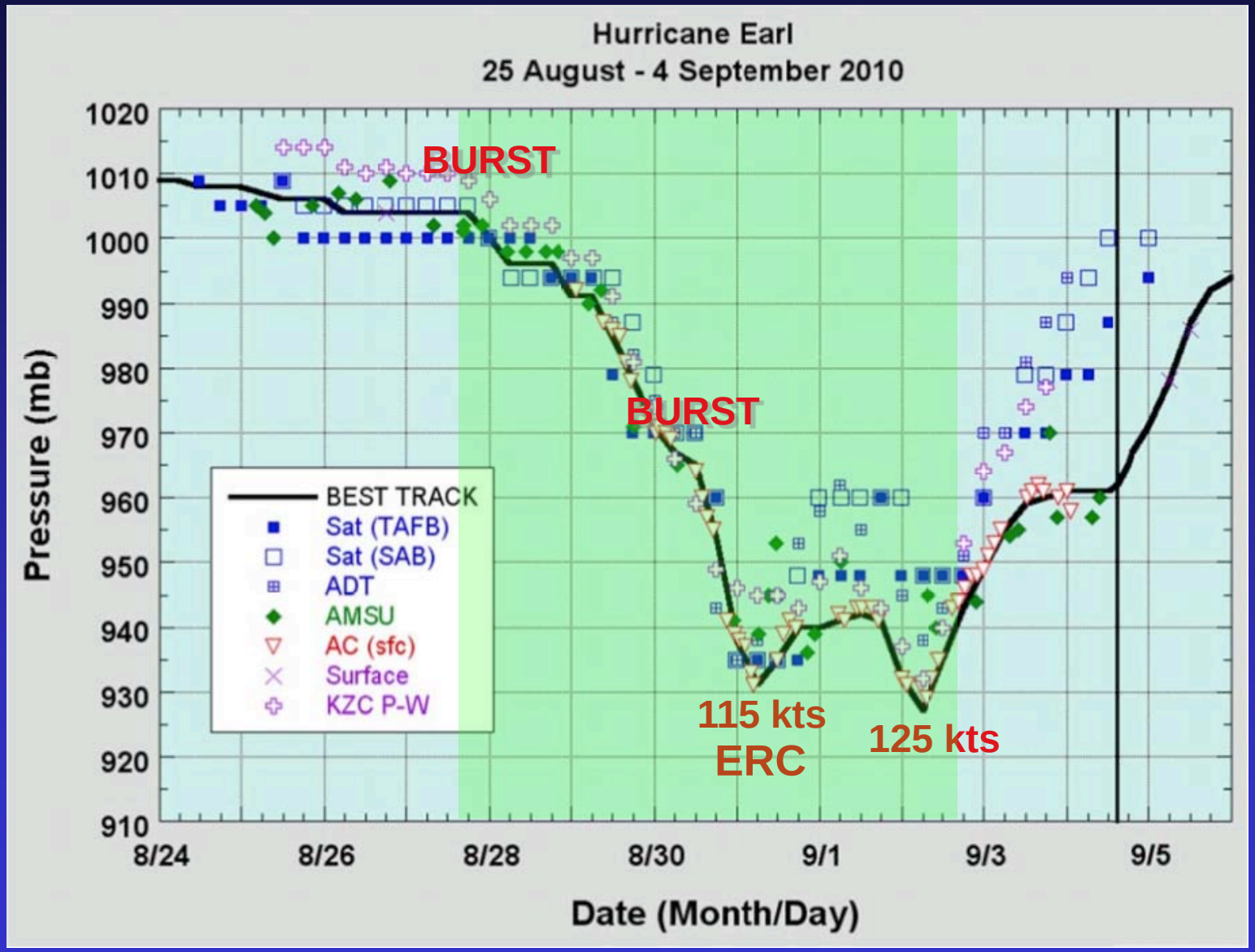
1.Multiple convective bursts
2.Multiple episodes of concentrated, inner-core lightning
3.4D evolution of the storm's warm core
4.Environmental factors (SST, OHC, shear, RH%)

Hurricane Earl's Track and Intensity Change





Hurricane Earl's Track and Intensity Change



Datasets Used

Multi-Scale Synthesis Approach:

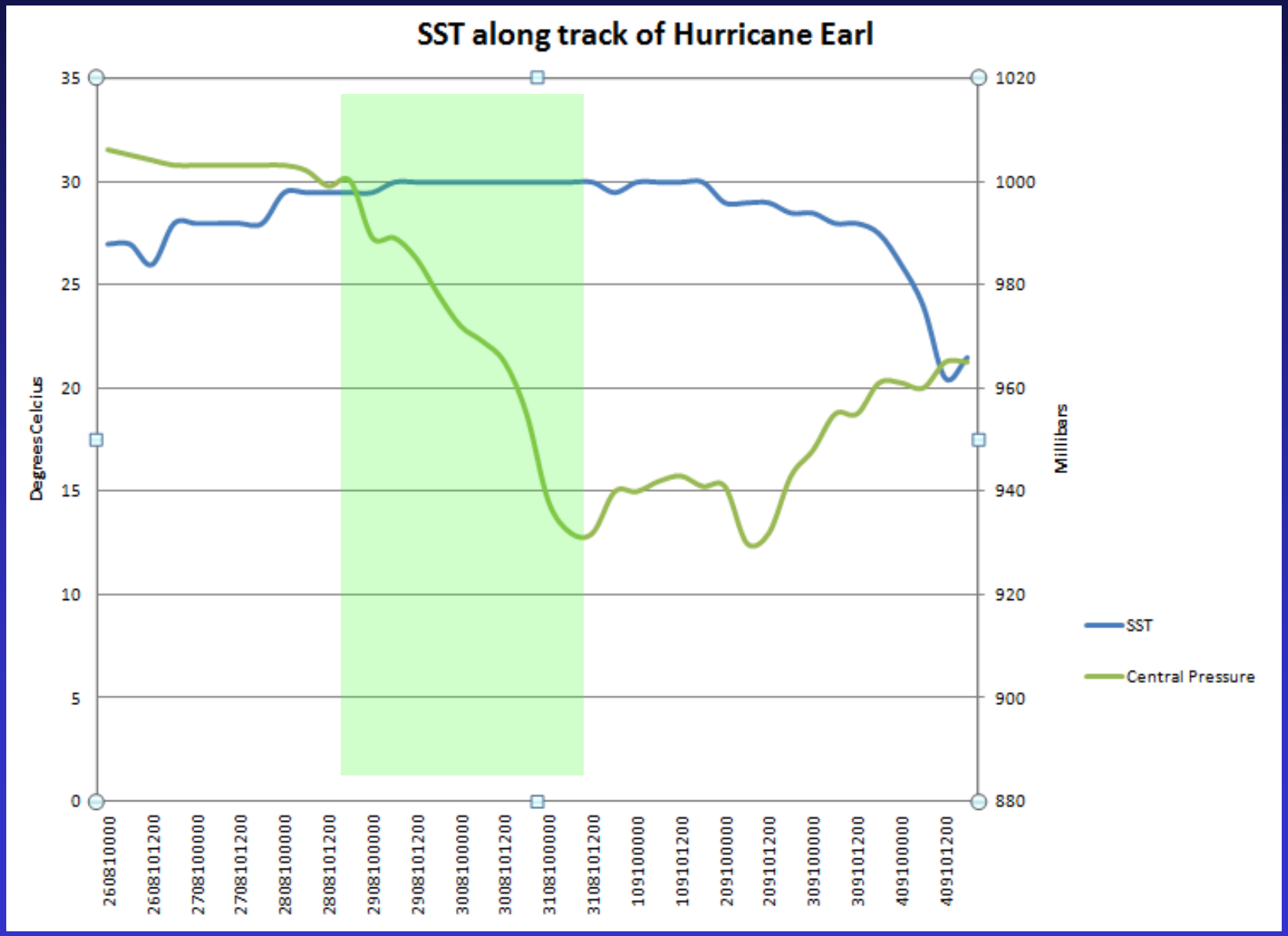
1.Meso-synoptic analysis products at multiple levels: Deep and shallow shear, vorticity (h85,h7), column RH/PW, low level convergence/upper tropospheric divergence, SST, OHC
2.Satellite: Enhanced IR, passive microwave (TMI, DMSP), PR, AMSU
3.Lightning detection (strike density as a function of radius and time): Vaisala GLD360, LIP, others
4.Radar: P3 Doppler, TRMM PR, APR-2, St. Martin
5.Dropsonde meso-analyses (DC-8, P-3, G-IV)
6.Aircraft in situ (DC-8, P-3, G-IV)
7.Others…?

Key Physical Questions:

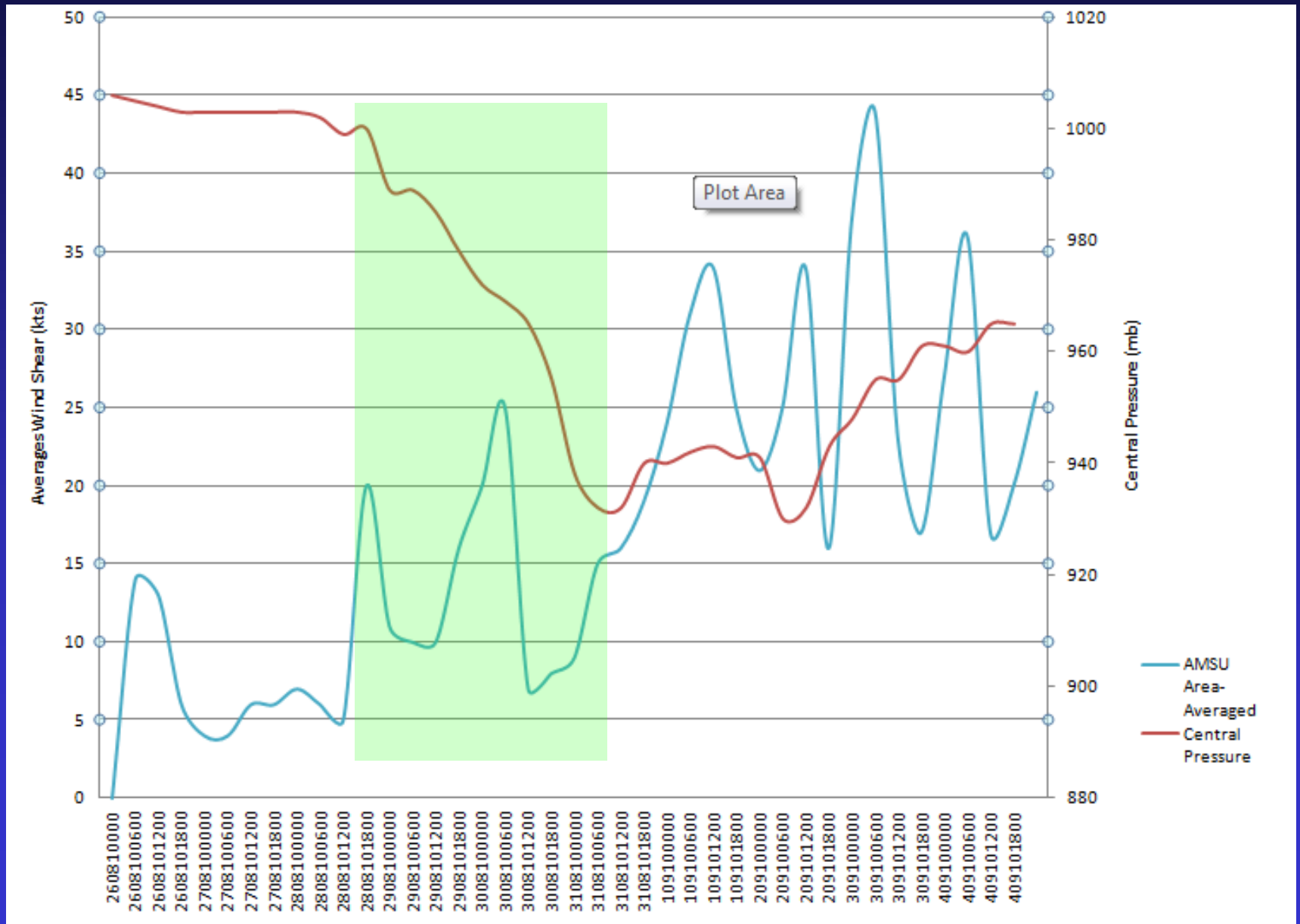
Construct a hypothesis chain that relates two or more of the following:

1. **What environmental factors conditioned or supported rapid deepening of Earl?**
2. **Did convective bursts contribute to the deepening?**
3. **Was inner-core lightning activity associated with the bursts?**
4. **How did the warm core develop (top-down vs. bottom-up, amplitude)?**
5. **How did the vortex structurally evolve (vertical wind maximum, RMW, ERCs, symmetry/asymmetry)?**

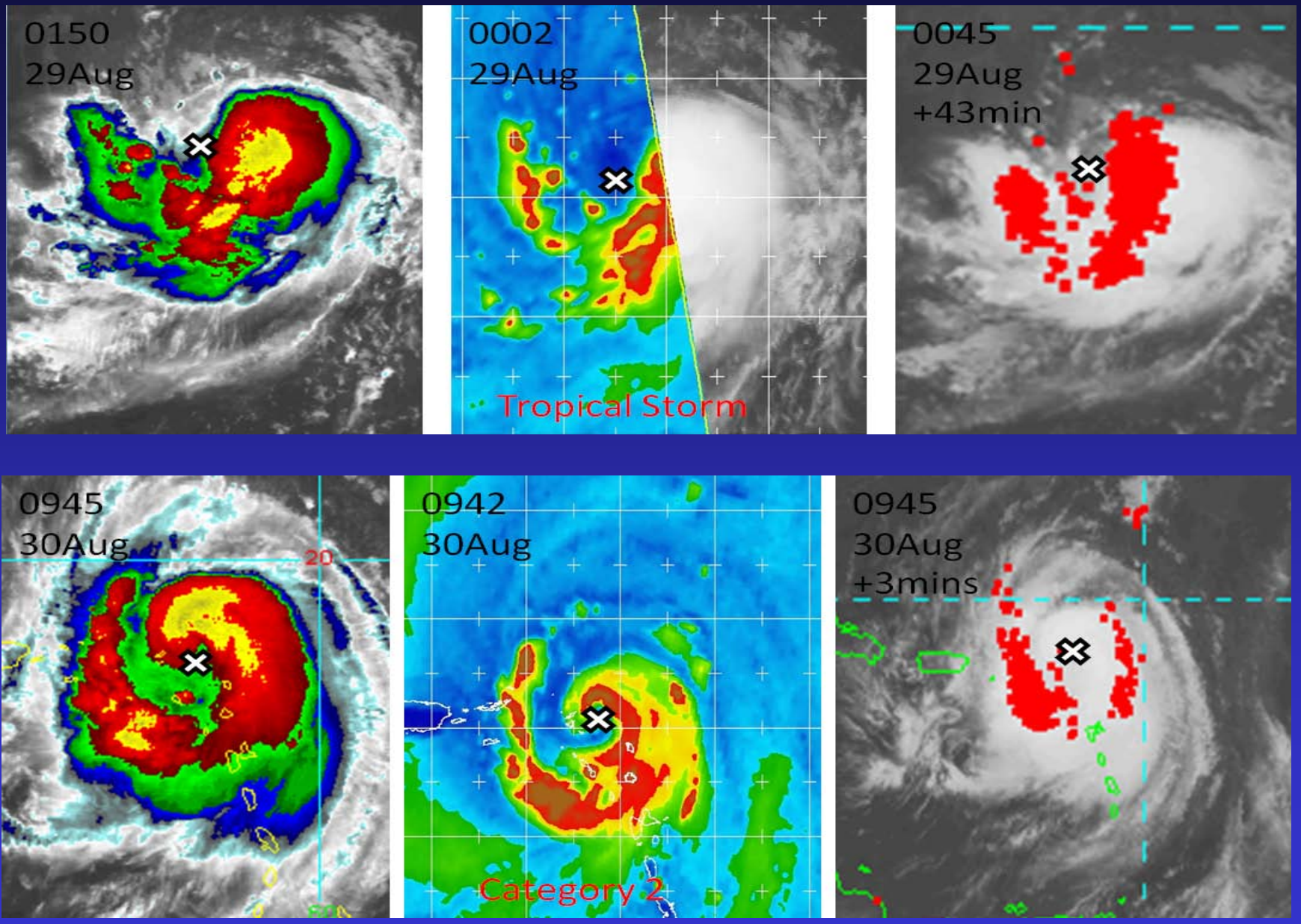
Environmental Correlations/Forcings Associated With Earl's RI: SST (AMSU + SHIPS)



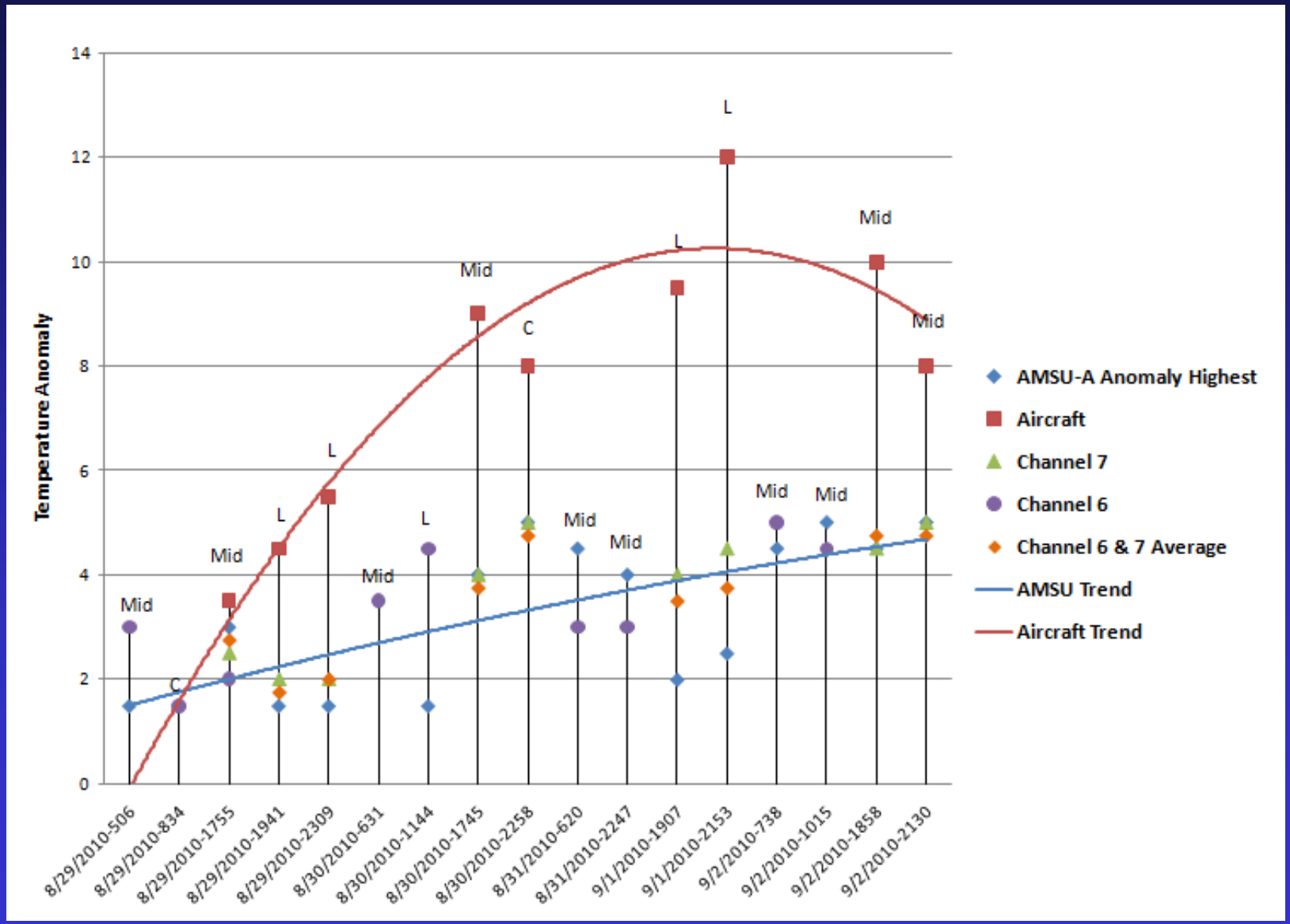
Environmental Correlations/Forcings Associated With Earl's RI: Deep Shear (AMSU)



Convective Bursts At Onset of RI

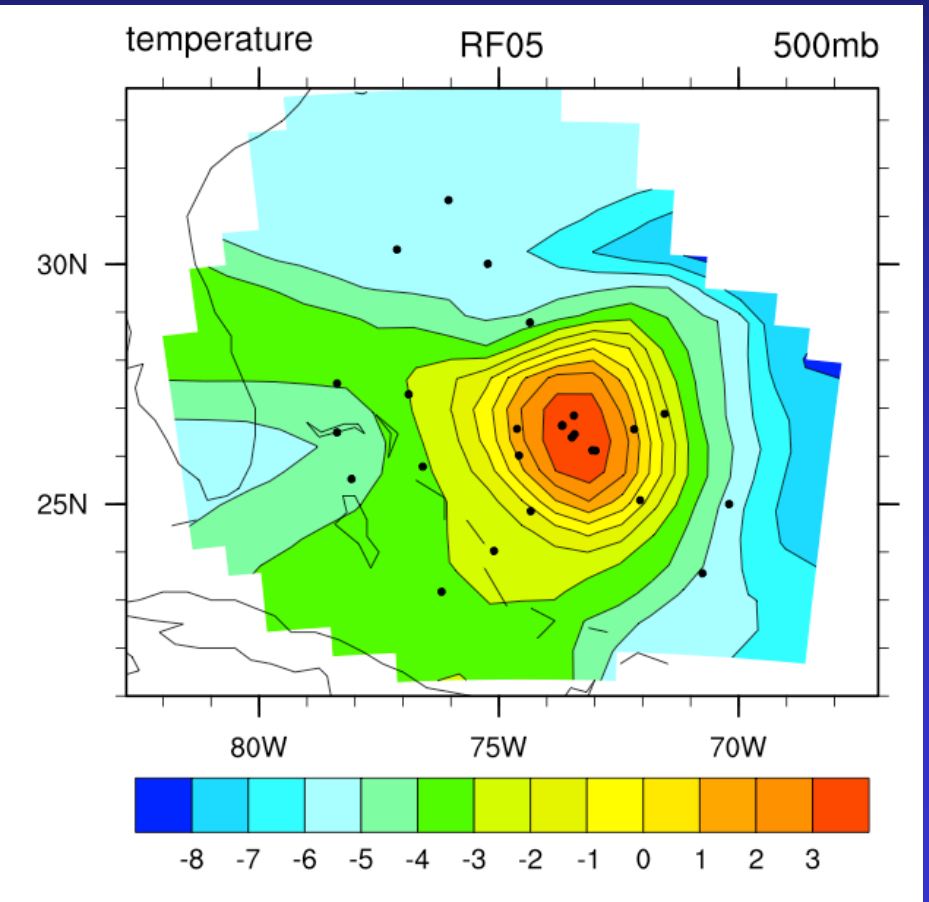


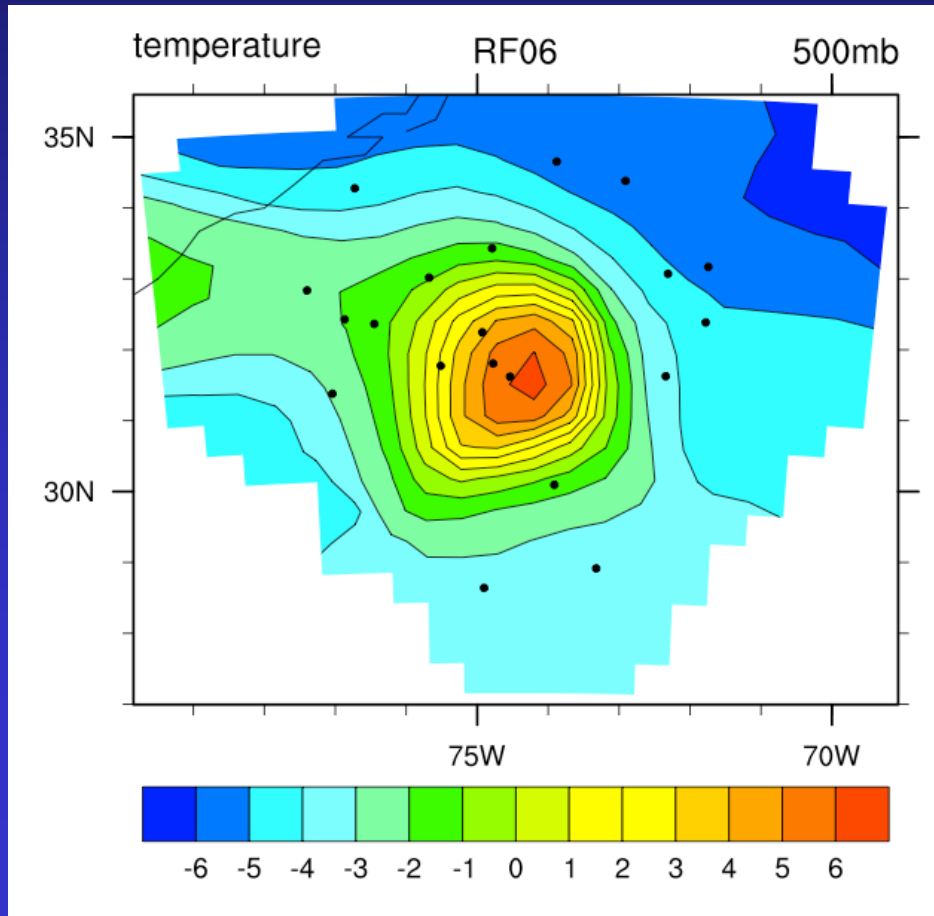
Upper Level Warm Core Evolution: AMSU Retrieval vs. *In Situ* Aircraft Measurements



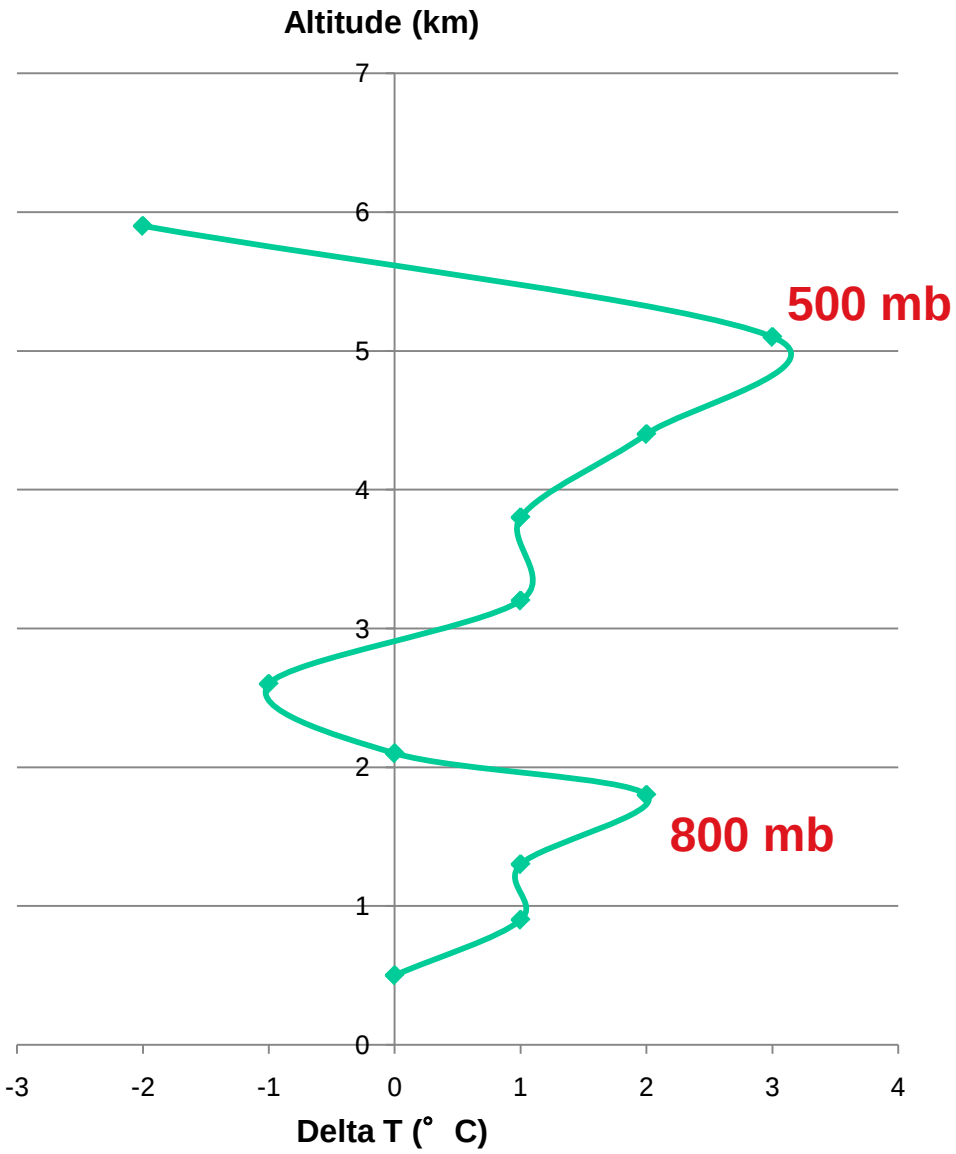
Mesoscale Warm Core Structure

- Quality controlled dropsonde data
- Data points subjected to time-space conversion
- Strong warm core through entire column
- Intensity increased from 110-115 kts to 120-125 kts during 9/1/10-9/2/10
- Warm core intensified +3 ° C at 500 mb, +2 ° C at 800 mb





Intensification of Earl's Warm Core



Looking for GRIP Collaborators!

1. Syed Ismael (Langley)/LASE – moisture profiles in and out of eye
2. Bob Pasken (SLU) – mesoscale modeling w/ dropsonde data assimilation
3. John Molinari (SUNY) – dropsonde thermodynamics/CAPE
4. Bjorn Lambrigtsen (JPL) – HAMSR
5. Rob Rogers (HRD) – P3 Doppler vortex evolution, reflectivity structure of convective bursts, low level warm core
6. Henry Fuelberg (FSU) – parallel work on Karl's RI