

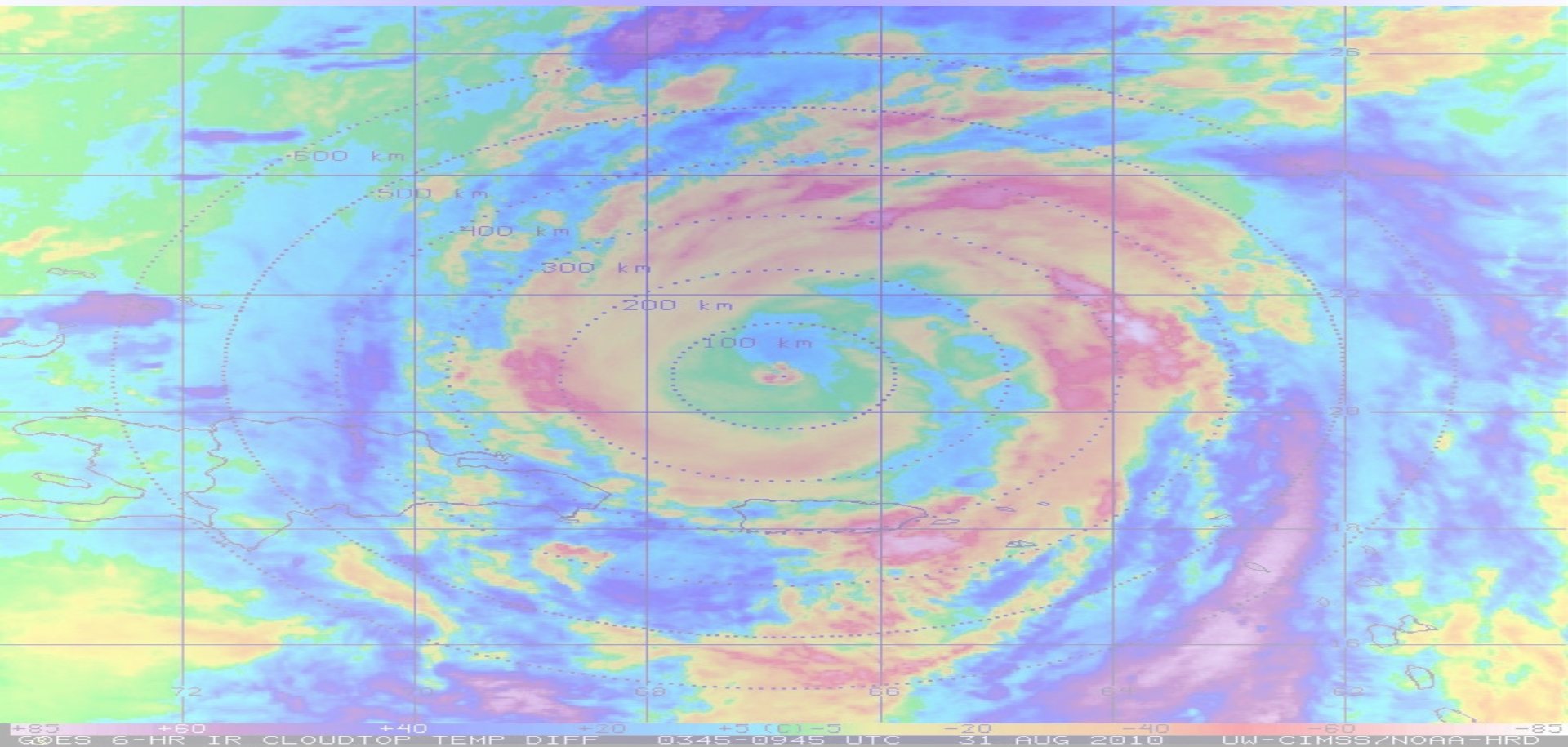
Diurnal Pulsing of Tropical Cyclones: An Overlooked Yet Fundamental TC Process?

Jason Dunion¹, Chris Thorncroft², & Chris Velden³

1 University of Miami/CIMAS - NOAA/AOML/HRD - SUNY/Albany

2 SUNY/Albany

3 University of Wisconsin-UW/CIMSS



Discussion Outline

- **Motivation:**

- Understand & describe the notion of TC diurnal pulsing
 - Fundamental process?
 - Implications for TCs?

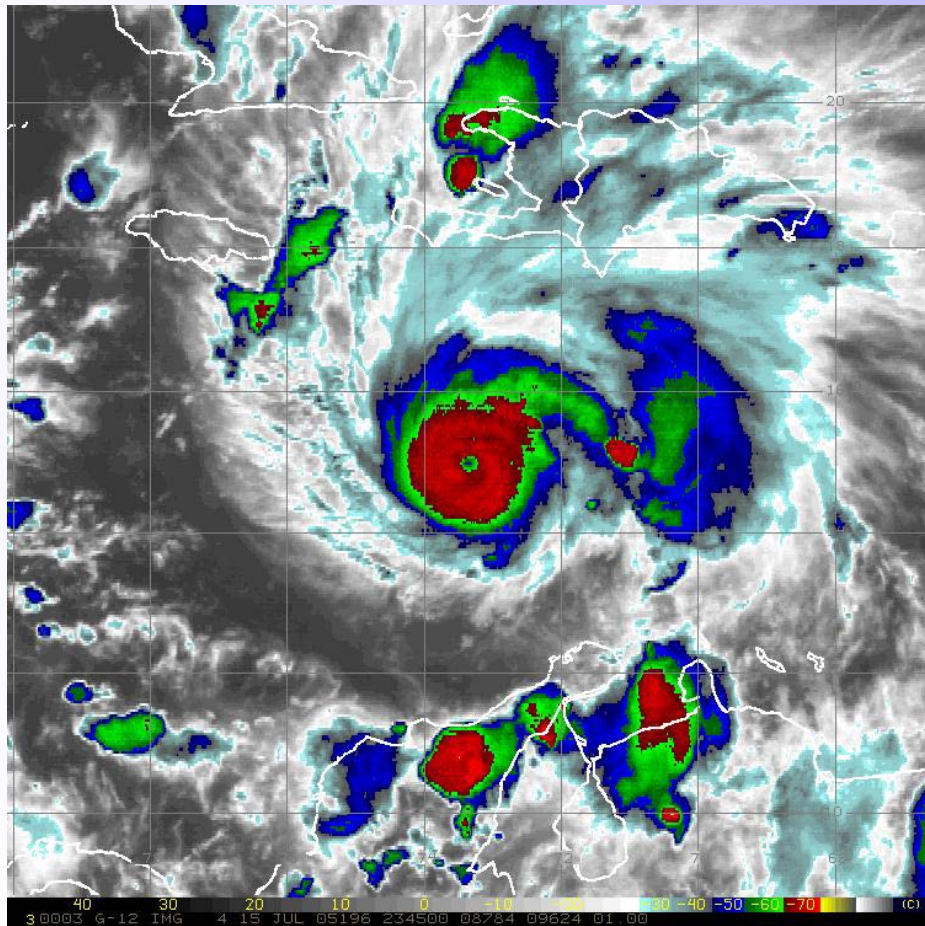
- **TC Diurnal Pulsing:**

- 1) Sample NATL Cases
- 2) A "Big Ben" TC process?
- 4) What are they?
- 5) Implications: Intensity and Dvorak
- 6) Modeling

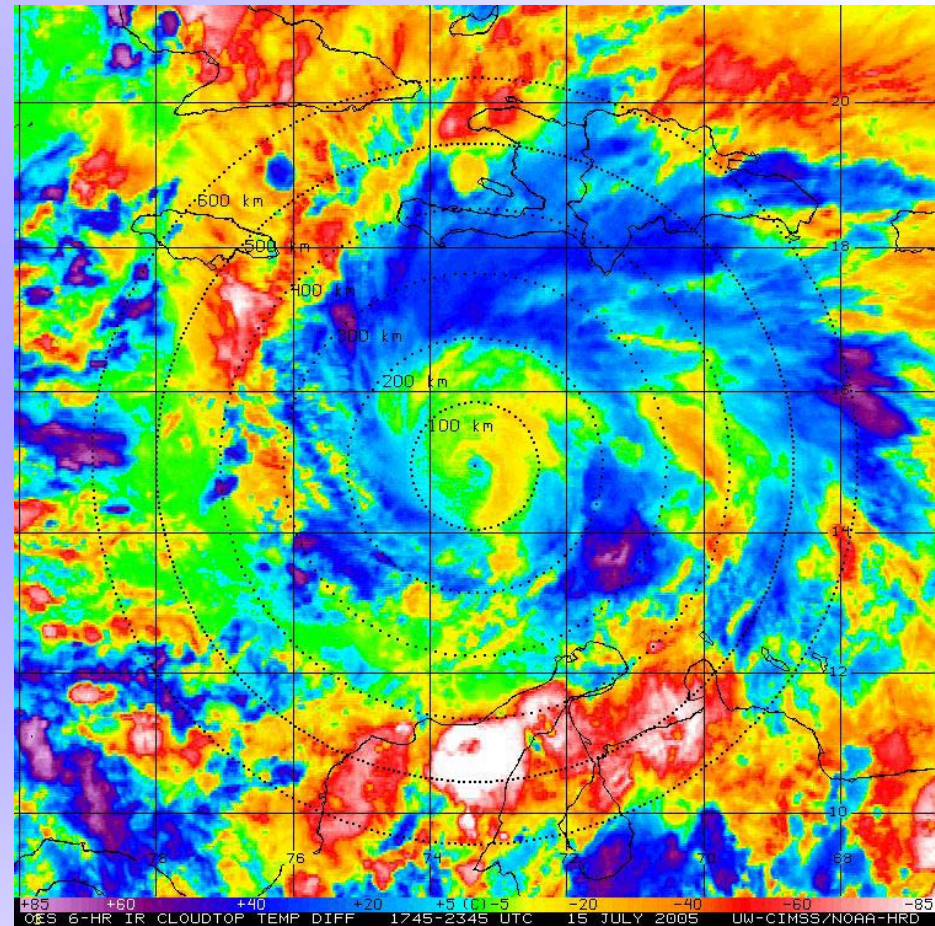
- **Conclusions & Future Work**

Hurricane Emily: 14-15 July 2005

GOES IR (storm relative)

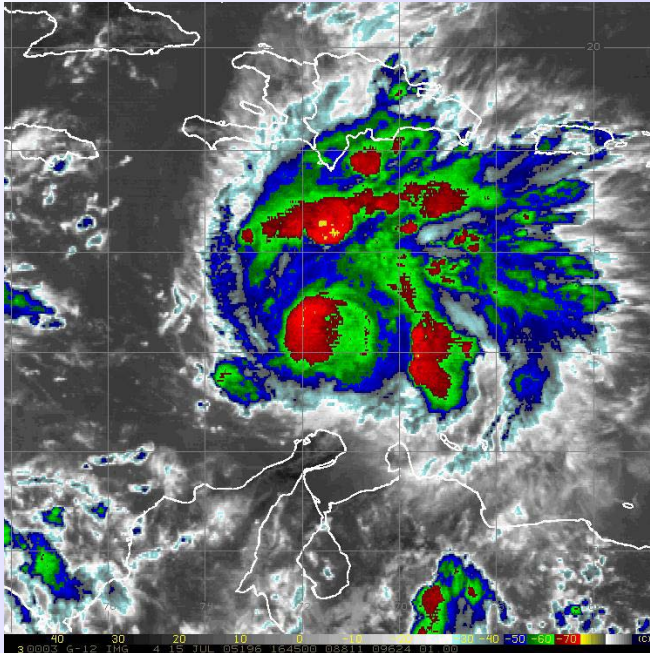


GOES BT Diff (storm relative)

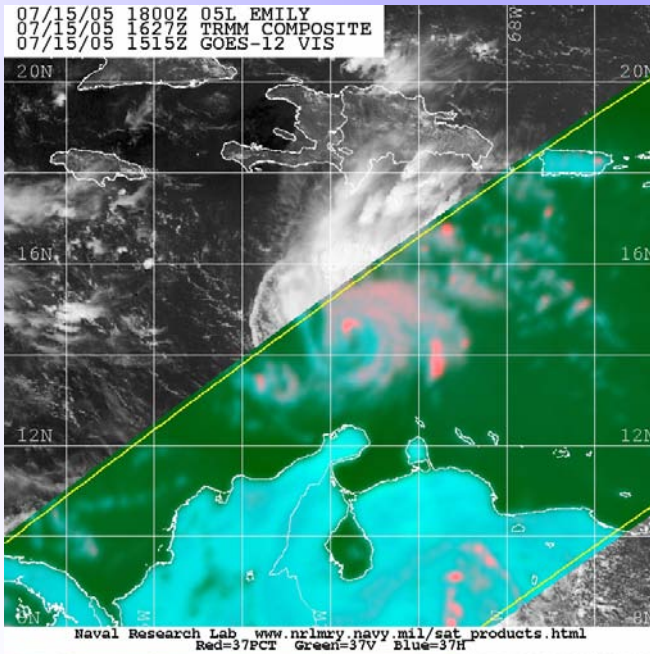
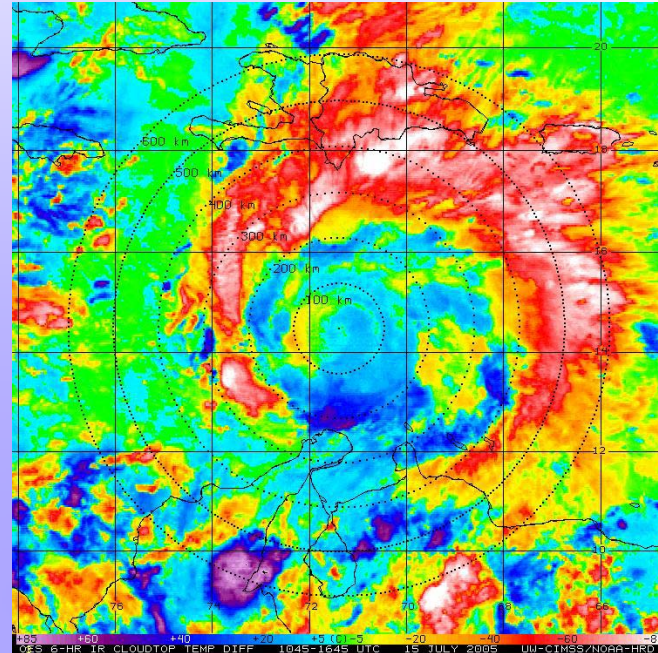


Hurricane Emily: 15 July 2005

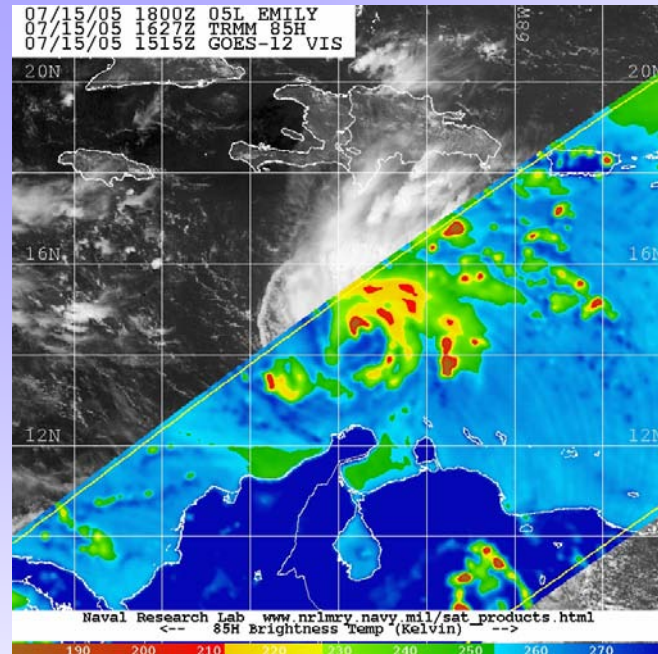
GOES IR



GOES IR
BT-Diff



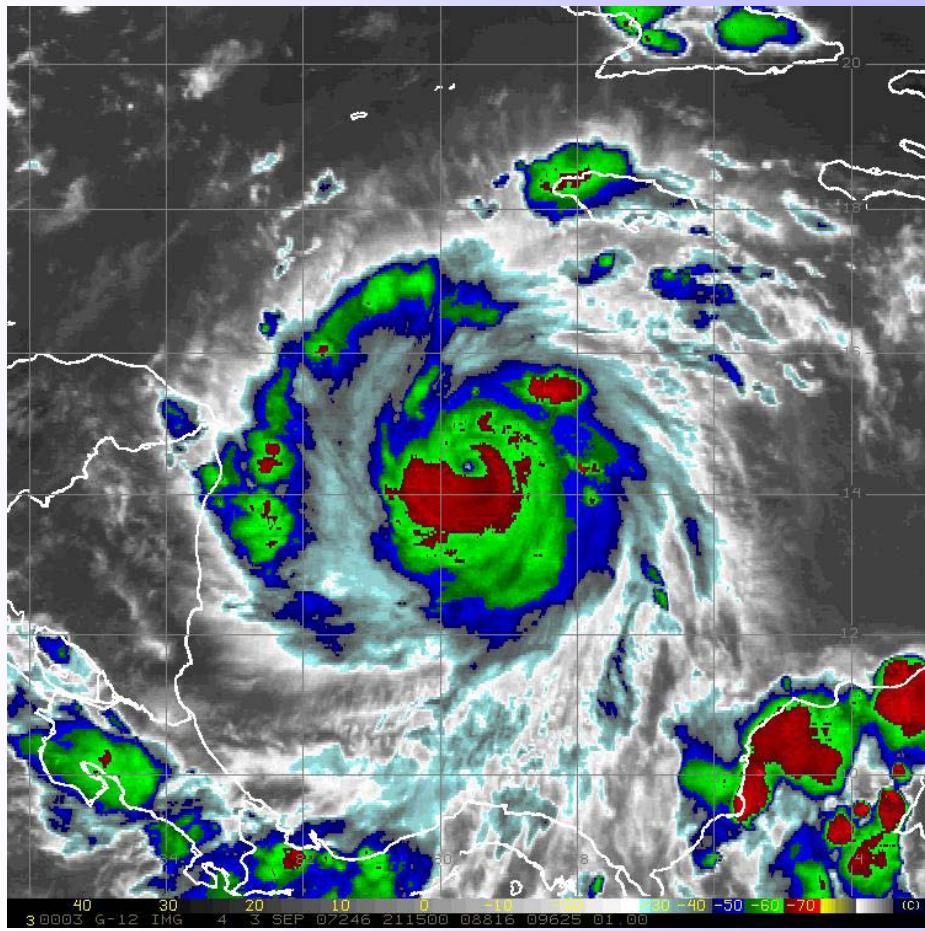
37 GHz



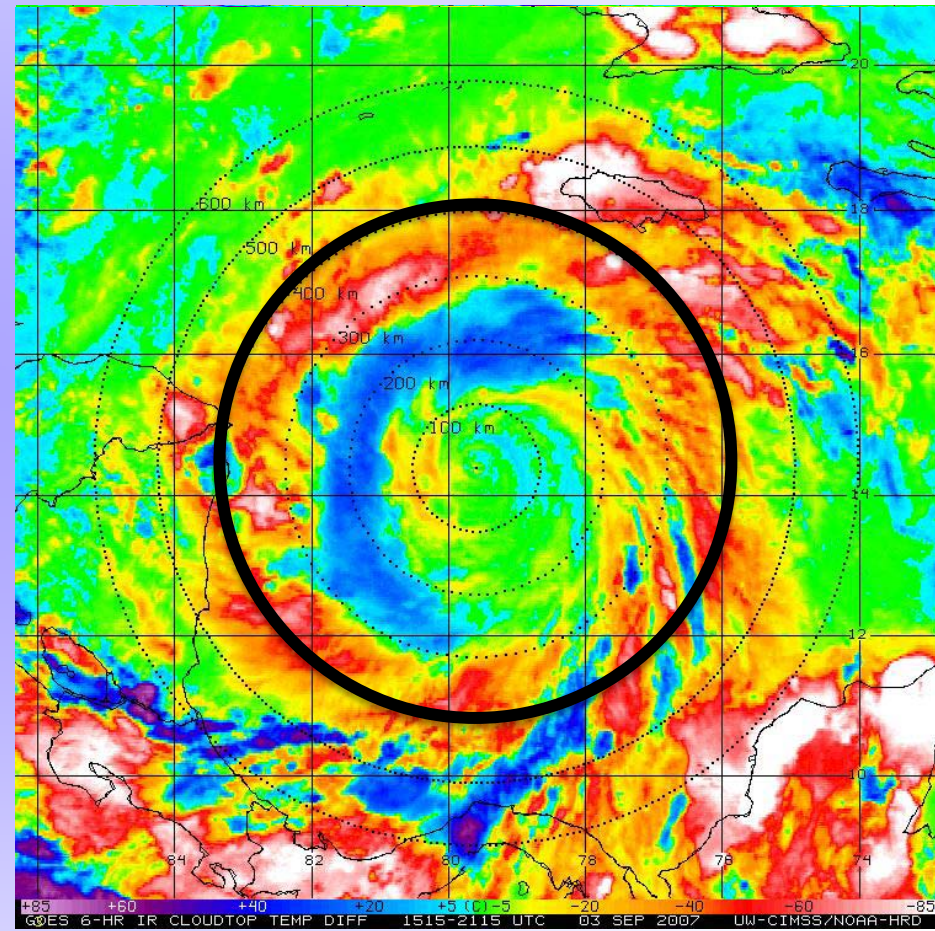
85/89 GHz

Hurricane Felix: 02-03 Sept 2007

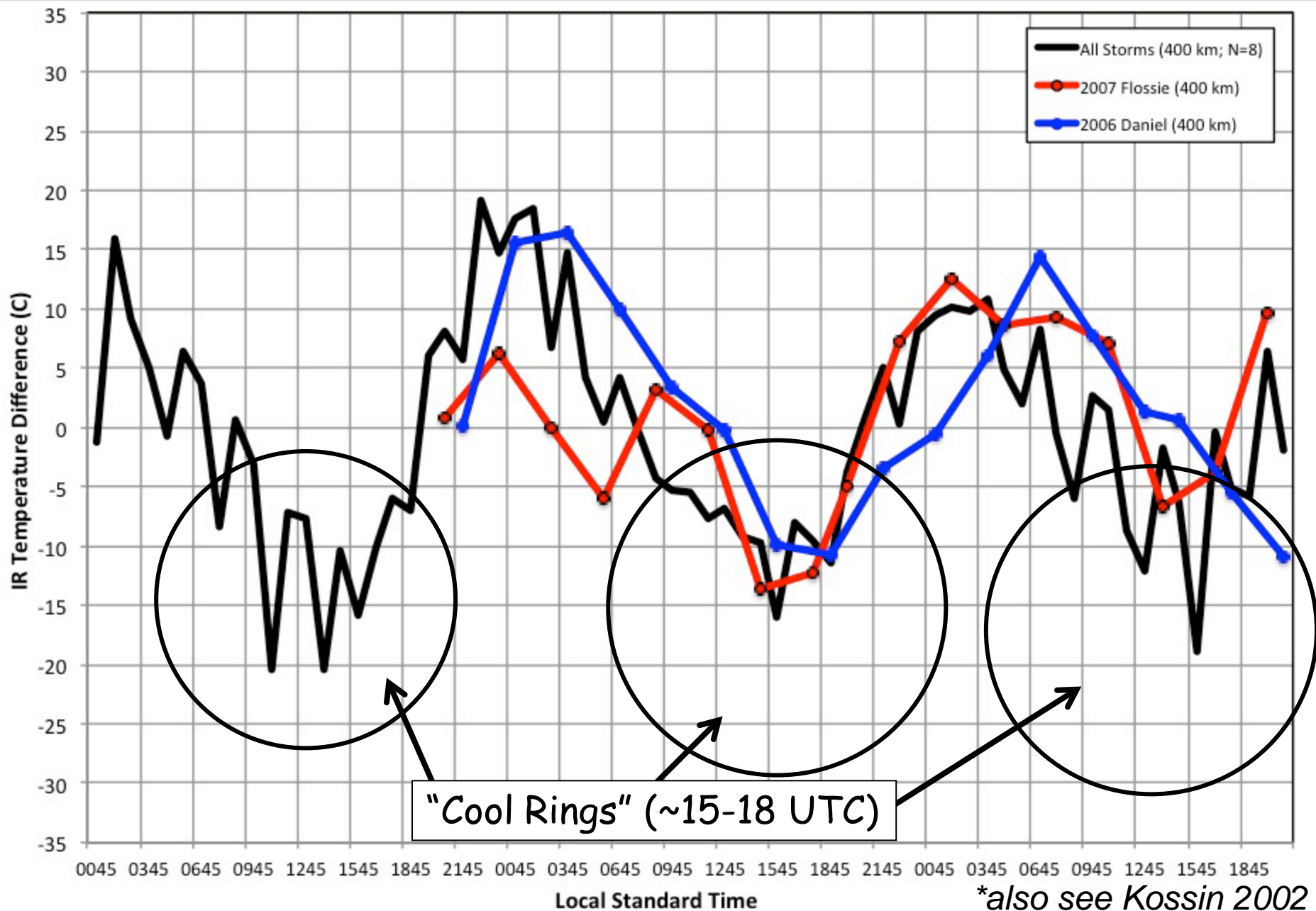
GOES IR (storm relative)



GOES BT Diff (storm relative)

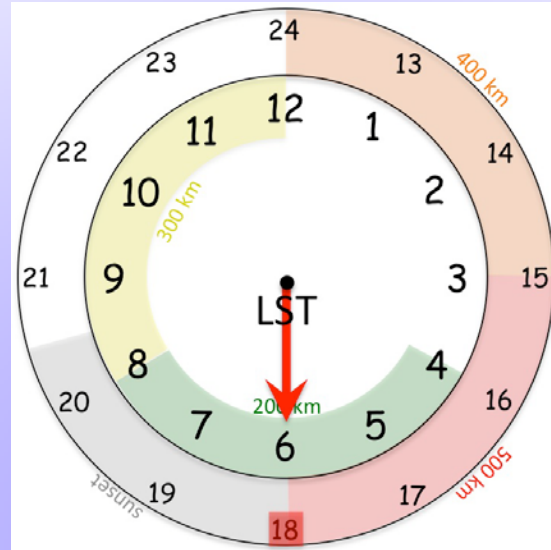


GOES IR BT Differences: Azimuthal Mean (400km)

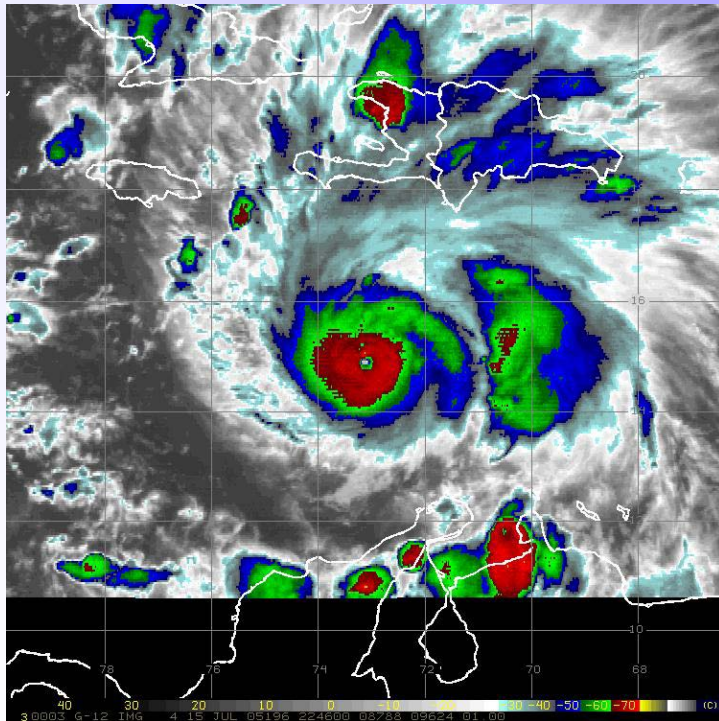


*also see Kossin 2002

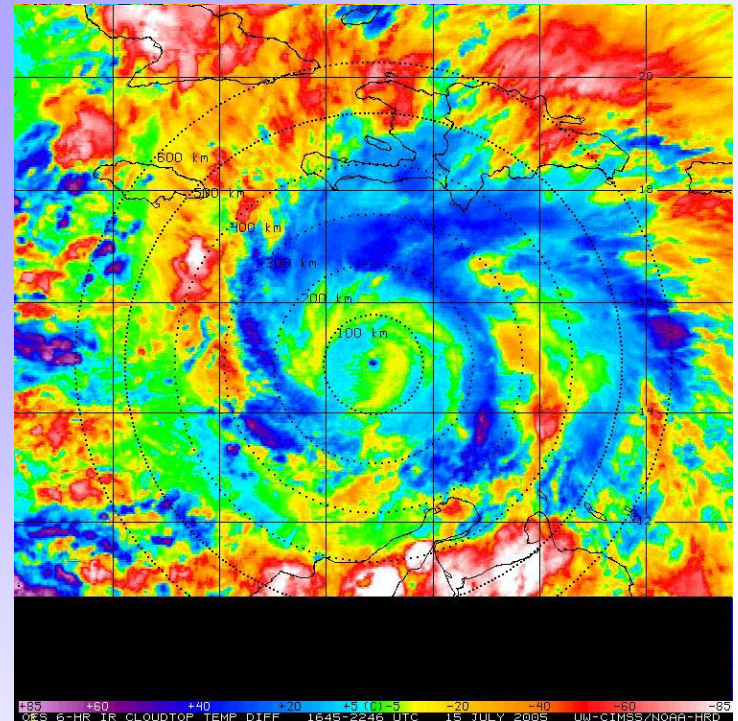
Hurricane Emily: 15 July 2005



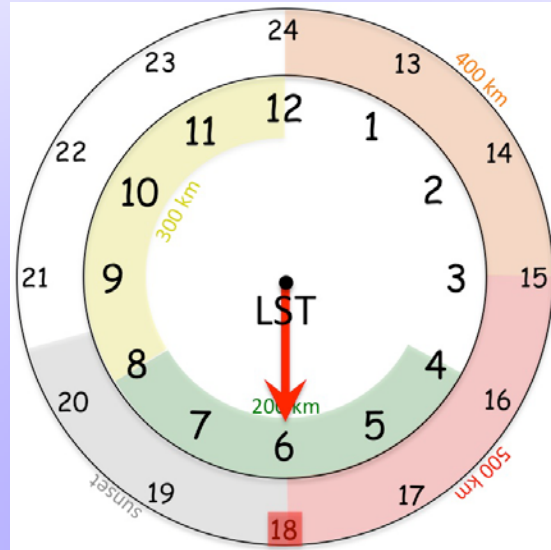
GOES IR (storm relative)



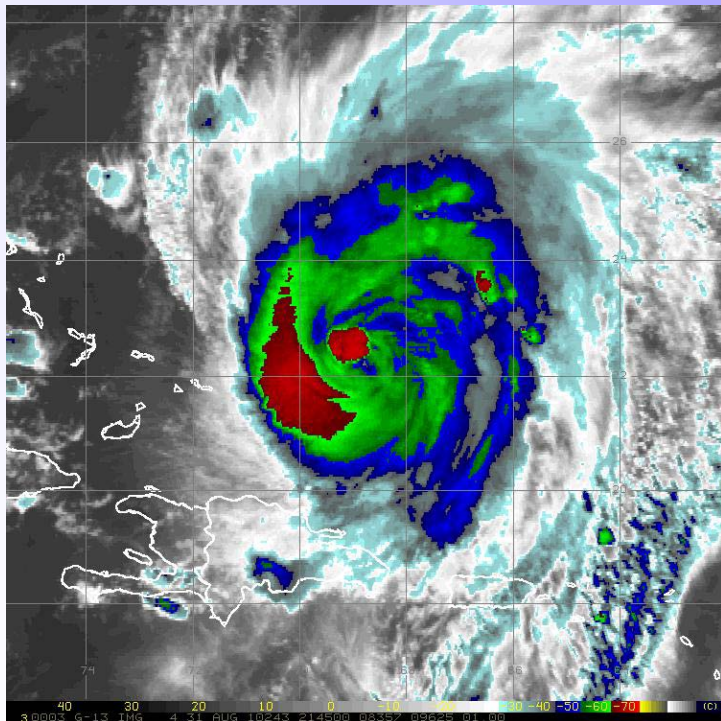
GOES BT Diff (storm relative)



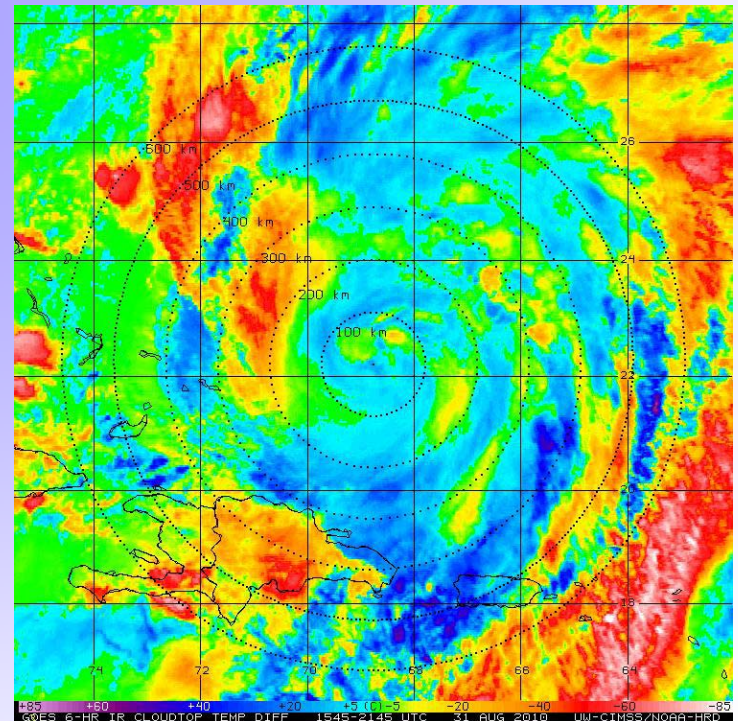
Hurricane Earl: 30 August 2010



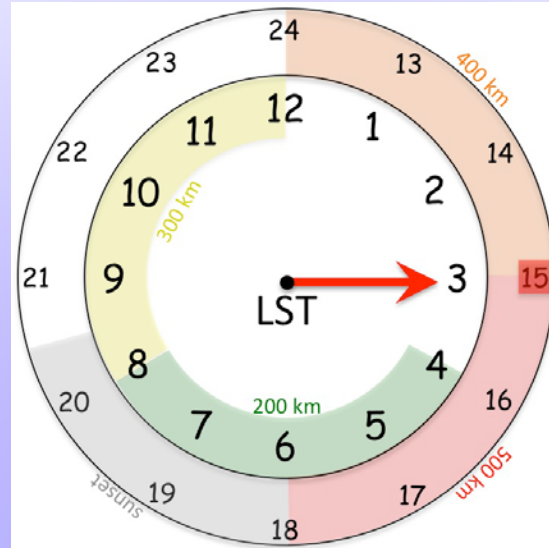
GOES IR (storm relative)



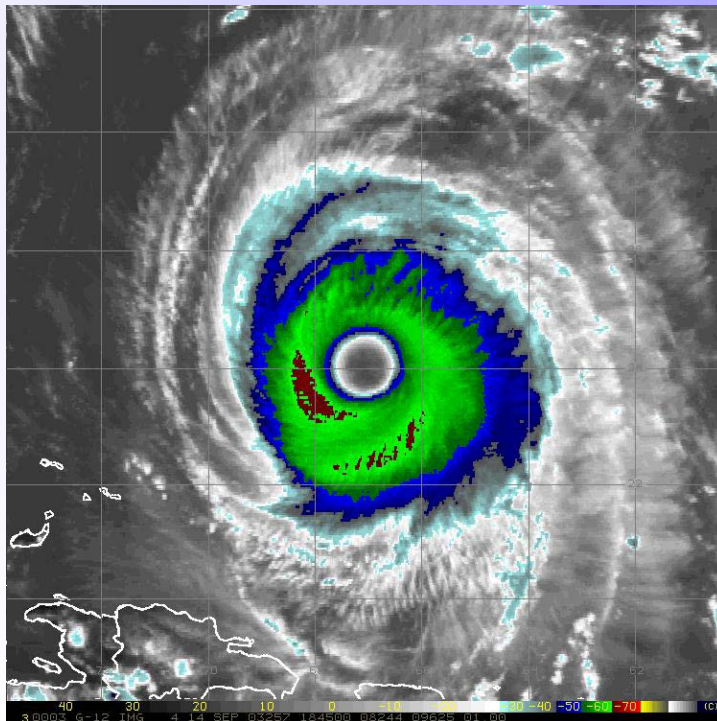
GOES BT Diff (storm relative)



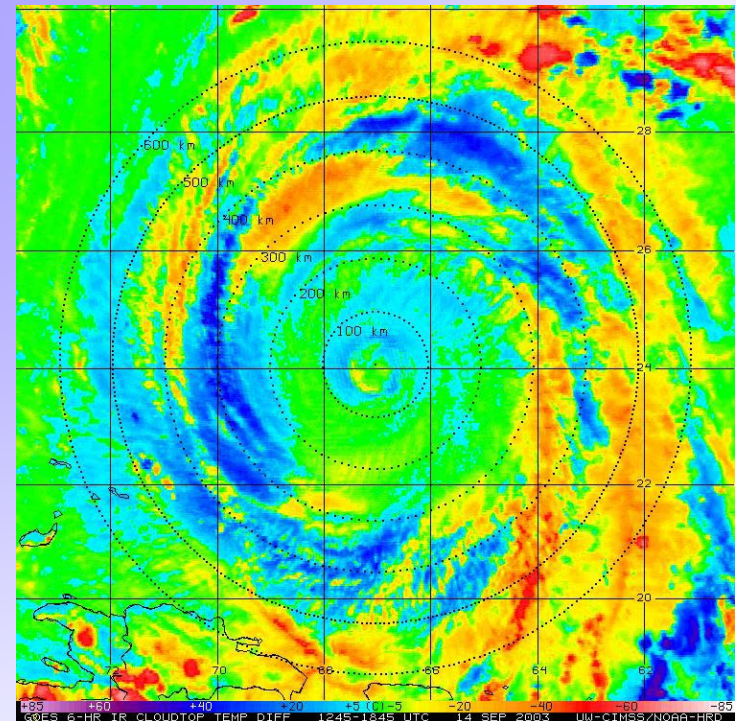
Hurricane Isabel: 14 September 2003



GOES IR (storm relative)



GOES BT Diff (storm relative)



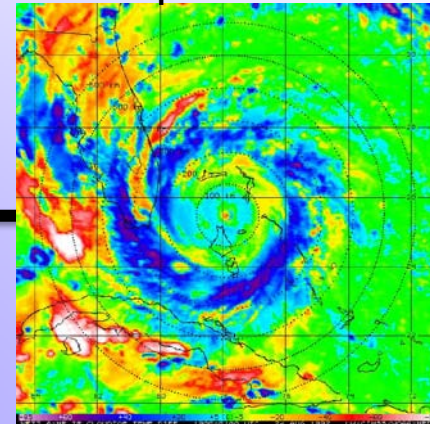
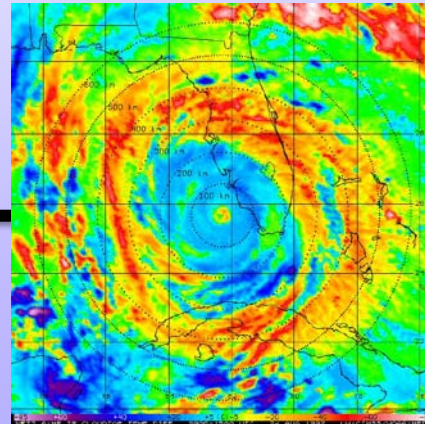
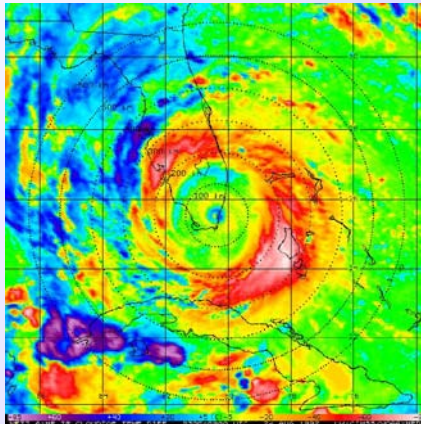
Diurnal TC Pulsing: A Global Phenomenon

4am LST

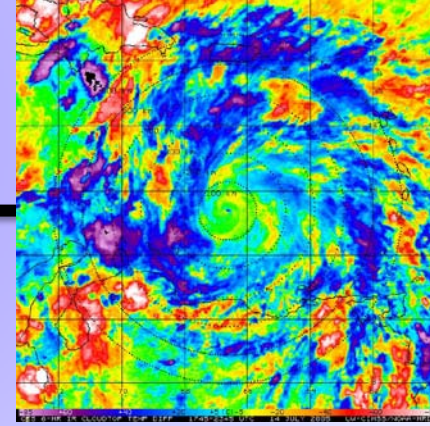
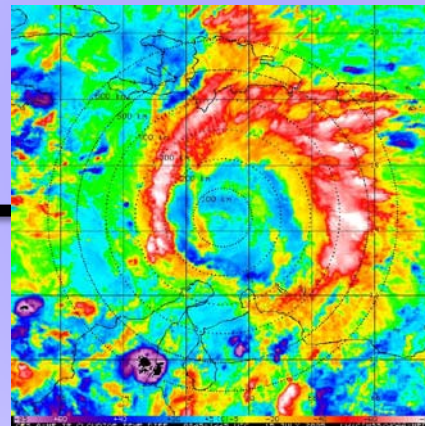
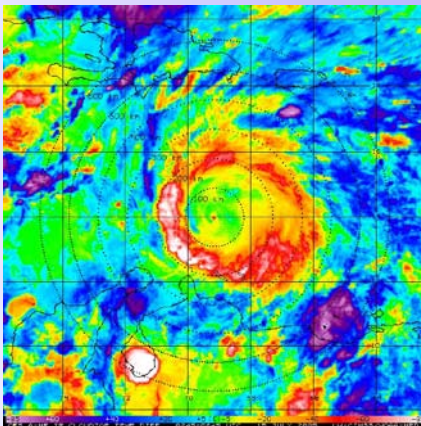
10am LST

8pm LST

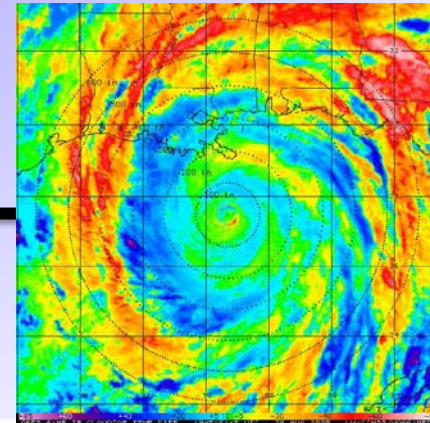
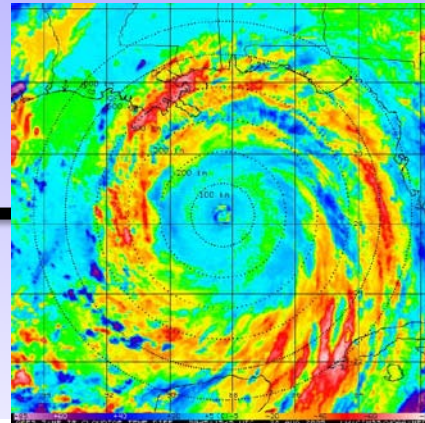
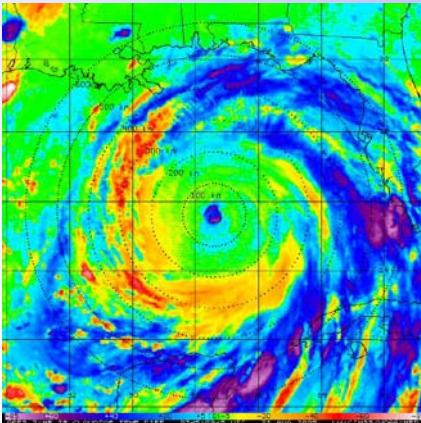
Andrew
1992



Emily
2005



Katrina
2005



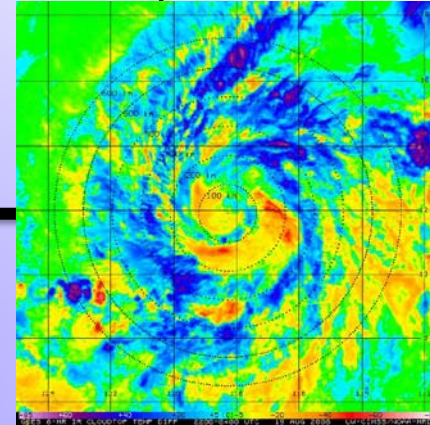
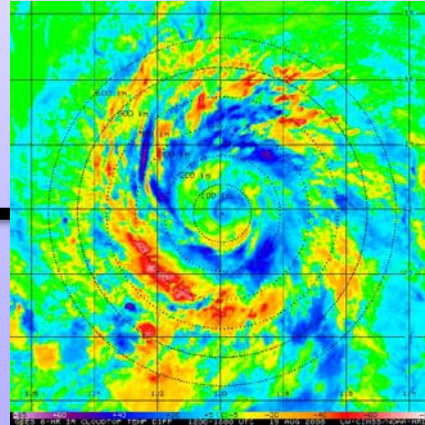
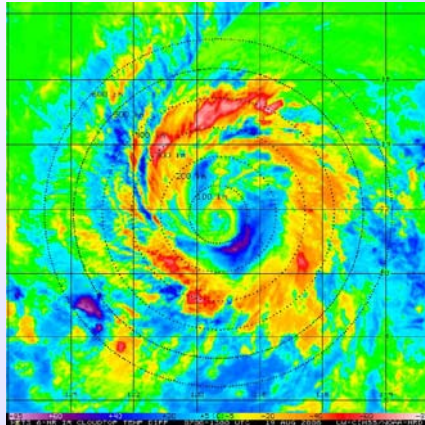
Diurnal TC Pulsing: A Global Phenomenon

4am LST

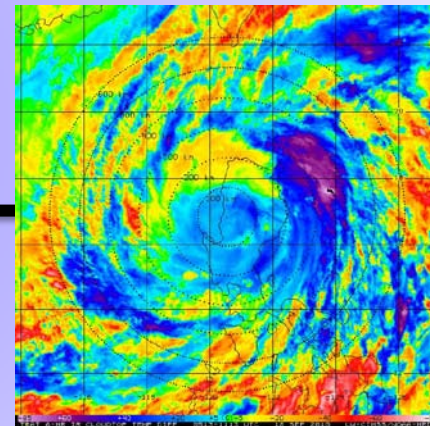
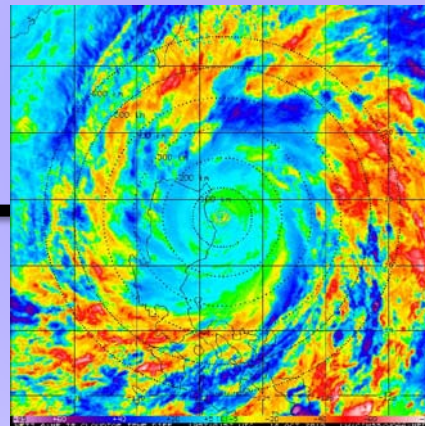
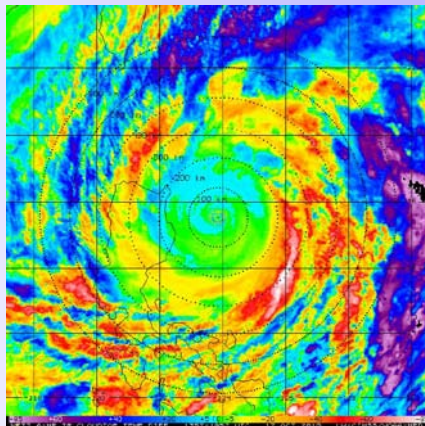
10am LST

8pm LST

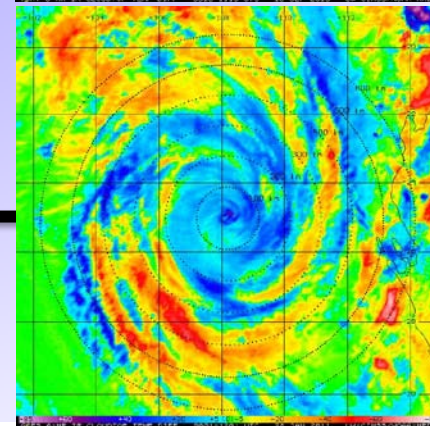
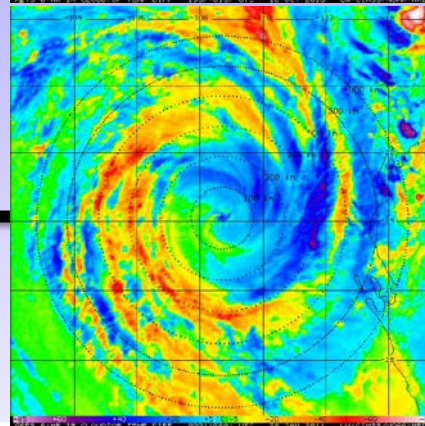
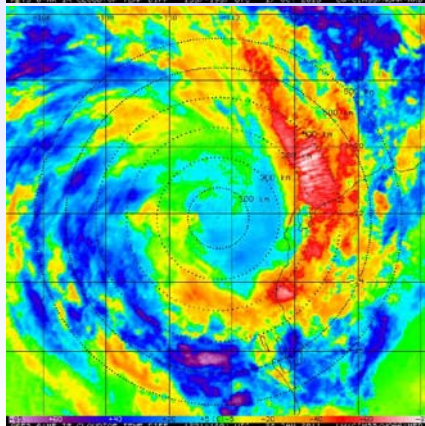
Daniel
2006



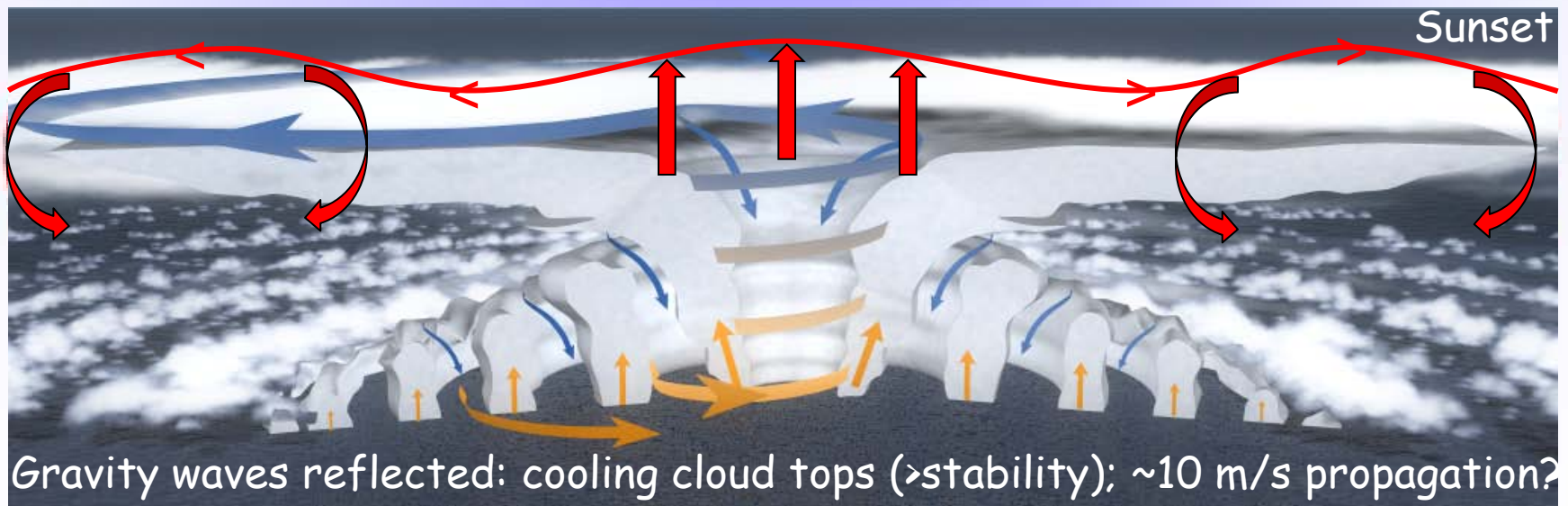
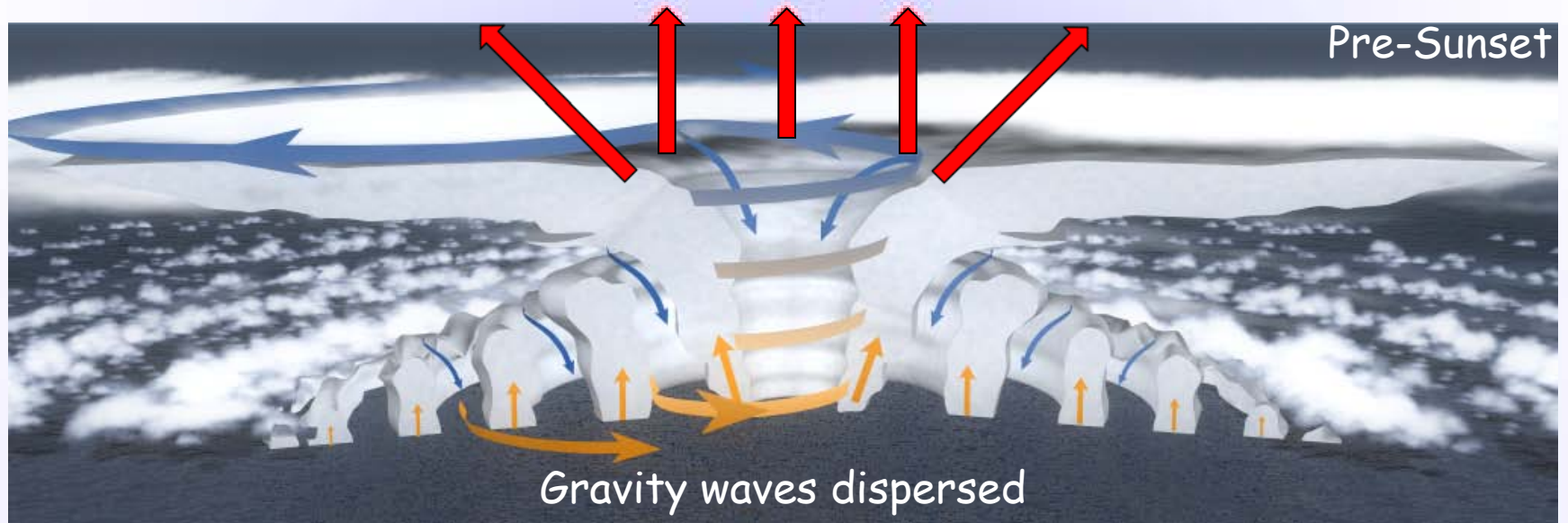
Megi
2010



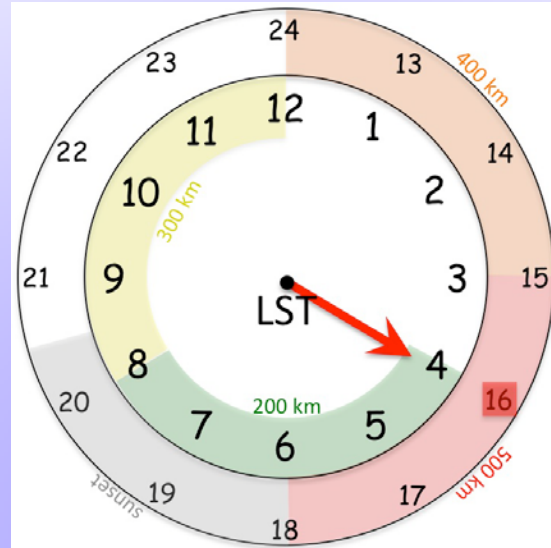
Bianca
2011



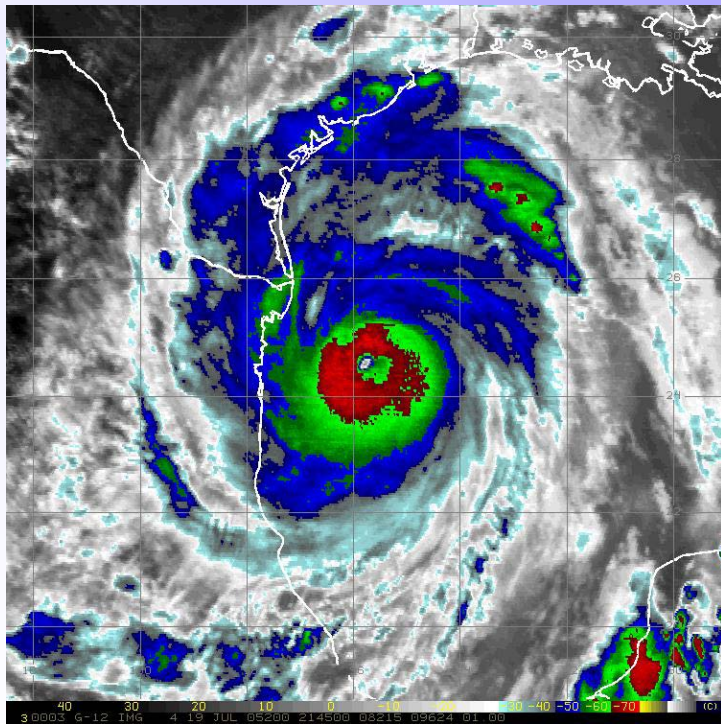
GOES IR BT-Difference Cool Rings...what's going on?



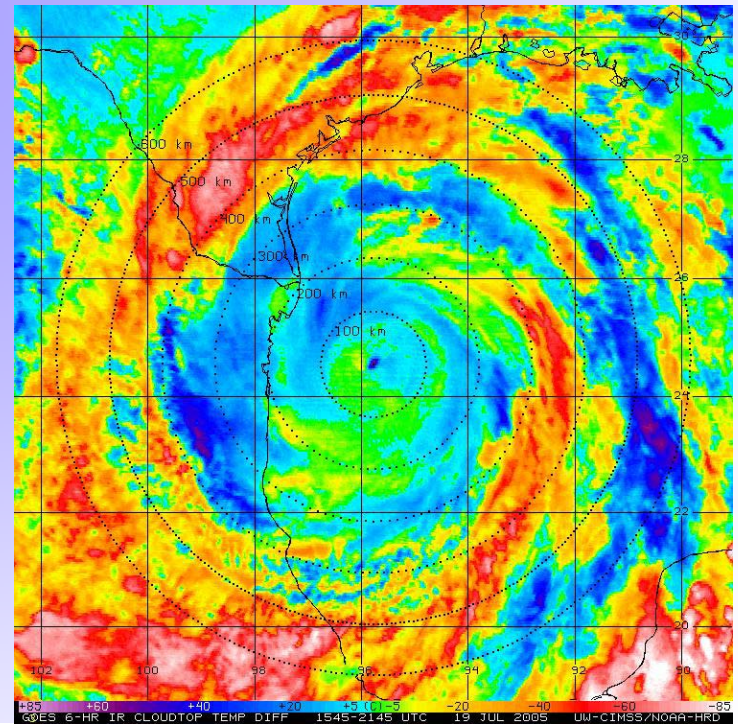
Hurricane Emily: 19 July 2005



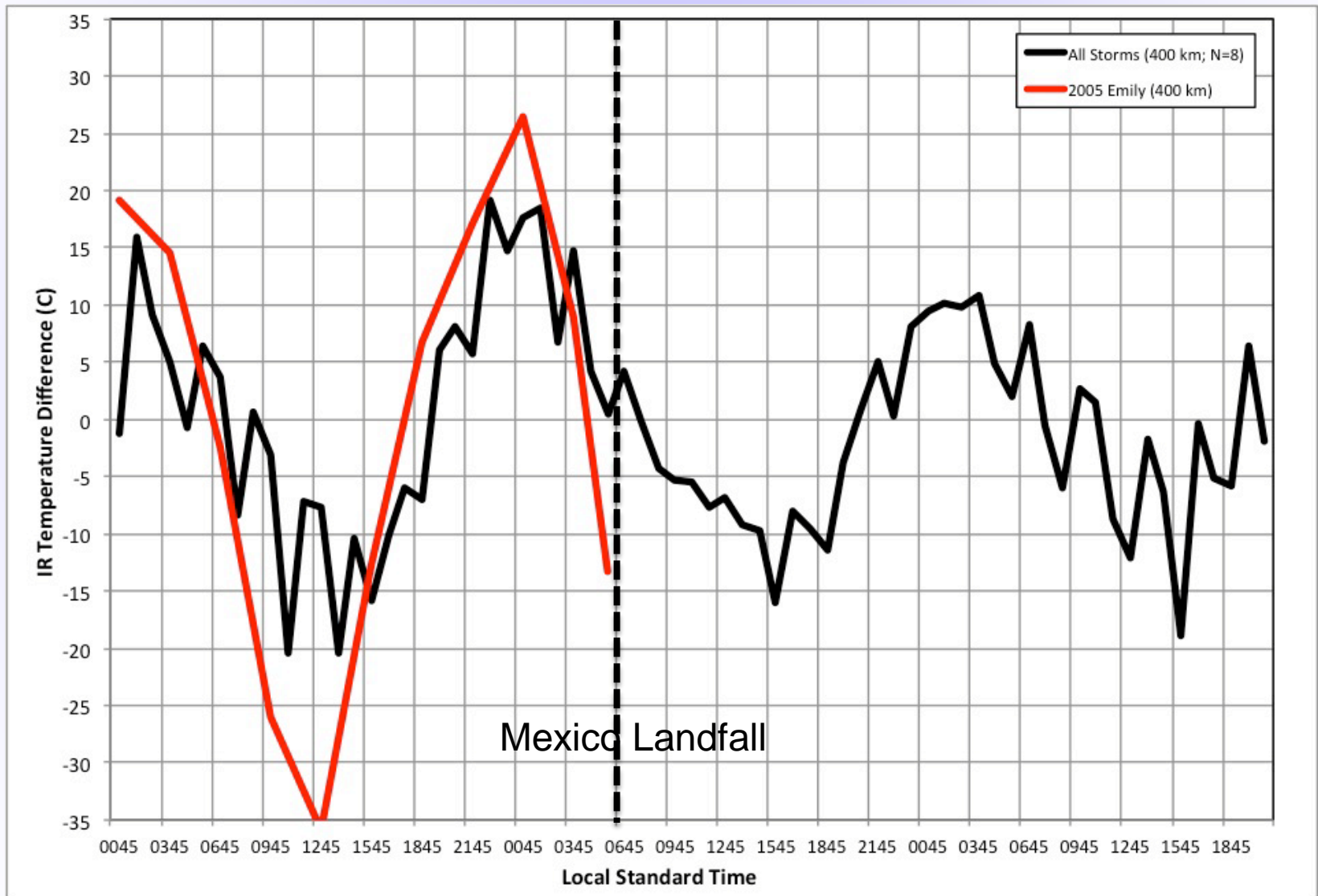
GOES IR (storm relative)



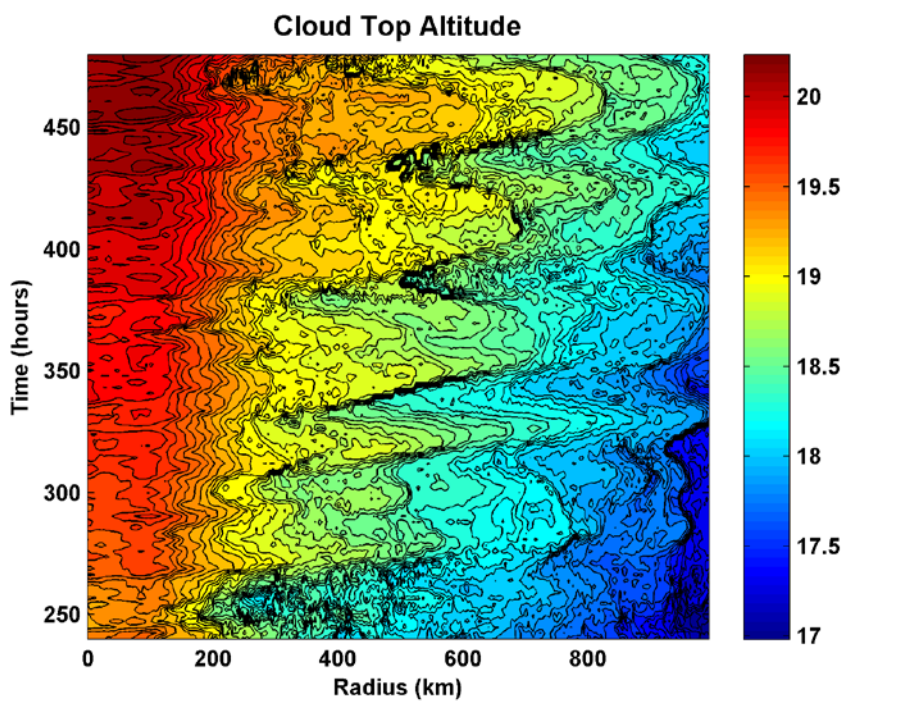
GOES BT Diff (storm relative)



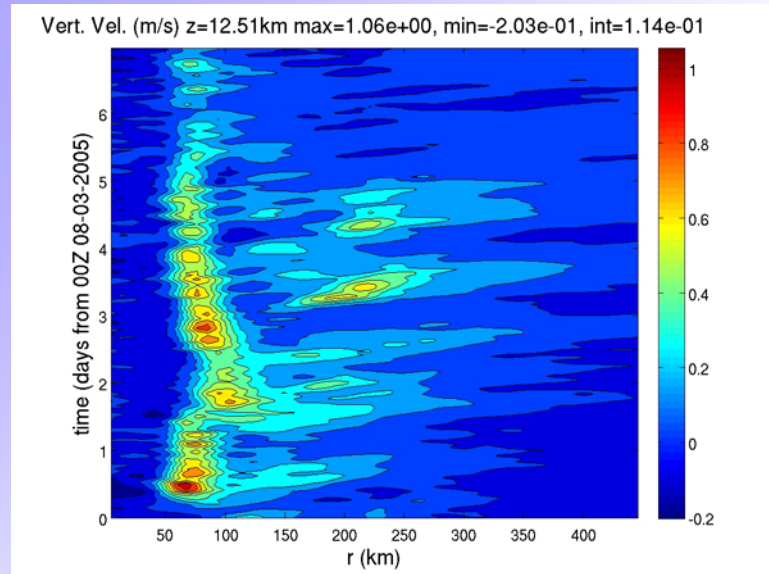
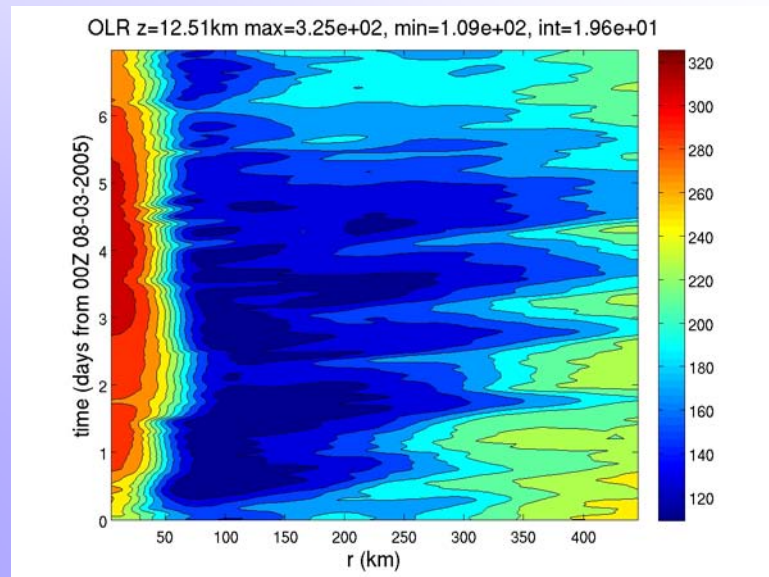
Hurricane Emily: 19-20 July 2005



TC Diurnal Pulsing: Can We See it in the Models?



Axisymmetric hurricane model
Rotunno and Emanuel 1988



WRF/ECMWF Hurricane Nature Run
Dave Nolan, Univ. of Miami

Conclusions & Future Work

Diurnal Pulsing

- diurnal process (and predictable)
- gravity waves?...remarkable symmetry; flight-level turbulence
 - harmonic oscillation?...anvil expansion?...inertial stability changes?*
- propagation: $\sim 10 \text{ m s}^{-1}$ (pass 400 km at $\sim 1200\text{-}1500$ LST)
- global (hurricanes, typhoons, cyclones, MCSs, AEWs)

TC Implications:

- favorable \gg "wee hours" (sunset to 6am LST)
- unfavorable \gg larger radii (6am to late afternoon LST)
- changes in inner core structure (quantify with GOES IR)
- DVORAK implications? (quantify with ADT)
- links to secondary eyewall formations? Lightning?
- TC pulsing in numerical models (hints of pulsing)

Continuing the "Pulsing Hunt"

- experimental real-time diurnal pulsing product on CIMSS page
- sampling with the NOAA P-3s, G-IV & NASA Aircraft
- numerical modeling of TC pulsing (timing, structure, etc.)