# Tropical Transition: The Genesis of Tropical Cyclones from Extratropical Disturbances

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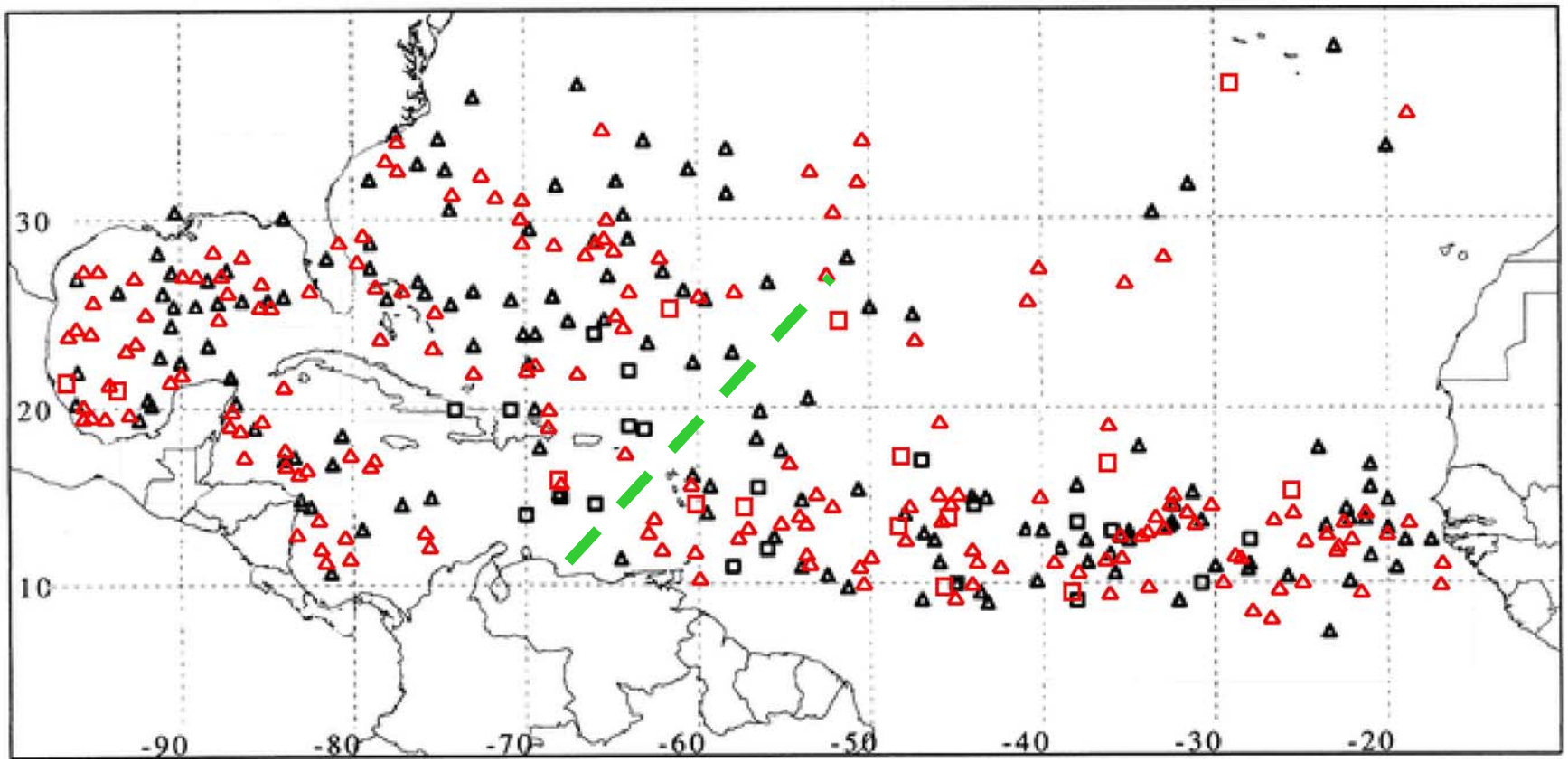
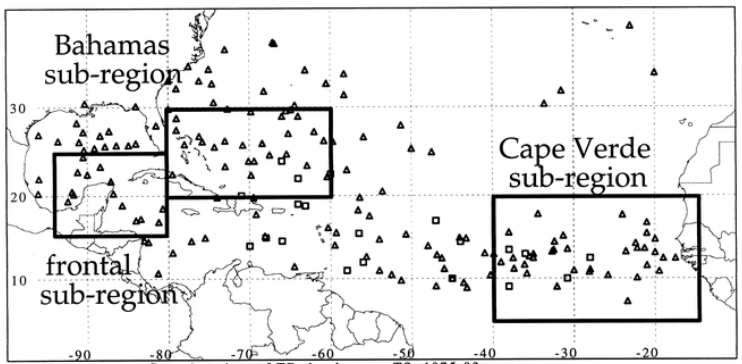
# Atlantic Genesis (1975-2005)




Black = 1975-1993

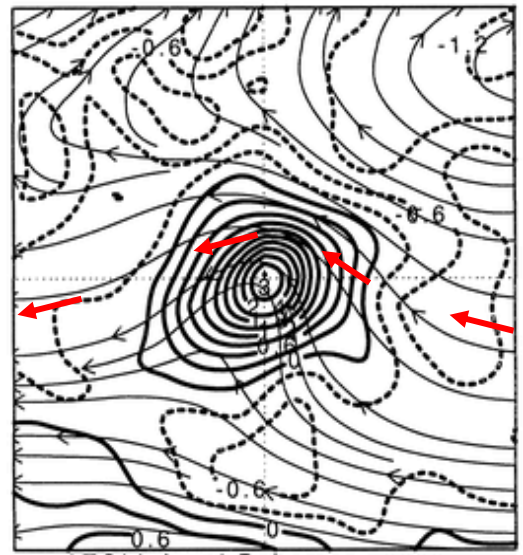
Red = 1994-2005

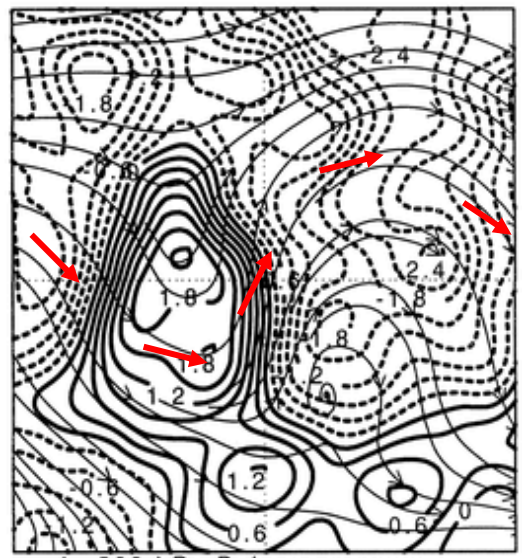
Bracken and Bosart (2000)
*Monthly Weather Review*

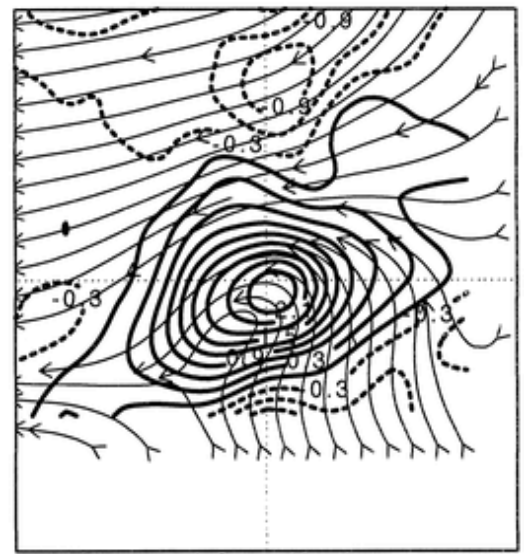


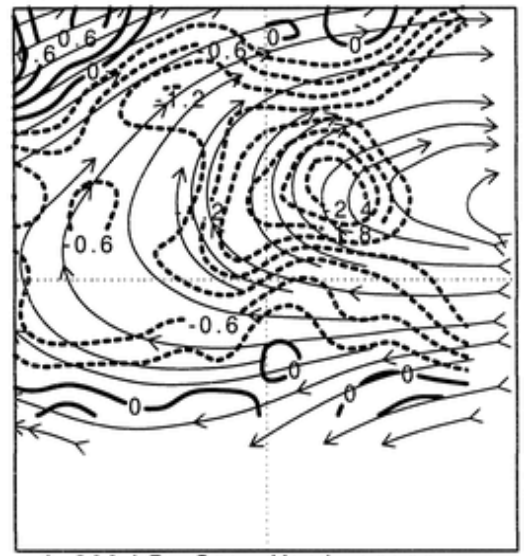
Genesis points of TD that become TS: 1975-93
and lysis points for overwater TDs equatorward
of 25N for TDs that don't become TS: 1975-87

*Shear exists in composite of developing depressions over Western Atlantic.*


a. ATOLL level Bahamas cases


b. 200 hPa Bahamas cases


c. ATOLL level Cape Verde cases


d. 200 hPa Cape Verde cases

# Tropical Transition

- Subtropical or Extra-tropical precursors
  - Cold-core upper tropospheric lows
  - Fronts
  - Mesoscale Convective Vortices
- Initially cold-core (vorticity maximizes at 700 hPa or above)
- May involve easterly waves
- Relies on finite vertical wind shear
  - Diabatic-baroclinic development (strong precursor)
  - Organization of convection (weak precursor)

# Atlantic Tropical Transitions by Season

(defined as having non-tropical origin)

| Year | TTs | Other |
|---|---|---|
| 2000 | 4 | 9 |
| 2001 | 8 | 7 |
| 2002 | 9 | 3 |
| 2003 | 6 | 9 |
| 2004 | 5 | 10 |
| 2005 | 8 | 19 |
| total | 40 | 57 |

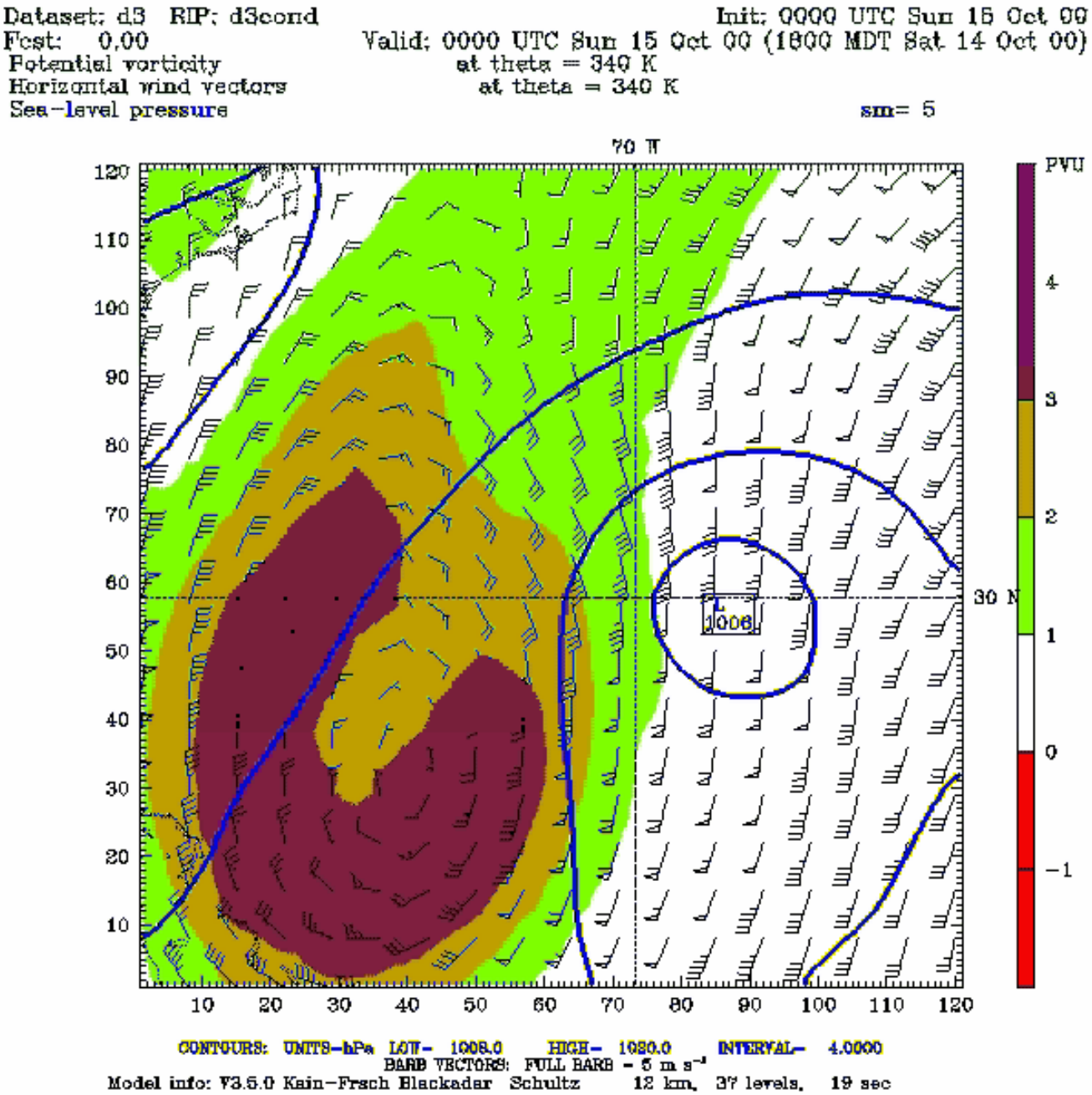
# MM5 Simulation of Michael (2000)

Potential Vorticity (PVU) and Wind on 340 K θ Sfc.

Sea-level Pressure

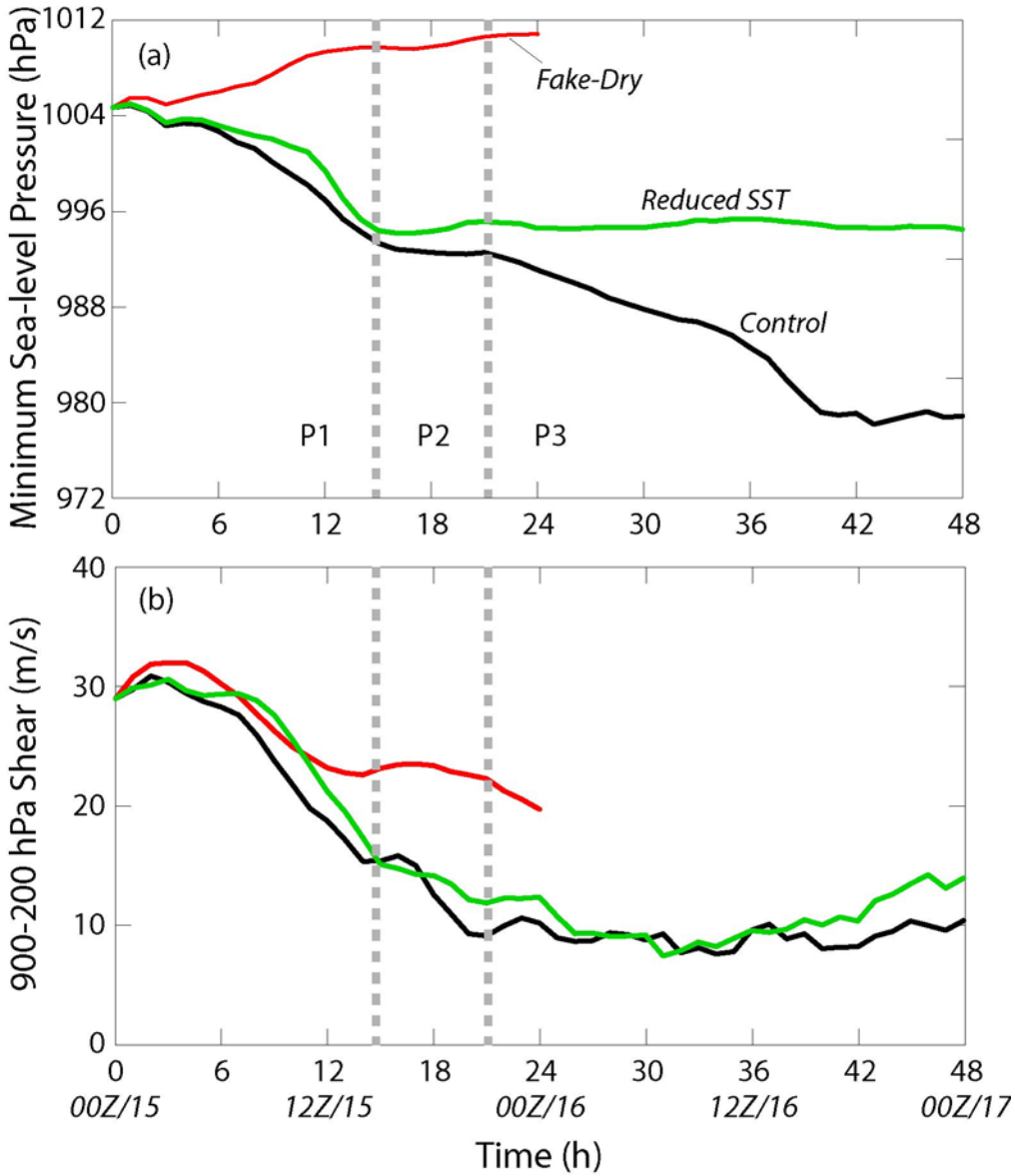
Start: 00 UTC 15 Oct. 2000

End: 00 UTC 17 Oct. 2000



# MM5 Simulation of Hurricane Michael (2000)

- Nested 12.3-km grid
- Cold start from global analysis (NCEP)
- 48-h integration
- Kain-Fritsch CP
- Blackadar PBL
- Schultz Cloud Physics






*Davis and Bosart, 2003: Monthly Weather Review*

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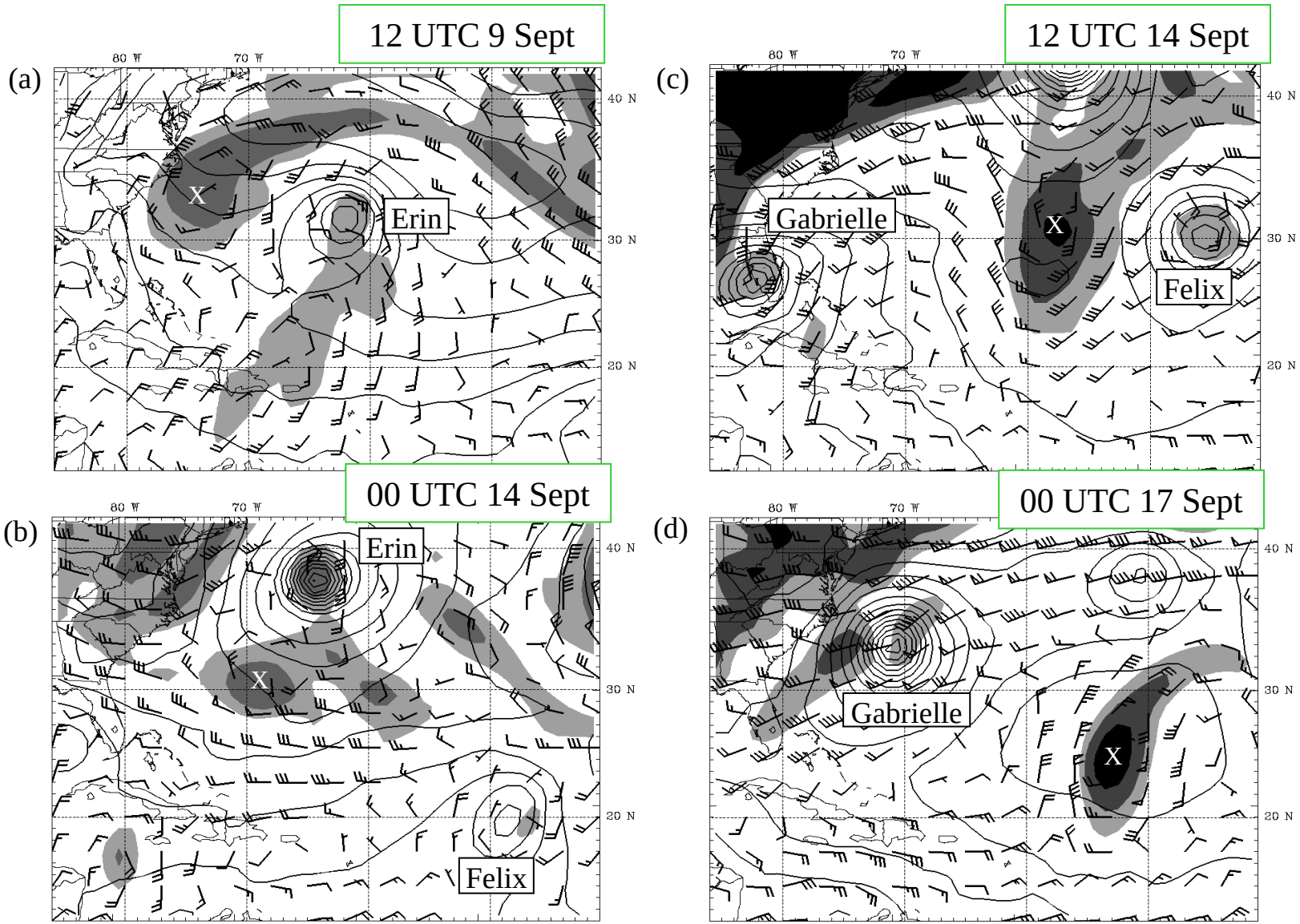
# PV and Wind on 340 K Isentropic Surface



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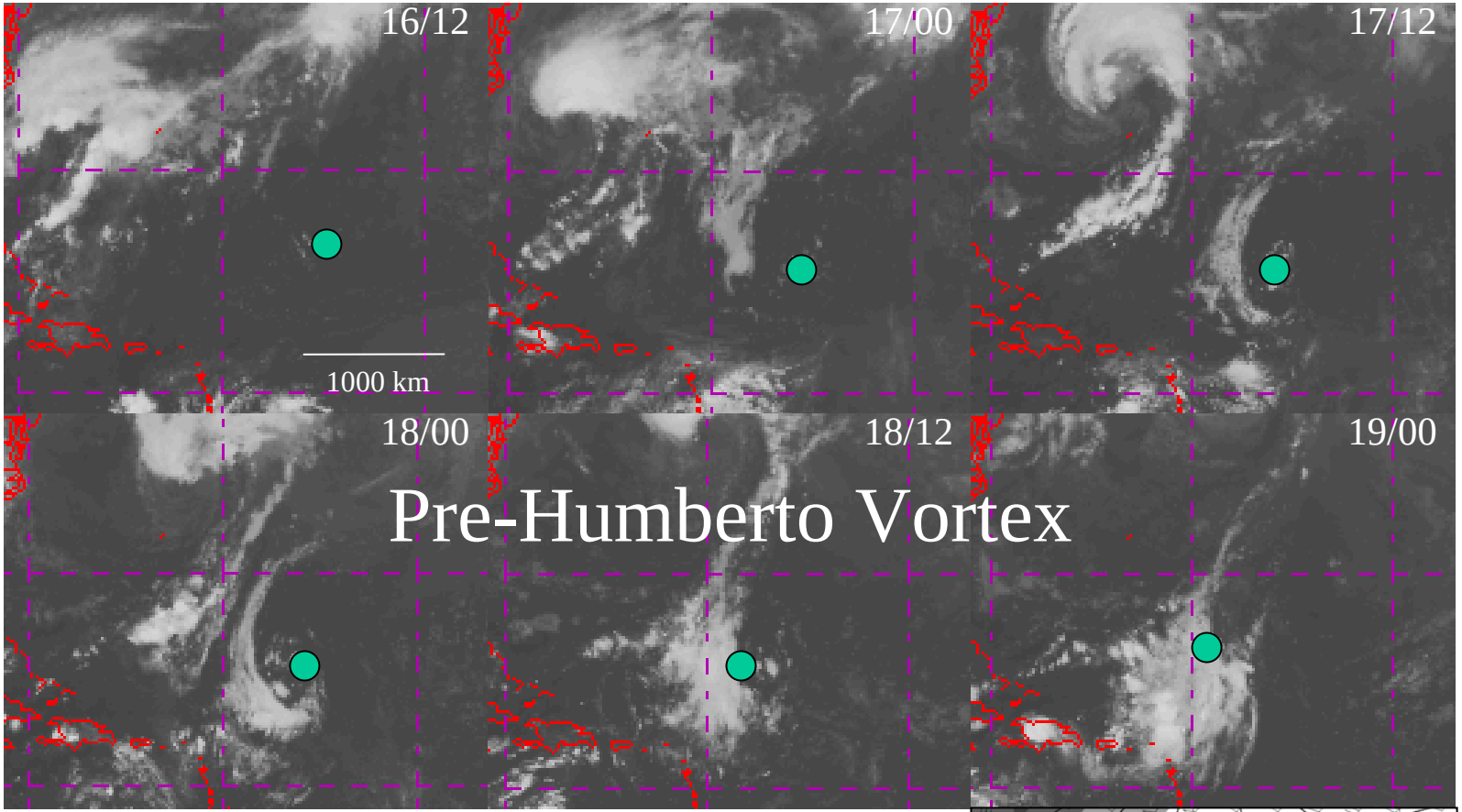
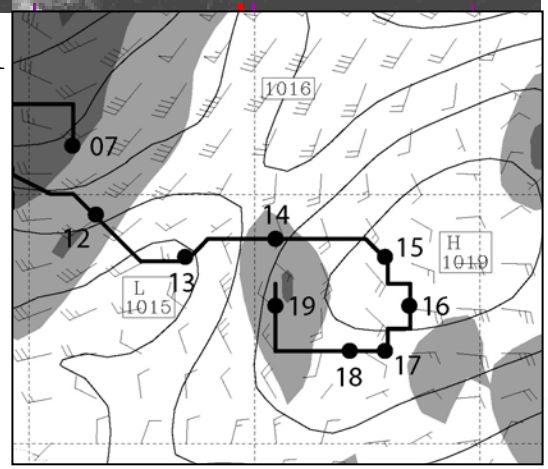



IR Satellite Images 12Z 16 Sept. to 00Z 19 Sept. 2001

Vortex centroid location on 340 K sfc.

Images obtained from
*http://weather.unisys.com/archive/sat_ir/*




340 K PV at
00 UTC 19
Sept.



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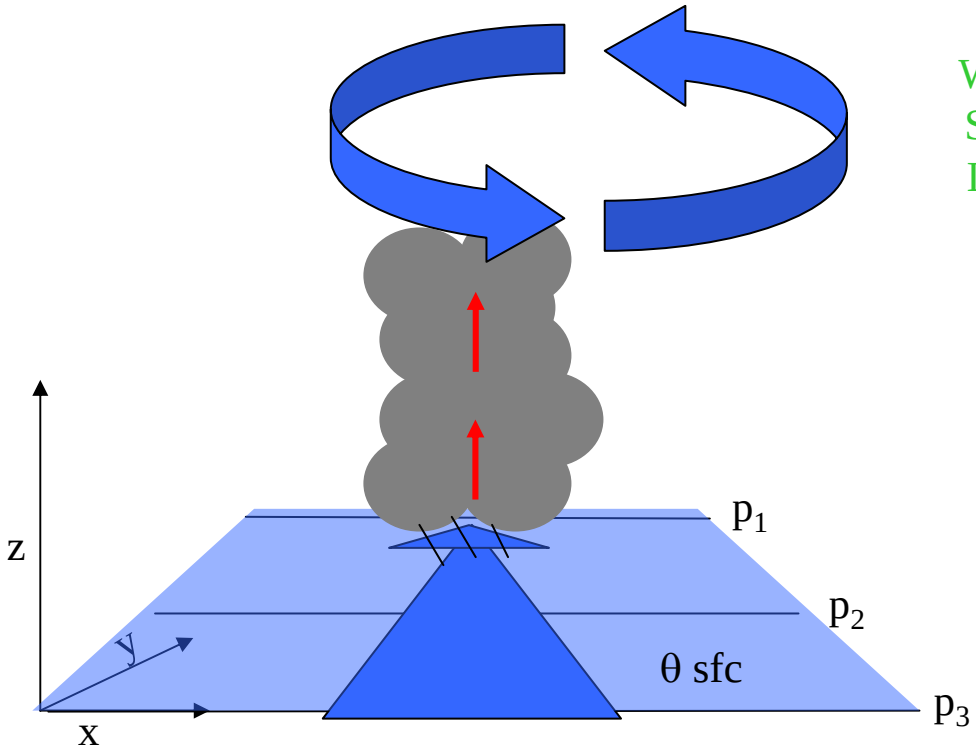
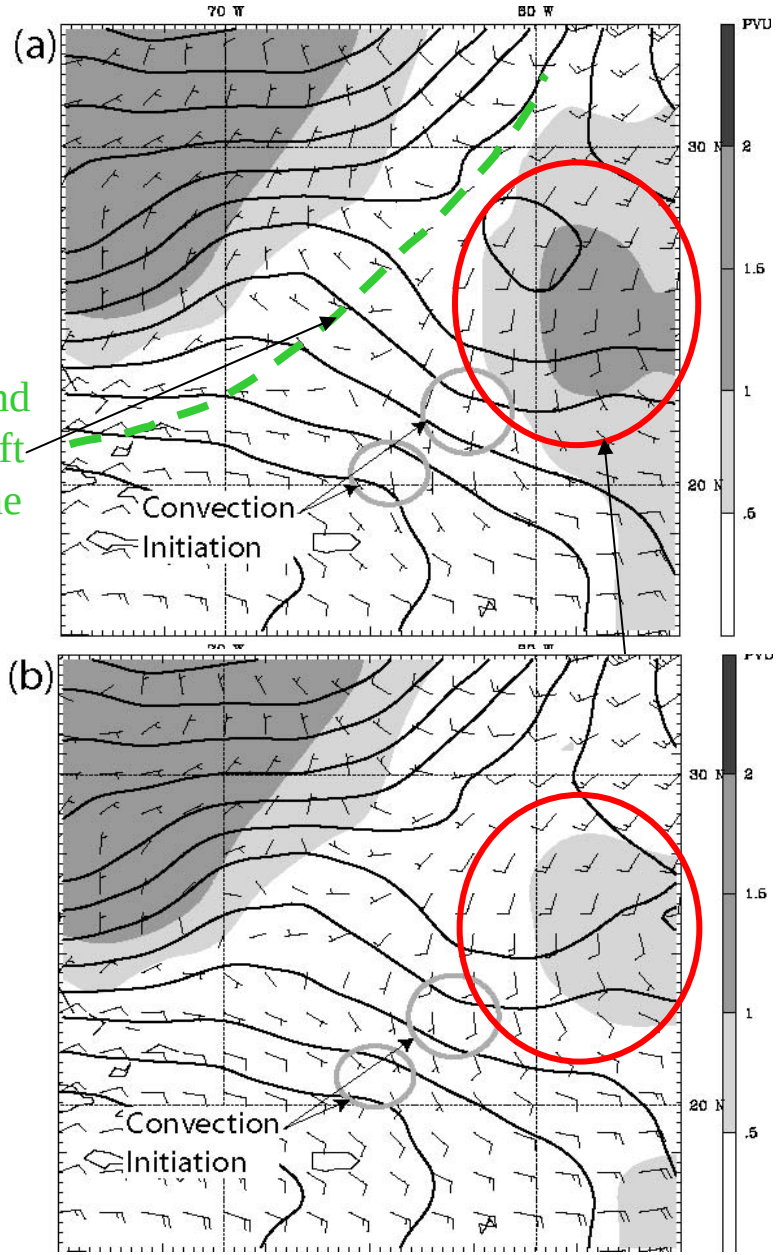
# Modification of Wind Profile




Control




"Weak" PV



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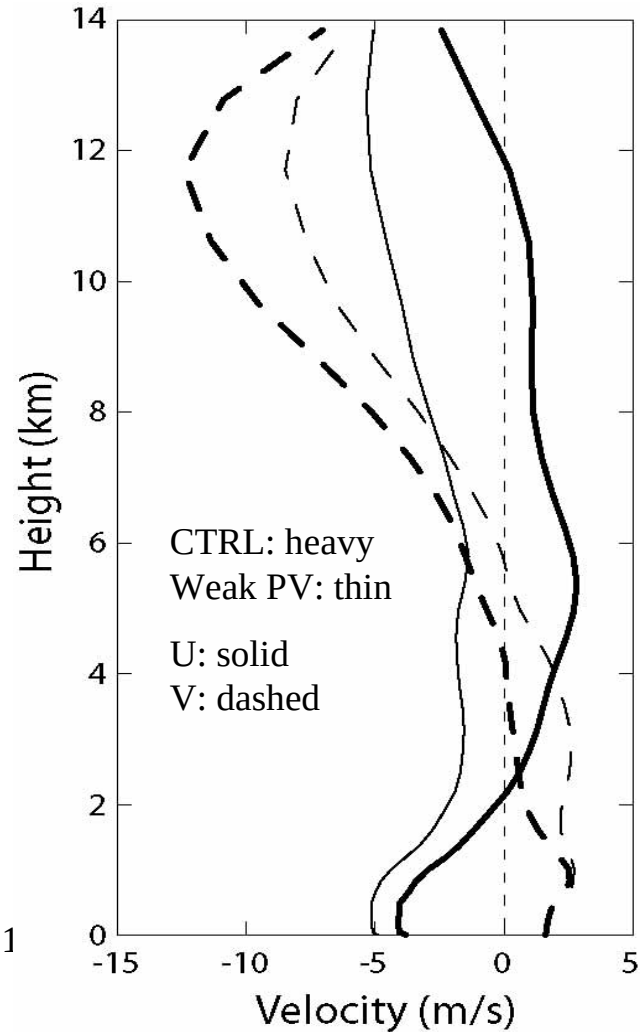
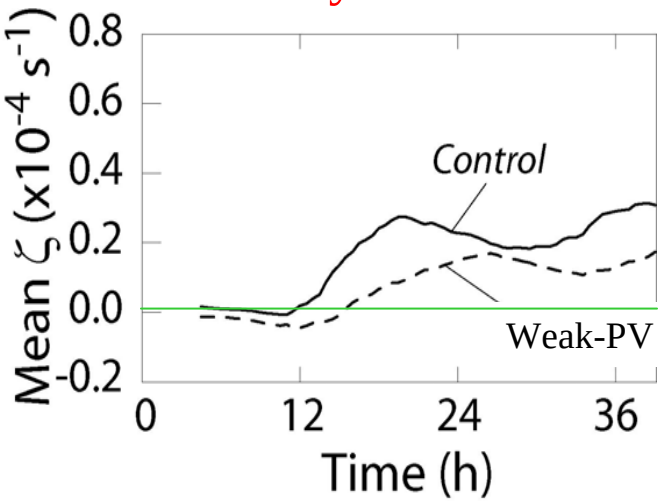
# Slower Development Without Shear

*CTRL simulation is initialized with more shear on flank of upper-tropospheric cold low*




Wind Profiles prior to convection

Vorticity time-series





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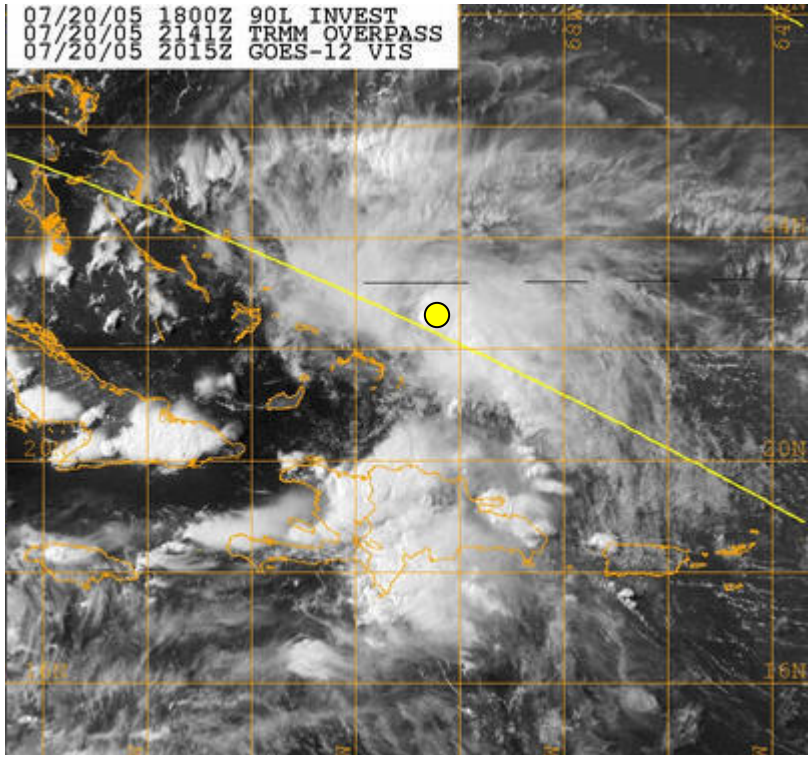
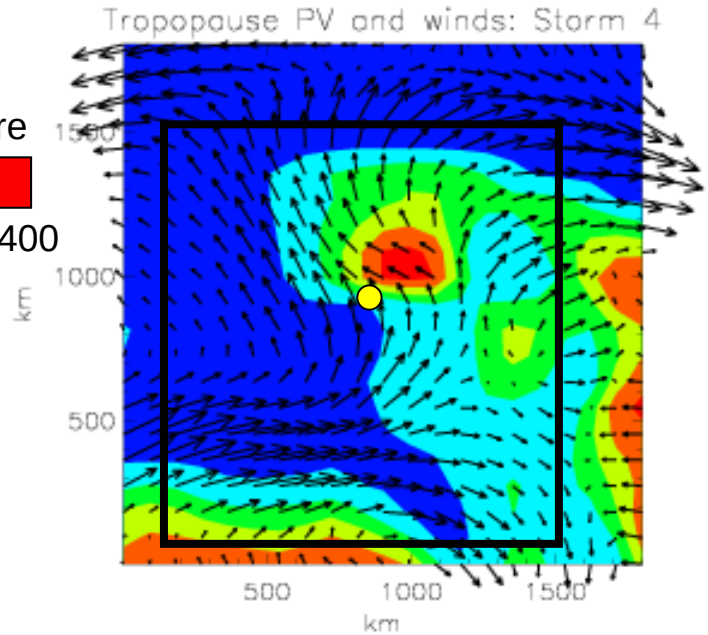
# What About 2005?

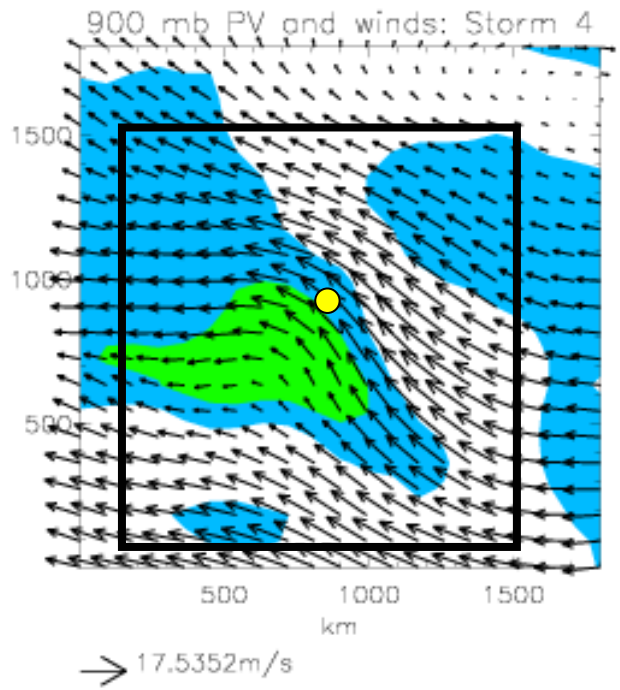
# Franklin

Tropopause Potential Temperature

320 330 340 350 360 370 380 390 400




900 hPa Potential Vorticity (PVU)

-0.25 0.0 0.25 0.5 1.0 1.5 2.0



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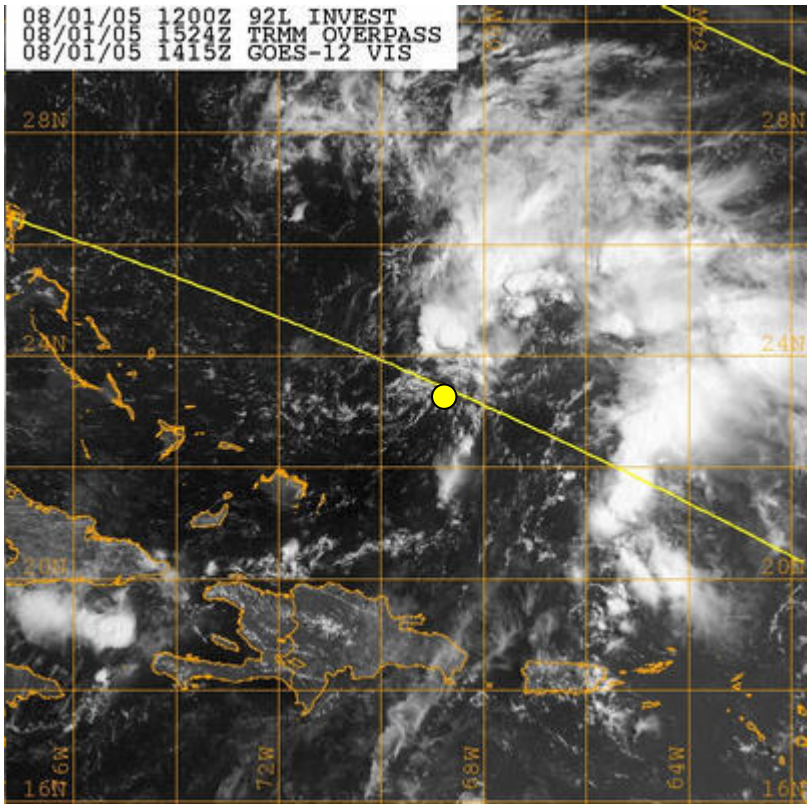
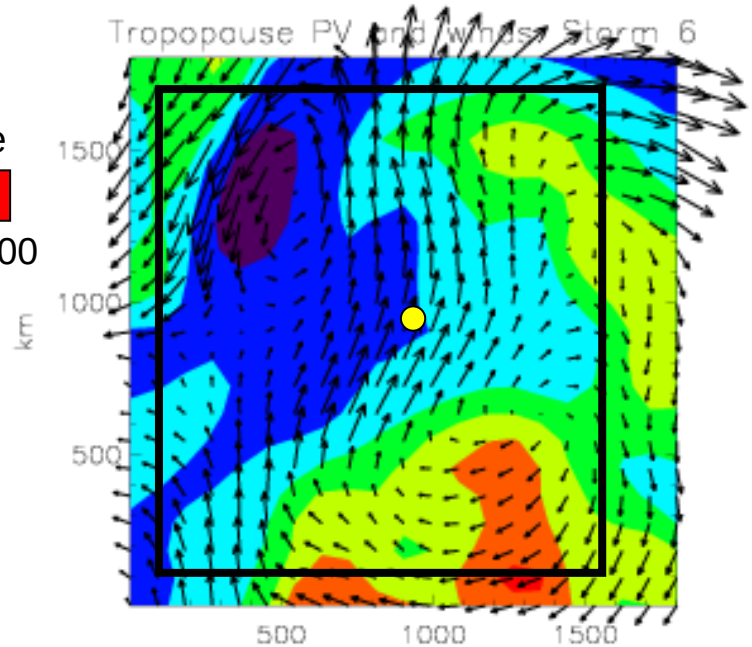
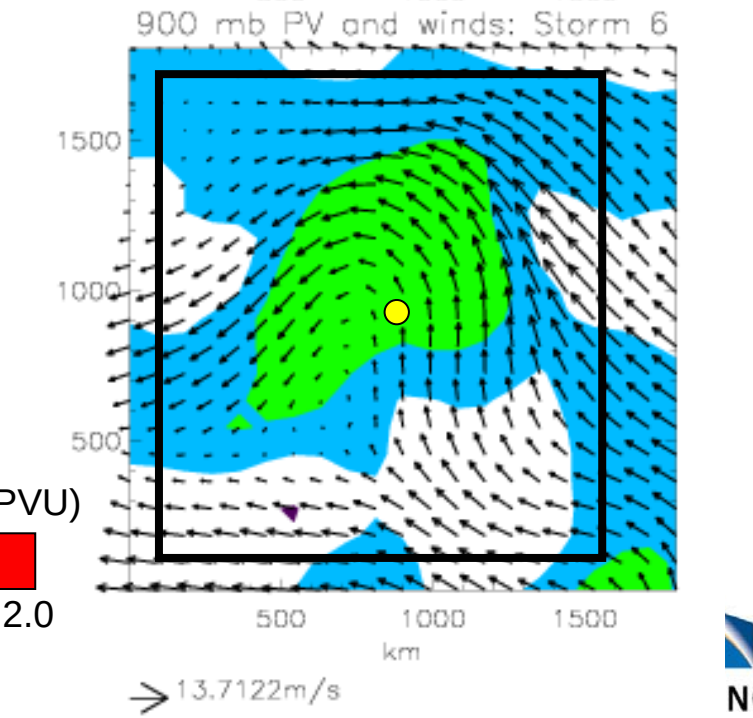
# Harvey

Tropopause Potential Temperature

320 330 340 350 360 370 380 390 400




900 hPa Potential Vorticity (PVU)

-0.25 0.0 0.25 0.5 1.0 1.5 2.0

21 March, 2006

60th IHC

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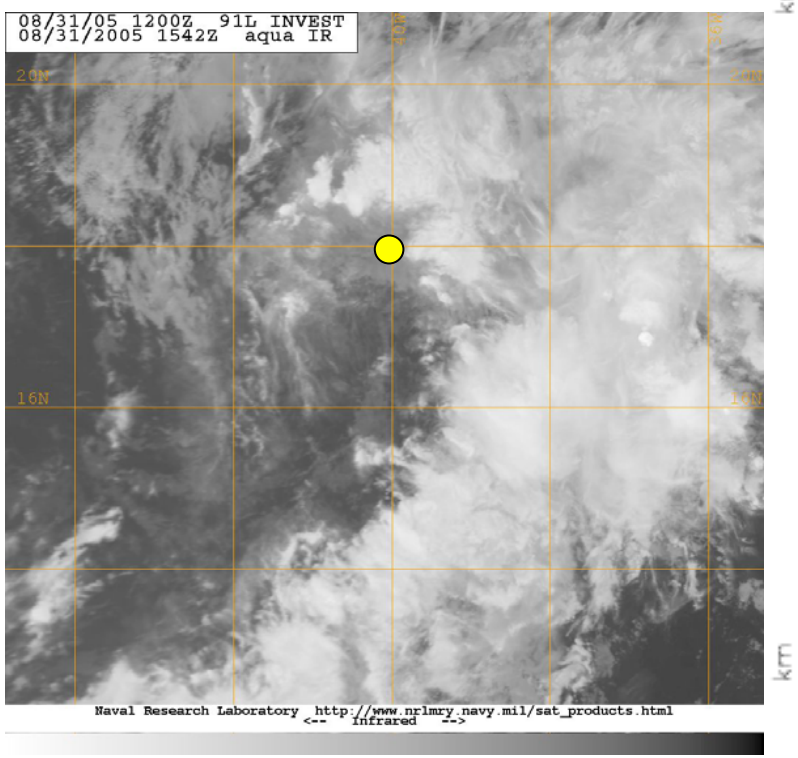
# Maria

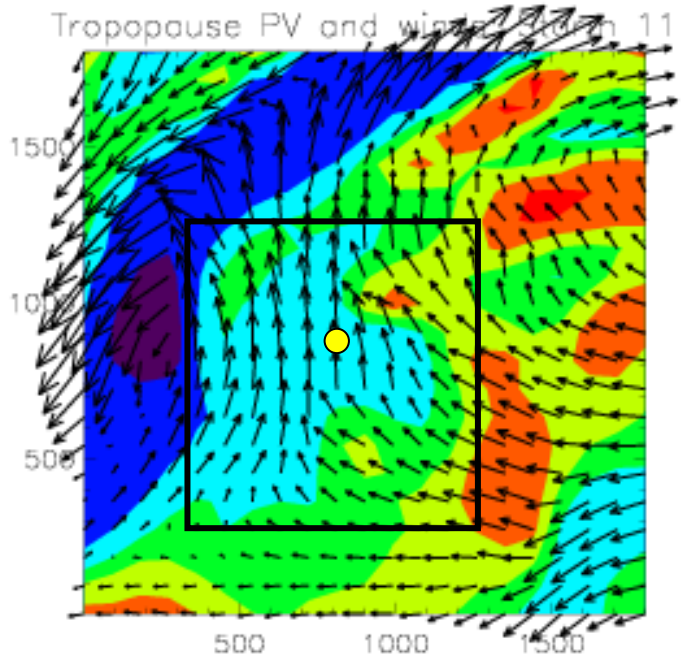
Tropopause Potential Temperature

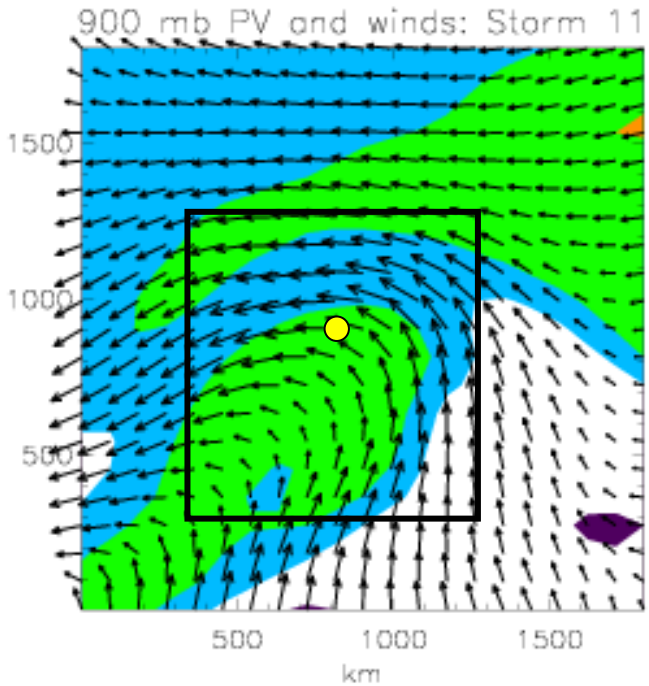
320 330 340 350 360 370 380 390 400




900 hPa Potential Vorticity (PVU)

-0.25 0.0 0.25 0.5 1.0 1.5 2.0




21 March, 2006

60th ]

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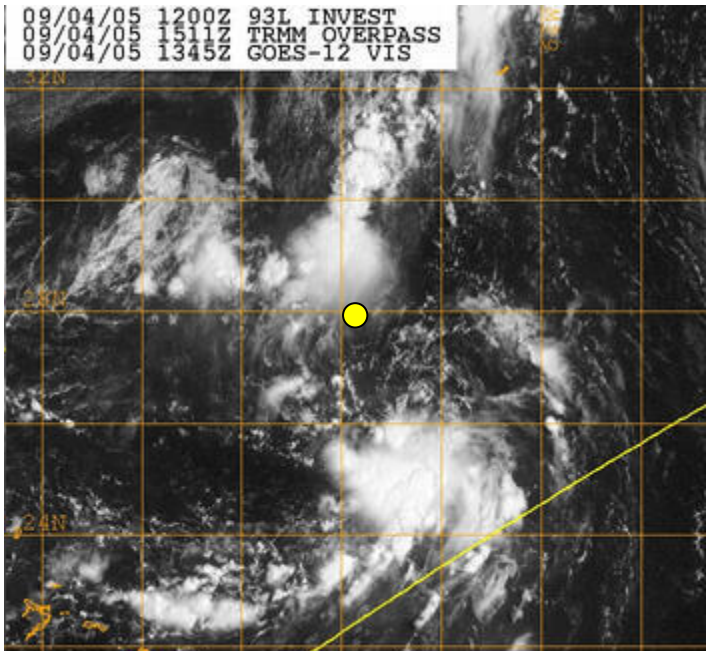
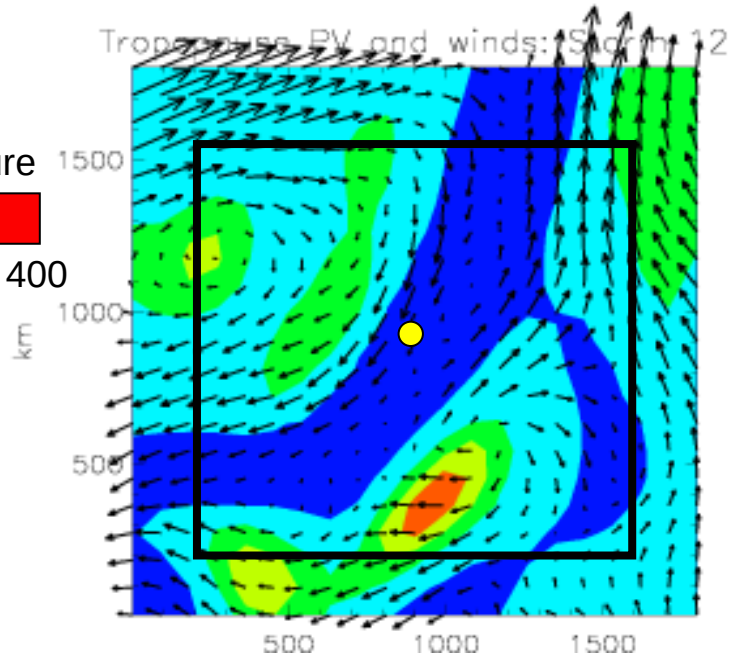
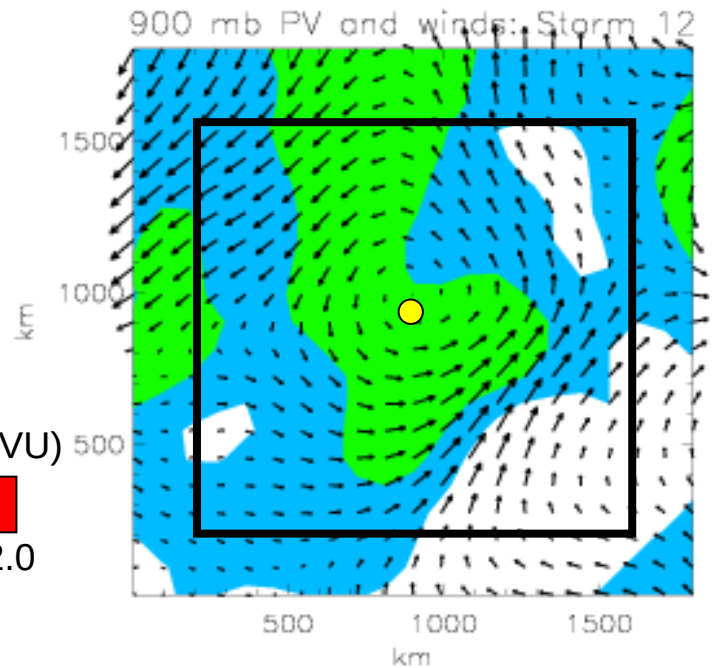
# Nate




Tropopause Potential Temperature

320 330 340 350 360 370 380 390 400



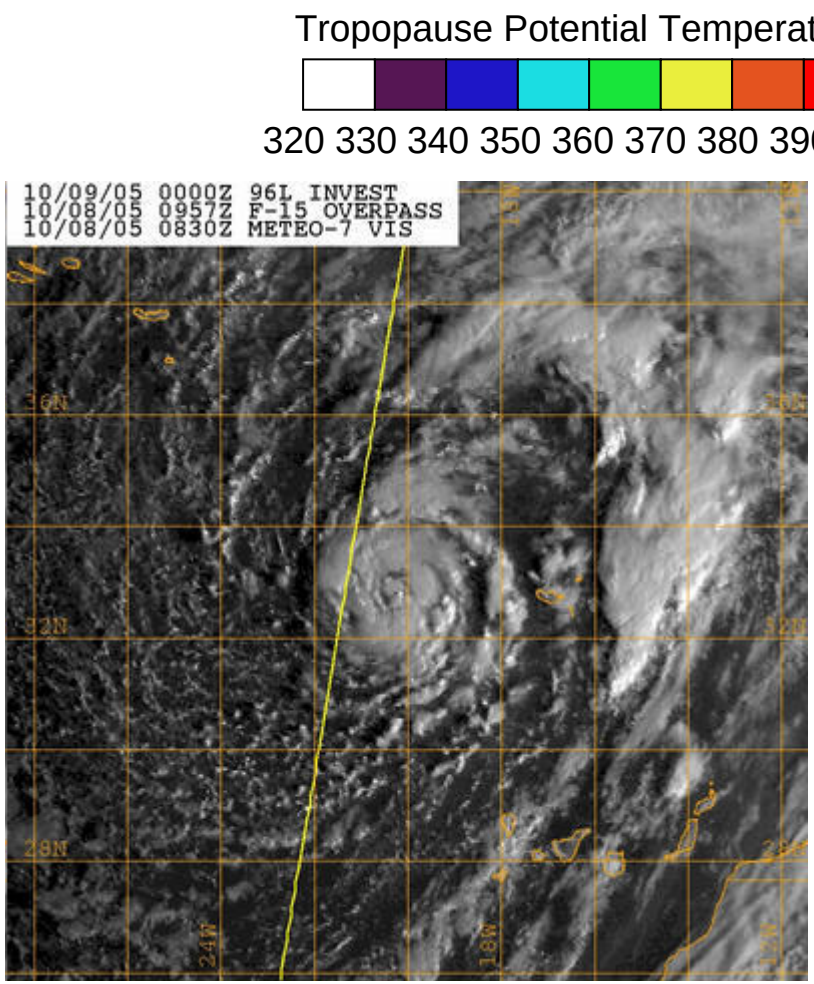




900 hPa Potential Vorticity (PVU)

-0.25 0.0 0.25 0.5 1.0 1.5 2.0

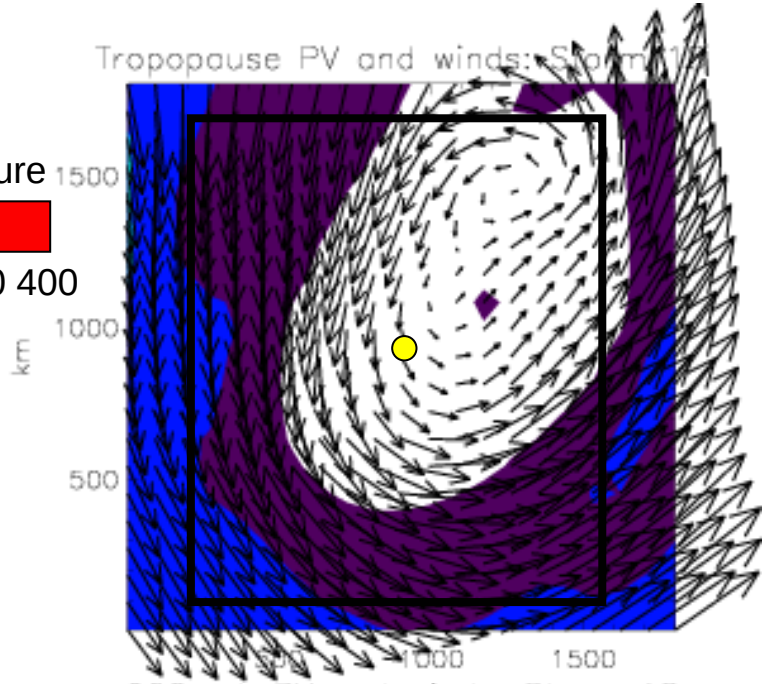
>9.81035m/s

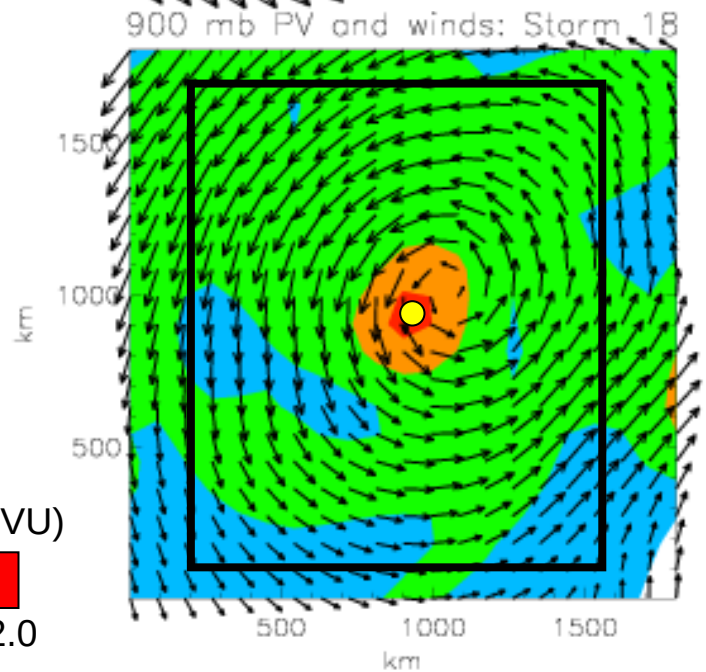
# Vince




Tropopause Potential Temperature

320 330 340 350 360 370 380 390 400




900 hPa Potential Vorticity (PVU)

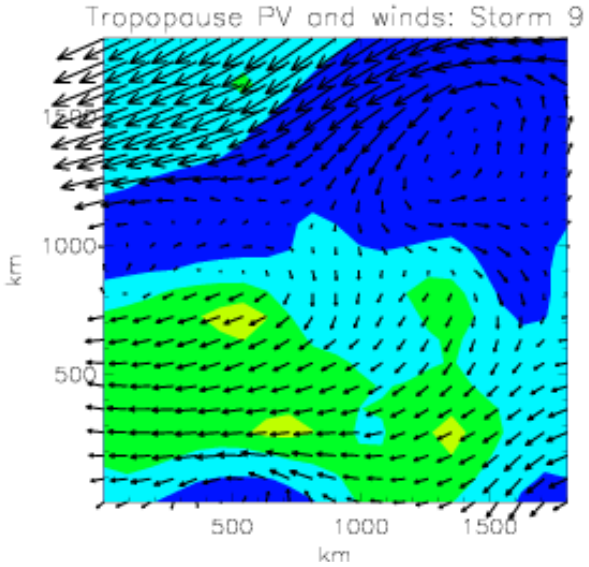
-0.25 0.0 0.25 0.5 1.0 1.5 2.0

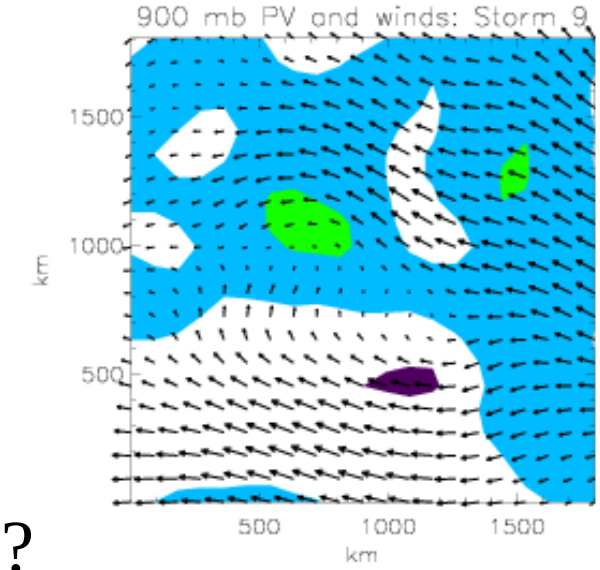
21 March, 2006

60th IH

NCAR

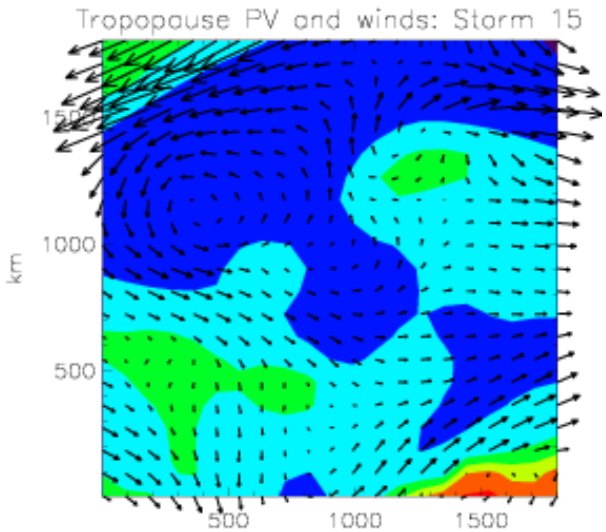
Katrina

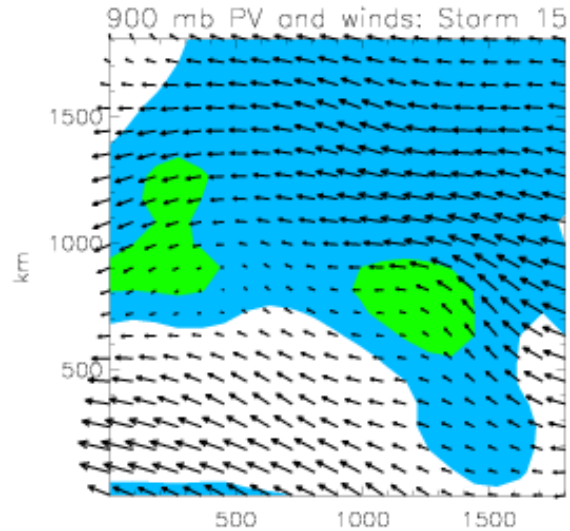



TT ?

Rita



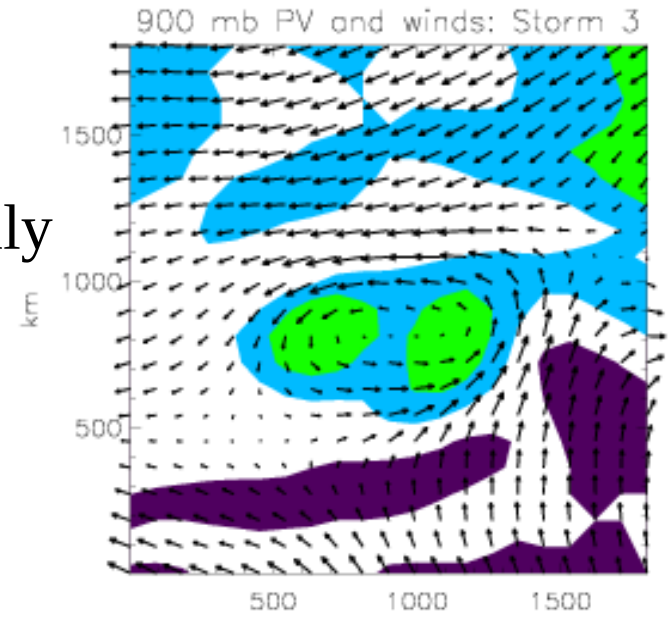

Tropopause Potential Temperature

320 330 340 350 360 370 380 390 400

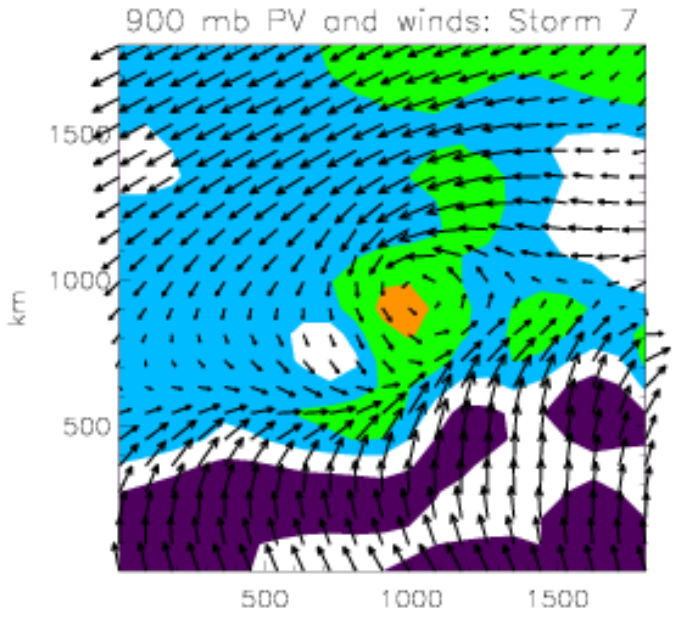
900 hPa Potential Vorticity (PVU)

-0.25 0.0 0.25 0.5 1.0 1.5 2.0

Emily

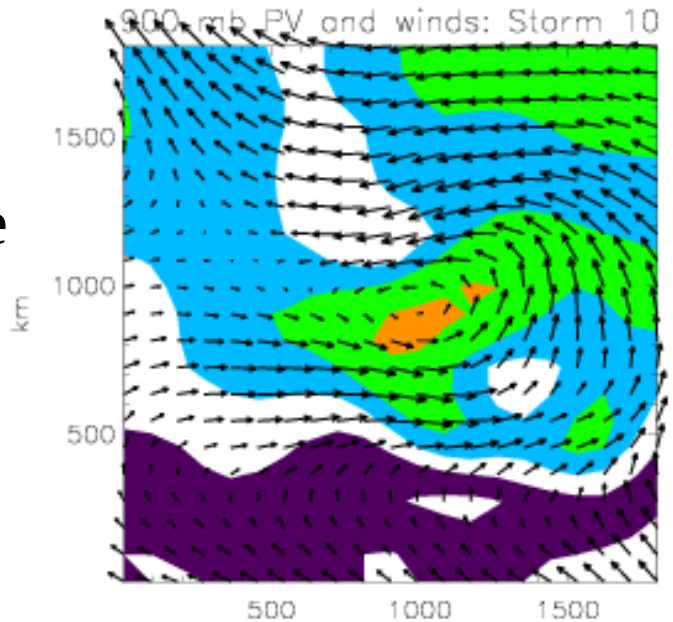



Irene

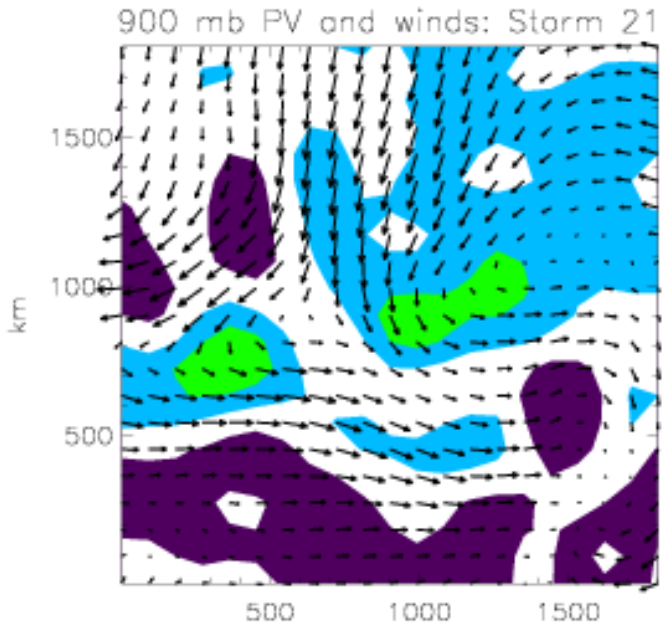



ITCZ?

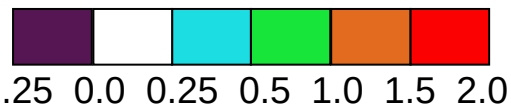
Lee




Beta




900 hPa Potential Vorticity (PVU)




21 March, 2006

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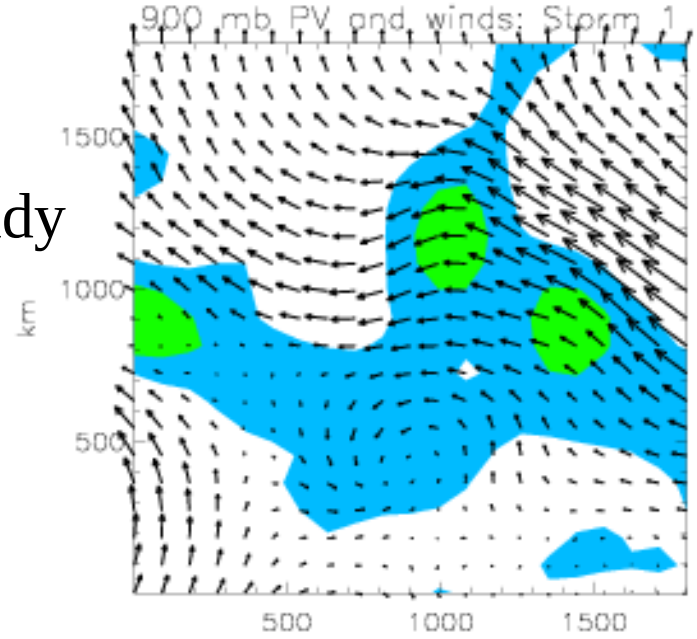
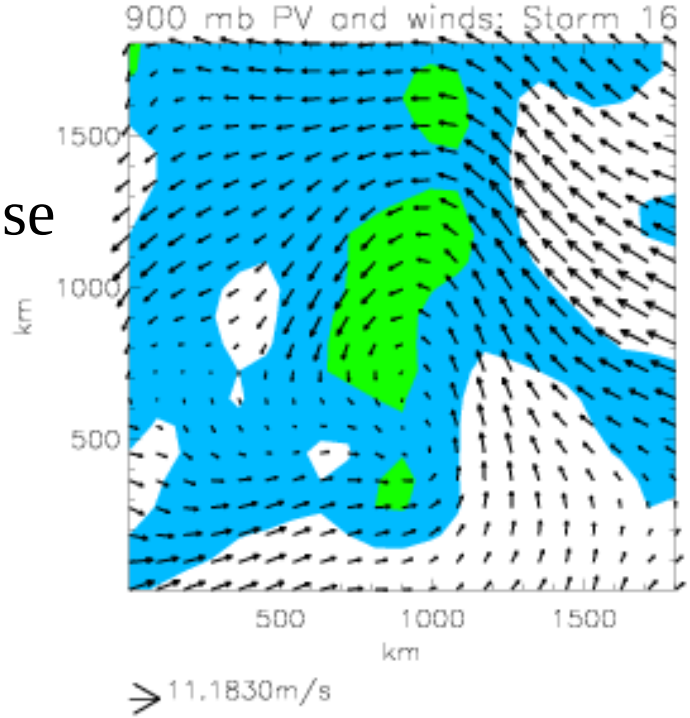
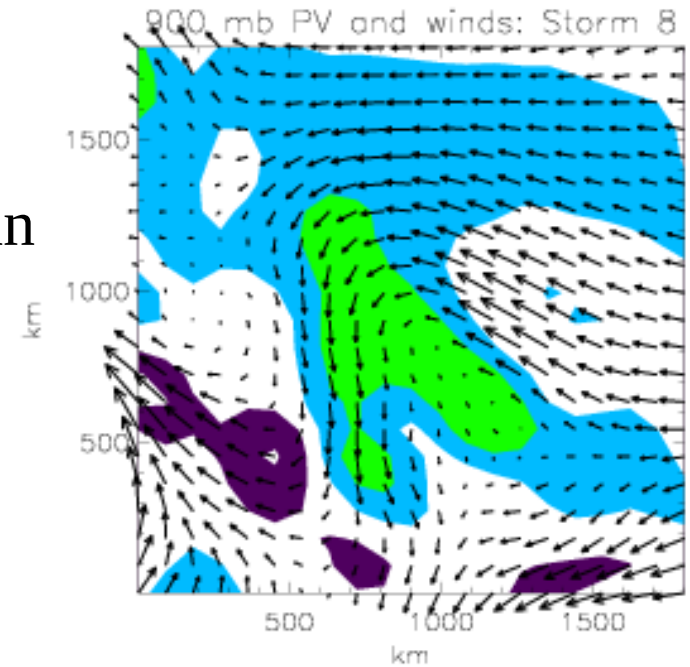
Cindy




Jose




Stan




Wave Accumulation?

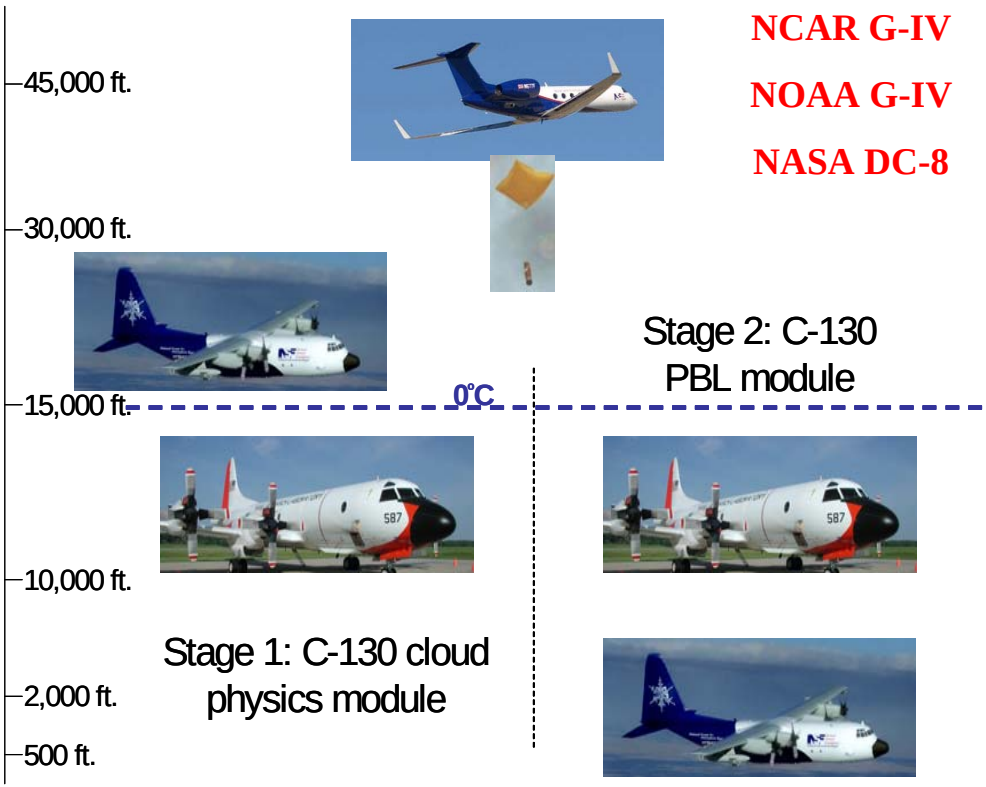
$dU/dx < 0$

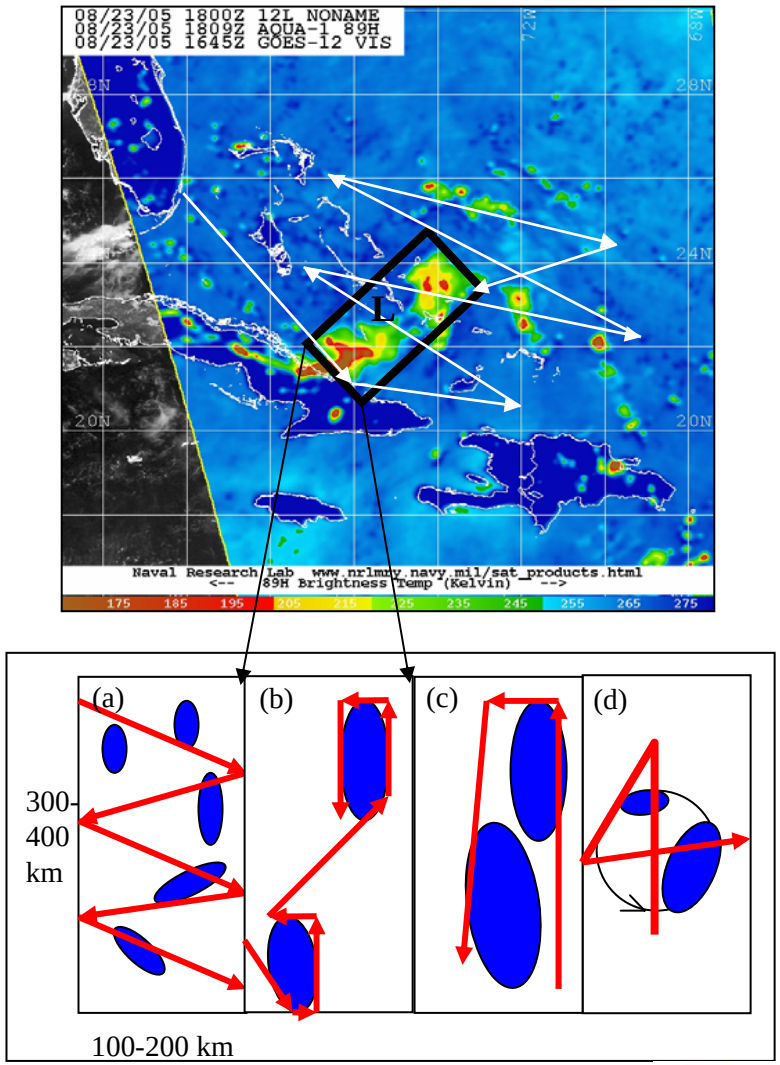
# Western Atlantic Genesis Issues

- Large-scale influences (waves, troughs)
- Mesoscale (MCSs, MCVs, fronts)
- Convective scale (convective bursts, VHTs)
- Numerical prediction capability
- Critical observations?

# WATTAGE

*Western Atlantic Tropical Transition and Genesis Experiment (2008)*



# Conclusions

## Key Points about Tropical Transition

- Vertical shear organizes convection => vorticity production
- Convection decreases shear => warm core formation
- TT can occur with easterly waves: issue is shear => upper trough, lower tropospheric mesoscale ascent

## General Points

- Broad spectrum of genesis mechanisms, strong hints apparent in analyses
  - *Wave genesis*
  - *TT*
  - *ITCZ*
- Multi-scale observations crucial for sorting out genesis mechanisms and improving prediction