The Operational HWRF System: Asymmetric Intensification of Hurricane Earl

Hua Chen and Gopal Sundararaman

Acknowledge: HWRF modeling team
Thiago Quirino
Robert Rogers
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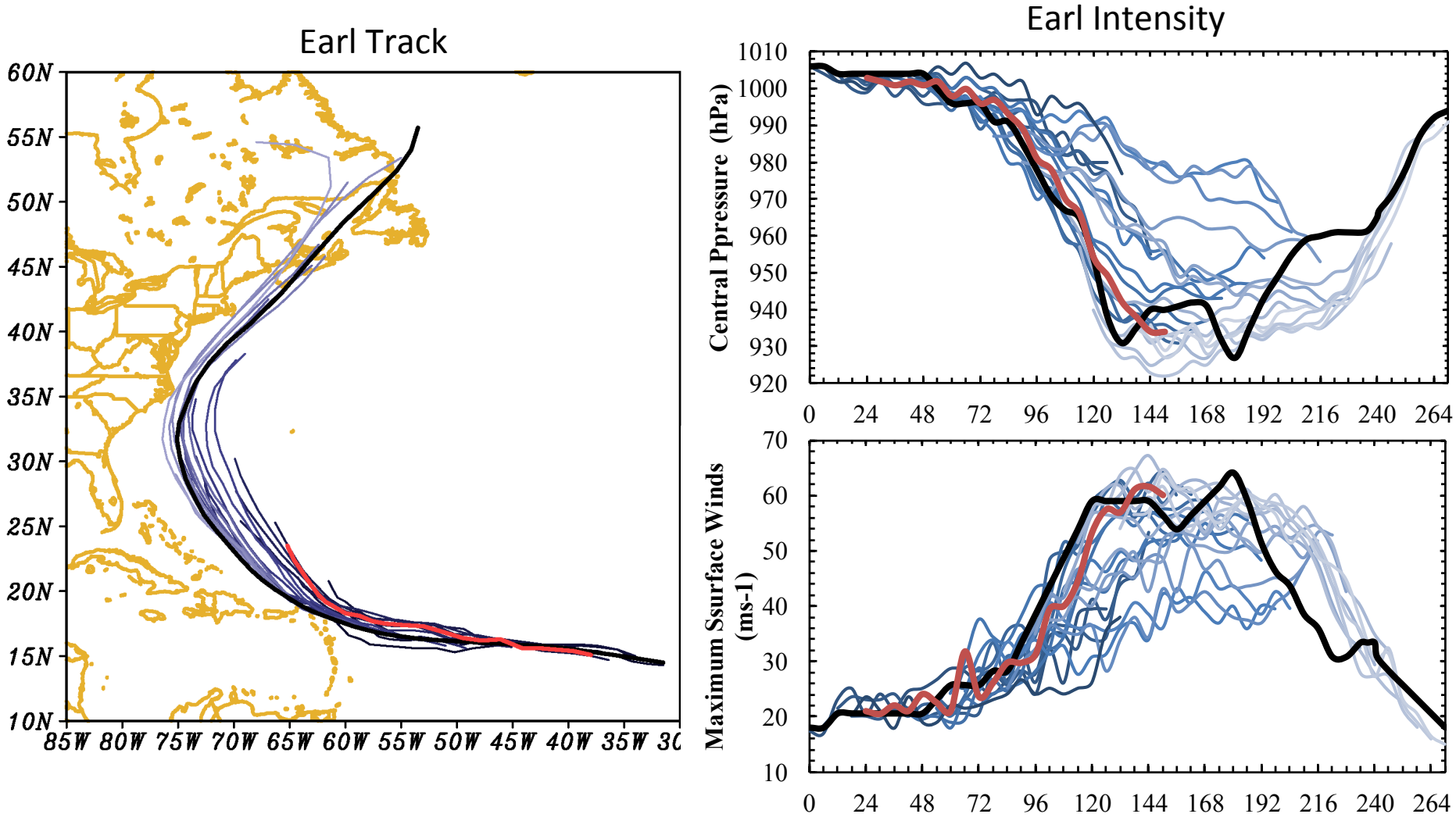
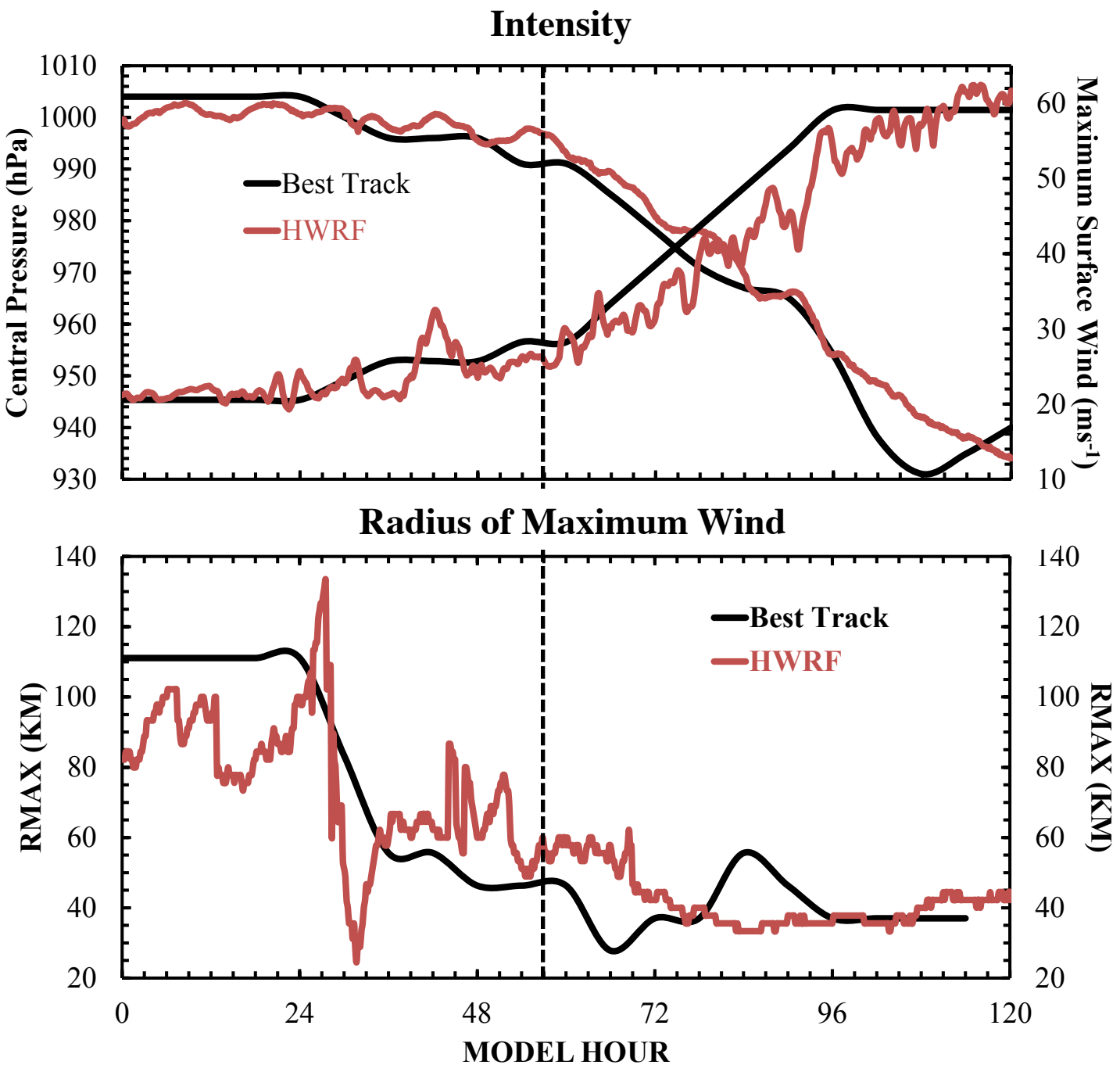
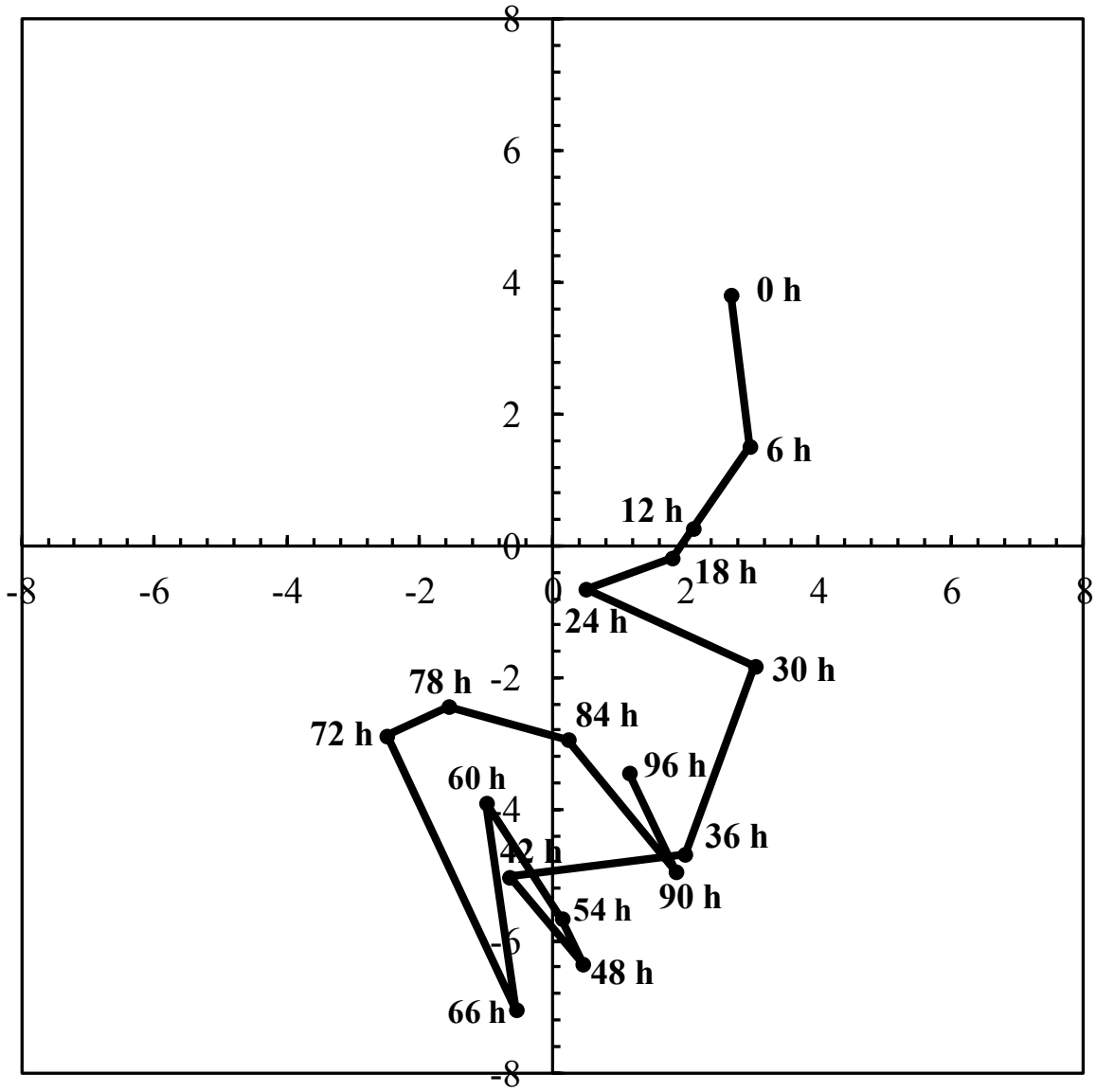


To understand the HWRF modeled intensification process (Gopal et al. 2011 MWR) based on the best predication and support that with OBS as much as possible


Intensity
Central Pressure (hPa)
Maximum Surface Wind (ms-1)
Best Track
HWRF
1010
1000
990
980
970
960
950
940
930
60
50
40
30
20
10
Radius of Maximum Wind
RMAX (KM)
RMAX (KM)
Best Track
HWRF
140
120
100
80
60
40
20
0
24
48
72
96
120
MODEL HOUR

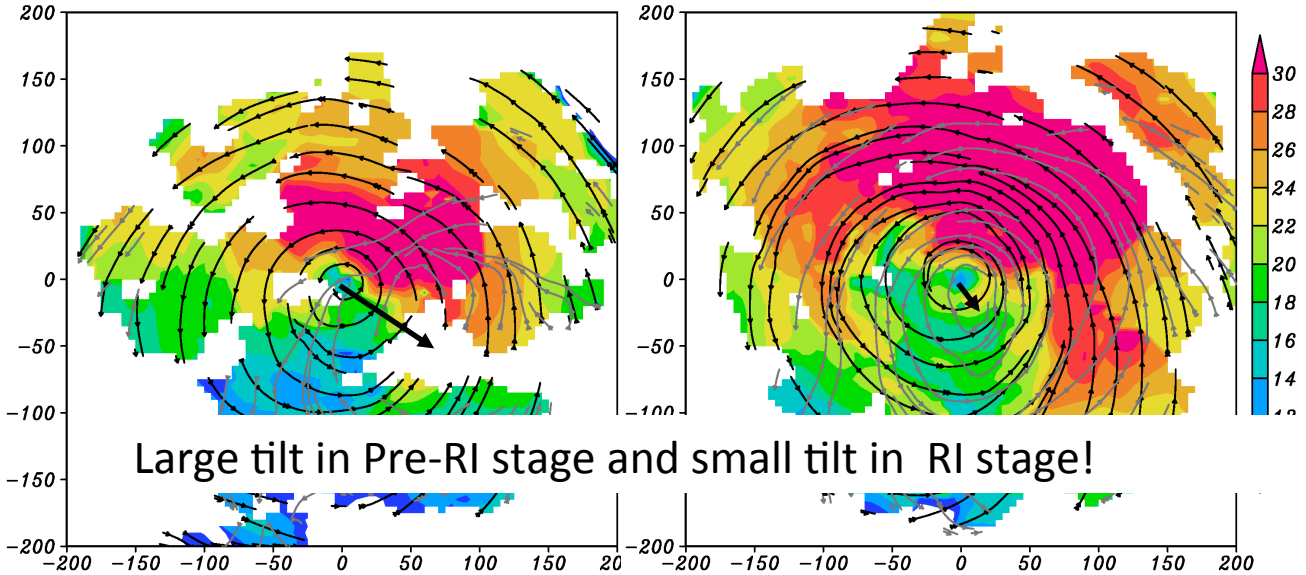
850-200 hPa shear within 1000 km x 1000 km domain



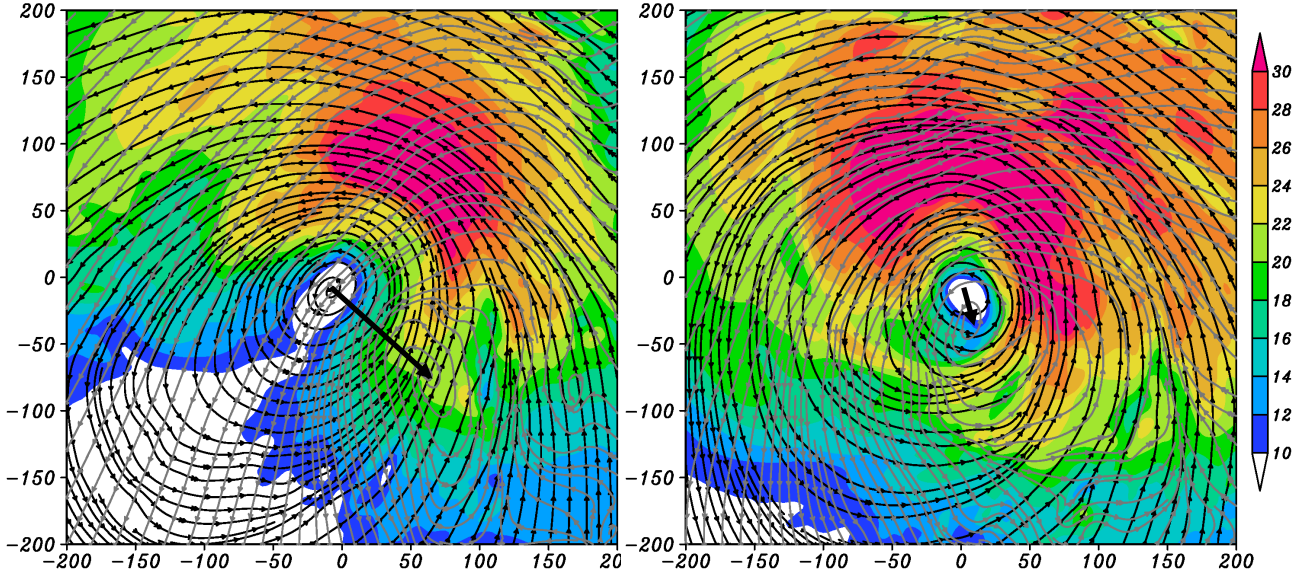
Pre-RI

RI

Radar Observation



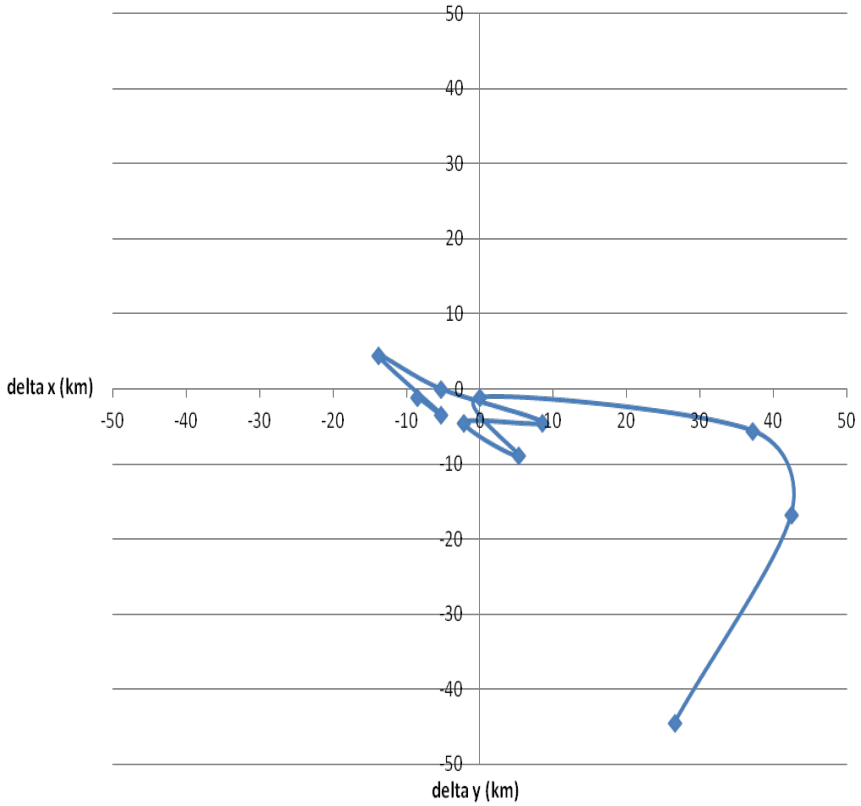
HWRF



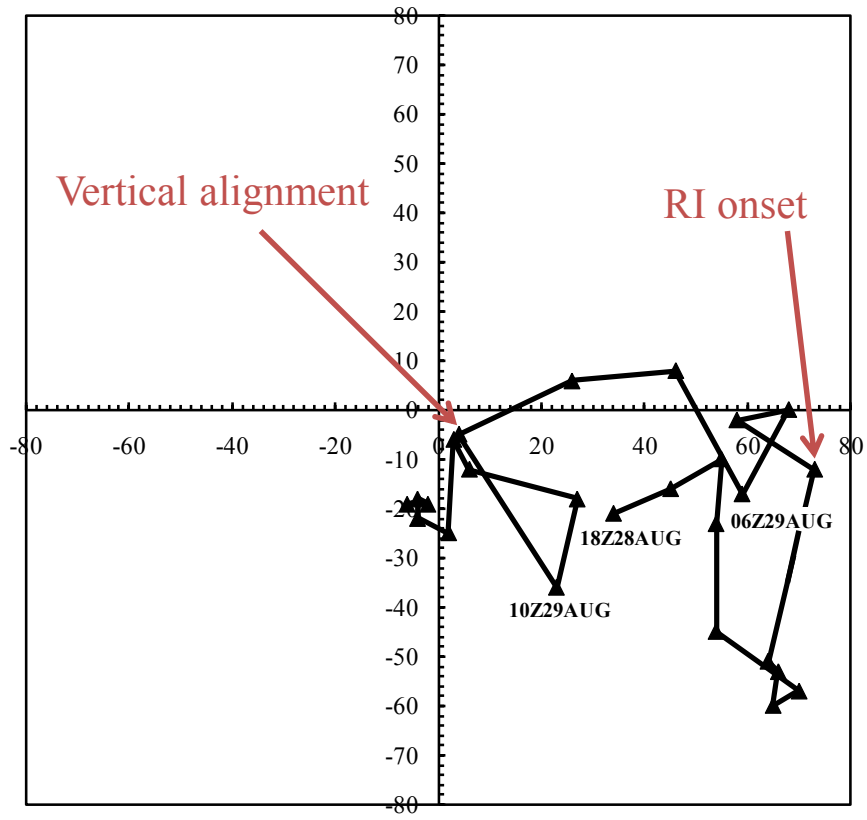
Shading: wind speed at 2km
Thin black lines: streamline at 2km
Grey lines: streamline at 8km
Thick arrows: tilt

Tilt precession

obs



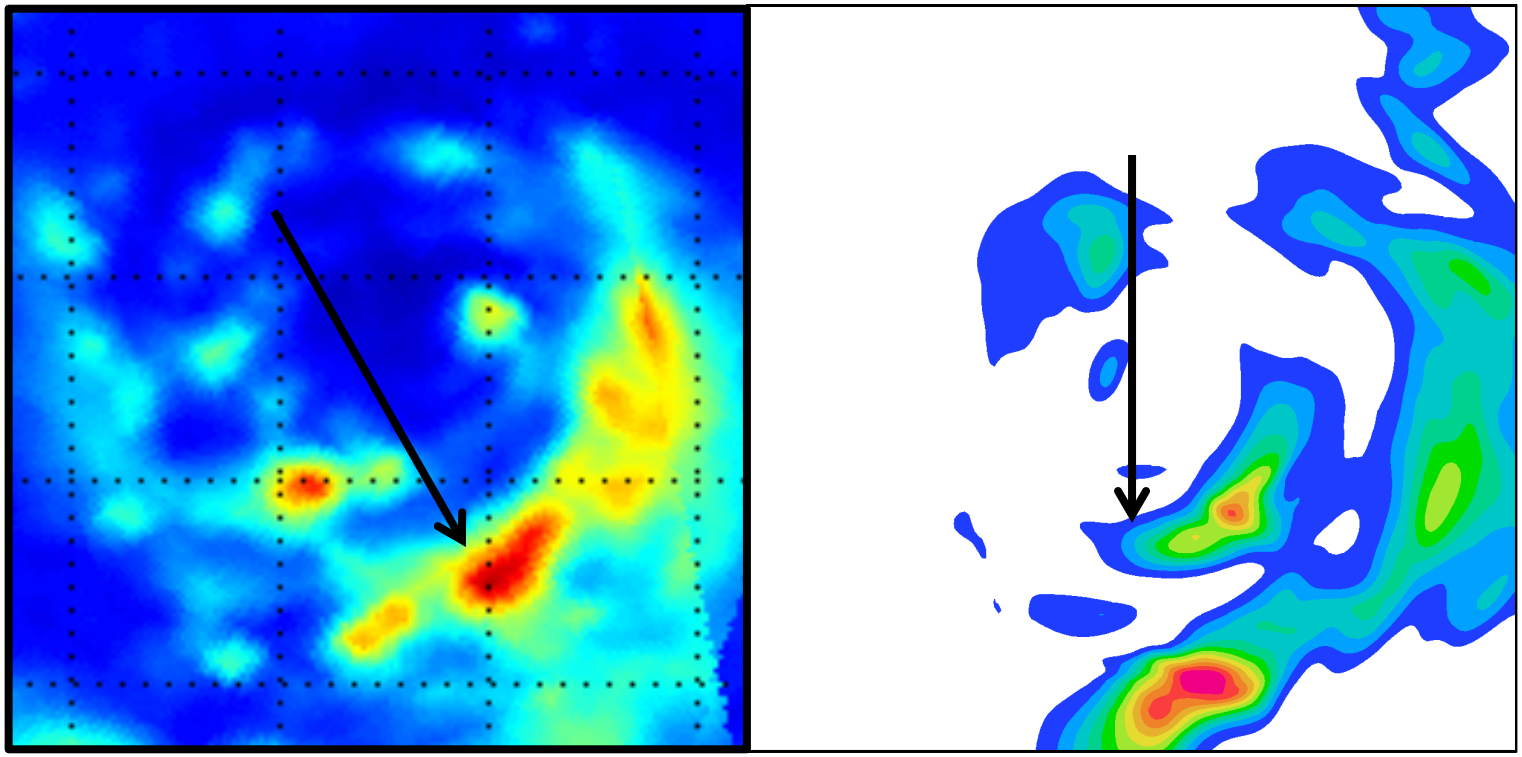
HWRF



RI onset leads vertical alignment 6 hours!

Morphed Integrated
Microwave Imagery
06Z29AUG (t = 60 h)

Total condensate water averaged
between 0.25 km and 20 km
04Z29AUG (t = 58 h)



http://cimss.ssec.wisc.edu/tropic/real-time/marti/2010_07L/webManager/mainpage.html

Black arrows: shear direction

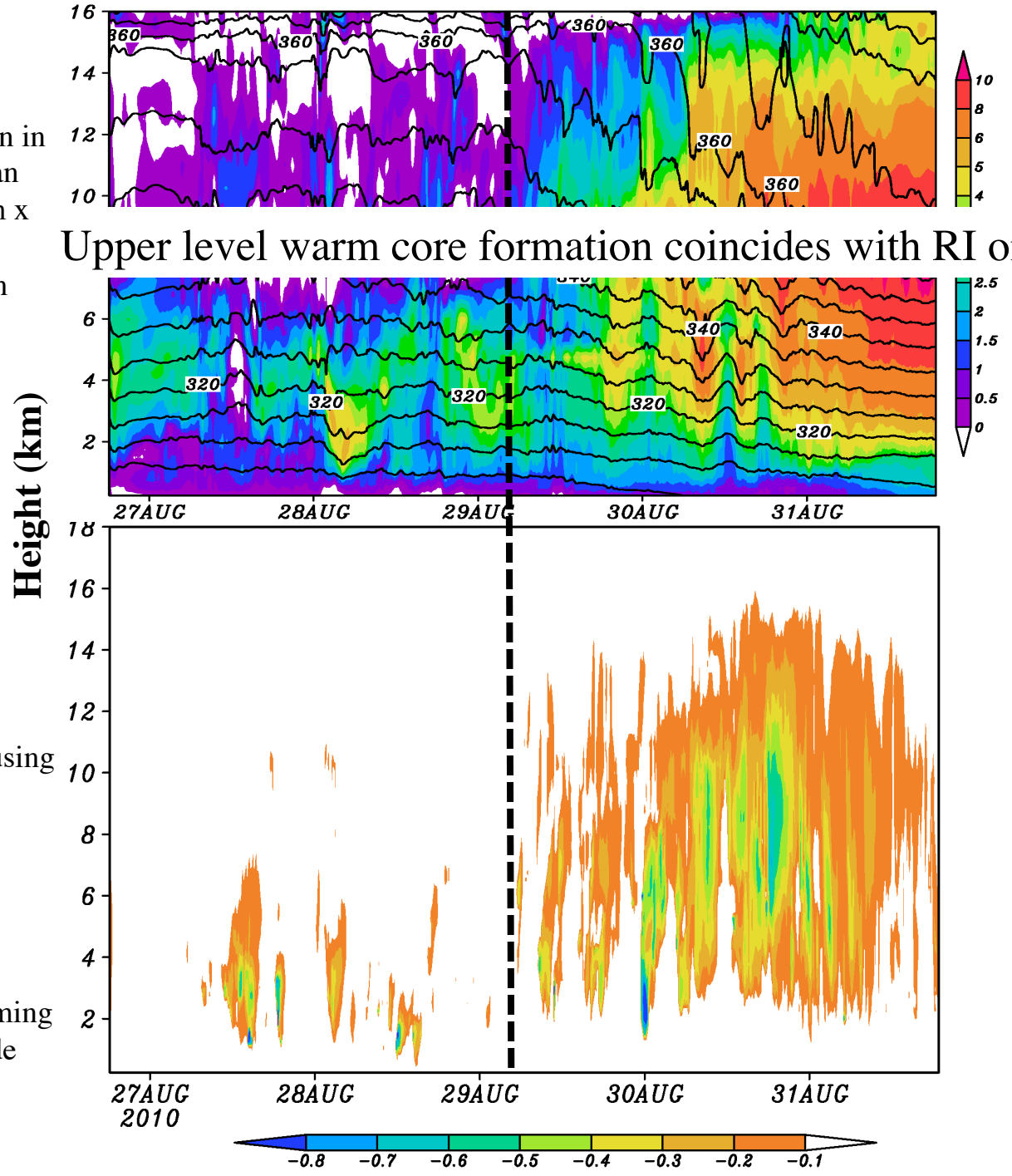
Shear induced WN-1 asymmetry dictates convection

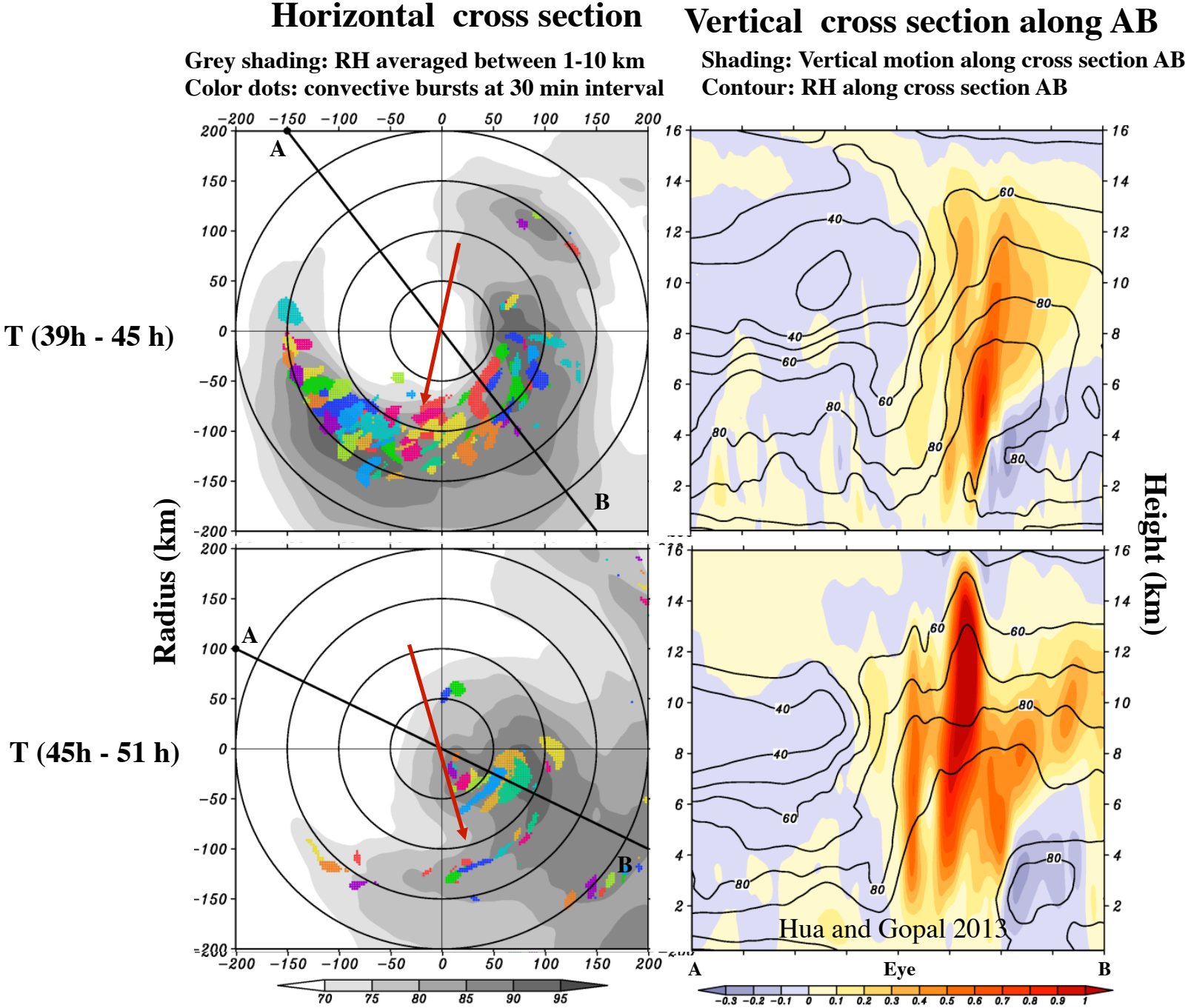
Shading: temperature perturbation in the eye center with respect to mean temperature averaged over 400km x 400km domain

Contour: potential temperature in the eye center

Shading: mean vertical motion averaged over 50 km x 50 km domain surrounding eye center using RH ≤ 70%

Note: the magnitude of vertical motion corresponding to the warming rate instead of warming magnitude




Horizontal cross section
Grey shading: RH averaged between 1-10 km
Color dots: convective bursts at 30 min interval
Vertical cross section along AB
Shading: Vertical motion along cross section AB
Contour: RH along cross section AB
T (39h - 45 h)
T (45h - 51 h)
Radius (km)
Height (km)
A
B
Eye
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Horizontal cross section

Grey shading: RH averaged between 1-10 km
Color dots: convective bursts at 30 min interval

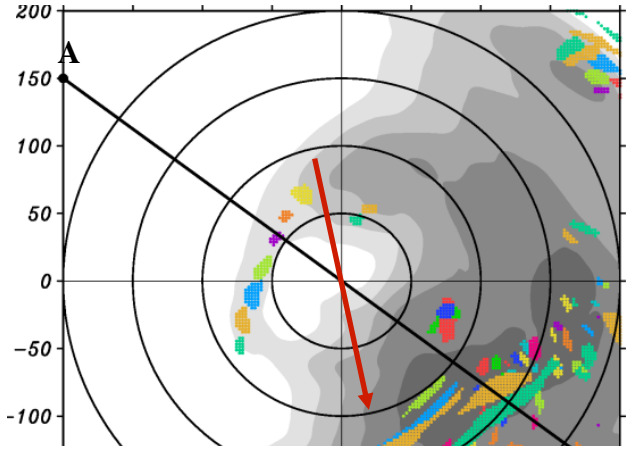
Vertical cross section along AB

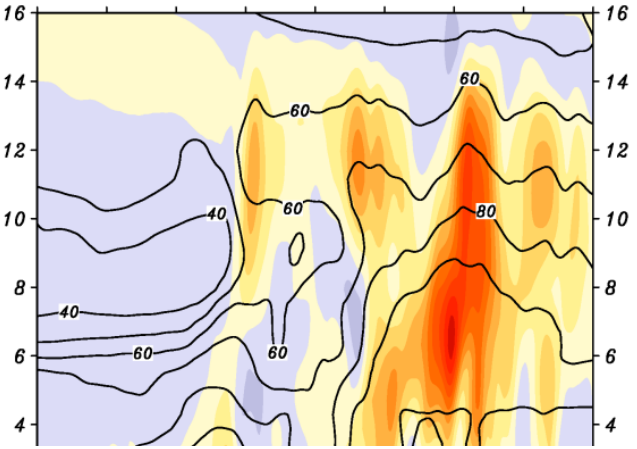
Shading: Vertical motion along cross section AB
Contour: RH along cross section AB

T (51 - 57 h)

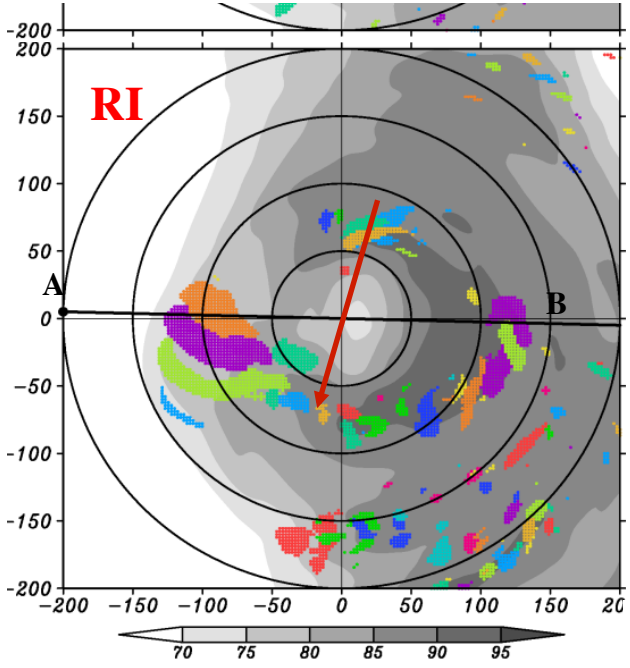
T (57 - 63 h)

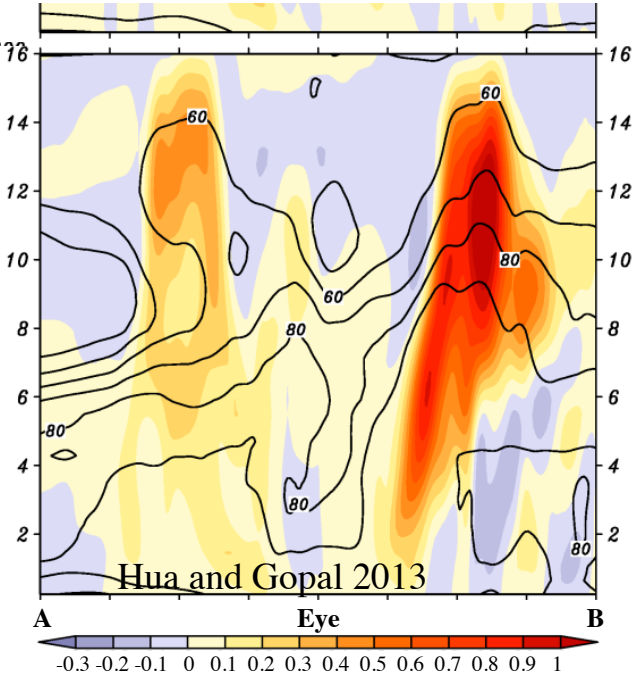
Radius (km)





Moisture work up downstream and wrap around the eye center!





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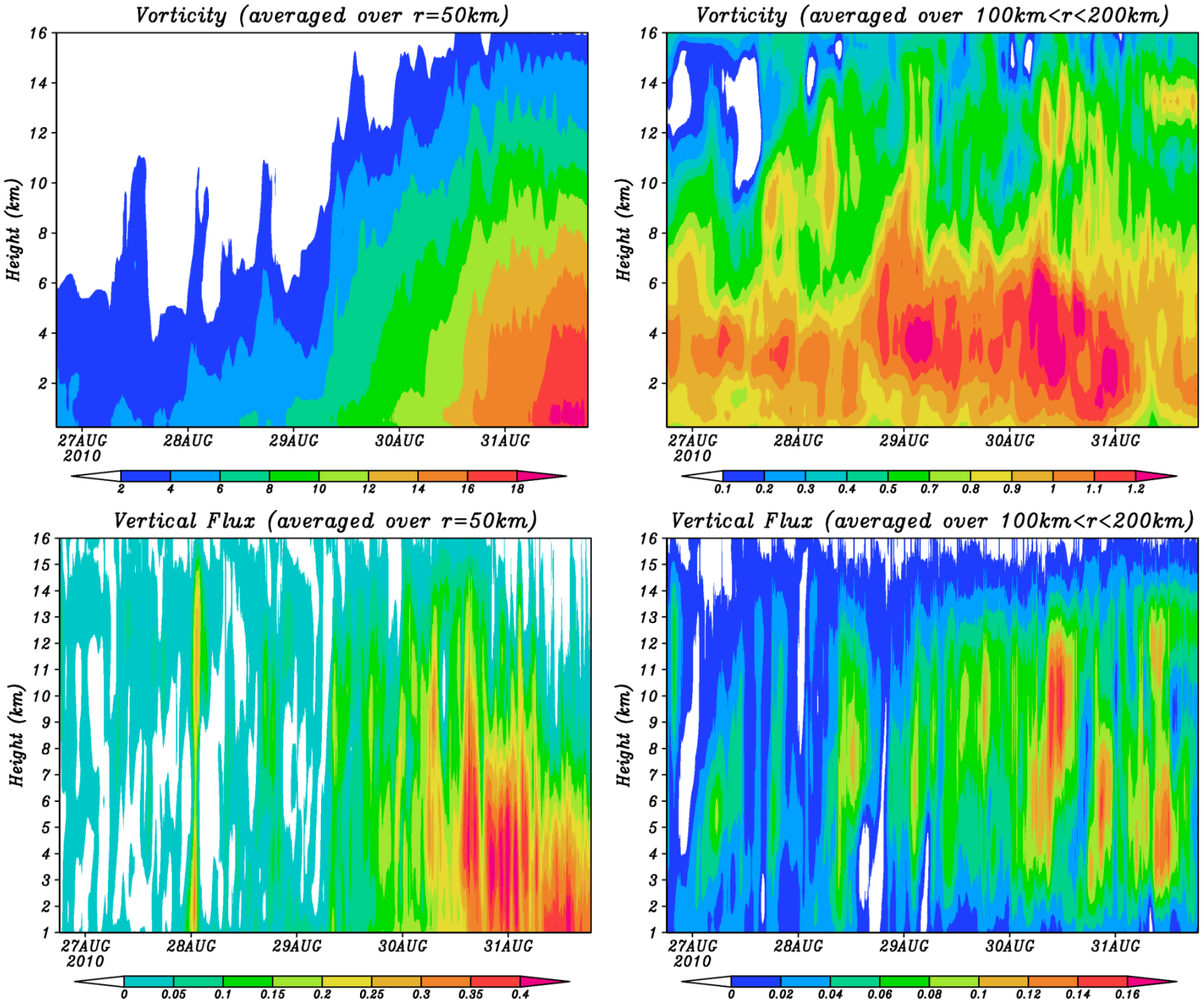
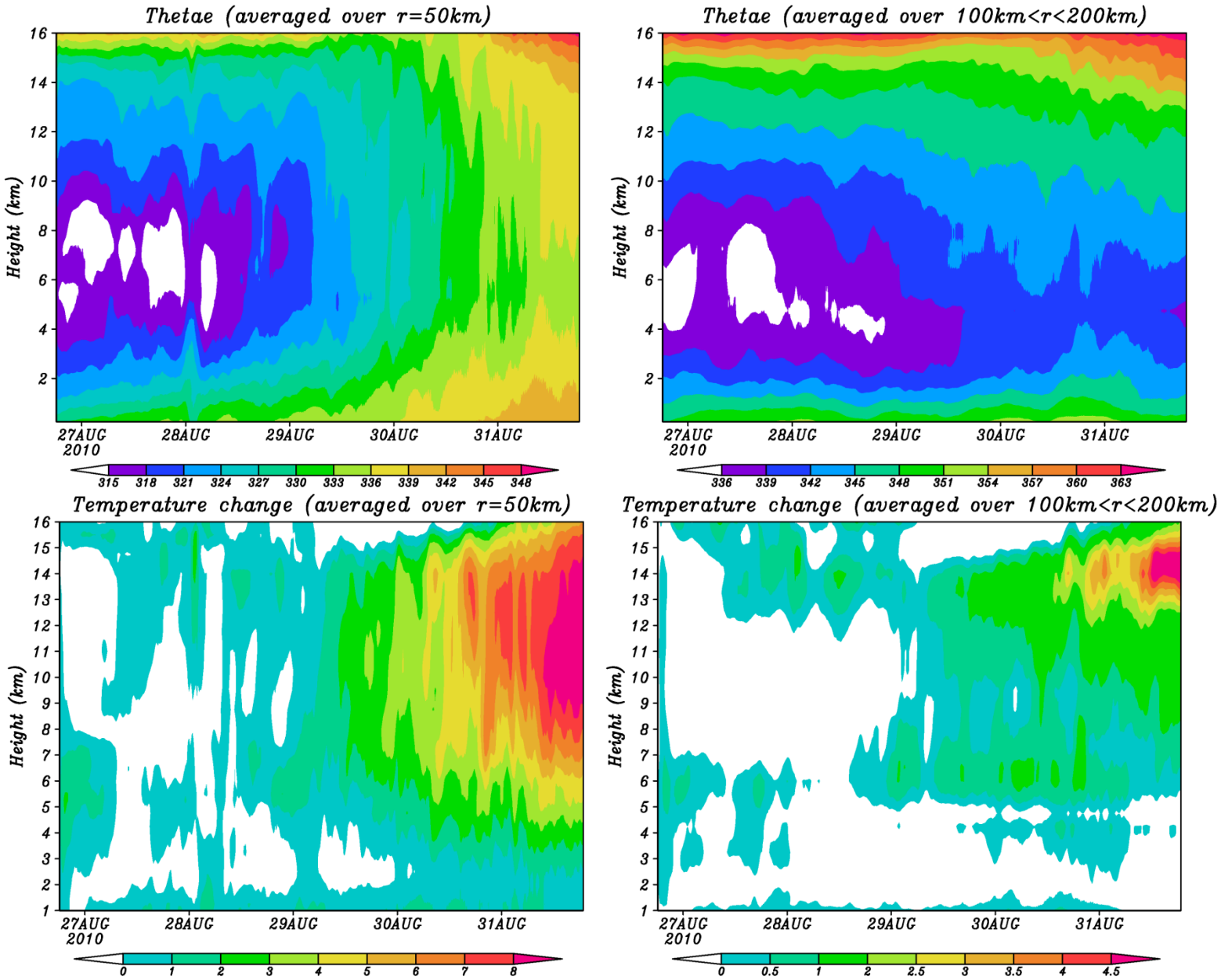
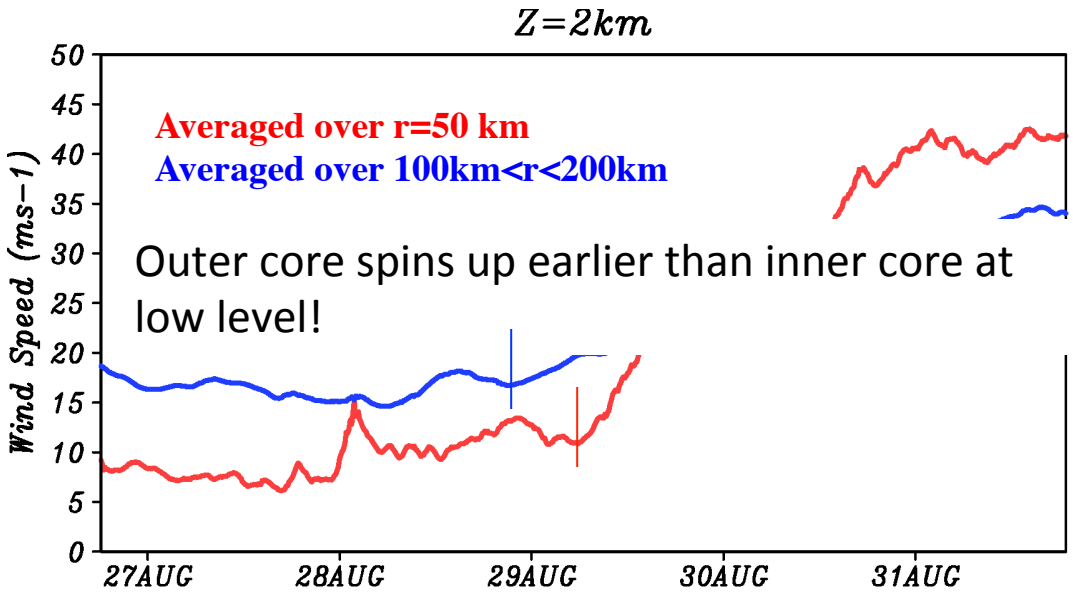
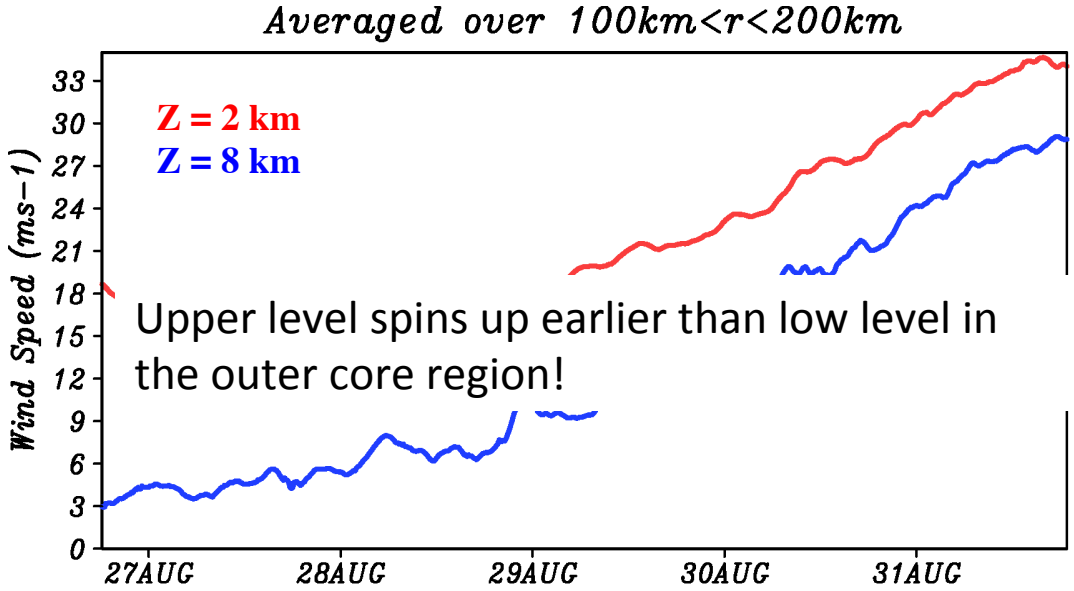
Time-Height cross section for inner core and outer region



Time-Height cross section for inner core and outer region




Z=2km
Averaged over r=50 km
Averaged over 100km<r<200km
Outer core spins up earlier than inner core at low level!
Wind Speed (ms-1)
50
45
40
35
30
25
20
15
10
5
0
27AUG
28AUG
29AUG
30AUG
31AUG


Averaged over 100km<r<200km
Z = 2 km
Z = 8 km
Upper level spins up earlier than low level in the outer core region!
Wind Speed (ms-1)
33
30
27
24
21
18
15
12
9
6
3
0
27AUG
28AUG
29AUG
30AUG
31AUG

Conclusion

- RI onset leads vertical alignment 6 hours;
- RI onset coincides with the formation of upper level warm core;
- RI onset coincides with moisture wrap-around;
- Outer core spins up earlier than inner core at low level;
- Upper level spins up earlier than low level in the outer core region!
- Inner core structure is very much different from outer core structure