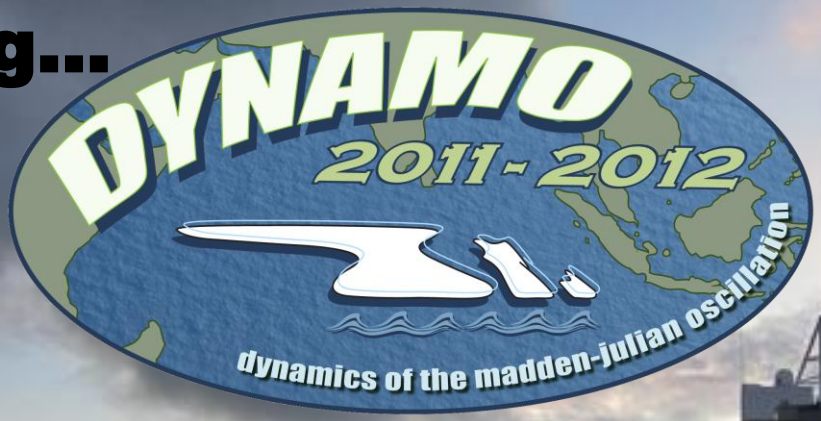
Radar analysis of precipitation influenced by TC – MJO interaction during…



Elizabeth J Thompson
Steven A. Rutledge
Timothy J. Lang

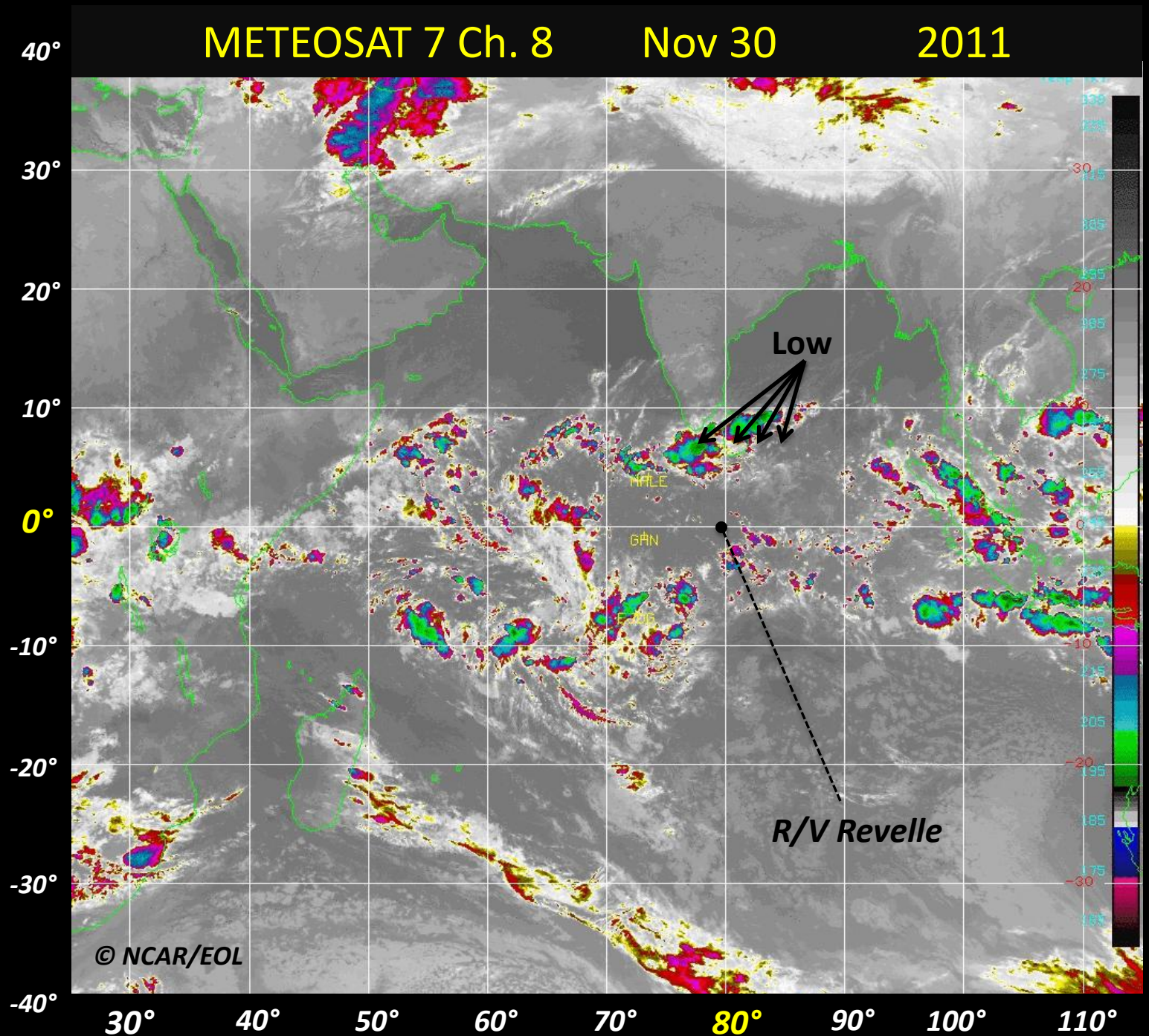
GOAL:
Analyze the nature of precip before, during, and after MJO initiation: central Indian Ocean

Colorado State University

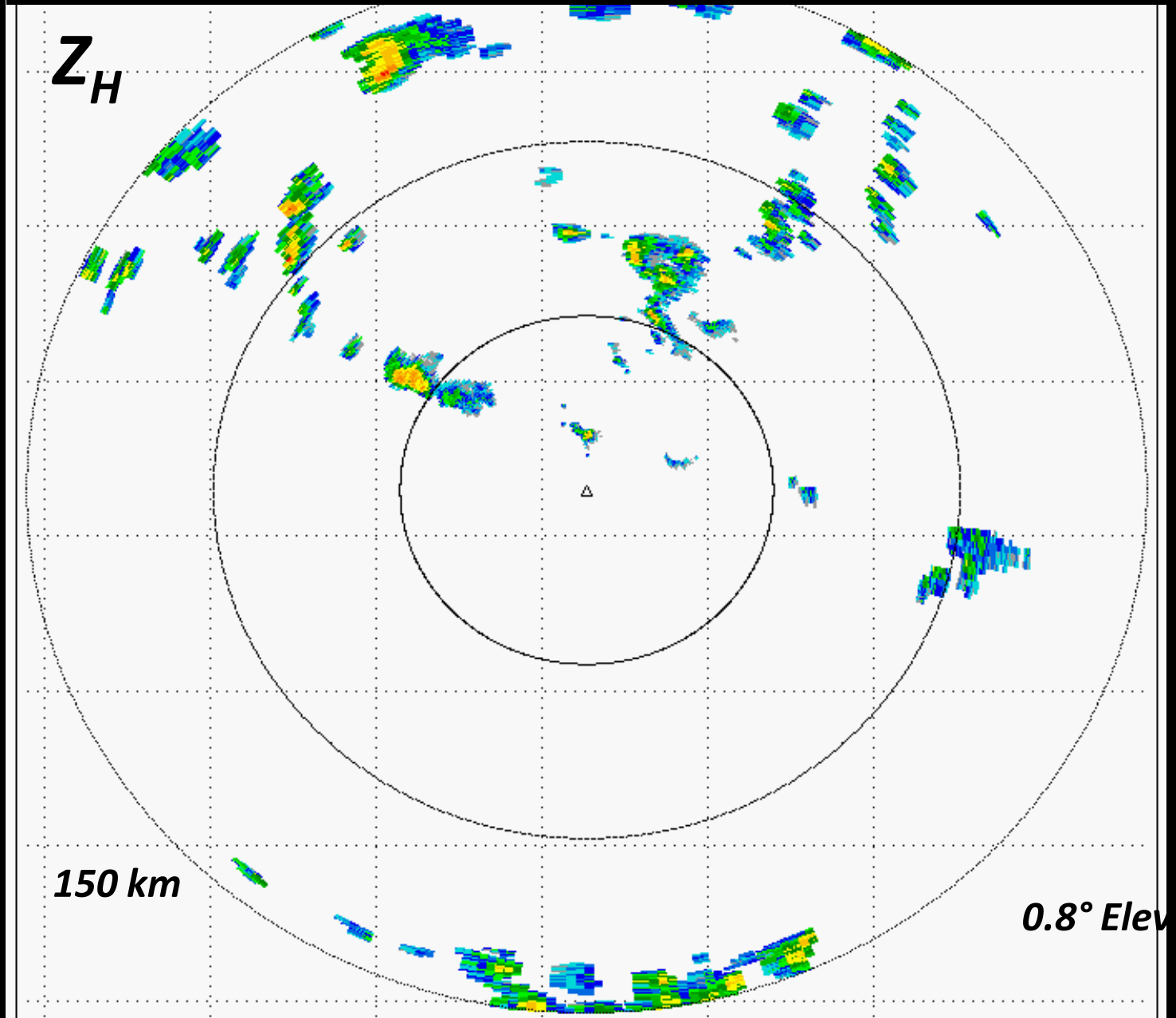
NSF

Outline

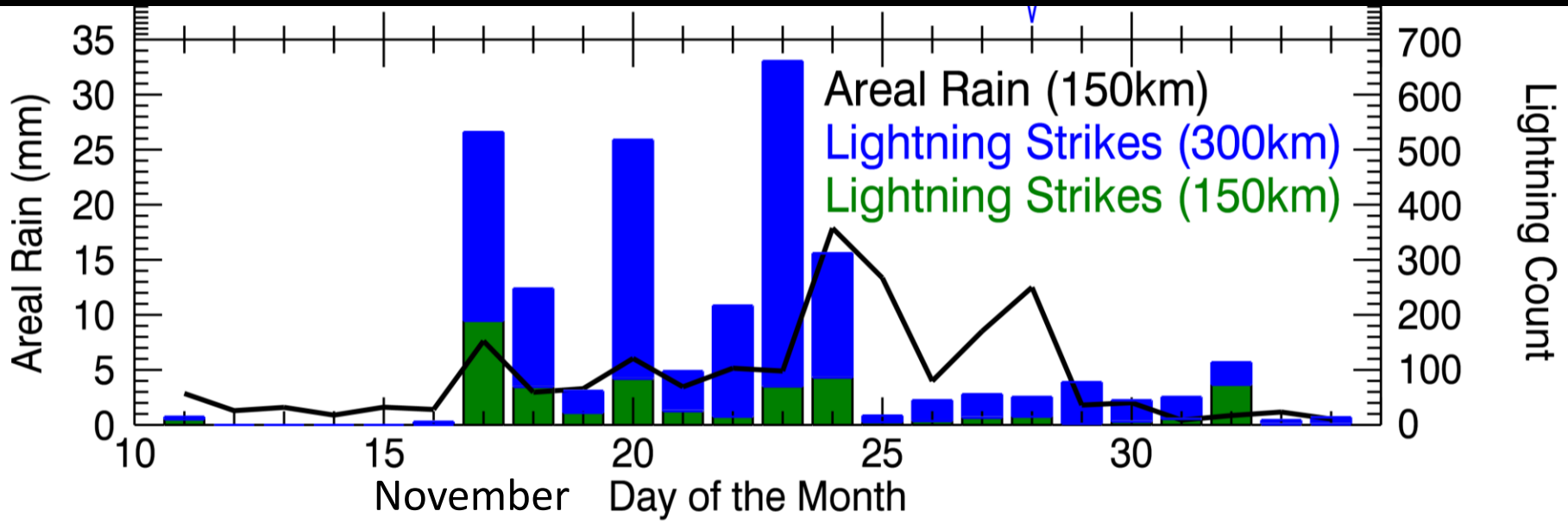
- Motivation: Madden-Julian Oscillation is the leading mode of tropical intraseasonal variability, but is not well understood (*Zhang et al. 2005)*
  - TOGA radar domain:150 km radius x 20 km height ~representative of central equatorial Indian Ocean
- Objective: convective/stratiform partitioning of precipitation area and rainfall relative to MJO evolution and lightning activity ***(Nov 2011)***
  - *Yuter and Houze 1998 – QJRMS*
  - *Steiner, Houze, and Yuter 1995 - J. Appl. Meteor.*


METEOSAT 7 Ch. 8 Nov 30 2011
40°
30°
20°
10°
0°
-10°
-20°
-30°
-40°
30°
40°
50°
60°
70°
80°
90°
100°
110°
Low
R/V Revelle
© NCAR/EOL

R/V Revelle TOGA Radar Nov 25 18 Z 2011

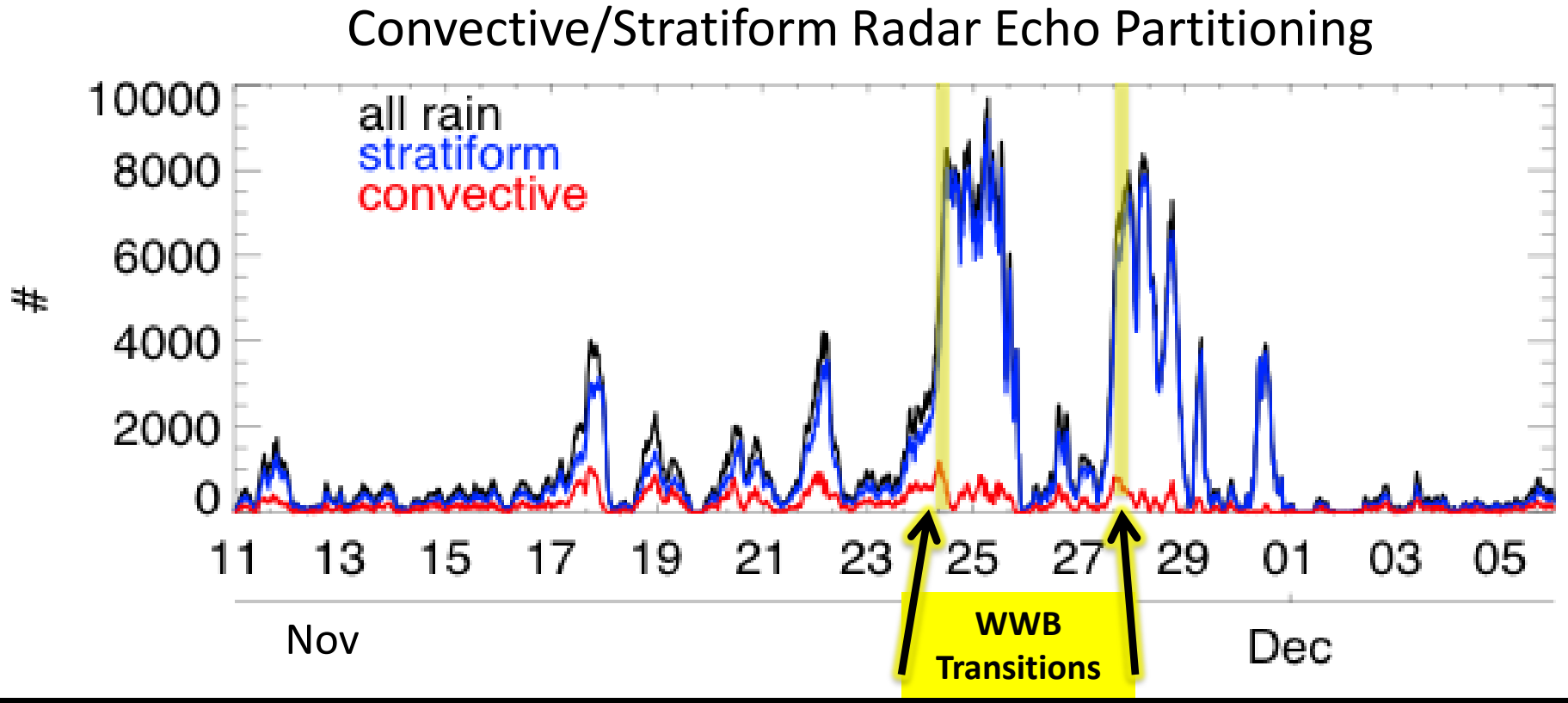


Areal Rain and Lightning Statistics (150 km)



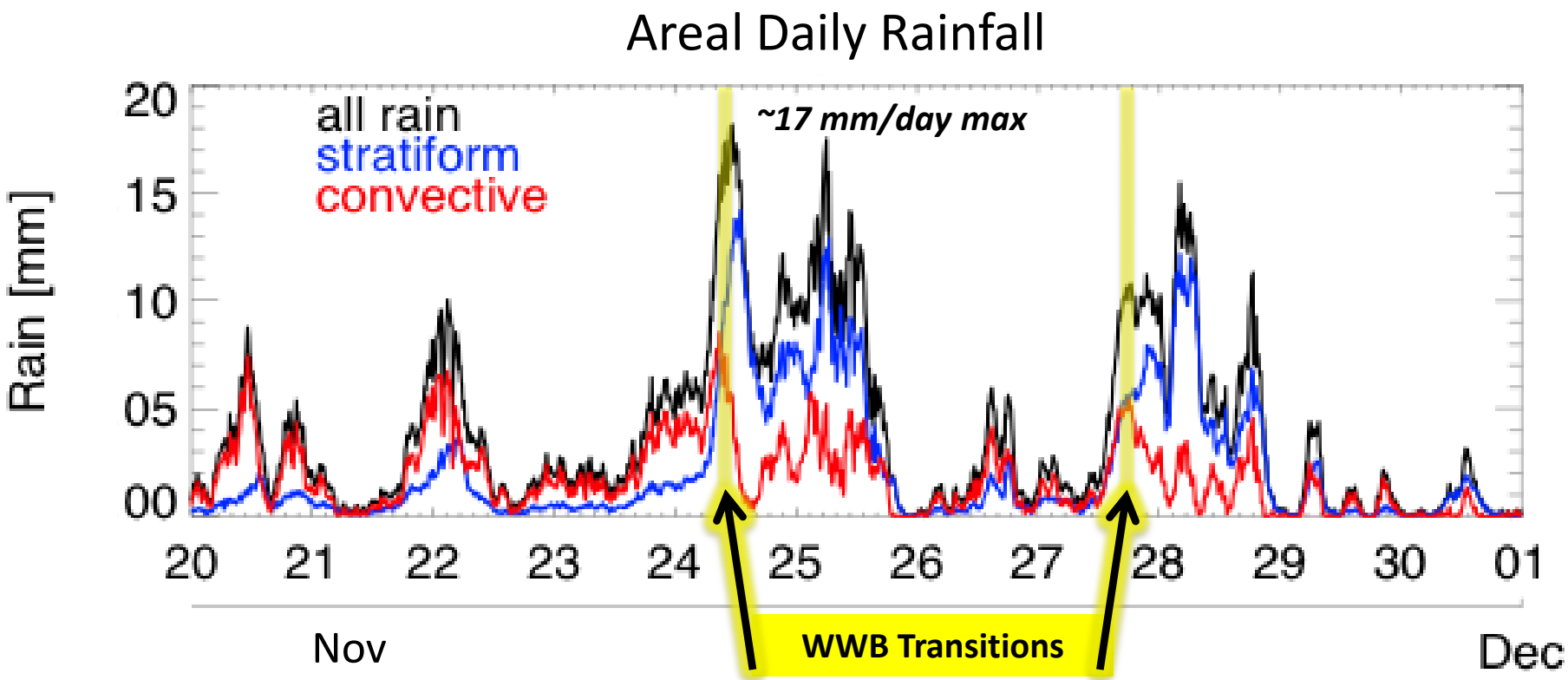
- Lightning activity peaks evidently associated with deep convection
- Substantial rain falls with little to any lightning
  - Suspect weak convection or extensive stratiform precipitation

WWB TOGA Radar metrics (150 km)



- Stratiform echo area fraction > Convective echo area fraction ALWAYS
- Stratiform echo area dramatically increases during WWB

WWB TOGA Radar metrics (150 km)



Just Before WWB Transition:

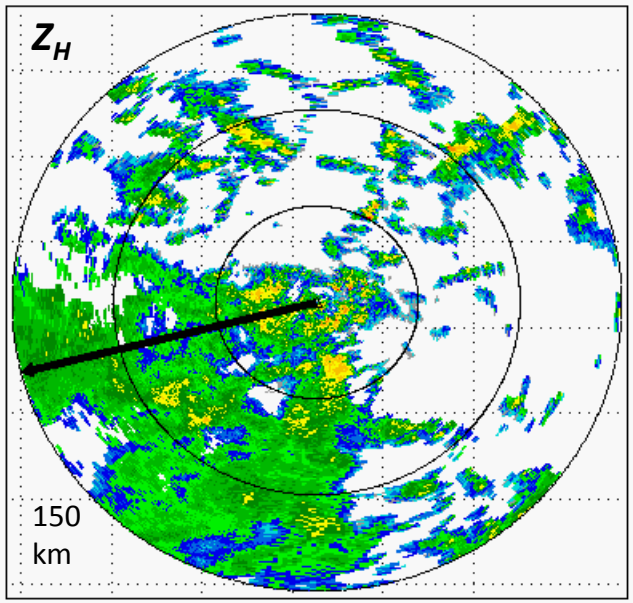
- highest echo top heights
- maximum convective Z_H & rain rate
- max lighting activity
- convective rain > stratiform rain

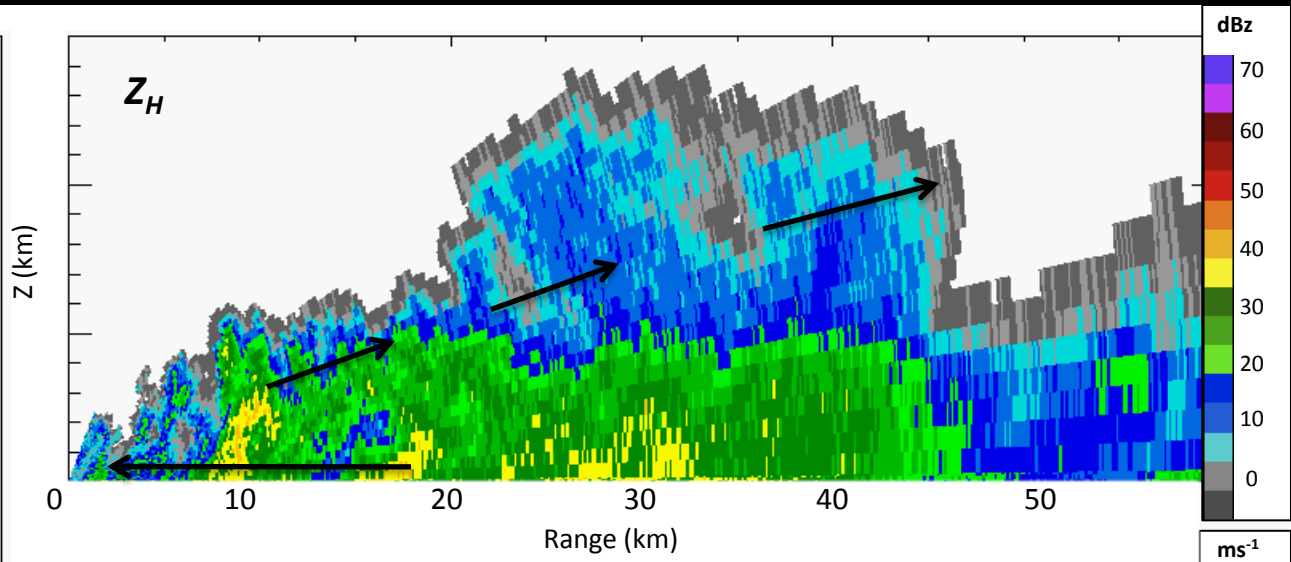
At and After WWB Transition:

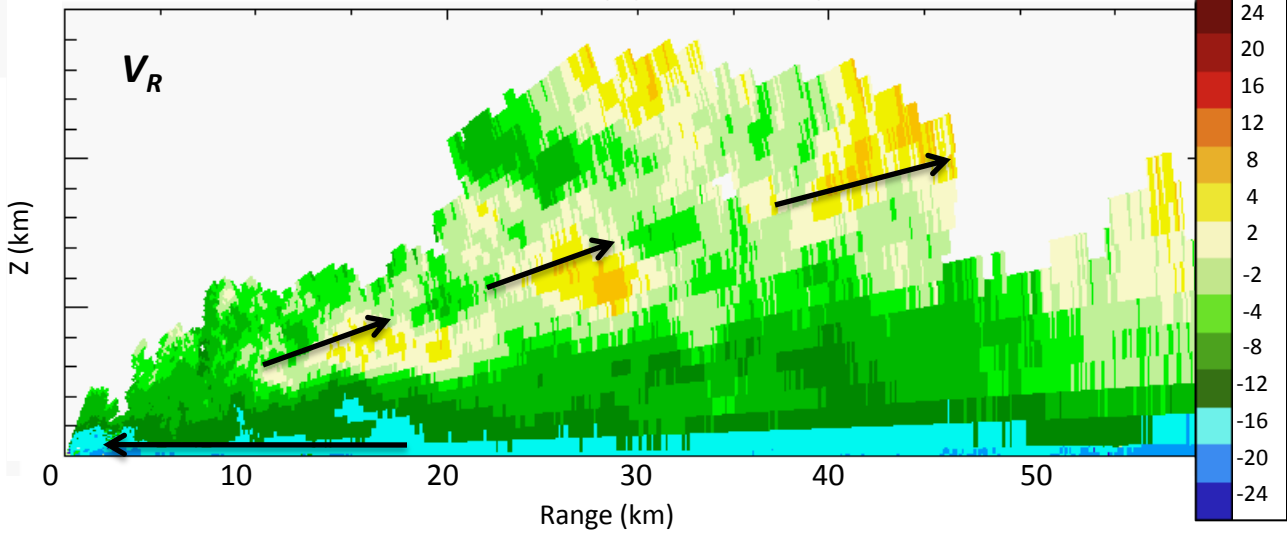
- *maximum westerly winds and rainfall*
- echo top heights decrease
- convective rain rate decreases
- little to no lightning
- stratiform rainfall > convective rainfall

Same characteristics for Oct & Nov 2011 MJOs and both Nov MJO rain events

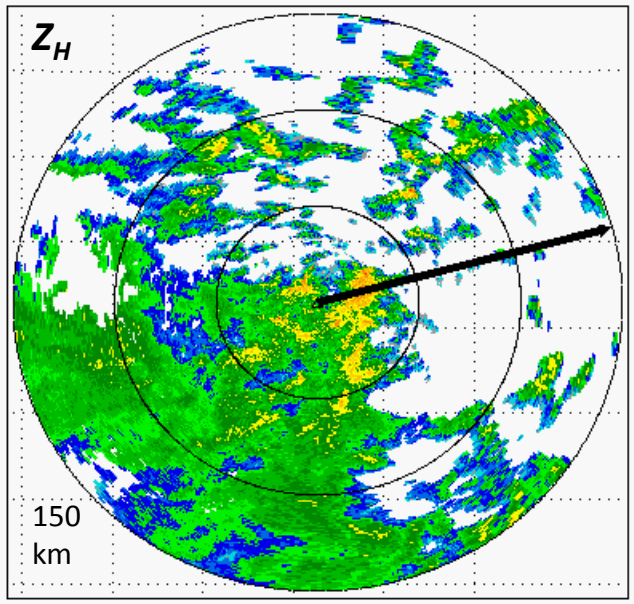
R/V Revelle TOGA Radar Nov 24 0909 Z 2011
Developing Convection at WWB Onset (0900 Z)

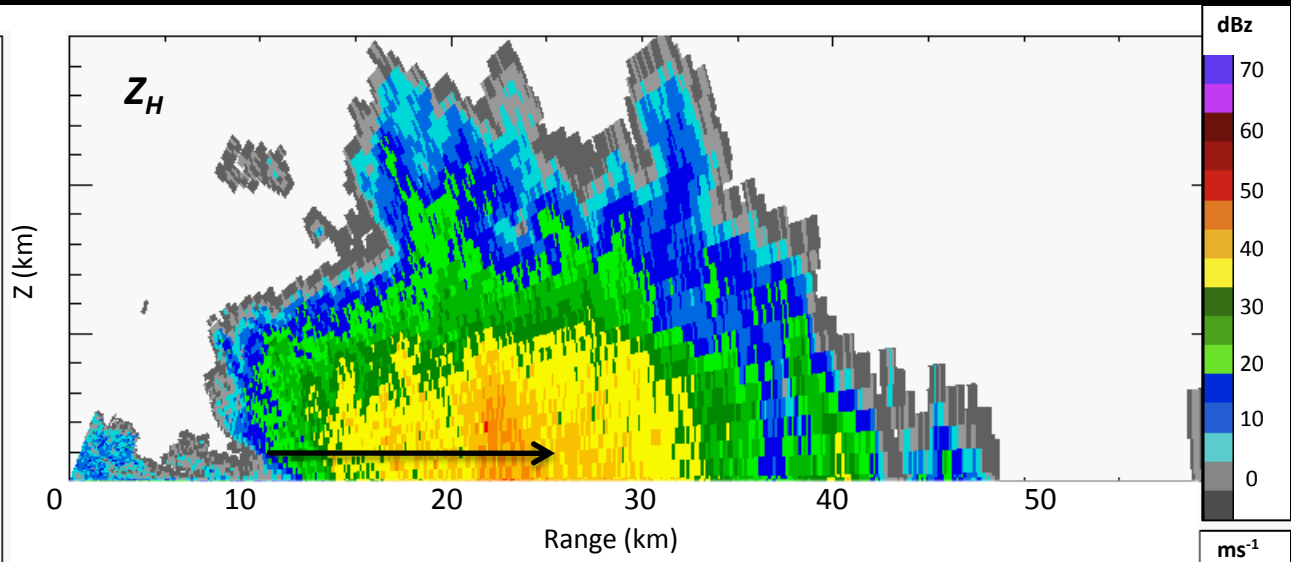


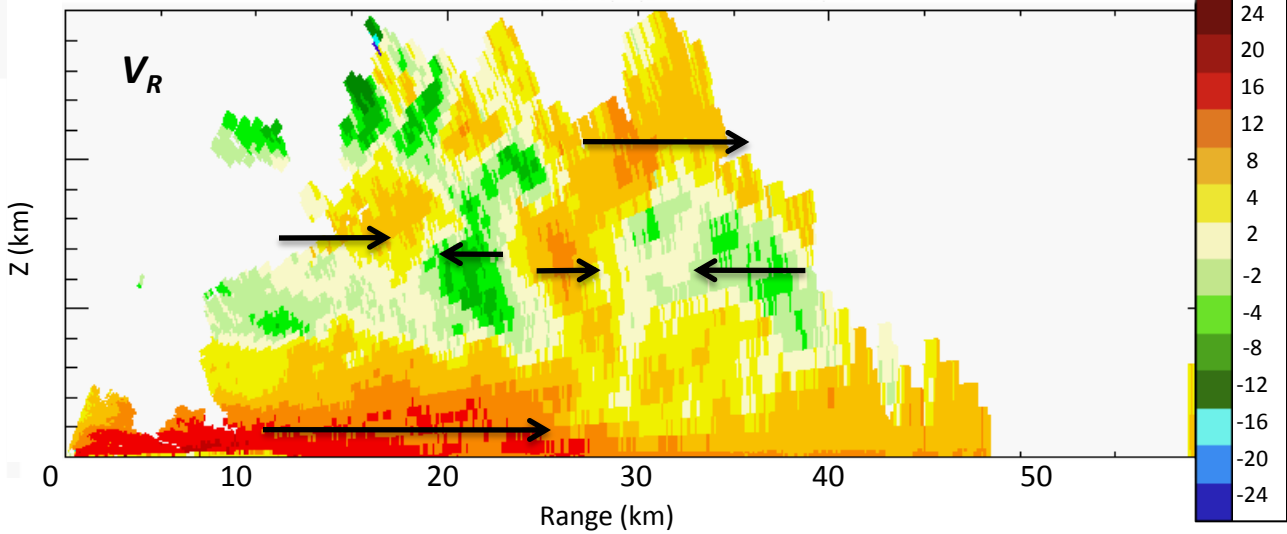




R/V Revelle TOGA Radar Nov 25 0949 Z 2011
Mature Convection during WWB onset



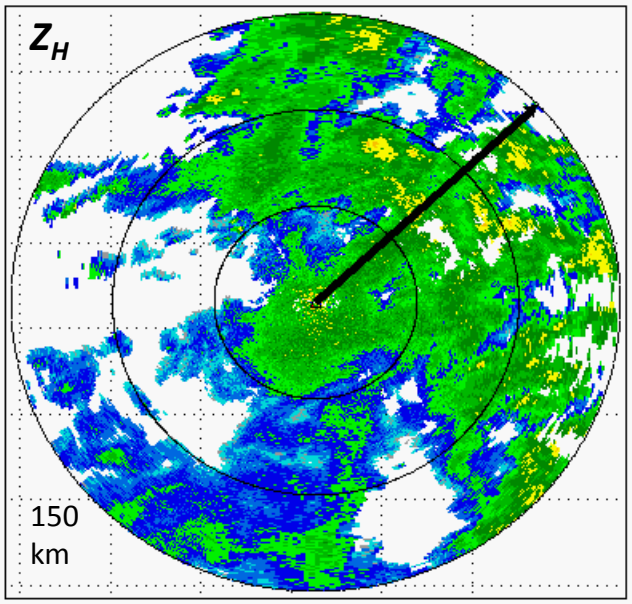


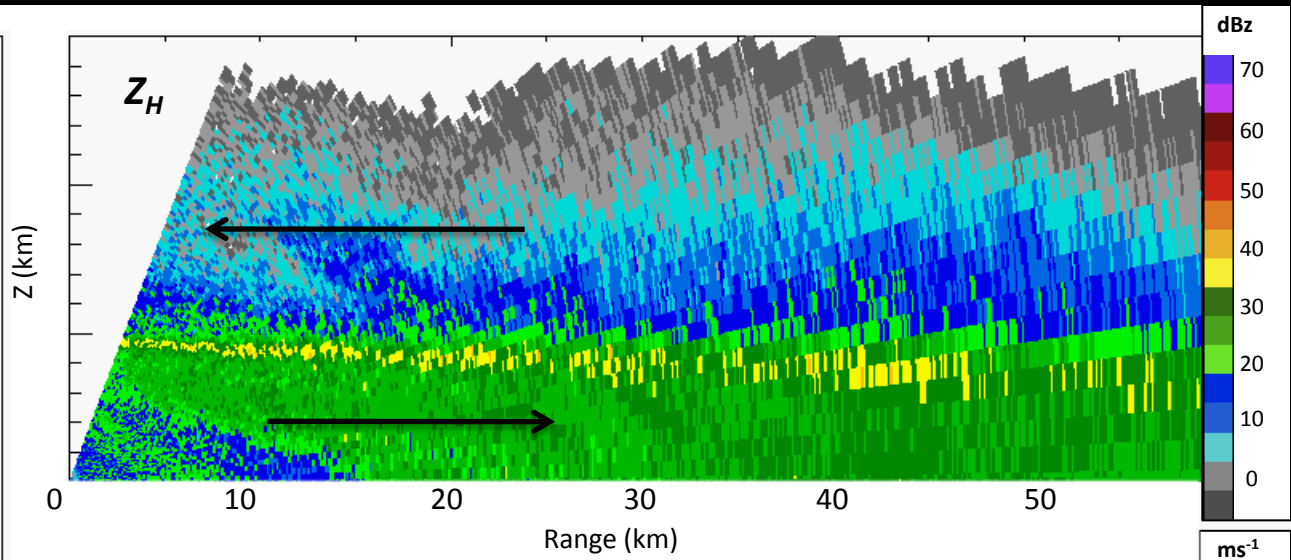


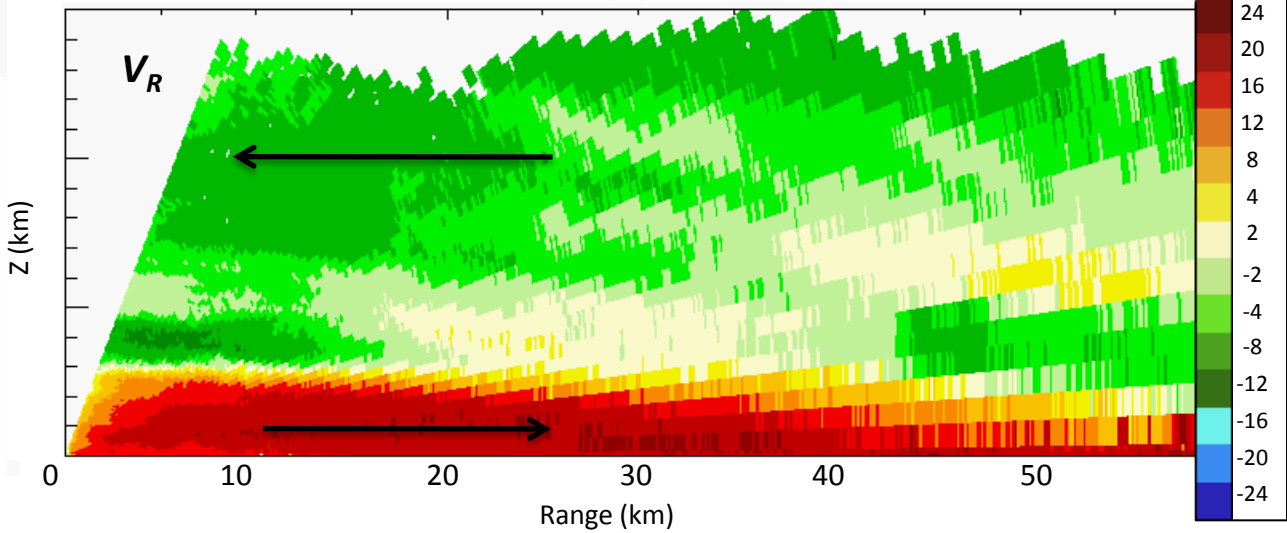
~ highest echo top heights

R/V Revelle TOGA Radar Nov 24 1319 Z 2011

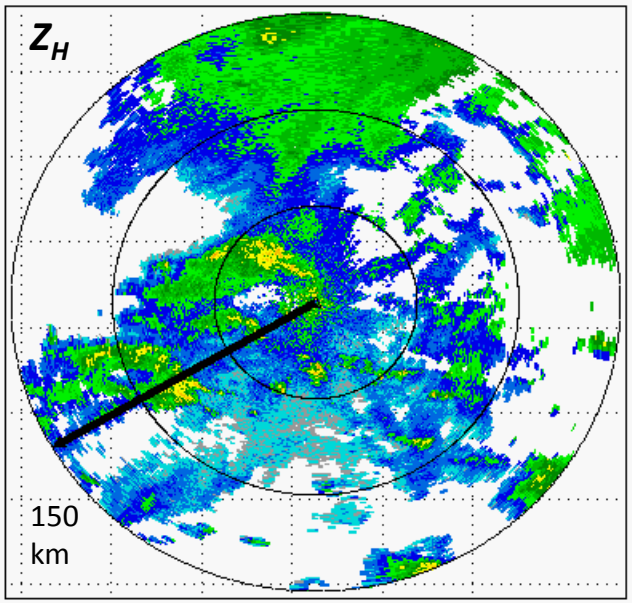
Stratiform rain during WWB: surface westerlies > 26 m s^{-1}

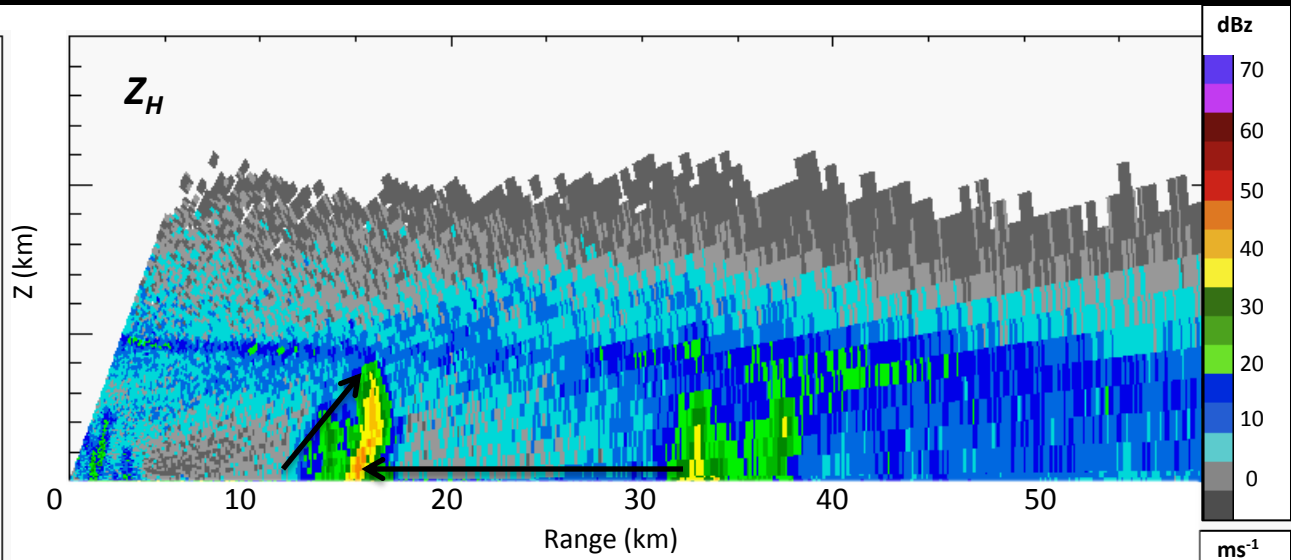


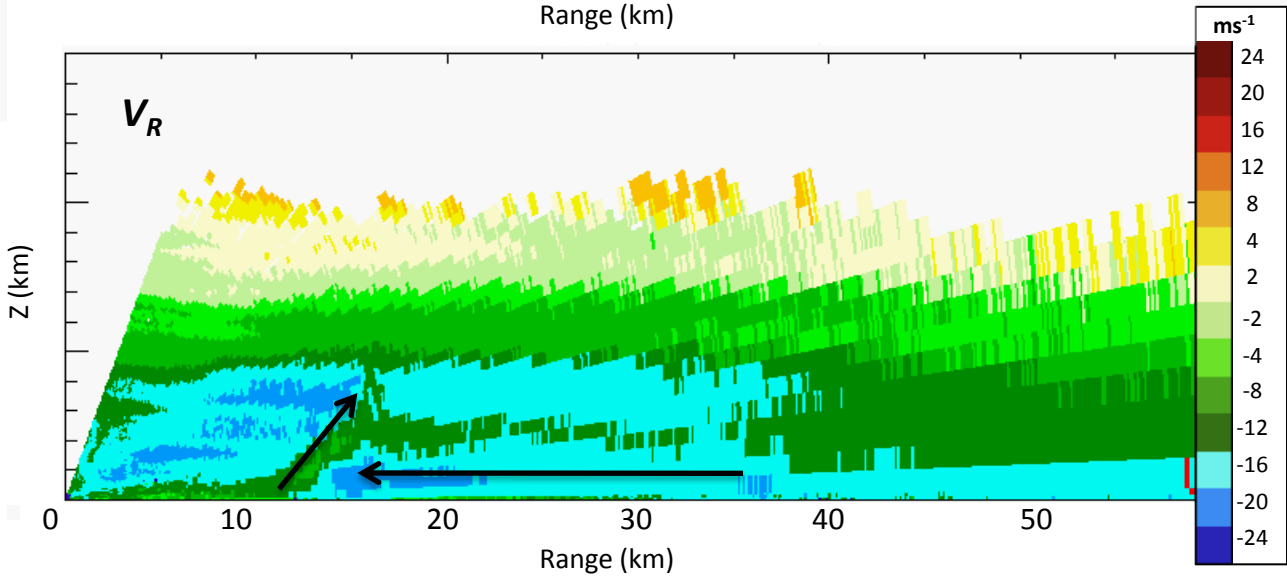




R/V Revelle TOGA Radar Nov 24 1739 Z 2011
Embedded convection in stratiform rain during WWB



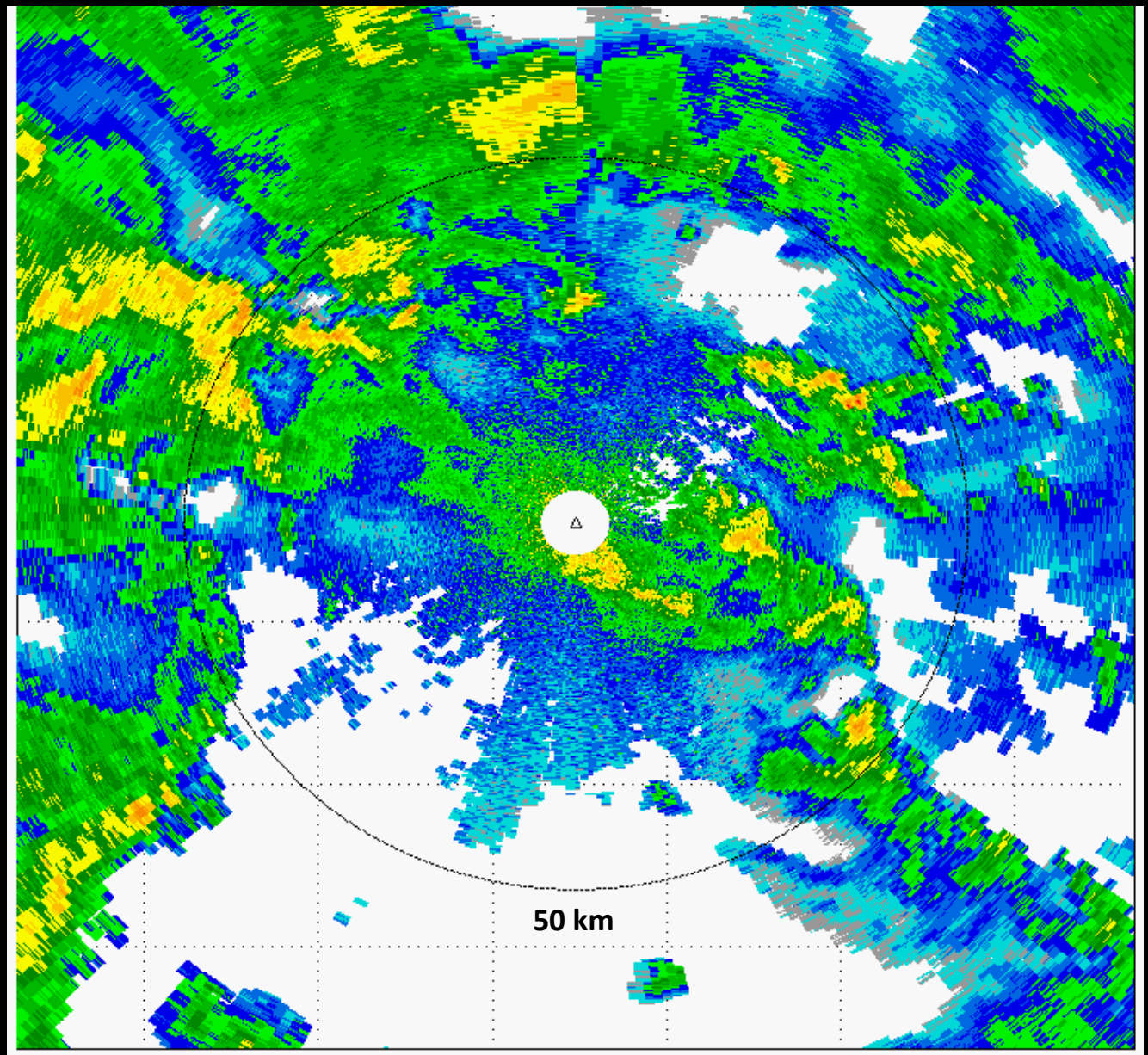




~ cold pool triggering shallow embedded convection

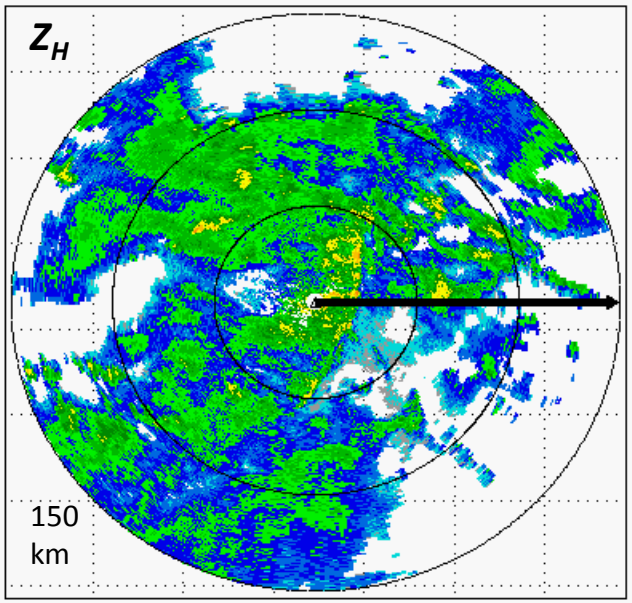
R/V Revelle TOGA Radar Nov 25 0330-0530 Z 2011

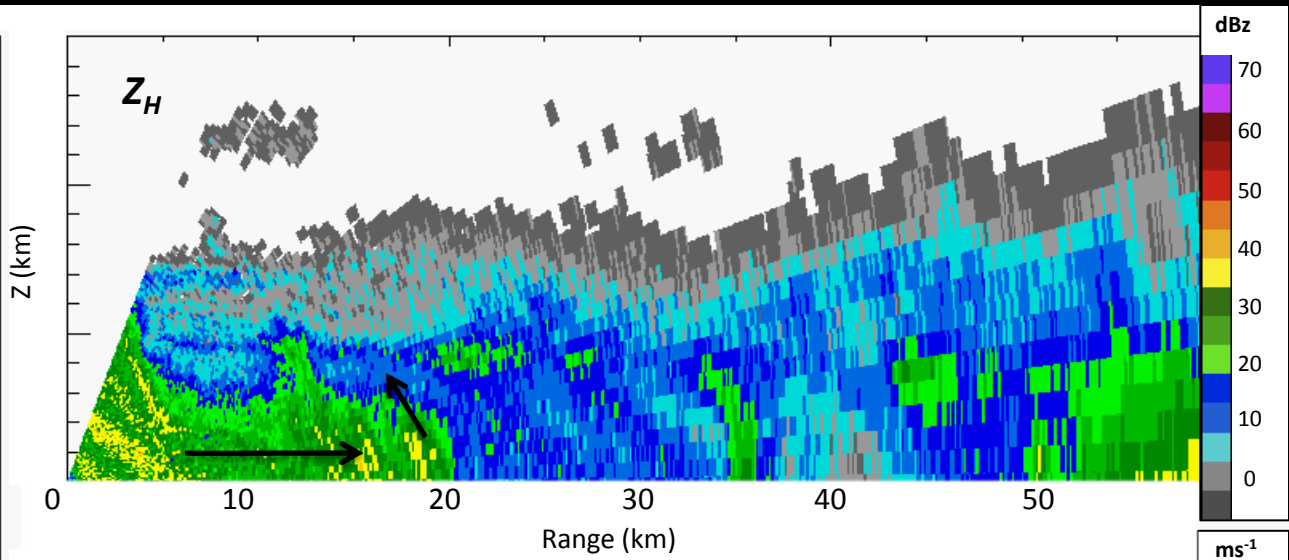
Squall line embedded in stratiform rain during WWB

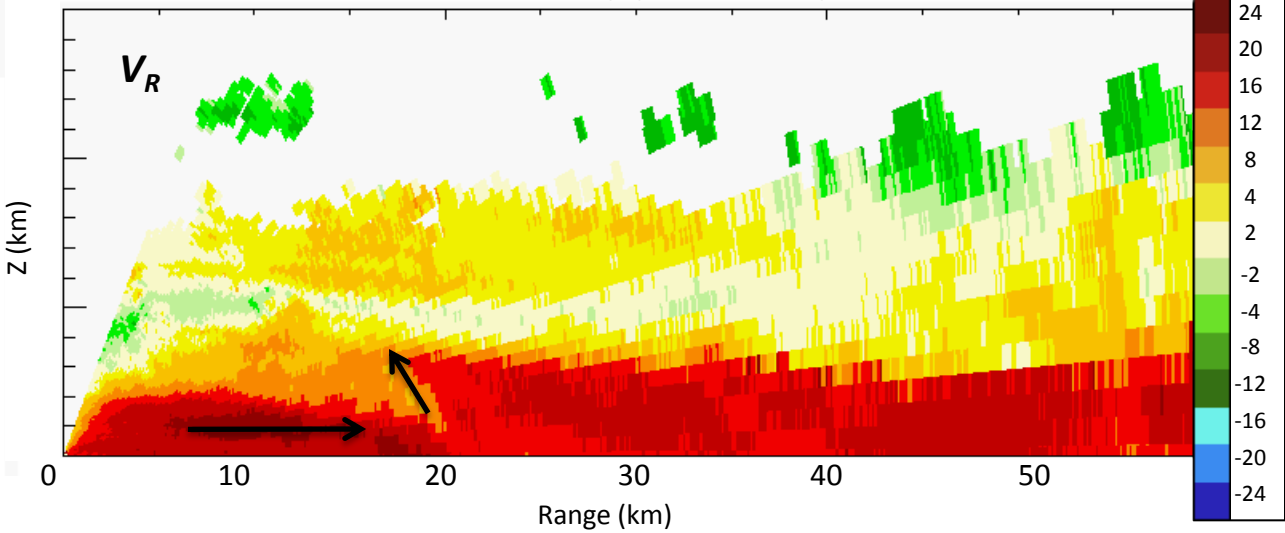


R/V Revelle TOGA Radar Nov 25 0439 Z 2011

Embedded squall line in stratiform rain during WWB







~shallow embedded convection

What do these WWB look like?

Onset : Convective rain and lightning

During : Stratiform rain, shallow embedded convection, & strong SFC winds

c/o Owen Shieh

Lingering Science Questions:

- Why are TOGA radar echo top heights suppressed during WWB?
- Why and how does SF rain persist without deep convection?
- Different Z-R relationships?
  - MJO phase
  - conv/strat regimes
- Air-sea interactions?
- Produce TOGA radar metrics for CRM investigations

During WWB: Stratiform rain, shallow embedded convection, & strong SFC winds

c/o Owen Shieh