The Relationship Between Cloud And Rain Cells And The Role Of The Environment In Convective Processes During CHUVA-GoAmazon2014/5

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Workshop on Aerosol-Cloud-Precipitation Interactions in Amazonia during the ACRIDICON-CHUVA Campaign

Ilhabela – SP Brazil

INTRODUCTION – ENVIRONMENT FEATURES

CAPE (Convective Available Potential Energy) Higher CAPE implies stronger updrafts within the convective towers (Myoung; Nielsen-Gammon, 2010).

CINE (convective inhibition Energy) is a measure of the magnitude of the triggering mechanism needed to initiate convection (Myoung; Nielsen-Gammon, 2010).
Previous studies have suggested that the wet season onset in the southern Amazon is initiated by increased evapotranspiration (ET) as a result of the rainforest's response to a seasonal increase of solar radiation Increased ET provides moisture into the atmospheric boundary layer and reduces CINE (Yin et al., 2014).

PW (Precipitable Water) is a measure of the depth of liquid water in a column of the atmosphere if it were completely condensed to the surface (Aylward & Dyer, 2010).
PW increases before precipitation events (Poan; Roehrig; Couvreux; Lafore, 2013).
Higher PW indicates larger amounts of moisture available to condense and precipitate out and less dry air to be entrained from the midtroposphere (Myoung; Nielsen-Gammon, 2010).

Vertical Wind Shear can organize deep convective systems and extend their lifetimes (Anber; Wang; Sobel, 2014).

INTRODUCTION – RAIN AND CLOUD CELLS

Wind: Advection by the mean wind of a representative layer is the most fundamental mechanism of movement control of the deep moist convection (Zeitler; Bunkers, 2005).

Deviations of storms with respect to wind, occur due the interaction between updrafts and wind shear. Furthermore, the temporal variability of the storms movement at environments with high CAPE (Convective Available Potential Energy) values, looks like to result from increased susceptibility of the storm's splitting (Kirkpatrick et. al., 2007).

OBJECTIVES

1. What the influence of the wind on Cloud and Rain Cells Motion?

2. Is there differences between Cloud and Rain Cells Motion?

3. Is there variability at system's motion during wet/dry season?

4. What the influence of the environment?

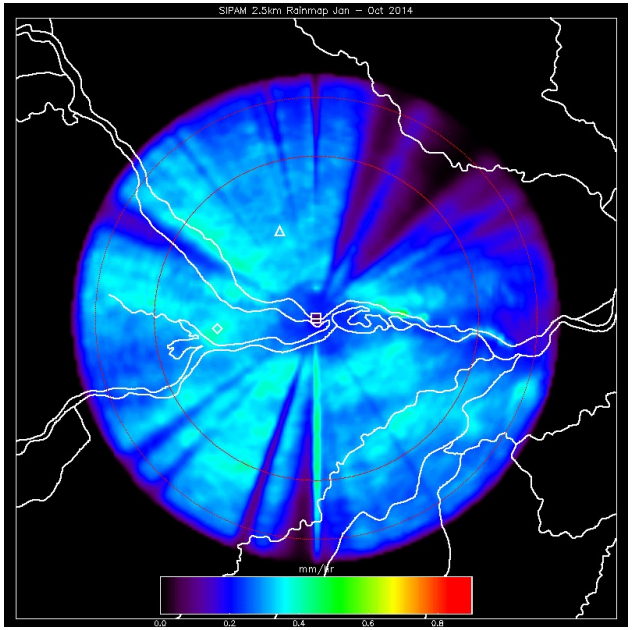
DATA AND METHODOLOGY

- **Manacapuru (T3) radiosonde data (2014);**
  - Environment features
    - Wind
    - CAPE (Convective Available Potential Energy)
    - CINE (Convective inhibition Energy)
    - PW (Precipitable Water)

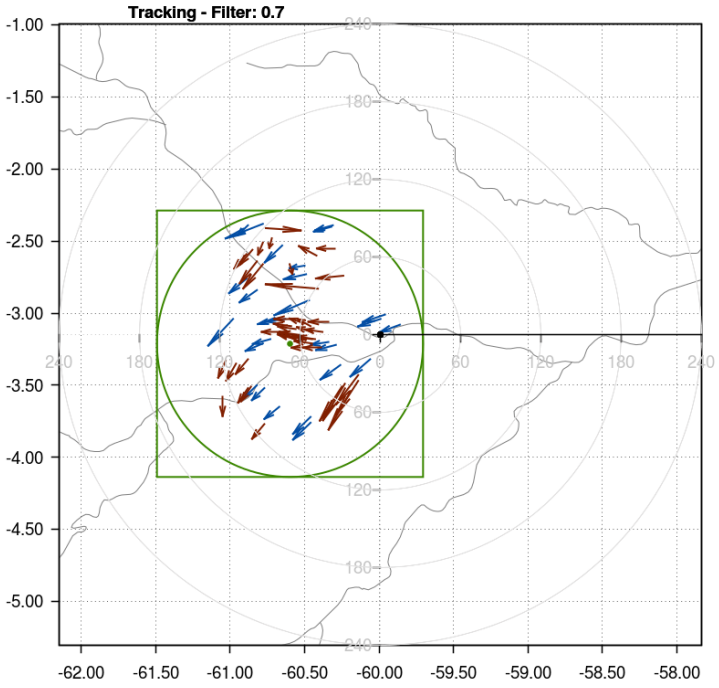
- **SIPAM S-Band Radar data (2014);**
  - Rain Cells Tracking by fortracc technique (Vila et al., 2008);
  - Cases Features by Mapes and Lin (2005) methodology;

- **GOES Satellite images channel 4 infrared (2014);**
  - Cloud Cells Tracking by fortracc technique (Vila et al., 2008);

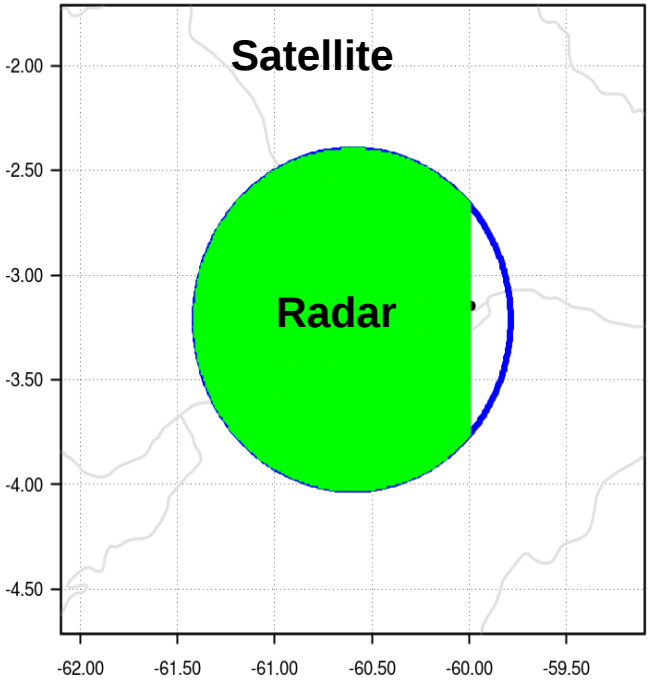
DATA AND METHODOLOGY



Rain Rate Oct-2014
Texas A&M Courtesy

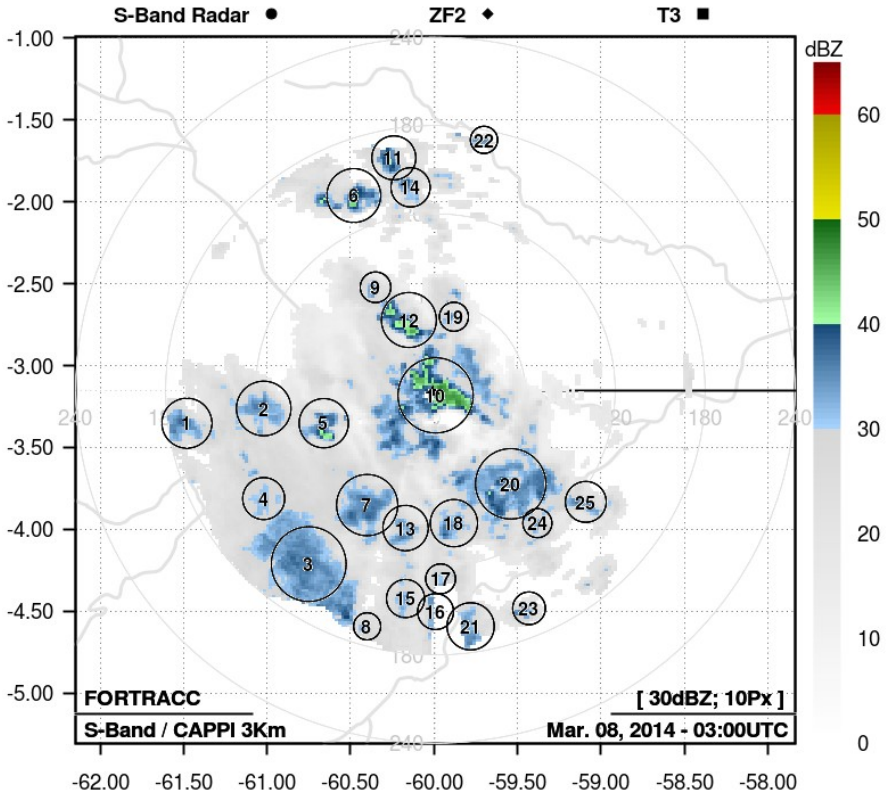


Clutter Filter Adapted
Holmlund (1998)

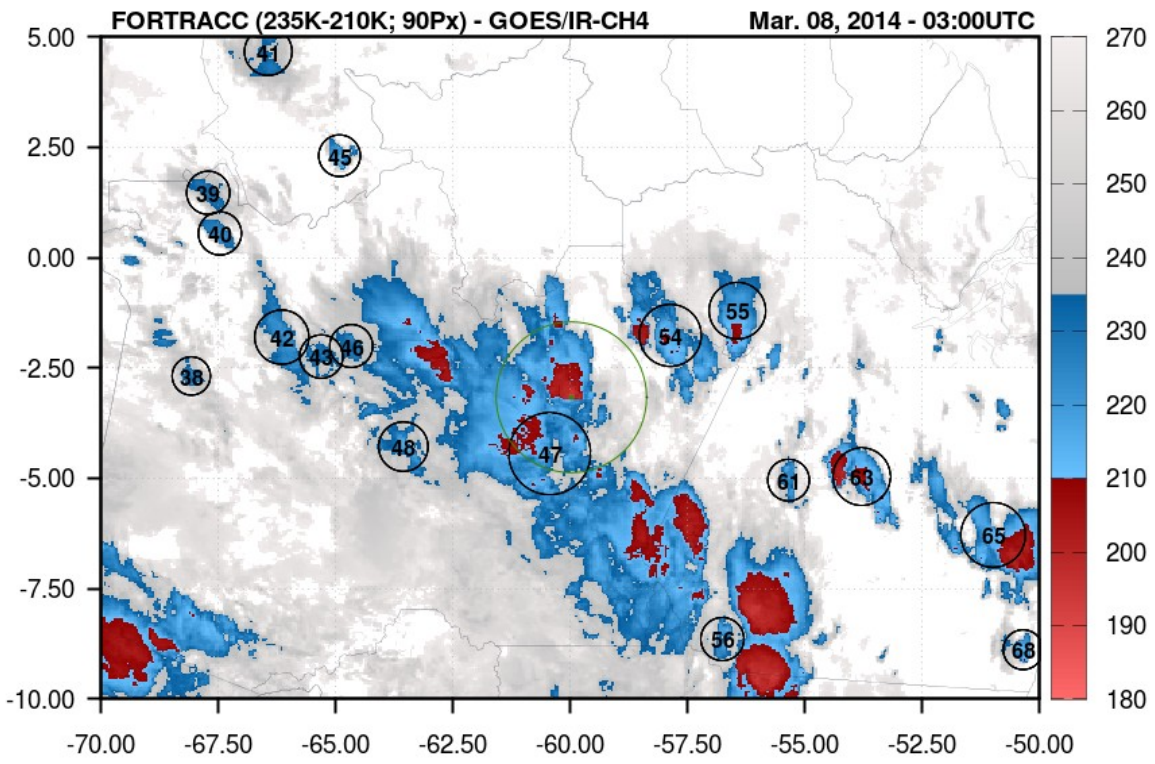


Area of Study

DATA AND METHODOLOGY

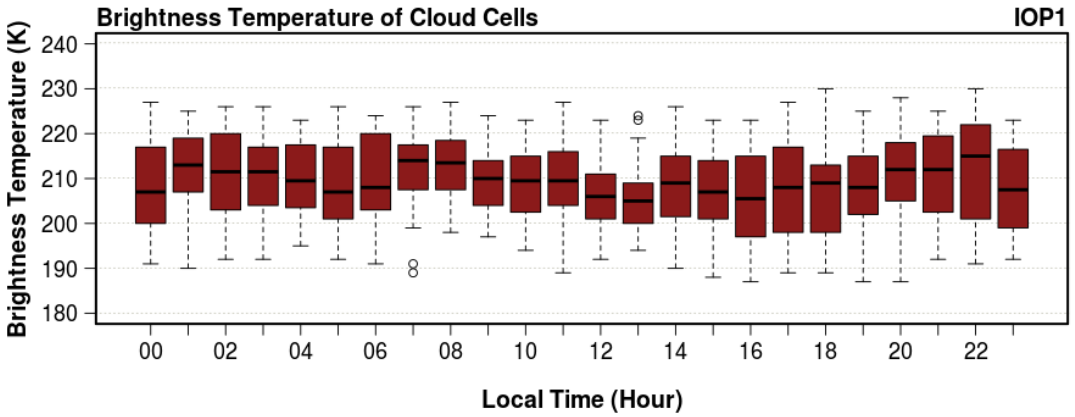


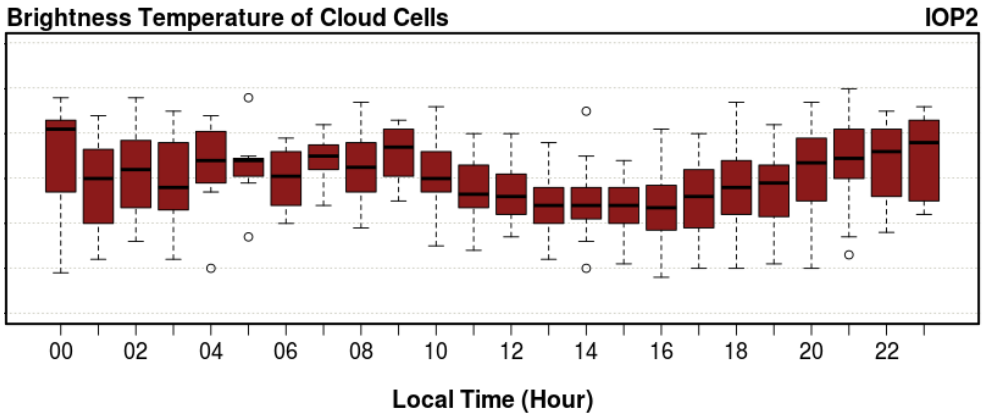
Rain Cell Definition

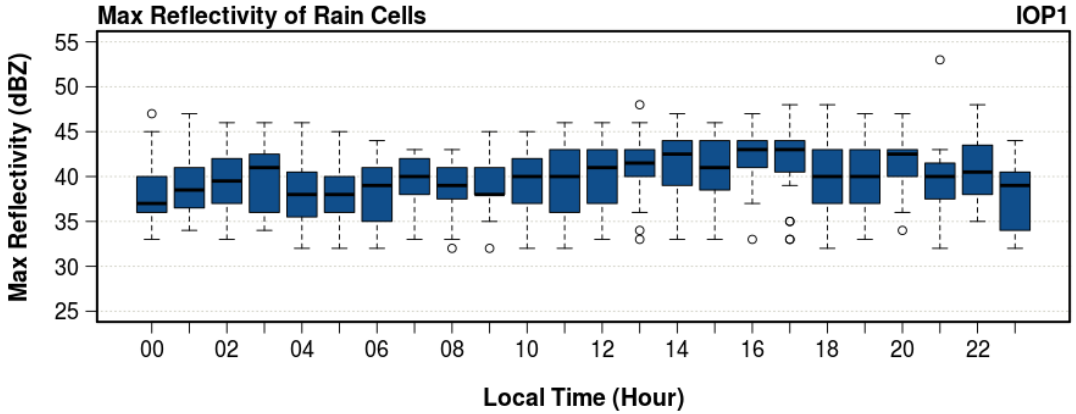


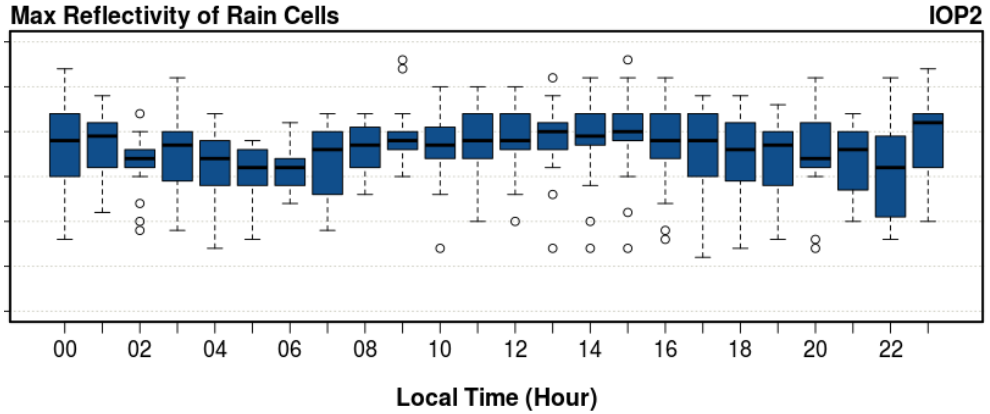
Cloud Cell Definition

CLOUD/RAIN CELLS FEATURES

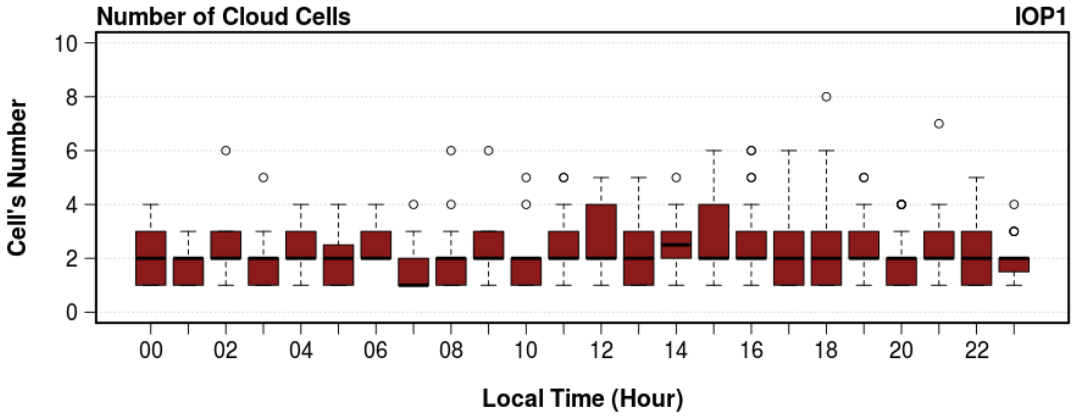


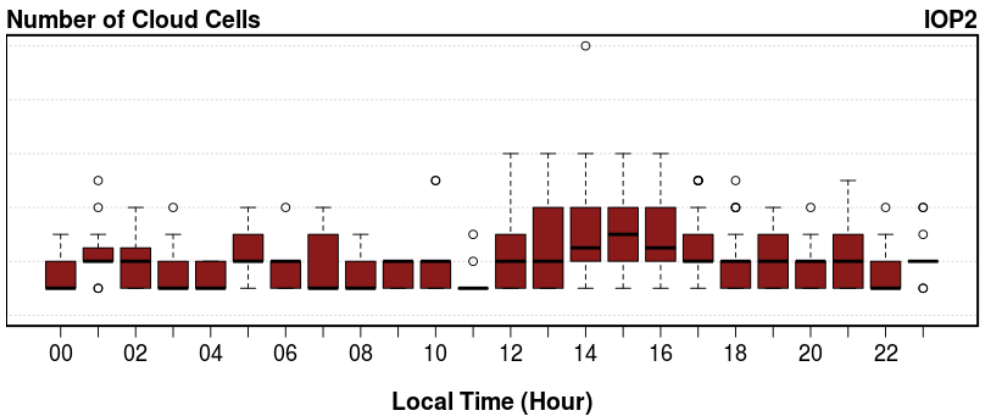


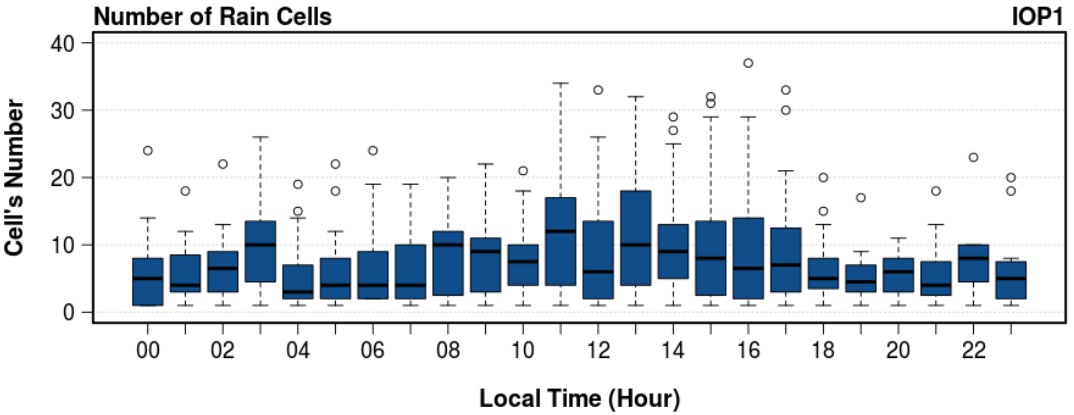


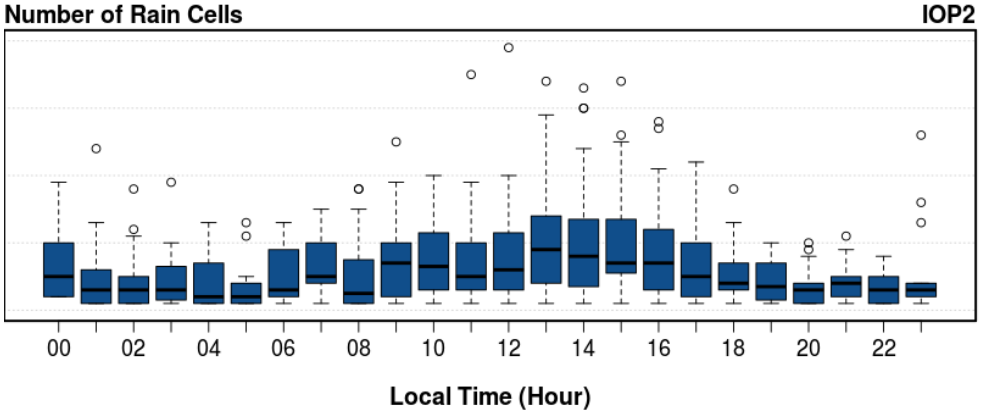


CLOUD/RAIN CELLS FEATURES









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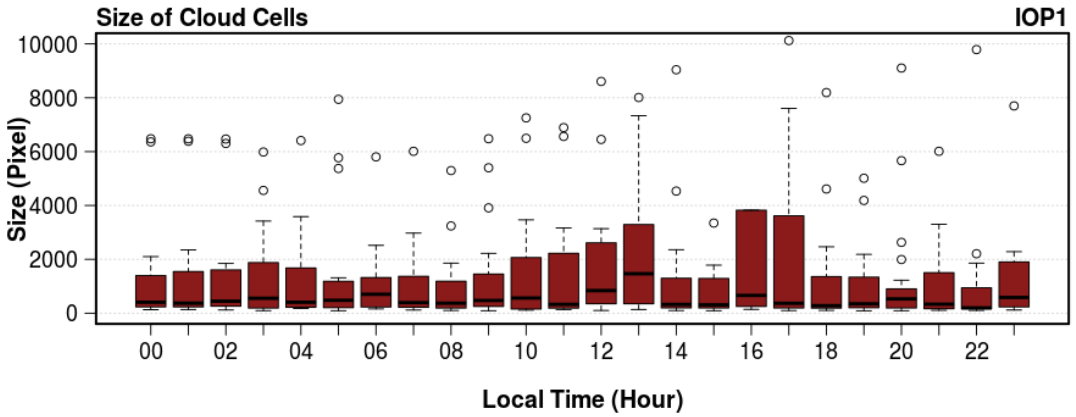
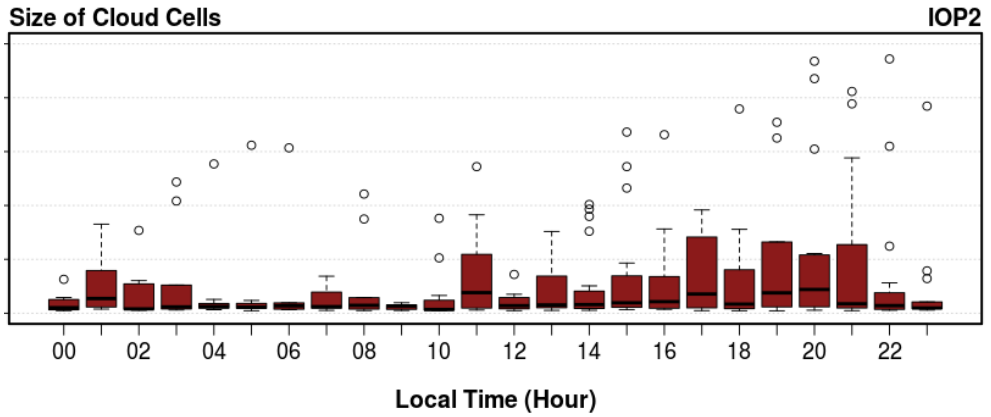
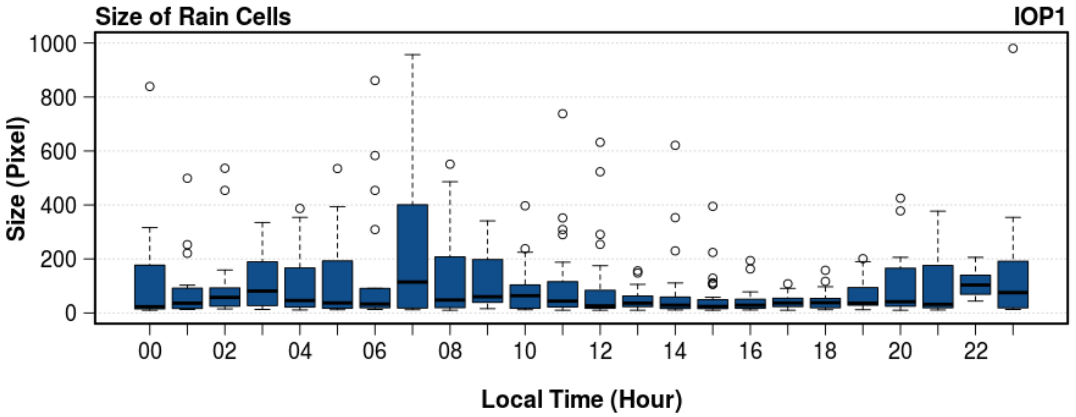
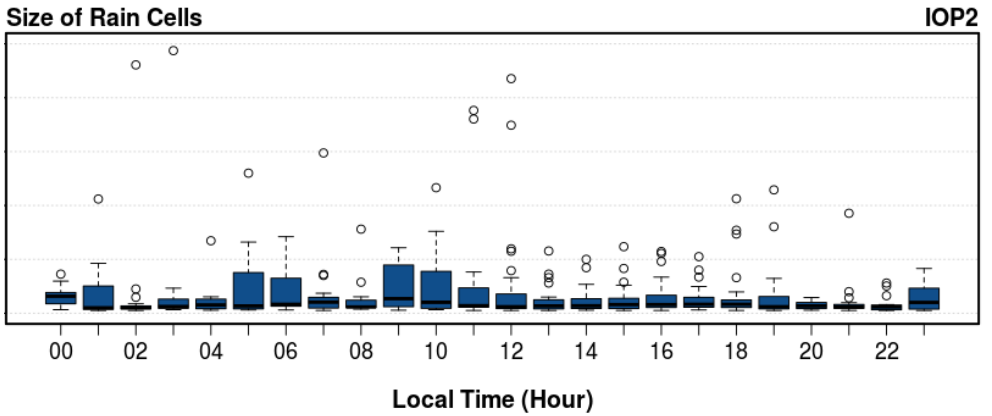
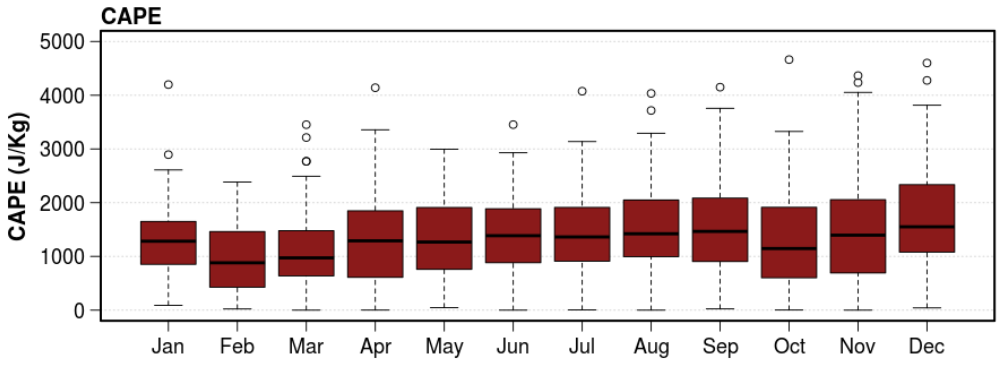


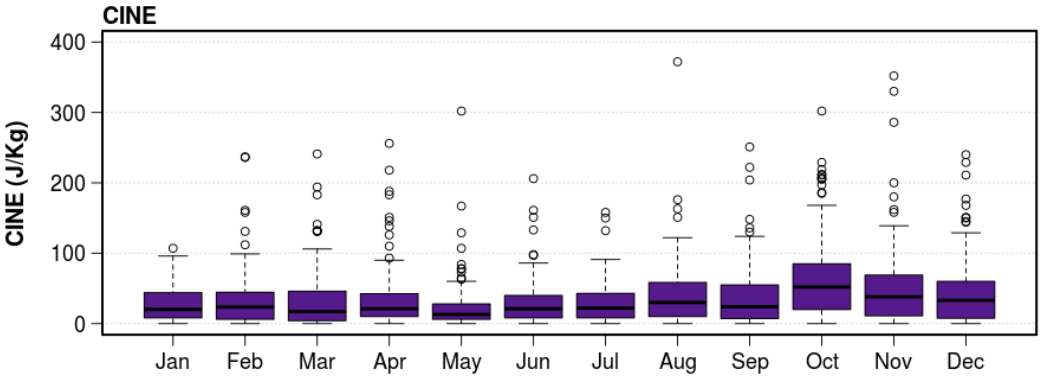


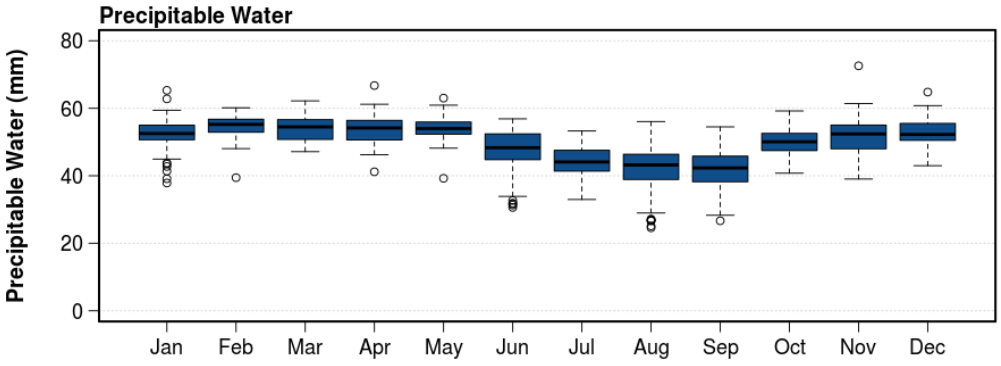


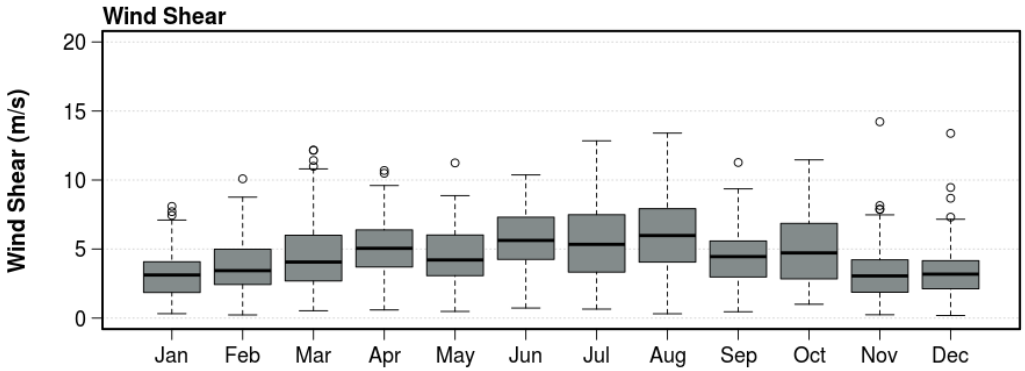


ENVIRONMENT FEATURES (ARM-T3-2014)

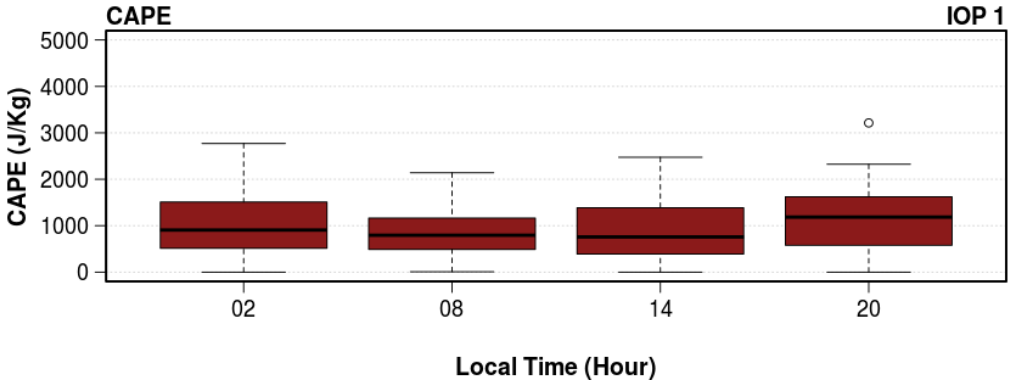


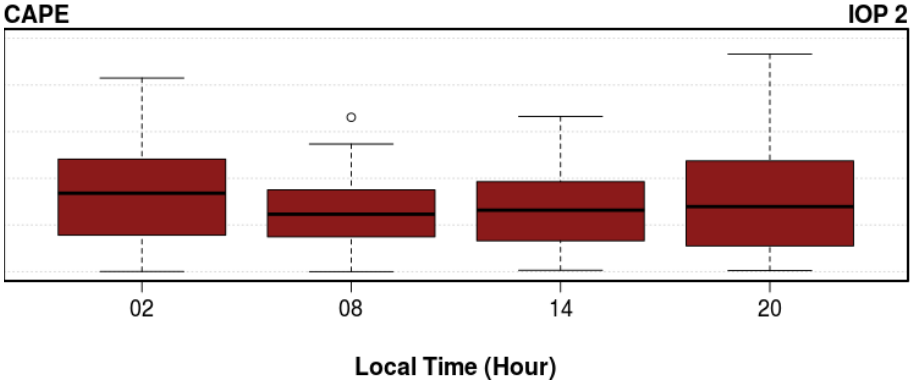


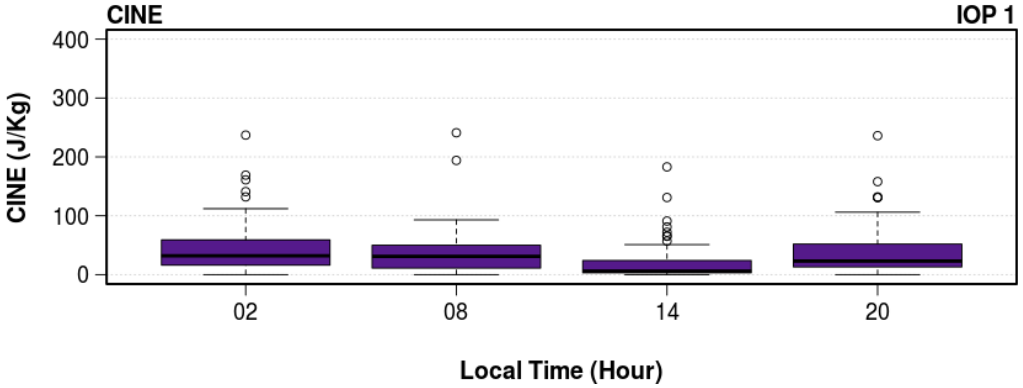


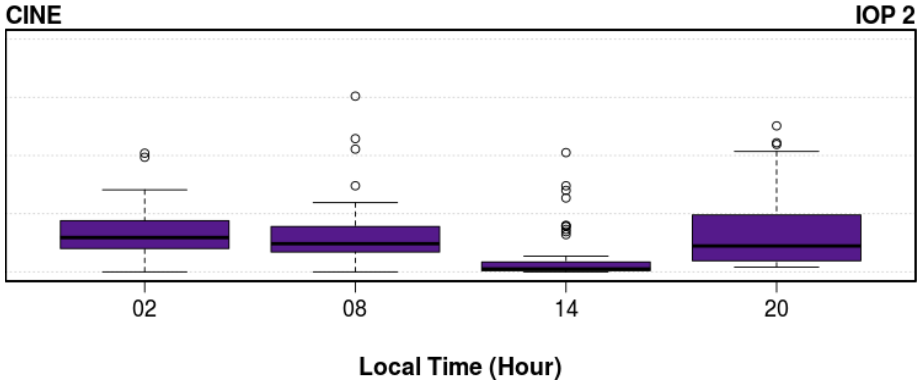


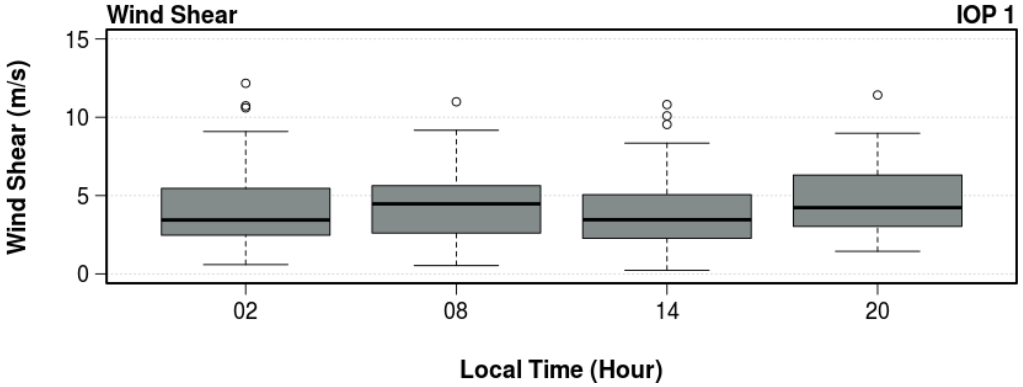
ENVIRONMENT FEATURES (ARM-T3-During IOPs)

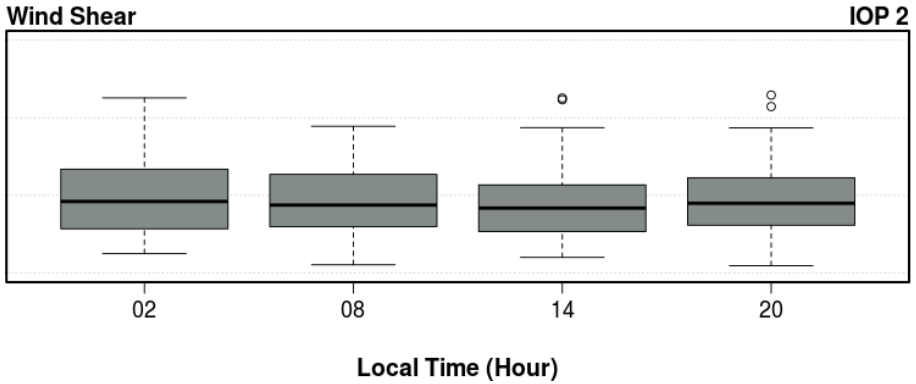




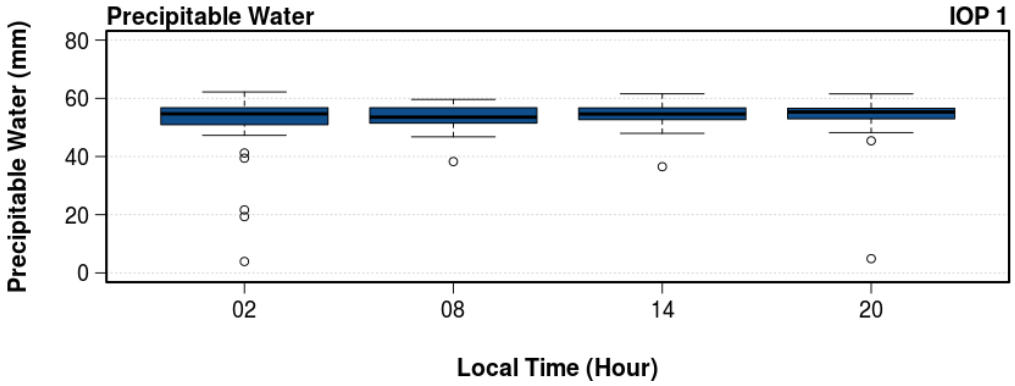


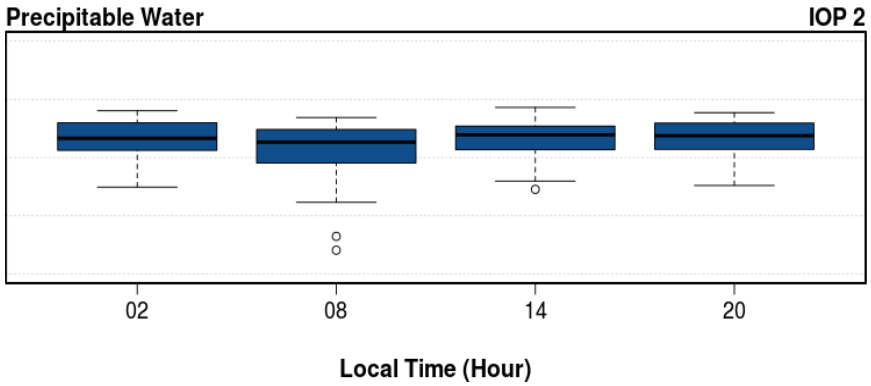




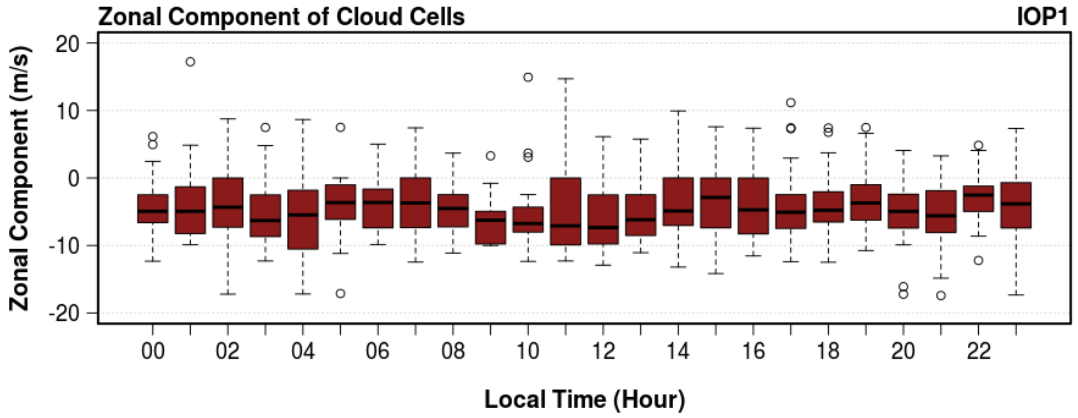


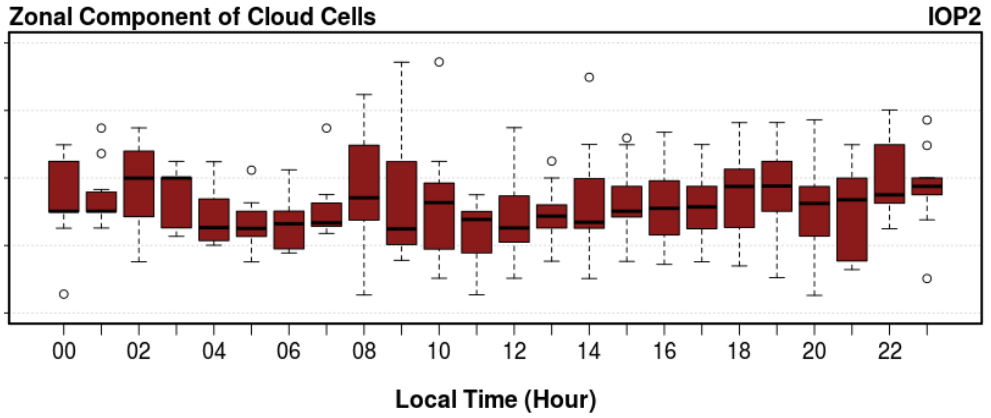
ENVIRONMENT FEATURES (ARM-T3-During IOPs)

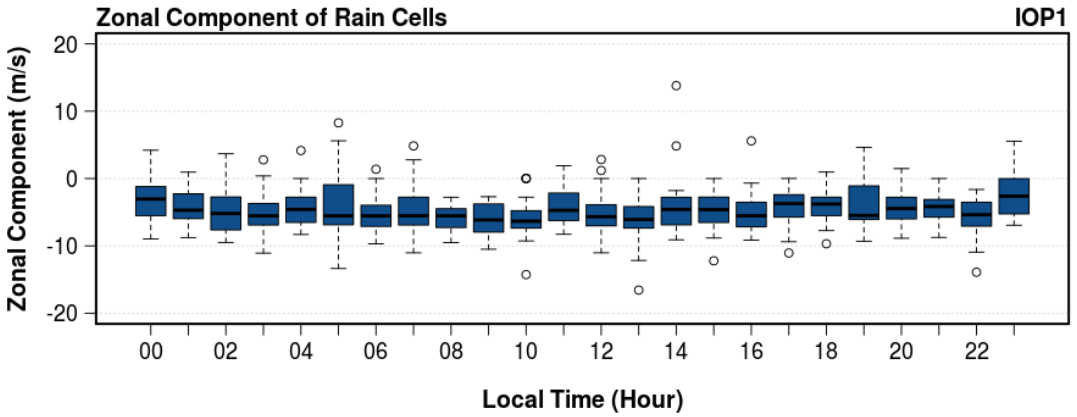


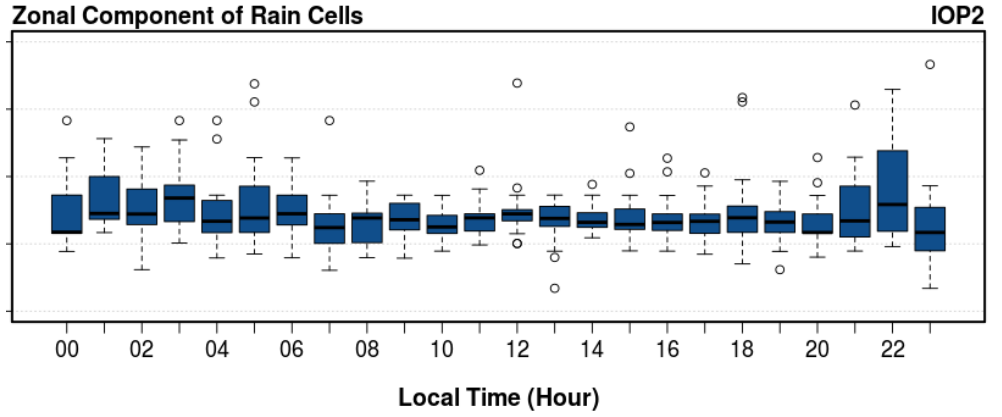


CLOUD/RAIN CELLS FEATURES

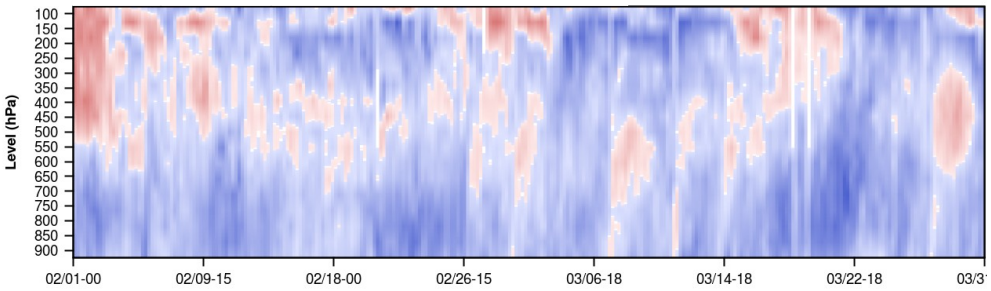




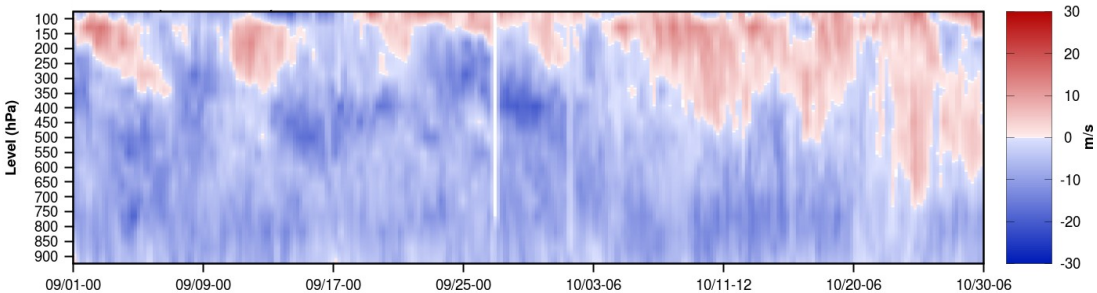




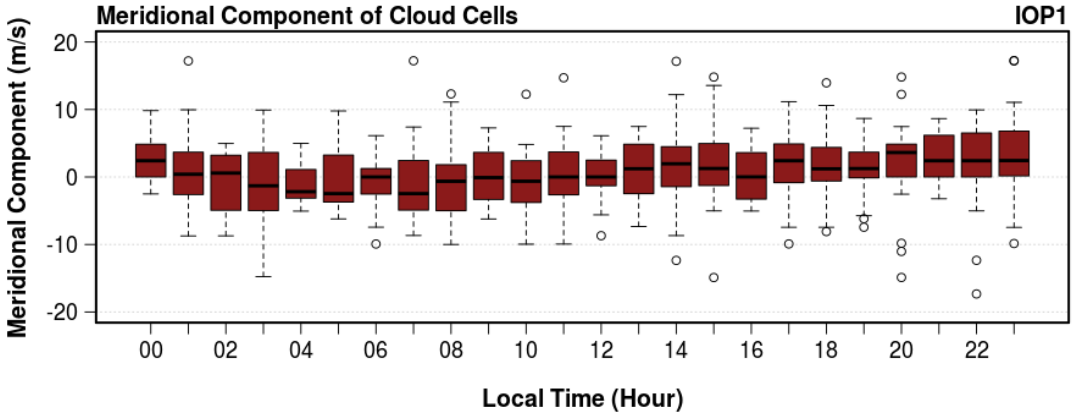
Zonal Wind (ARM – T3 - IOP1)

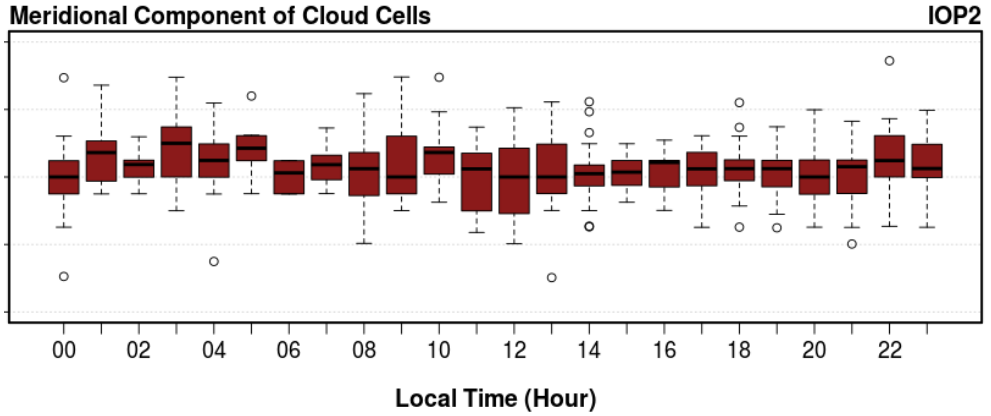


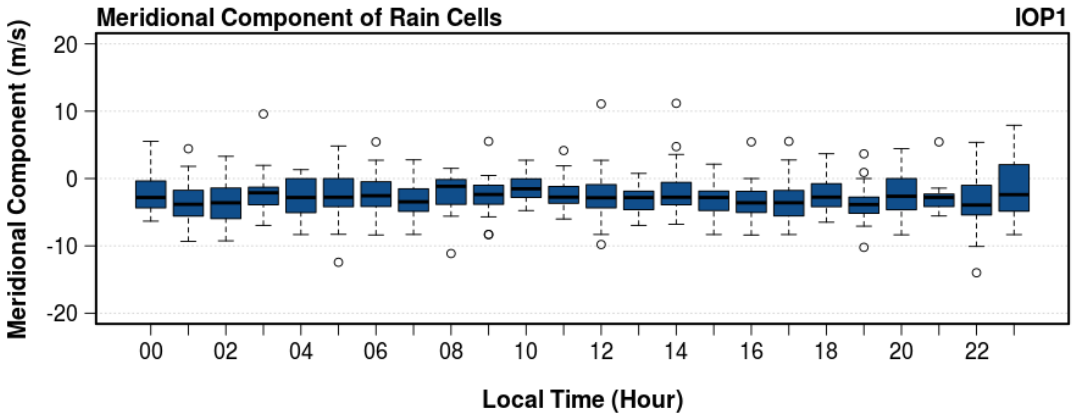
Zonal Wind (ARM – T3 - IOP2)

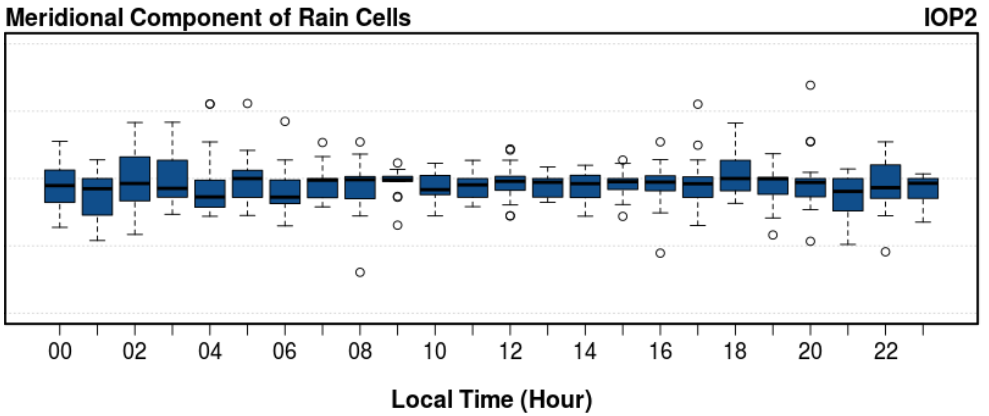


CLOUD/RAIN CELLS FEATURES

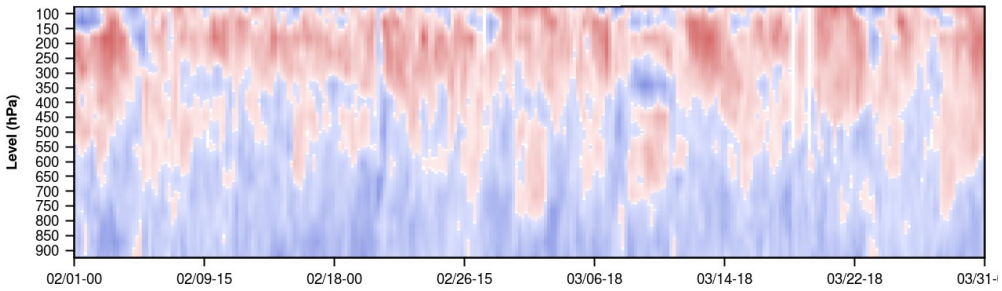




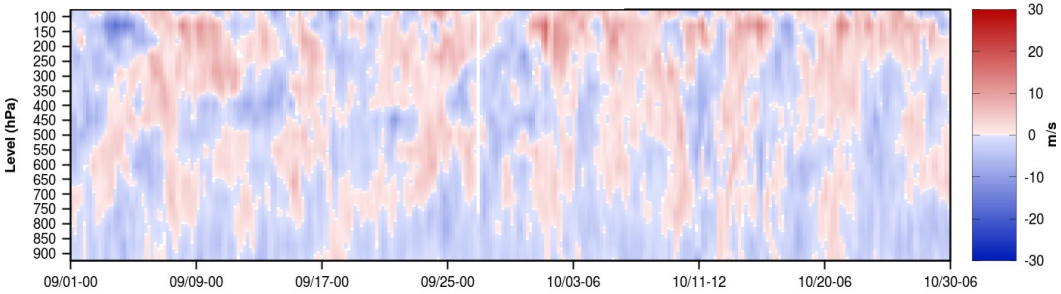


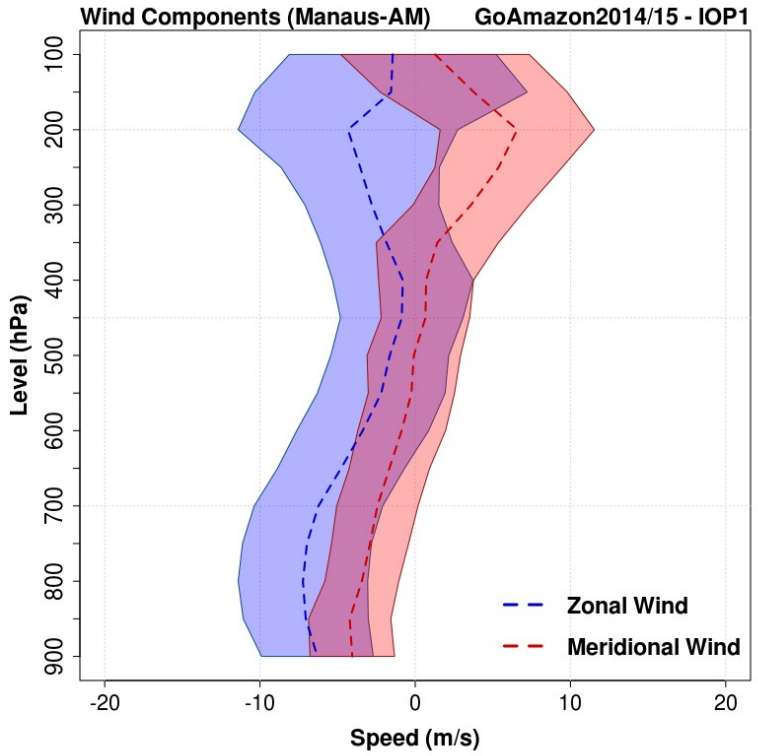


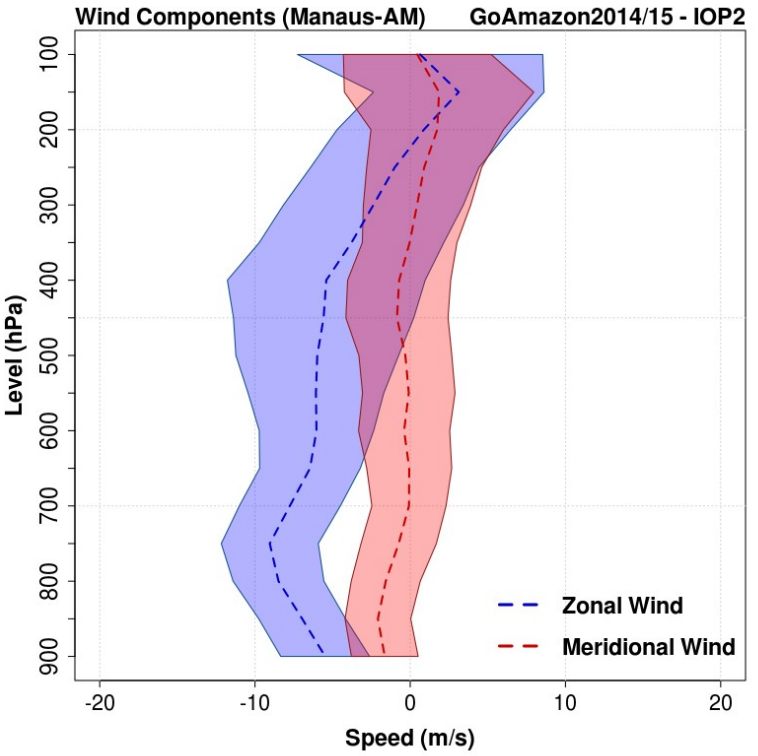
Meridional Wind (ARM – T3 - IOP1)

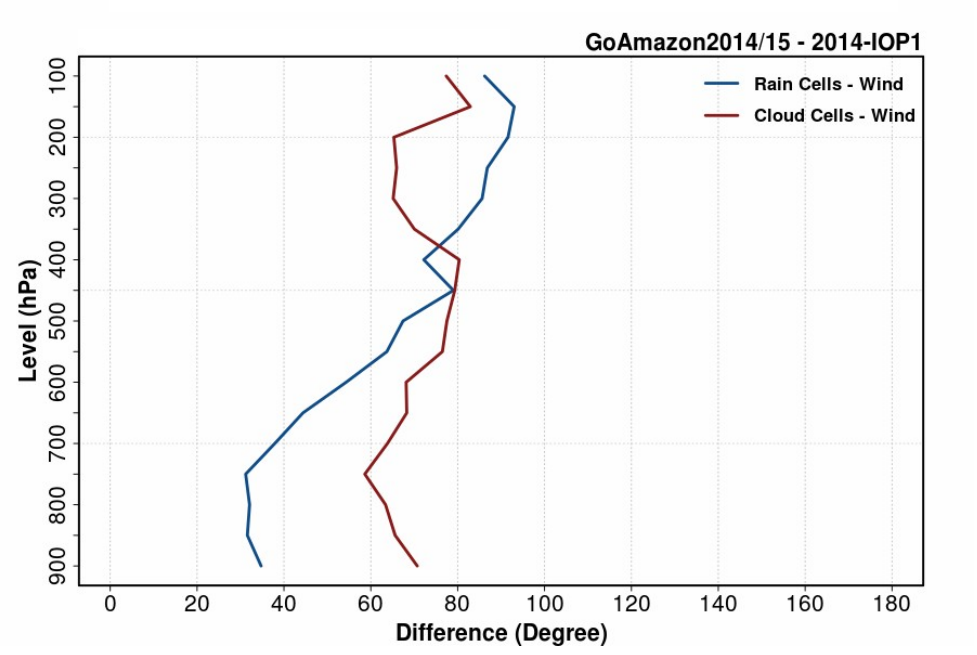


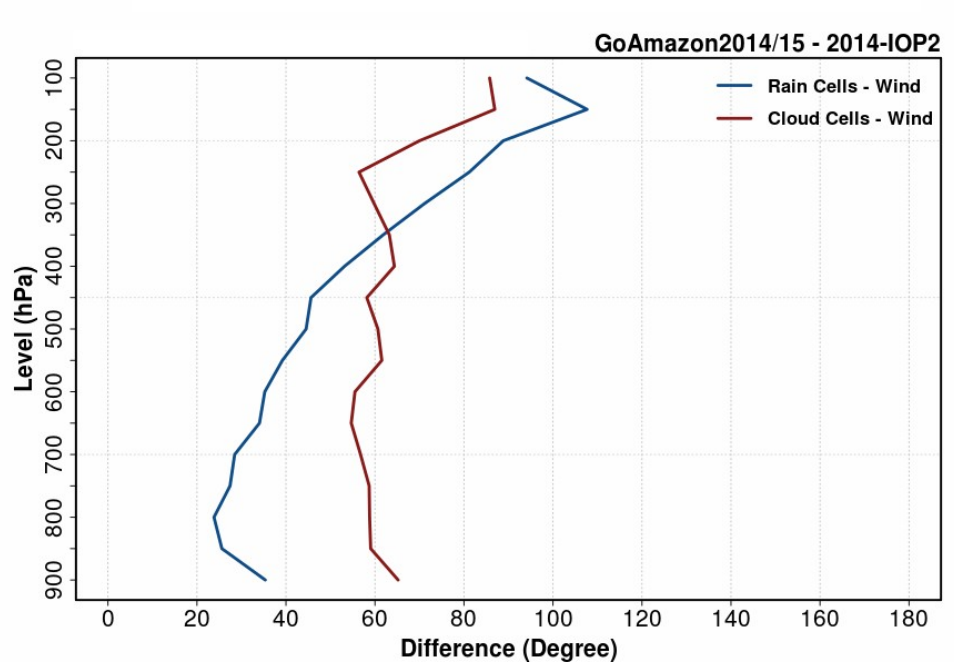
Meridional Wind (ARM – T3 - IOP2)



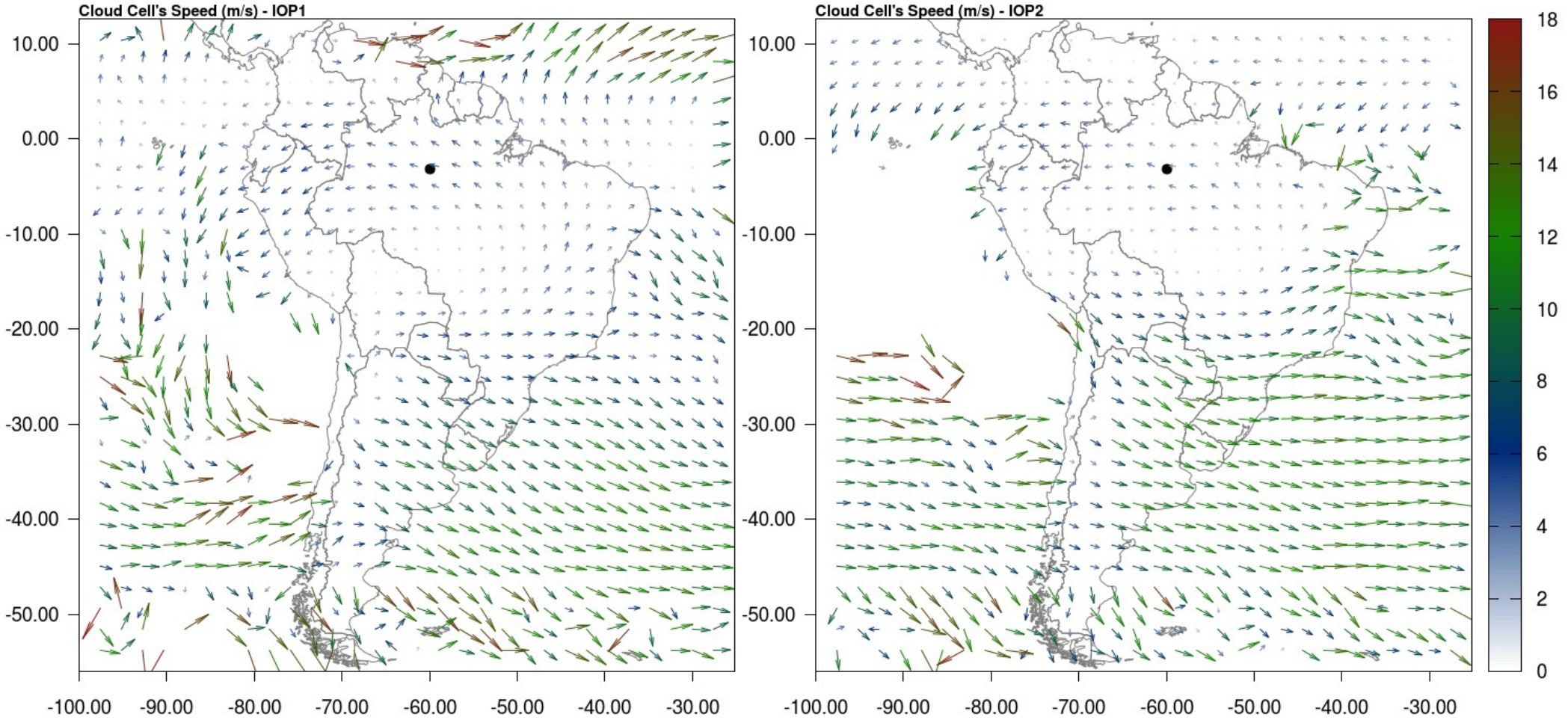

Wind Components (Manaus-AM)
GoAmazon2014/15 - IOP1
Level (hPa)
100
200
300
400
500
600
700
800
900
-20
-10
0
10
20
Speed (m/s)
Zonal Wind
Meridional Wind


Wind Components (Manaus-AM)
GoAmazon2014/15 - IOP2
Level (hPa)
100
200
300
400
500
600
700
800
900
-20
-10
0
10
20
Speed (m/s)
Zonal Wind
Meridional Wind

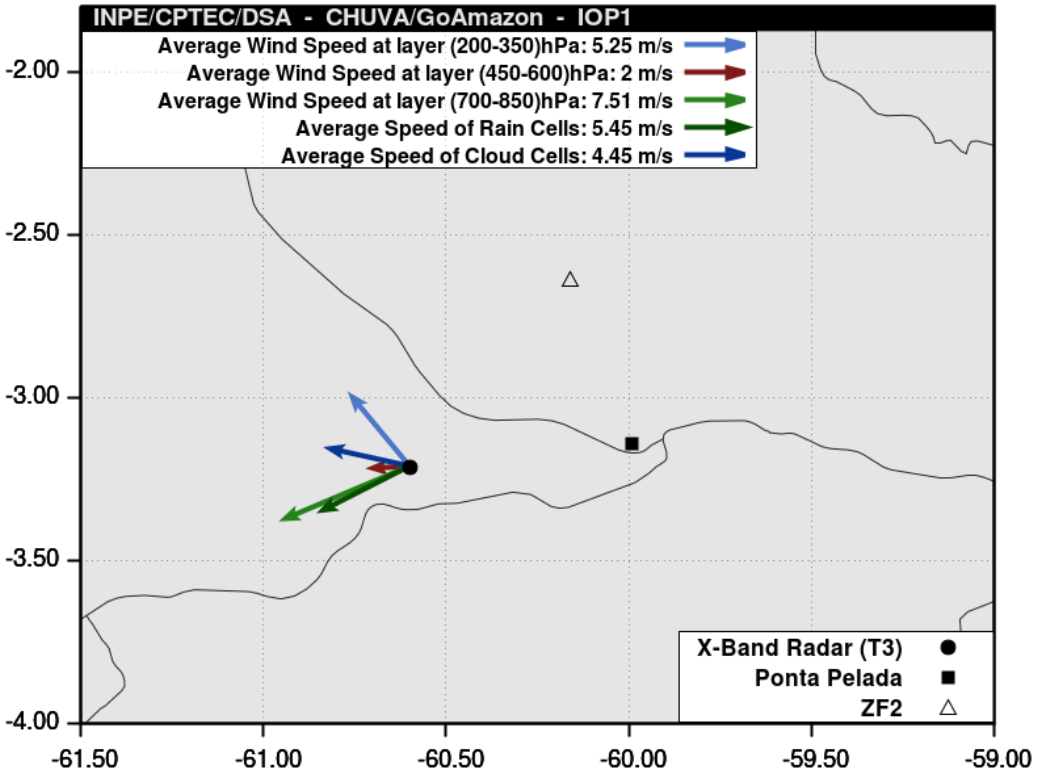

GoAmazon2014/15 - 2014-IOP1
Level (hPa)
100
200
300
400
500
600
700
800
900
0
20
40
60
80
100
120
140
160
180
Difference (Degree)
Rain Cells - Wind
Cloud Cells - Wind

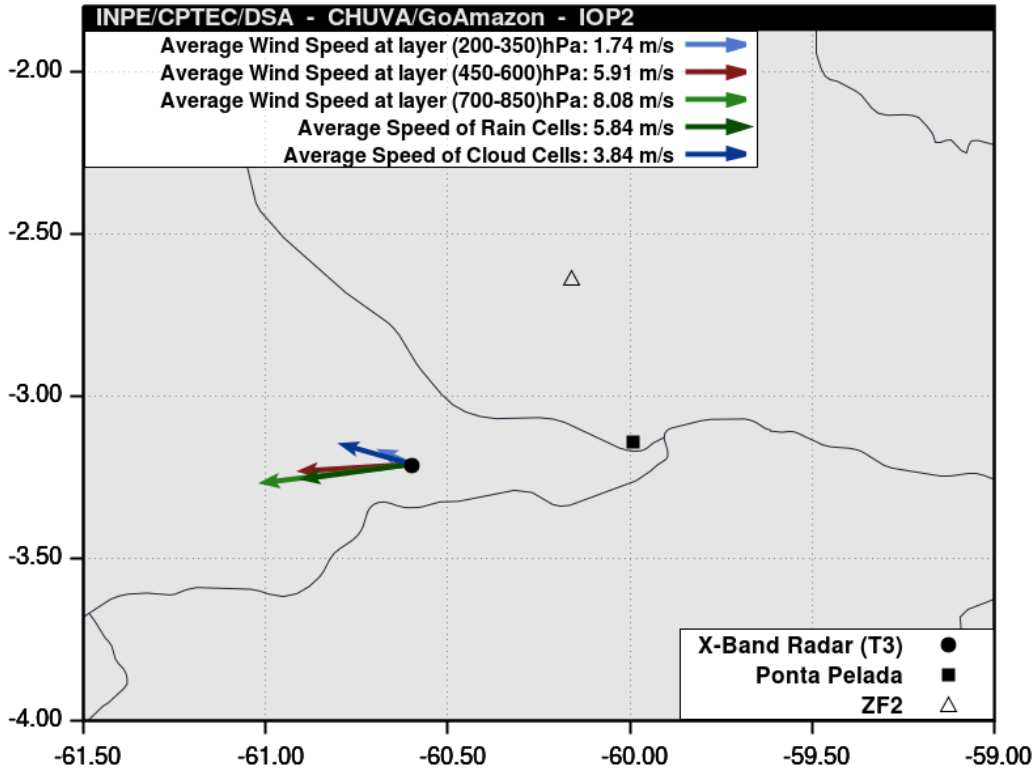

GoAmazon2014/15 - 2014-IOP2
Level (hPa)
100
200
300
400
500
600
700
800
900
0
20
40
60
80
100
120
140
160
180
Difference (Degree)
Rain Cells - Wind
Cloud Cells - Wind

CLOUD CELLS AVERAGE MOTION

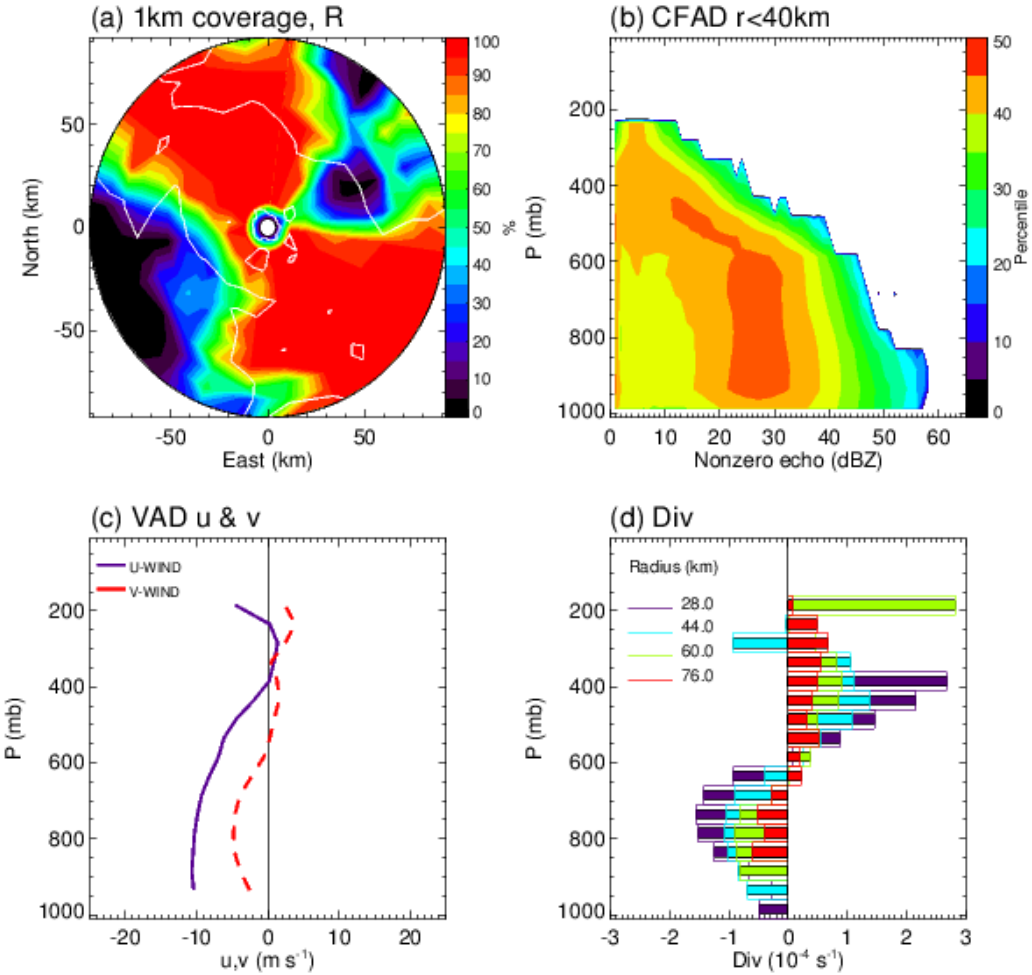


AVERAGE WIND-CLOUD/RAIN CELLS MOTION

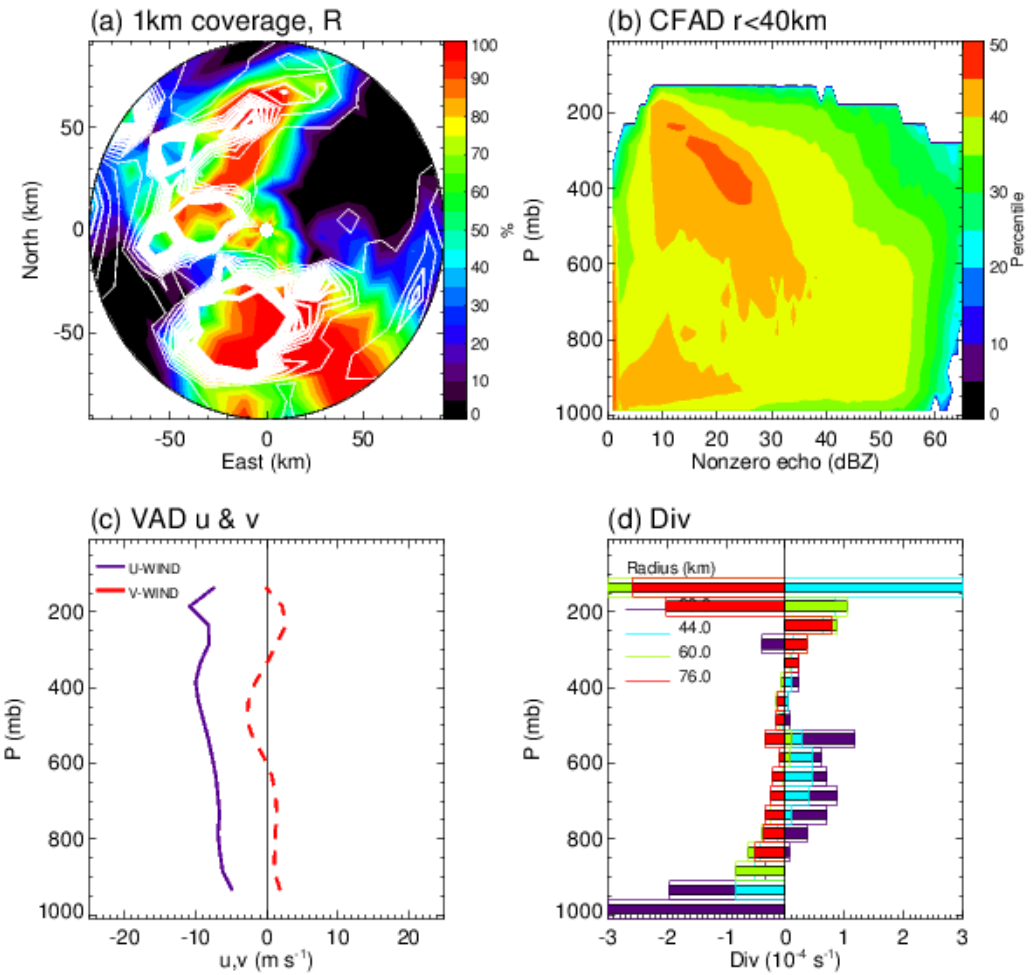




CASES DURING IOPs

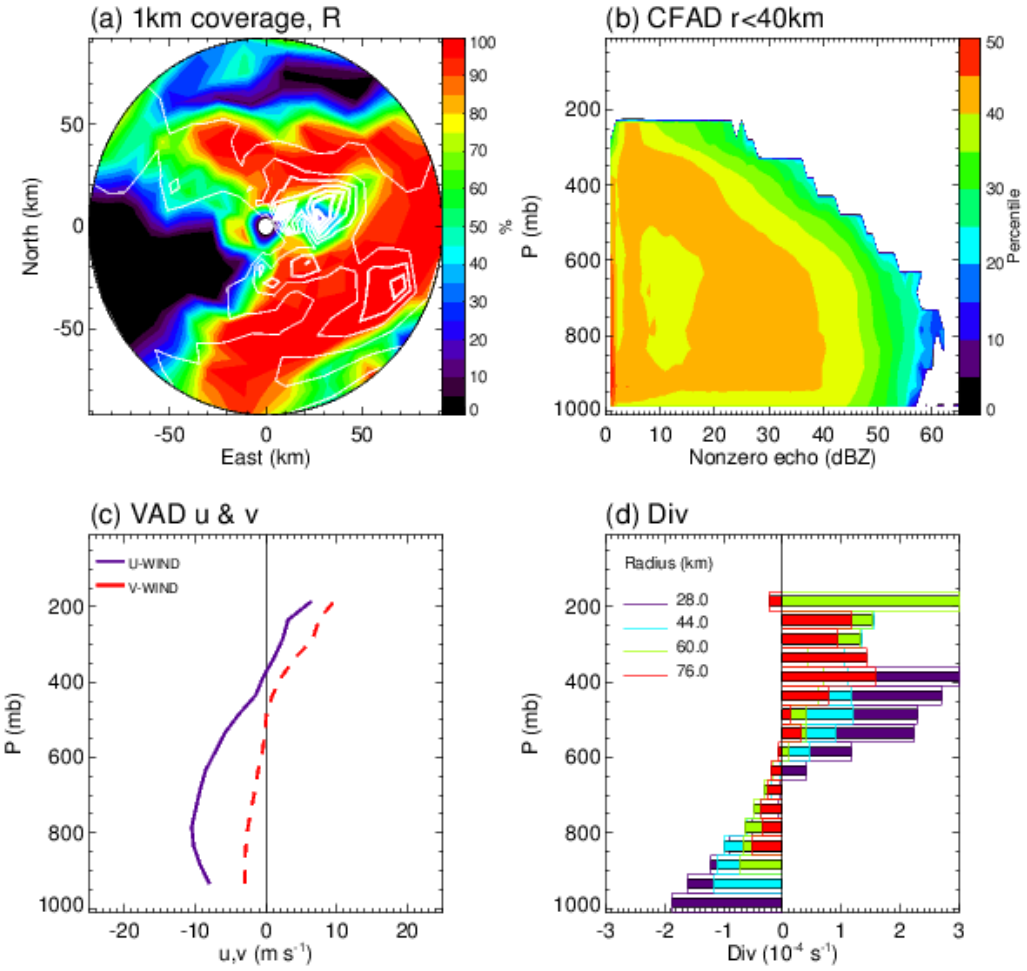


Feb 11, 2014 - 11UTC

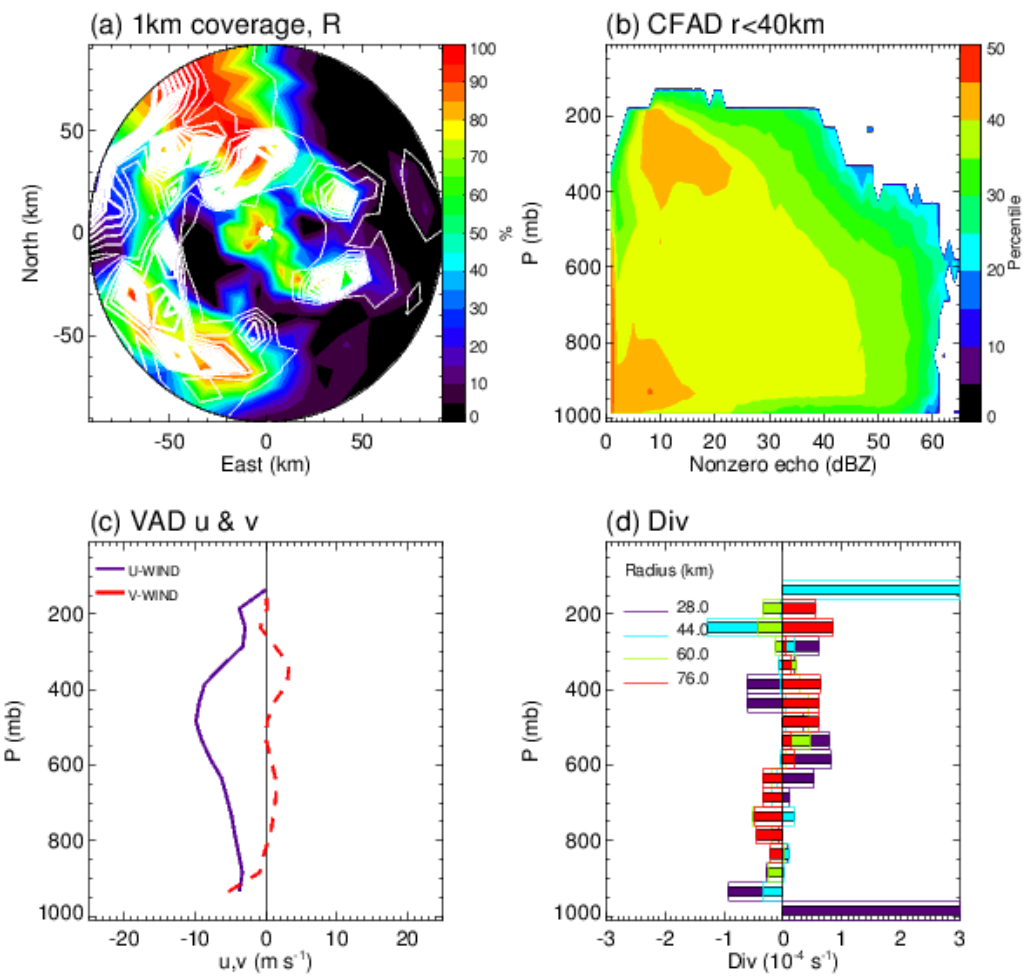


Sep 08, 2014 - 19UTC

CASES DURING IOPs

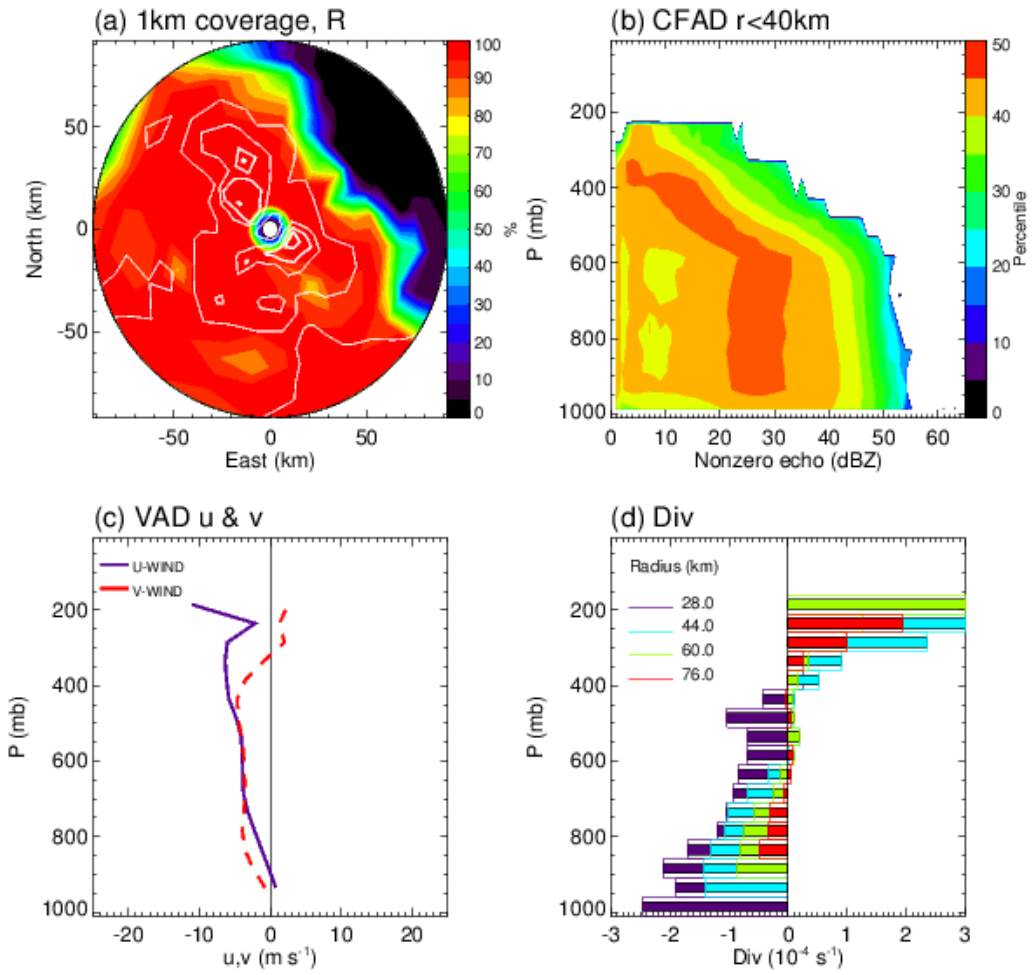


Feb 26, 2014 - 14UTC

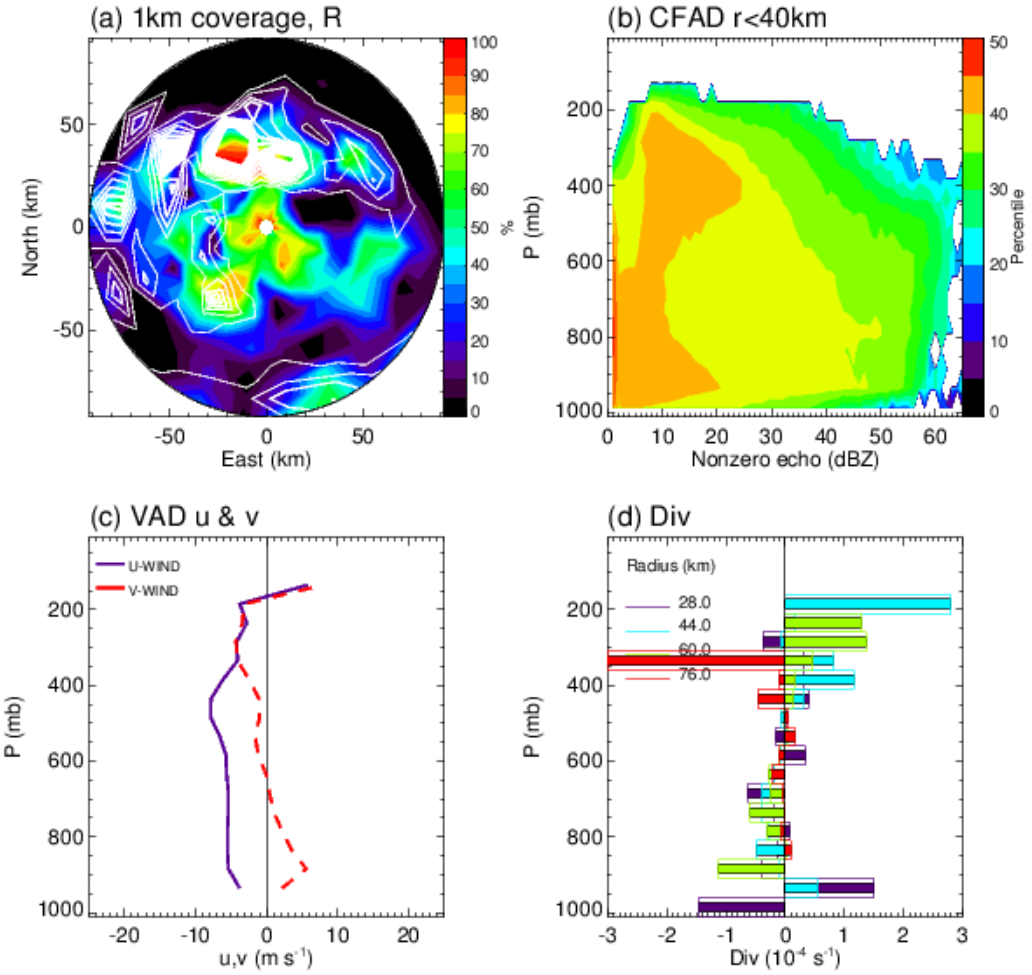


Sep 17, 2014 - 17UTC

CASES DURING IOPs



Mar 08, 2014 - 03UTC



Sep 18, 2014 - 18UTC

1. What the influence of the wind on Cloud and Rain Cells Motion?

The wind at Low levels have more influence in the rain cells motion (750hPa – Wet Season; 800hPa – Dry Season);
About Clouds Cells, different wind levels showed influence at system's motion; During the wet season the level of 750 hPa had more influence at system's motion, just like in the rain cells case.

2. Is there differences between Cloud and Rain Cells Motion?

Yes. Rain Cells appear to be more influenced by the low level winds. While Cloud cells appear to be more influenced by different wind levels.

3. Is there variability at system's motion during wet/dry season?

Yes. The systems were influenced by different kind of environment wind during wet and dry season. Besides, different kind of systems happened during the seasons (wet– systems more stratiforms; dry – systems more convectives).

4. What the influence of the environmental features?

Seasonal variations in CAPE and CINE impact convective development over the Amazon, Precipitable Water appears to play a large role in convective intensity and organization while wind shear profiles are more likely to impact rain and cloud system propagation.

Low-level winds dictate the motion of rain cells, while upper level winds dictate the motion of cloud cells; however, different wind levels impact rain and cloud cell propagation more depending on the time of day and intensity and organization of the convective system.

FUTURE WORKS

Future work will analyze rain and cloud cells in different regions of the Amazon and tropics to determine the sensitivity of their characteristics and propagation to a wider range of environmental forcing and shear.

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Thank you!!!