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

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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)

Satellite

Radar

Area of Study
DATA AND METHODOLOGY

Rain Cell Definition

Cloud Cell Definition
CLOUD/RAIN CELLS FEATURES

Brightness Temperature of Cloud Cells

Max Reflectivity of Rain Cells
CLOUD/RAIN CELLS FEATURES

Number of Cloud Cells

Local Time (Hour)

IOP1

Number of Rain Cells

Local Time (Hour)

IOP1

IOP2

IOP2
CLOUD/RAIN CELLS FEATURES

Size of Cloud Cells

Local Time (Hour)

Size of Rain Cells

Local Time (Hour)
ENVIRONMENT FEATURES (ARM-T3-2014)
ENVIRONMENT FEATURES (ARM-T3-During IOPs)

**CAPE**

- **IOP 1**
  - Local Time (Hour): 02, 08, 14, 20
  - Cape Values

- **IOP 2**
  - Local Time (Hour): 02, 08, 14, 20
  - Cape Values

**CINE**

- **IOP 1**
  - Local Time (Hour): 02, 08, 14, 20
  - Cine Values

- **IOP 2**
  - Local Time (Hour): 02, 08, 14, 20
  - Cine Values

**Wind Shear**

- **IOP 1**
  - Local Time (Hour): 02, 08, 14, 20
  - Wind Shear Values

- **IOP 2**
  - Local Time (Hour): 02, 08, 14, 20
  - Wind Shear Values
ENVIRONMENT FEATURES (ARM-T3-During IOPs)
CLOUD/RAIN CELLS FEATURES

Zonal Component of Cloud Cells

Zonal Component of Rain Cells

Zonal Wind (ARM – T3 - IOP1)

Zonal Wind (ARM – T3 - IOP2)
CLOUD/RAIN CELLS FEATURES

Meridional Component of Cloud Cells (IOP1)

Meridional Component of Cloud Cells (IOP2)

Meridional Component of Rain Cells (IOP1)

Meridional Component of Rain Cells (IOP2)

Meridional Wind (ARM – T3 - IOP1)

Meridional Wind (ARM – T3 - IOP2)
CLOUD CELLS AVERAGE MOTION
AVERAGE WIND-CLOUD/RAIN CELLS MOTION

**INPE/CPTEC/DSA - CHUVA/GoAmazon - IOP1**
- Average Wind Speed at layer (200-350)hPa: 5.25 m/s
- Average Wind Speed at layer (450-600)hPa: 2 m/s
- Average Wind Speed at layer (700-850)hPa: 7.51 m/s
- Average Speed of Rain Cells: 5.45 m/s
- Average Speed of Cloud Cells: 4.45 m/s

**INPE/CPTEC/DSA - CHUVA/GoAmazon - IOP2**
- Average Wind Speed at layer (200-350)hPa: 1.74 m/s
- Average Wind Speed at layer (450-600)hPa: 5.91 m/s
- Average Wind Speed at layer (700-850)hPa: 8.08 m/s
- Average Speed of Rain Cells: 5.84 m/s
- Average Speed of Cloud Cells: 3.84 m/s

X-Band Radar (T3) • Ponta Pelada □ ZF2 △
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.
REFERENCE


Thank you!!!