

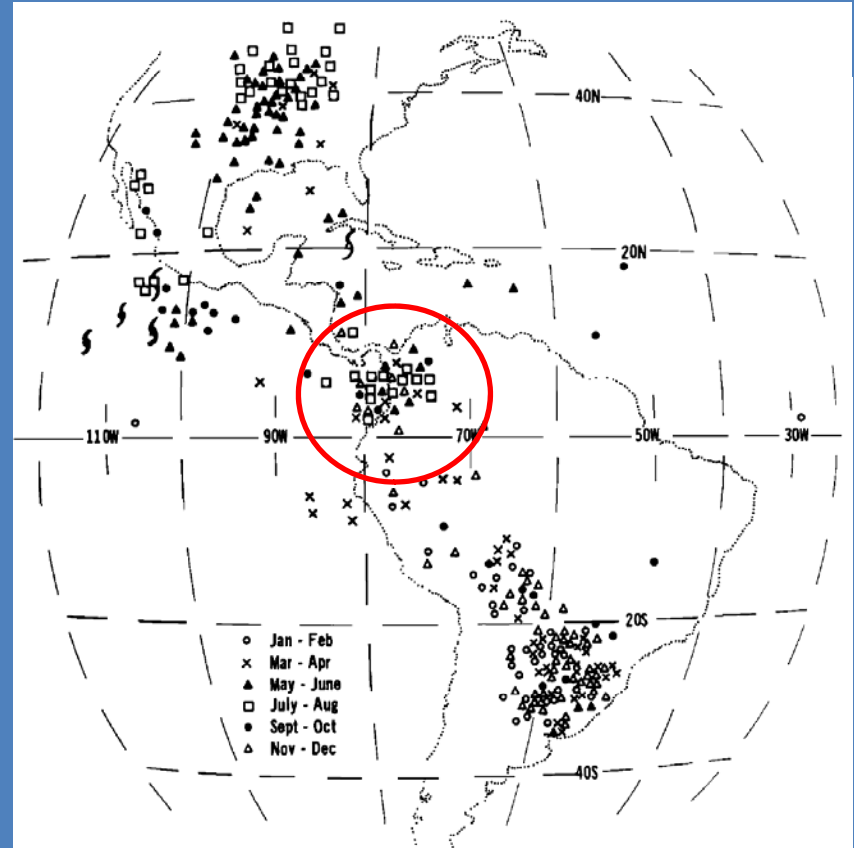
Characteristics of Extreme Summer Convection in the Tropical Americas

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30th Conference on Hurricanes and Tropical Meteorology,
15-20 April 2012, Ponte Vedra Beach, Florida

Motivation

- MCC “hot spots” over the Americas
- Severe weather and flash floods
- Much has been done over mid-latitude areas of North and South America
- Less where the ITCZ intersects the Andes

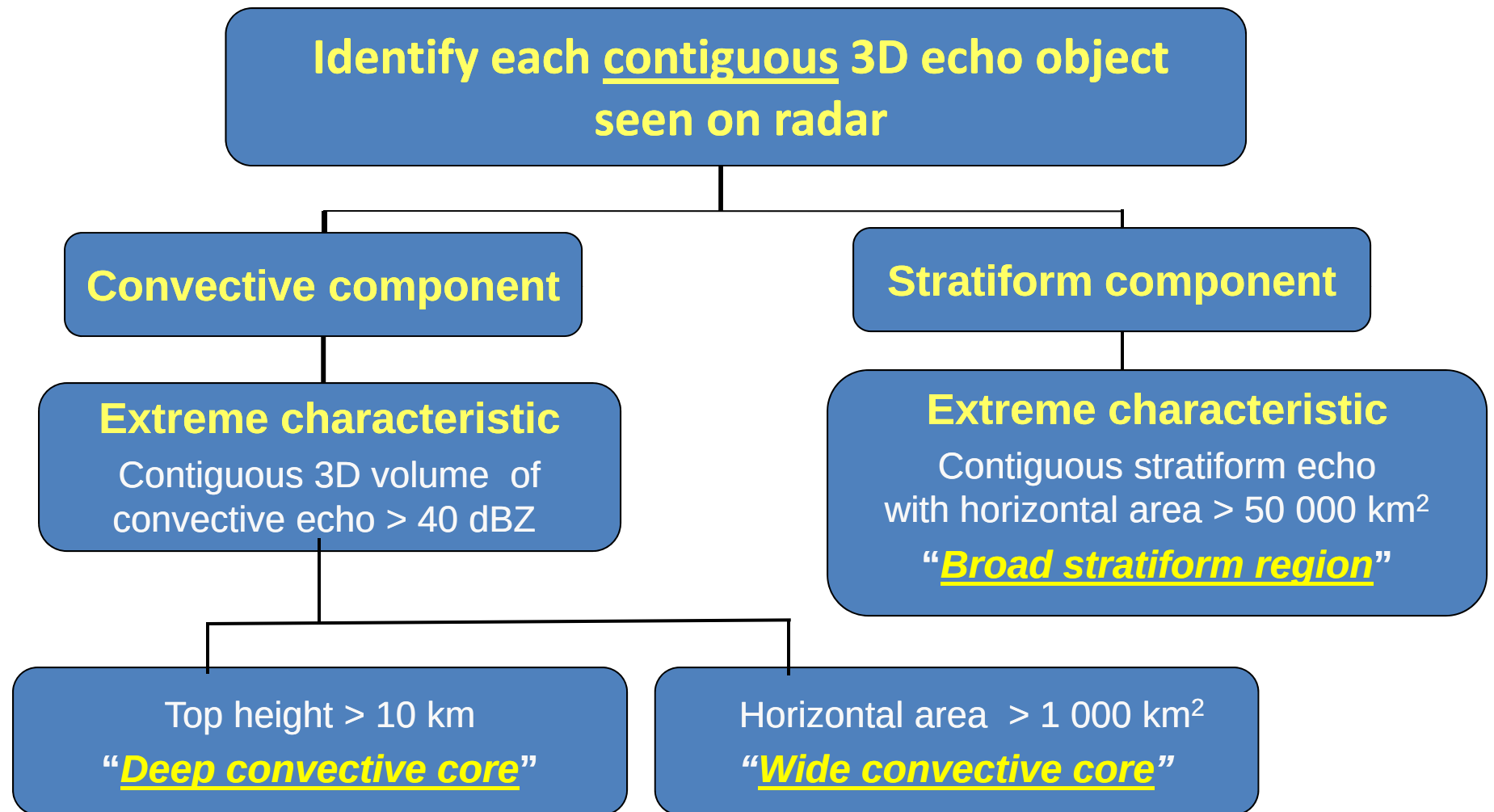


Velasco and Fritsch, 1987

Objectives

- Document **occurrence, frequency and characteristics** of extreme convection where ITCZ intersects Andes
 - 14 years of **TRMM** radar reflectivity and rain type (version 7)
- Describe **synoptic conditions** leading to these forms of extreme convection
 - **ECMWF ERA interim reanalysis** to characterize the atmospheric conditions in which extreme convection occurs

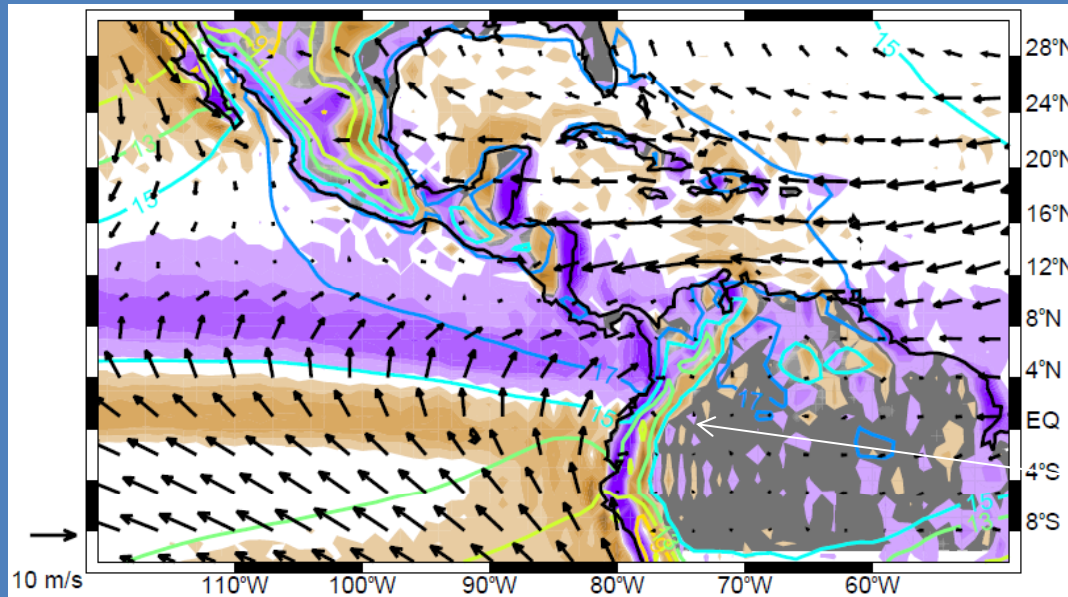
Radar identification of extreme events



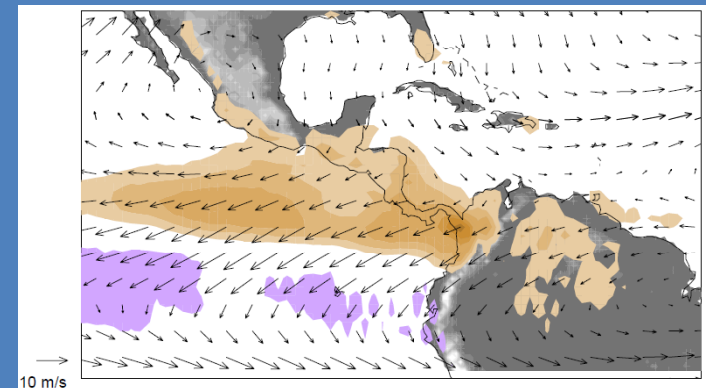
(e.g., Houze et al. 2007; Romatschke et al. 2010)

JJA – ERAi divergence, wind and humidity

Surface

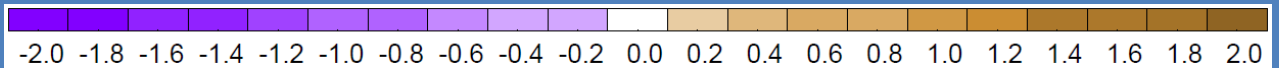


200 hPa



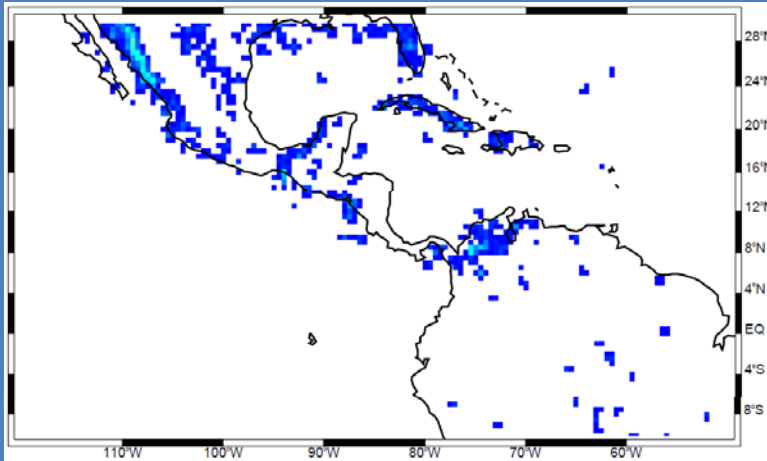
Contours:
Specific humidity [g/kg]

divergence [1/s]

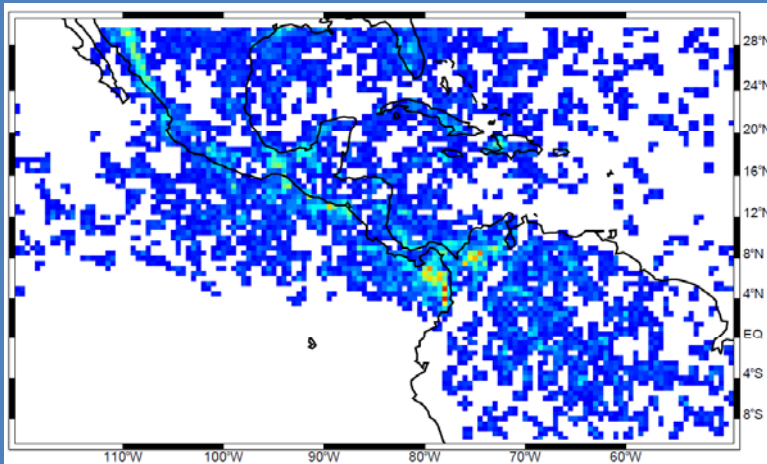


- Trade wind convergence of energy and moisture (Hadley circulation)
- Local concentration: North American monsoon circulation, Intra-Americas jet, and the Chocó low level jet
- Operating in regions of significant low-level moisture gradients areas

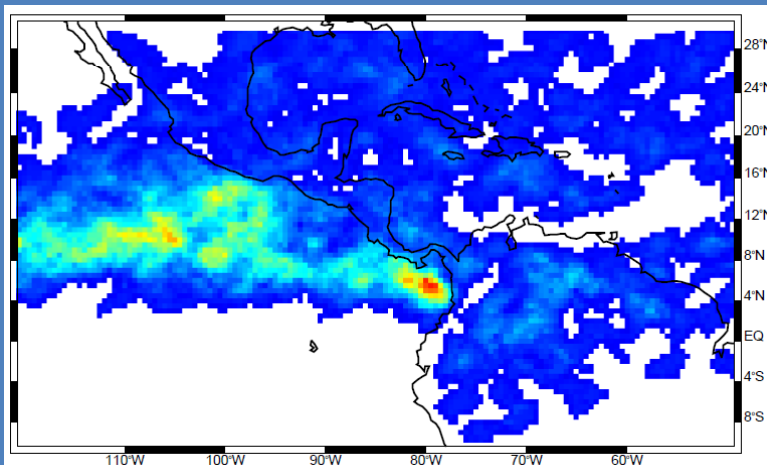
Deep Convective cores (DC)



Wide Convective cores (WC)

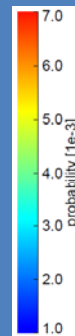


Broad Stratiform regions (BS)

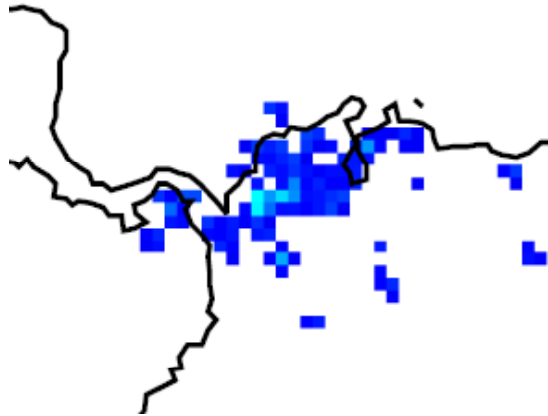


Frequency of occurrence

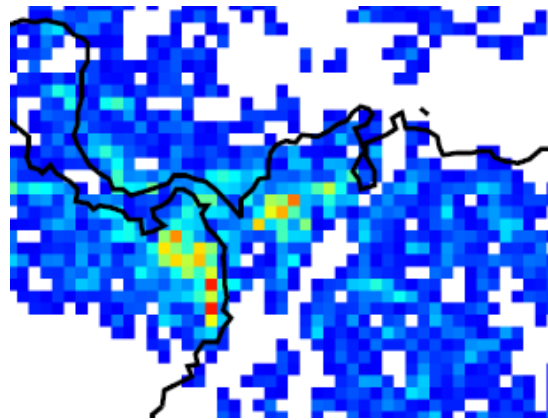
- **Deep Convective cores:**
 - West of Sierra Madre range
 - Northern fringes of the Andes
 - Central America
 - Caribbean Islands
 - South Florida
- **Wide Convective cores:**
 - Same regions as DC
 - Amazon region
 - Pacific coast of Colombia and Panamá
- **Broad Stratiform regions:**
 - ITCZ
 - Pacific coast of Colombia and Panamá



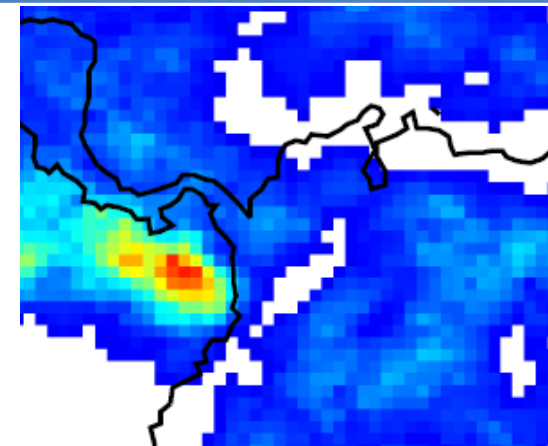
**Deep
Convective
cores
(DC)**



**Wide
Convective
cores
(WC)**



**Broad
Stratiform
regions
(BS)**



Frequency of occurrence

- **Deep Convective cores:**

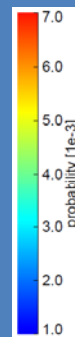
Northern fringes of Los Andes
(Bajo Cauca region)

- **Wide Convective cores:**

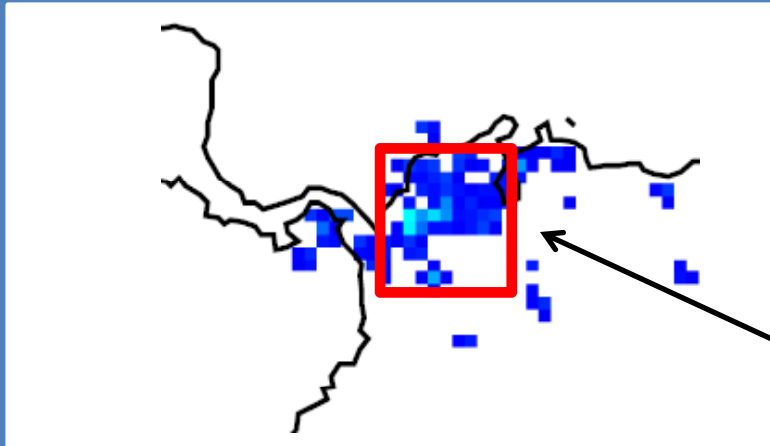
Both Cauca and Chocó regions

- **Broad Stratiform regions:**

Pacific coast of Colombia and
Panamá (Chocó region)



**Deep
Convective
cores
(DC)**

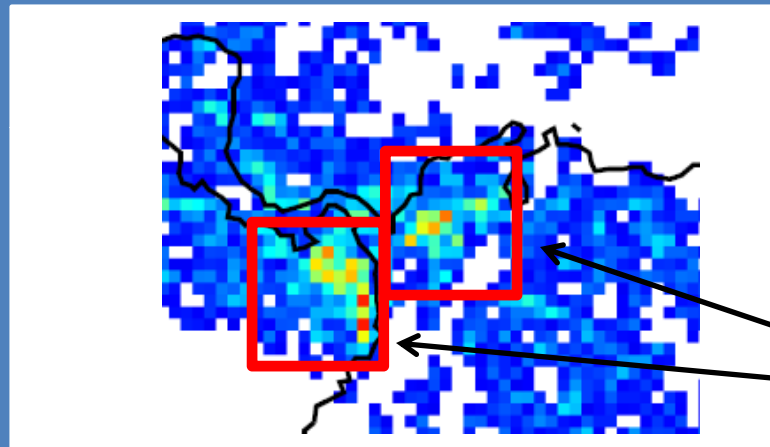


Frequency of occurrence

- **Deep Convective cores:**

Northern fringes of Los Andes
(Bajo Cauca region)

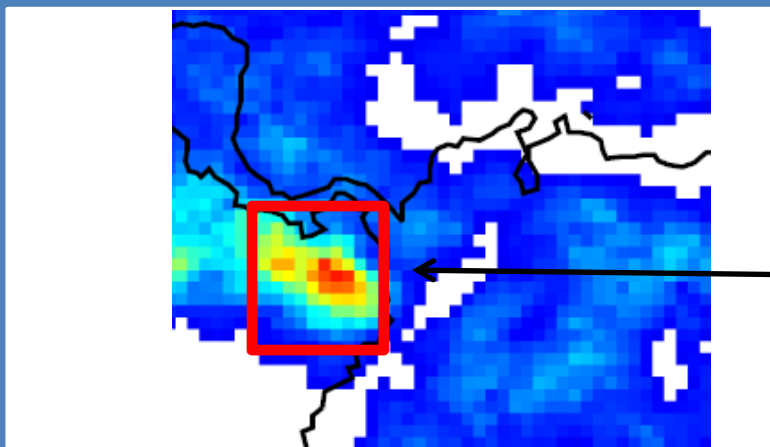
**Wide
Convective
cores
(WC)**



- **Wide Convective cores:**

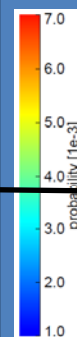
Both **Cauca and Chocó** regions

**Broad
Stratiform
regions
(BS)**

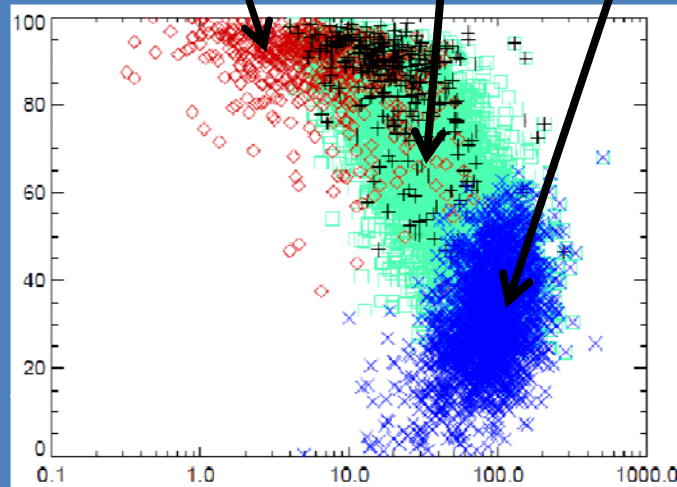


- **Broad Stratiform regions:**

Pacific coast of Colombia and
Panamá (**Chocó** region)



Convective rain percentage



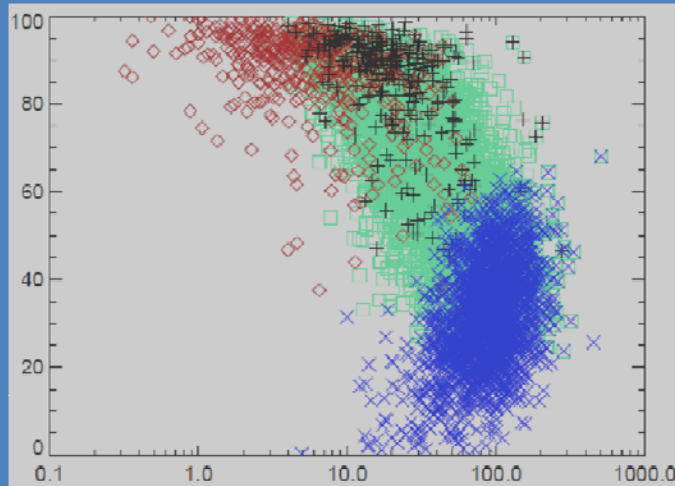
Volumetric rain [kg/s]

Rainfall, % convective, and echo type

- Storms containing **DC cores** have very high convective rain percentage but relative low volumetric rain
- In contrast, **BS regions** have low convective rain but higher volumetric rain rates

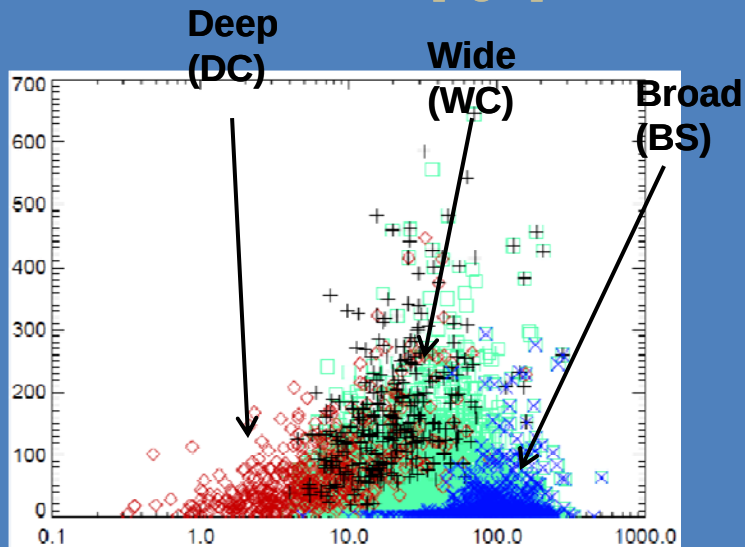
Rainfall, % convective, and echo type

Convective rain percentage



Volumetric rain [kg/s]

Number of flashes

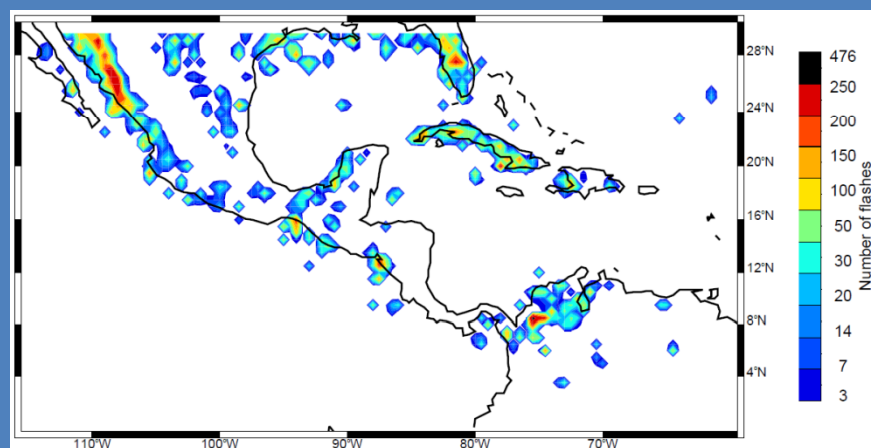


Volumetric rain [kg/s]

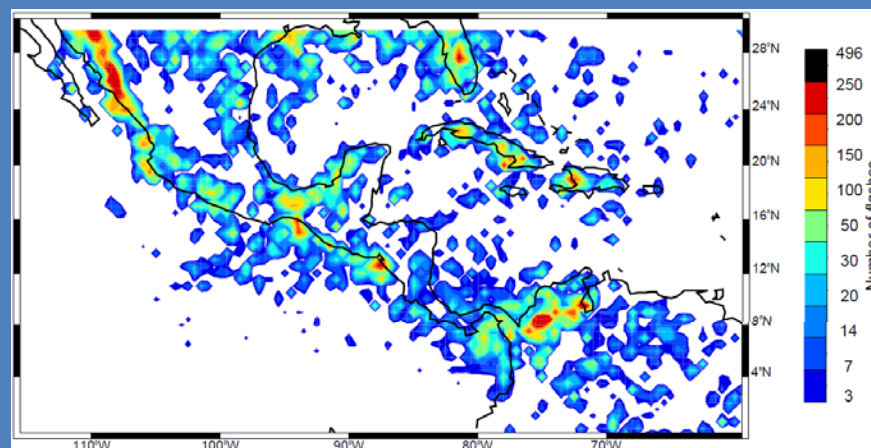
- Storms containing DC cores have very high convective rain percentage but relative low volumetric rain.
- In contrast, BS regions have low convective rain but higher volumetric rain rates.
- Most of the storms with **BS regions** have little to no lightning
- Storms containing **convective cores** are the ones that produce the most lightning

Number of Lightning flashes

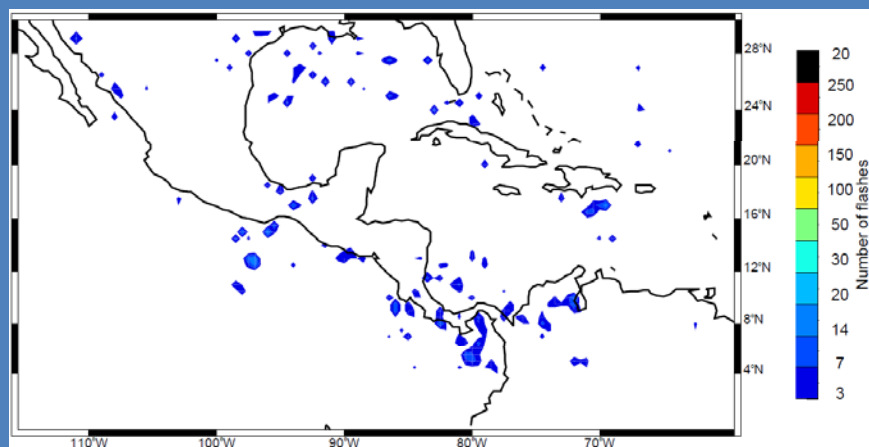
Deep Convective



Wide Convective



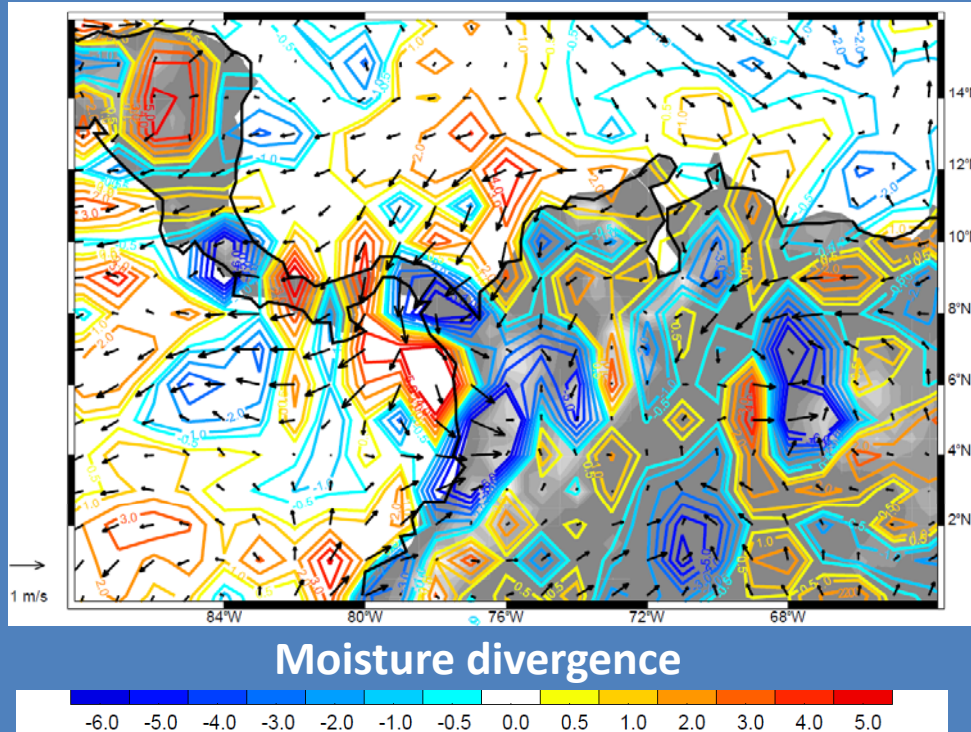
Broad Stratiform



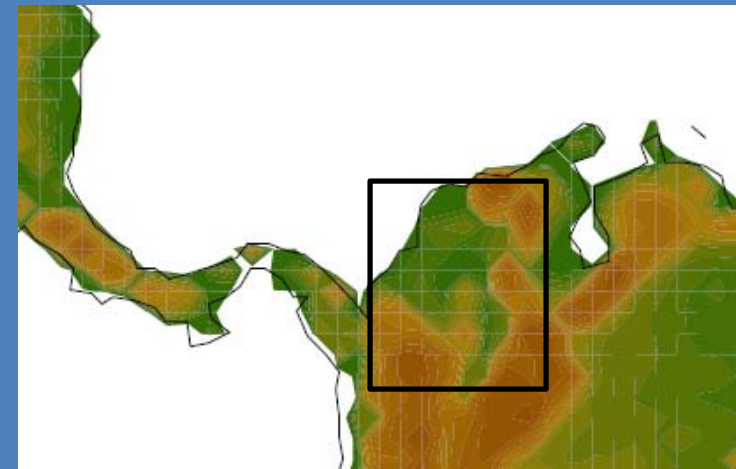
- Lightning flashes directly related with the location of Convective cores
- **WC cores** produce more lightning flashes per area
- **BS regions** produce little to no flashes

Anomaly composites for the closest hour when **DC cores** occurred over the **Bajo Cauca region**

850 hPa



Terrain elevation

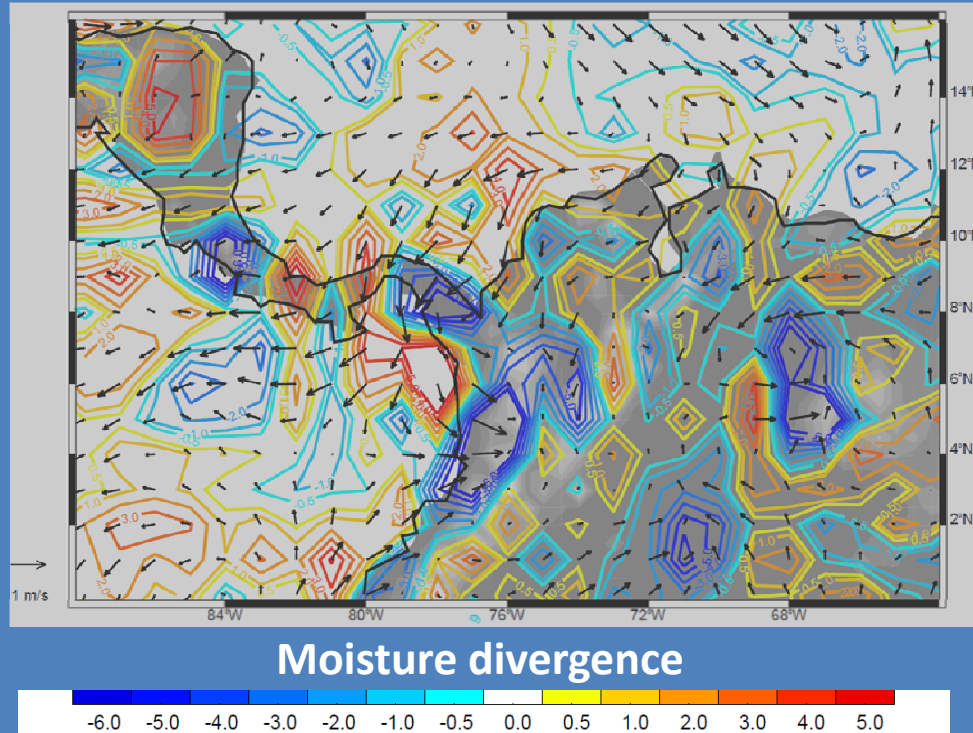


N=30 events

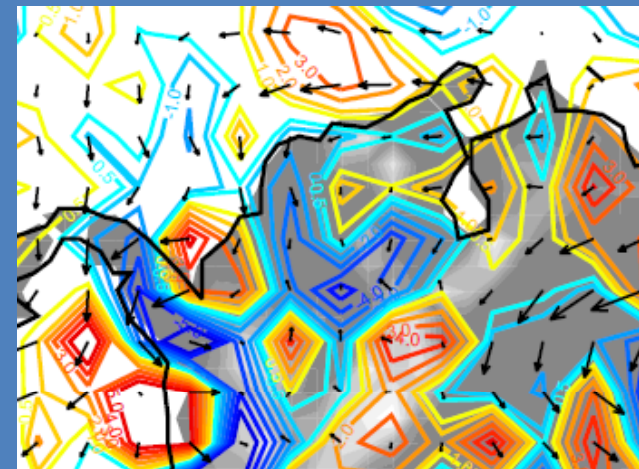
- **Anomalous northeasterly flow** converging moisture over the northern slopes of the Andes

Anomaly composites for the closest hour when
DC cores occurred over the **Bajo Cauca region**

850 hPa



850 hPa - 6 hours before

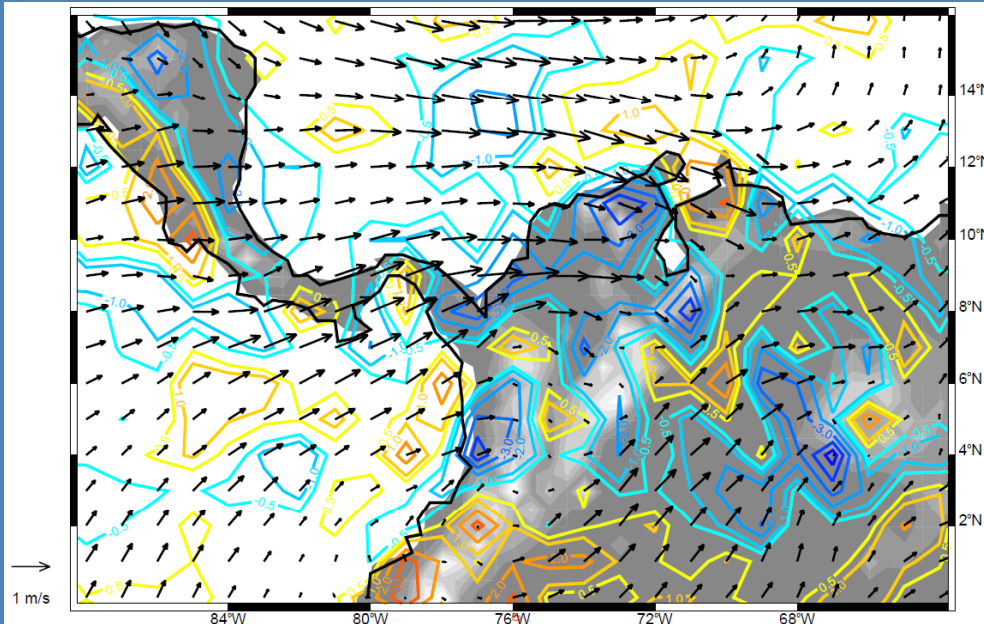


N=30 events

- **Anomalous southward flow** 6 hours before the event

Anomaly composites for the closest hour when **WC cores** occurred over **the Bajo Cauca region**

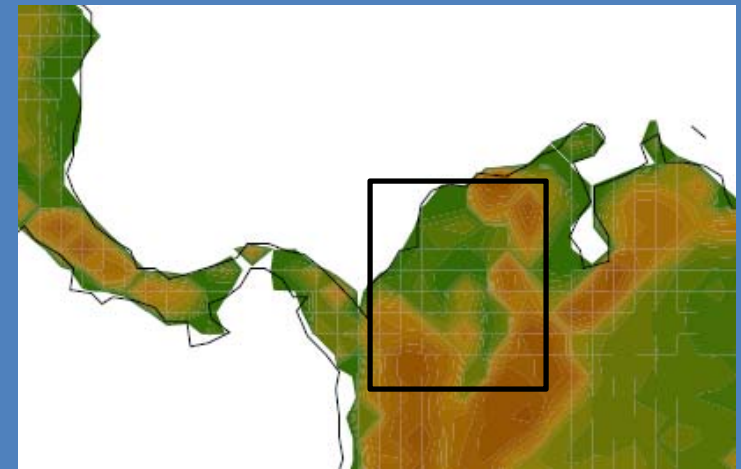
850 hPa



Moisture divergence

-6.0 -5.0 -4.0 -3.0 -2.0 -1.0 -0.5 0.0 0.5 1.0 2.0 3.0 4.0 5.0

Terrain elevation

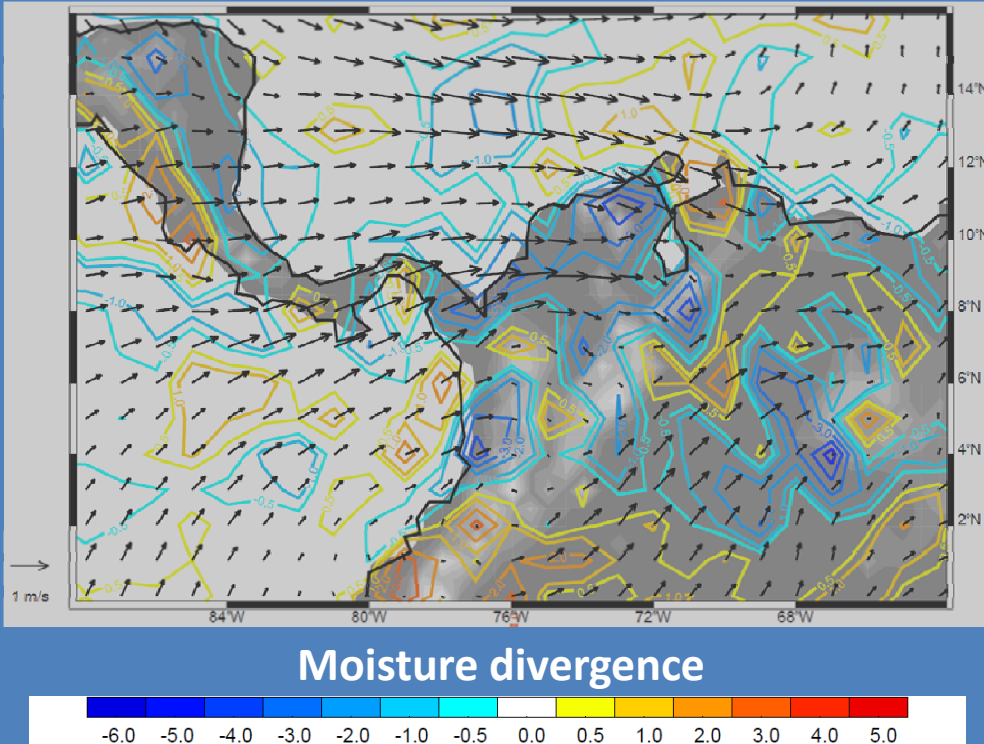


N=142 events

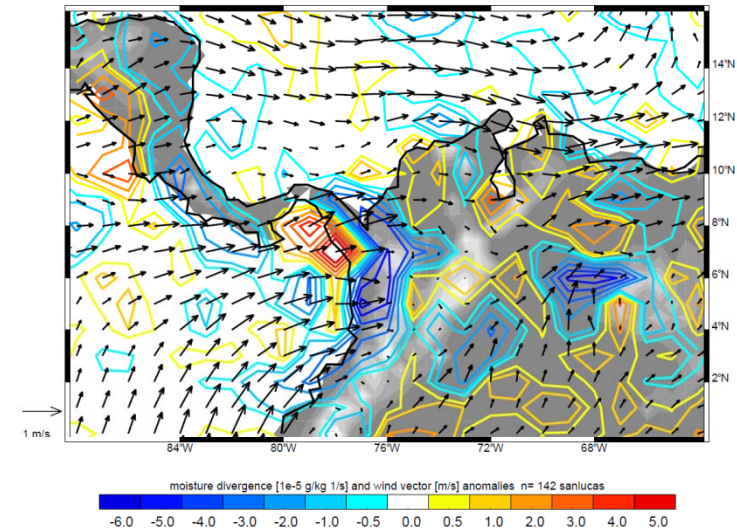
- Significant **westerly anomalous flow** converging in the low-lands of the northern fringes of the Andes.

Anomaly composites for the closest hour when **WC cores** occurred over **the Bajo Cauca region**

850 hPa



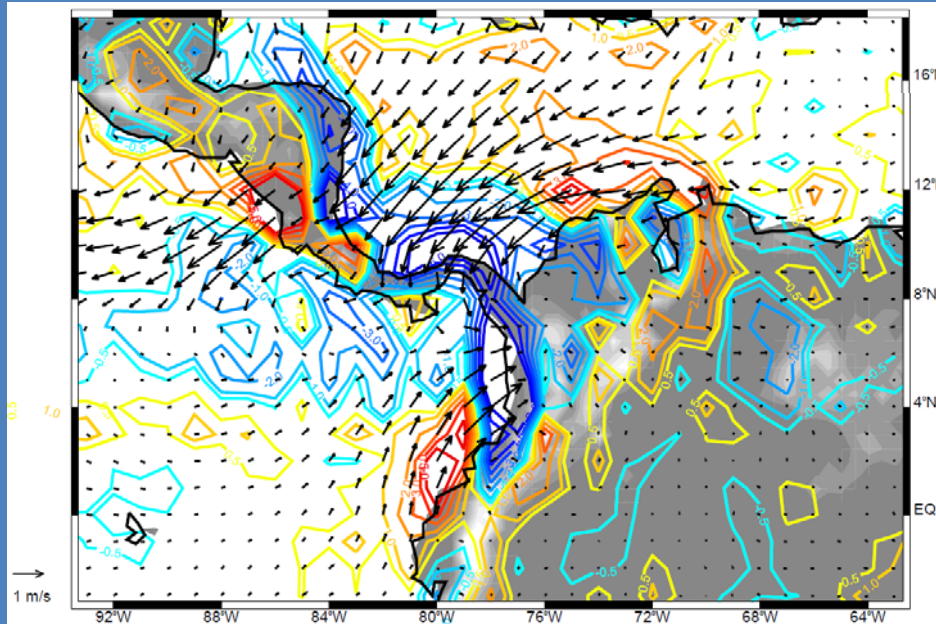
-18 hours



- Shift of convergence from Pacific coast of Colombia towards the Bajo Cauca region

Anomaly composites for days when **WC cores** occurred over **the Chocó region**

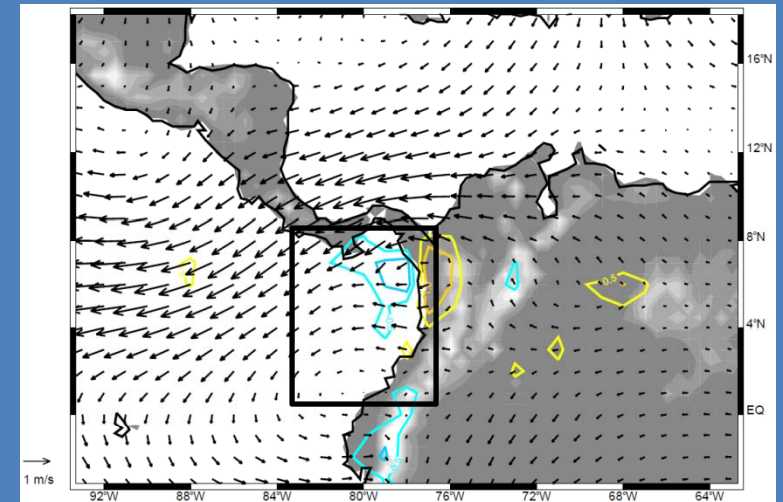
Surface



Moisture divergence

-6.0 -5.0 -4.0 -3.0 -2.0 -1.0 -0.5 0.0 0.5 1.0 2.0 3.0 4.0 5.0

500 hPa

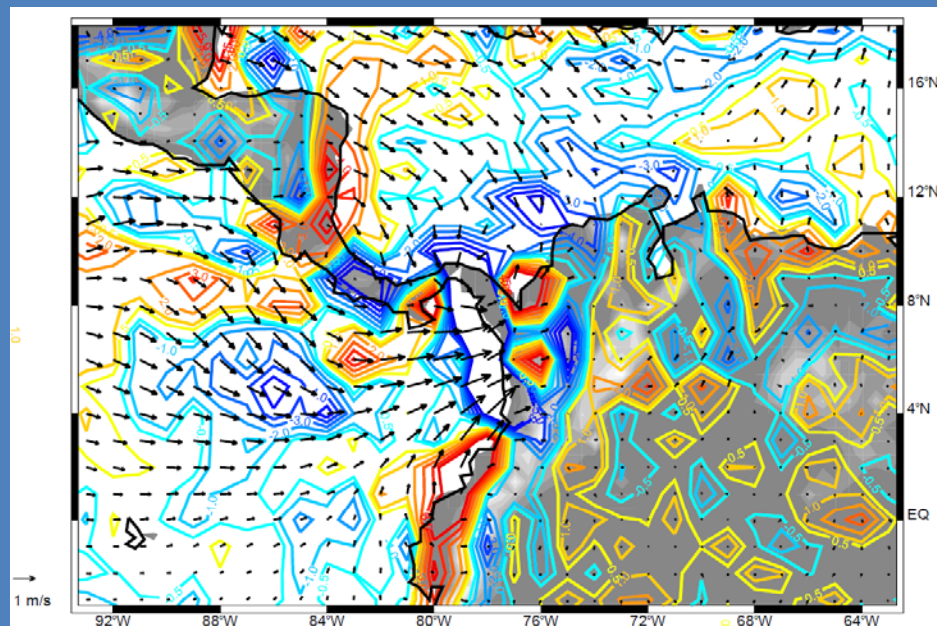


N=165 events

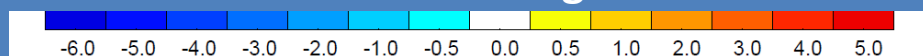
- Events occur in the confluence of recurving branch of **the Intra-Americas low level jet** from the north and **the Chocó Jet** from the south

Anomaly composites for days when **BS regions** occurred over **the Chocó region**

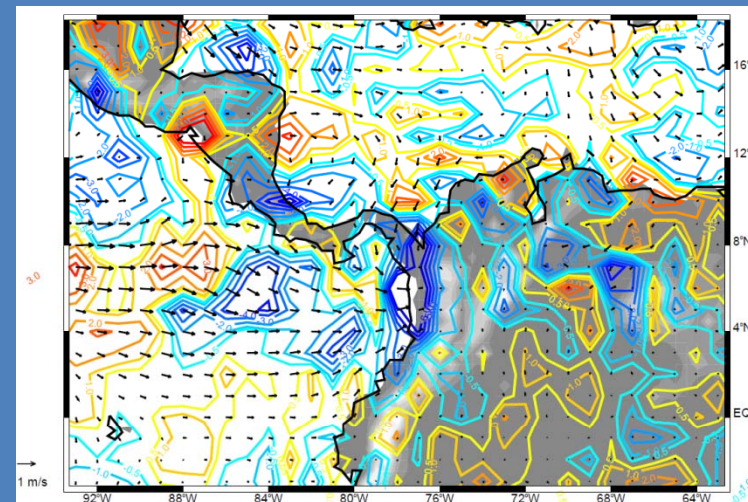
Surface



Moisture divergence



Surface previous day



N=40 events

- **Zonally oriented** anomalous flow bringing moisture from the Pacific ocean up to the coastal region.

Conclusions

- **Deep convective** cores are located only in the Bajo Cauca region, with a northeasterly flow impinging on the northern end of Los Andes range
- **Wide convective** cores are located in both, Bajo Cauca and Chocó regions, were a recurving branch of the Intra-Americas Jet and the intensification of the Chocó low-level jet concentrate moisture on the west side of Los Andes range
- **Broad stratiform** regions are located mainly over the coast of Colombia and Panamá, region were the Chocó low-level jet runs against the west side of the Los Andes and is enhanced by westerly flow of the ITCZ winds

This research was supported by NASA grant NNX10AH70G AND NSF grant ATM-0820586

