Role of Caribbean low-level jet and Choco jet in the patterns of atmospheric moisture transport towards Central America

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Introduction

Regional characteristics such as **high rate of evaporation**

+

Development of low-level jets (LLJs)+ topography + other regional factors

↓

Regional climate

↓

Relevant condition to the main **economic activities** like **agriculture**

Interannual variability

↓

Extreme events

↓

Large **economic losses** associated with **hydrometeorological** phenomena

Objectives

General

- To analyze the seasonal patterns of water vapor transport to Central America and their interannual variability, with special emphasis on the role of the Caribbean low-level jet (CLLJ) and the Choco jet (CJ).

Specific

- To identify the possible changes observed in the transport patterns from these sources in the face of interannual climate variability events, such as ENSO.

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What has been done before?

Moisture sources for Central America: Identification of moisture sources using a Lagrangian analysis technique

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Role of moisture transport for Central American precipitation

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Variability of the Caribbean Low-Level Jet and its relations to climate

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The Intra-Americas Sea Low-level Jet

Overview and Future Research

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Model

Dynamic Recycling Model (DRM):

- Semi-Lagrangian 2D Model
- Based on the principle of mass conservation
- Used to estimate exchange of moisture from different sources

Assumption:
Well-mixed atmosphere

Input Data:

- Evaporation
- Precipitable Water
- Precipitation
- Vertical Integrated of Moisture Flux (VIMF)

Data Set:

ERA-Interim data to 0.75°
From 1980 to 2012

Additional data for analyses:

Caribbean low-level jet index (ICLLJ), Choco jet index (ICJ) and Oceanic Niño Index (ONI)

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Study Area

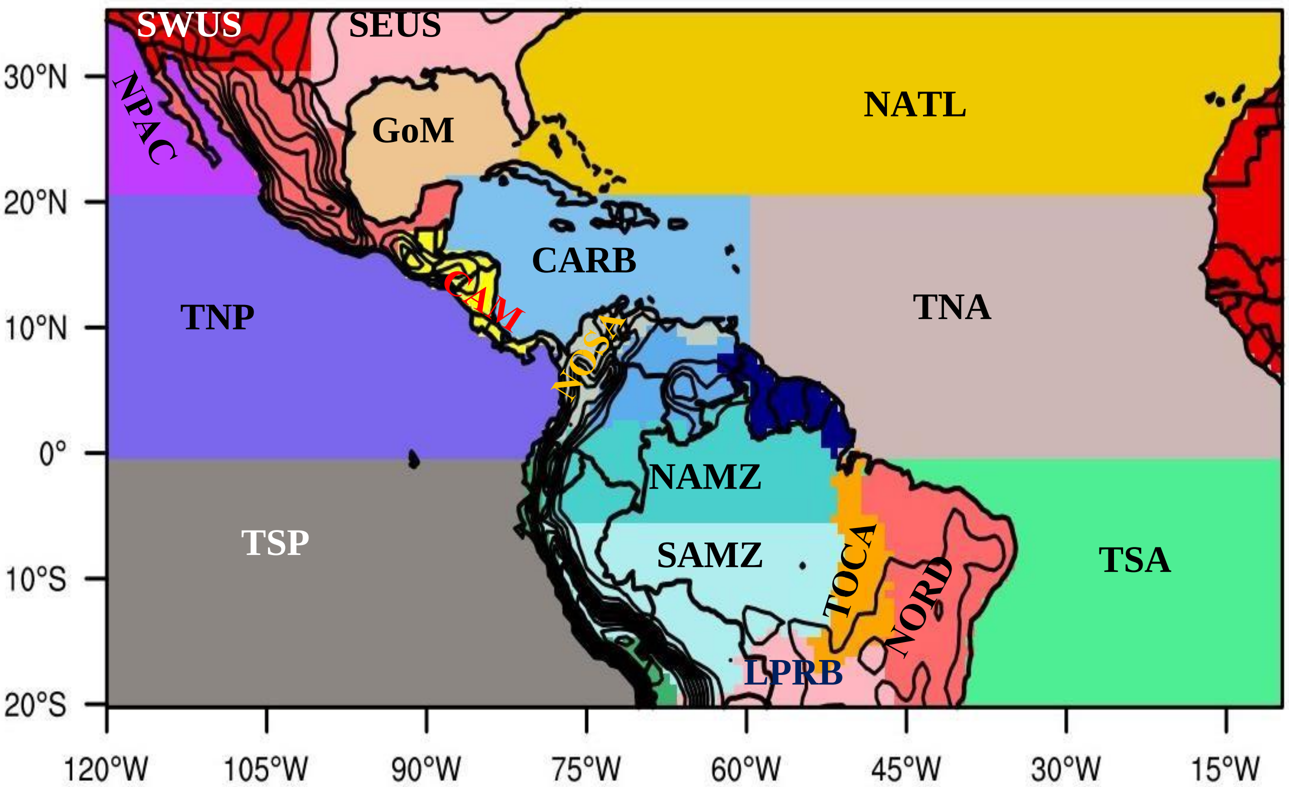

Figure 1. Region of study. Regions considered as possible moisture sources to Central America domain. The contours represent the topography over the region of study from ERA-Interim data.

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Precipitable water climatology

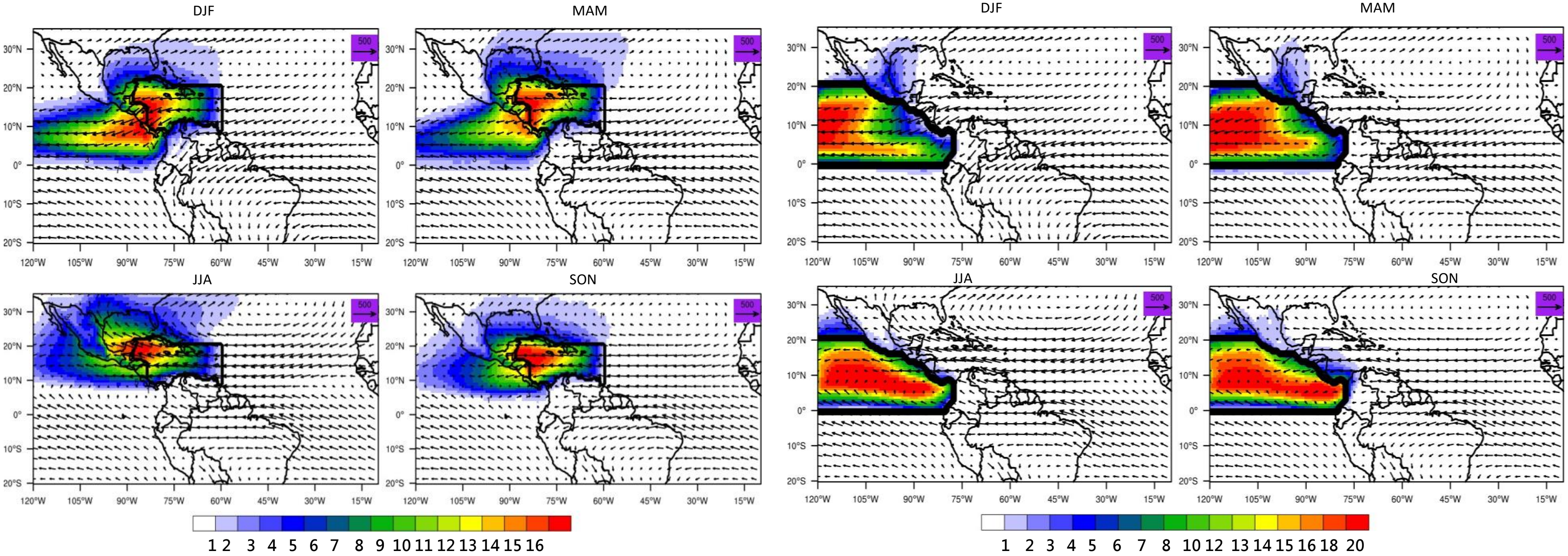

Figure 2. Seasonal patterns contributions of precipitable water (mm) for 1980–2012 (shaded contours) from CARB (left) and from TNP (right). Vectors represent the VIMF.

There is a marked seasonality in the transport form both CARB and TNP to CAM, related to LLJs

Precipitable water climatology

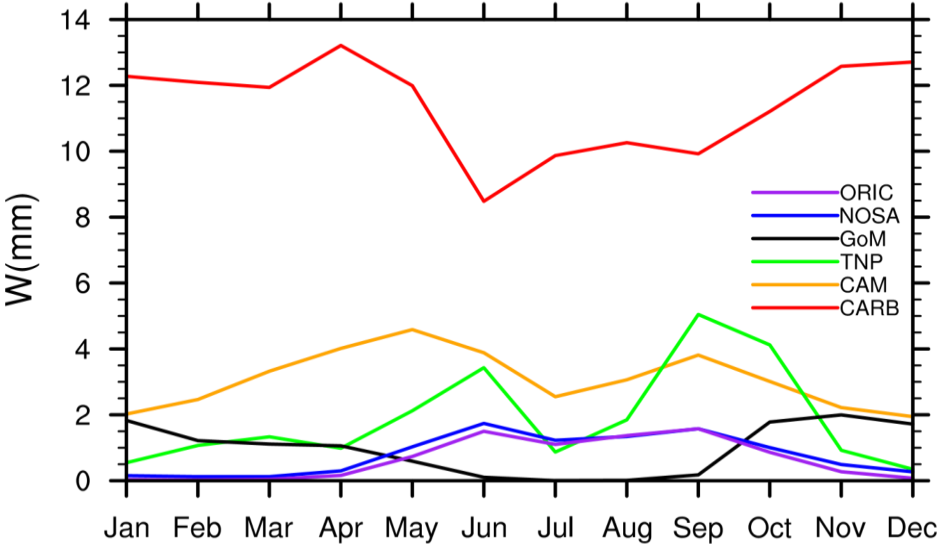

Figure 3. Mean annual cycle of contributions to precipitable water (W) over the CAM from the main sources (CARB, CAM, TNP, GoM, NOSA and ORIC).

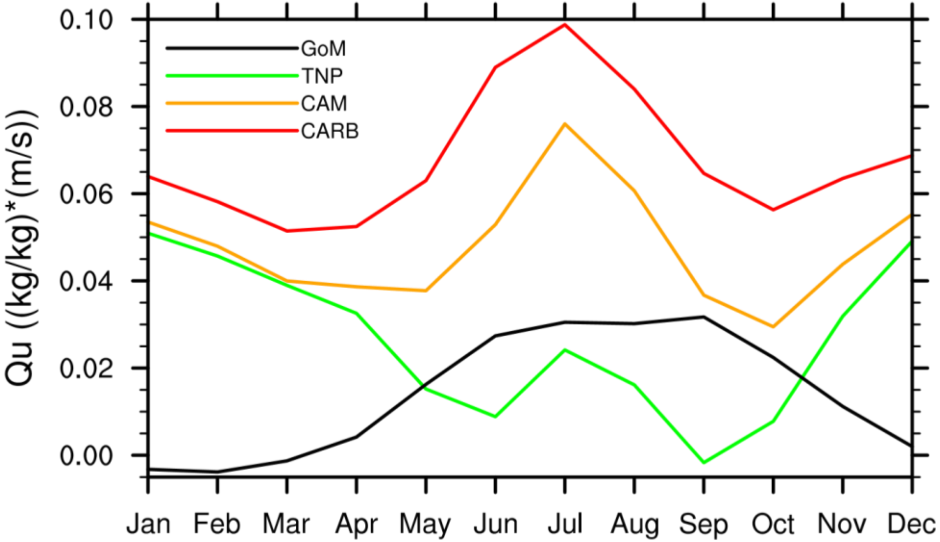

Figure 4. Mean annual cycle of vertical shear of moisture flux over the analyzed subregions (CARB, CAM, TNP y GoM).

Biases associated to high values of the vertical shear of moisture flux (VSMF) in the transport from CARB to CAM and recycling over CAM.

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Interannual variability associated to CLLJ and the CJ

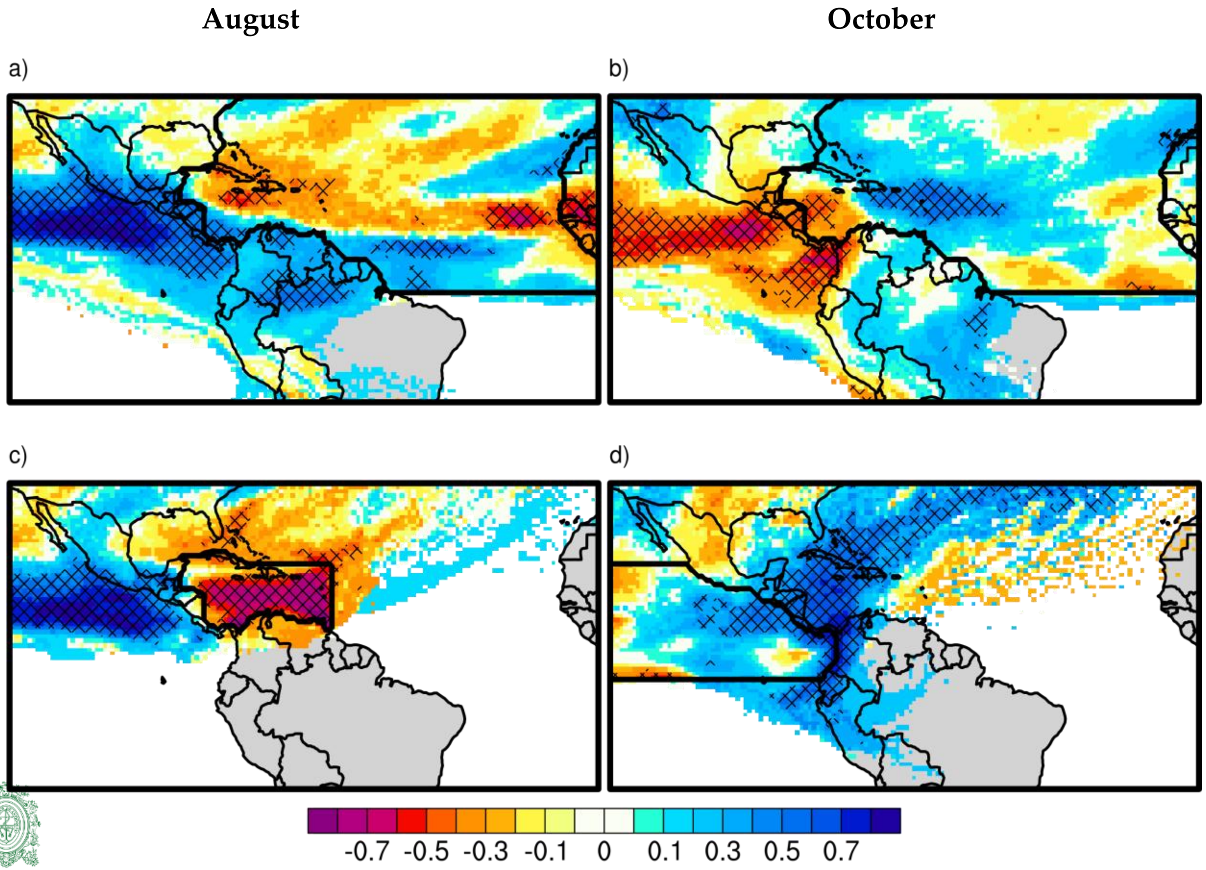

Figure 5. Correlation between the ICLLJ and moisture transport from Atlantic (a) and CARB (c) for August. Correlation between the ICJ and moisture transport from Atlantic (b) and TNP (d) for October.

Interannual variability associated to ENSO

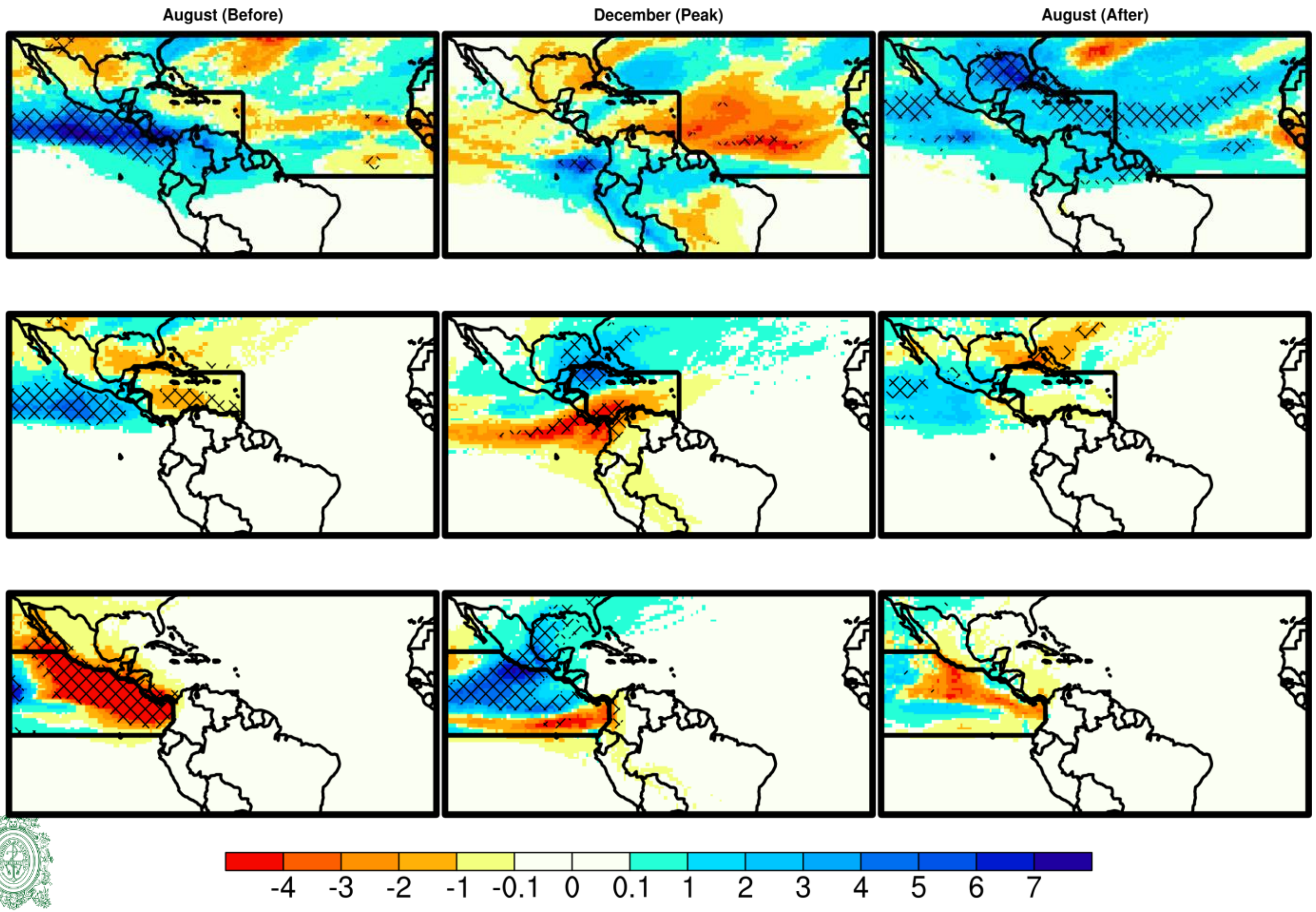

Figure 6. Composites of differences in moisture transport (mm/day) to CAM during El Niño and La Niña: from the Atlantic (top), the Caribbean (middle) and the TNP (lower panel).

The influences of the ENSO evolution is evident in the pattern of moisture transport from these source regions.

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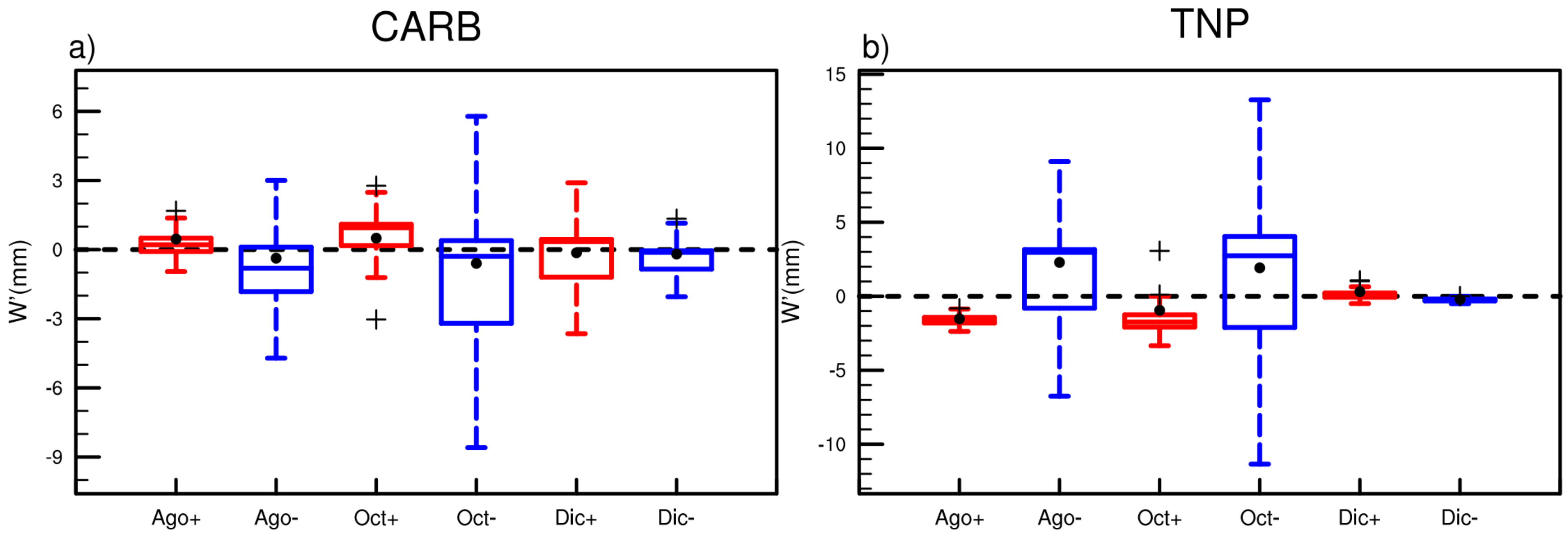

Figure 7. Composites of anomalies of the contribution to monthly precipitable water (mm) over the CAM by CARB (left) and TNP (right) during the extreme phases of ENSO. The plus (minus) sign denotes the positive (negative) phase of ENSO.

There is more variability during La Niña phase, and this variability is larger for the transport of moisture from the TNP compared to CARB.

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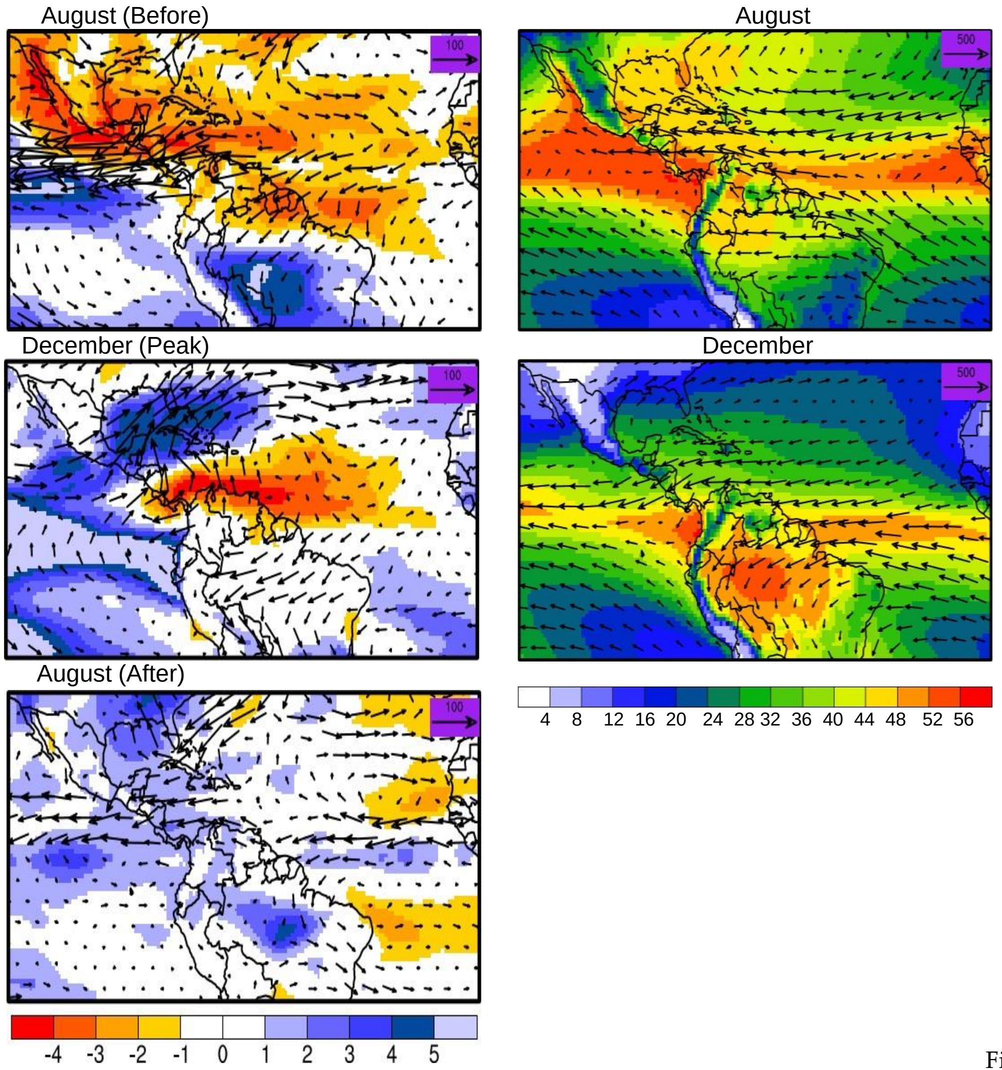

Figure 8. Composites of differences in VIMF (Vectors) and W (shaded contours, mm) during El Niño and La Niña (Left column). Climatology of VIMF and W (mm) for 1980–2012 during August and December, including El Niño, La Niña and neutral years (right column).

Relationship between transport of moisture from different sources during ENSO and the VIMF field.

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Conclusions

- The Caribbean Sea is the largest contributor of moisture to Central America during the year, with an annual variation modulated by the Caribbean low-level jet dynamics.
- Moisture from sources such as northern South America and Gulf of Mexico is relevant for the Central America. Given the period in which they develop their large contribution.
- Despite the biases that present DRM related to the wind shear, DRM is able to capture the interannual variability associated to both low-level jet and ENSO.
- An anomalously strong (weak) Caribbean low-level jet induce a higher (lower) transport from Atlantic to Central America.

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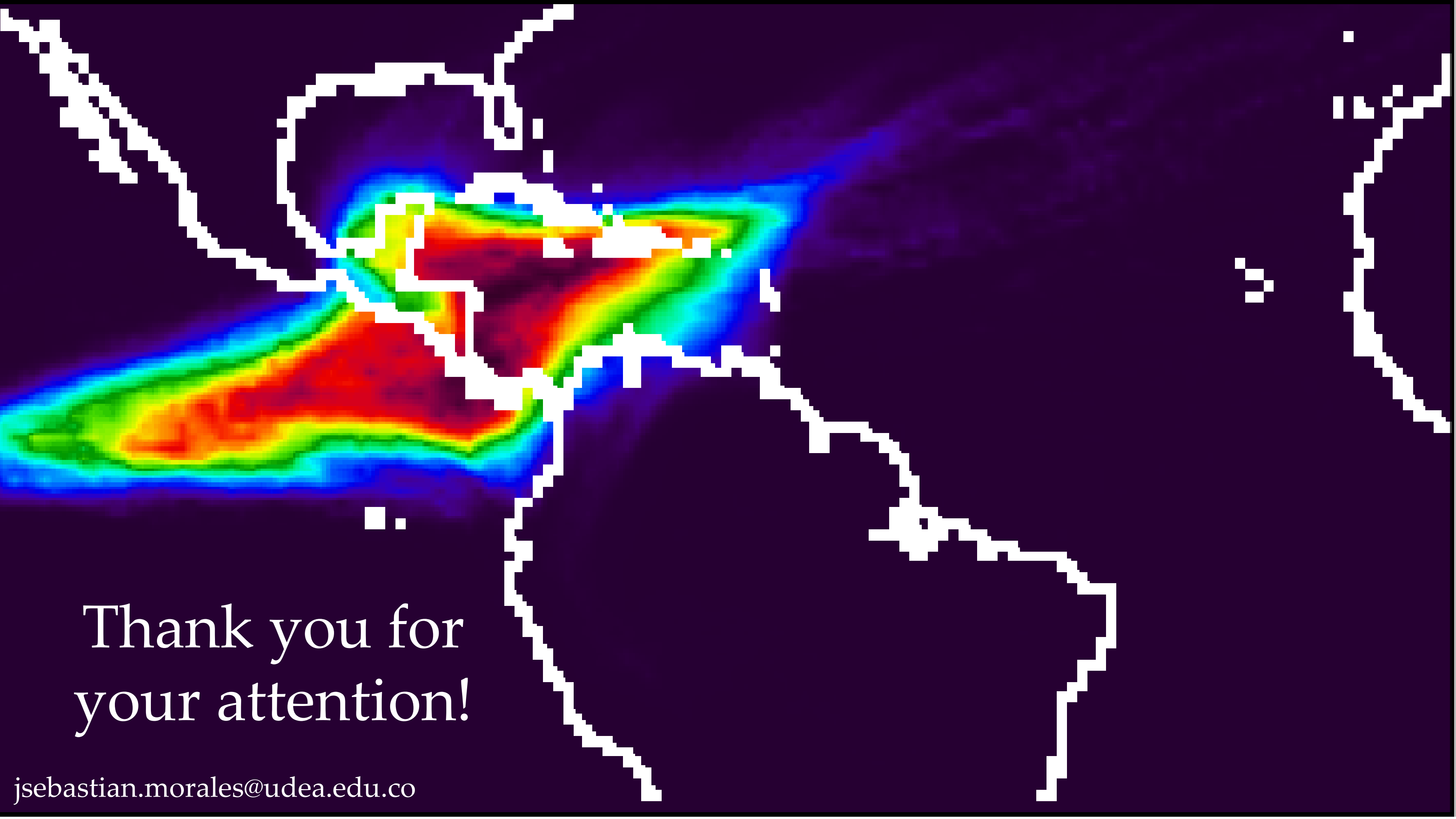
- An anomalously strong Choco jet induces a higher (lower) transport from the Pacific (Atlantic) to Central America during October.

- The transport of moisture from the Atlantic, Caribbean Sea and Tropical North Pacific presents a high response to the annual cycle of evolution of the ENSO.


Thank you for your attention!
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