Estimating Decadal Changes in the South American Low Level Jet

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1. Introduction

Rainfall in the Amazon region is seasonal, particularly in the southwest region. In the northern regions, there tends to be more consistent rain throughout the year, but in the southwestern region, there is a dry season from June to October (Coe et al., 2016). The precipitation in the southwest region is primarily driven by the Low Level Jet, which transports moisture from the Atlantic Ocean to the southwestern Amazon region near the Andes mountain range (Jiménez-Sánchez et al., 2019). The carbon storage in this region is strongly dependent on the precipitation.

2. Motivation and Objectives

In the last 10 to 15 years, we have seen a decrease in precipitation in the southwest Amazon. We investigate the changes in moisture and wind velocity in this region. There are concerns with how the low level jet has changed over time and we want to determine what is causing this change.

3. Data

We use data from the ERA5 reanalysis dataset from the European Center for Medium-Range Weather Forecasts (ECMWF) (Hersbach et al., 2020). We focus on data from 1980 to 2022 for specific humidity, horizontal wind velocity, temperature, vertical velocity, and geopotential height.

Result 1: Climatological Low-level Jet and Specific Humidity

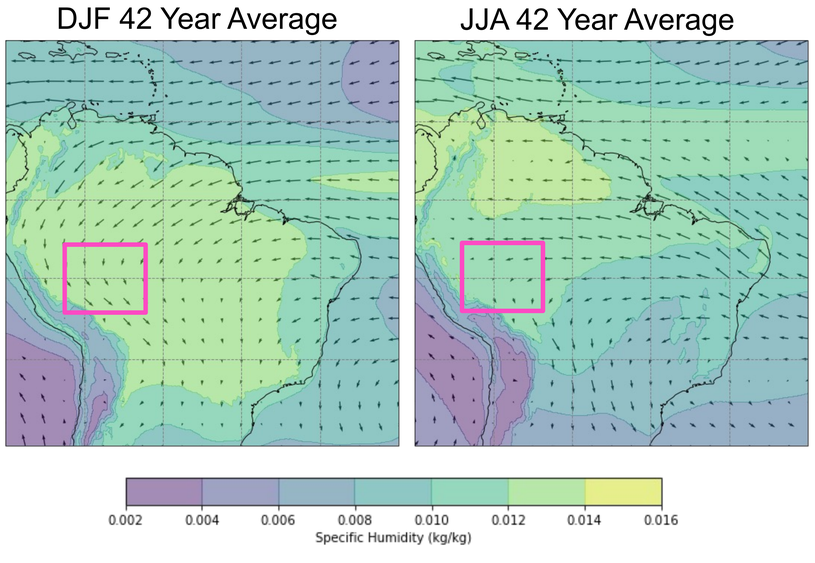

Figure 1: Climatological 850 hPa horizontal wind vectors and specific humidity for December, January and February (DJF, left), and June, July and August (JJA, right) from 1980-2022. Magenta box identifies the Southwest Amazon region.

Result 2: Decadal Changes in Specific Humidity and Wind Fields

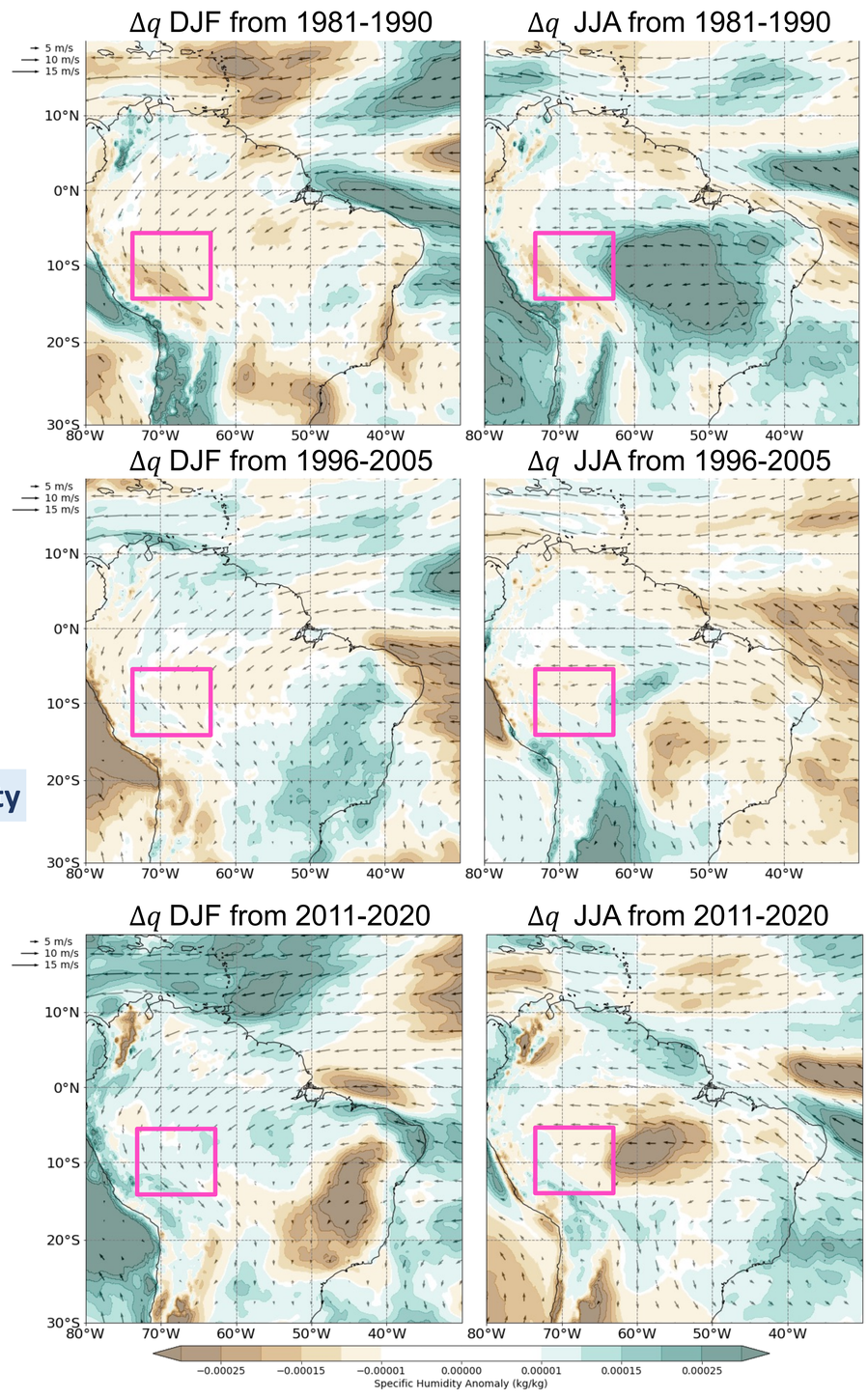

Figure 2: Decadal averaged horizontal wind vectors and anomalies of specific humidity at 850 hPa for seasonal changes (DJF and JJA) for: 1981-1990, 1996-2005, and 2011-2020 with respect to the 1980-2022 climatology.

4. Methods

We estimate the 42 year monthly and yearly averages for specific humidity, and both the u (East-West) and v (North-South) components of horizontal wind velocity. We are then calculating the 10-year averages for specific humidity, and the u and v components for horizontal wind velocity from 1981-1990, 1996-2005 and 2011-2020, as well as the specific humidity anomalies between the decadal averages and the 42-year average.

5. Results and Conclusions

We identified a difference between the decadal averages and the 42-year climatological average specific humidity. Based on previous work in the southwest Amazon, we focused respectively on DJF and JJA as the rainy and dry periods. Using the ERA5 data, in Figure 1, we identify that during DJF, most of the Amazon basin has higher specific humidity, with the exception of the northwestern portion. In Figure 2, in DJF, we estimate that specific humidity, q, has increased in the southwestern portion of the Amazon, while it has decreased in JJA. This suggests that the kinematic advection of q has increased during the rainy season, while there has been a decrease during the dry season.

6. References

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