A21B-03. Connections between the Intertropical Convergence Zone and other climatic features in Central America.

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ABSTRACT

This work explores statistical connections between the displacements and strength of the Intertropical Convergence Zone (ITCZ) and the Caribbean Low Level Jet (CLLJ). Indicators of the position and of the strength of the ITCZ include the latitude (LATC) and longitude (LONC) of the center of mass of precipitation and the domain precipitation (Pdomain) in a region bounded by coordinates -10 and 25 degrees latitude and -100 and -55 degrees longitude, respectively. Preliminary analyses show that there is a strong correlation (0.82) between summer (JJA) LATC and JJA CLLJ index, and this correlation is lower in other seasons (0.63 for Autumn, 0.20 for Winter and 0.49 for Spring). These correlations were verified in the zonal wind composites at 925 hPa for the 5 lowest and 5 highest years of LATC. LONC does not seem to have the same strong relationship with the CLLJ. At daily level, composites show precipitation in the Central America region is influenced by Pdomain, LATC, CLLJ index, and to a less extent to LONC. Composites of Sea Surface Temperature for the 5 years of highest and lowest LATC show some relationship with ENSO, although there is a disproportionate influence of the 1997-98 El Niño that may be affecting the results. There is however a consistent feature: during years of high LATC, there are warm anomalies in the tropical Atlantic off the coast of Venezuela, that are not present during years of low LATC.

INDEXING THE INTERTROPICAL CONVERGENCE ZONE (ITCZ) AND THE CARIBBEAN LOW LEVEL JET (CLLJ).

Two particular climatic features of the Interamerican Seas that are of particular importance in this poster are: 1) The Intertropical Convergence Zone (ITCZ), which is the area encircling the earth near the equator where the northeast and southeast trade winds come together defining a precipitation maximum; and 2) a maximum of easterly zonal wind (larger than 13 m/s) that is observed in the lower troposphere of the Caribbean (about 925 hPa) during the summer, called the Caribbean Low Level Jet (CLLJ) (Amador 1998; 2008; Amador and Magaña 1999; ; Mo et al. 2005; Poveda et al. 2006).

In order to index the displacements and magnitude of the ITCZ, precipitation data from the Global Precipitation Climatological Project (GPCP) from 1979 to 2010 at a monthly temporal resolution and at a spatial resolution of 2.5 x 2.5 degrees was used. A domain of interest covering the center of action of the ITCZ over the Central American region and northern South America was extracted from the global domain (Figure 1). This region is bounded by coordinates -10 and 25 degrees latitude and -100 and -55 degrees longitude. For each month, three indexes were computed from the data : 1) Pdomain = average precipitation for the entire domain, 2) LATC = latitude of the center of mass of precipitation, and 3) LONC = longitude of the center of mass of precipitation. The 1979-2011 climatology for these indexes are shown on Figure 2.

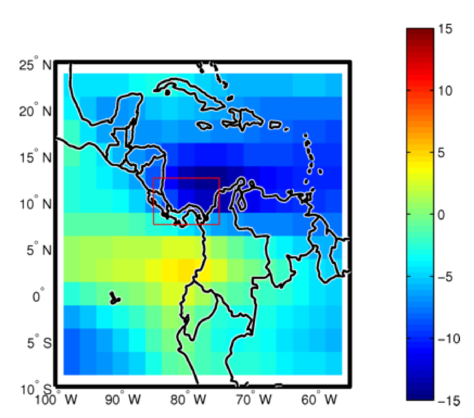

Figure 1. Domain for the calculation of ITCZ indexes (outermost domain) and domain for the calculation of the CLLJ index (red box). The color shading represents the U925hPa average (m/s) during July. Negative (positive) values speeds are correspond to easterly (westerly) winds.

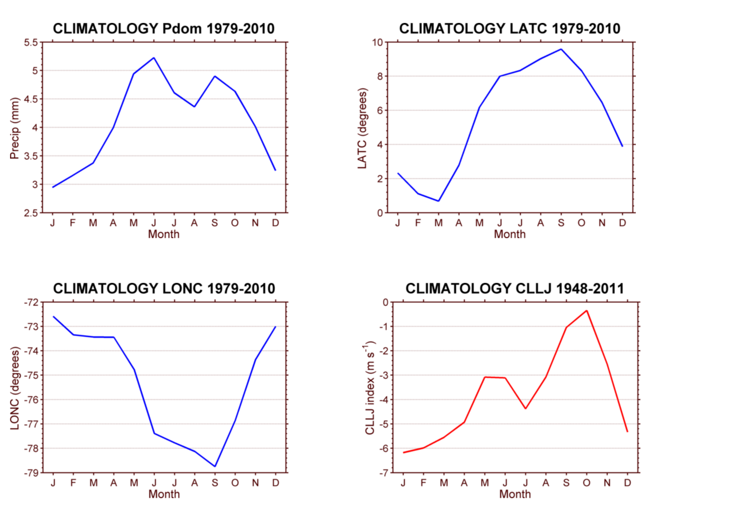

Figure 2. Climatologies of ITCZ indexes (blue) and of the CLLJ index (red).

In a similar fashion the Caribbean Low Level Jet Index was defined using the average zonal wind velocity at 925 hPa (U925hPa) over a region bounded by 7.5 and 12.5 degrees latitude and -85 and -75 degrees longitude. The climatology of the CLLJ index is shown in Figure 2.

RELATIONSHIP BETWEEN THE CENTRAL LATITUDE OF ITCZ (LATC) AND THE CARIBBEAN LOW LEVEL JET (CLLJ).

The correlation between LATC and CLLJ for different seasons is shown in Table 1.

Table 1. Correlations between seasonal averages of LATC and CLLJ

corr	1980-2010	DEF	CLLJ	y	LATC	=	0.2023
corr	1979-2010	MAM	CLLJ	y	LATC	=	0.48761
corr	1979-2010	**JJA**	CLLJ	y	LATC	=	**0.8264**
corr	1979-2010	SON	CLLJ	y	LATC	=	0.63269

As can be seen there is a strong association between summer LATC and CLLJ (Figure 3). In fact, a map of the JJA correlations between LATC and precipitation in Central America (Pca) or CLLJ and Pca show very similar patterns (Figure 4). Significant correlations are seen in other seasons too, but the summer correlation are the strongest.

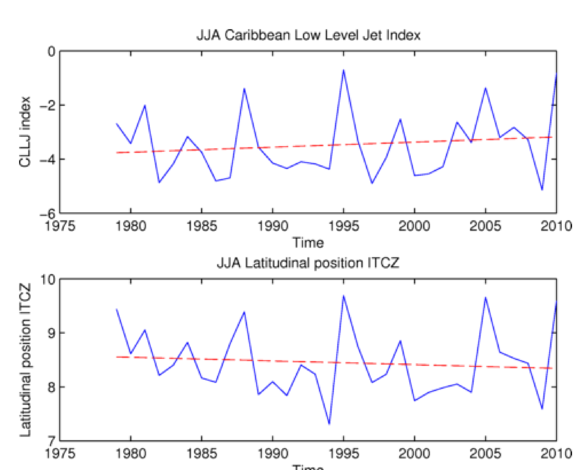

Figure 3. JJA time series of CLLJ index and LATC.

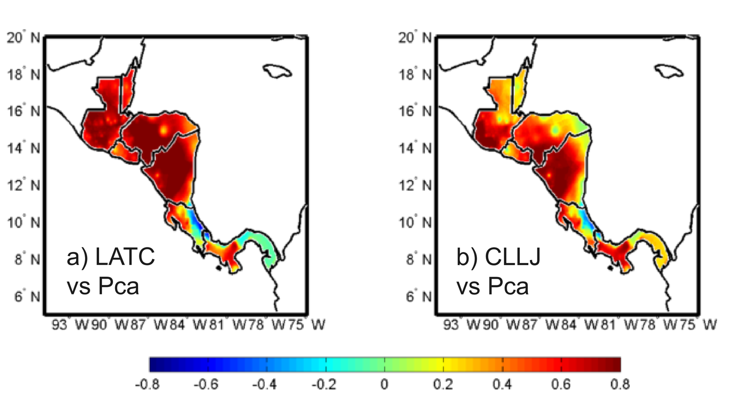

Figure 4. JJA correlations between: a) LATC and Central American precipitation (Pca), and b) CLLJ and Pca.

CLIMATE COMPOSITES DURING YEARS OF HIGH AND LOW LATC.

The correlations found before were explored using composites for the five years of lowest LATC and the five years of the highest LATC (Figure 5).

LOW LATC 1989, 1991, 1994, 2000, 2009 — **HIGH LATC** 1979, 1988, 1995, 2005, 2010

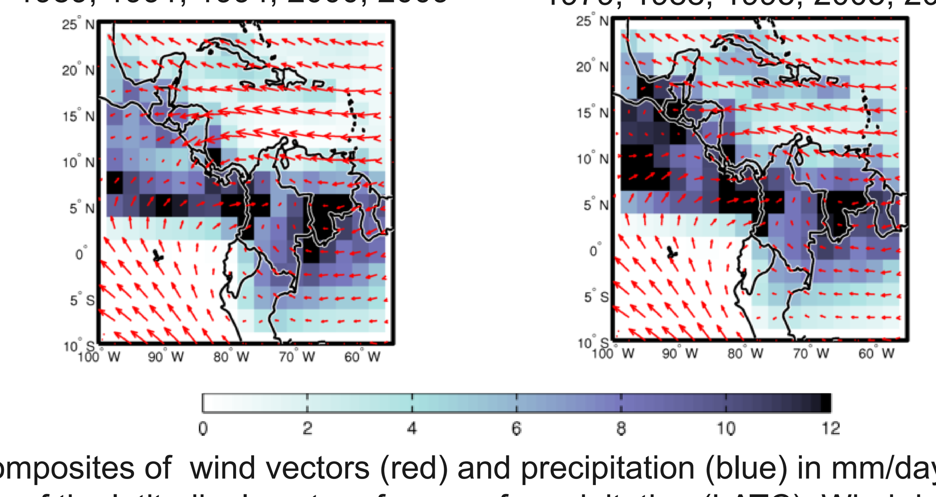

Figure 5. Composites of wind vectors (red) and precipitation (blue) in mm/day for the 5 lowest and 5 highest years of the latitudinal center of mass of precipitation (LATC). Wind data from NCEP/NCAR reanalysis (Kalnay et al. 1996) and precipitation data from GPCP. Selected years from 1979 to 2010.

Flow through Central America from the Caribbean (i.e. a stronger jet) seems to be promoted during years of low LATC due to reinforcement of the winds by the center of convection just south of the CLLJ core. During years of high LATC although the mechanism is less clear, stronger winds in the Caribbean and the Pacific are still forced to the convection center but these winds are located in a more northern position compared to the jet and thus the jet is weaker without the influence of the ITCZ.

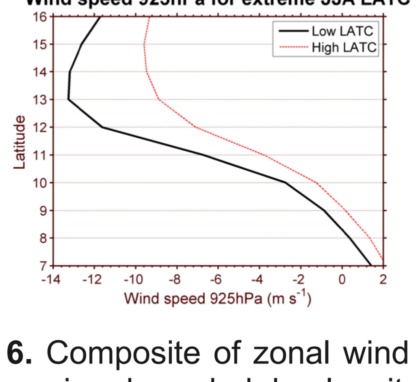

Figure 6. Composite of zonal wind speed (m s^{-1}) from a region bounded by longitudes 81°W to 75°W for the 5 highest and 5 lowest cases years of LATC. Wind data from ERA-Interim, and precipitation parameters from GPCP. Data from 1979 to 2010.

Zonal wind composites for a region bounded by longitudes 81°W and 75°W for opposite extreme LATC conditions show a definite difference in the wind speed for both conditions (Figure 6). Such difference is also found with less strength during SON, but it is not found in the other seasons (not shown). The larger difference in the jet is at latitude close to 13 °N, which is in the northern border of where we defined the CLLJ index (Figure 1). Defining a CCLJ index in a more northern position (following Whyte et al. (2008) for example) does not affect significantly the results (not shown).

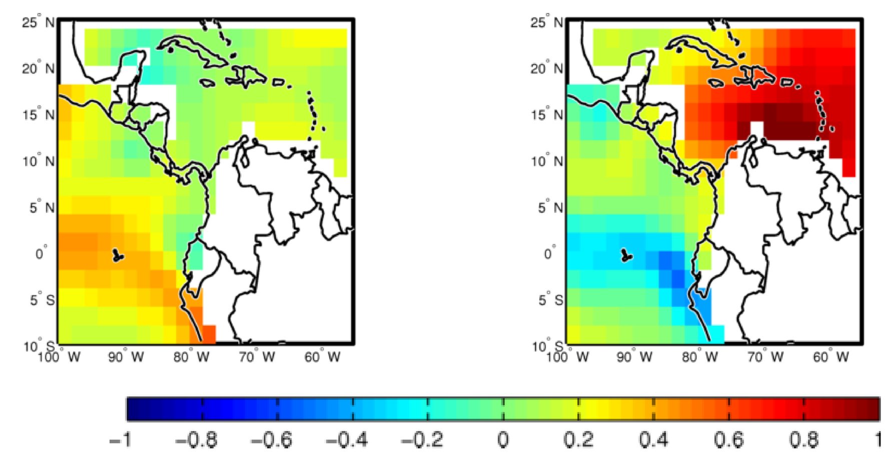

Figure 6. Composite of sea surface temperature (SST) anomalies (°C) for the 5 highest and 5 lowest cases years of LATC. SST data from Reynolds (1988), and precipitation parameters from GPCP. Data analyzed from 1979 to 2010.

As can be seen, SSTa (SST anomalies) in the Niño1.2 region appears to be correlated with LATC, but in fact the correlation is weak (r=-0.14), meaning that perhaps one or a few ENSO events are dominating the anomalies in the composites. In years of high LATC there is a tendency for warm SSTa to be present in the Caribbean Basin, off the coast of Venezuela. In cases of low LATC there are no anomalies registered in the same region.

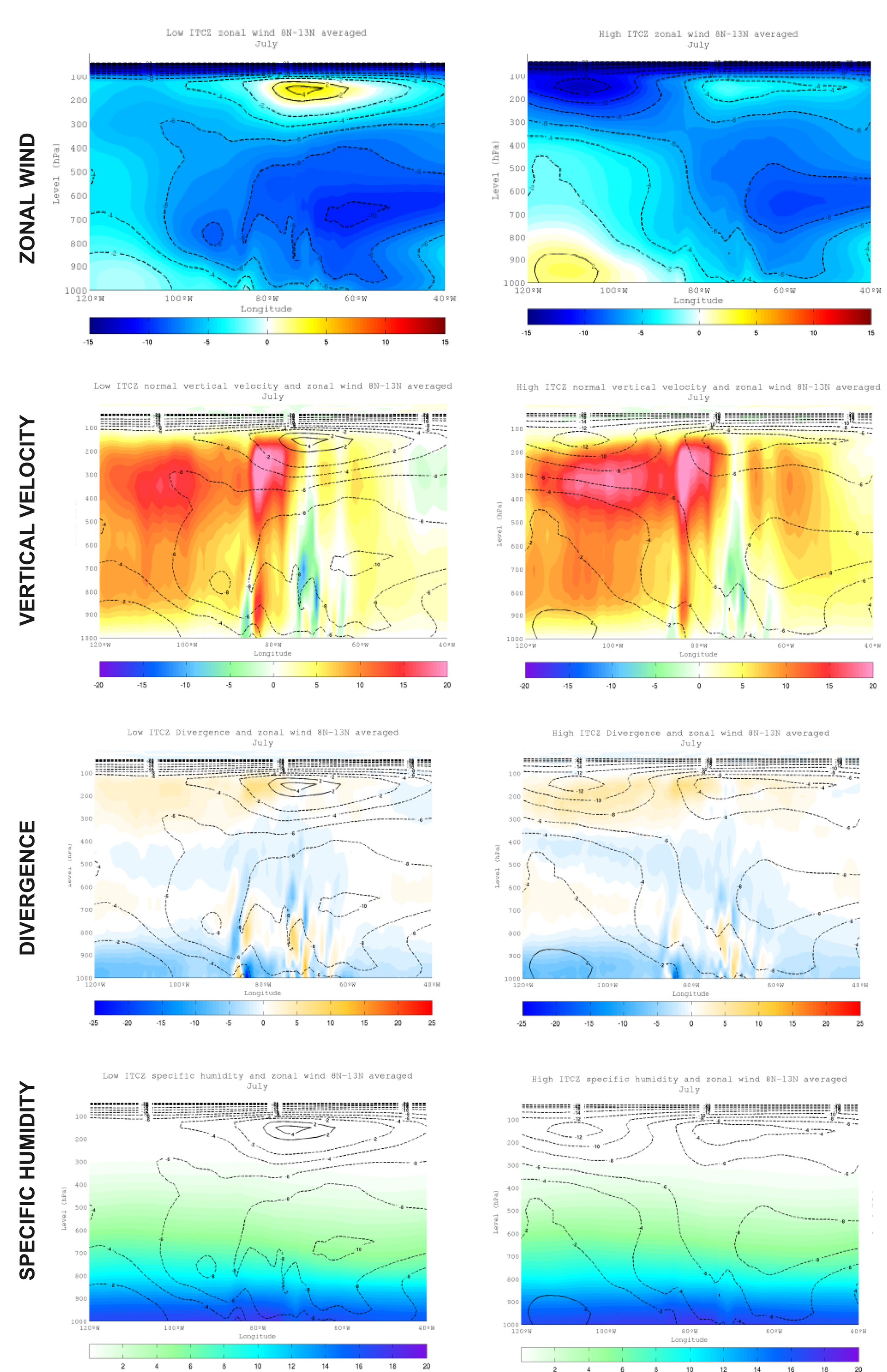

Figure 7. July composites of zonal wind, vertical velocity, divergence and specific humidity for a band covering 8°N to 13°N for the 5 years of lowest and highest LATC. The shading colors represent the values of the variable examined and the contours always represent the zonal wind.

Figure 7 shows composites for different conditions of LATC for a band covering latitudes 8°N to 13°N. As can be seen the penetration of the CLLJ occurs during years of low LATC (due to a stronger CLLJ), while during the years of high LATC there is even westerly flow in the western border of the plot. There seem to be little differentiation according to LATC in the other variables in terms of what is happening in the lower levels. In Figure 8 the relative position of the Western Hemisphere Warm Pool (WHWP) position is shown along with monthly precipitation data from GPCPfor opposite conditions of LATC. As can be seen the WHWP is lower and larger in the tropical Atlantic during years of high LATC compared to the low LATC conditions, which is consistent with the SST patterns of Figure 6.

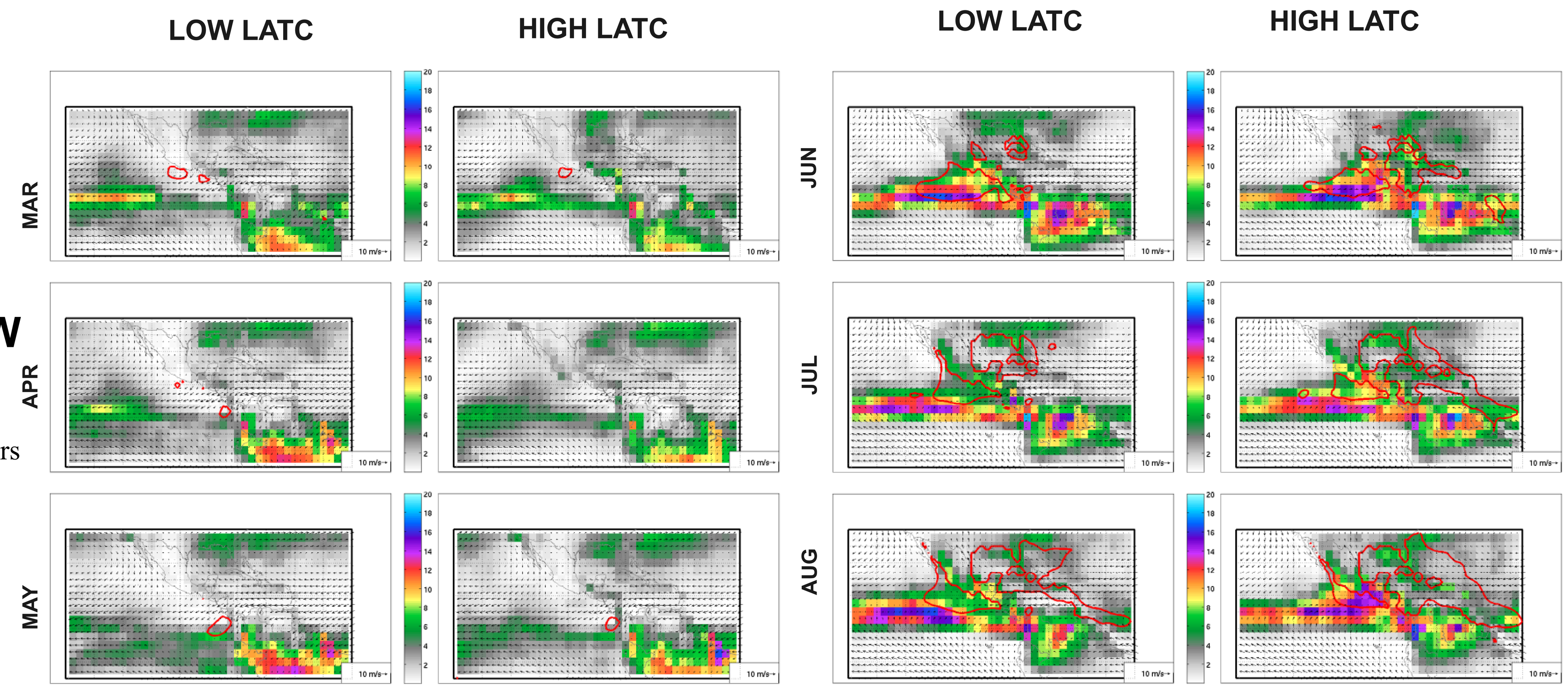

Figure 8: Composites of the monthly averaged PCP and 925 hPa wind vector composites for 5 maximum cases of Low (left) and High (right) ITCZ LATC position for the 1979-2011 period using ERA Interim monthly means 1 degree of horizontal resolution, precipitation from GPCP with 2.5 horizontal resolution. Black contour for 28.5 isoterm indicates the area enclosed by the WHWP.

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