Possible mechanisms responsible for strengthening and weakening the monthly mean Subtropical Jet over South America during the austral winter

Pablo Luis Antico and Guillermo Jorge Berri

Department of Atmospheric and Oceanic Sciences, University of Buenos Aires
National Research Council of Argentina
Ciudad Universitaria, 1428 Buenos Aires, Argentina
Tel/Fax 54 11 4576 3356/3364
E-mail: antico@at.fcen.uba.ar

The monthly mean subtropical jet stream (STJ) in South America is identified from monthly mean vertical cross sections of zonal wind during 1978–1999. During July-September, when the STJ is well defined, we identify two sets in terms of the zonal wind speed, one with 4 cases of intense STJ and the other one with 5 cases of weak STJ. Data from the NCEP/NCAR reanalysis are used to analyze the spatial structure of the STJ anomalies and the relationships with other variables

Simultaneously with the occurrence of intense STJ, enhanced convection occurs in the eastern tropical Pacific Ocean off the coast of Central America. This region of ascending air constitutes the upward branch of a Hadley type circulation, that seems to be responsible for the strengthening of the STJ over South America. In the case of weak STJ, we observe that weaker than normal convection occurs off the coast of Central America, suggesting that a weak Hadley cell would be responsible for the weakening of the STJ.

However, we find two particular cases that differ from the others. One case corresponds to the set of intense STJ and occurs in 1995, and the other one occurs in 1992 and belongs to the set of weak STJ. None of these two cases can be explained in terms of anomalous Hadley cells as explained above. In both cases there is evidence of Rossby wave activity in response to tropical convection. In one case (intense STJ), Rossby waves generate in the tropical western Pacific and travel eastward to South America following an arching path through extratropics. In the other case (weak STJ), there is evidence of Rossby waves excited over tropical South America and adjacent oceans by anomalous convection in the same region.

As a consequence of the anomaly in the STJ intensity, anomalous meridional circulation develops downstream. OLR composites show a characteristic cloudiness pattern associated with this thermically indirect circulation. When the STJ is intense, upward motions prevail southeast of South America, favoring cloud persistence. At the same time, subsidence prevails north of this area, suppressing cloudiness. A preliminary analysis of precipitation data gives additional evidence, supporting this meridional circulation located downstream of the STJ.