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A global climatology of Night Low Level Jets and associated moisture sources and sinks

Iago Algarra Cajide (1), Raquel Nieto (1,2), and Luis Gimeno (1)

(1) Environmental Physics Laboratory (EPhysLab), Facultad de Ciencias, Universidade de Vigo, Ourense, Spain, (ialgarra@uvigo.es), (2) Department of Atmospheric Sciences, Institute of Astronomy, Geophysics and Atmospheric Sciences, University of São Paulo, São Paulo, Brazil

Low-level jets are defined as maximum winds within the first kilometre of the atmosphere. They are filamentous structures that can be (or not) related to the transport of moisture. The aim of this study is the development of a daily database of LLJs, and then the relationship of these structures with the transport of moisture, analysing the sources and sinks in terms of climatology and anomalies. The studied period is 37 years, from 1980 to 2016. As the LLJ are predominant during summer, we focused on January for the austral summer and July for the boreal one. To identify the LLJs we used an index of nocturnal LLJ (NLLJ, Rife et al. 2010) activity based upon the vertical structure of the wind's temporal variation. Two criteria must be satisfied simultaneously: winds at the core of the jet (500 m AGL) need to be stronger at midnight than at noon, and the wind speed at the core of the jet must be stronger than that at higher levels. To compute our database ERA-Interim reanalysis data at sigma levels (53 and 42, 500 and 4000 m AGL, respectively) from the ECMWF were used with a horizontal resolution of 0.25° at every 6-h.

We have identified 27 LLJs on a global scale, 12 during austral summer and 15 during boreal summer. For each LLJ the point of its maximum intensity were calculated, as well as the wind velocity and direction, the horizontal extension, geographical orientation and amplitude of the diurnal variation. At the point of maximum LLJ intensity, we calculated the distribution of the NLLJ index at each location. As an example, for the Great Plains LLJ (GPL) of North America the jet core is located on 32.75°N-99°W with 81% of jet days, with a maximum frequency of NLLJ at 11 m/s.

Once identified the LLJs we calculate the sources and sink of moisture and their anomalies for each LLJ. For this, we use the Lagrangian FLEXPART model, which simulates the trajectory of the particles in the atmosphere allowing to calculate changes in q along them, and the balance of Evaporation minus Precipitation (E-P) could be estimated. To detect the sources, the backward mode of this model was applied, and the forward mode was used for the sinks. A threshold by applying a 90 percentile help us to delimit these areas of interest. For instance, in the case of the GPL jet the climatologically the moisture is transported from the Gulf of Mexico that acts as the main source of moisture, and the sinks are over to the southern Great Plains. Source and sink moisture anomalies were calculated using the difference between jet days and non-jet days. In this way, we can know the influence of moisture transport associated with the LLJs identified.