CHARACTERIZATION OF THE NIGHT LOW LEVEL JETS (NLLJ) ON A GLOBAL SCALE

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The Low-level jets (LLJ) 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 (Gimeno et al., 2016), and they act as climatic modulators. For instance, Great Plains low level jet (GPLLJ) are associated with enhanced precipitation over the north central United States over the Great Plains, and on the other hand with a decreasing precipitation along the Gulf Coast and East Coast. LLJ are also associated with extreme precipitation events, and a higher transport of moisture can cause large rainfall and they could be responsible for important floods (Mo et al., 2004).

The lack of data at high temporal and spatial resolutions become the LLJ studies in a particular challenge. However, exists a few exceptions where high-resolution observational data are available, such as for the GPLLJ and the South America low-level jet (SALLJ) that have been subject of intensive studies which have allowed well-documented these structures. There are many different definitions to refer to these structures (Nicholson, 2016). In this work, we detect the Night low-level jets (NLLJs) that refers to those jets which have a maximum strength at night, and that is formed from the decoupling of the planetary boundary layer after sunset. NLLJs tend to have a wind maximum near local midnight, with the height of the core ranging from 300-600 m above ground level (AGL), with a mesoscale and synoptic-scale extent (Rife et al., 2010). NLLJs arise from two major mechanisms, first depends on the decoupling and eventual recoupling of the lower troposphere to the surface thought diurnally varying eddy viscosity driven by changes in solar heating (Blackadar, 1957), and the second is related to the response to changes in horizontal baroclinicity arising from spatial contrasts in insolation and horizontal variations in the topography (Parish, 2017).

The aim of this research is the detection of the NLLJ, using an objective methodology, on a global scale and examine their structure and vertical profile, as well as their time evolution. The period study was 37 years (1980-2016). ERA-Interim reanalysis data from the ECMWF was used with a 0.25° horizontal resolution. Until now, the coarseness (space and time) of available global models hinder the study of LLJ. We interpolate the 6h data through CDO to obtain hourly outs. To take into account the elevation of the land, sigma coordinates were used. LLJs are primarily a warm-season phenomenon so, we study January for the austral summer and July for the boreal summer. To identify the NLLJ we used an index used by Rife et al. (2010) based on the nocturnal LLJ activity using CFDDA data. This index is based upon the vertical structure of the wind's temporal variation. According to the methodology proposed by Whiteman et al. (1997) two criteria must be satisfied simultaneous: the first requires the winds at 500 m AGL (near jet level) to be stronger at local midnight than at local noon, and the second requires the wind speed at the core of the jet (500 m AGL) to be stronger than that at a higher level (4 km AGL). The vertical sigma levels used in this study were 53 and 42, approximately 500 and 4000 m AGL, respectively.

We have identified 34 LLJs on a global scale, 14 during austral summer and 20 during boreal summer. For each LLJ the point of its maximum intensity was determined, as well as the wind velocity and direction, horizontal extension, geographical orientation and amplitude of the diurnal variation over this LLJ point. As an example, the Figure 1a shows the climatological NLLJ index for the GPLLJ region in colours and the wind at 53-sigma level (in arrows) at local midnight for 1980-2016. The jet core is located at 32.75ºN-99ºW (indicated with a black cross) with 81% of LLJ days. The vertical wind profile for the GPLLJ is represented in Figure 1b. A maximum in the wind speed is observed within the first kilometre of height at 500 m AGL.

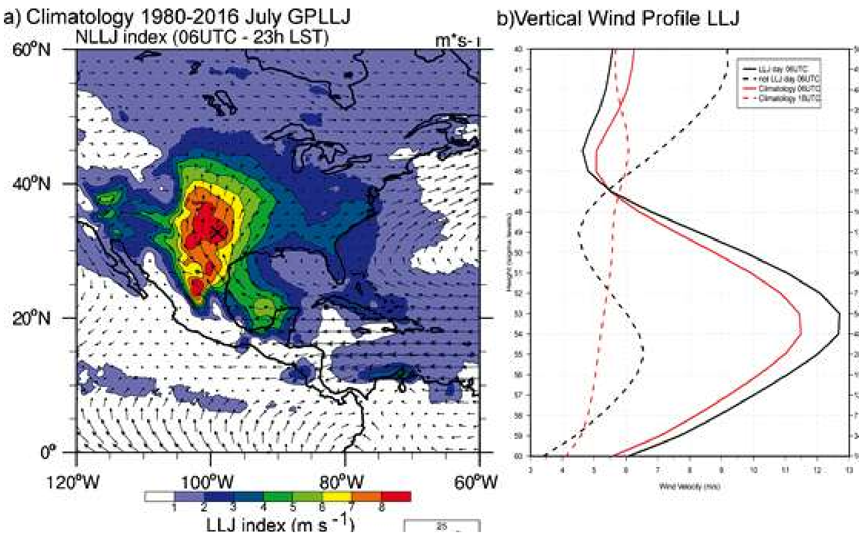
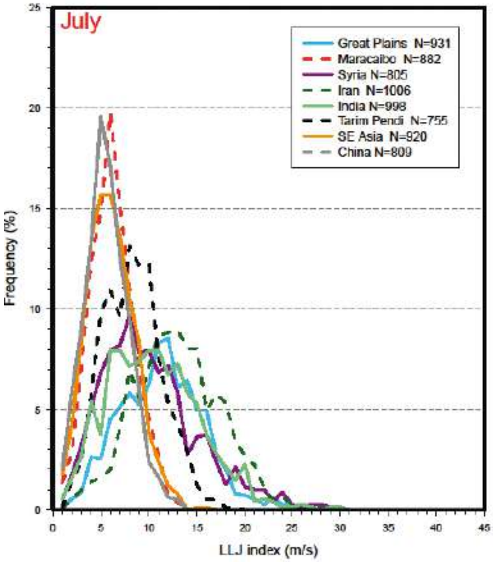


Fig 1.- a) NLLJ index and 53 sigma level wind (arrows) at local midnight for 1980-2016 for GPLLJ. b) Vertical wind profile of Great Plains Low Level Jet for July (warm session). In line black wind profile for LLJ events at 06UTC. In black dashed line LLJ no events at 06UTC. In red line climatology of GPLLJ at 06UTC and in red dashed line climatology of GPLLJ at 18UTC. Note: 6UTC and 18UTC refer to local midnight and local midday, respectively.



In the point of maximum LLJ intensity, we calculated day by day the value of the NLLJ index at each location, and its distribution and frequency. Figure 2 shows the frequency of each jet detected for July is represented according to the speed of the index. Following the same example for the GPLLJ, we can see for instance that the maximum frequency of the GPLLJ occurred at 11 m/s (black line).

Fig 2.- Distributions of NLLJ indices for 8 locations identified for 1980-2016 for July. There are a total possible of 1147 days (31 days x 37 years). The number in the box denoted those days with LLJ.

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