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Climatic Features and Their Relationship with Tropical Cyclones Over the Intra-Americas Seas

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In this work, indexes of the Intra-Americas or Caribbean Low-Level Jet (IALLJ or CLLJ, respectively), Niño 3, Tropical North Atlantic (NATL), Atlantic Multidecadal Oscillation (AMO), and Outgoing Long Wave Radiation (OLR) are quantified for the period 1950–2007, to study their relationship with tropical cyclone (TC) frequency for summer–autumn of the Northern Hemisphere. A remarkable inverse relationship is found between both, the strength of the wind speed at 925 hPa and the vertical wind shear at low levels, and the monthly relative frequency of TCs for two selected areas in the Caribbean. The July peak in wind speed and low-level vertical wind shear are associated with a minimum in themonthly relative frequency of TCs. On the contrary, a decrease in the wind speed and vertical shears are associated with a maximum value of the relative frequency of TCs. Stronger (weaker) than normal IALLJ summer winds (July–August) during warm (cold) ENSO events imply a stronger (weaker) than normal vertical wind shear at low-levels in the Caribbean. This condition may inhibit (allow) deep convection, disfavoring (favoring) TC development during these months. Correlation values of the monthly mean CLLJ core winds and the monthly normalized values of NATL – Niño 3 index for 1950–2007 showed statistical significance greater than 99% during July–August. During El Niño years, low-level wind increases at the jet core strengthening the low level convergence near Central America at the jet exit and the low-level divergence in the central Caribbean at the jet entrance. The descending motion associated with the latter acts as an inhibiting factor for convection and TC development. TC activity in the Caribbean is not only sensitive to ENSO influences, but to the strength of the CLLJ vertical wind shear, to barotropic energy conversions induced by the lateral wind shear, to the intensity of the regional scale descending motion associated with the jet entrance, and to the SST cooling generated by the CLLJ at the sea surface. Climatology of a group of General Circulation Models used in the 2007 report of the IPCC were tested to study their ability to capture the low-level wind annual cycle over the Caribbean and the known CLLJ structure. Some models do not capture basic characteristics of the jet. A discussion of cyclone potential over the Caribbean, based on the relationships developed using the models climatology, is presented for the period 2010–2050. As a study case, the findings were contrasted with the observed 2008 climate over the IAS region. Rainy season for 2008 in Central America evolved in a way consistent with the presence of La Niña event and the meridional migration of the ITCZ. Wind anomalies associated with the IALLJ were larger (smaller) than normal during February (July) 2008, in agreement with earlier findings in regards to the relationship of the IALLJ and ENSO phases. The year of 2008 was very active for tropical storm formation in the Caribbean basin (10–22.5° N, 60–82.5° W). From 16 named storms observed in the Atlantic, 10 entered the Caribbean basin. Eight (five) Atlantic cyclones were hurricanes (strong hurricanes) and from the five hurricanes crossing the Caribbean basin, four were strong.