High resolution characterization and future evolution of atmospheric coastal jets in the Peruvian Upwelling System

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Wind maxima at low levels of the atmosphere, so-called jets or coastal jets, frequently occur in Eastern boundary upwelling systems (EBUS), which host high productive fisheries and marine ecosystems. These coastal jets play an important role in oceanic dynamics by promoting coastal cooling, intensified surface currents, low levels of oxygen and pH, with significant impacts on the regional climate and a series of human activities. The coastal jet in the Peruvian upwelling system is one of the less studied boundary layer wind jet features in the EBUS. This study presents the characteristics in occurrence, frequency, height, intensity and direction of coastal jets off Peru, using data from a high-resolution atmospheric simulation (7 km) with the regional WRF model, for the 1994-2003 period, following a set of criteria based on the analysis of wind and temperature vertical profiles. In addition, an analysis of the future evolution of coastal jets is performed using a climate change regional simulation for the 2086-2095 period under the RCP8.5 scenario. Results show that coastal jets over the Peruvian sea can occur during all months of the year, although they vary in frequency and spatial location. These jets are more frequent in summer and are concentrated very close to the coast. They predominantly have an intensity between 8 and 10 $m.s^{-1}$ and occur between 200 and 300 m a.s.l. On the other hand, in winter coastal jets are less frequent and have a greater spatial extension; they predominantly have an intensity between 9 and 11 $m.s^{-1}$ and a height between 400 and 500 m a.s.l. The direction of the coastal jets is mostly south-southeast (parallel to the coastline) for all seasons, except in winter when the jet also presents high occurrences from the southeast direction. Under the climate change scenario, the frequency of occurrence of coastal jets increases mainly in the northern and central coast. In June, July, August, September and October, an increase is expected up to 20% off the northern coast and north of the Paracas peninsula (14°S). The distribution of the intensity of the coastal jets does not change substantially in all the months of the year and the height distribution of coastal jets shows a shift toward lower altitudes. Drivers and mechanisms involved in the change of these events are explored.