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Relationship between the Coastal Low-Level Jet and El Niño-like phenomenon in the Benguela region

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The Benguela Eastern Boundary Upwelling System (EBUS) is characterised by intense coastal upwelling off the southwestern Africa, and is one of the most productive marine ecosystems in the world's oceans. Its highly nutrient-rich waters make this EBUS an essential habitat to many species and is crucial in supporting the livelihood of the local population. Forced by the wind-driven equatorward Benguela Current, the upwelling system is directly influenced by the surface winds. In turn, these are associated with the quasi-permanent Benguela Coastal Low-Level Jet (CLLJ), an atmospheric feature characterised by southeasterly wind speeds superior to 10 m/s and especially intense during the austral spring. Every few years, an El Niño-like phenomenon affects the Benguela coastal region, disrupting the fragile upwelling ecosystems and the regional climate. This anomalous warming of the ocean surface is known as Benguela Niño, and may reach, in average, SST anomalies of 1.5ºC. While the El Niño and some CLLJs have been extensively studied in separate, little has been documented about their respective Benguela counterparts, and the relationship between the two features is rather unexplored. This study uses the high-resolution NOAA Optimal Interpolation Sea Surface Temperature V2 (OI SST V2) dataset and the Japanese 55-year Reanalysis (JRA-55) surface and model-level data for the time period between 1980 to 2016. For the first time, it is shown how the vertical structure of the marine atmospheric boundary layer (MABL) physical properties responds to the influence of both the Benguela Niño and the northern core of the CLLJ, establishing a connection between the two highly-impactful phenomena. Although the period studied is limited and the sampling for the Niño and Niña events is small (6 and 9 identified events for Niño and Niña, respectively), some characteristics of the Benguela jet for SST-based composites of Niño, Niña and "neutral" cases are presented. There is evidence that the physical background associated with the Benguela Niño (Niña) sustains weaker (stronger) manifestations of the Benguela CLLJ, and place it lower (higher) in the MABL. Additionally, the jet is less frequent during Niños than Niñas. It is also shown that a horizontal spatial analysis of the surface wind field is insufficient to study the development of the Benguela CLLJ, and even the study of the vertical structure of the MABL properties cannot relay all the complex interaction between the lower atmosphere and the surface.

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