Understanding atmospheric differences in the water vapor transport for the Atacama and Namib deserts

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The Atacama and Namib Deserts are one of the driest places in the world. They are both located west coast of their respective continents (18-28°S), under the effects of the east margin of the subtropical anticyclones, strong subsidence and cold ocean currents. However, they also differ in terms of topography, precipitation, and humidity, being the Atacama much higher and drier than the Namib. Until now, our understanding of how water vapor is brought to these regions and interacts with the different local circulations and topography is still limited. The objective of this study is to investigate similarities and differences of the spatio-temporal variability of water vapor between both deserts in order to asset the impact of the distinctive local factors. We will use newly developed reanalysis, satellite observations, and ground-based remote sensing of the vertical temperature, humidity, and cloud structure during a one-year (2018/19) measurement campaign at Iquique airport (22°S).

We found a marked seasonal cycle in the total column water vapor (TCWV) in both offshore deserts areas. The highest values are found between January and March, reaching up to 30% more in Namib than Atacama. Our analysis suggests that at least two factors contribute to the common summer maxima of the TCWV. First, warmer sea surface temperatures (SSTs) along the west coasts produce a moistening of the marine boundary layer (MBL). Second, weaker southerly winds in the MBL as a consequence of the southward displacement of the subtropical anticyclones, thus decreasing the dry advection from the south. The excess of humidity in the Namib seems to be associated to a strong moisture advection feature observed in the lower part of the free-troposphere (900-750 hPa), bringing moist air from the center of the continent toward the coast, also transporting clouds and precipitation. In the Atacama, the presence of the Andes cordillera blocks most of the potential exchange of humidity with the continent, leading to the Pacific Ocean as the major source of moisture.

While the driest period presents similar TCWV amounts (∼12 Kg/m2) in both areas, it is surprising to find that occurs later in the Atacama (spring season) than in the Namib (winter). A potential cause to the shifted dry season in Atacama is associated with a more close dependency of the TCWV to the MBL and SST conditions in comparison with the Namib.

Finally, we will study the origin and impacts in the TCWV of a summer structure of humidity advection, observed offshore Atacama but not in the Namib, bringing moist air from the north above the MBL. This structure has not been described in the literature, however, it could be a major source of humidity for the inland region in Atacama.