EGU22-12975
https://doi.org/10.5194/egusphere-egu22-12975
EGU General Assembly 2022

The connection of Stratocumulus Clouds at the West Coast of South America to environmental parameters.

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Marine stratocumulus clouds above the eastern Pacific form one of the largest permanent cloud fields of the planet.
They play an essential role in the Earth's energy and radiation budget. At the west coast of South America they reach the continent and provide a major water source for the hyperarid Atacama desert. As part of the DFG collaborative research center 'Earth evolution at the dry limit' we observed these clouds over one year with state of the art remote sensing instruments from the coastal town of Iquique at 20.5°S. The instruments provide vertical profiles of wind, turbulence and temperature, as well as integrated values of water vapor and liquid water. The cloudnet algorithm is used to exploit instrument synergy and provides vertical cloud structure information.

The stratocumulus shows here a distinct diurnal behaviour with the cloud dissolving in the morning, and recurring in the afternoon. The observations show that the clouds dissolve from the surface. Comparison with surface measurements reveals that this is the result of an interplay between surface heating and a somewhat delayed advection of dry air from the desert during night and early morning and moist air from the ocean during daytime.

The annual course with stratocumulus at nearly all times in austral winter and less frequent and higher clouds in austral summer shows a strong connection to sea surface temperature (SST): During winter stratification in the maritime boundary layer (MBL) is neutral and temperature is about that of the ocean surface. In contrast hereto stratification in summer is slightly stable and the MBL is warmer than the ocean. This inhibits moisture transport into the MBL and thus does not allow a persistent stratocumulus cloud. Interestingly the temperature of the coastal MBL would be in equilibrium with the SST some 50 km off the coast. The low coastal SST is related to upwelling of ocean water along the coast, while the warmer waters off the coast are result of a displacement of the cold waters of Humboldt current in summer.
This points to a rather complex interplay of ocean dynamics and atmospheric circulation.