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Variability of low-level clouds over the southern oceans

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Climate model simulations of cloud radiative properties over the Southern Ocean (SO) show that clouds reflect too little solar radiation compared with observations. This results in large errors in the modelled sea surface temperature, atmospheric circulation and climate sensitivity. Low-level (LL) mixed-phase clouds (MPCs) in the cold sectors of extratropical cyclones are identified as the main contributor to the SO radiation bias.

In this study, LL clouds are investigated between 40°S and 82° S to provide a new insight into their geographical distribution, as well as their spatial and temporal variabilities. The methodology relies on DARDAR products which exploits the synergy of CALIPSO's lidar and CloudSat's radar space-borne remote sensing observations. Based on DARDAR cloud-type products, a cloud classification program was developed to establish cloud spatial and temporal distributions. This study concerns all types of cloud, including MPCs and supercooled-water containing clouds. The mean seasonal LL cloud cover for 2007-2010 over oceans (including sea-ice) varies from 64.4% in winter to 68.4% in fall. Larger cloud covers are observed between 50°S and 65°S where clouds are present more than 80% of the time. Dividing the studied area into smaller regions allowed to extract homogeneous sectors in term of cloud coverage. This analysis draw attention on some regions, such as the Tasman Sea sector that undergoes the highest seasonal variations for MPC and USLC occurrence, and the Argentinian coasts that presents important differences with other regions at the same latitudes. Over the Southern Ocean, the Weddell Sea sector stands out with a relatively low LL cloud occurrence.

Statistical analyses were carried out to determine the influence of the meteorological and biological conditions on cloud occurrence. Even though air temperature drives all cloud-type occurrences, it was found that the lower-tropospheric stability (LTS) is a good predictor of ice-cloud occurrence between 40°S and 50°S, particularly. With biological activity, first results indicate strong correlations with cloud occurrence, where chlorophyll-a, nanophytoplankton and particulate organic carbon concentrations are investigated between 40°S and 60°S.