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Dynamical Impacts on Change of Net Precipitation over Antarctica in an A1B Scenario

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This study investigates mechanisms leading to changes of net precipitation (E-P) over Antarctica and the Southern Ocean in a multi-model ensemble of coupled AOGCMs for a 21st century time period according to the IPCC SRES A1B scenario. Meridional moisture flux is divided into time-averaged and transient parts. The latter constitutes the main contribution to total flux. Net precipitation is calculated from the divergence of the vertically integrated moisture flux. Hence, it is divided into contributions from transient and time-averaged components. With respect to the climate signal, the changes in moisture transport are subdivided into a part assigned to the change in atmospheric moisture content and a component related to dynamical changes. Since extra-tropical cyclones are mainly responsible for transient poleward moisture transport, the results of changed net precipitation is compared to changes in Southern Hemisphere (SH) cyclonic activity.

The multi-model mean of net precipitation within the Antarctic Circle (66°33'S) is slightly overestimated compared to ERA40. The transient flux divergence (approximately equivalent to net precipitation due to cyclonic activity) holds more than 90% of total flux divergence in all model integrations. The climate change signal shows an increase in the warmer climate, amounting about 12% in the ensemble mean. The dynamical part of net precipitation does not show any increase even though there is a poleward shift of cyclonic activity which could cause enhanced moisture flow into Antarctica. This characteristic of the climate change signal may be explained by a different signal in intense cyclones. These systems, which dominate transient moisture fluxes, do not feature a distinctive poleward shift, except for the Indic sector off the Antarctic coast and the Australian sector north of 60°S. The diagnosis of detailed mechanisms to explain changes in net precipitation is part of ongoing studies.