Abstract

Over the last 50 years, there is some evidence that the Atlantic Meridional Overturning Circulation (AMOC) has weakened, and it is projected to weaken further or even collapse this century driven by the increase in atmospheric greenhouse gases. Several modelling studies and paleo records suggest that the AMOC could have markedly weakened during Heinrich stadials, possibly due to iceberg discharges into the North Atlantic Ocean.
However, the impact of an AMOC weakening on Australasian hydroclimate is still unclear, particularly under a climate warmer than the pre-industrial (PI). In this study, using the Australian Earth System Model (ACCESS-ESM1.5) we investigate the response of Australian precipitation to AMOC shutdown under pre-industrial (PI) and last interglacial (LIG) boundary conditions.
Our findings reveal similar large-scale responses to AMOC shutdown under both PI and LIG boundary conditions. However, significant changes in Australian hydroclimate are observed between the two climates. Overall, AMOC shutdown leads to intensified austral summer precipitation over northern Australia in the LIG scenario, while in the PI scenario, precipitation increase occur over the northwestern part of Australia.
This precipitation increase is attributed to the Rossby wave generation originating from the equatorial South Atlantic. Additionally, changes in northern Australian precipitation are linked to the southward shift of the Intertropical Convergence Zone. During austral winter, drying in the Australian continent is simulated under PI boundary conditions, whereas under the LIG climate, there is an increase in precipitation in the northwestern part and a decrease in the southwestern part. Our study implies that understanding the impact of AMOC shutdown on Australian hydroclimate requires consideration of the background state dependence.