SO-ASE: Southern Ocean & Antarctic Sea ice Evolution, with AWI-CM3

Despite global warming, Southern Ocean sea surface temperatures (SSTs) cooled and Antarctic sea ice expanded from the beginning of continuous satellite observations to around 2014. Unexpectedly, these trends then reversed, with the last decade featuring a series of successive record sea ice lows. Atmospheric variability, clouds, precipitation fluxes, eddy-driven ocean circulation, deep ocean convection, ocean–sea ice feedbacks and freshwater forcing from the Antarctic ice sheet all potentially play a role in this paradox. Thus far, the roles of these various processes have mostly been investigated by studies that focus only on a single component. Amongst the various atmospheric, oceanic and cryospheric processes, it is unclear to what extent the changes are driven by internal variability versus the forced response to greenhouse gases, ozone and aerosols. This puzzling behaviour is not captured by global climate models, casting doubt on global climate projections and making it difficult to project the future sea level contribution from Antarctica. Our Helmholtz Young Investigator Group will apply recent advances in climate model technology and in climate model experimental design to address these critical issues. We will uniquely consider and constrain each of the relevant physical processes and their role in recent Antarctic sea ice change, accounting for feedbacks between ocean, atmosphere, sea ice and land ice.

Such research is only possible with state-of-the-art Earth system modelling. Here, we apply for a computing project to investigate the drivers of recent past and future Antarctic sea ice change using the Alfred Wegener Institute Climate Model (AWI-CM3; OpenIFS-FESOM2). We will develop process representation and conduct model experiments to examine the roles of (i) interactions with icebergs and ice shelf cavities, (ii) atmospheric circulation variability, and (iii) sea ice thermodynamics.