



## **The impact of CO<sub>2</sub> and ice sheet changes on the temperature evolution during the Middle Miocene climate transition**

Gregor Knorr and Gerrit Lohmann

Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

About 14 million years ago the middle Miocene climate transition (MMCT) is characterized by the final transition to a large Antarctic ice sheet with an ice volume similar to modern conditions. The overall cooling trend during the MMCT is characterized by multiple alterations of the surface and deep water temperatures associated with e.g. changes in atmospheric CO<sub>2</sub> and ice volume changes in Antarctica. During the overall cooling trend marine proxy data from the Southern Ocean reveal a puzzling observation, which is the occurrence of a temperature increase at the ocean surface in the southern high-latitudes at a time of pronounced ice sheet growth in Antarctica and a time delayed response in the deep ocean. With the aid of a comprehensive coupled atmosphere-ocean model we investigate the role of CO<sub>2</sub> changes and Antarctic ice sheet growth for the characteristic spatio-temporal surface and deep water temperature evolution during the MMCT. We show that dynamical changes in the coupled atmosphere-ocean-sea ice system in response to ice sheet expansion and a CO<sub>2</sub> reduction can explain the observed temperature evolution as recorded in marine proxy data.