# Abrupt Climate Shifts and Extremes over Eurasia In Response to Arctic Sea Ice Change (ACE)

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We examine the climate relationship between the Arctic and the mid- latitudes, focusing on the abrupt changes and extremes in the Eurasian climate system in response to the temporal fluctuations of the Arctic sea ice. So far, the processes of Arctic sea ice and their linkage to mid-latitudes have not yet been clarified. In this project, we will systematically create a database for the Arctic and Eurasian regions in order to characterize temporal and spatial characteristics of abrupt climate changes and extremes in the Holocene. This is combined with climate modeling using the coupled Earth System Model (AWI-ESM), which is equipped with a water isotopes module.

On the climate modelling side, we will apply a multi-resolution Atmosphere-Ocean-Ice Sheet Model with an integrated water-isotope module: Alfred-Wegener-Institute Earth System Model - wiso (AWI-ESM-wiso). It will be used for the process-oriented understanding about triggering and feedback mechanisms of abrupt and extreme changes in the Arctic-Eurasian system. A series of AWI-ESM-wiso experiments will allow us to detect roles of climatic factors, e.g. solar insolation, greenhouse gases, volcanic activity, vegetation and etc., in determining the climate history over the past 2,000 years, as well as their interactions in a coupled system. Specifically, we will also use AWI-ESM-wiso model to simulate the mid-Holocene following the PMIP protocol, 4.2 ka event and LIA, aiming to understand potential roles of the Arctic-Eurasian system in driving these climate variations, respectively (see list of all simulations). In particular, AWI-ESM-wiso will provide temporal and 3D imprints of oxygen isotope change coupled to the climate dynamic history. Moreover, we will perform simulations in the IPCC-RCP framework, aiming to decipher the impact of anthropogenic release of $CO_2$ from natural climate processes in the modern climate and also along with the global warming in the future.

We will utilize and apply a multi-resolution Atmosphere-Ocean-Ice Sheet Model AWI-ESM3.1 including its water-isotope version. The ocean component FESOM2 will use LR (25-150 km resolution, 126858 surface nodes) and HR (10-60 km resolution, 1306775 surface nodes) setups. Atmospheric model (OpenIFS) is planned to run on TCO159 (LR, 50 km horizontal resolution) and TCO319 (HR, 25 km resolution) grids.