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The Introduction of Stable Water Isotopes to the UK Earth System Model (UKESM2)

Content

Stable water isotopes (H_2^{18}O and HD^{16}O) are currently being added to the UK Earth System Model (UKESM2). They are a valuable diagnostic tool in a coupled climate model, with several potential uses including the ability to investigate the model's hydrological cycle and to aid the interpretation of ice core isotopic data.

Water isotopes are affected by the same dynamical, physical and biological processes that act on all water species. Therefore, the first stage of this model development is to add an array of non-isotopic water tracers to the coupled model, which undergoes the exact same processes as water. For example, in the atmosphere model, the water tracers are affected by the following processes: surface exchange; boundary layer mixing; convection; advection by the large-scale circulation; and microphysical processes in the clouds. The next model development stage is to convert the non-isotopic water tracers to water isotopes by modelling fractionation processes during certain phase changes. In the case of the atmosphere model, fractionation will occur during the condensation of water vapour to liquid or ice condensate; evaporation of liquid condensate; surface evaporation and during rainfall (due to evaporation and exchange between rain droplets and water vapour).

The physical component of UKESM2 comprises an atmosphere model (UM), an ocean model (NEMO) which includes the sea ice model (SI^3) and a land surface model (JULES). The initial development work has been focused on the atmosphere and land surface models. The development plan and progress of the project will be presented. This work is part of the EU Tipping Points in the Earth System (TiPES) project.

Primary author: MCLAREN, Alison (British Antarctic Survey)

Co-authors: GORGUNER, Merve (University of Bristol); WILSON, Simon (National Centre of Atmospheric Sciences, U.K.); SIME, Louise (British Antarctic Survey); RIDLEY, Jeff (Met Office, U.K.); GAO, Qinggang (British Antarctic Survey); VALDES, Paul (University of Bristol); LISTER, Grenville (National Centre of Atmospheric Sciences, U.K.)

Presenter: MCLAREN, Alison (British Antarctic Survey)

Track Classification: Progress in proxy development and interpretation