

Waterbelt solutions to avoid a hard Snowball Earth

Aiko Voigt

Geological evidence suggests that the Earth was completely or almost completely covered by ice during several periods of its deep time past, including the Neoproterozoic (1000-541 million years before present). While this is often explained by invoking a hard Snowball Earth with global ice cover, water belt solutions have been proposed as an alternative scenario with a narrow strip of open ocean at the equator. If waterbelt states were indeed solutions to the global climate system, they would provide a simple explanation for how life survived the harsh conditions of the Neoproterozoic climate. Waterbelt states are also relevant to the question of whether Earth-like exoplanets in the habitable zone of their host stars actually have a habitable climate. I will present work that articulates the crucial role of clouds for waterbelt states and for stabilising - or destabilising - the ice margin at low latitudes, either through cloud masking or through cloud feedbacks. This work combines mechanistic considerations using a Budyko-Sellers energy balance model with global climate model simulations using the ICON model and four generations of the CESM/CAM climate model.