



Snowball Earth hysteresis experiment with the FAMOUS coupled atmospheric-ocean general circulation model: thermodynamic and climatological analysis

Salvatore Pascale, Valerio Lucarini, and Robert Boschi

University of Reading, Department of Meteorology, Reading, United Kingdom (s.pascale@reading.ac.uk)

The FAMOUS coupled atmosphere-ocean general circulation model (the low resolution version of the HadCM3 GCM), is used to obtain, for the first time, the full hysteresis curve associated with the transition from present day climate to a snowball Earth (and vice versa) induced by variations of the solar constant. We use recent results on non-equilibrium thermodynamics and new entropy-related diagnostic tools developed for FAMOUS to perform an extensive thermodynamic analysis of the hysteresis experiment and to characterise the two bistable regimes. Such an analysis is then linked to the different climatological properties of the snowball Earth and present-day climates and to their differences in the hydrological cycle. We finally study the transitions between the two regimes and the role played by the different climate components and in particular by the ocean.