Fourth International Conference on Earth System Modelling
4ICESM-175-1, 2017

Impact of land model depth on long term climate variability and change.

F. González-Rouco (1), E. García-Bustamante (2), S. Hagemann (3), S. Lorentz (3), J. Jungclaus (3), P. de Vrese (3), C. Melo (1), and J. Navarro (2)

(1) Universidad Complutense de Madrid, IGEO (CSIC-UCM), Astrofísica y Ciencias de la Atmósfera, Madrid, Spain (fidelgr@fis.ucm.es), (2) CIEMAT (Energy, Environment and Technology Research Centre), Madrid, Spain, (3) Max Planck Institute for Meteorology, Hamburg, Germany

The available evidence indicates that the simulation of subsurface thermodynamics in current General Circulation Models (GCMs) is not accurate enough due to the land-surface model imposing a zero heat flux boundary condition that is too close to the surface. Shallow land model components distort the amplitude and phase of the heat propagation in the subsurface with implications for energy storage and land-air interactions. Off line land surface model experiments forced with GCM climate change simulations and comparison with borehole temperature profiles indicate there is a large reduction of the energy storage of the soil using the typical shallow land models included in most GCMs. However, the impact of increasing the depth of the soil model in 'on-line' GCM simulations of climate variability or climate change has not yet been systematically explored.

The JSBACH land surface model has been used in stand alone mode, driven by outputs of the MPIESM to assess the impacts of progressively increasing the depth of the soil model. In a first stage, preindustrial control simulations are developed increasing the lower depth of the zero flux bottom boundary condition placed for temperature at the base of the fifth model layer (9.83 m) down to 294.6 m (layer 9), thus allowing for the bottom layers to reach equilibrium. Starting from picontrol conditions, historical and scenario simulations have been performed since 1850 yr. The impact of increasing depths on the subsurface layer temperatures is analyzed as well as the ammounts of energy involved. This is done also considering permafrost processes (freezing and thawing).