3rd International Conference on Earth System Modelling
Vol. , 3ICESM-141, 2012
3rd International Conference on Earth System Modelling

Global response to solar radiation absorbed by phytoplankton in an Earth System Model

L. Patara (1,2), M. Vichi (1,3), S. Masina (1,3), P.G. Fogli (1), and E. Manzini (4)

(1) Centro Euro-Mediterraneo per i Cambiamenti Climatici (CMCC) , (2) Helmholtz-Zentrum für Ozeanforschung Kiel (GEOMAR), (3) Istituto Nazionale di Geofisica e Vulcanologia (INGV) , (4) Max-Planck-Institut für Meteorologie

The global climate response to solar radiation absorbed by phytoplankton is investigated by performing multi-century simulations with an Earth System Model. The impact of interactive marine biogeochemistry on all the physical components of the climate system is quantified. The absorption of solar radiation by phytoplankton raises sea surface temperature (SST) by overall $\sim$0.5ºC. The resulting increase in evaporation enhances specific atmospheric humidity by 2-5%, thereby increasing the Earth's greenhouse effect and the atmospheric temperatures. The Hadley Cell exhibits a weakening and poleward expansion, therefore reducing cloudiness at subtropical-middle latitudes and increasing it at tropical latitudes (except on the Equator). Higher SST at polar latitudes reduces sea ice cover and albedo, thereby increasing the high-latitude ocean absorption of solar radiation. Changes in the atmospheric baroclinicity cause a poleward intensification of mid-latitude westerly winds in both hemispheres. The combination of local and dynamical processes decreases upper-ocean heat content in the Tropics and in the subpolar Southern Ocean, and increases it at middle latitudes. Given that simulated impacts of phytoplankton on physical climate are within the range of natural climate variability, this study suggests the importance of phytoplankton as an internal constituent of the Earth's climate and its potential role in participating in its long-term climate adjustments.