MIROC4h

Climate Model Report Card

GLISA
A NOAA RISA TEAM

Model Name: Model for Interdisciplinary Research on Climate, version 4 with high-resolution

Developers: MIROC, Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology

Data Portal: https://cera-www.dkrz.de, https://esgf-node.llnl.gov

Spatial Resolution: 0.56° x 0.56°

Temporal Resolution: 3 hr, daily, monthly

Historical Run(s): 1950-2005 (daily, monthly), 1960-2005 (3 hr)

Future Scenario(s): RCP4.5

Future Time Period(s): 2006-2035 (daily, monthly), 2026-2035 (3 hr)

LAKE COMPONENT

Name: Lakes are dealt with by MIROC4h's ocean component, COCO version 3.4

Reference: [1]Hasumi, H. (2000). CCSR Ocean Component Model (COCO) Version 2.1, CCSR Rep. 13. *Center for Clim. Syst. Res., Univ. of Tokyo, Tokyo.*

Description: COCO is an eddy-permitting ocean general circulation model based on the primitive equations on a sphere under the hydrostatic and Boussinesq approximations.[1]

Vertical Layers | Depths: Figure 1 in Sakamoto et al. (2012) shows that the Great Lakes have a depth between 0 and 500m. COCO has 47 vertical layers total with the top 21 layers being less than 500m in depth,[2] although it is unclear to GLISA how layers are prescribed for lakes.

Vertical Mixing (y/n): Yes

Horizontal Mixing (y/n): Yes

Lake Ice: Lakes are dealt with by the sea-ice component, which is described in Hasumi (2004). The sea-ice model is a two-dimension continuum and is classified as a two-category model.[3]

ATMOSPHERE COMPONENT

Name: CCSR/NIES/FRCGC AGCM version 5.7, based on the CCSR/NIES AGCM

Reference: Numaguti, A. (1997). Description of CCSR/NIES Atmospheric General Circulation Model. Study on the climate system and mass transport by a climate model. *CGER's supercomputer monograph report,* 3, 1-48.

Physical Parameterizations: k-distribution method radiation scheme (Nakajima et al., 2000), cumulus convection scheme (Arakawa & Schubert, 1974; Pan & Randall, 1998), large-scale condensation scheme (Le Treut & Li, 1991), vertical diffusion (Mellor & Yamada, 1974, 1982), internal gravity wave drag (McFarlane, 1987).[2,3]

Chemistry: The radiation scheme accounts for water cloud, water vapor, soil dust, black and organic carbon, sulfate, and sea salt. Aerosol classification is based on SPRINTARS (Takemura et al., 2000, 2002).[3] Greenhouse gas concentrations used in CMIP5 are described in Nozawa et al. (2005).[2]

LAND COMPONENT

Name: Minimal Advanced Treatments of Surface Interaction and RunOff (MATSIRO)

Reference: [4]Takata, K., Emori, S., & Watanabe, T. (2003). Development of the minimal advanced treatments of surface interaction and runoff. *Global and Planetary Change, 38*(1-2), 209-222.

 # Land Cover Types: There are 10 vegetation types,[2] and land-cover type is a boundary condition prescribed by the USGS Global Land Cover Characterization database (GLCC)[3]

 # Soil Layers: 5 layers with thicknesses of 5, 20, 75, 100, and 200cm (+up to 3 layers for snow)[4]

Soil Moisture: Soil moisture is calculated separately in each later for the whole grid, even if there are snow-covered and snow-free fractions within a grid. The governing equation for soil moisture is Richard's equation.[4]

Runoff: Runoff types include base flow, Dunne runoff (saturation excess), Horton runoff (infiltration excess), and the upper soil layer's overflow. MATSIRO uses a simplified TOPMODEL scheme for runoff, evaluating each type of runoff separately.[1]

Sub-Grid Lakes (y/n): Undocumented

Carbon Fluxes: Undocumented

Land Use Change: Vegetation types and leaf area index (LAI) use the Land Use Harmonization data of Hurtt et al. (2009).[2]

Groundwater: Groundwater runoff (baseflow) enters the river routing scheme, and groundwater flow is considered in the TOPMODEL scheme.[2,4]

Additional References

[2]Sakamoto, T. T., Komuro, Y., Nishimura, T., Ishii, M., Tatebe, H., Shiogama, H., ... & Kimoto, M. (2012). MIROC4h—a new high-resolution atmosphere-ocean coupled general circulation model. *Journal of the Meteorological Society of Japan. Ser. II, 90*(3), 325-359.

[3]Hasumi, H., & S. Emori. (2004) K-1 coupled model (MIROC) description. *K-1 Tech. Rep.*, 34 pp.