SEASONAL CLIMATE MODEL WITH THERMOHALINE CIRCULATION DESCRIPTION

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C-GOLDSTEIN climate model [1] is used for numerical experiments, but seasonal incoming solar radiation distribution is taking into account. The ocean model is based on the thermocline (or planetary geostrophic) equations, with the addition of a linear drag term in the horizontal momentum equations. In the resulting frictional geostrophic system, density depends nonlinearly on the local values of temperature and salinity, which obey separate advection-diffusion equations and are also subject to convective adjustment. Model vertical levels are uniformly spaced in the logarithmic coordinate so that the upper layers are thinner, while the horizontal grid is uniform in the longitude and sin of latitude coordinates (giving boxes of equal area in physical space). In the vertical there are 8 density levels on a logarithmically stretched grid with vertical spacing increasing with depth from 140 m to 1120 m. The maximum depth is set to 5 km.

Energy Moisture Balance Model (EMBM) of the atmosphere is used [2]. The prognostic variables are air temperature, and specific humidity at the surface. The EMBM solves a vertically integrated equation for air temperature by balancing incoming and outgoing radiation fluxes, sensible (turbulent) heat exchange with the underlying surface, latent heat release due to precipitation, and a simple one layer parameterization of horizontal transport processes. The corresponding transport equation for specific humidity is forced only by precipitation and by evaporation and sublimation at the underlying surface.

A simple representation of sea-ice thermodynamics is similar to that used in the UVic model [2]. Dynamical equations are solved for compactness, the average height of sea ice and the surface temperature.

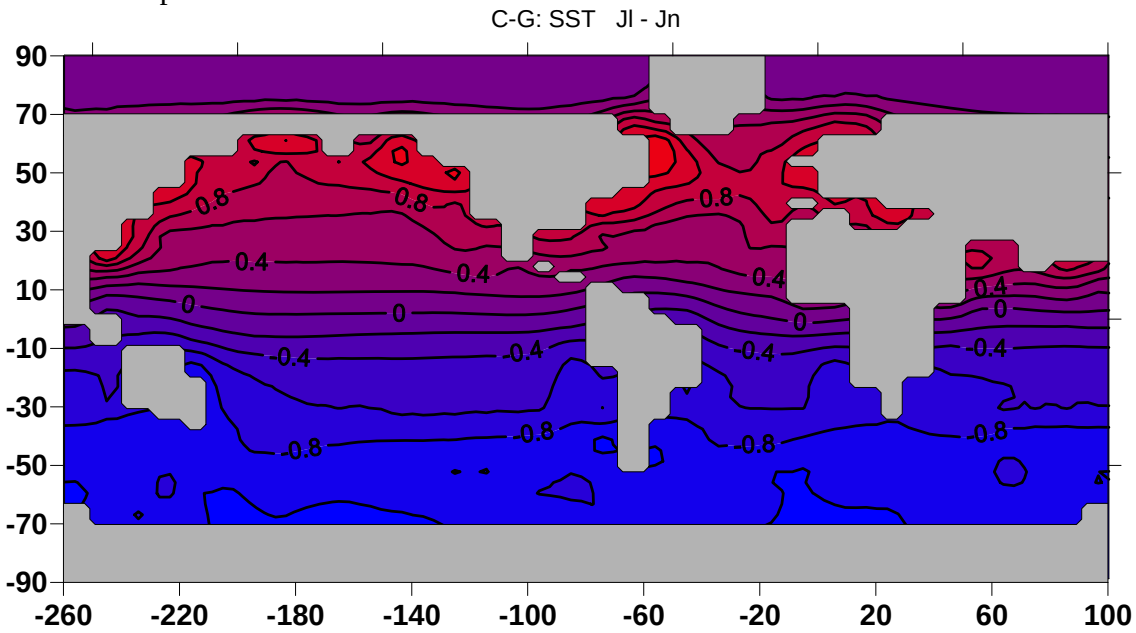

Fig. 1. July and January sea surface temperatures differences. Spinup experiment

Fig. 1 demonstrates July and January sea surface temperatures differences as a result of 2000 years run to obtain a near-equilibrium climate state.

Stable plastic pollution ocean zone is spreaded from California to Japan (Fig. 2) in the Pacific ocean north part [3]. It is possible, that plastic pollution leads to high heating of ocean surface, limiting solar radiation penetration in the deep layers of the ocean. It can cause great water evaporation and possible climate changes. Numerical experiments with climate model under corresponding assumptions show sea surface temperature decreasing in the pollution domain up to 1.8 degrees (Fig. 2). Other climate characteristics are changed also.

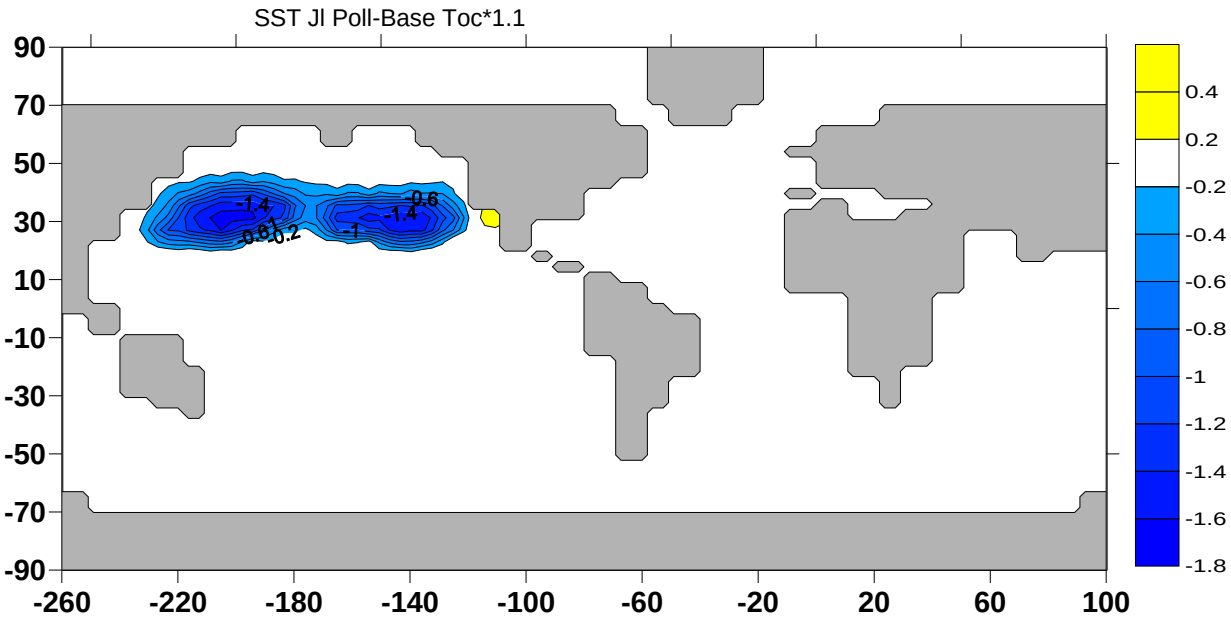

Fig. 2. Sea surface temperature decreasing in the pollution domain in July

References

1. N.R. Edwards and R. Marsh Uncertainties due to transportparameter sensitivity in an efficient 3-D ocean-climate model. Clim. Dyn. 24 (2005).
2. A.J. Weaver, M. Eby, E.C. Wiebe and others. The UVic earth system climate model: Model description, climatology, and applications to past, present and future climates. Atmos.-Ocean 39 (2001).
3. S. Casy Best Life Magazine. (2008).