

Japan's plan for the post-AR4 global warming projection with an integrated earth system model

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1. Introduction

An outline of Japan's plan on global warming projection is presented together with some former results. The "Kakushin" program (Innovative Program of Climate Change Projection for the 21st Century) is a 5-year one starting from this FY dedicated to global warming projection covering uncertainty estimation and impact assessment. Kakushin uses the Earth Simulator, which has yielded many results since its establishment in 2002 including those cited in the IPCC AR4 and will be upgraded this FY.

2. Project design

The Kakushin program has two target time scales, that is, decadal and centennial, consistent with the experimental design currently discussed as a standard protocol for global warming projection after the IPCC AR4. For the decadal time scale, we will at least adopt a horizontal resolution of ~50-100km for the atmosphere ~20km for the ocean. The model integration will start from a particular year blending observed data into the ocean component using an assimilation method. For the centennial time scale, a GCM-based earth system model (Fig.1, Kawamiya et al., 2005) with horizontal resolutions of ~280km for the atmosphere and ~100km for the ocean will be adopted. Those are not much different from common resolutions for this kind of experiment, but the uniqueness lies in the treatment of vertical girding for the atmosphere. The atmosphere component has its top at 80km and 80 vertical levels. Preliminary runs show that this setting enables reproduction of Quasi-Biennial Oscillation, adding some confidence on a future estimation of the impact of solar

variability on tropospheric climate through stratospheric dynamics. The model for the centennial time scale also incorporates full chemistry and carbon cycle with a capability of the "quasi-inversion" approach for stabilization scenarios (Hibbard et al., 2007). In addition, the program includes components dedicated to cutting-edge model development. In the presentation, more emphasis will be put on the centennial projection with the earth system model developed by the joint team of CCSR/NIES/FRCGC (CCSR: Center for Climate System Research, Univ. of Tokyo, NIES: National Institute for Environmental Studies, FRCGC: Frontier Research Center for Global Change, JAMSTEC).

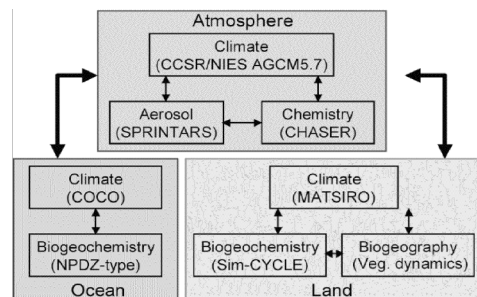


Fig.1: Structure of the GCM(MIROC)-based earth system model being developed by the joint CCSR/NIES/FRCGC team. The model includes land and ocean carbon cycle and atmospheric chemistry and aerosol transport processes, and will be used for the global warming projection of centennial time scales. The resolution is possibly T42L80 for the atmosphere with the model top at 80km altitude, and ~1 deg. for the ocean with 44 layers, although they are subject to change. In addition to the "conventional" projection for temperature and precipitation etc., experiments with biogeochemical cycles are performed with this earth system model.