

to deeper layers. The ocean and sea ice models, in turn, provided the sea surface temperature and velocity, sea ice thickness, concentration and bottom temperature to the atmospheric model.

The coupling interval was six hours. Within each coupling interval, the atmospheric model runs separately for six hours with a fixed sea surface temperature and velocity, sea ice thickness, concentration and bottom temperature, accumulating relevant time-mean fluxes (ocean-surface fluxes of momentum, heat and freshwater, conductive heat flux through the sea ice and momentum flux at the sea ice surface). These fluxes were then used to drive the corresponding 6-hour integration period of the ocean and sea ice models, following which the updated sea surface temperature and velocity, and sea ice thickness, concentration and bottom temperature were passed back to the atmospheric model for the next coupling interval. The atmospheric model used 1-hour time steps for the physical processes, while the ocean and sea ice models used 30-minute time steps.

3 Numerical Experiments

In order to obtain an equilibrium state for the coupled ocean-atmosphere system, four stages of preliminary time integration were performed (Fig. 6). In the first stage, the AGCM was run for 2.5 years forced by the observed SST and sea-ice coverage. The surface fluxes of turbulent heat, radiation, fresh water and momentum obtained from this AGCM-run were stored.

In the second stage, the OGCM was integrated with the acceleration method of Bryan (1984) for 1000 years initiated from a rest state with a uniform potential temperature (1.5°C) and a uniform salinity (34.65 ppt), using the surface fluxes obtained from the first stage as the upper boundary conditions. The temperatures and salinities of the uppermost layer were relaxed toward the SST used in the first stage and the seasonally varying sea surface salinity (SSS) compiled by Levitus (1982), respectively.

In the third stage, since the sea ice was not reproduced realistically using the final state of the second stage, the spin up of the ocean was extended by another 500 years using the same method as that used in stage 2 except that the temperature and salinity of the layers from the surface to 130 m between the South Pole and 70°N , and from top to 30 m between 70°N and the North Pole were relaxed to modified climatological temperature and salinity values from Levitus (1982). The

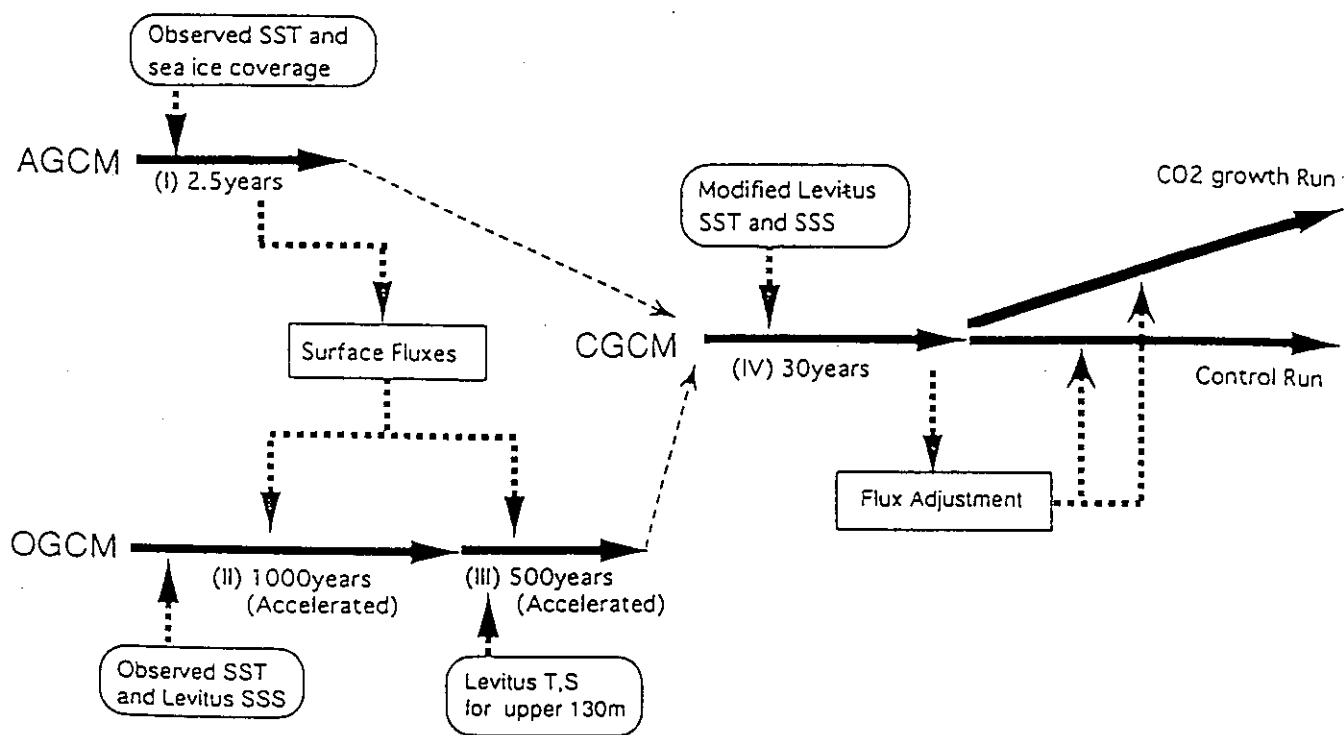


Fig. 6 The sequence of experiments conducted in the present study.