Introduction*

The climate system is composed of the atmosphere, the ocean, the cryosphere, the lithosphere and the biomass. It has various time-scales of variation. The shortest one is the upper limit of the predictable period in the sense of short-range weather forecasting. The largest one is the span of the earth's age itself. Even if we limit ourselves to the shortest time-scale, our present knowledge and understanding of their characteristics are still very fragmentary. As is repeatedly stated in the documents of the World Climate Research Program, model research is one of the promising approaches for the improvement of our present knowledge and understanding of them. Atmospheric general circulation models have succeeded in reproducing the basic characteristics of the global circulations of the atmosphere. Of course, the models are still far from complete. Model atmospheres show systematic biases from the real atmosphere. For example, see Tokioka *et al.* (1985) for the Meteorological Research Institute model (the MRI·GCM-I).

Although the model is not identical to the real atmosphere yet, we can still consider the former as a good analogue of the latter. Study of long-term variations of a model atmosphere is therefore useful for the understanding of the variations of the real atmosphere as well as for the understanding of the model climate itself and thus for the improvement of the model. Manabe and Hahn (1981) first conducted such a study. They integrated a spectral general circulation model with rhomboidal truncation at wavenumber 15 for 18 model years, and analyzed the 15-year data. Their results show that most variability in the extratropics is reproduced without year-to-year changes in the prescribed sea surface temperature (SST). Lau (1981) has further surveyed the characteristics of long-term variations of the model atmosphere. Recently Lau (1985) has run two 15-year integrations including observed year-to-year changes of the SST over the tropical Pacific basin. He showed that the temporal variance of the 200 mb height in the perturbed SST run is larger than the corresponding quantity in the climatological SST run by a factor of 2–6 over the tropics; whereas the same SST fluctuations are much less effective in enhancing the variability in middle and higher latitudes. At Oregon State University (OSU) a 10-year integration has been performed with the OSU two-layer GCM. Kushnir and Esbensen (1985) have studied a subseasonal variability

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for northern hemisphere winter with the use of simulated data.

Recently, a 12-year integration has been performed at the Meteorological Research Institute (MRI) with the 5-layer MRI·GCM-I without prescribing year-to-year changes in the SST. This technical report is presented for the purpose of showing the mean statistical maps of the MRI·GCM-I based on the 12-year run. Therefore detailed descriptions, interpretations and discussions of the results are not included. They will be published in separate papers in near future.

Model

The model (the MRI·GCM-I) used for the present study is a tropospheric five-layer grid model with its top at 100 mb. The horizontal resolution is 4° in latitude and 5° in longitude. Physical processes included are the parameterizations of the penetrative cumulus convection by Arakawa and Schubert (1974) and of the planetary boundary layer based on Randall (1976), radiation (Katayama, 1972), ground thermodynamics and hydrology (Katayama, 1978). The diurnal variation as well as the seasonal variation of solar insolation is included in the model. There are no interannual variations in prescribed boundary conditions, *i.e.*, the sea surface temperature and the sea ice coverages. The prescribed sea surface temperature and the sea ice distributions together with the model topography used are shown in Fig. 0. See Tokioka *et al.* (1984) for further details of the model. January and July performances of the model are presented in Tokioka *et al.* (1986) and Kitoh and Tokioka (1986).

Experiment

The run was started at January 1 00Z of year 1 and was continued until March 1 00Z of year 13. The initial condition of the run was taken from the atmospheric condition on January 1 produced by another simulation with a different version of the model. Excluding the first two months of the simulation, the 12-year simulated data are analyzed in this report. Data were originally sampled for every 6 hours. In this report, maps are based not on the original but on the 10-day mean and the monthly mean data.

Chapter 1 describes the horizontal distributions of the 12-year average of the monthly mean quantities. Chapter 2 shows the horizontal distributions of the year-to-year variation of the monthly mean quantities. Chapter 3 shows the latitude-height cross sections of the monthly mean quantities. Chapter 4 describes the mean annual variation in the latitude-time cross sections. Finally, Chapter 5 shows the longitude-time cross sections at selected latitudes. Both the mean annual variation and year-to-year variations are included.