B-5 Study on the Estimation of Climate Change by a Climate Model

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The development of a trustworthy atmospheric and ocean general circulation models for use of climate study was accomplished. Accurate models for cloud parametrization, atmospheric radiation process and hydrological processes are also incorporated into the model. In parallel with the model development, 3-dimensional mass transport models within the troposphere and between the troposphere and stratosphere were also evaluated. The cumulus cloud system was investigated from analysis of satellite observation data.

1. Study on the development and the improvement of a climate model : An atmospheric and oceanic general circulation model (GCM) has been developed and subsequently revised. Physical parameterizations of atmospheric radiation and hydrological processes were developed and applied under realistic boundary conditions. It was found that the GCM is compatible with the most advanced models in the world by comparing with observed climate data. In addition, a land-surface model and sea-ice model were developed and their characteristics investigated.

2. Modeling of material transport in the troposphere : A three dimensional global transport model was developed using a semi-Lagrangian transport scheme and analyzed meteorological data. The model was equipped with non-local planetary boundary layer diffusion and total mass fixer. Interhemispheric exchange time was calculated about one year. Interhemispheric gradient of CFC-11 was simulated as 15 pptv which is consistent with ALE/GAGE observations.

3. The study of mass transport between the troposphere and stratosphere : A perpetual July integration was run with the Meteorological Research Institute 12 layer GCM with ±2℃ SST(Sea surface temperature) perturbations in order to examine mass transport between troposphere and stratosphere. Ozone in the stratosphere decreased while ozone in the troposphere increased in the +2℃ SST perturbation experiment. The time integration with the 15 layer model was also completed for 3 years and compared with the SST anomaly experiment.

4. Research on the interaction between the cloud systems and dynamical processes related to climate change: The interaction processes between cumulus activity and large-scale atmosphere dynamics was studied by data analysis utilizing meteorological satellite data and numerical studies with GCM. Theoretical equatorial wave modes in the tropical cloud fields and the characteristic value of the atmospheric waves associated with the cloud activity were analyzed. A method for estimating large-scale distribution of cloud optical properties from satellite data was established. Numerical experiments with the GCM revealed that cloud parametrization schemes play a significant role in simulating the climatological global precipitation distribution.