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.

1. Study on the development and the improvement of a climate model : An atmospheric general circulation model and an ocean general circulation model have been developed and improved to reproduce the climatology of the real atmosphere.The accuracy of reproduction of the atmospheric general circulation model was increased by improving parameterizations of physical processes.Global material transport in the atmospheric circulation showed that there are latitudinal bands in both of the mid-latitudes, where the meridional material transport is less active than that in other latitudes.

2. Modeling of material transport in the troposphere : A three-dimensional global chemical transport model developed by National Institute for Resources and Environment (NIRE-CTM-93)is used to estimate the three dimensional distribution of greenhouse gases in the troposphere.Estimates of emission and absorption of those gases are also made by comparing simulated concentrations and observed ones.

3. Mass circulation variations in the middle atmosphere circulation: Off-line transport experiments are made with general circulation models(GCMs) in order to investigate the details of the air mass inflow from the troposphere into the stratosphere in low latitudes. Effect of vertical and horizontal resolutions on the simulated middle atmosphere was investigated with GCMs extending from the surface to the middle mesosphere.

4. Research on the accurate modeling of the feedback process related to climate change: (1) The sensitivity of the land-atmosphere water cycle to the runoff process was investigated through numerical experiments with an AGCM. Regional atmospheric circulation model studies were also conducted to examine the effect of the GCM's subgrid scale land-surface process. (2) The role of cloud feedbacks in the global climate change was performed with the advanced analysis studies utilizing the satellite data.Cloud radiative forcing for various cloud types was also examined utilizing the ISCCP cloud data and and advanced radiative transfer model.

5. An atmospheric general circulation model for climate studies (CCSR/NIES AGCM) was used for quantitative evaluation of climate system variability. An initial ten year integration based on observed SST, and performed as part of the AMIP (atmospheric model intercomparison project) was analyzed. Analysis of a number of variables shows that the model provides a reasonable reproduction of observed climatology.AGCM coupled to an ocean mixed layer model was used to examine climate change under conditions of doubled atmospheric CO_2 concentration.