Preface and Introduction*

A description of the general circulation model of the Earth's atmosphere currently used at the Meteorological Research Institure (*i. e.* the MRI • GCM-Ⅰ) is given in this report. The main reason for us to present this description is not because we have developed an original GCM. The MRI•GCM-Ⅰ is based on the previous version of the UCLA•GCM, the description of which is given by Arakawa and Mintz (1974). Mathematical part of the model is also detailed by Arakawa and Lamb (1977). Modeling principles described in both of the descriptions are closely followed by the MRI • GCM-Ⅰ. Thus it might seem to be needless for us to write a description again, although revisions of the model have been made in several respects. As the description by Arakawa and Mintz (1974) has not been distributed widely, especially in Japan, physical part of the UCLA • GCM, except possibly cumulus part, has not been known widely compared to the mathematical part of it. This is the main reason for us to present this description without fearing repetitions of explanations found in Arakawa and Mintz (1974)or Arakawa and Lamb (1977). To summarize details of the MRI • GCM-Ⅰ, including boundary conditions and empirical constants adopted, is another purpose of this description.

This report can be separated into two parts. One is the mathematical part, where the treatment of adiabatic fluid motions is described. Chapters 1 through 6 are devoted to this end. Chapter 1 describes vertical differencing. In Chapter 2, problems related to the upper boundary condition is discussed. Horizontal differencing is described in Chapter 3. In Chapter 4, special treatments of the horizontal differencing near the poles are given. Chapter 5 describes time differencing. In Chapter 6 is found a description of advective process of water vapor and ozone.

The other is the physical part, where diabatic processes as well as sub-grid-scale processes important for the global atmospheric circulation are described. The processes included are schematically shown in Fig. P1. They are covered in Chapters 7 through 13. Chapter 7 describes a parameterization of penetrative cumulus convection. In Chapter 8 is given a parameterization of the planetary boundary layer. Convective adjustment other than that by penetrative cumulus and condensation processes are treated in Chapter 9. In Chapter

---

* Presented by T. Tokioka, *K.* Yamazaki, I. Yagai and A. Kitoh.: Forecast Reseauh Division.

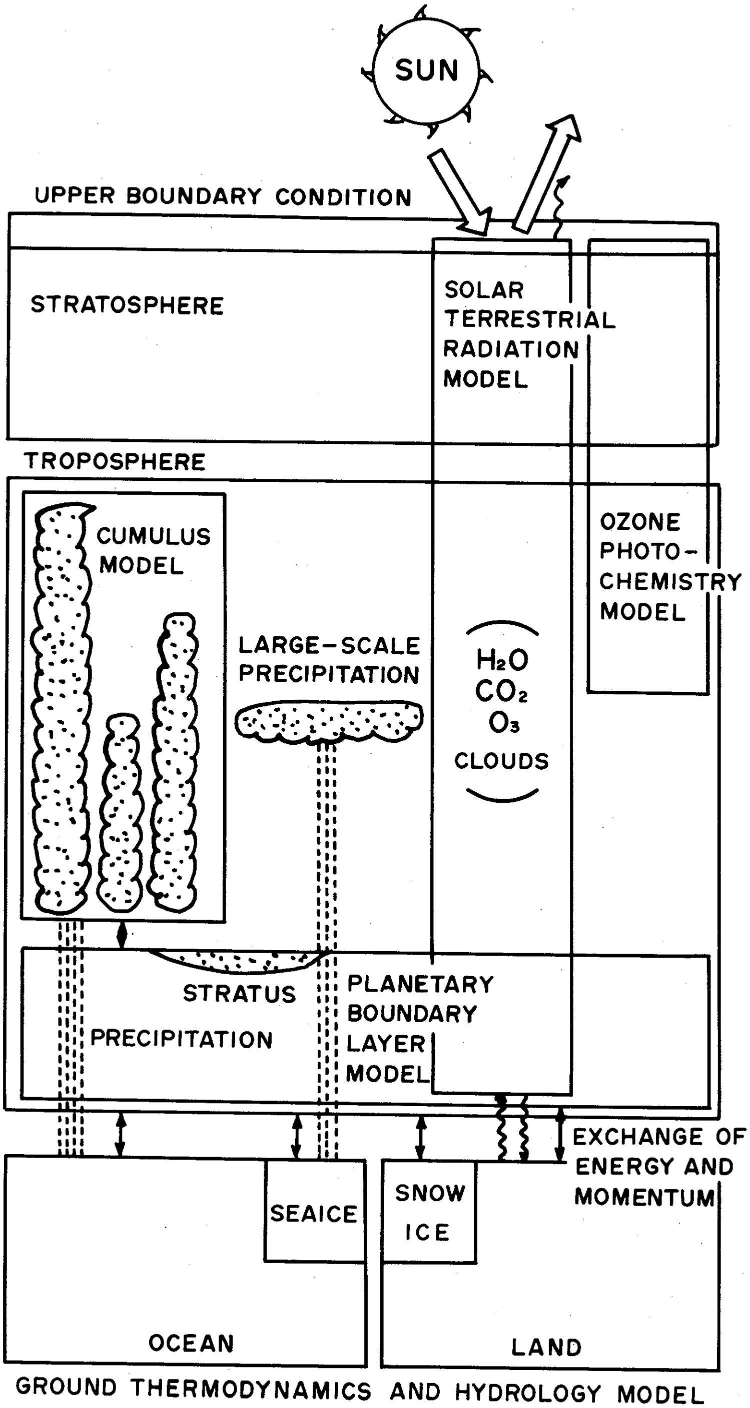

Fig. P1 Physical processes included in the GCM.

10 a description of both ground hydrology and ground thermodynamics is given. Sub-grid -scale mixing is described in Chapter 11. Source and sink of ozone is treated in Chapter 12. Finally in Chapter 13 is given a description of both solar and terrestrial radiation. In some of the chapters are included appendices to help readers understand the details and the performance of each sub-model.

At the end of this volume, another appendices are included, where selected examples of model results taken from a simulation of annual cycle with the five layer tropospheric version are shown as well as boundary conditions and list of parameters and constants currently assigned.

The authors thank Prof. Akio Arakawa of the UCLA for making the basic UCLA model available to the MRI, for giving them useful suggestions and for providing some of the members opportunities to visit the UCLA. We also thank Dr. Akira Katayama, the former head of the forecast research division of the MRI, for his encouragement and his warm support throughout this work. Thanks are due to Dr. Robert Schiffer, Office of Space & Terrestrial Applications/NASA, for offering us the Nimbus 7 ERB data. Thanks are extended to Mr. Taiji Yoshida, the head of the forecast research division, and to the former heads of the division, Mr. Hiroshi Ito and Dr. Eiji Uchida, for their continuous encouragement and patience through this work. The excellent job of drafting by Miss Hiroko Imai is also appreciated.

The numerical time integrations of the model were made on the HITAC M-200H Computer of the Meteorological Research Institute.