Regional climate Models and GCMs in ICCAP

Fujio Kimura
University of Tsukuba
Terrestrial Environment Research Institute

Objectives

To provide scenarios of the likely climate change in precipitation, temperature and insolation around the Mediterranean region after the global warming, modeling studies are carried out using GCMs and regional climate models.

IPCC report 2001

Regional climate information was only addressed to a limited degree in the IPCC. Coarse resolution GCMs simulate general circulation features well in general. At the regional scale, however, the models display area-average biases which are highly variable from region to region and among models. There are three way to improve them: high and variable AOGCM, regional climate model and empirical / statistical method. Finer resolution GCM sometimes gives larger systematic errors. RCMs driven by observed boundary conditions give area averaged temperature biases below 2℃ in IPCC, precipitation biases below 50%.

Research plan

・Multi-model study--(2x2) model ensemble

For GCMs, JMA-MRI(T106) and CCSR-NIES(T42 or T106) will be applied, while MS (Tsukuba) and MM5 (Prof.Alpert & TERC-Tsukuba) will be applied for RCMs.

・Sensitivity study

Sensitivity tests of the major weather / climate system around Mediterranean Region will be carried out as well as sensitivity tests on the land-use.

・Analytical studies(statistical downscale)

Relation between local climate and major variability of global scale climate system (ENSO,NAO...) must be studied

Findings during the Feasibility Study 2001

(1) RCM derived by twice daily NCEP-NCAR gives fairly good agreement with observation. (2) RCM with monthly mean JMA-MRI GCM prediction seems to give almost equivalent precipitation to the nesting run with observed monthly mean boundary conditions. (3) Cyclogenesis over the Mediterranean Sea is essential for precipitation in the East Mediterranean region. (4) Temperature difference between Mediterranean Sea and atmosphere seems to be very important for the precipitation.

JMA-MRI GCM run by IPCC scenario A2

Meteorological Research Institute (MRI), Japan Meteorological Agency(JMA) carried out 100 years integration assuming IPCC scenario A2 by the CGCM with the resolution of T106. Grid data of the run were provided every eight hours during the periods of 1981-2020 and 2051-2080. Predicted thirty years mean precipitation in the first period (Fig.2) agree well to the observed one (Fig.1). However, precipitation in Bay of Bengal is overestimated, but too weak in the southern Indian Ocean. Precipitation around the Mediterranean region agrees well to the observation.

Figure 3 shows the difference in precipitation between the first and the latter period. One of the most clear difference is that precipitation around the Mediterranean region is predicted to be significantly decreased.

Nested regional model

Monthly simulation assuming observed boundary conditions are carried out for January, 2000 with the nested grid systems of three stages(100km,25km and 8.3km). Precipitation estimated by the second grid system (Fig.4) shows the orographic effects much clearer than the coarse grid system(100km).The estimated precipitation fairly agree with the station data provided by NOAA Daily Global Summary of Day. However, the precipitation obtained by the third grid system with interval of 8.3km gives almost similar distribution with these by the second grid system. orographic effects on the precipitation can be estimated by the RCM with grid interval of 25km(second grid system). For the prediction of the regional climate feed back by the land use change, the higher resolution may be necessary.

Fig. 1
Observed precipitation
during 1979-1999

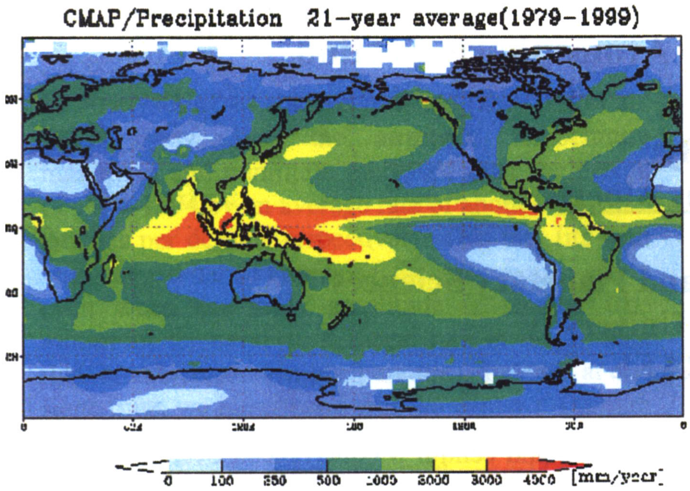


Fig.2
Precipitation by JMA-MRI GCM
during 1981-2010
(current state)

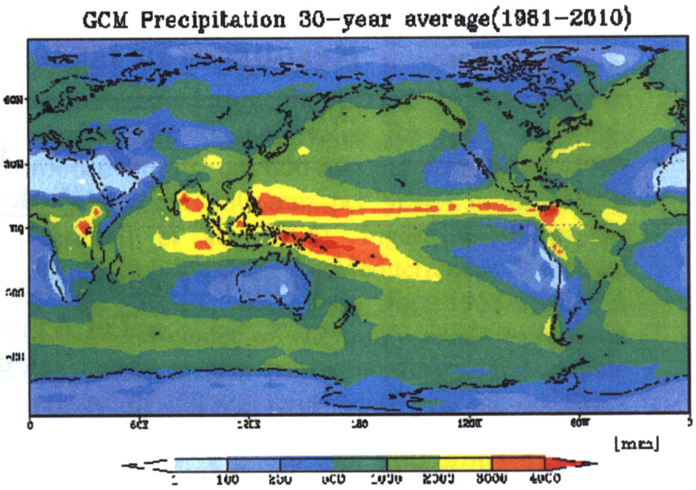
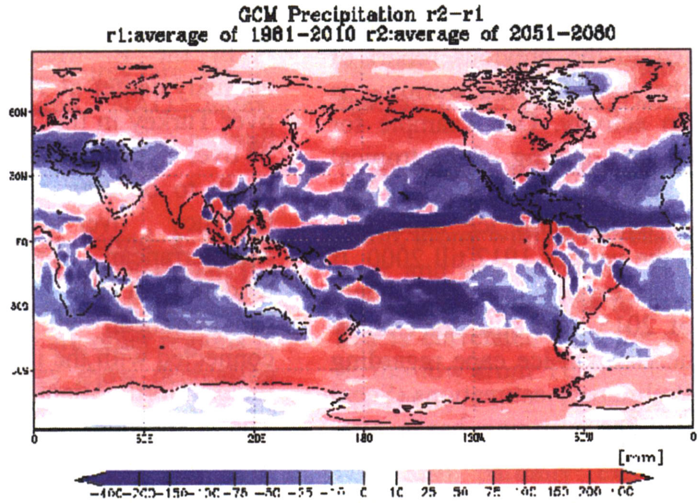


Fig.3
Mean precipitation
difference
(2051~2080)-(1981~2010)
by JMA-MRI GCM
after IPCC scenario A2



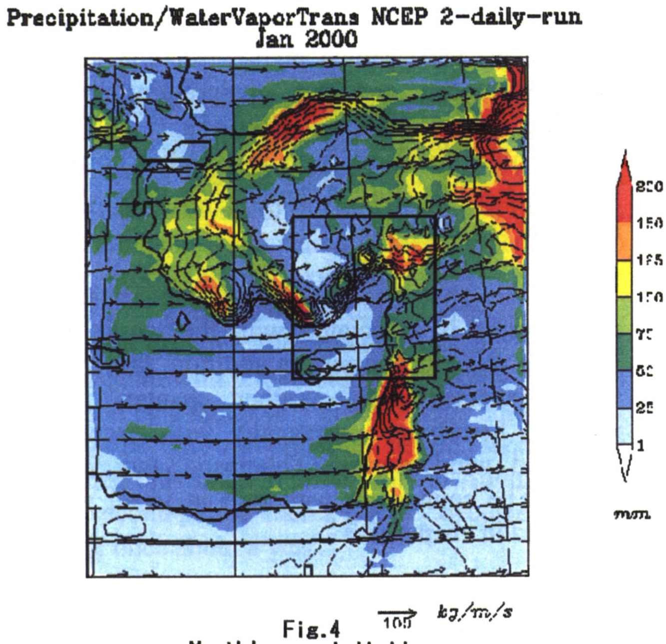


Fig.4
Monthly precipitation
by nested TERC-RAMS
during Jan 2000

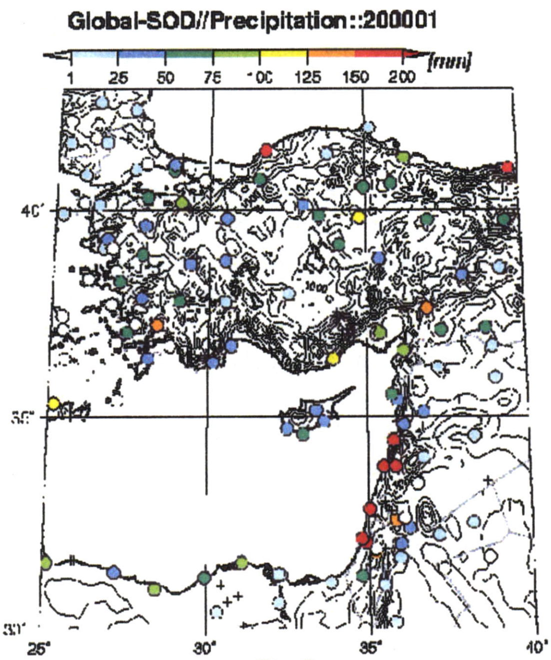


Fig.5
Monthly precipitation
station data
during Jan 2000

F.KIMURA