

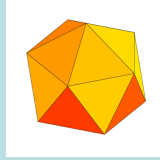
A cloud feedback study using NICAM

Yoko Tsushima¹, Shin-ichi Iga¹, Hirofumi Tomita¹, Masaki Satoh^{1,2}
JAMSTEC/Frontier Research Center for Global Change, Japan
Center for Climate System Research, Japan
Jun 3rd , GCSS workshop, Toulouse

Perpetual July+2K simulations, Models and their settings

NICAM

(Nonhydrostatic ICosahedral Atmospheric Model)



- Dynamics
 - Finite Volume Method
 - Grid Horizontal: Icosahedral, Vertical: Lorenz
 - Topography Terrain following coordinate
 - **Non-hydrostatic elastic system with deep atmosphere**
- Physics
 - Turbulence & surface process Mellor&Yamada 2 / Louis(1979)
 - Radiation MSTRNX (Sekiguchi, 2005)
 - Microphysics Grabowski(1998)
 - **Cloud liquid, rain, cloud ice, snow**
 - Land-surface Buckets

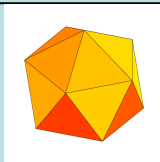
Settings

- Spatial resolution **G-level10(7km)Z40**
- 30 days integration after the g-level9 (14km) integration of 200 days.

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MIROC 3.2(CCSR/NIES/FRCGC GCM)

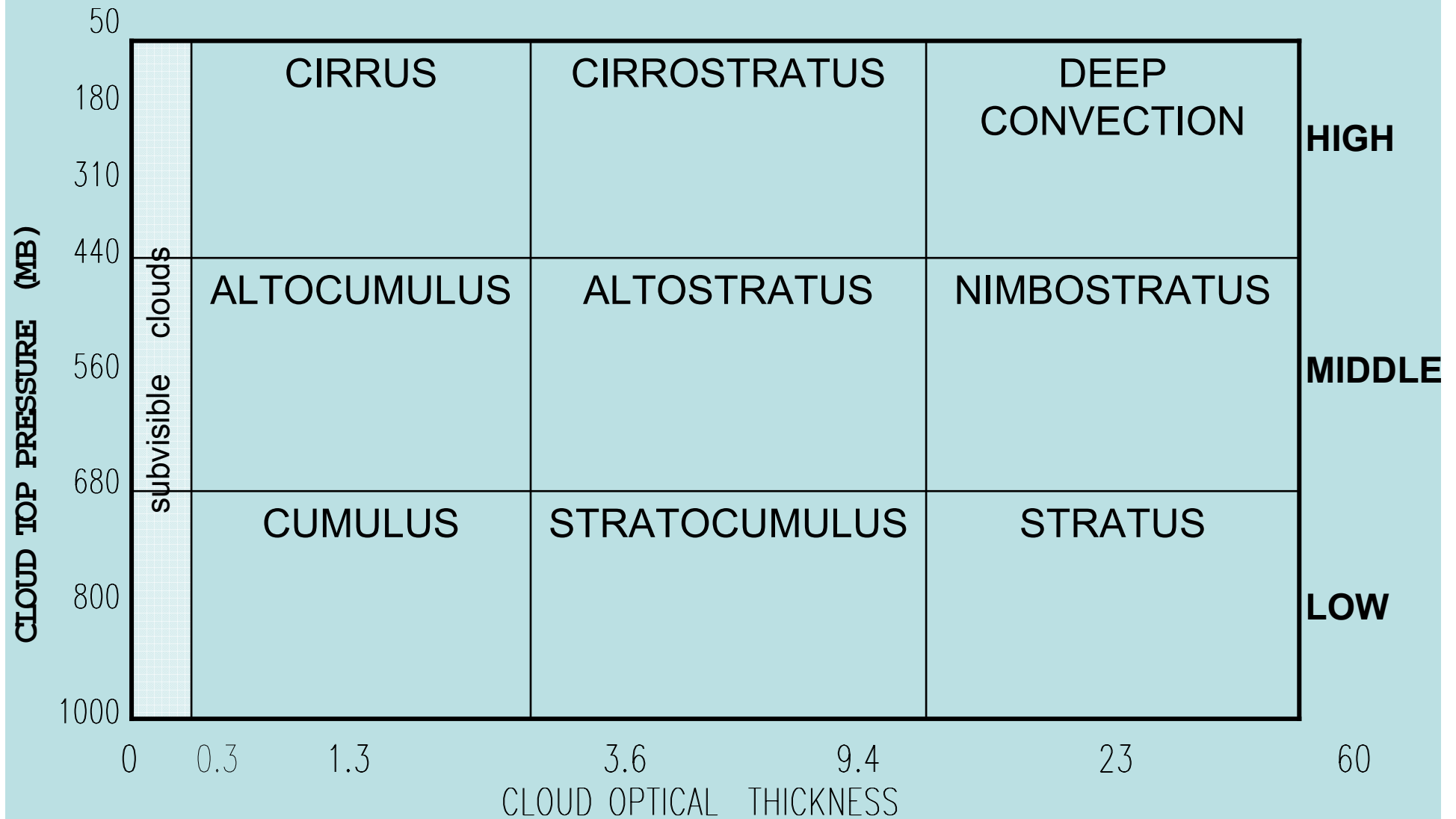
- Dynamics
 - Spectral dynamics
 - vertical coordinate
 - Grid advection for tracers (FFSL)
- Physics
 - Turbulence & surface process: Mellor&Yamada 2
 - Radiation MSTRN8 (Nakajima et al.2000)
 - Microphysics Direct and indirect radiative effects of aerosols (for cloud liquid) (dust / sea salt / sulfate / carbon) Takamura et al.(2001)
 - **Cloud liquid, cloud ice**
 - Land-surface MATSIRO (vegetation canopy + 3-layer snow + 5-layer soil)

3.8K
Climate sensitivity

Settings

- Spatial resolution: T42I20
- Integration: 240days. Last 120 days for the analysis.

ISCCP cloud analysis

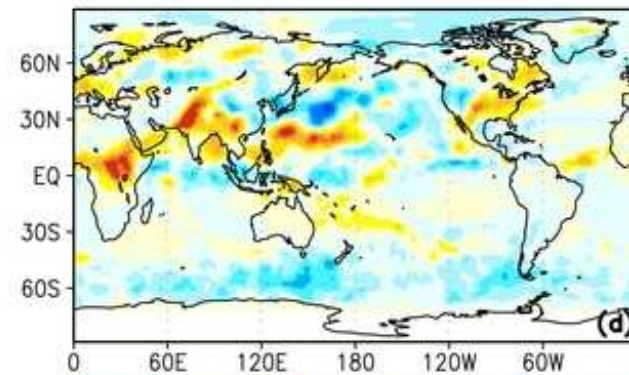
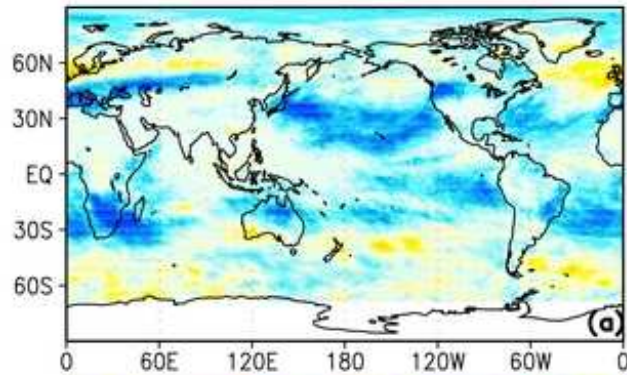


Changes in ISCCP-simulator cloud cover

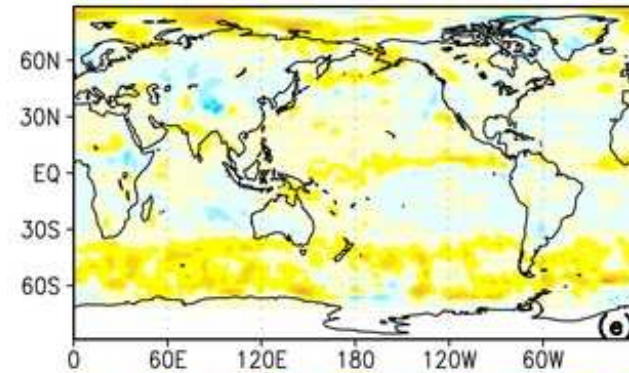
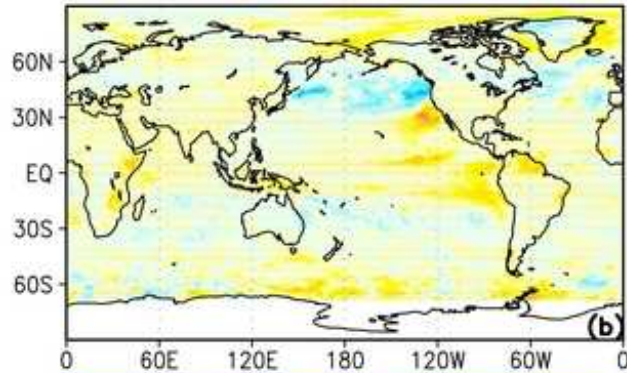
NICAM

MIROC

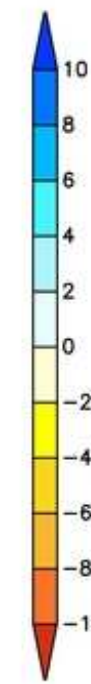
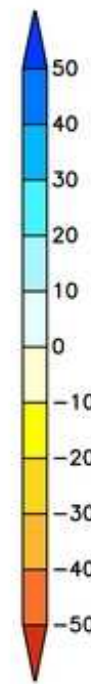
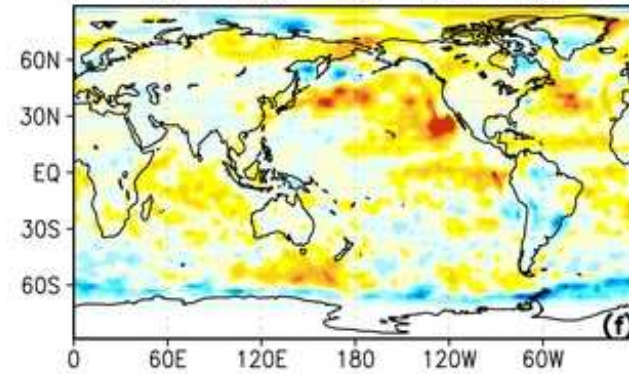
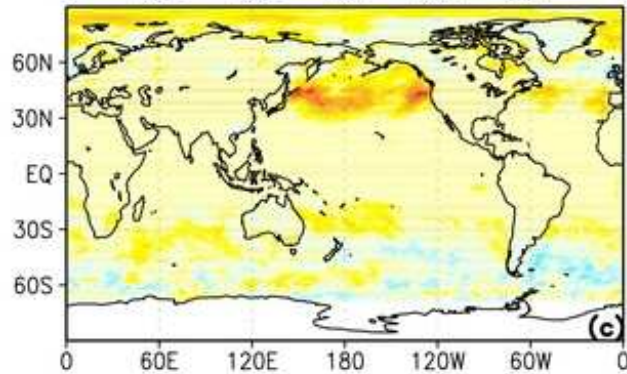
High



Mid

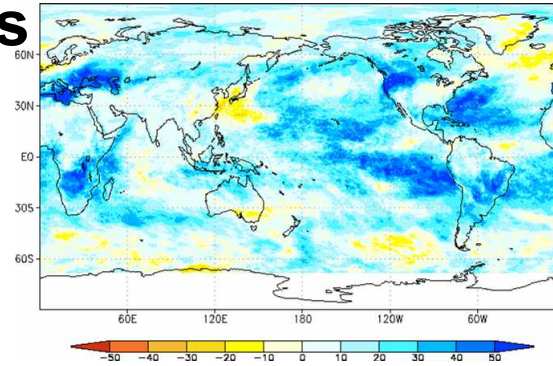


Low

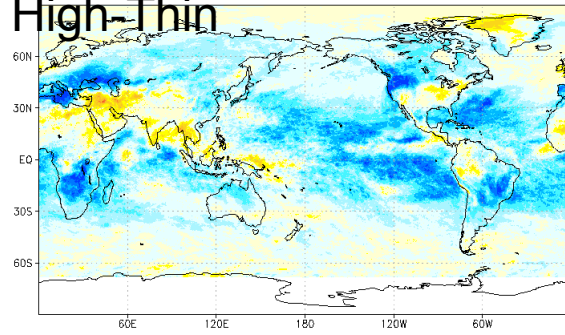


Changes in high clouds

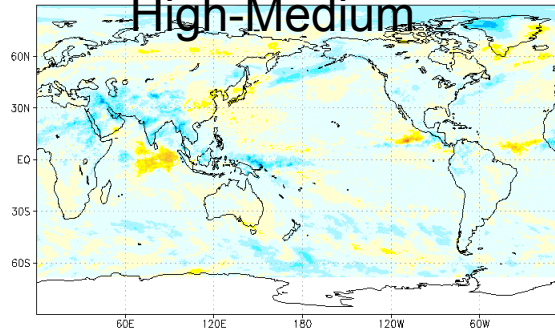
NICAM



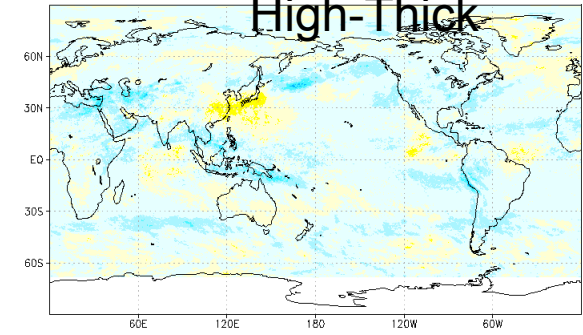
High-Thin



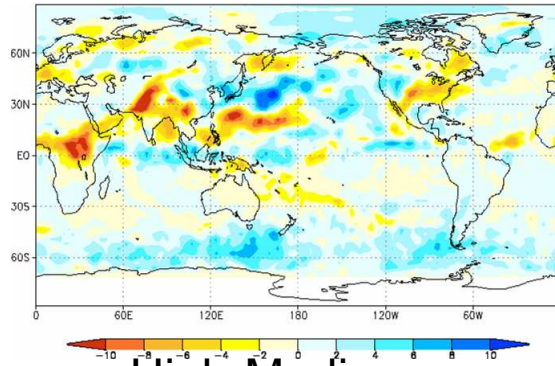
High-Medium



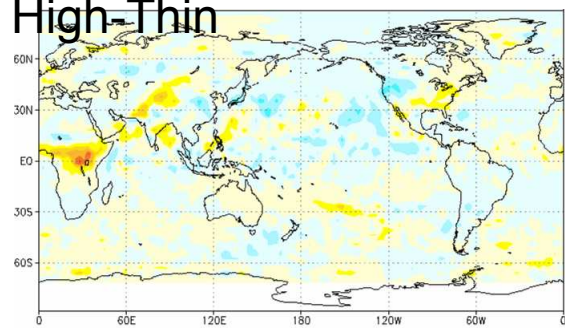
High-Thick



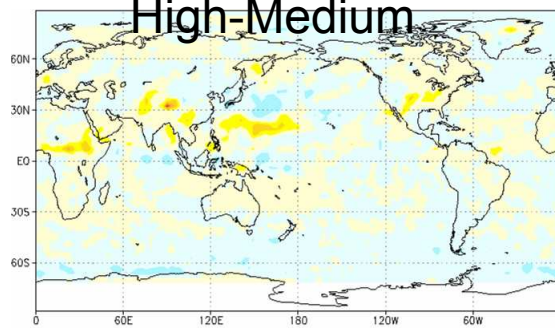
MIROC



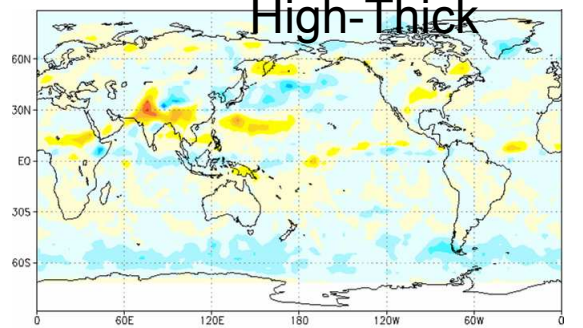
High-Thin



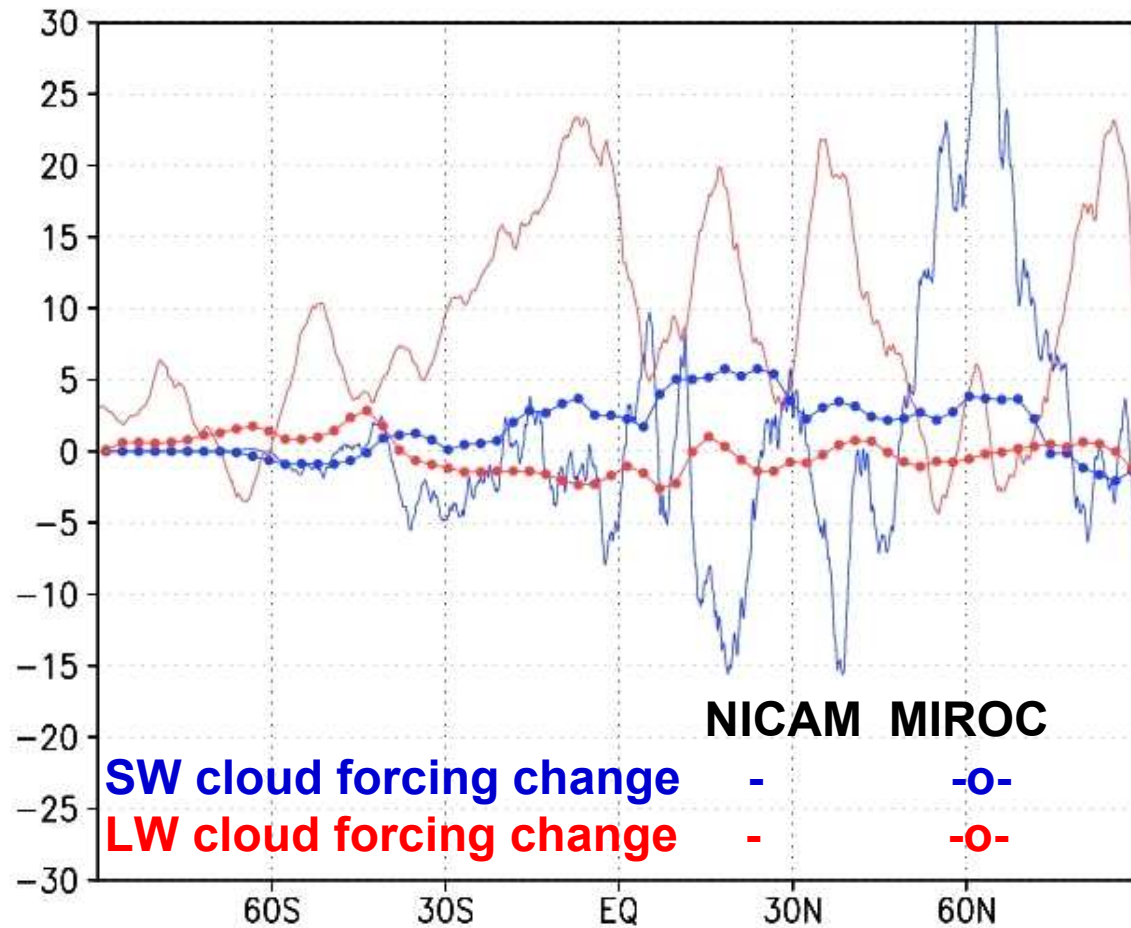
High-Medium



High-Thick



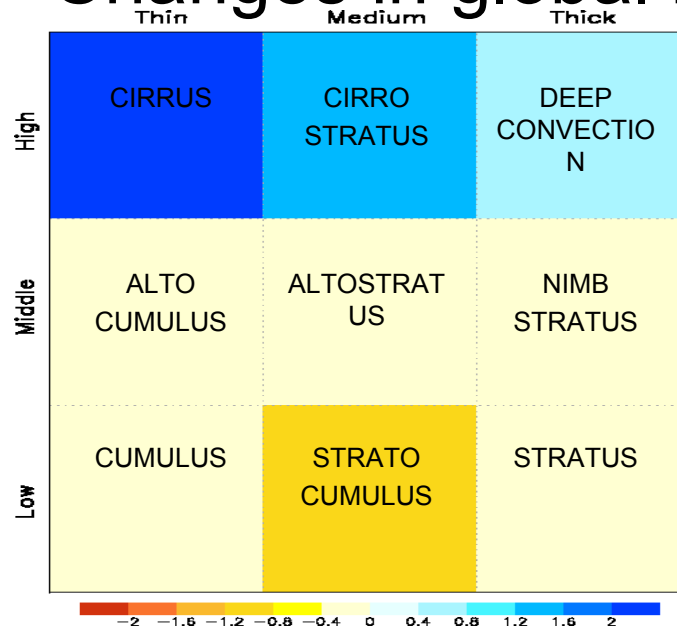
cloud radiative forcing (+2K-ctl)



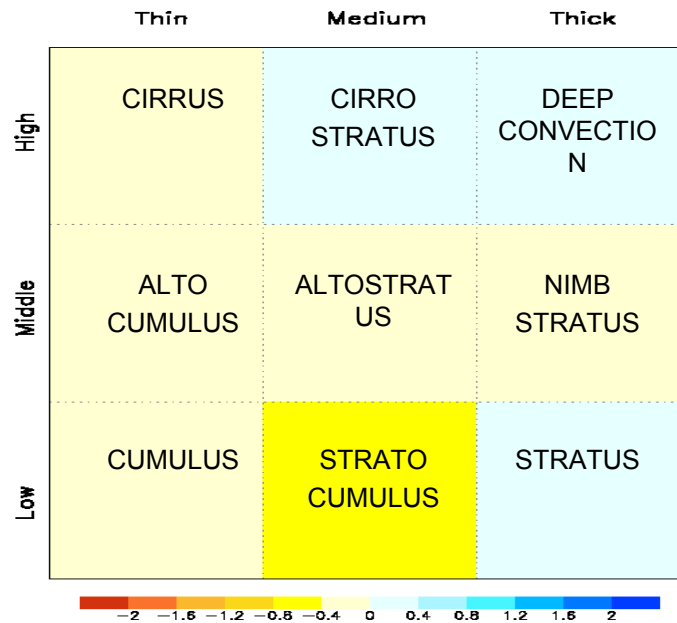
The magnitude was intensified in 7km grid simulation!

Changes in global mean ISCCP clouds

NICAM



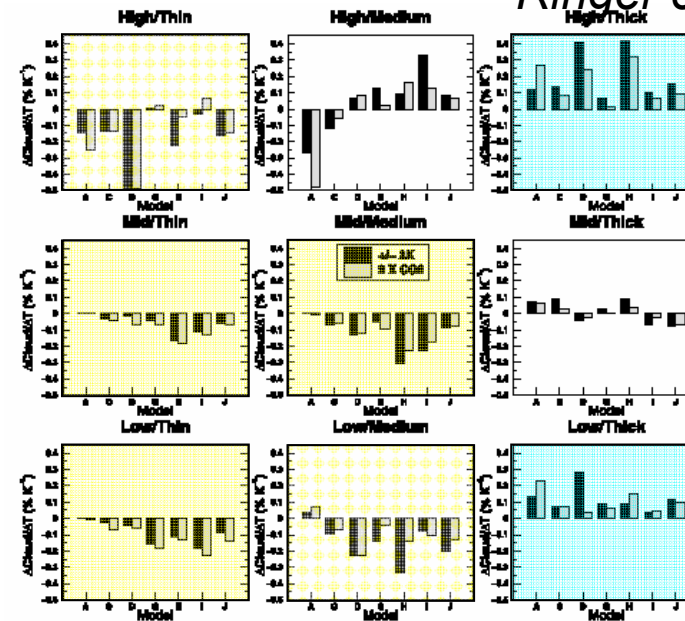
MIROC



CFMIP comparison

Perpetual July +2K & 2xCO2 experiments

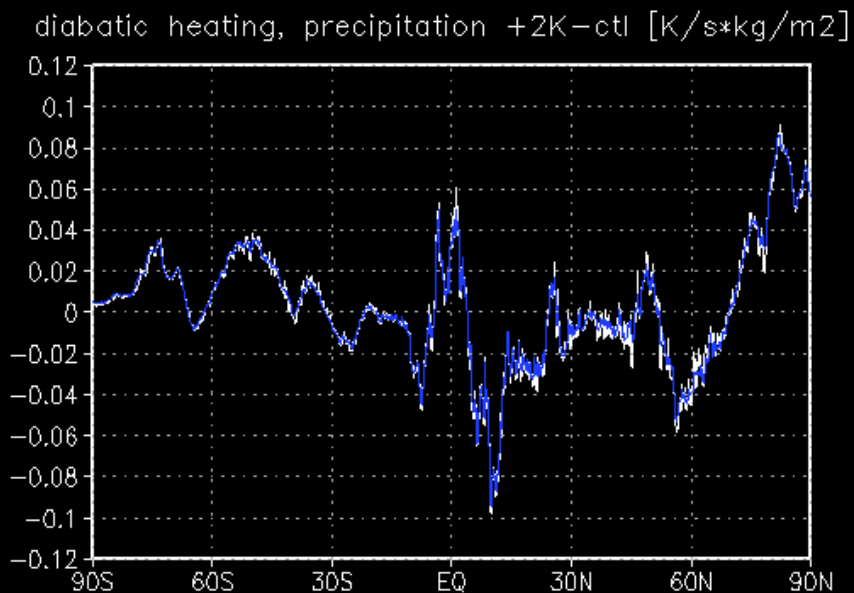
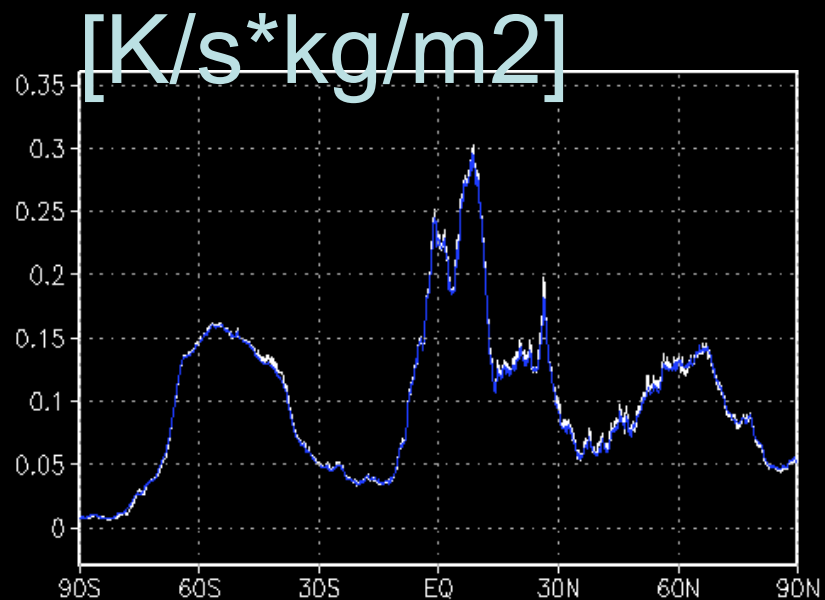
Ringer et al., 2006



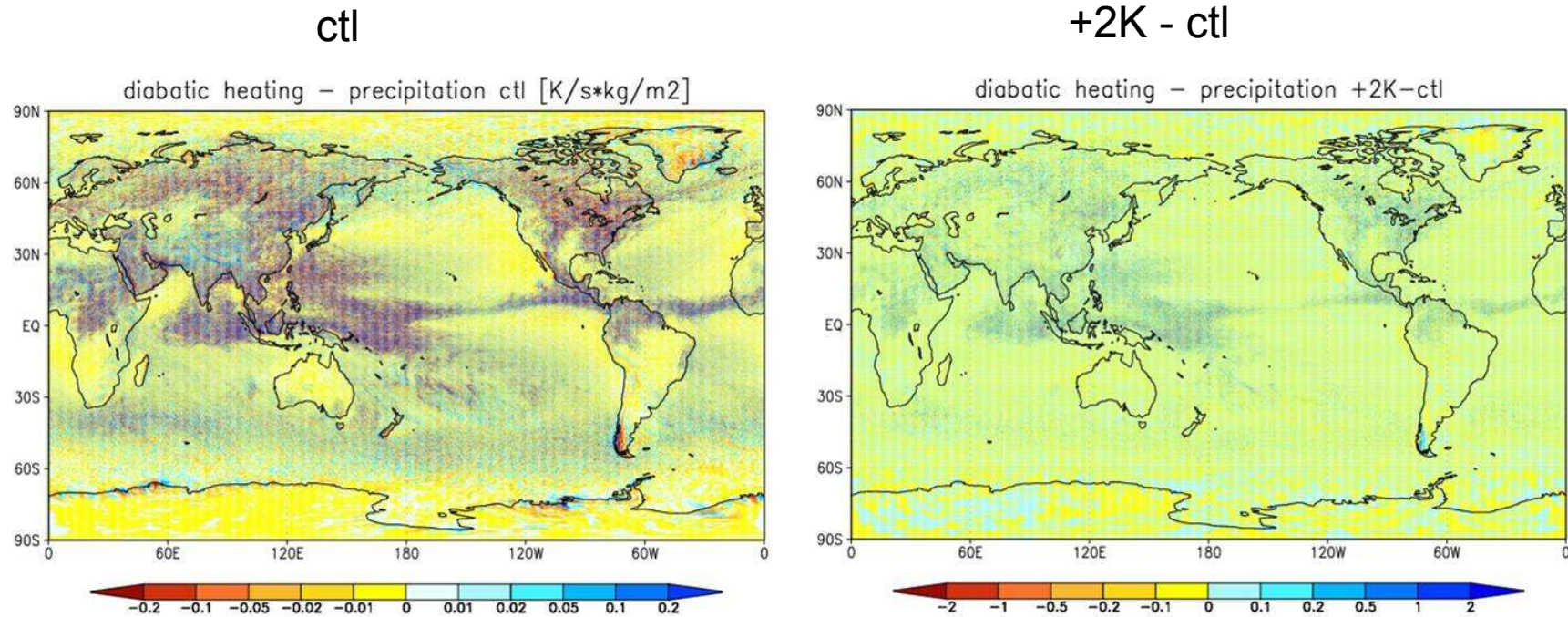
Diabatic heating and precipitation

Diabatic heating

precipitation



Diabatic heating - precipitation



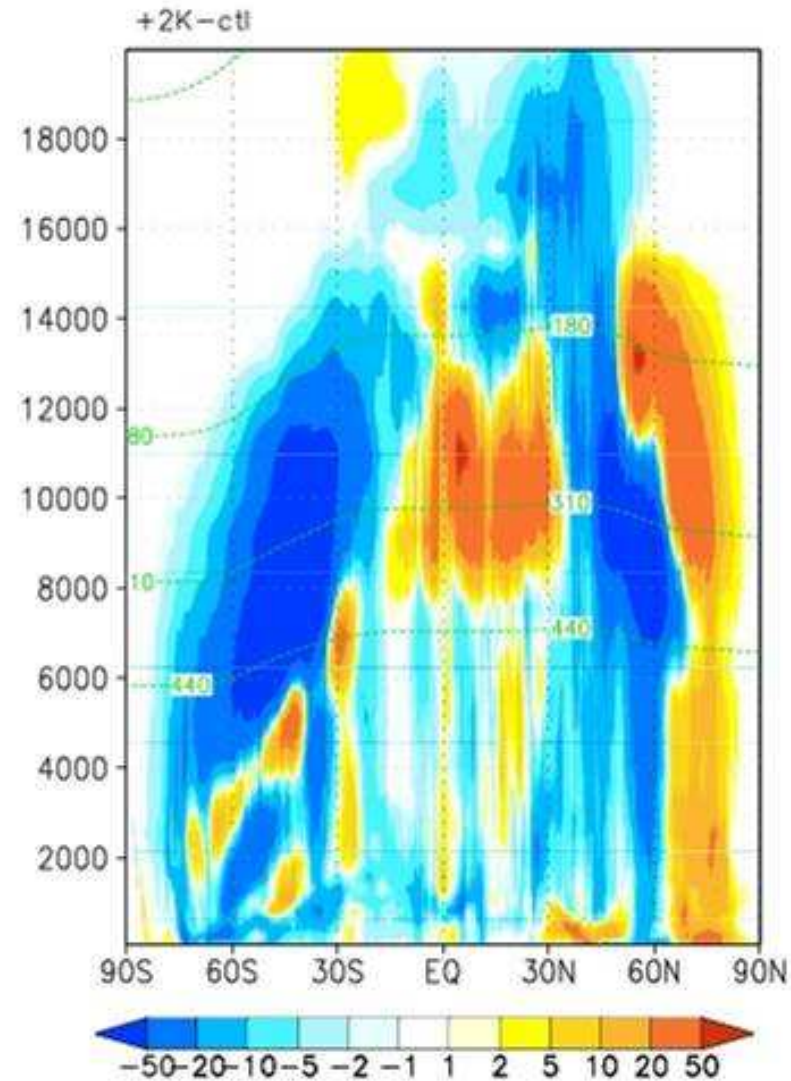
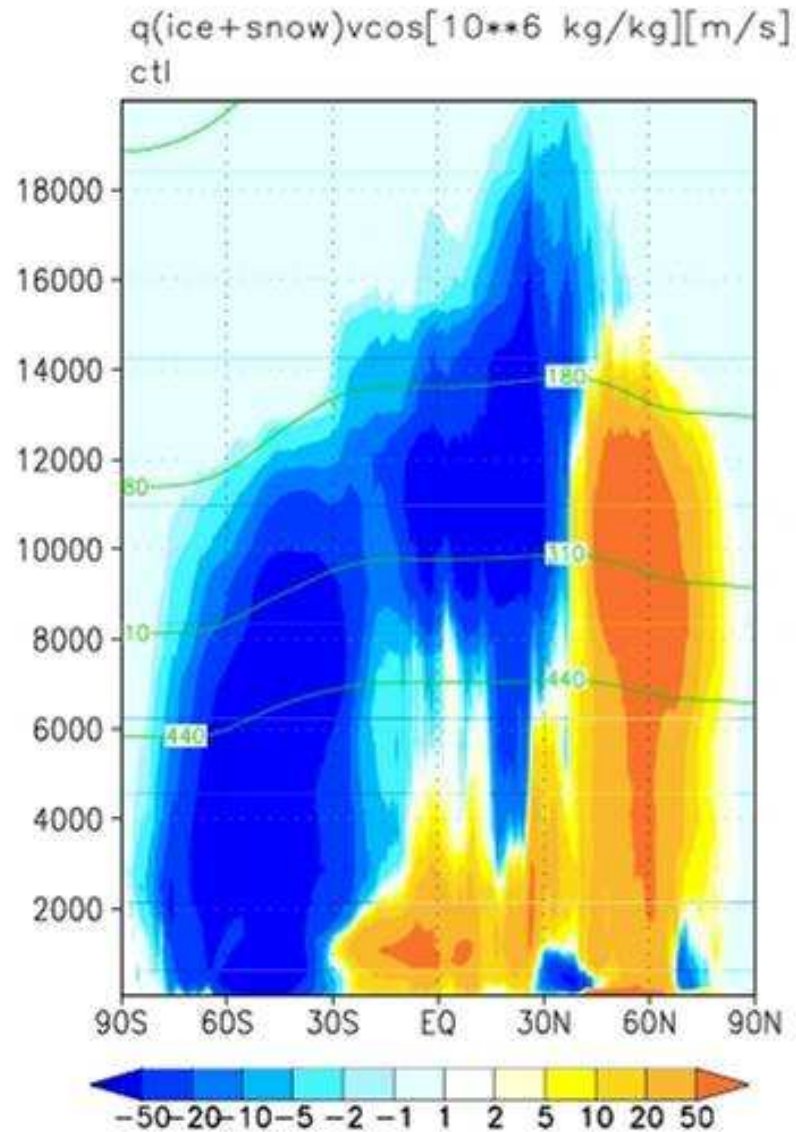
1. Western pacific, NH land & midlatitudes:
the amount of condensate which does not precipitate increases.
2. Oceanic region other than the west pacific:
the amount of condensate which does not precipitate decreases.

→ advection of the condensates from the 1st region to the 2nd region.

Zonal transportation of water vapor

Ctl

+2K - ctl



Light green line: ISCCP cloud top pressure threshold

Summary of our current understandings

- **The dominant cloud feedback in climate sensitivity study using the current version of NICAM is the increase in high thin clouds, which results in strong positive feedback in LW.**
 - High thin cirrus cover the subtropics : like cloud ice blanket
- **This result is quite different from those from IPCC AR4 GCMs. It indicates the uncertainty in the response of high level clouds which is recognized but not shown by the current GCMs.**

Works on going

- Evaluate the robustness of these results
 - Sensitivity experiments
 - with different cloud microphysics and experimental condition