Progress of NICAM researches & GCRM exp. of MJO

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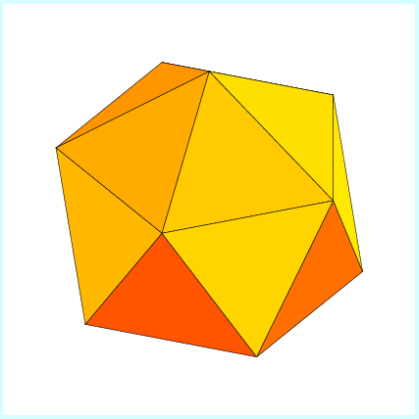
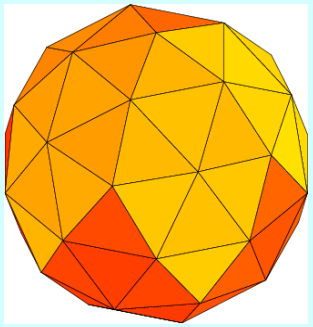
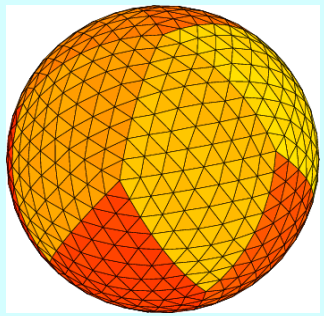
CMMAP meeting 2007, CSU, Fort Collins, USA, 7-9 Aug. 2007

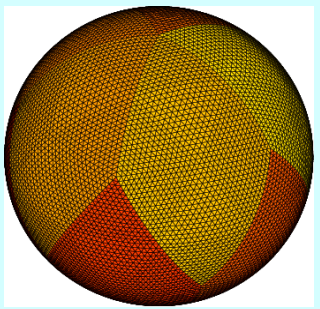
Overview

- Outline of NICAM
  - Global Cloud Resolving Model
  - NICAM (Nonhydrostatic ICosahedral Atmospheric Model)
- Overview of NICAM experiments
- MJO: H.Miiura's talk and poster
- Low clouds: breakout session #3
- Ongoing Tropical cyclones studies
- Climatology
- Current works and prospects







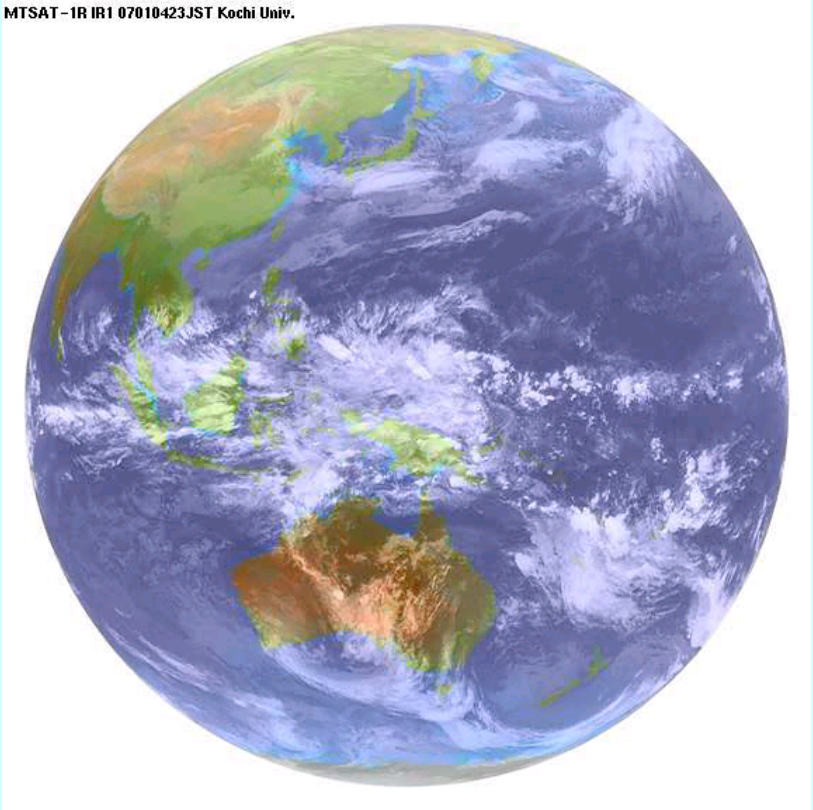


Overview of NICAM GCRM exp.

- **NICAM GCRM exp. with explicit cloud processes dx=3.5, 7, 14km**
  - **Short term exp.**
    - Exp. Apr. 2004: Typhoon, boundary layer effects on deep conv.
    - Exp. Dec. 2006: MJO : H.Miura
    - Exp. Sep. 2005: Tropical cyclogenesis: T0514(Nabi), Katrina
      - One-week dx=3.5km, one-month dx=7km, more dx=14km
  - **Long term exp.**
    - Perpetual July exp. & Cess-type climate sensitivity
    - Intra-seasonal exp. : June-Aug 2004
      - Summer/winter/ElNino/LaNina cases
      - TC genesis, seasonal change, low clouds, climatology & sensitivity
      - ~200days dx=14km, 7km
  - **NICAM-SPRINTARS: Aerosols**
    - Exp. Jul. 2006, Apr. 2001 : K.Suzuki (poster)

MJO Exp.
Dec 2006

Miura et al.(2007)



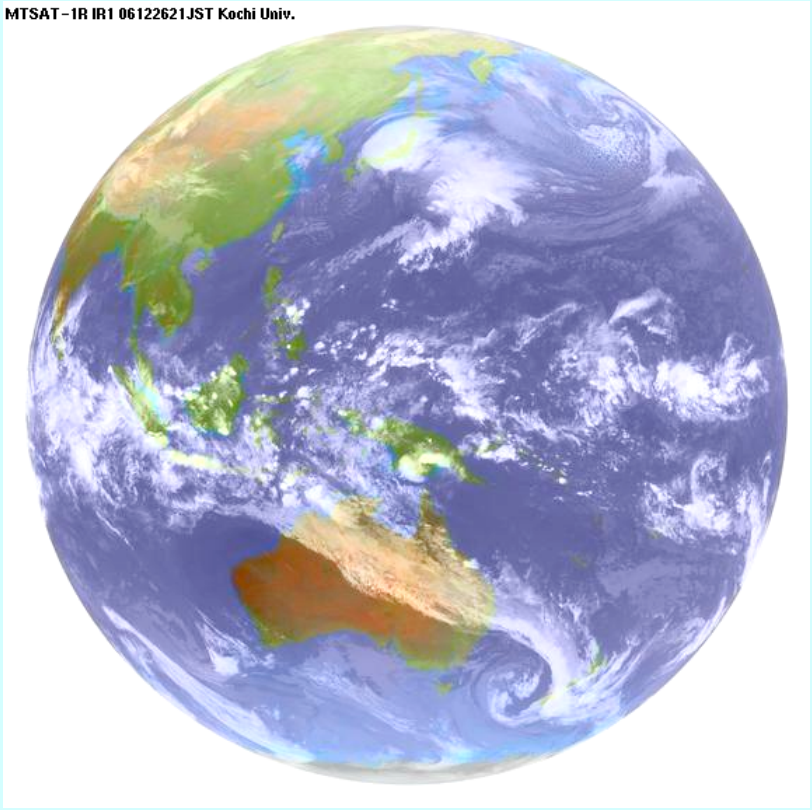
An intense MJO
MISMO field obs.(Nov 2006)
Malaysian heavy rainfall

MJO event Dec. 2006

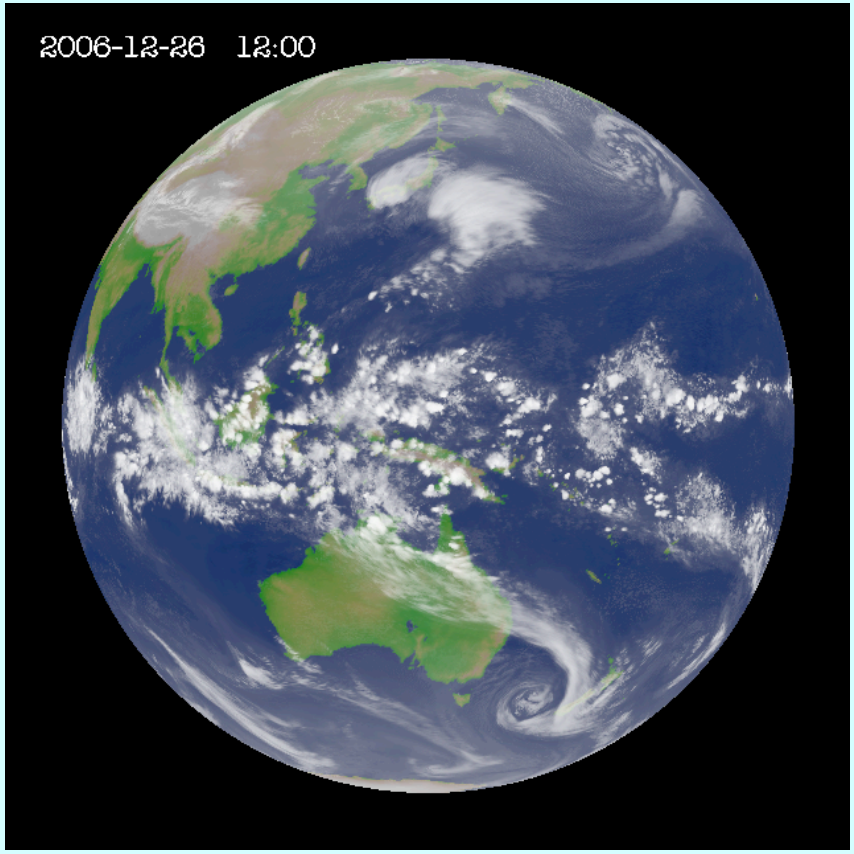
2006年12月26日21JST

Miura et al.(2007)

Initial 00UTC, 25 Dec.



MTSAT-1R TBB
http://weather.is.kochi-u.ac.jp/



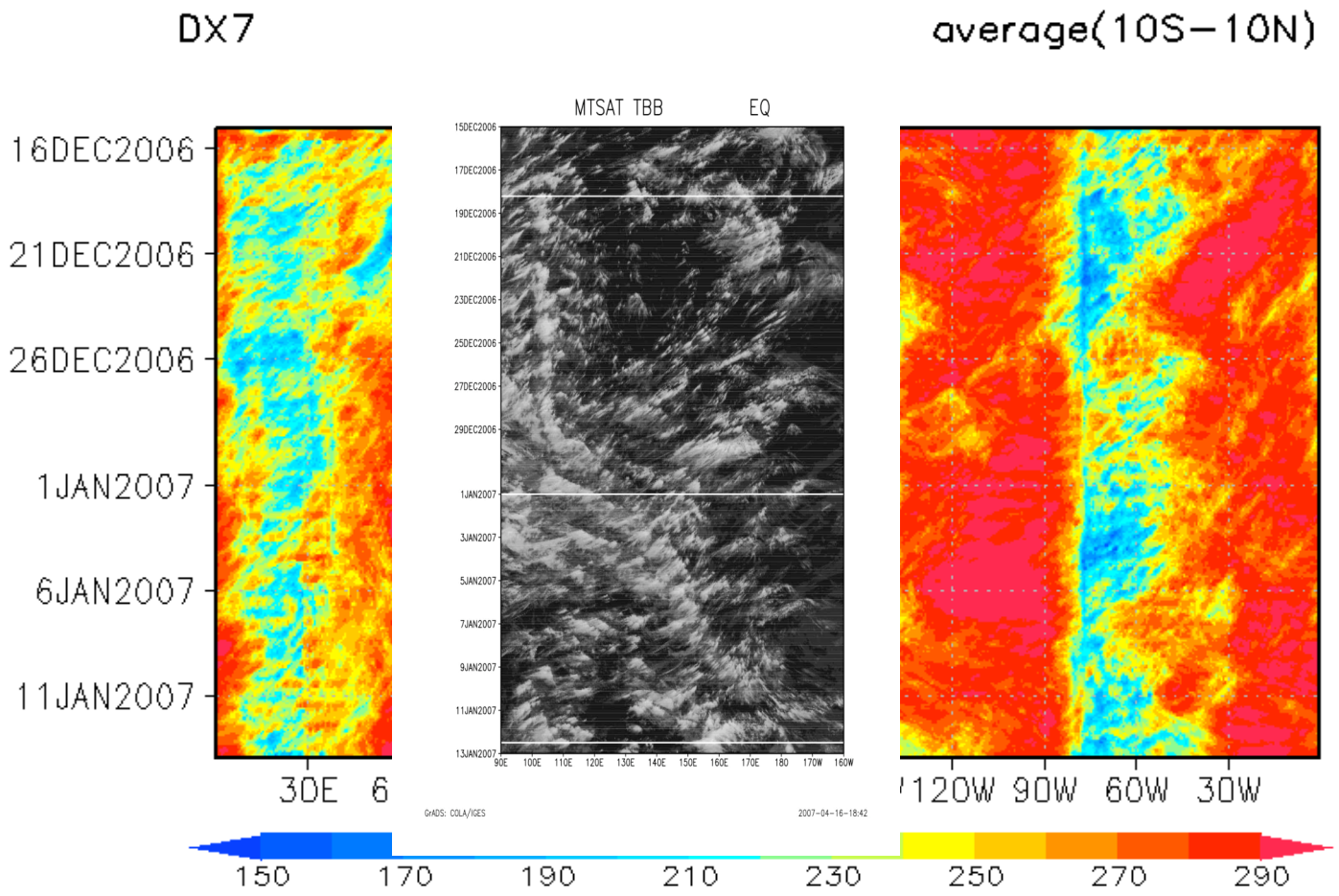
NICAM dx=3.5km

Hovmoller along equator

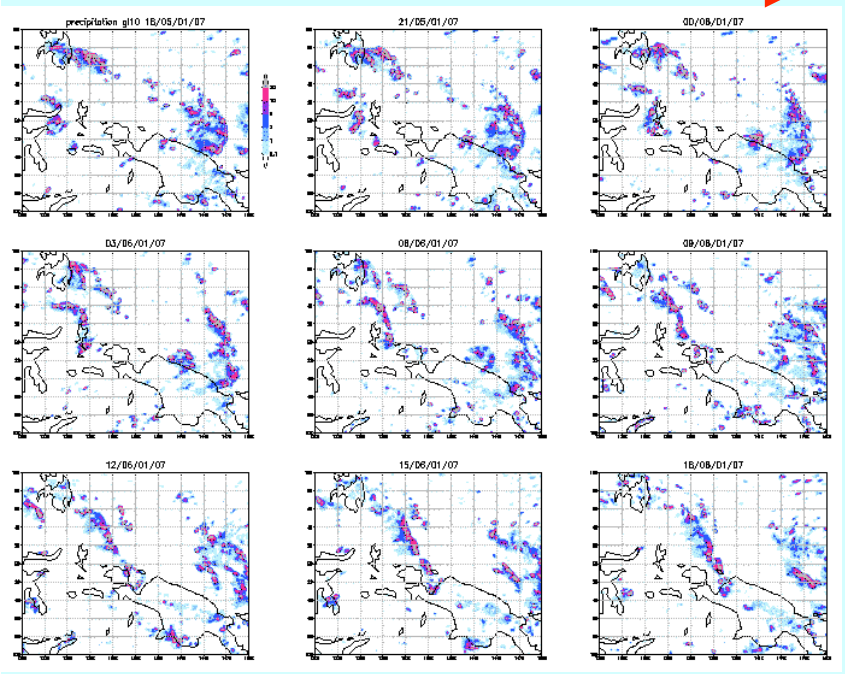
MTSAT-1R TBB by T.Nakazawa

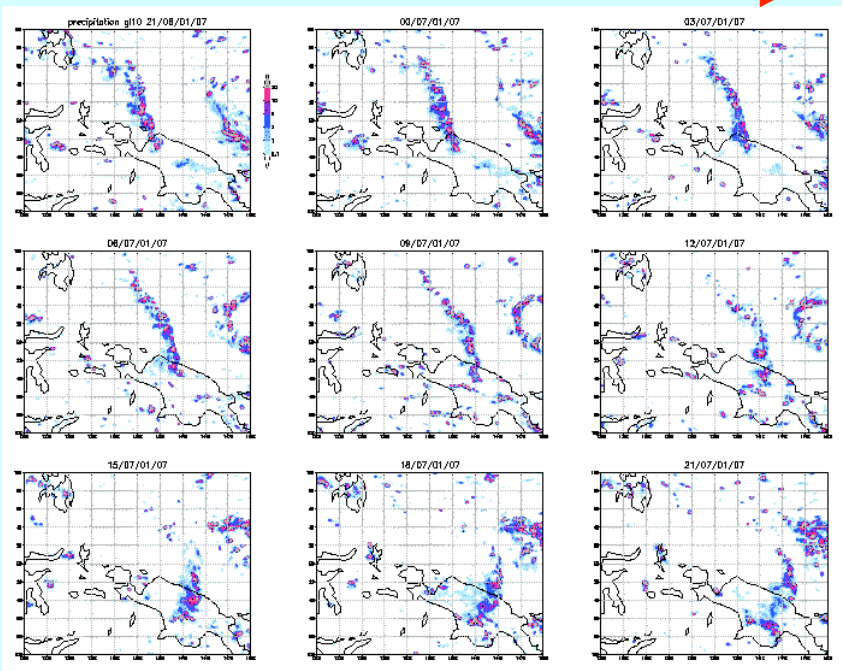
NICAM dx=7km OLR

Miura et al. (2007)



Rainband structures are captured in NICAM



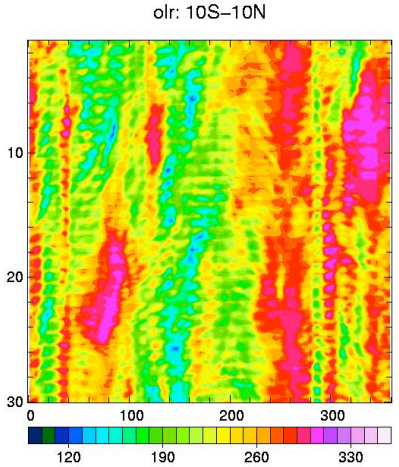


To be compared with Tbb/MTSAT image (courtesy of T.Nakazawa)

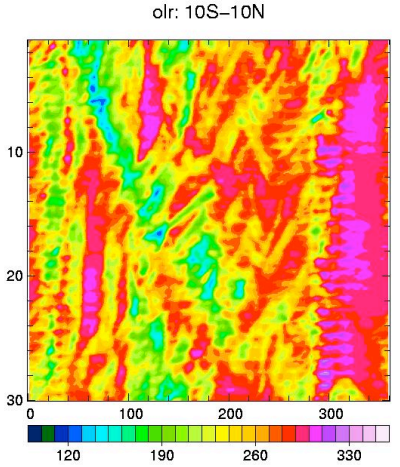
■Possible key roles on MJO: Suppression & triggering

NICAM low res. exp. dx=240km(gl-5) with PAS

OLR
Hovmoller 10S-10N
15 Dec-15 Jan



RH_{crt}=0%



RH_{crt}=80%

■ Suppresion of PAS by Cloud-mean relative humidity

Suzuki et al.(2006, *Dyn. Atom. Ocean.*)

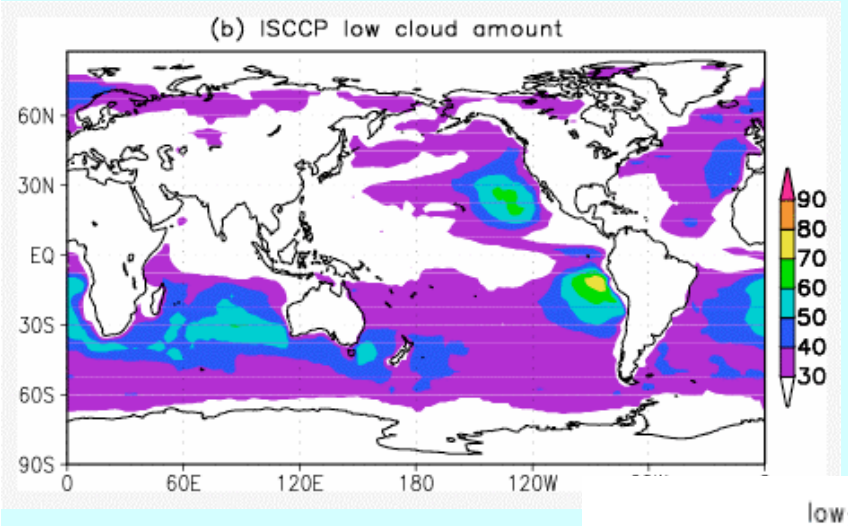
$$\overline{RH} = \frac{\int_{Z_M}^{Z_T} q dz}{\int_{Z_M}^{Z_T} q^* dz} > 80\%$$

Intra-seasonal Exp.
Jun-Aug 2004
& Apr 2004

Noda et al.
Miura et al.(2007)

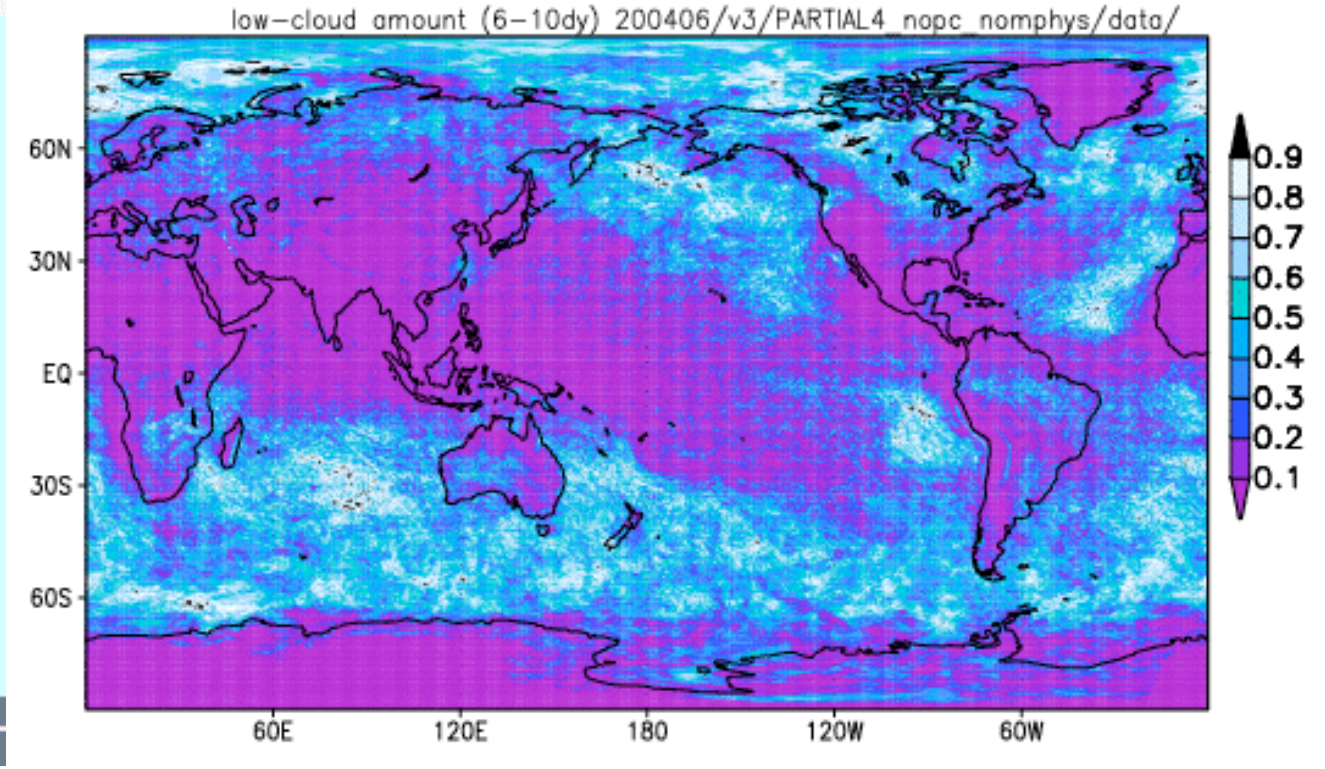
Seasonal change of monsoon
Tropical cyclones: 10 typhoons came to Japan
Boundary layer clouds
GPCI(GCSS Pacific Cross Section Intercomparison)-type exp.

Low-level clouds in Globe

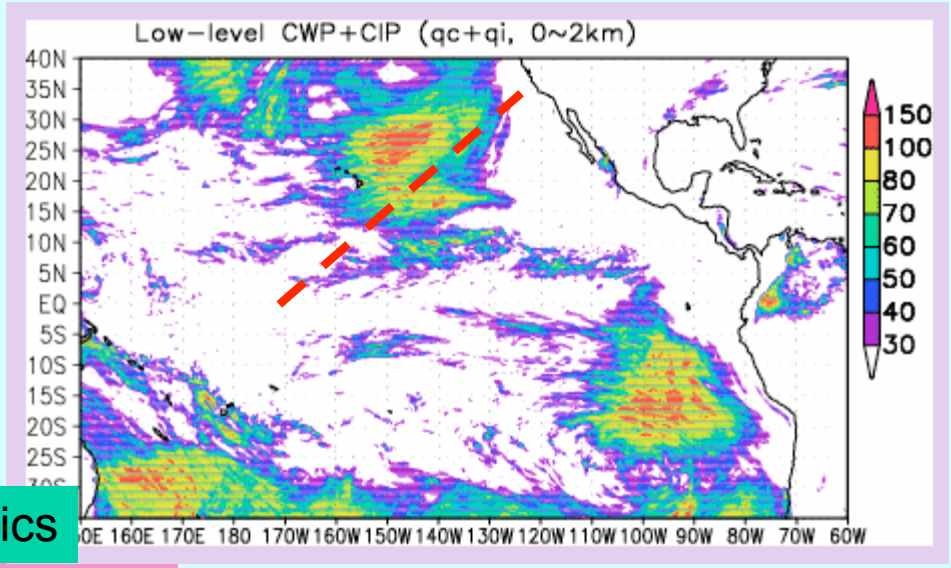


ISCCP June Climatology

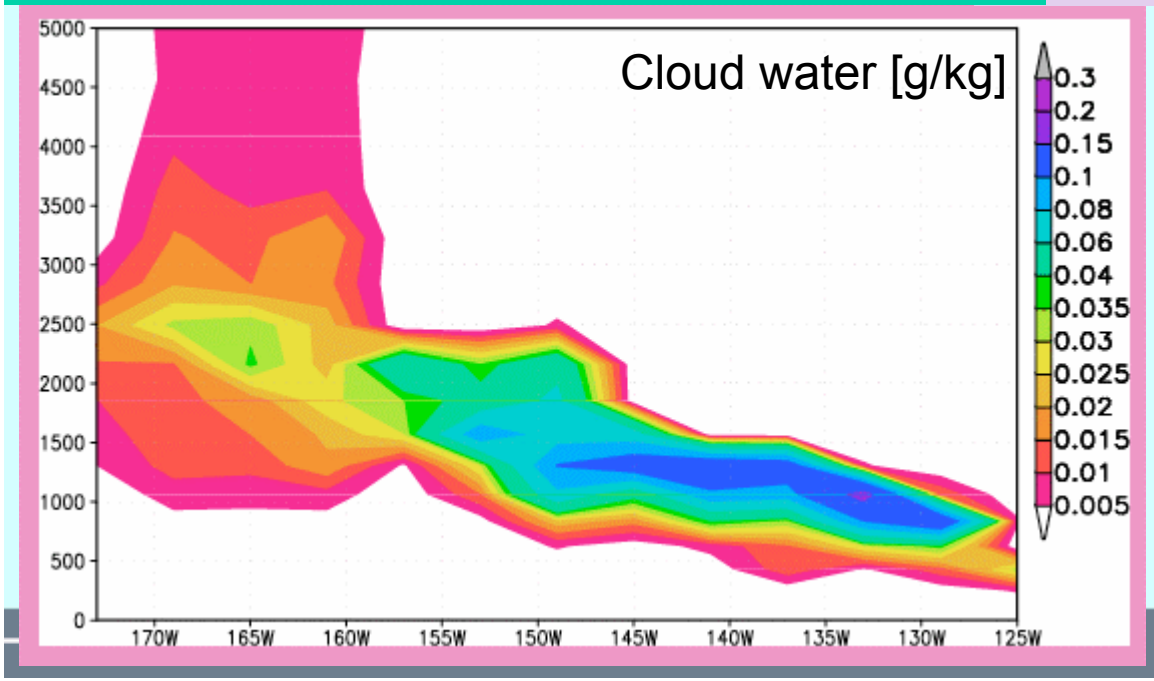
NICAM: ISCCP simulator (6-9 June 2004)



GPCI cross-section



Spatial development of PBL cloud in subtropics



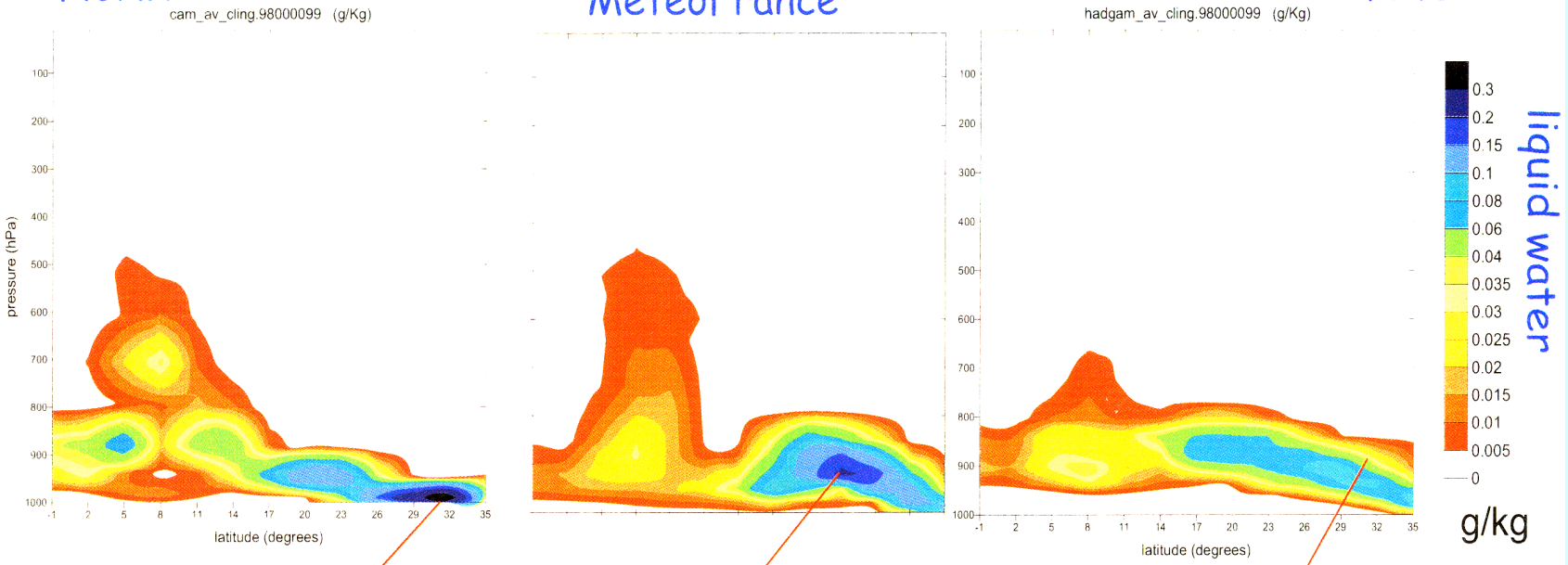
※averaged over 6~9 June 2004

Mean GPCI liquid water crossection - JJA98

NCAR

MeteoFrance

UKMO



Too shallow -> fog

Is this too much liquid water?

How deep should the PBL be..?

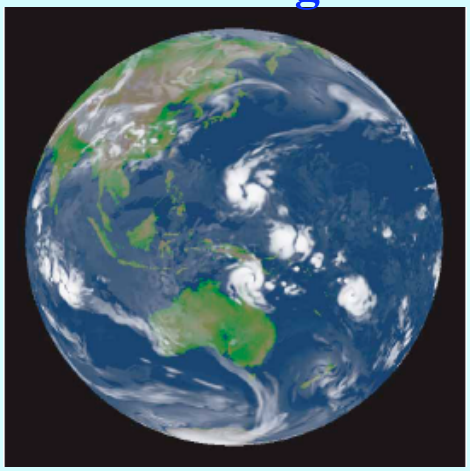
We need observations of cloud and boundary layer (PBL) parameters: PBL height, liquid water,..

Slide by Joao @ GISS meeting

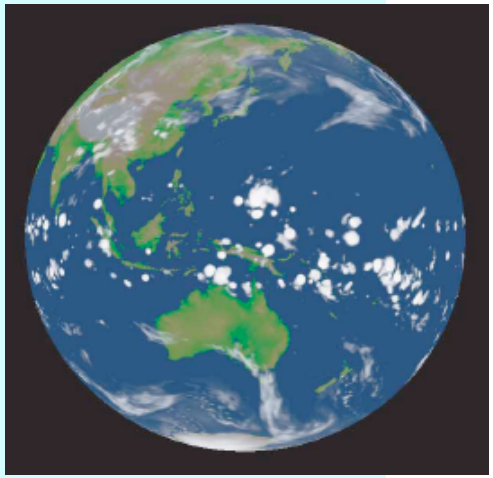
Sensitivity to boundary layer scheme

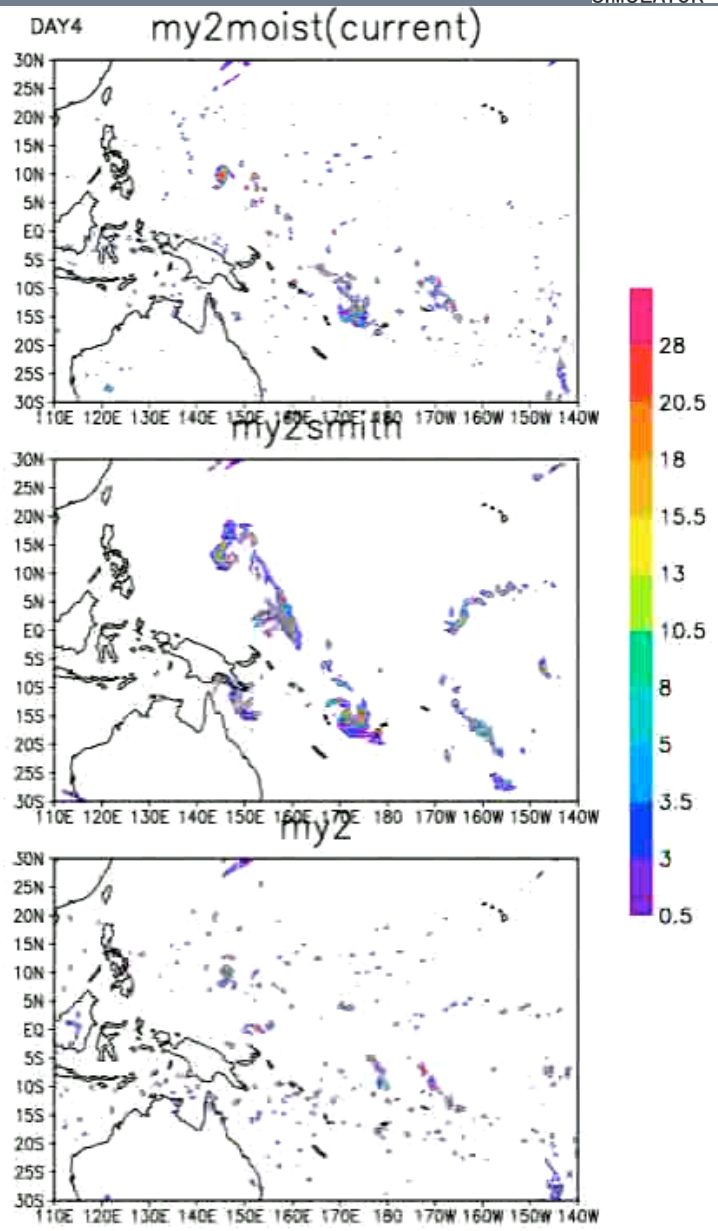
NICAM, dx~14km

MY2smith
enhanced moisture mixing



MY2
without moist effect





Exp. Apr 2004
Miura et al.(2007,GRL)

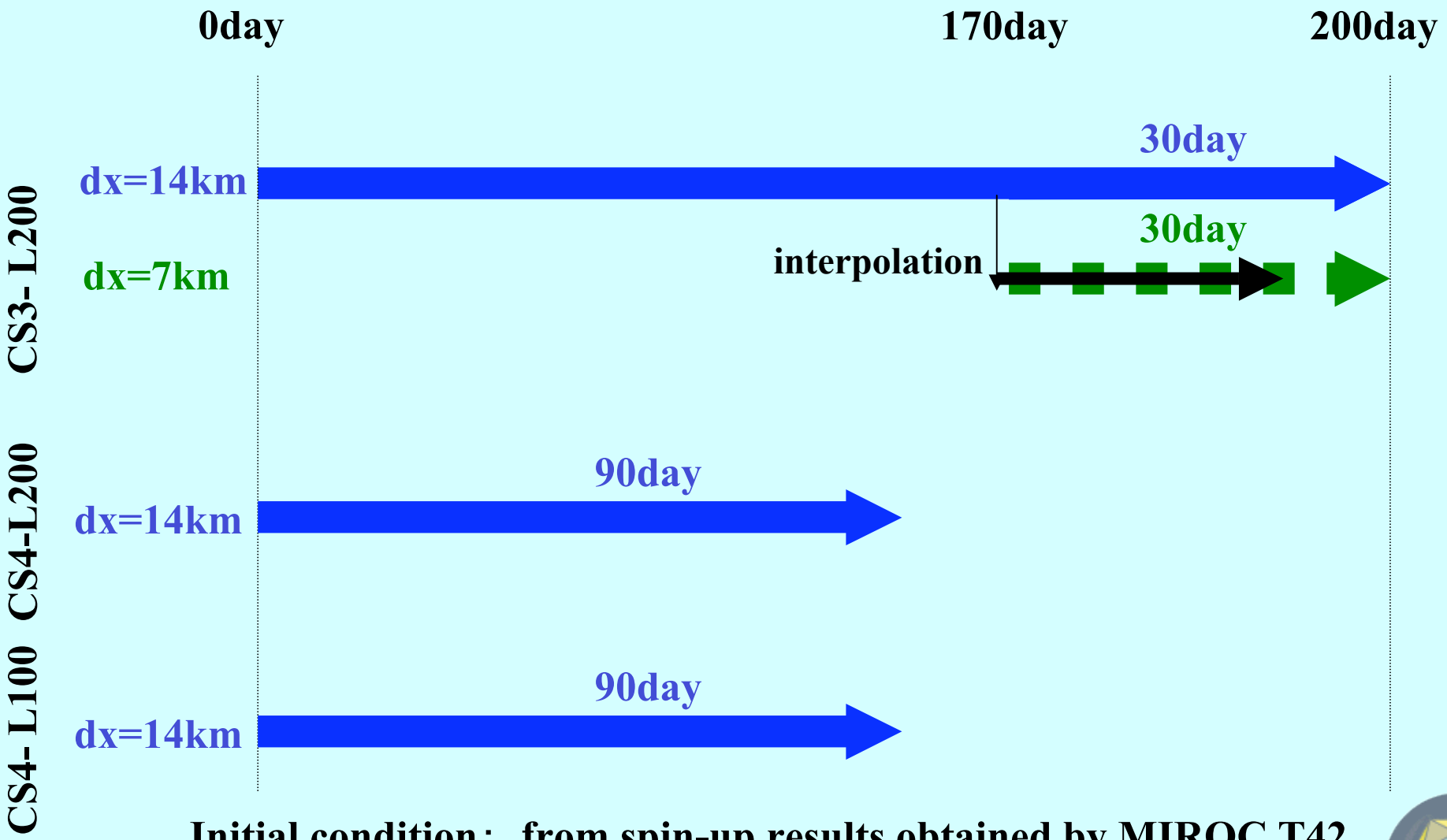
Perpetual Jul Exp.
& Cess-type climate sensitivity

Iga et al.(2007)
Tsushima et al.(2007)

Climatology
Parameter dependency on microphysics and boundary layer
Climate sensitivity

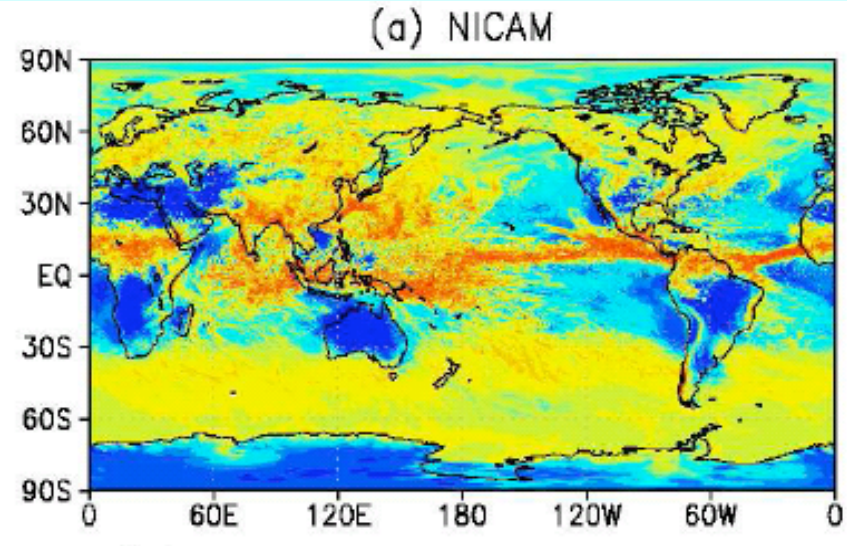
Integration time

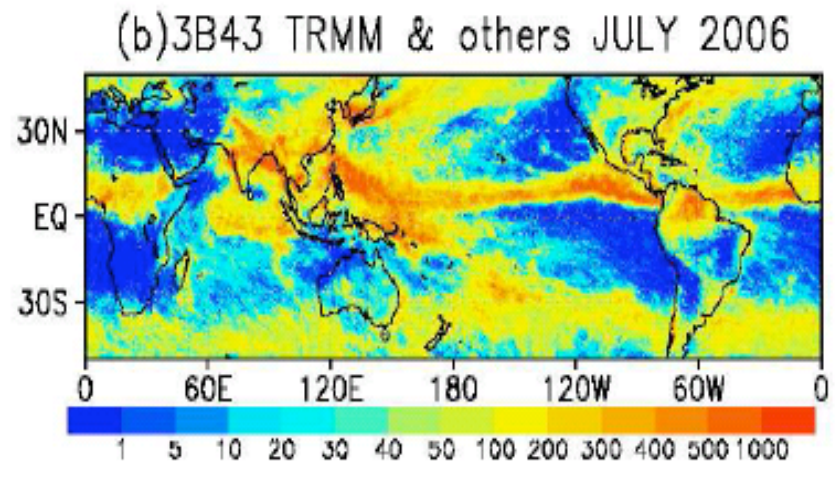
Iga et al. (2007,submitted to GRL)

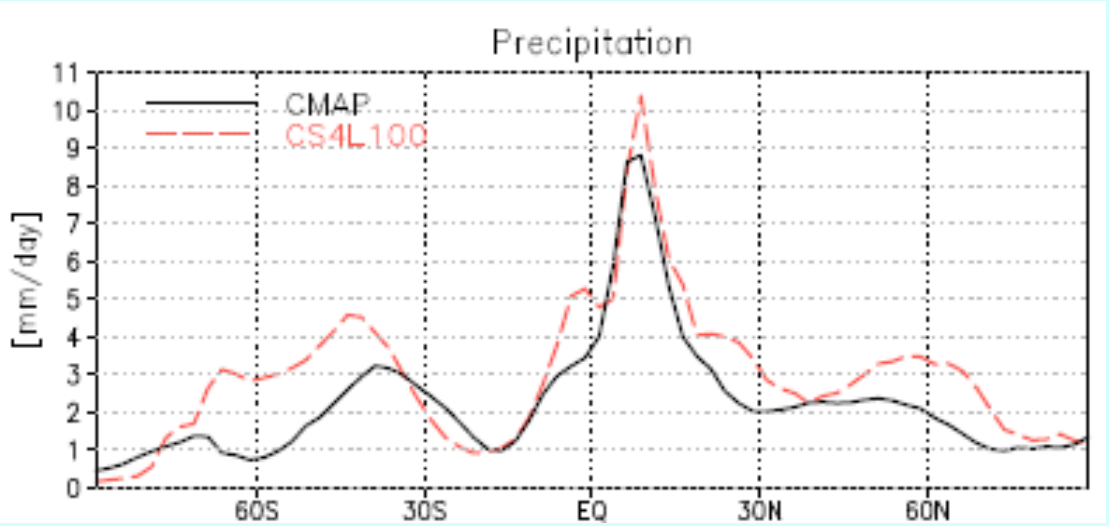


Initial condition : from spin-up results obtained by MIROC T42

Precipitation (1month, dx~14km)

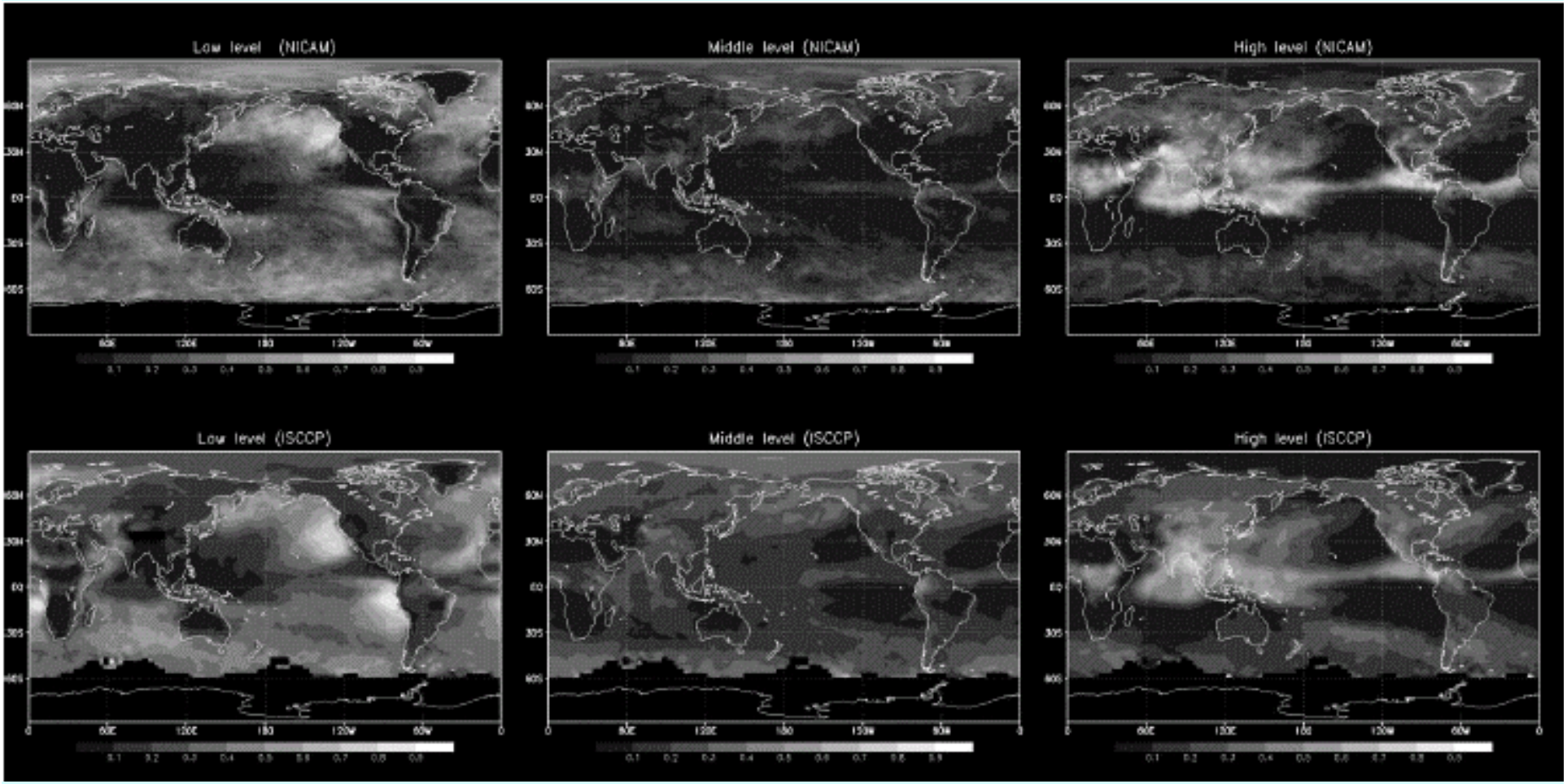






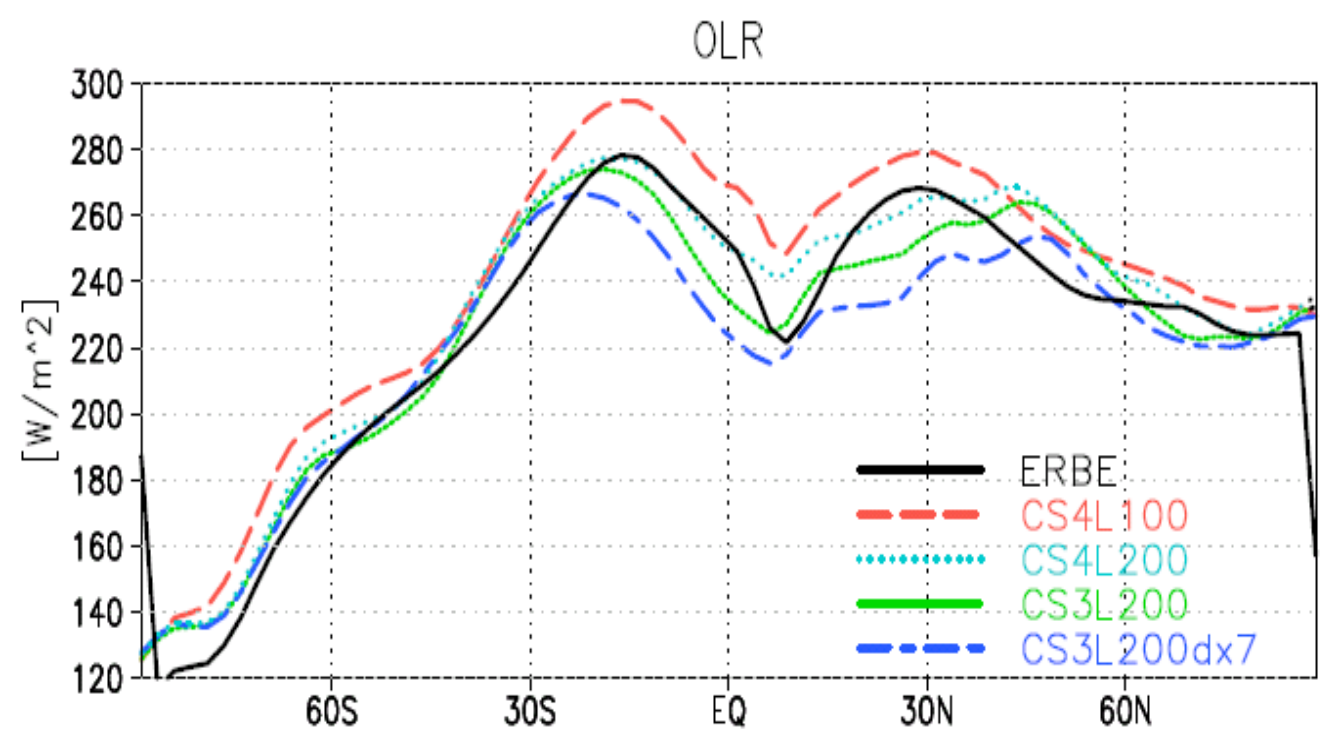
ISCCP Cloud fraction

NICAM: lower middle upper clouds



ISCCP: lower middle upper clouds

OLR sensitivity

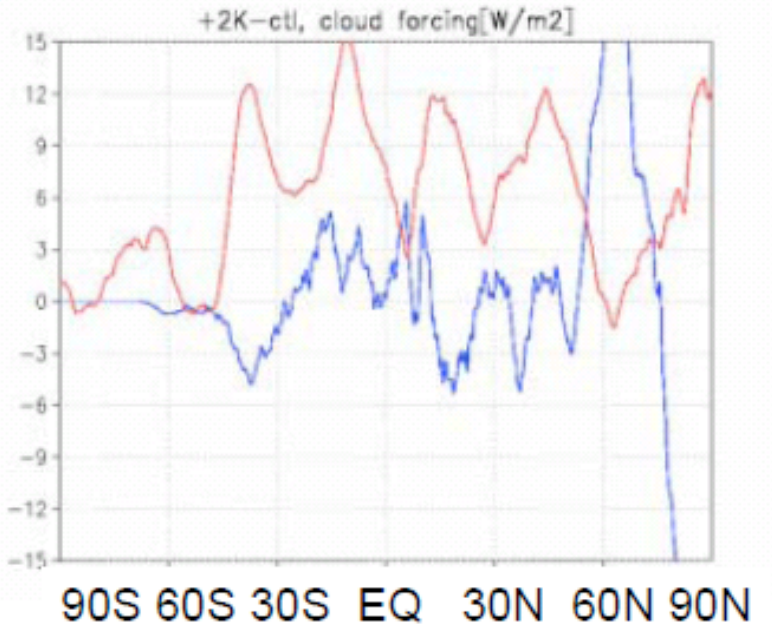


- Control: CS4, L100, dx~14km
- Slower Snow sedimentation speed: CS3
- Enhanced boundary mixing: L200
- Higher resolution: dx~7km

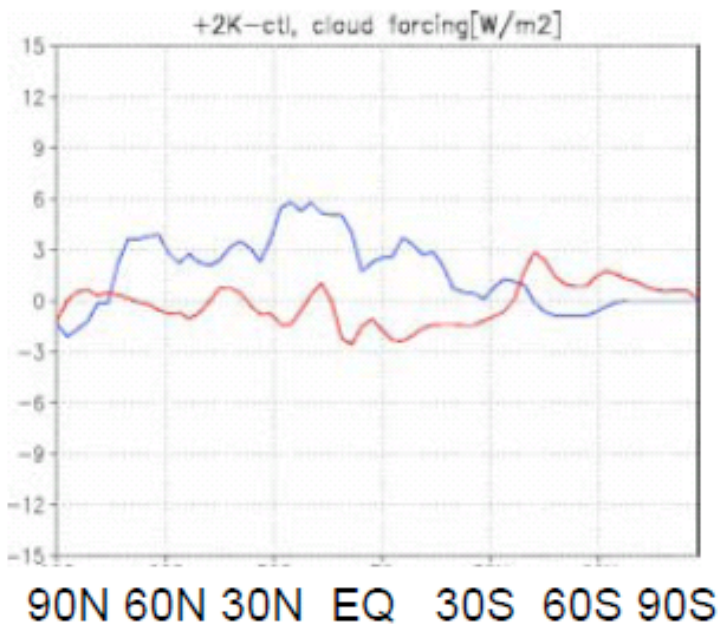
Sensitivity of cloud forcing

SW cloud forcing change
LW cloud forcing change

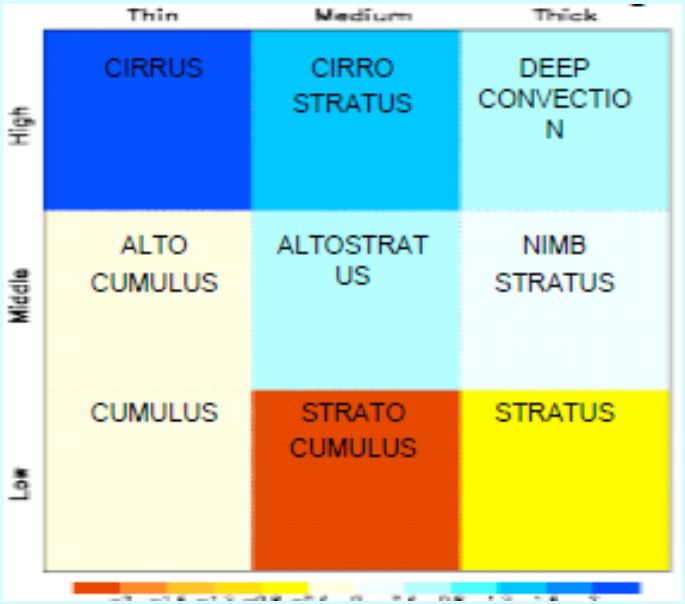
(a)

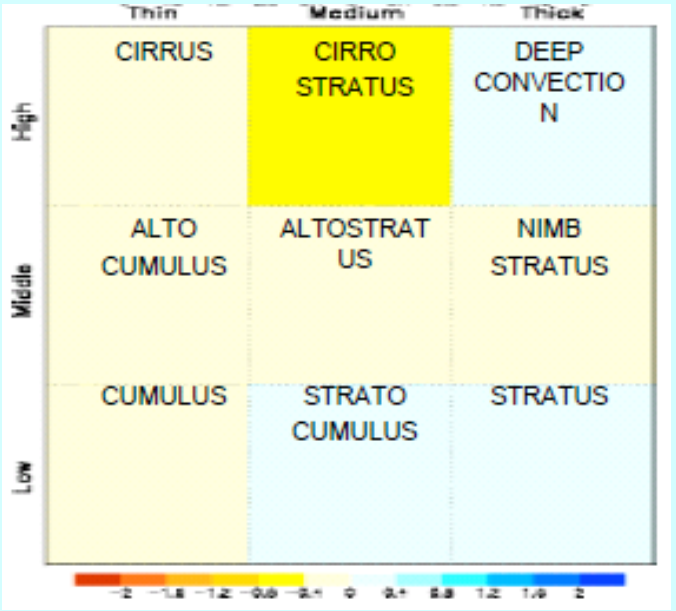


(b)



NICAM **MIROC**


Thin
Medium
Thick
High
Middle
Low
CIRRUS
CIRRO STRATUS
DEEP CONVECTIO N
ALTO CUMULUS
ALTOSTRAT US
NIMB STRATUS
CUMULUS
STRATO CUMULUS
STRATUS


Thin
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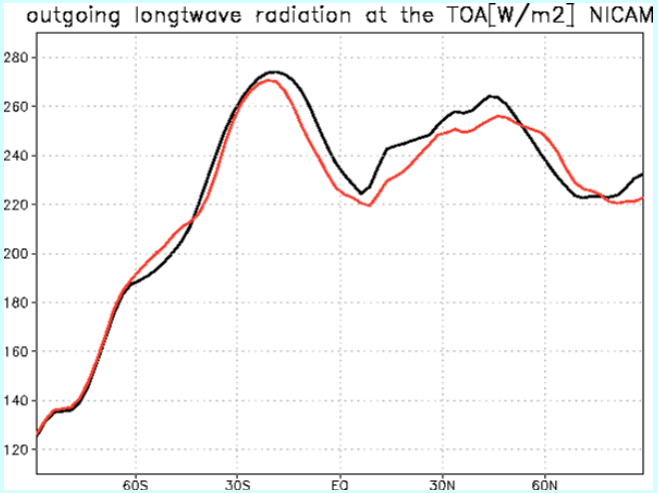
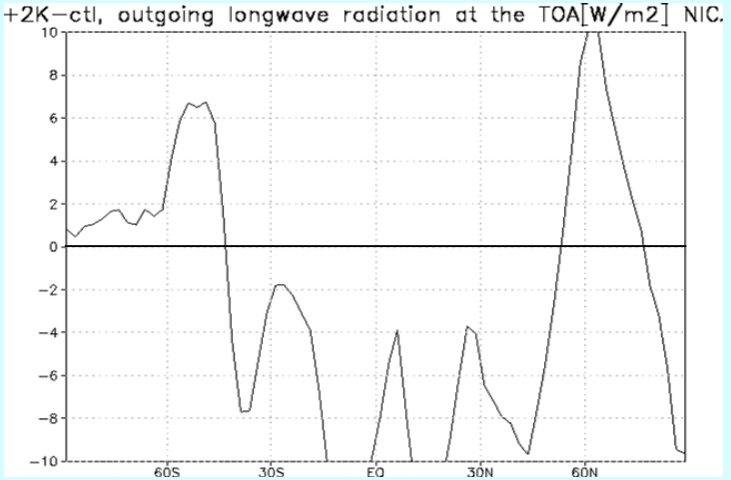
DEEP CONVECTIO N
ALTO CUMULUS
ALTOSTRAT US
NIMB STRATUS
CUMULUS
STRATO CUMULUS
STRATUS

NICAM **MIROC**

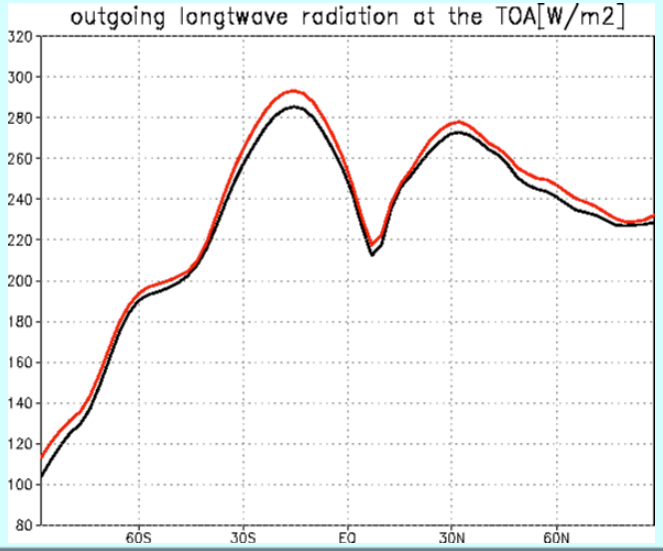
Climate sensitivity: SST+2K
OLR response

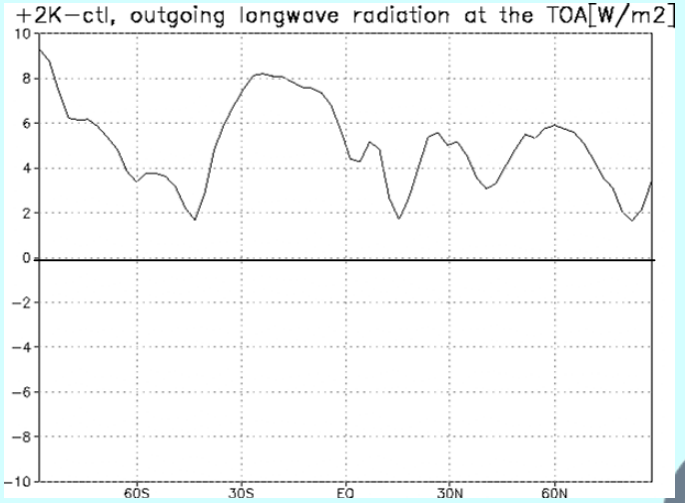
NICAM
dx~14km



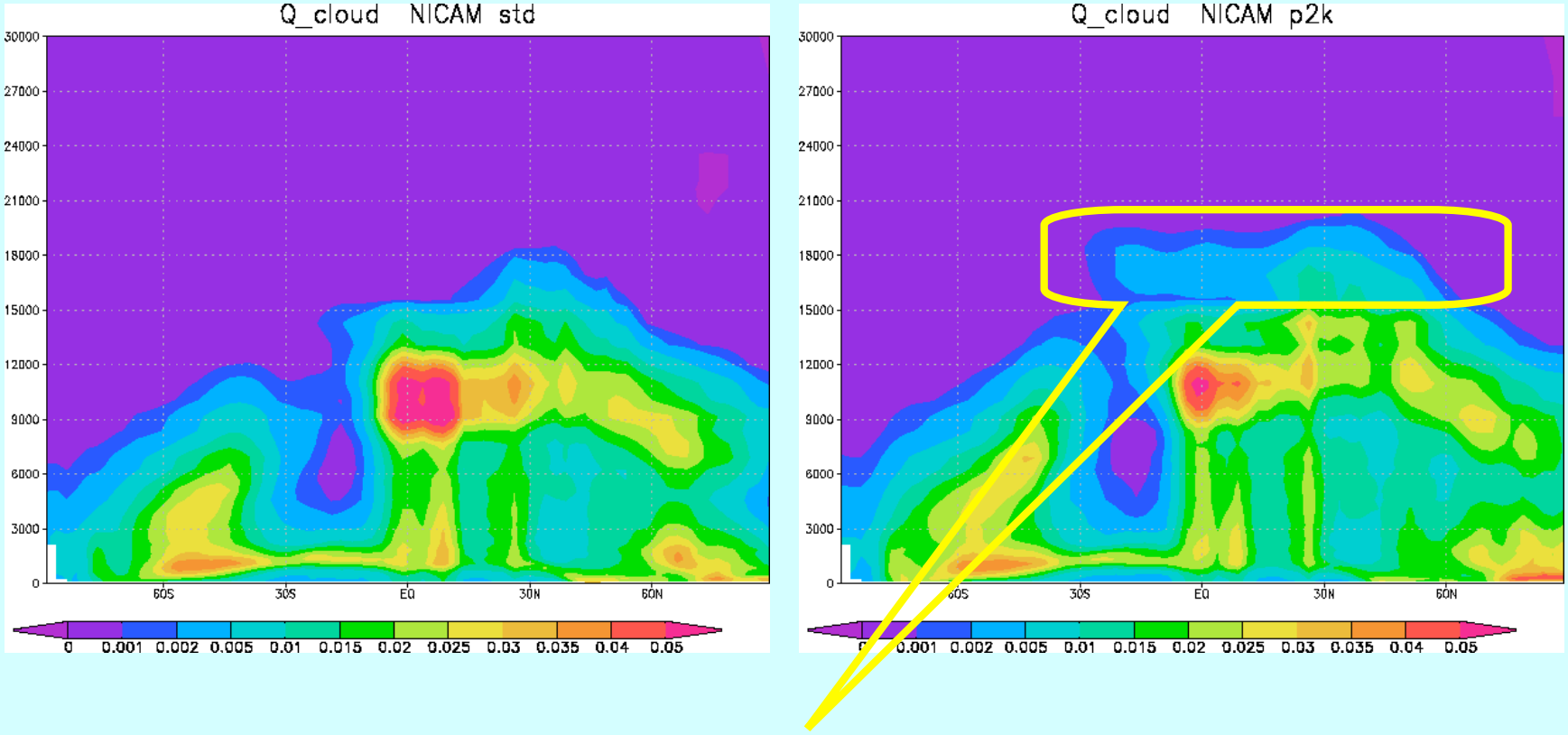


MIROC 2.0
AGCM T42





Total condensate mixing ratio



Slightly larger for +2K at 15km<z<18km in tropics
Smaller for +2K at z<15km

Summary of current works and prospects

- NICAM GCRM exp.
  - Validation and improvements of NICAM
- Common behaviors both for NICAM and MMF
  - A nice MJO; amplitude is a little over-emphasized
  - Good low level clouds
  - Climate sensitivity
- Tropical cyclogenesis
- Satellite observations
  - Analysis of size distribution of anvils (T.Inoue, B.Mapes)
  - Tbb/split window(T.Inoue)
  - CloudSat/Calipso camparison (K.Suzuki)
  - TRMM PR/TMI (H.Masunaga)
- Physics
  - Cloud microphysics: Grabowski(1998), NSW6 (H.Tomita 2007), Lin et al.(1983)
  - Boundary layer: MY2, 2.5, 3 with moist effects (Nakanishi & Niino 2004)
  - Radiation: partial clouds of low clouds
  - Subgrid convection (K.Oouchi, M.Yamasaki)