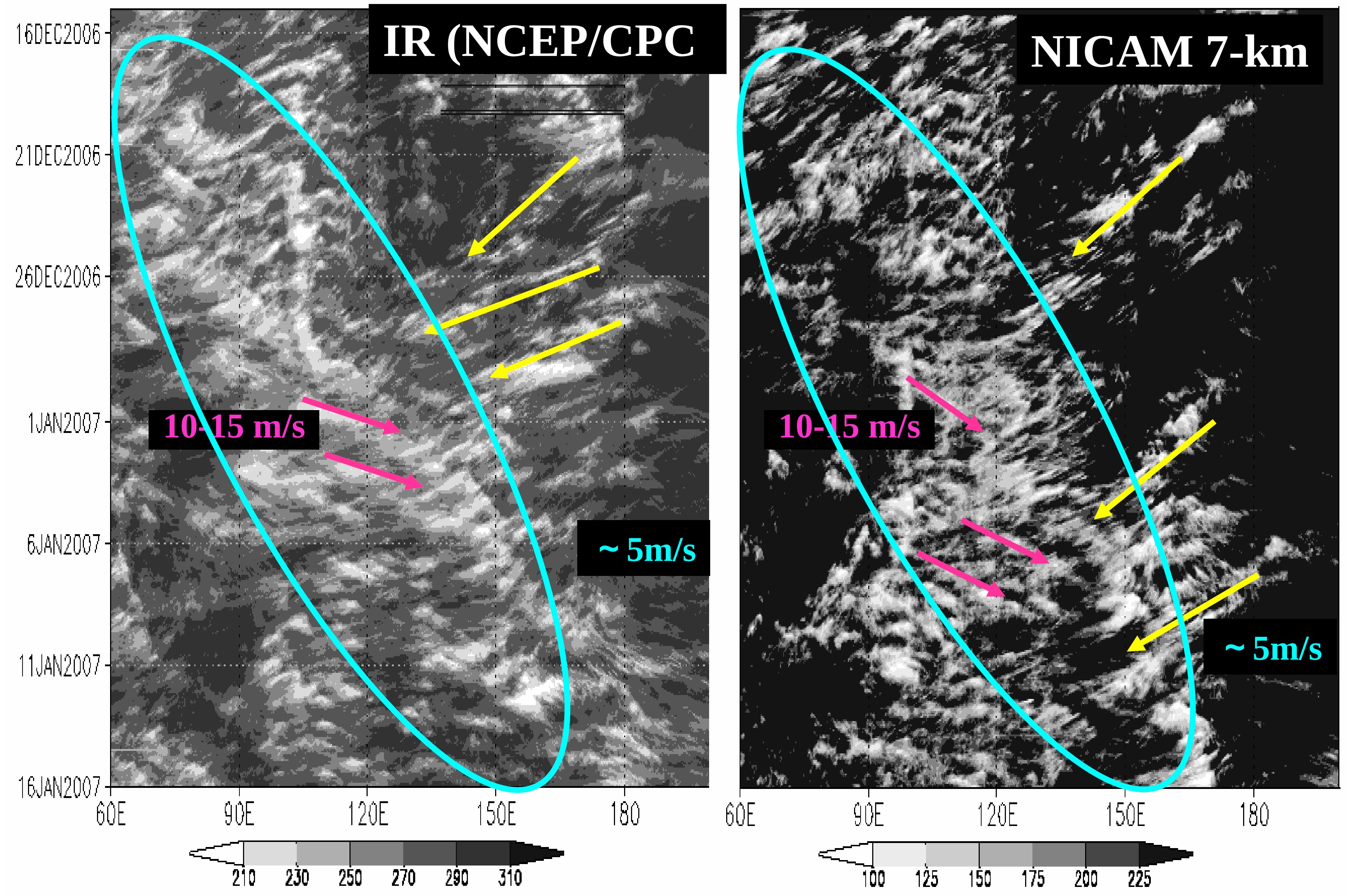
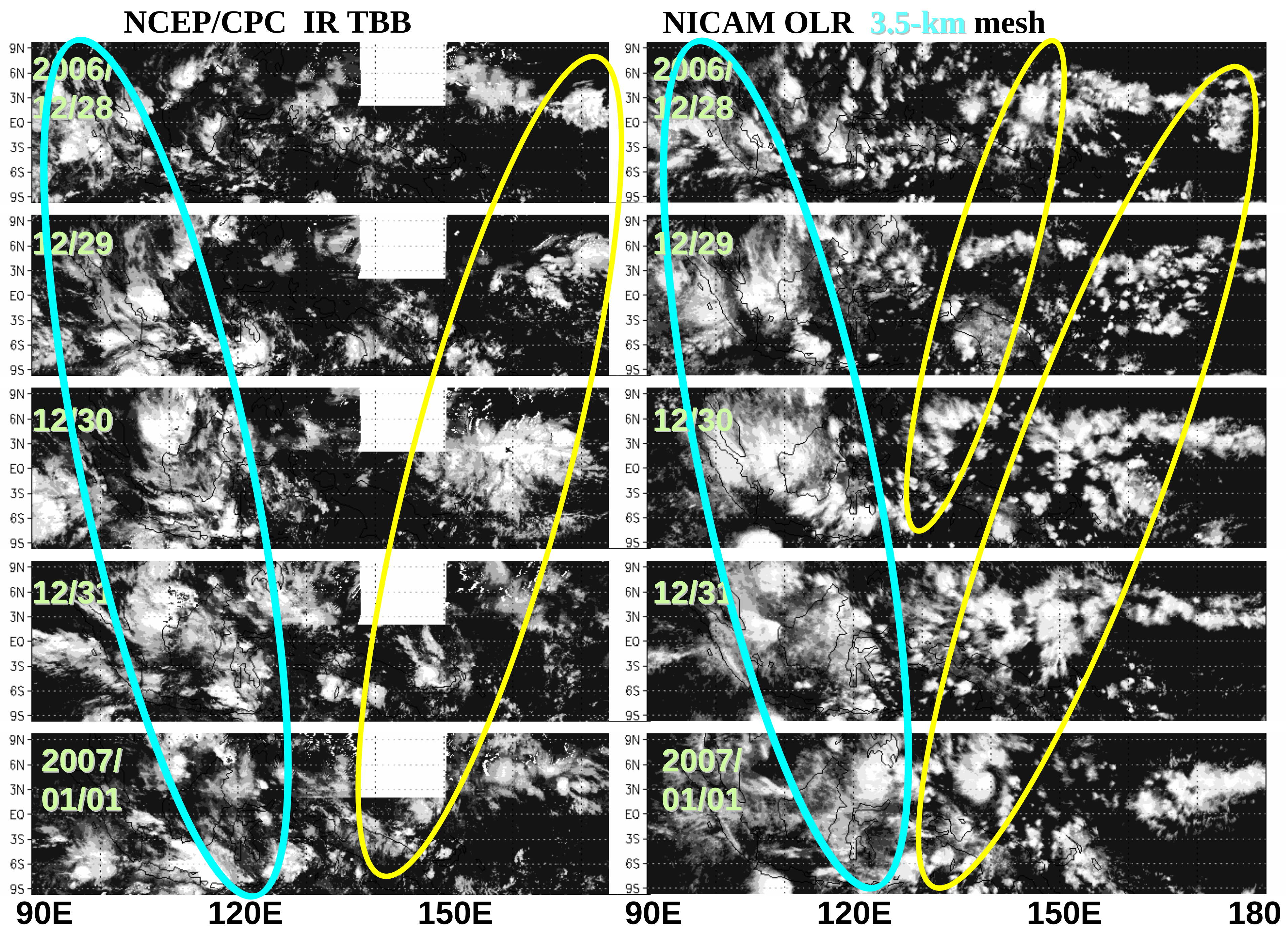
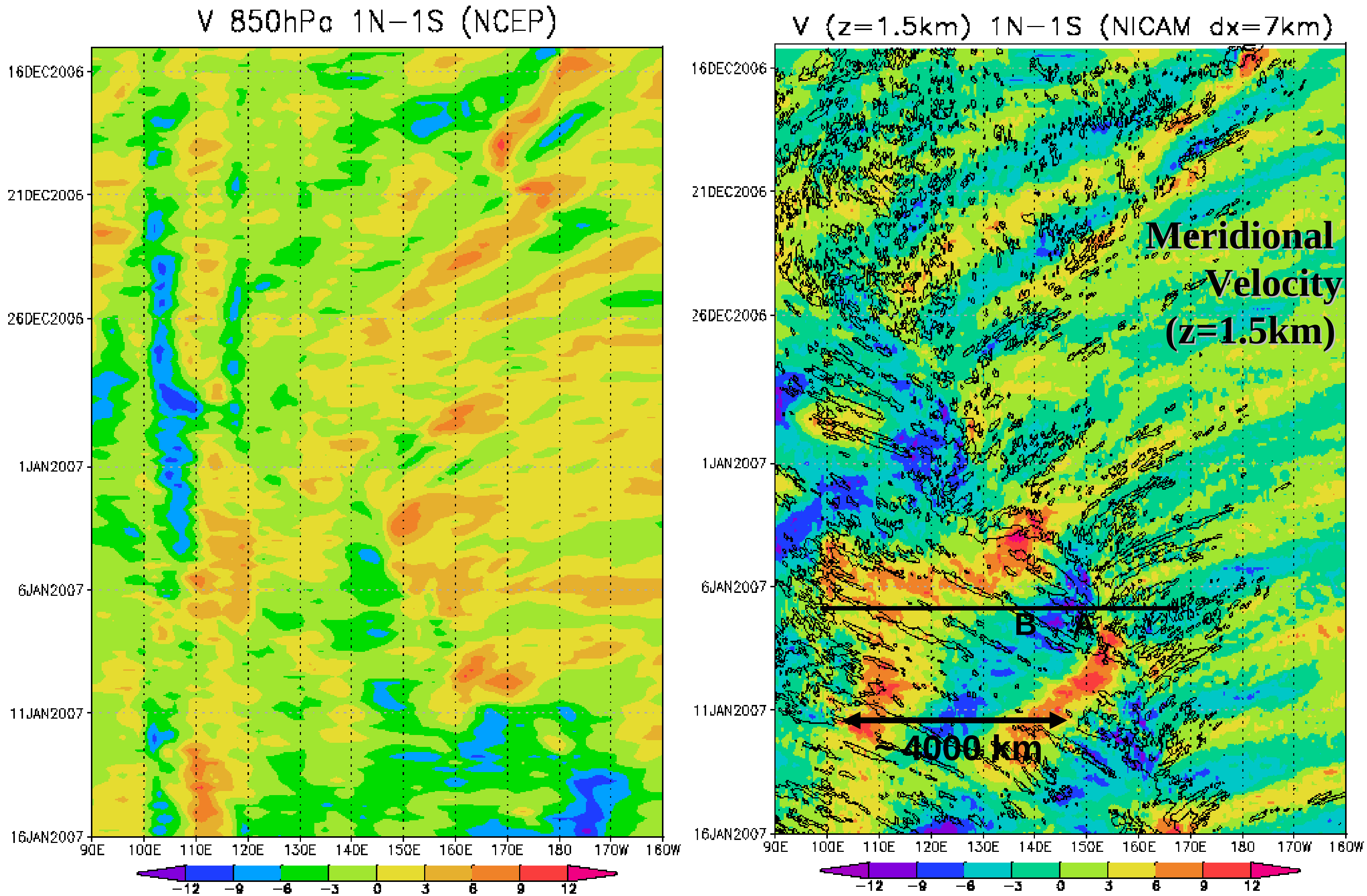
Use of GCRM simulations in ISV/Monsoon study

- It is extremely beneficial to construct diagnostics for short-time simulation (~1month)or case study that meets the interest of MJOWG diagnostics.
- We try to do this in CINDY/DYNAMO & YOTC project.
- Idea: moisture(process of low-level moistening leading deep convection), latent heating (by explicit representation), CMT (Dr. Miyakawa's poster), wave interactions (MRG, ER, Kelvin... associated convection quite often collide/merge in NICAM simulations)
- Difficulty: objective method to quantify multi-scale interactions are not yet established. 1st step: sub-grid effects in a GCM-grid-scale domain. Next step: identify convective systems (MCS, CCW, Cloud cluster, Super-cluster etc)

Hovmöller diagrams: IR/OLR (Equator)




NCEP/CPC IR TBB
NICAM OLR 3.5-km mesh
2006/
12/28
12/29
12/30
12/31
2007/
01/01
9N
6N
3N
EQ
3S
6S
9S
90E
120E
150E
180


V 850hPa 1N-1S (NCEP)
16DEC2006
21DEC2006
26DEC2006
1JAN2007
6JAN2007
11JAN2007
16JAN2007
90E 100E 110E 120E 130E 140E 150E 160E 170E 180 170W 160W
-12 -9 -6 -3 0 3 6 9 12
V (z=1.5km) 1N-1S (NICAM dx=7km)
16DEC2006
21DEC2006
26DEC2006
1JAN2007
6JAN2007
11JAN2007
16JAN2007
90E 100E 110E 120E 130E 140E 150E 160E 170E 180 170W 160W
-12 -9 -6 -3 0 3 6 9 12
Meridional Velocity (z=1.5km)
B
A
~4000 km

What we know from NICAM simulations

- Reproducibility of ISV is similar to other GCMs in

1. Boreal winter case (Dec 2006 case; Miura et al. 2007) is better than boreal summer case (JJA 2004; Oouchi et al. 2009, Apr 2008; Taniguchi et al. 2010)

   --- but northward migration of precipitation and westerly are captured.

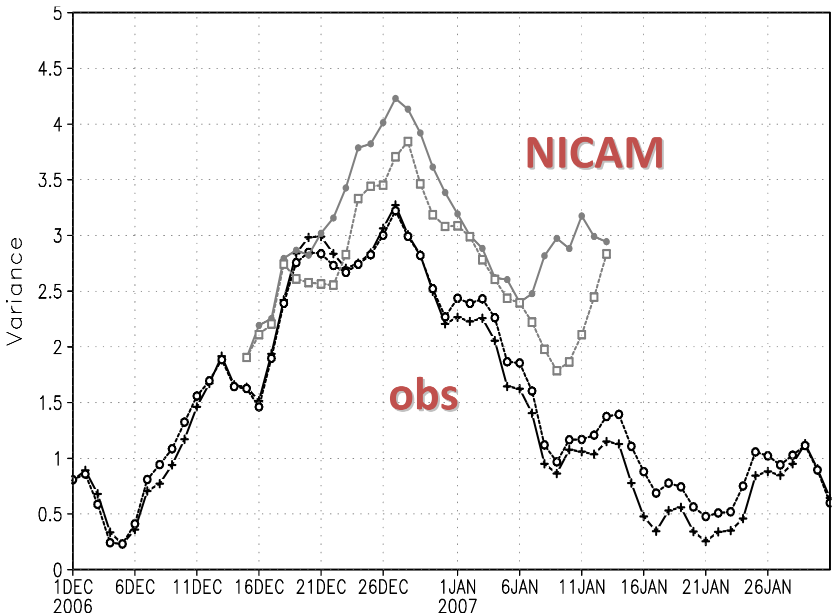
2. Predictability of ISV is ~30days. It is questionable whether ISV cycles can be reproduced by extension of simulation period as initial condition problem.

   --- but we can apply MJOWG diagnostics using multiple sets of several-months simulations

3. Strong MJO event can be simulated with rough initialization (simple interpolation of reanalysis data onto NICAM grid) even with 14 and 7 km mesh (2006 case). The key will be realistic response of convection to large-scale state.

Liu, et al. (2009), Mon. Wea. Rev.

MJO index



Phase diagram

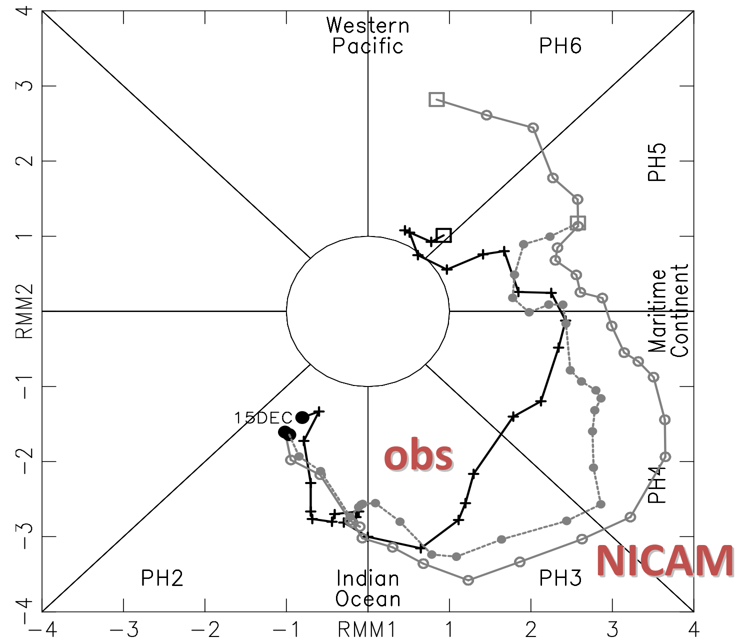
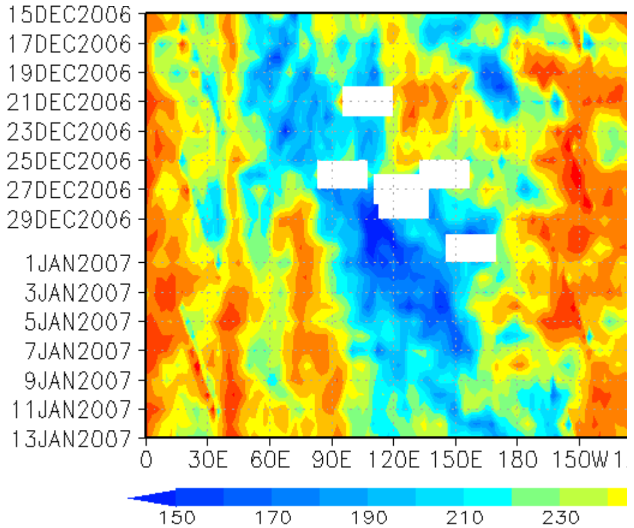


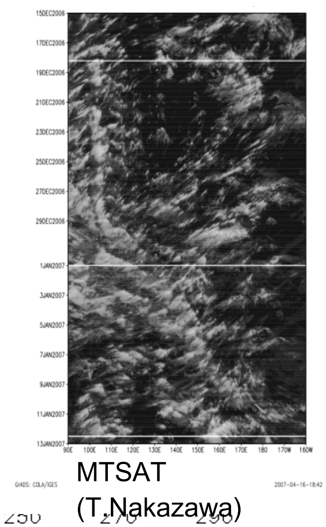
Fig. 3 Evolution of the MJO event in amplitude represented by $(RMM1^2 + RMM2^2)^{1/2}$. The black-solid curve is derived using the anomalous fields described in WH04; others use simple anomalies by excluding the observed climatology for observations (black-dashed), the 14-km NICAM (gray-solid), and the 7-km NICAM (gray-dashed).

Fig. 4 RMM diagram for the MJO event in observations (black-solid), the 14-km NICAM (gray-solid) and the 7-km NICAM (gray-dashed).

NOAA OLR



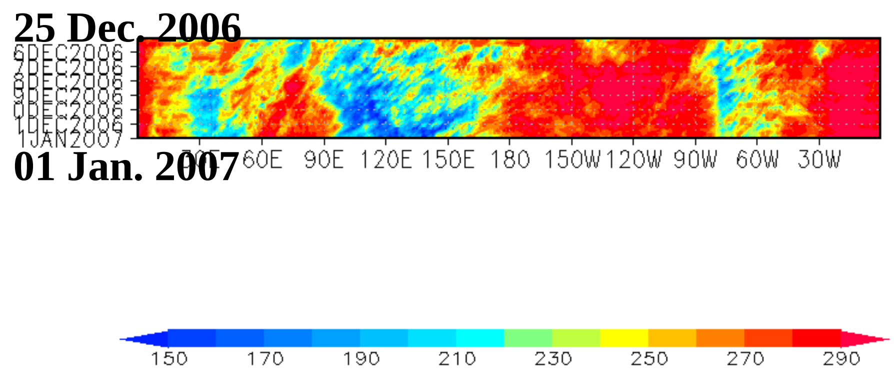
MTSAT TBB



DX3.5 average(10S−10N)

OLR

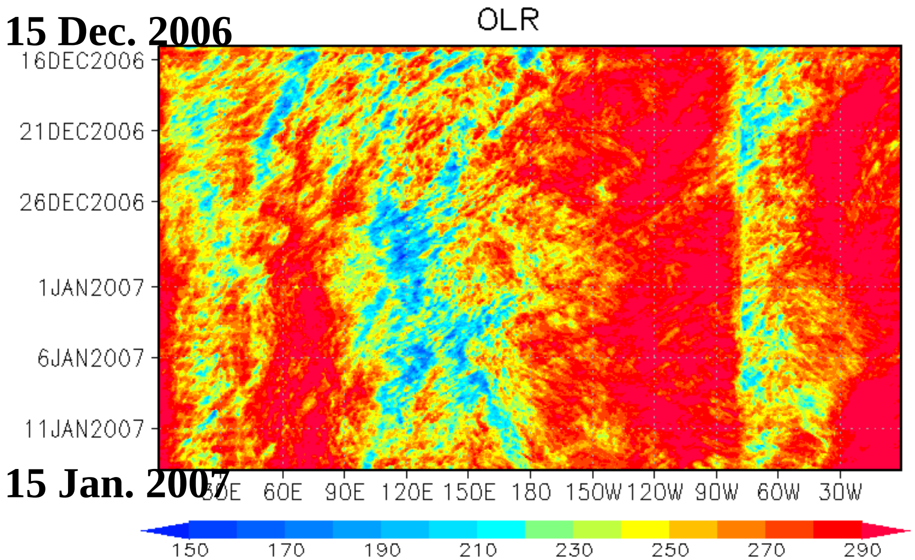
NICAM dx=3.5 km



NICAM dx=14 km

average(10S−10N)

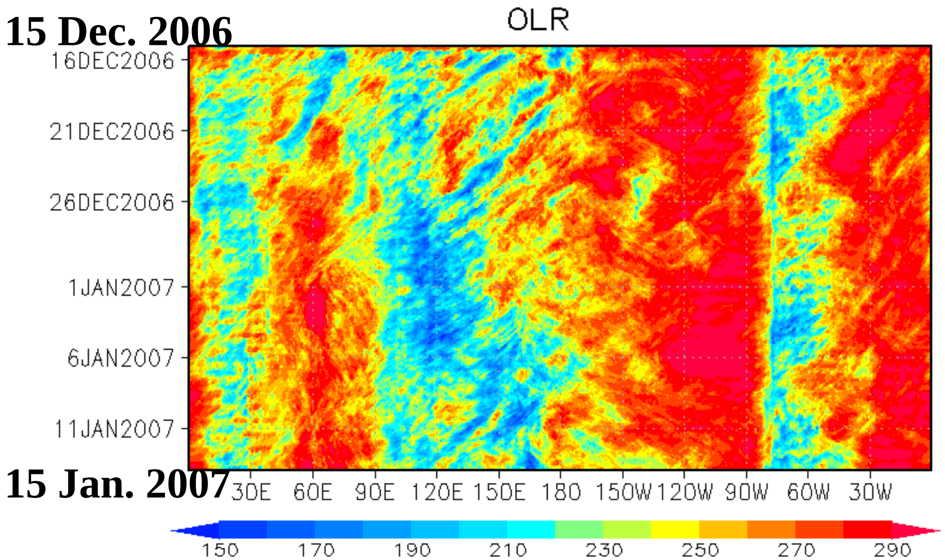
OLR



NICAM dx=7 km

average(10S−10N)

OLR



- Sensitivity tests and tuning are oriented to improvement of global balance; radiation, cloud amount, precipitation.

  --- but basic study using aquaplanet setup is executed.

  we had no MJO with zonally invariant SST distribution.

  intraseasonal scale variability appeared with sinusoidal SST.

- <u>collaborative use of NICAM simulation data</u>

  WE OPEN OUR DATA TO COLLABORATORS.

  (no free access, by individual communication)

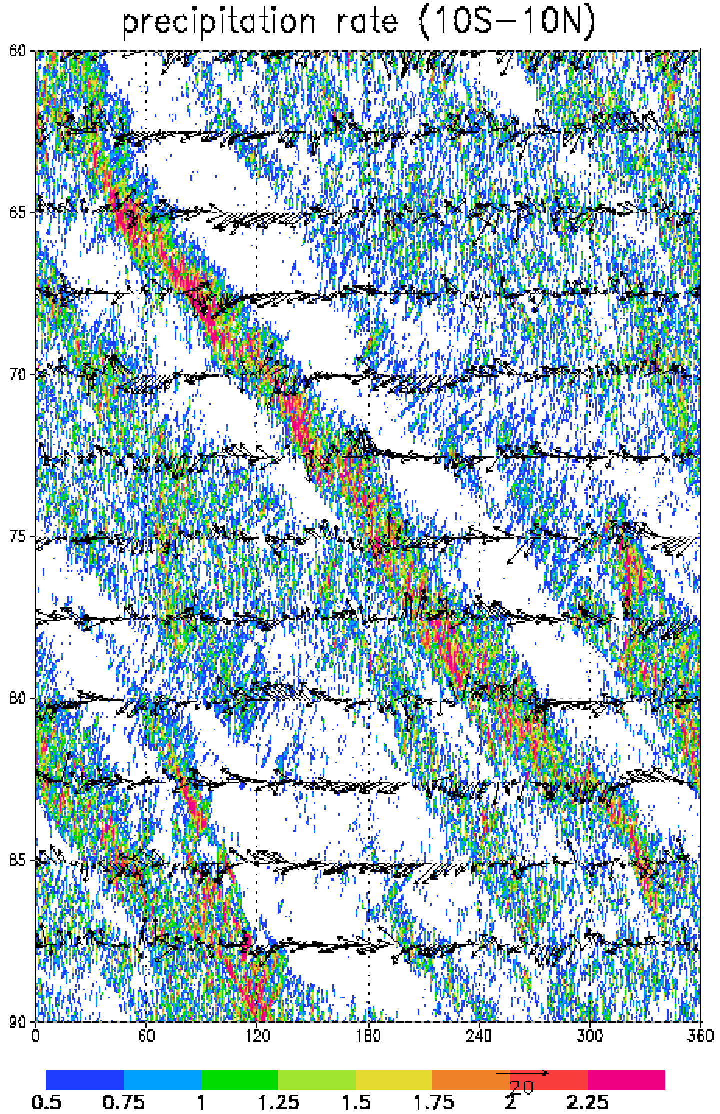
  please contact us if you want to use our data.

  simulation of YOTC period (2008/6/15-22) with 14 and 3.5 km will be open at an appropriate timing (7 days integration just finished last week)

  * reduced resolution dataset for first look

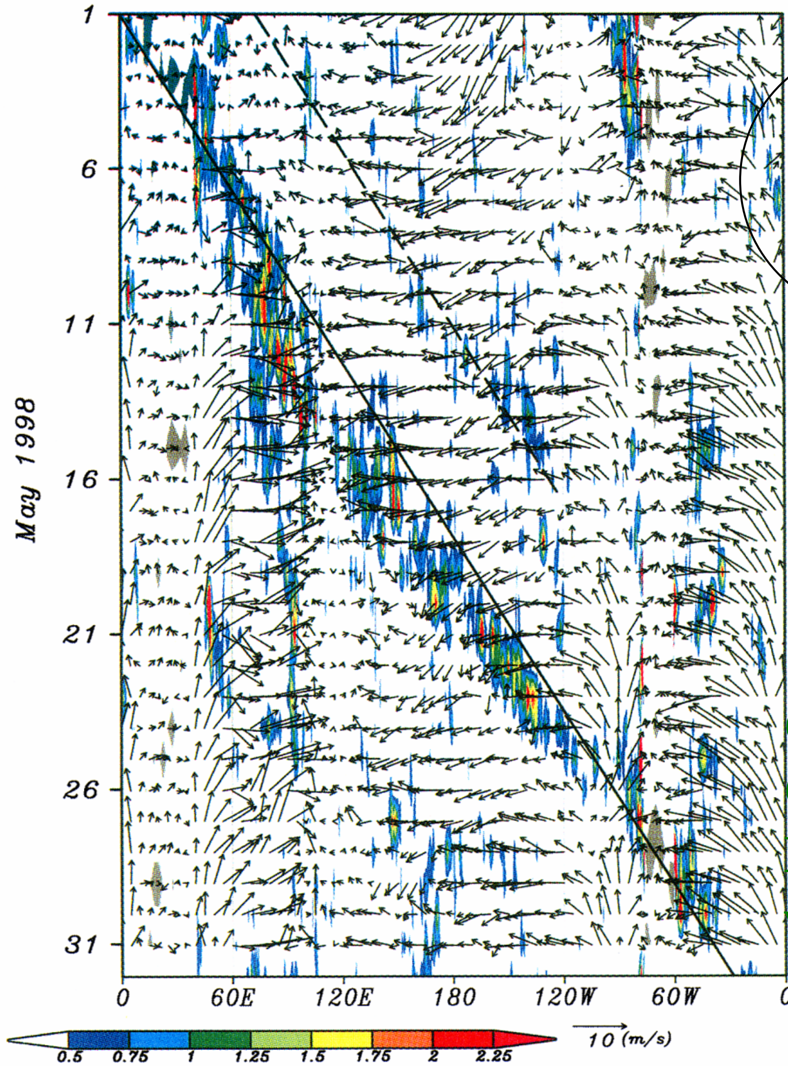
Aquaplanet experiment (Tomita et al. 2005, GRL)

NICAM (7-km mesh)



TRMM (Takayabu et al. 1999)

May 1998



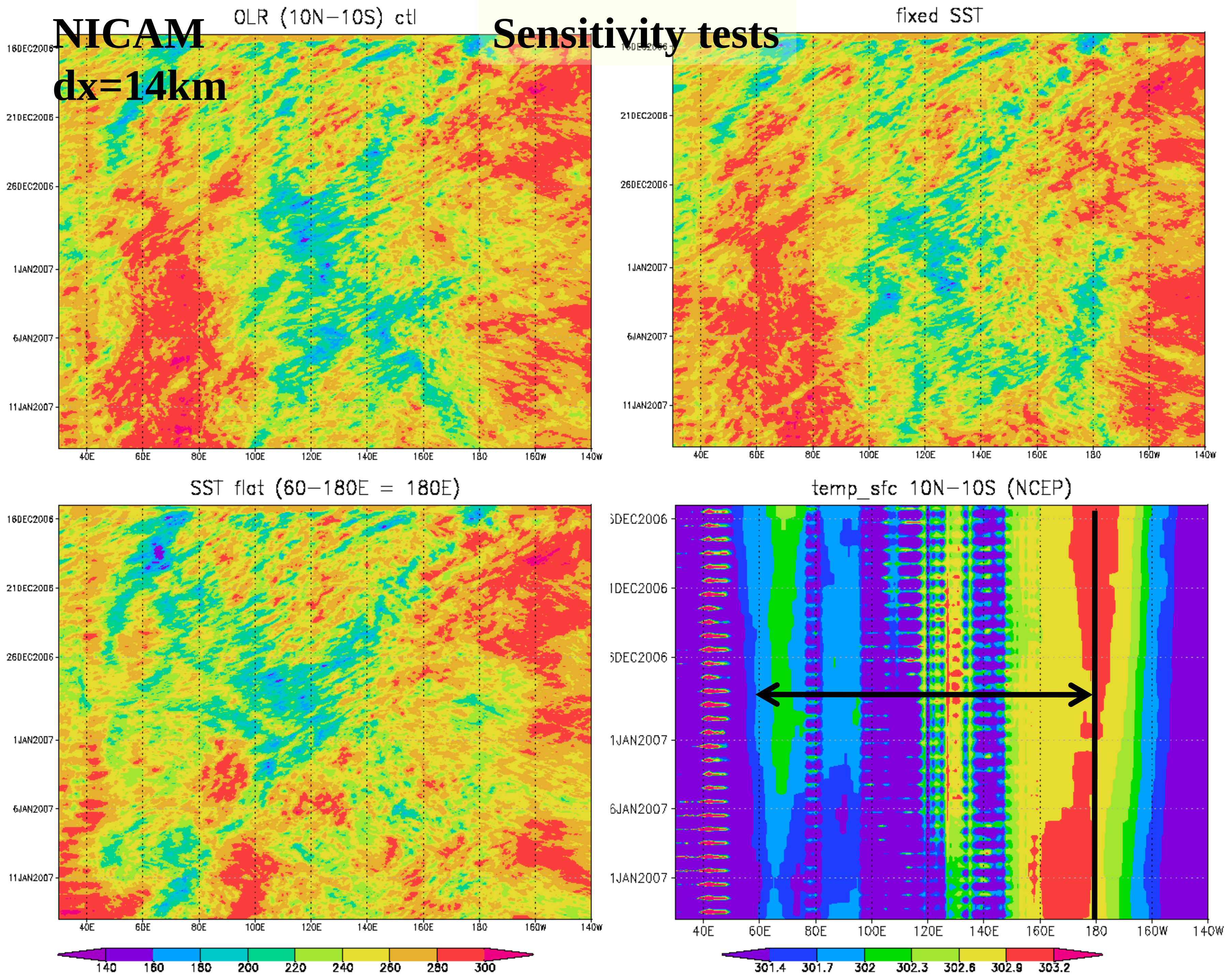
Weak SST gradient

~ 1 5 m/s

Convectively Coupled Kelvin wave

NICAM dx=14km

Sensitivity tests



data size

7 km mesh, single-level (32days, 1.5 hourly) = 27GB

3.5 km mesh, single-level (7days, 1.5 hourly) = 21GB

7 km mesh 40L, (32days, 6 hourly) = 270GB

3.5 km mesh 40L, (7days, daily) = 52.5GB

output variables (Grads format)

[MULTI LEVEL -- 13 variables] (glevel-09, 10:6-hourly) (glevel-11: daily) snapshot

ml_dh : diabatic heating rate (cloud microphysics) [K/s]

ml_pres : pressure [Pa]

ml_qc : cloud water mixing ratio (microphysics) [kg/kg]

ml_qi : cloud ice mixing ratio [kg/kg]

ml_qr : rain mixing ratio [kg/kg]

ml_qs : snow mixing ratio [kg/kg]

ml_qv : water vapor mixing ratio [kg/kg]

ml_rh : relative humidity [frac.]

ml_rho : density (all species) [kg/m^3]

ml_tem : temperature [K]

ml_ucos : zonal velocity (multiplied by cos(lat)) [m/s]

ml_vcos : meridional velocity (multiplied by cos(lat)) [m/s]

ml_w : vertical velocity [m/s]

[SINGLE LEVEL -- 27 variables] (1.5-hourly mean)
sl_albedo : albedo [frac.]
sl_cld_frac : cloud fraction [frac.]
sl_cldi : column integrated solid water [kg/m^2]
sl_cldw : column integrated liquid water [kg/m^2]
sl_evap : evaporation rate [kg/m^2/s]
sl_lw_toa : outgoing long-wave flux at TOA [W/m^2]
sl_lw_toa_c : outgoing long-wave flux at TOA (clear sky) [W/m^2]
sl_ps : surface pressure [Pa]
sl_q2m : 2 m water vapor mixing ratio [kg/kg]
sl_slh : surface latent heat flux [W/m^2]
sl_slwd : surface long-wave radiation (downward) [W/m^2]
sl_slwu : surface long-wave radiation (upward) [W/m^2]
sl_ssh : surface sensible heat flux [W/m^2]
sl_sswi : surface short-wave radiation (downward/incident) [W/m^2]
sl_sswr : surface short-wave radiation (upward/reflected) [W/m^2]
sl_sw_toai : downward short-wave radiation at TOA [W/m^2]
sl_sw_toar : upward short-wave radiation at TOA [W/m^2]
sl_sw_toar_c : upward short-wave radiation at TOA (clear sky) [W/m^2]
sl_t2m : 2 m temperature [K]
sl_tauucos : surface stress by zonal velocity (multiplied by cos(lat)) [N/m^2]
sl_tauvcos : surface stress by meridional velocity (multiplied by cos(lat)) [N/m^2]
sl_tem_atm : mass weighted column averaged temperature [K]
sl_tem_sfc : surface temperature [K]
sl_tppn : surface precipitation rate [kg/m^2/s]
sl_ucos10m : 10 m zonal velocity (multiplied by cos(lat)) [m/s]
sl_vap_atm : precipitable water [kg/m^2]
sl_vcos10m : 10 m meridional velocity (multiplied by cos(lat)) [m/s]

Guidelines for NICAM simlation data users June 2009

It would be most helpful if data users adhere to the following guidelines agreed to by the NICAM team members.

Please include the NICAM team members who performed the model run as coauthors when you consider publications or presentations using NICAM simulation data.

Assigned member:

(Aquaplanet case: Hirofumi Tomita htomita@jamstec.go.jp)

2006-2007 boreal winter case: Hiroaki Miura miurah@jamstec.go.jp 1month (7km)

2004 boreal summer case: Kazuyoshi Oouchi k-ouchi@jamstec.go.jp 3months (7 km)

Akira T. Noda a_noda@jamstec.go.jp 5months (14km mesh)

Please include the following references of the experiment case in your manuscript:

- Aquaplanet case: Tomita et al. (2005) *Geophys. Res. Lett.*, 32, L08805.
- 2006 Dec–2007 Jan case: Miura et al. (2007) *Science*, **318**, 1763-1765.
- 2006 Nov (MISMO) case: Miura et al. (2009) *Geophys. Res. Lett.*, in press.
- 2004 boreal summer case: Oouchi et al. (2009) *SOLA,* **5**, 65–68; Noda et al. (2010), *Atmos. Res*.
- NICAM model: Satoh et al. (2008) *J. Comput. Phys.*, **227**, 3486-3514.

The above reference information can be found by referring to the NICAM website (http://nicam.jp/hiki/?NICAM+Papers)

Also, please send Dr. Masaki Satoh (satoh@ccsr.u-tokyo.ac.jp) information of your manuscript before submission.

Please contact the NICAM team members before starting your research using NICAM output data so that we can coordinate collaborative studies, and avoid conflict of specific ideas and interests among researchers.

Contact person:

All the cases: Masaki Satoh satoh@ccsr.u-tokyo.ac.jp

Aquaplanet and 2006 case: Tomoe Nasuno nasuno@jamstec.go.jp

2004 case: Kazuyoshi Oouchi k-ouchi@jamstec.go.jp

or any NICAM team member of your acquaintance.

Data users are encouraged to give any feedbacks to the NICAM team members regarding progress of your study, questions /requests about the dataset, etc.

We have performed many simulations (http://nicam.jp/publications).

Please contact us if you are interested in using those data.

NICAM model (code) is also opened (no free access, individual communication)

(ATHENA project, in collaboration with COLA) http://wxmaps.org/athena/home/