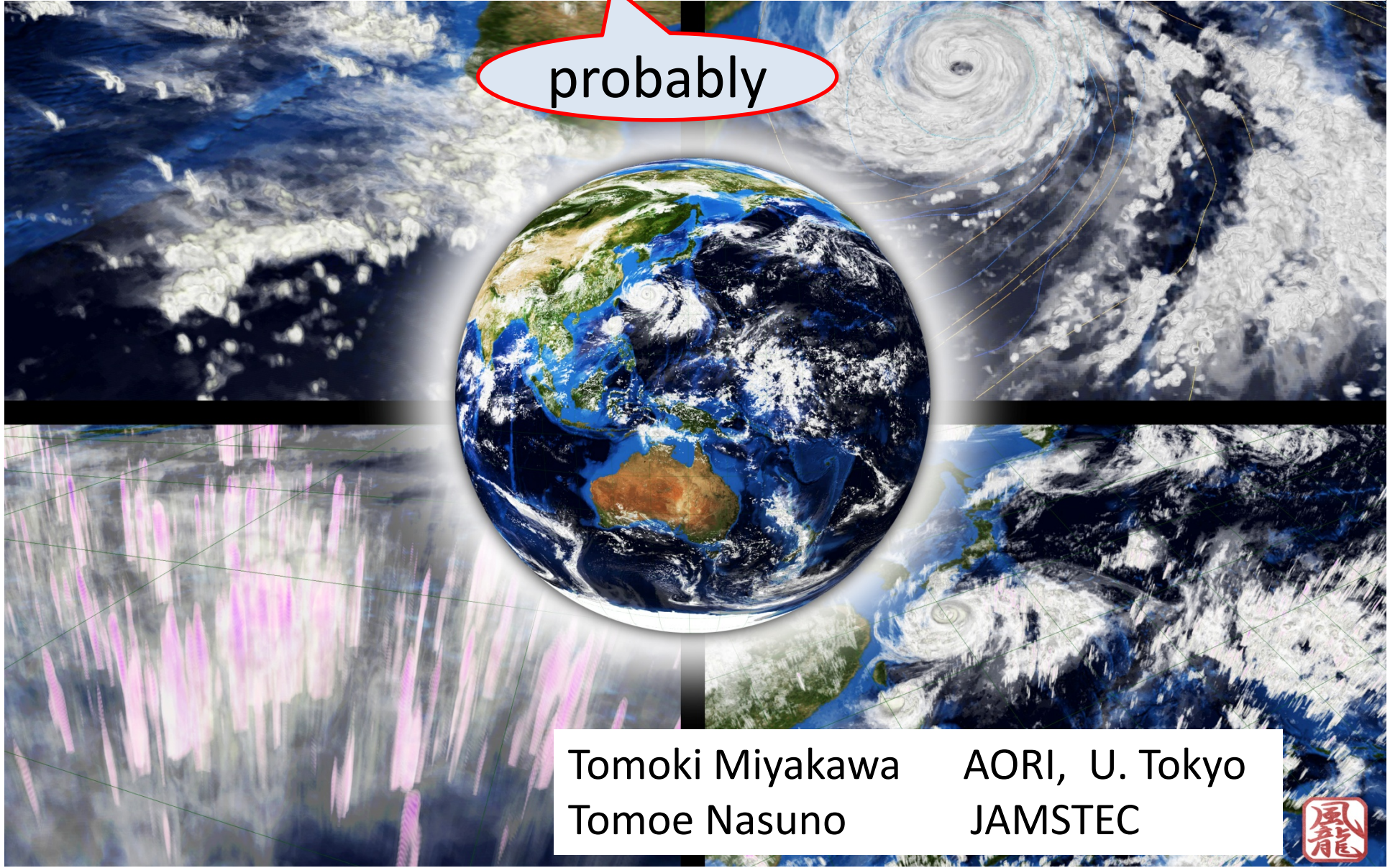


— Global CRM (NICAM) —

What we can provide / what we want

probably



Tomoki Miyakawa  
Tomoe Nasuno

AORI, U. Tokyo  
JAMSTEC



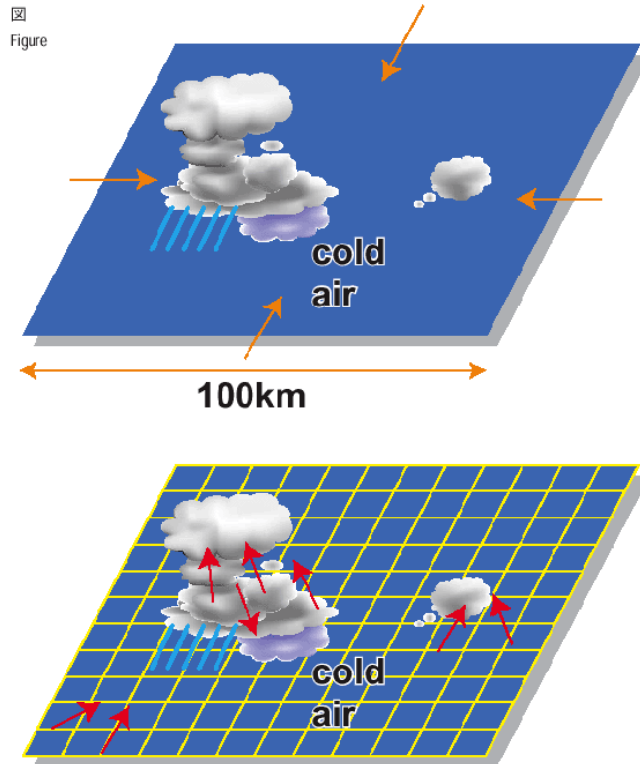
# What NICAM can't do

- Remove overestimation of rainfall over the Indian Ocean
  - Climate ensemble simulation
  - Standard statistical tests regarding climatology
  - Produce realistic surface temperature over the Tibetan Plateau
  - Produce realistic mean rainfall to the east of Philippine
  - Tune the model systematically
  - Initial shock free simulations (data assimilation)
  - MJO simulations at resolutions higher than 1.7 km
  - Remove equatorial precipitation bias overly confined to the ITCZ and SPCZ
  - Baiu-prediction
  - Future climate projection
  - Evaluate Model performance at high-resolutions ( $\sim 3.5$  km) with standard skill measures
  - Predictions run at sub-kilometer resolutions
  - Predict rapid intensification of TCs
  - Apply realistic ice sheets that interact with ocean
  - Simulations that include chemical transactions
  - Prognostic aerosols
  - Flood simulations
  - Reliable snowfall prediction
  - Reliable short-term rain intensity prediction
  - Produce convective cell intervals unaffected by model resolution
  - Produce shallow clouds
  - Produce enough congestus heating
  - Remove overestimation of zonal winds
  - Send full 3-D dataset at the original resolution to you on-line
- and so on ....

# Nonhydrostatic Icosahedral Atmospheric Model (NICAM)

Satoh et al. (2008, 2014)

[Group web page http://nicam.jp](http://nicam.jp)



➤ “cloud system resolving”

- global **14 km - 3.5 km** mesh

Tomita et al.(2005), Miura et al.(2007)

Miyakawa et al. (2014)

➤ “cloud-resolving”

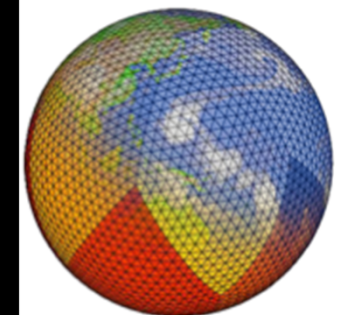
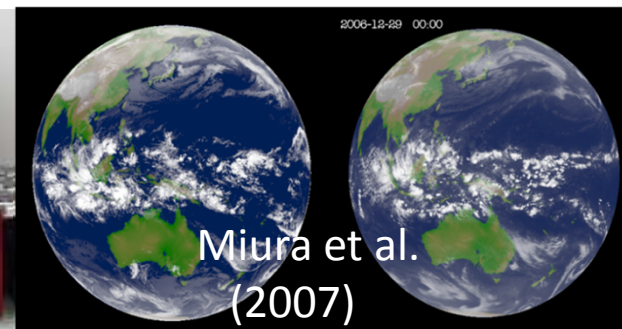
- global **870 m** mesh

Miyamoto et al. (2013, GRL)

➤ “cloud-un-resolving”

- global **220 km – 28 km** mesh

- Turn on/off cumulus parameterization

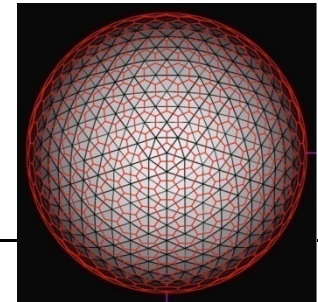


# NICAM

Satoh et al. (2008, 2014)

## ■ Dynamics

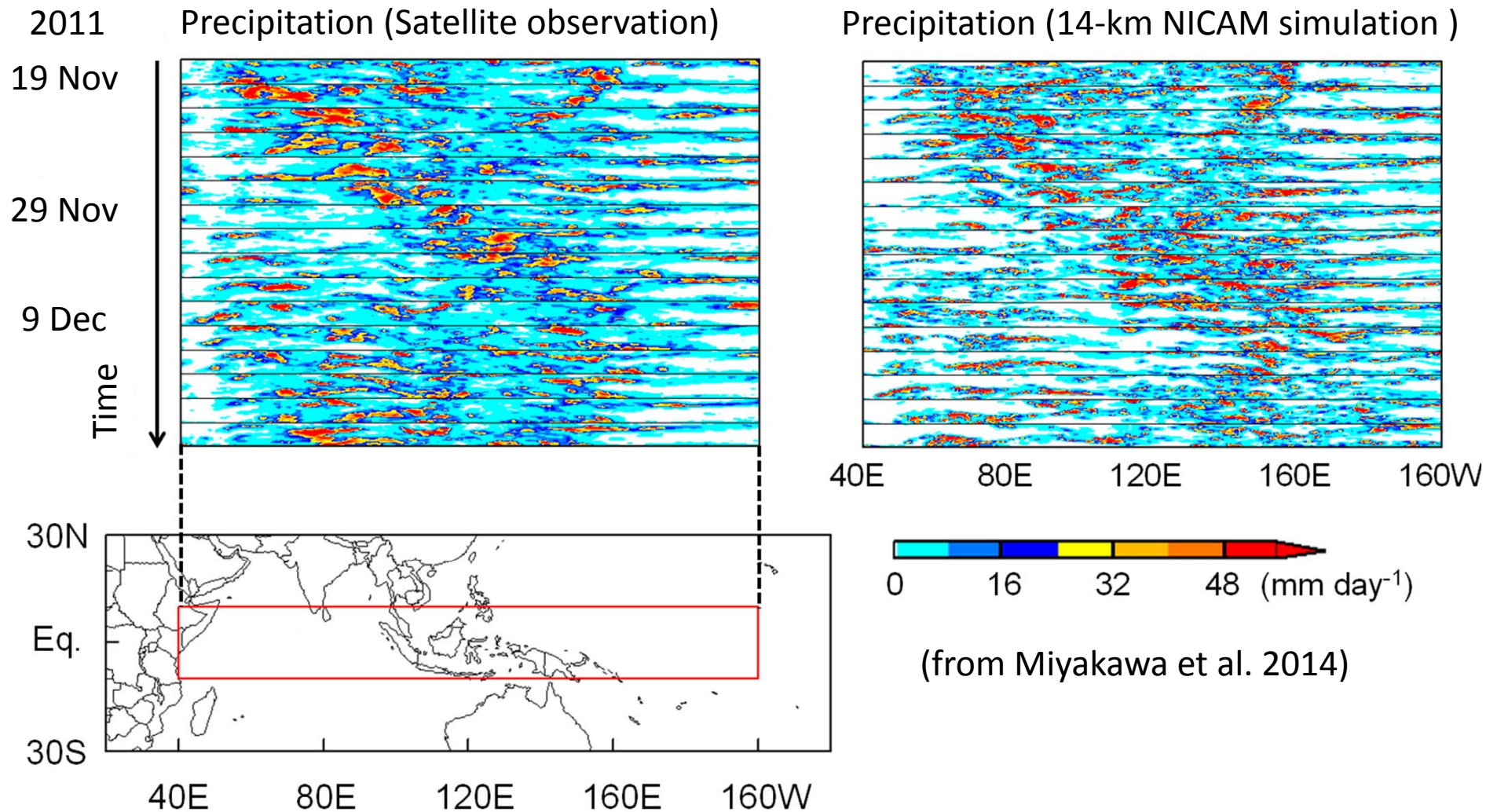
governing equations	<b>Fully compressible non-hydrostatic system</b>
spatial discretization	Finite Volume Method
horizontal grid	<b>Icosahedral grid (Tomita et al. 2001, 2002)</b>
vertical grid	Lorenz grid
topography	Terrain-following coordinate
conservation	<b>Total mass, total energy Satoh (2002, 2003)</b>
temporal scheme	Slow mode — explicit scheme (RK2, RK3) Fast mode — Horizontal Explicit Vertical Implicit scheme



## ■ Physics

radiation	<b>MSTRNX / MSTRNX-AR5 (Sekiguchi and Nakajima, 2008)</b>
cloud physics	Grabowski(1998); <b>NSW6(Tomita 2008)</b> ; <b>NDW6(Seiki et al 2013)</b>
shallow clouds boundary layer	<b>MY level 2 (Mellor and Yamada 1982; Noda et al. 2010) or</b> <b>MYNN level 2.5 or 3 (Nakanishi and Niino 2006)</b>
surface flux	Louis(1979), Uno et al.(1995)
Land surface processes	Bucket or <b>MATSIRO</b>
Ocean	Specified sst or <b>mixed-layer slab ocean or COCO (full ocean)</b>

# 1) Real MJO case: Hindcast of CINDY2011/DYNAMO MJO event



NICAM produces nice MJO if we are fairly lucky... but, we don't know if it is interacting with MC realistically or not.

## 2) Diurnal cycle

**global 3.5km NICAM**

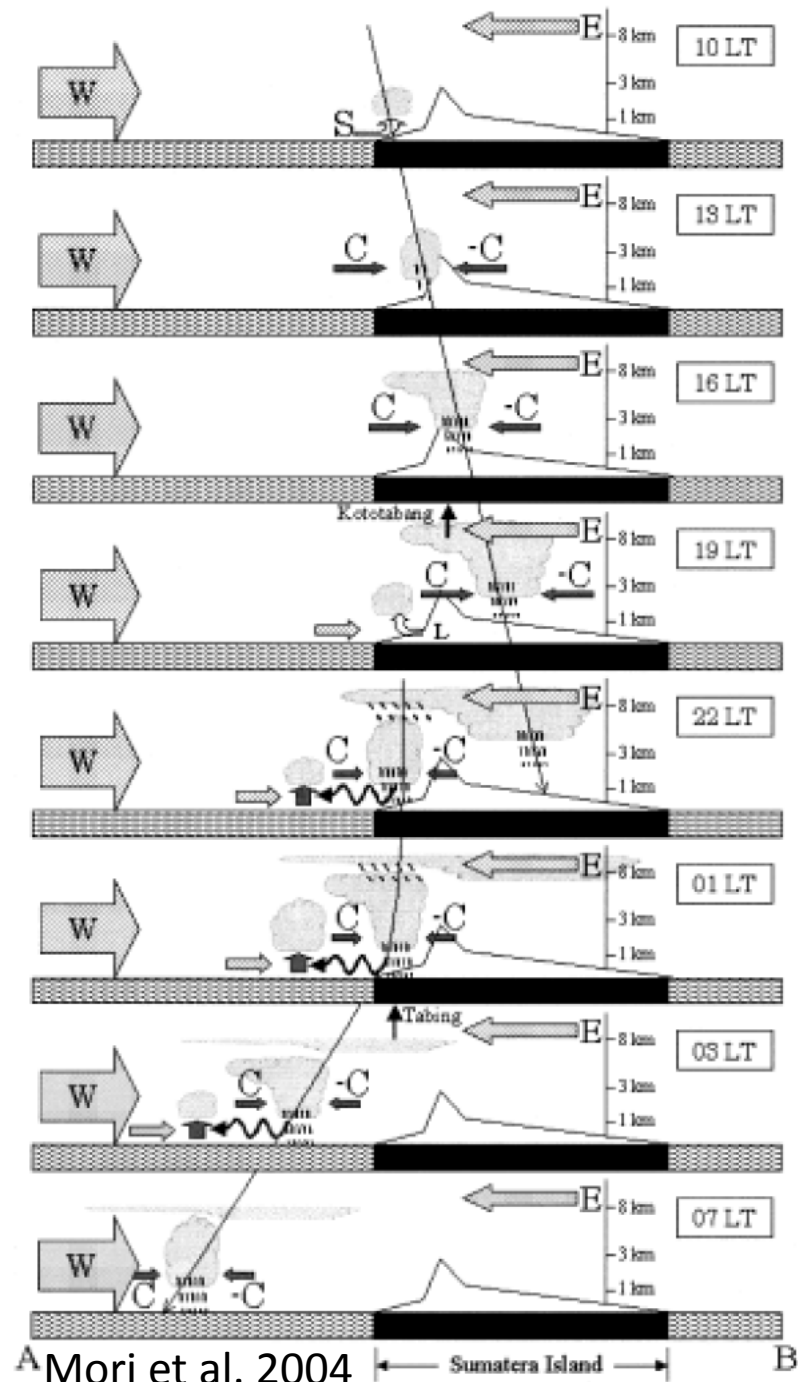
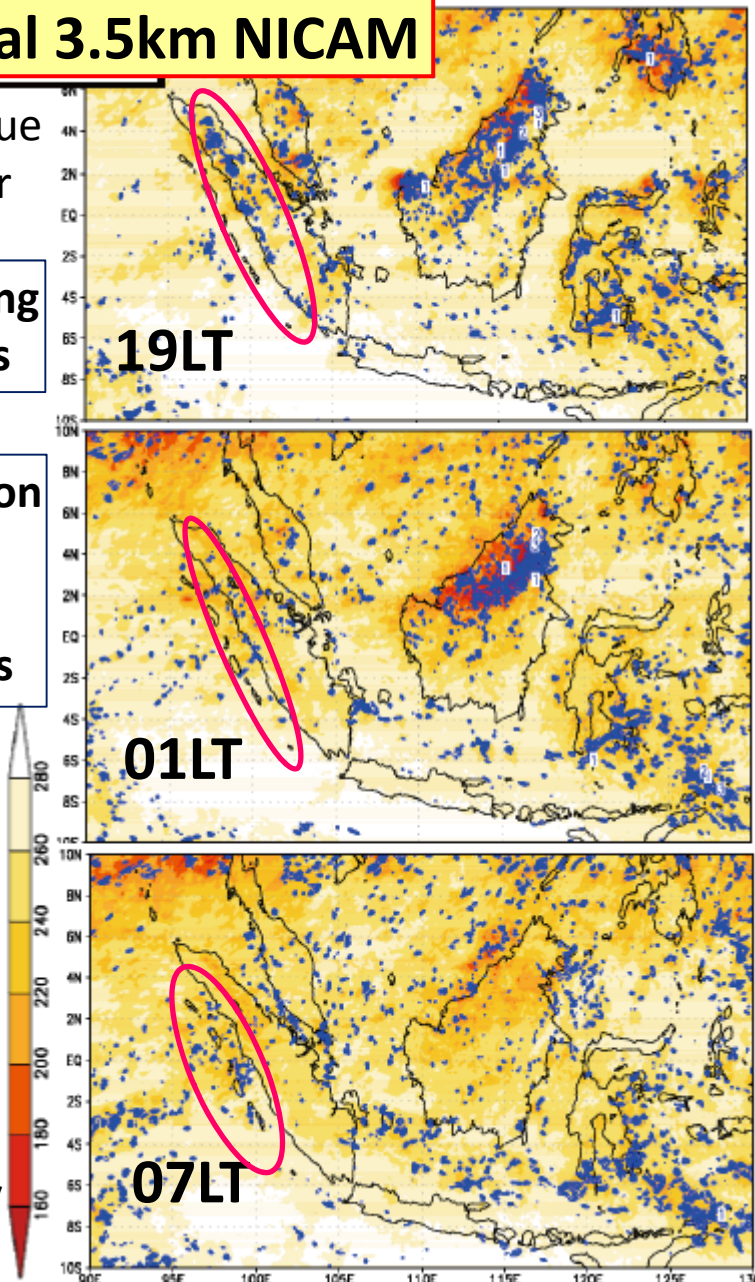
Precip: blue  
OLR: color

Precip along  
Mountains

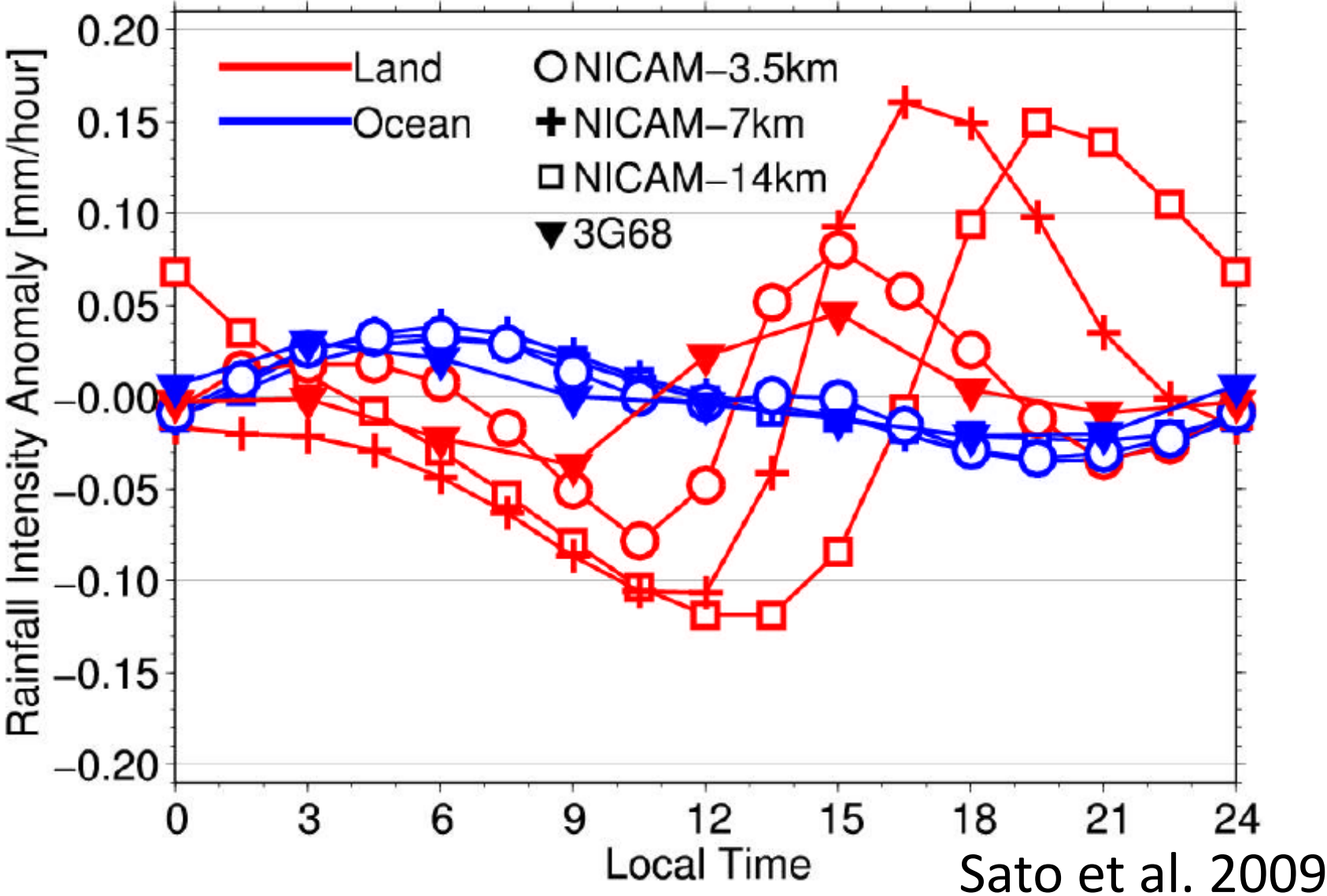
Propagation  
toward  
Inland /  
Coast lines

Precip  
offshore

Analysis by  
M. Fujita



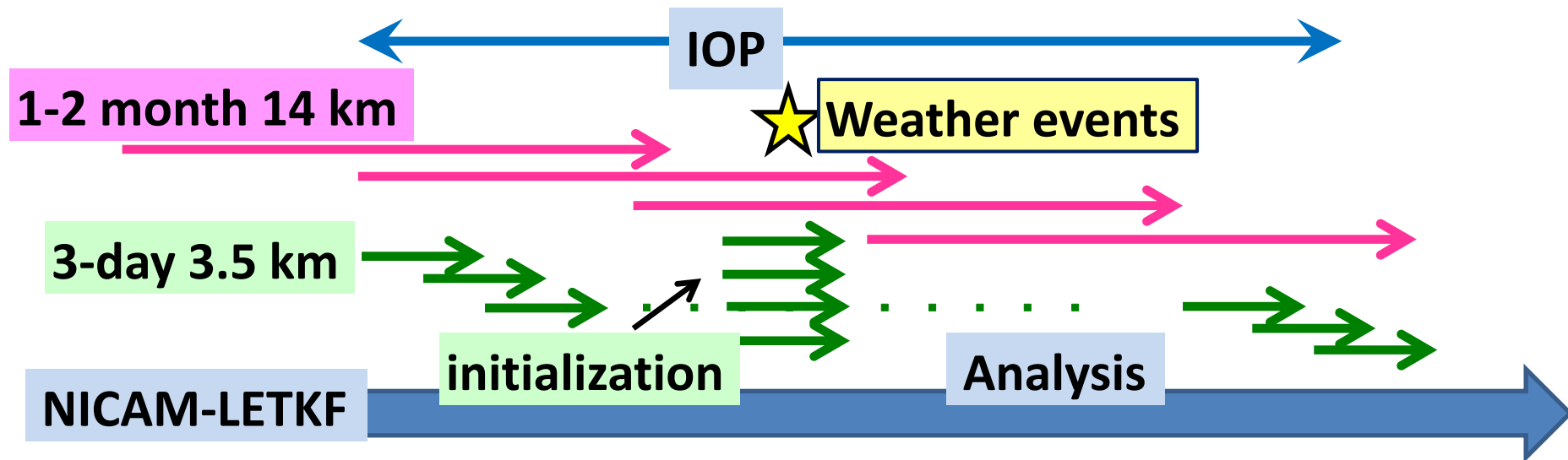
## 2) Diurnal cycle



3.5 km NICAM might have somewhat realistic diurnal cycles in the MC region

# NICAM (tentative) plan for YMC

1. 1~2 month ensemble simulation (~14 km, 20 members)
2. 3-day simulation ( 3.5 km)
3. **Data Assimilation** (NICAM-LETKF; developing@Riken)



## 4. Science fiction simulations

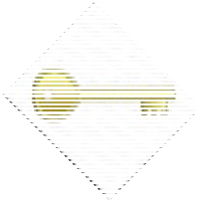
- Data to be shared for field operations and research use.



Can be provided:

- Consistent 3-D dataset (probably at 14 km)
- A bit of entertainment
  - Daily 3.5 km 3-day predictions during the IOP to boo/hurrah at.
  - Idealized experiments (removal of MC, etc.)

Wanted:

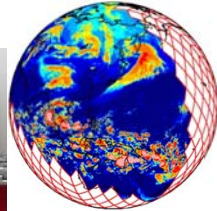
- Feedbacks
    - Tell us in what way the model failed.  
... preferably with implications of why.  
(missing process?)
-  diurnal cycles/ offshore travelling systems

Conceptual illustration of an ideal real-time observation-modeling collaboration

Earth simulator  
K computer



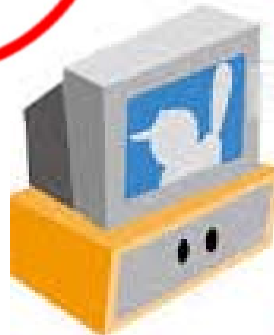
NICAM



3.5 km 3 days  
14 km 30 days



Haha, model missed this squall line!  
Underestimating graupel?



みらい Ship or island

