

First International Science and Planning Workshop on Years of the Maritime Continent  
28-30 January 2015, Centre for Climate Research Singapore

Day 3 (Thursday, January 29)  
Session 7 Modeling

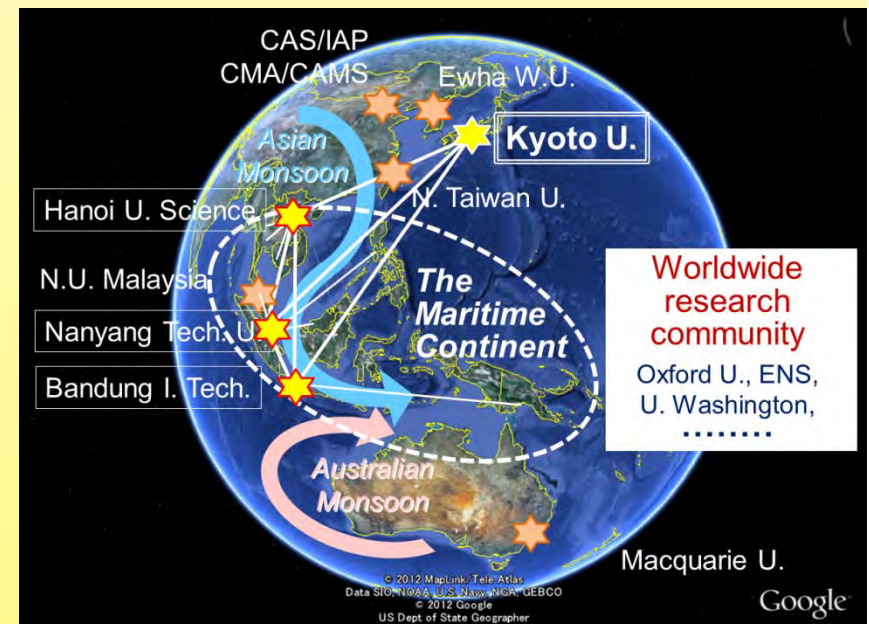
Regional nonhydrostatic models

International research collaborations and  
networking on extreme weather  
in changing climate in the MC

Shigeo Yoden (Kyoto U., Japan)

## ❖ International research collaborations and networking on extreme weather in changing climate in the MC

- FY2015-2017 Japan Society for the Promotion of Science (JSPS) Core-to-Core Program: Asia-Africa Science Platforms
- PI: Shigeo Yoden (Kyoto U.)
- Japan: Kyoto U., JMA/MRI (K. Saito), Riken/AICS (T. Miyoshi)
- Indonesia (T.W. Hadi, ITB), Singapore (T.-Y. Koh, NTU), Vietnam (T.T. Tran, VNU), and S/SE Asian countries
- Numerical model studies with regional cloud-permitting **nonhydrostatic models**
  - JMA NHM, WRF, DWD HRM,...
- Observations and data analyses
- Applications of probabilistic NWP data
  - for societal, economic, and environmental decisions



# ❖ Science and application on synoptic-scale disturbances: cross-equatorial cold surge and Borneo vortex

- description of the phenomena

- observations and data analyses

Note: reanalysis datasets have limitations due to the problem of model performance in the tropics

- dynamical understanding

- numerical model studies

- on-off type experiments

- GFD-style parameter sweep experiment with hierarchy of models

Science

---

- forecast experiment

- pre-operational R&D phase of NHMs

- collaboration between operational center and university

- JMA/MRI – Kyoto U

Application

- societal application for “needs”

- needs of operational forecasts (ensemble probabilistic data)

- disaster prevention/mitigation, economical decision, and more

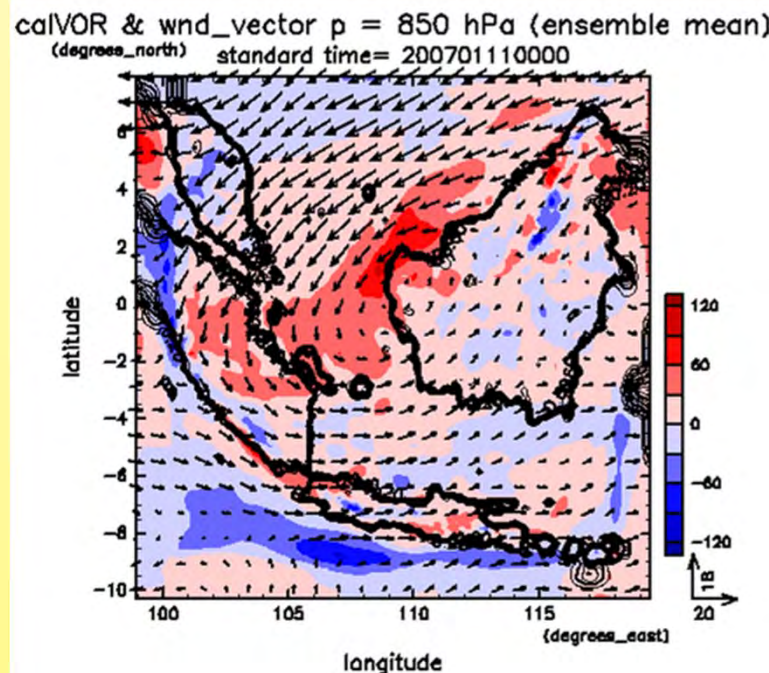
## ❖ An example: hindcast experiment of Borneo vortex

- similar to Trilaksono, Otsuka and Yoden (2011, 2012)

- Japan Meteorological Agency Non-Hydrostatic Model (Saito et al. 07)
- $\Delta x = 20$  km,  $115 \times 103$  grids;  $0 \leq z^* \leq 22.1$  km, 40 levels
- 2007 Jan. 11 00:00 UTC  $\sim$  Feb. 09 23:00 UTC
- 9 members of **time-lagged ensemble runs**  
start every 6 h and use the period of  $19 \text{ h} \leq t \leq 72 \text{ h}$

- animation of two BV events

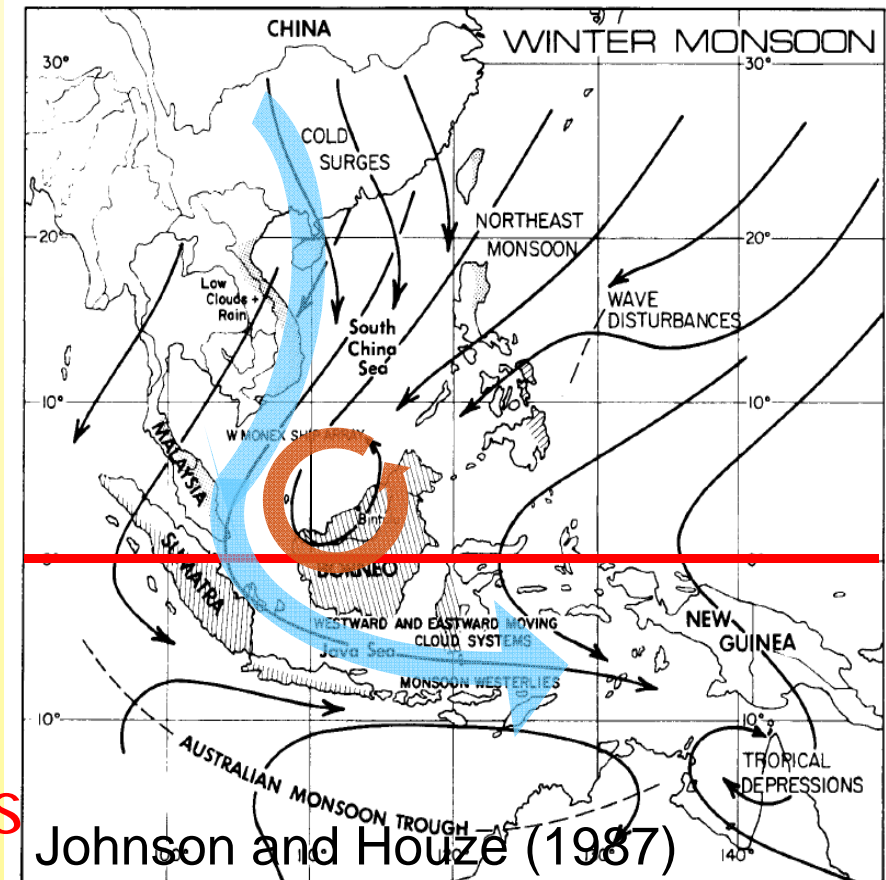
- vertical component of relative vorticity and horizontal winds



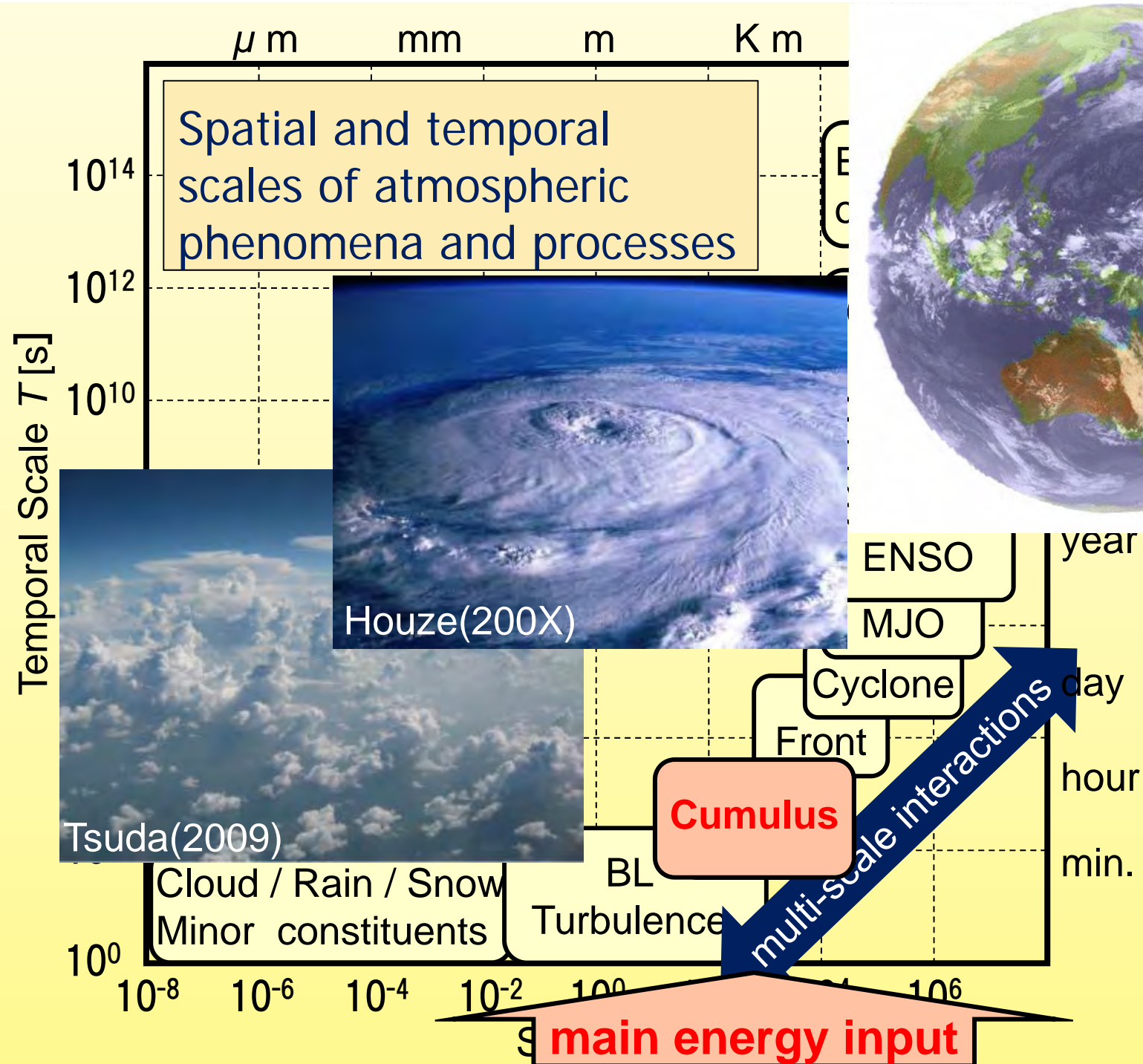
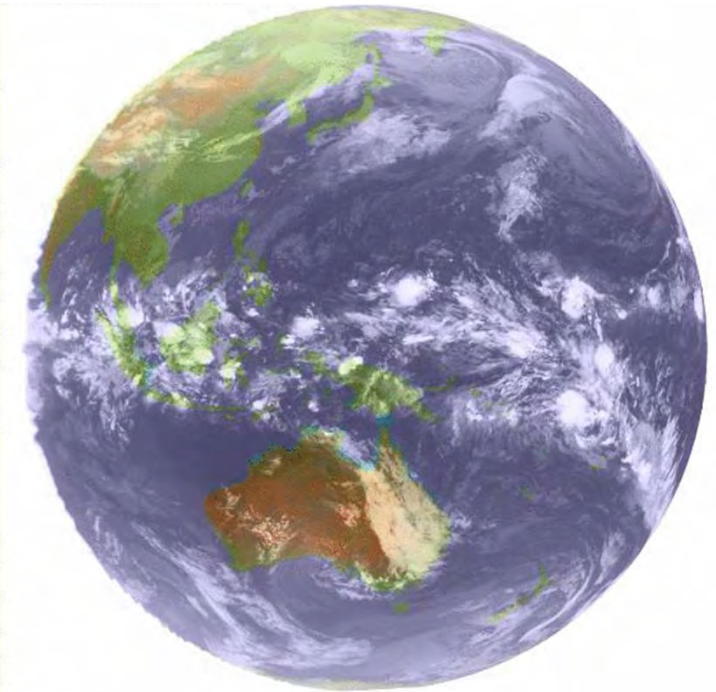
## ❖ Dynamical uniqueness of cross-equatorial cold surge and Borneo vortex

- geographical asymmetry with the equator
  - ➔ boreal winter
- around the equator ( $f \sim 0$ )
  - ➔ free from quasi-geostrophic balance
  - ➔ vertically independent “thin-layered” motions
- complex topography
  - ➔ wind-terrain interaction
  - ➔ multiple-scale variations

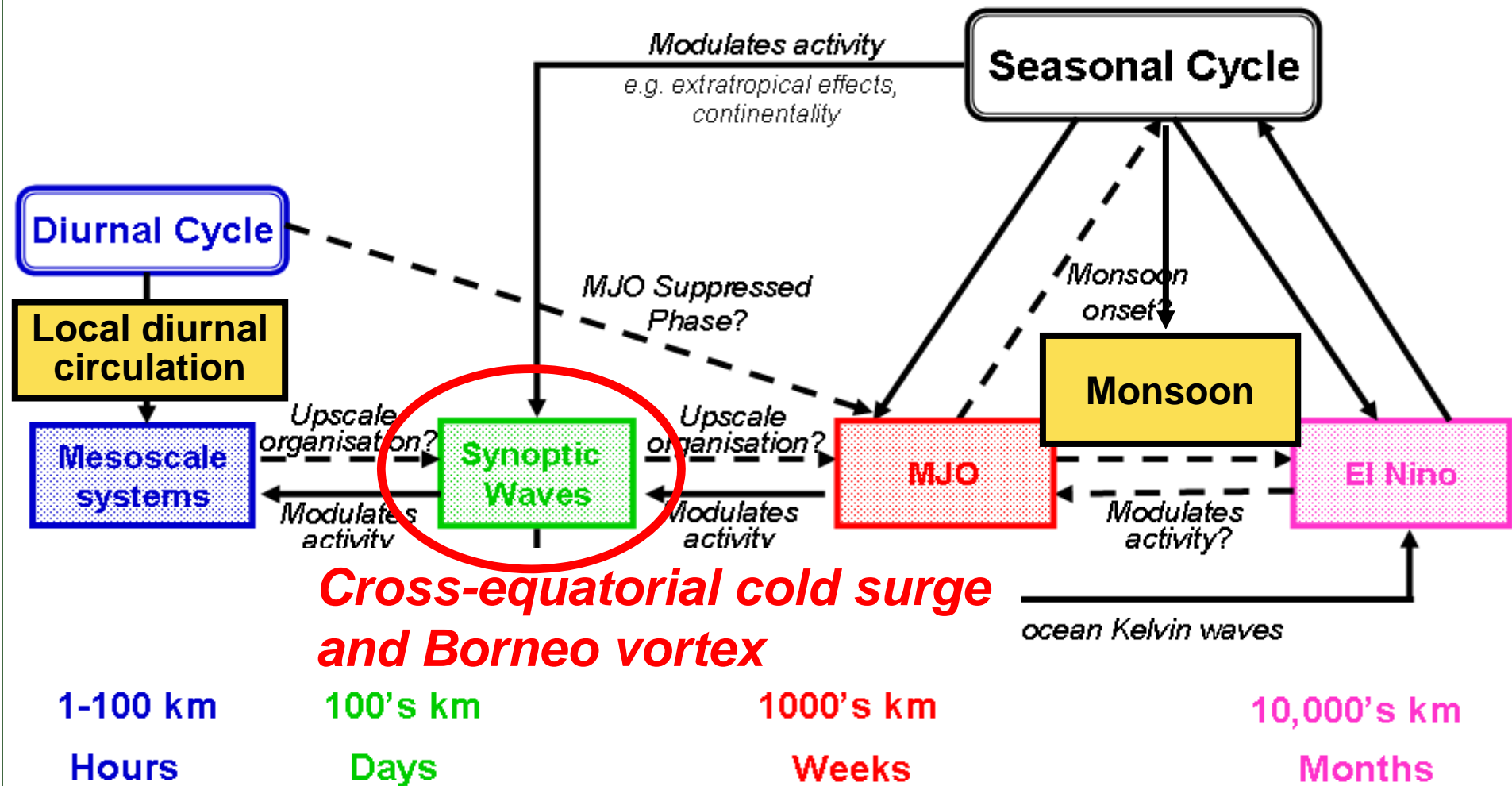
❖ Further studies in all aspects should be necessary for better understanding the dynamics and their roles in the maintenance and variations of the MC monsoon







## Interactions between space and time scales of tropical convection: Linking THORPEX and WCRP



## ❖ Science and application on synoptic-scale disturbances: cross-equatorial cold surge and Borneo vortex

- description of the phenomena

- observations and data analyses

Note: reanalysis datasets have limitations due to the problem of model performance in the tropics

- dynamical understanding

- numerical model studies

- on-off type experiments
    - GFD-style parameter sweep experiment with hierarchy of models

- forecast experiment

- pre-operational R&D phase of NHMs

- collaboration between operational center and university  
JMA/MRI – Kyoto U

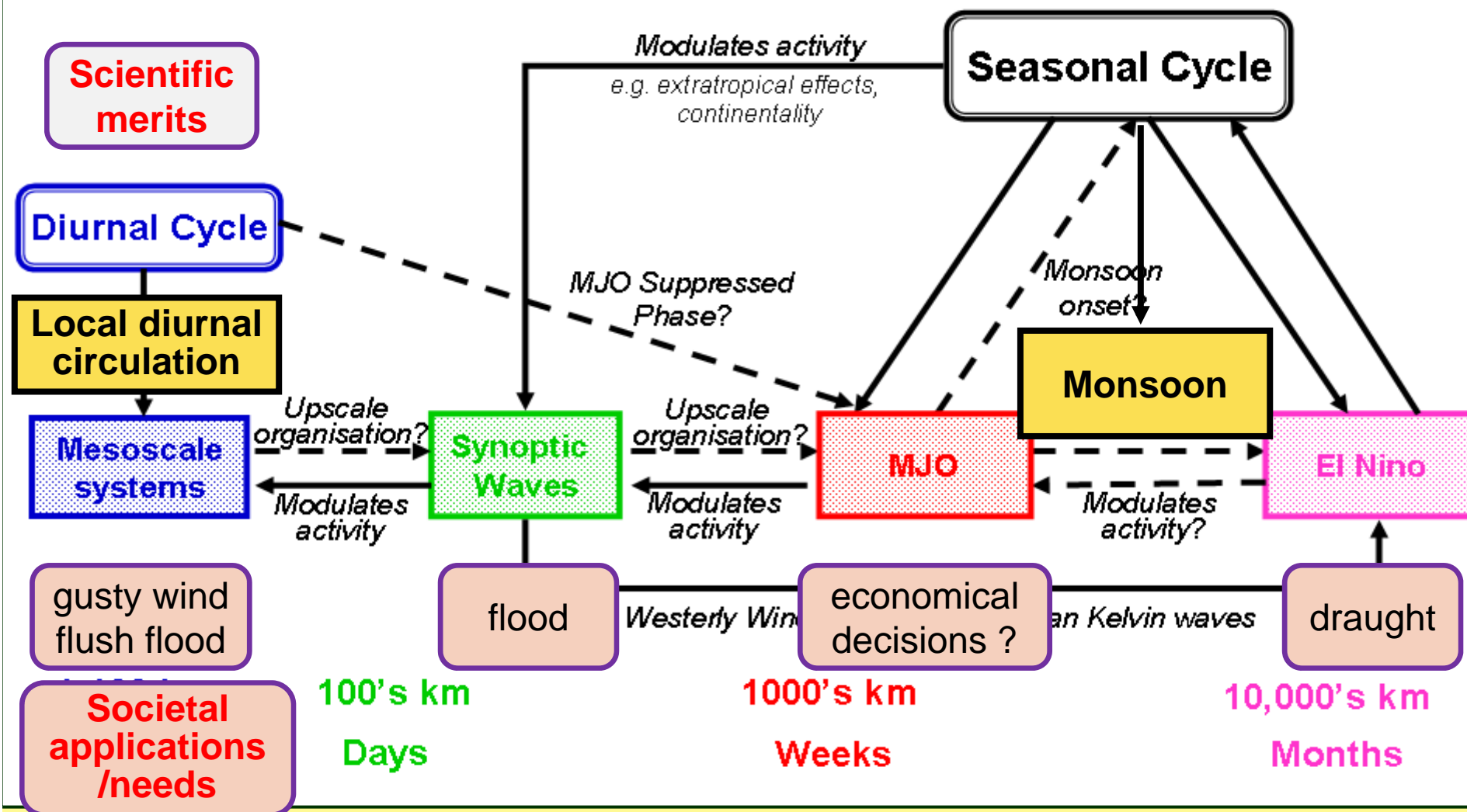
- societal application for “needs”

- needs of operational forecasts (ensemble probabilistic data)

- disaster prevention/mitigation, economical decision, and more

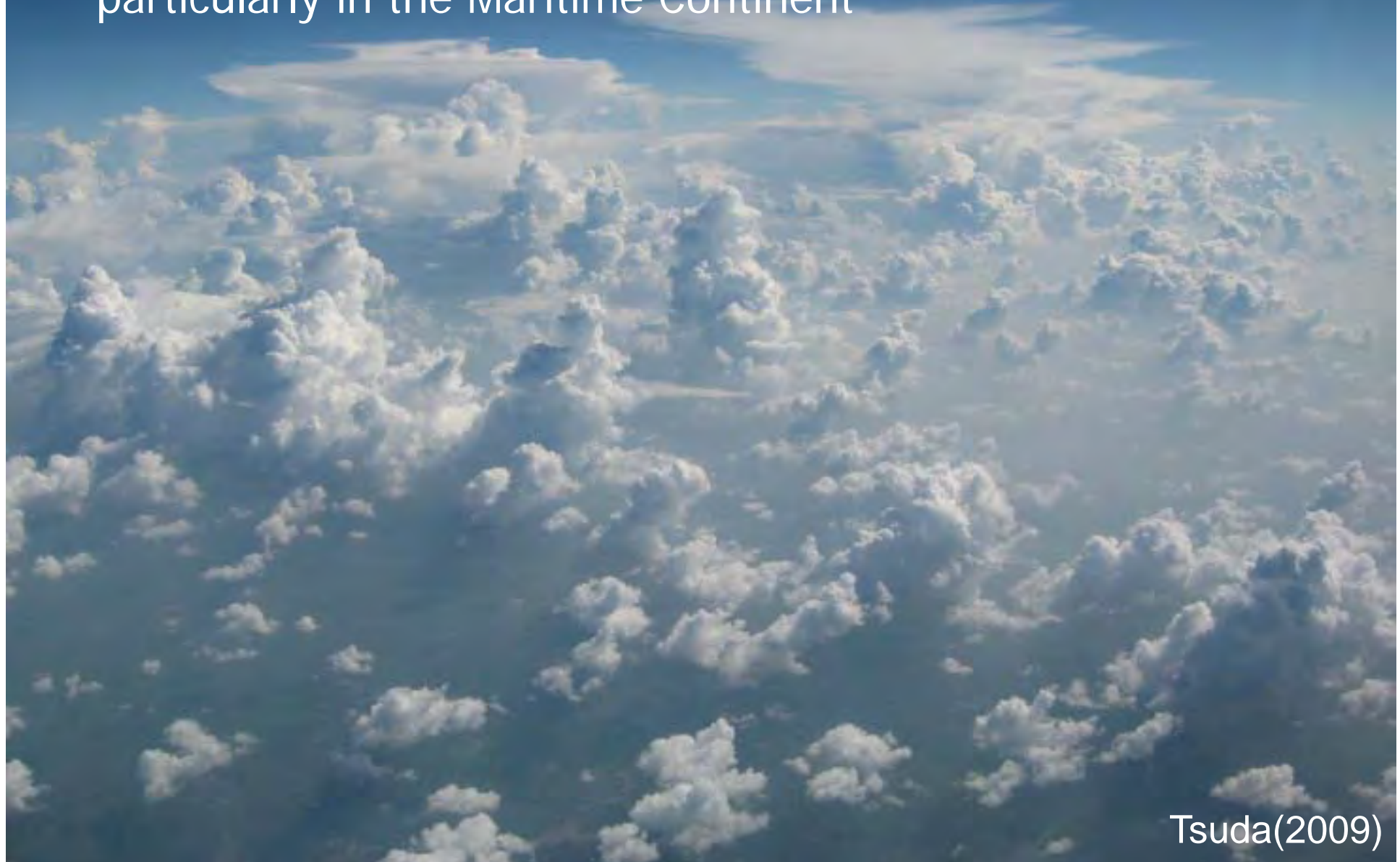


# Interactions between space and time scales of tropical convection: Linking THORPEX and WCRP

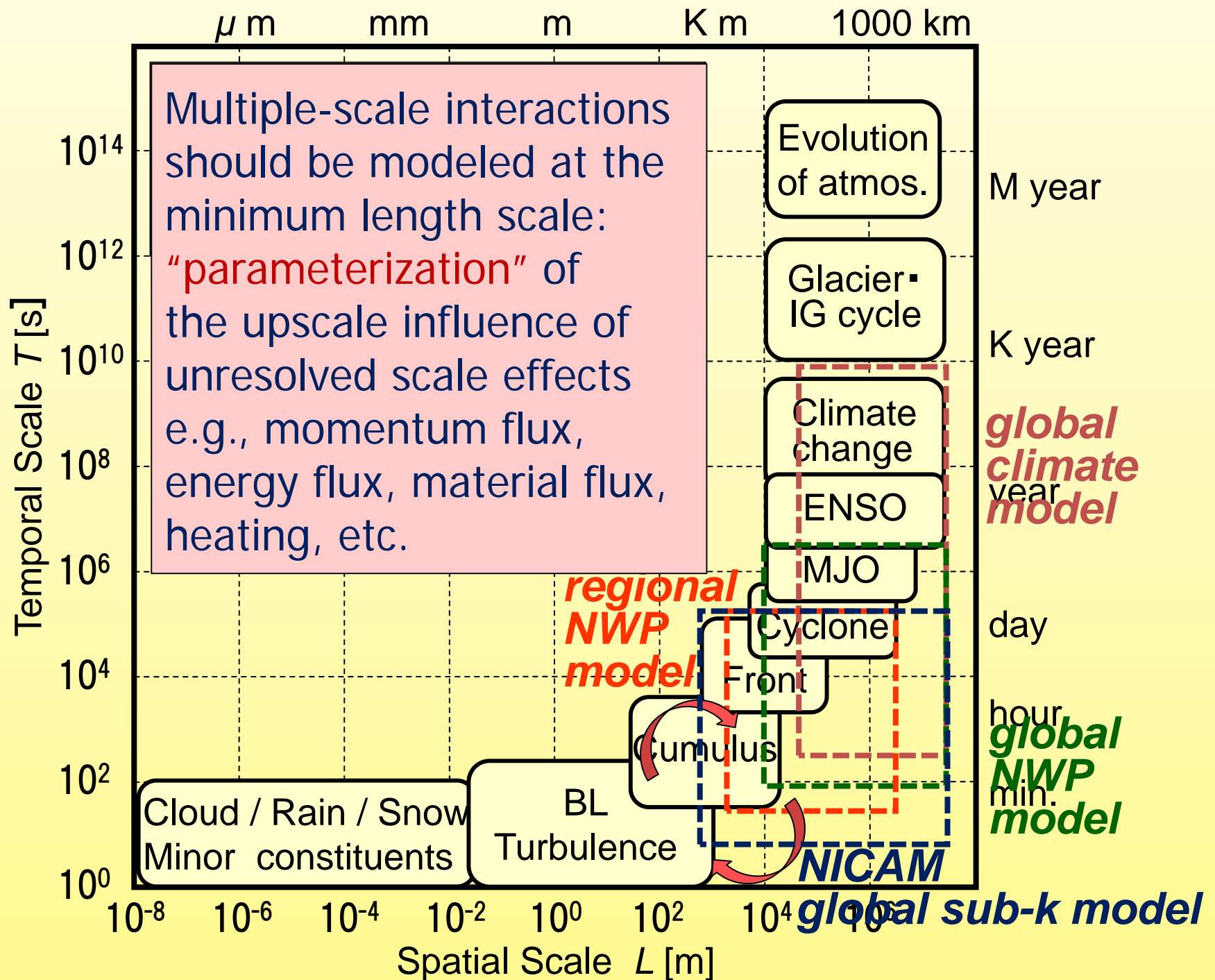


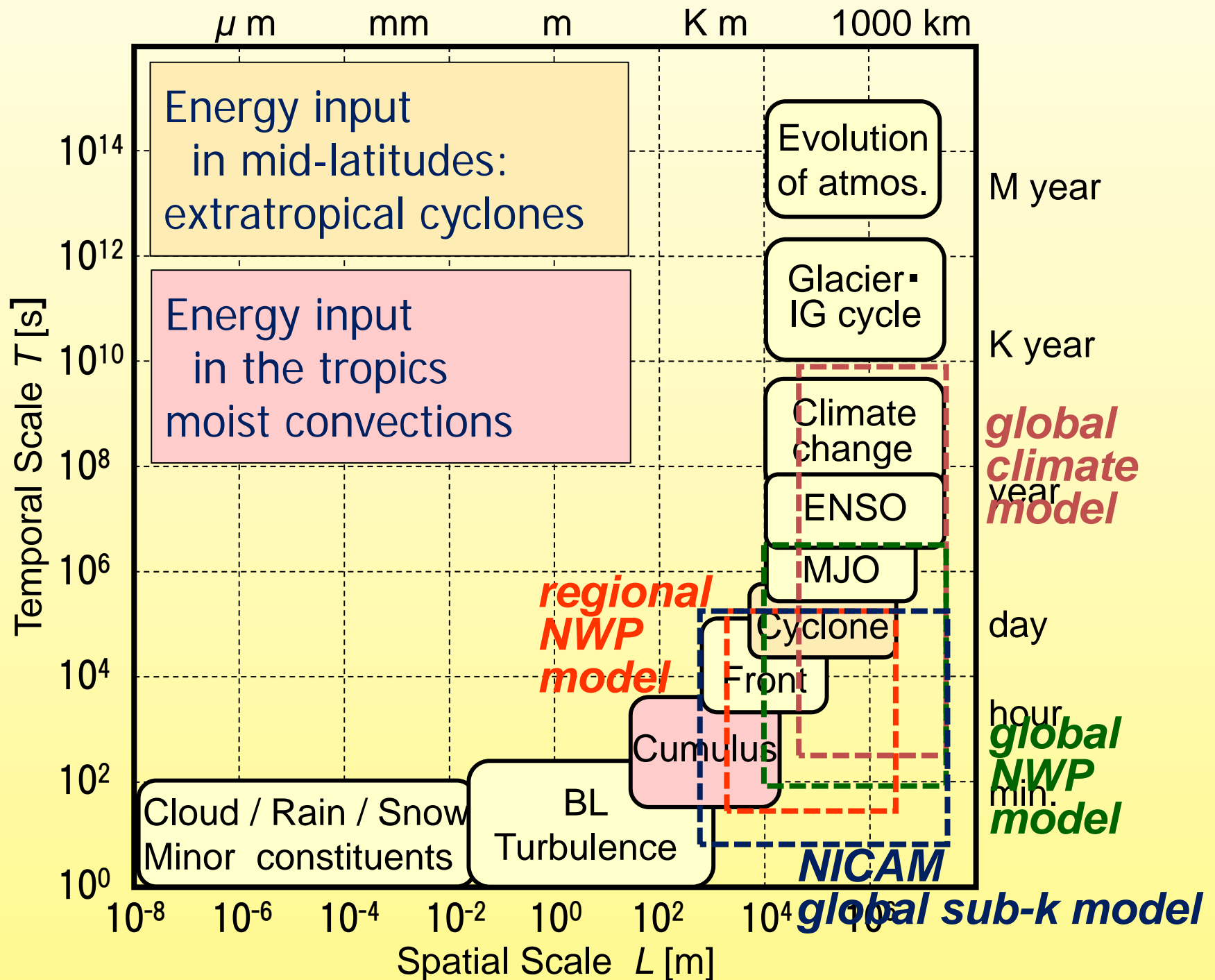
# Self-organization of convective clouds in the tropics

Interaction with complex topography and land-sea contrast,  
particularly in the Maritime Continent



Tsuda(2009)



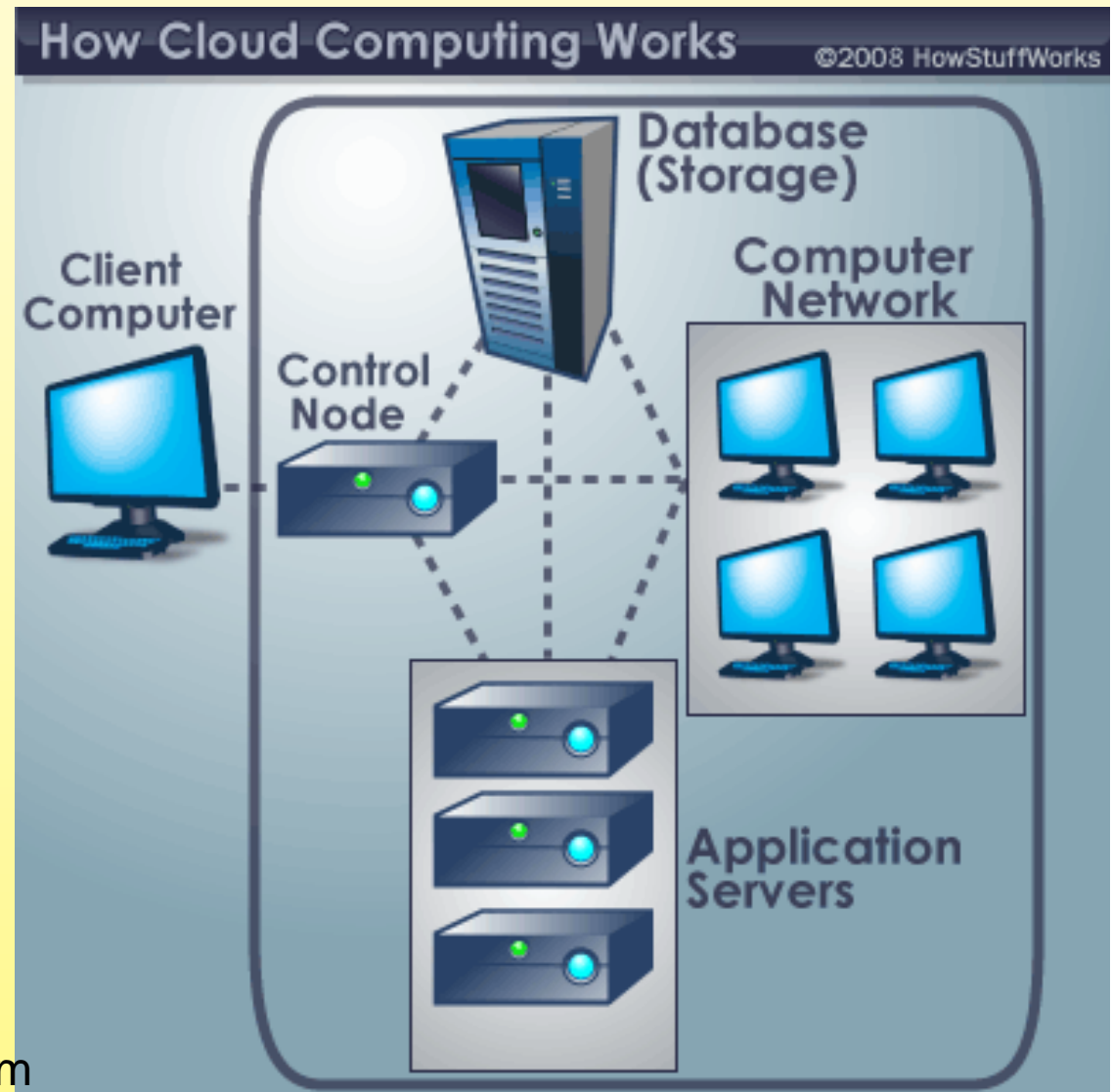


## 2. Plan of participating in the YMC field campaign

- ❖ In the MC countries, infrastructures in computations and internet communications have been improved largely in these years
- ❖ It would be a good timing to start international research collaboration on numerical model studies of extreme weather events in the MC, such as
  - cross-equatorial cold surge
  - Borneo vortexwith high-resolution regional non-hydrostatic models



- ❖ Multi-model and multi-analysis ensemble experiments will be possible through “cloud computing”
  - with our own application servers and database storages



<http://computer.howstuffworks.com/cloud-computing/cloud-computing.htm>

❖ The following subjects should be pursued under the YMC

(1) Hindcast experiments on some typical events

such as, cross-equatorial cold surge and Borneo vortex

<a> to check and tune the performance of numerical models

→ process oriented validation of numerical models

<b> to make detailed dynamical analyses

(2) Near real-time forecast experiments

in collaboration with the YMC observational campaigns, including

<1> the design of adaptive observations

<2> the assessment of their impact to improve the forecast

(3) Geophysical Fluid Dynamics-oriented numerical experiments

for better understanding the fundamental dynamics of

cross-equatorial cold surge and Borneo vortex

❖ JSPS Core-to-Core Program: Asia-Africa Science Platforms

- International Research Collaborations and Networking on Extreme Weather in Changing Climate in the MC (FY2015-17)

July 2, 2010, way to Visakhapatnam from Delhi, India

Thank you !

