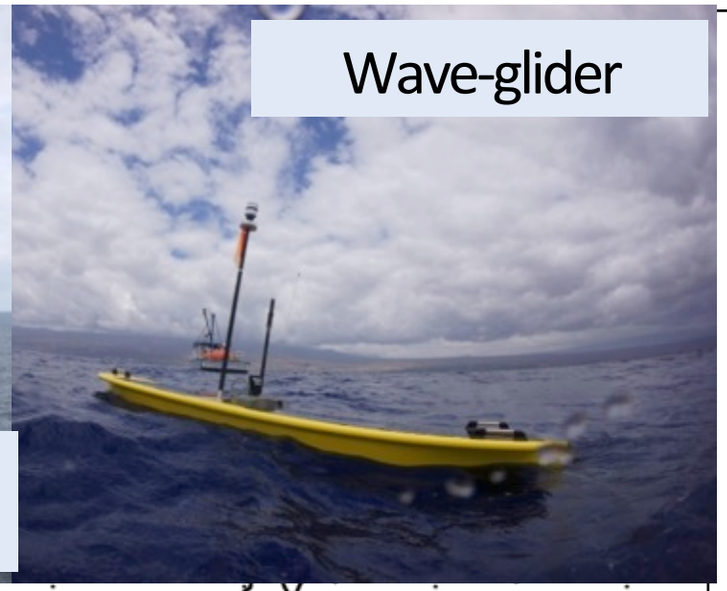
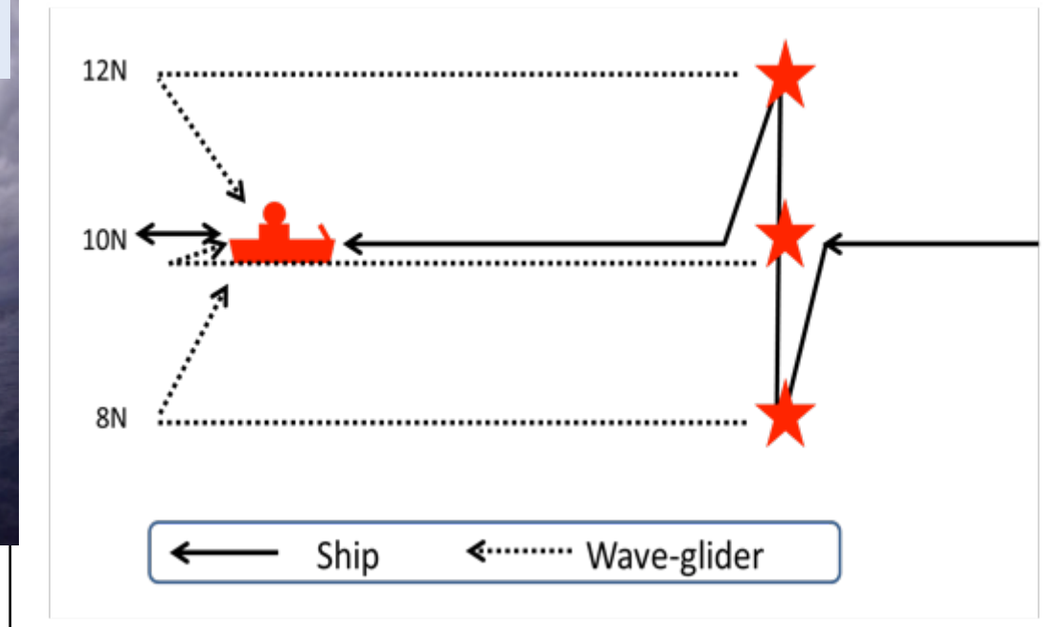
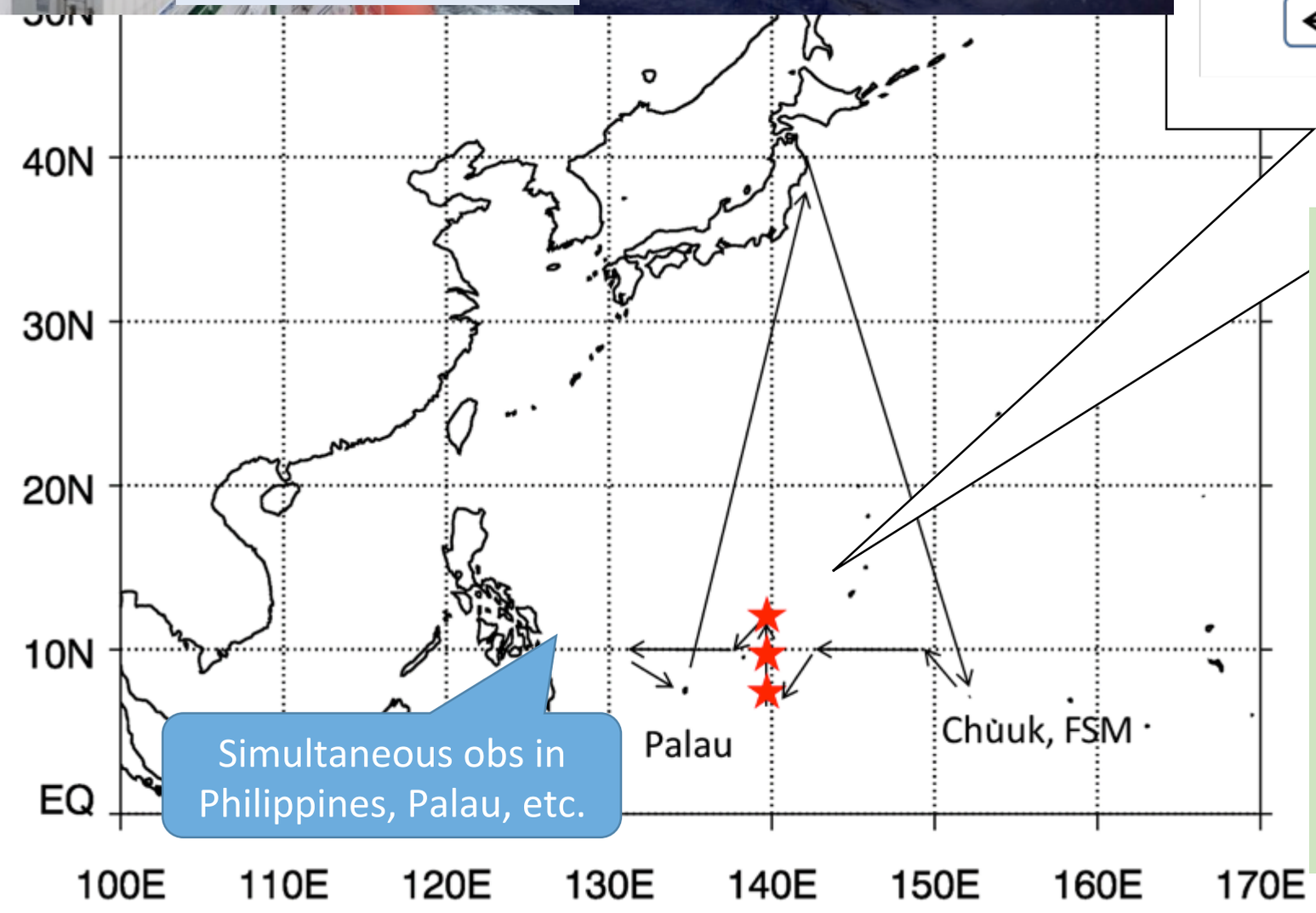
Study on air-sea interaction associated with Boreal Summer Intraseasonal Oscillation

C-Pol Doppler radar,
Radiosonde, etc.



Wave-glider





Purpose:
To study the relationship btwn convective activity and meso-scale SST gradient.

Period: June - July 2020

Methods:

R/V MIRAI (radar, sonde, etc.)
Wave glider (SST, WV, current)
Land-based

Post MAHASRI plan

- Now planning phase
  - Loosely combining existing / new various independent projects
  - CORDEX-Asia
  - Cordinating network of all Asia hydroclimatic researchers
- Scientific targets
  - Following impacts of MAHASRI
  - Key interests emerging in research communities
  - Incorporating AMY 2020 plan
- Meeting GHP criteria, scientific questions, CC-projects
- It will be proposed in 2018.

Achievements of MAHASRI-NEISC (NorthEastern India SubContinent)

A self introduction of our sub MAHASRI research group

Study area of MAHASRI-NEISC

- NEISC is in the "Tropics" subarea of MAHASRI project
- We focused on Northeastern Indian subcontinent, GBM (Ganges, Brahmaputra and Meghna) river basin.

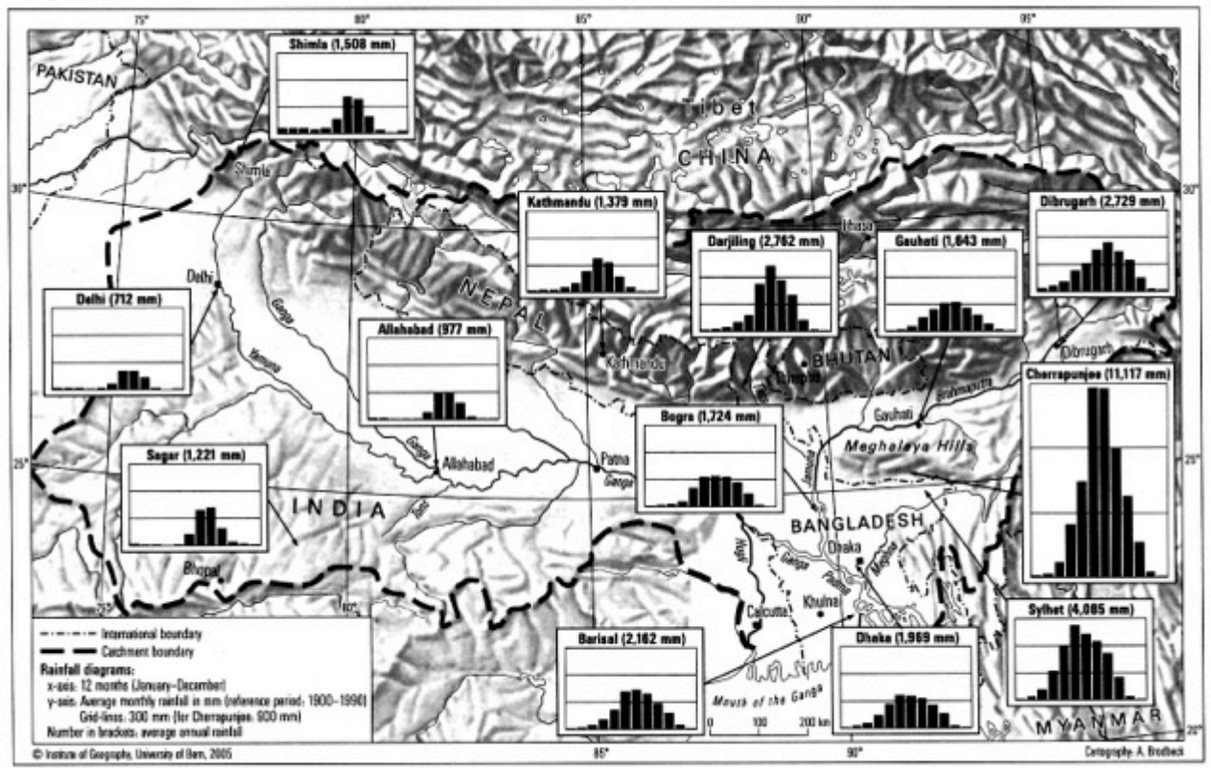
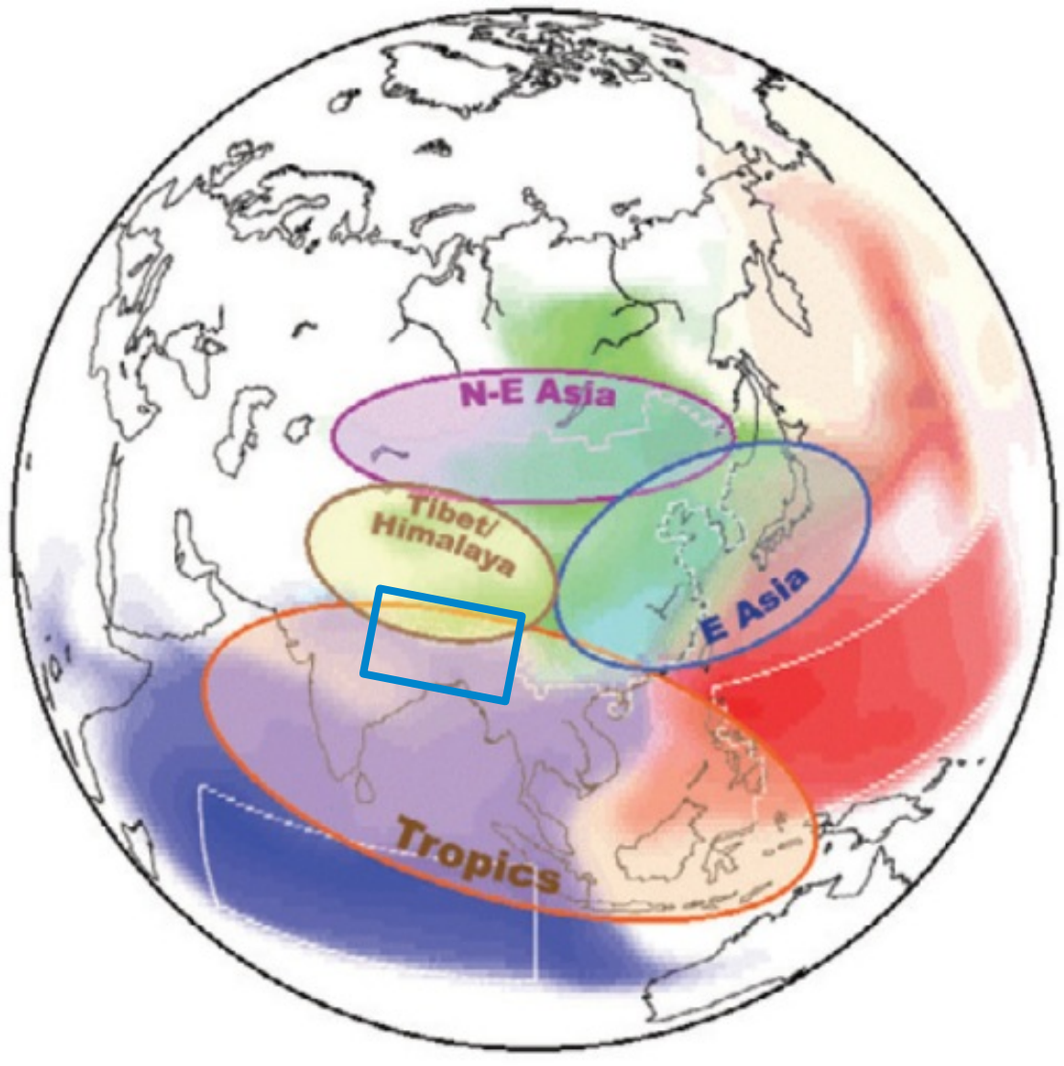
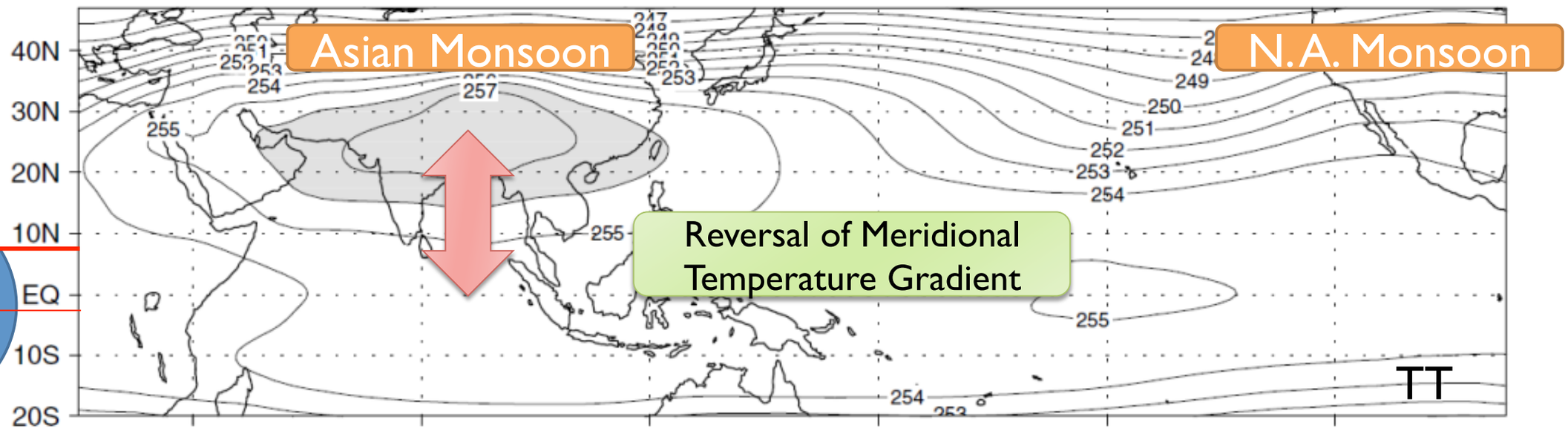


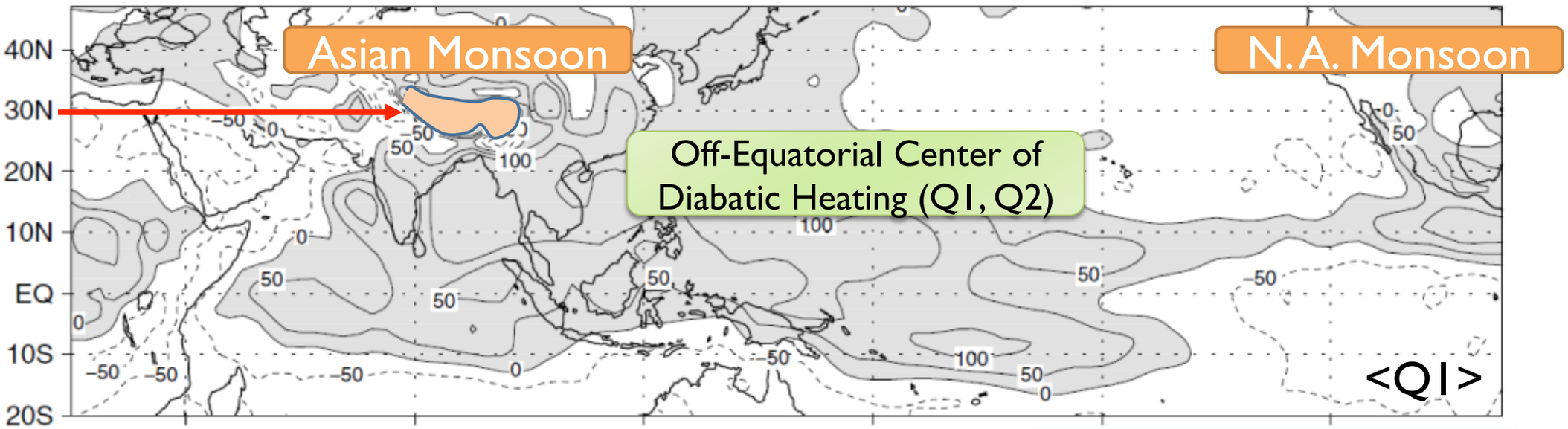
Figure 2.4 Average monthly rainfall at selected stations in the Ganga–Brahmaputra–Meghna basin.
Sources: For data sources, see Table 3.2.



NEISC in the Asian Monsoon

- Temperature and diabatic heating distribution, July

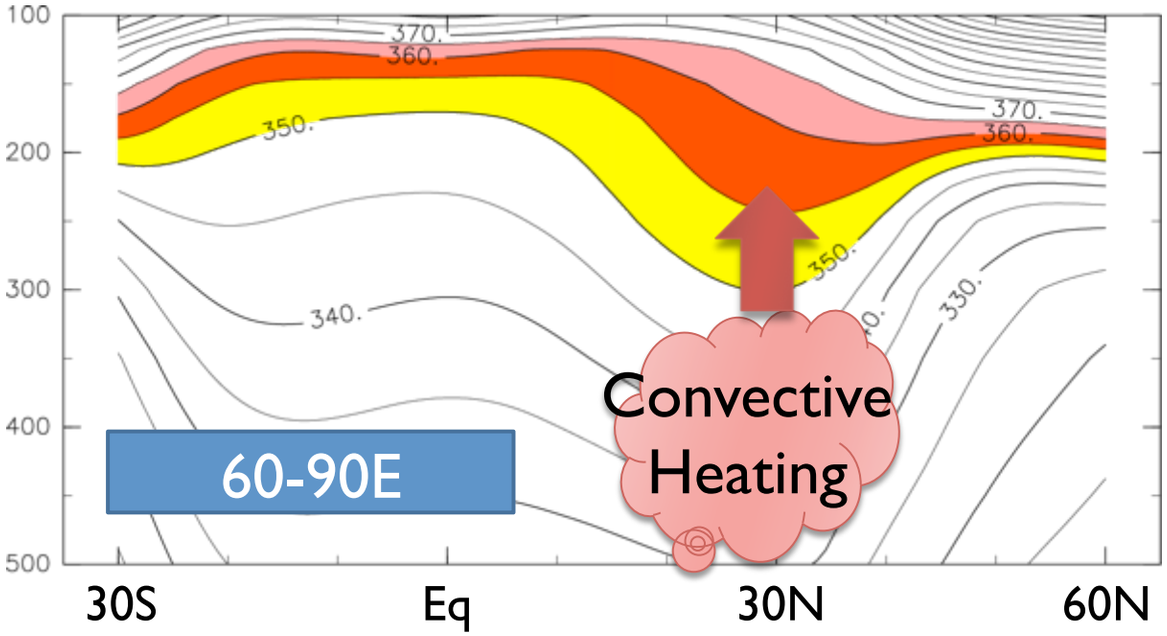


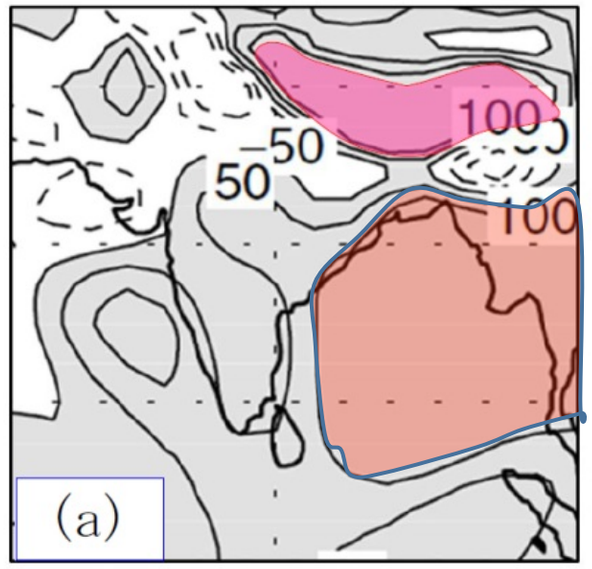


Xavier et al. (2007)

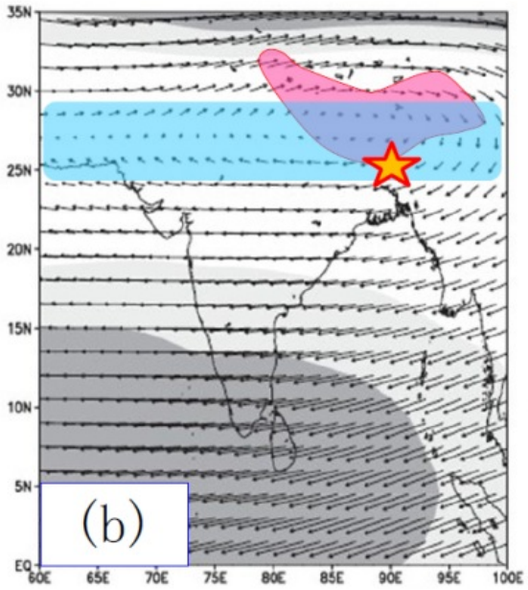
Convective Heating and Tibetan High

- Northern Center of Asian summer monsoon / NEISC

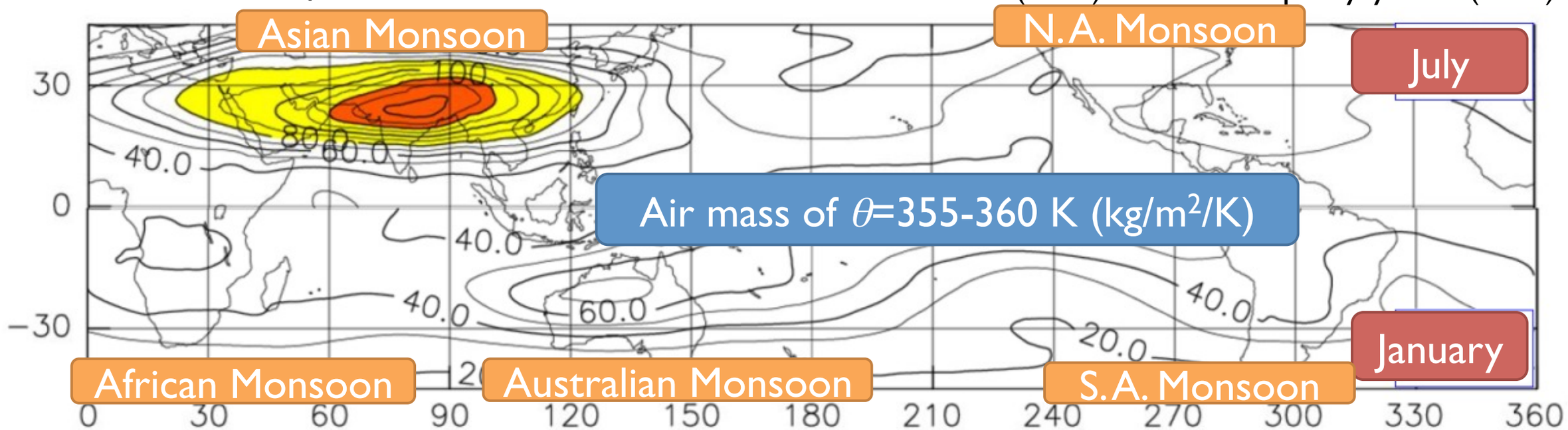




Xavier et al. (2007)

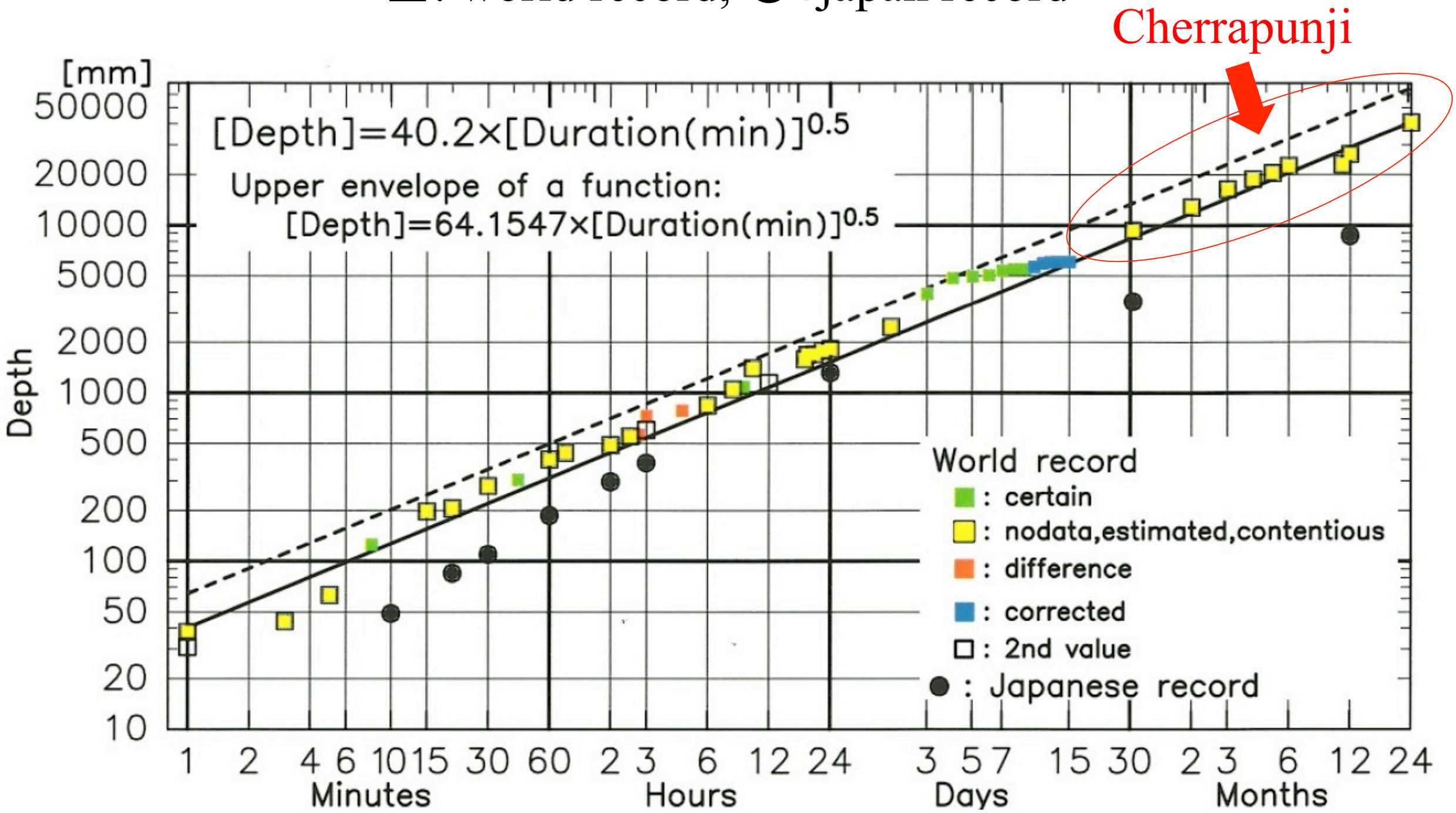


Mukhopadhyay et al. (2010)



Rainfall duration vs. Maximum accumulated rainfall

■: world record, ● : japan record



Kiguchi and Oki (2010)

History of Our Research in NE India SC

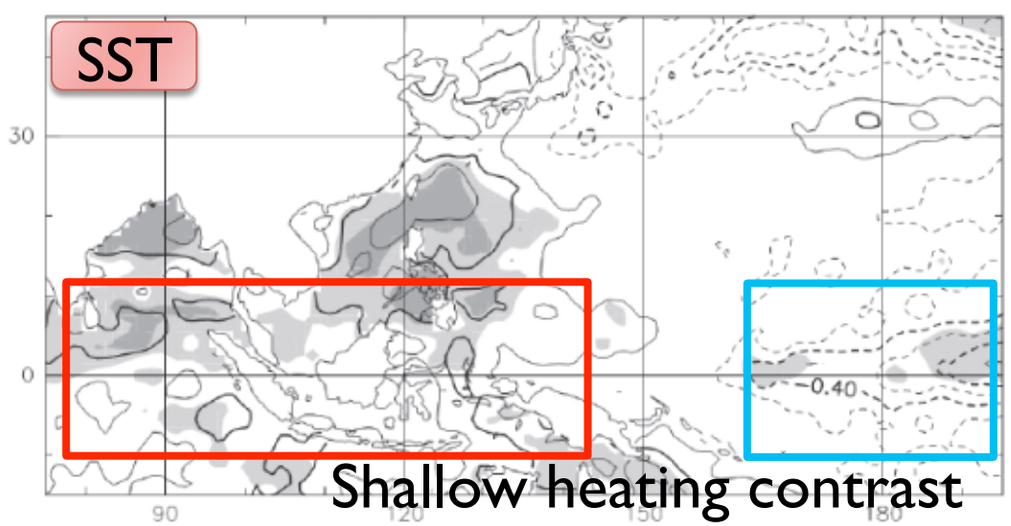
- 1987 Flood(JSPS)
- 1991 "Killer"Cyclone(JSPS)
- 1992-1994 Flood(JICA)
- 1996 Tornado in Tangail (private)
- 1995-1997 Flood and Cyclone(JSPS)
- 1999-2001 Flood(JSPS)
- 2000-2002 Flood(JICA)
- 2000-2002 Summer Monsoon(JSPS)
- 2002-2007 Infectious Diseases(KAGI21, DPRI)
- 2005-2007 Heavy rainfall monitoring(JEPP,GEOSS)
- 2006-2008 Brahmaputra River and Rural development (JSPS)
- 2006-2008 Infectious diseases(JSPS)
- 2007 Cyclone "Sidr"(JSPS)
- 2006-2015 MAHASRI Project
- 2014-2018 Data Rescue (JSPS)
- 2016-2018 TRMM Validation by Raingauge Network (JAXA)

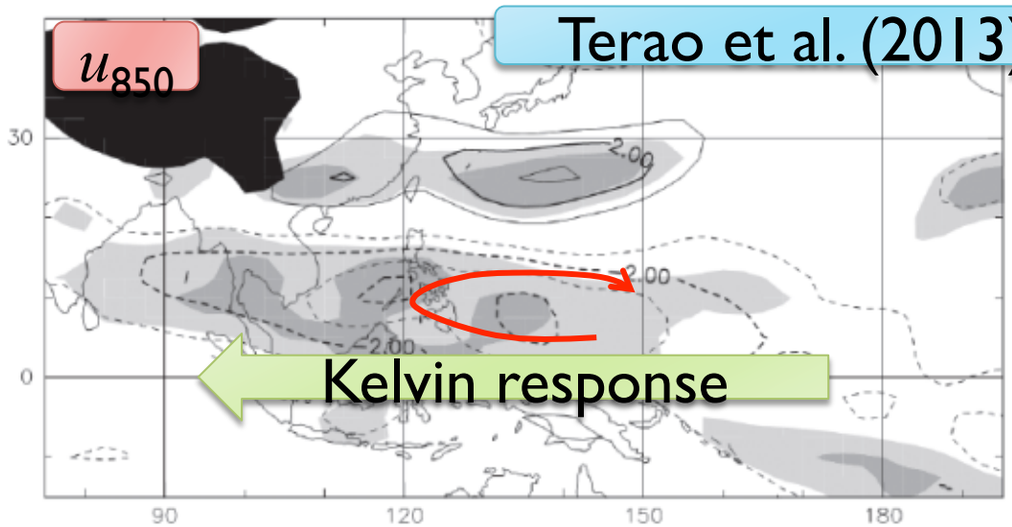
Achievements of MAHASRI-NEISC

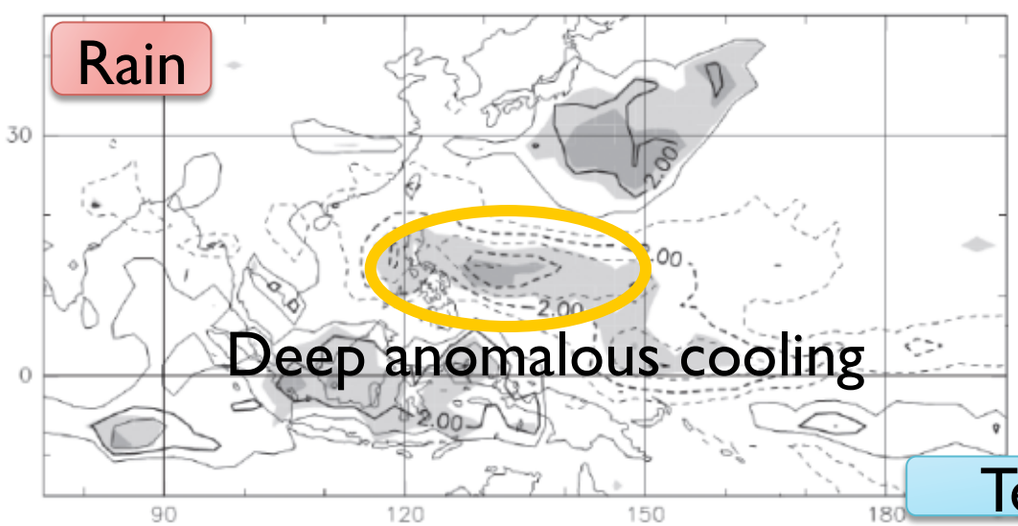
- Large scale seasonal prediction of rainfall in NE India
  - ENSO-NEI monsoon system
  - Indian/Pacific Ocean SST – WNPM – NEI monsoon
- Rainfall mechanism of the Meghalaya Plateau
  - Interaction between intraseasonal – diurnal variations
  - Mesoscale topography and monsoon variability
- Premonsoon SLS (severe local storm) climatology & prediction
- Validation of rain estimate products from GPM project
  - Direct validation method with raingauge network
  - Large underestimation in mountainous areas
- Climatic change of rainfall characteristics in Bangladesh
  - Daily rainfall data analysis 1950-2008
  - British India data rescue 1891-1947

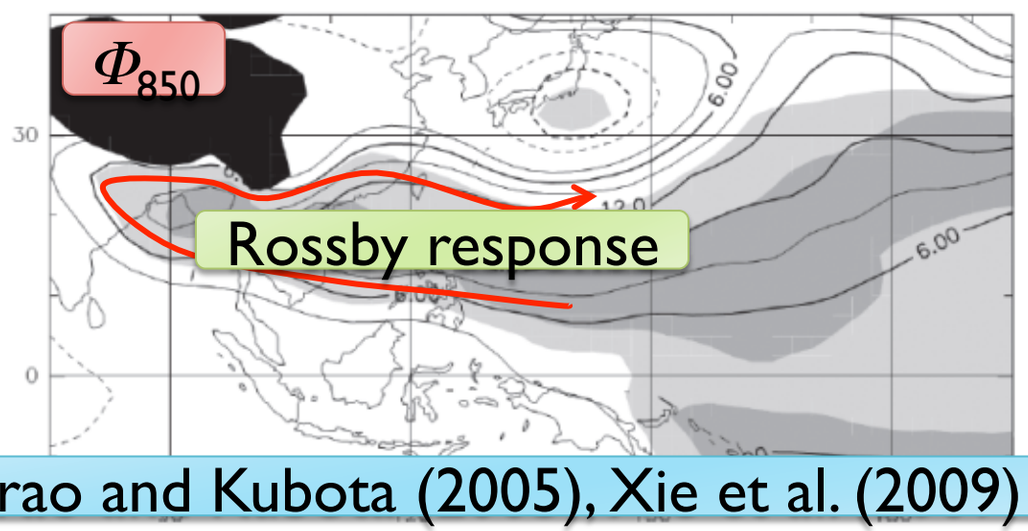
Seasonal prediction of NEI monsoon

- Rapid transition from El Nino to La Nina precedes strong rain in August & severe floods in Bangladesh (1988, 1998).
- Reduction of WNPM links ENSO-NEI monsoon relation.









Terao and Kubota (2005), Xie et al. (2009)

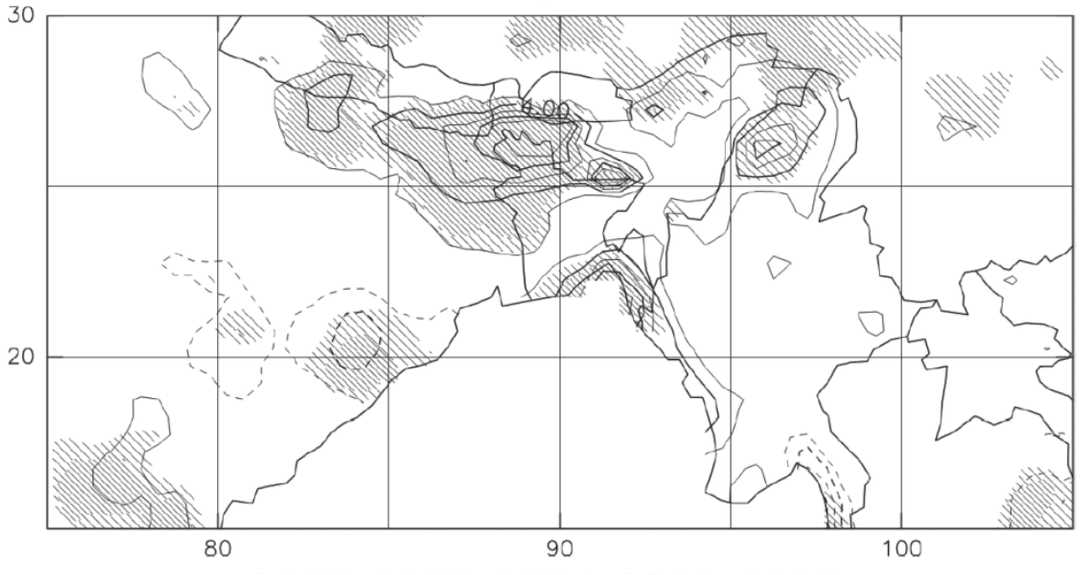
Linkage between WNP & NEI monsoon

Terao et al. (2013)

Interannual time scale

- WNP suppression ->
- Monsoon trough ->
- NEI heavy rain

APHRODITE, WNPMI<1σ

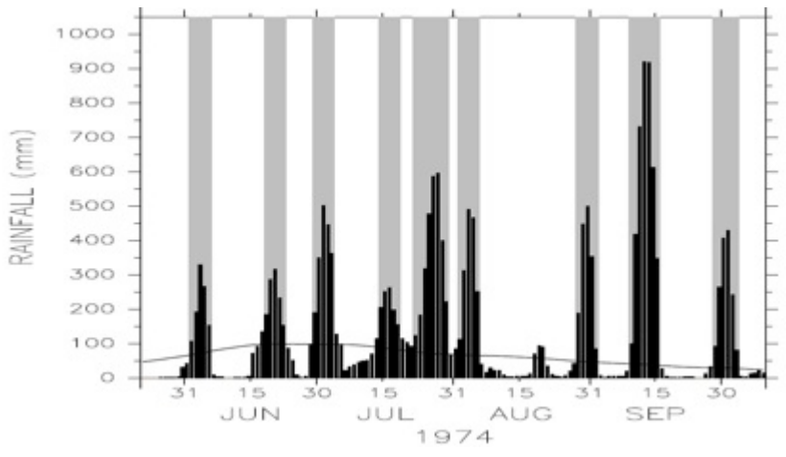


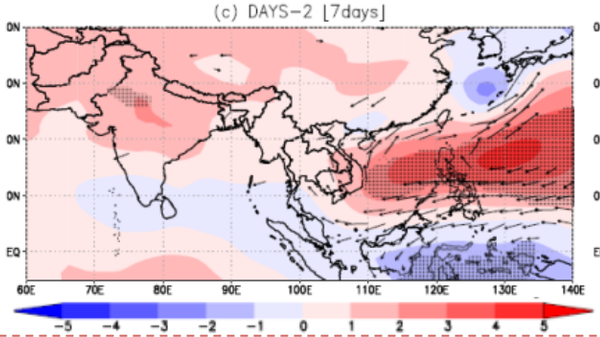
1987, 1988, 1996, 1998, 1999

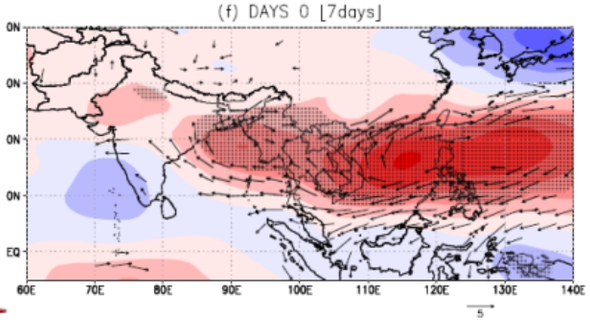
Murata et al. (2017)

Intraseasonal time scale

- WNP anti-cyclone ->
- Monsoon trough ->
- Cherrapunjee heavy rain

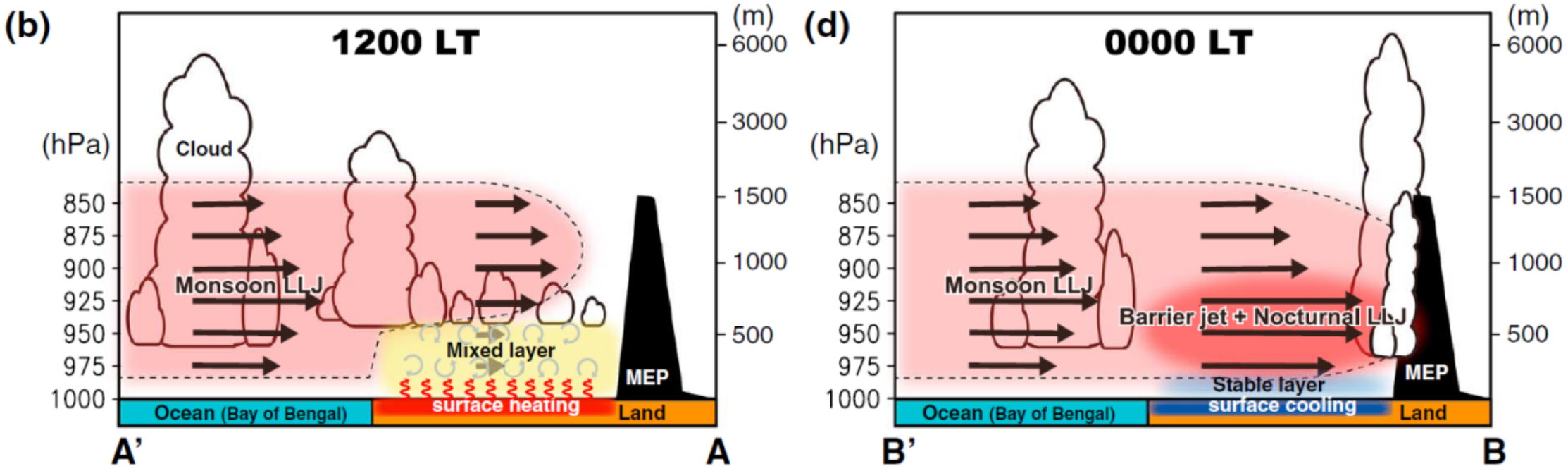






Mechanism of diurnal rainfall variation

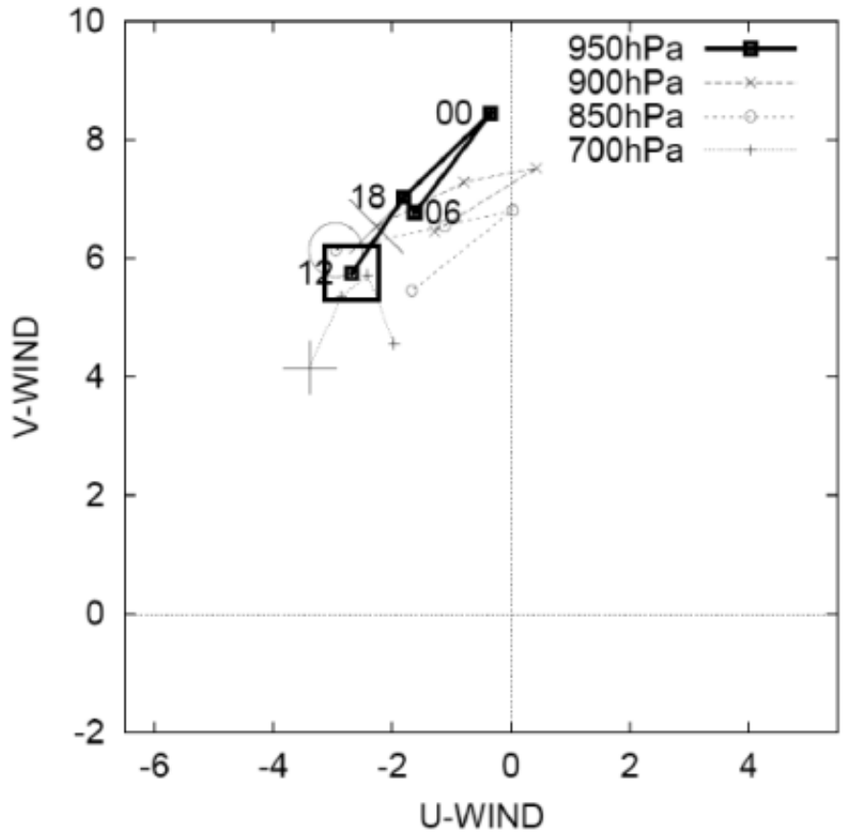
- Nocturnal acceleration of Low Level Jet enhances night to early morning rainfall peaks
- Nocturnal acceleration is explained by the development of mixed layer in the lower layer in the daytime, which is associated with the convection over the Bengal Plain.



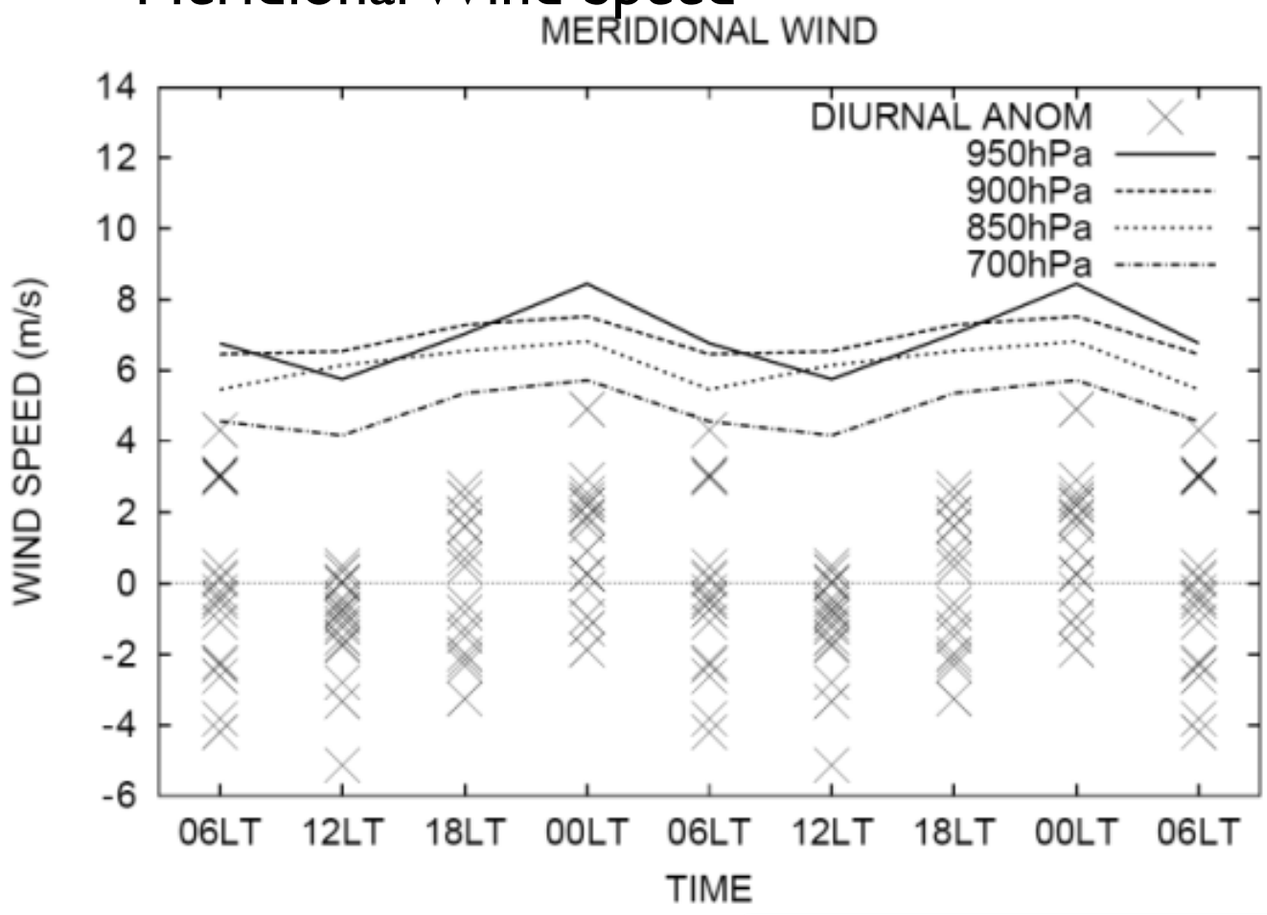
Fujinami et al. (2017)

Evidence of LLJ over the Bengal Plain

- Four-times daily R-S observation at Dhaka, Bangladesh
  - Significant nocturnal acceleration of 950 hPa level wind
  - Clockwise wind change / intertial oscillation



Meridional Wind Speed

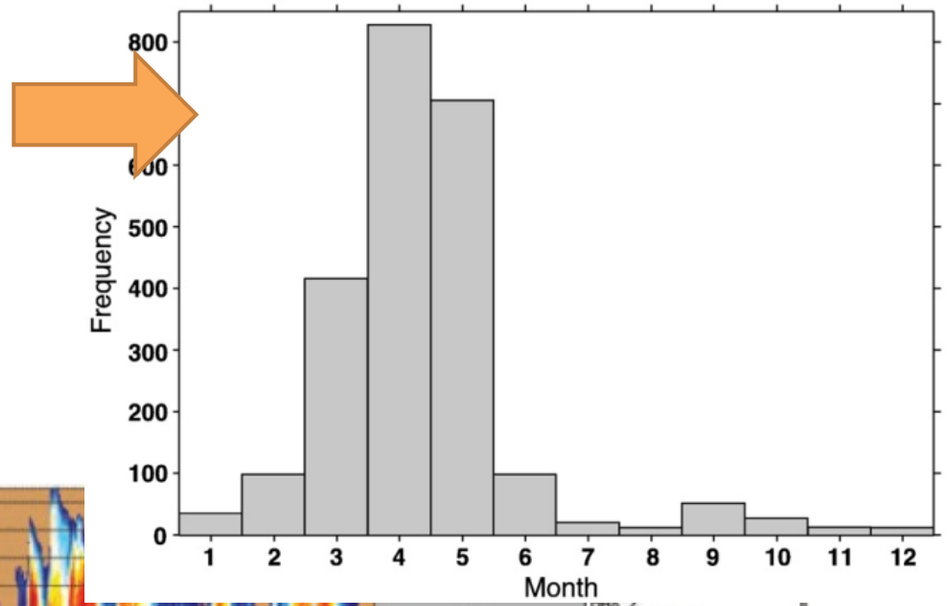


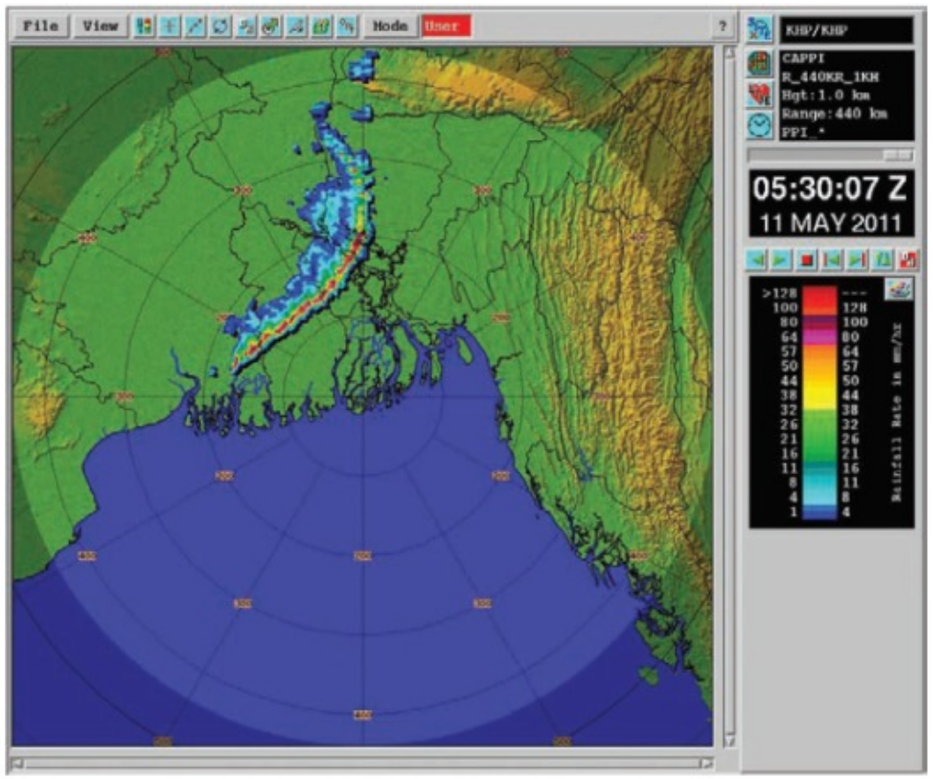
17 cases: 12, 14, 18, 25 Jul. 2000 / 28, 29 Jun., 4, 11, 18, 21, 22, 26, 27, 30 Jul., 1, 5, 15 Aug. 200.

Terao et al. (2006)

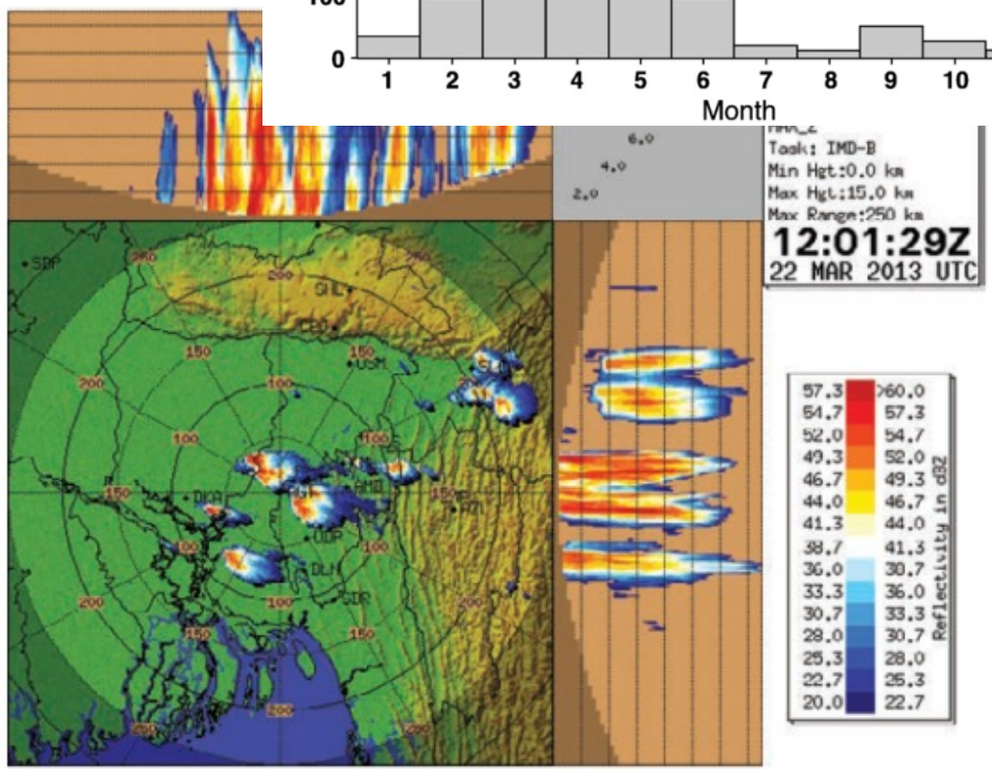
Premonsoon Severe Local Storms

- March to May (Yamane et al. 2010)
- Nor'wester / Kalbaishakhi





Khepupara Radar



Agartara Radar

Das et al., 2014

Severe local storms in Bangladesh (Yamane et al., 2010a)

- Severe local storms, which are severe weather such as tornadoes, frequently occur in Bangladesh, and produce damages almost every year.
- There are many severe local storms during the pre-monsoon season from March to May.
- Severe local storms concentrate over the central area of Bangladesh.
- The peal of occurrence of severe local storm in between 20 BST (Bangladesh Standard Time) and 20 BST. There is little in the midnight and early morning.

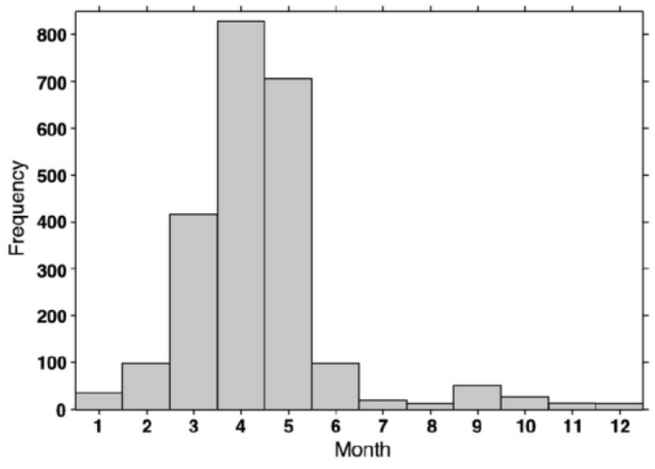


Fig. 2. Monthly frequency of severe local convective storms in Bangladesh from 1990 and 2005.

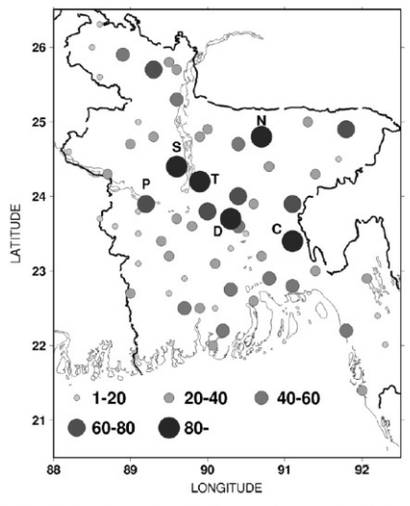


Fig. 4. Geographical distribution of severe local convective storms in Bangladesh from 1990 and 2005. Dots are located at the headquarters of districts and the shade and size of a dot indicates the number of events for each district. D: Dhaka (90.3°E 23.7°N), T: Tangail (89.9°E 24.2°N), N: Netrakona (90.7°E 24.8°N), S: Sirajganj (89.6°E 24.0°N), C: Comilla (91.1°E 23.4°N) and P: Pabna (89.2°E 23.9°N), respectively.

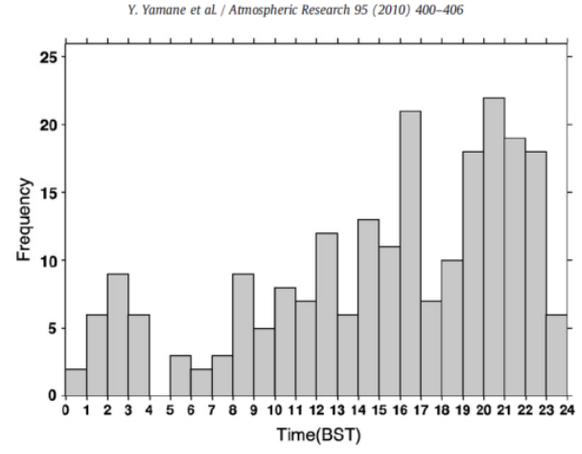
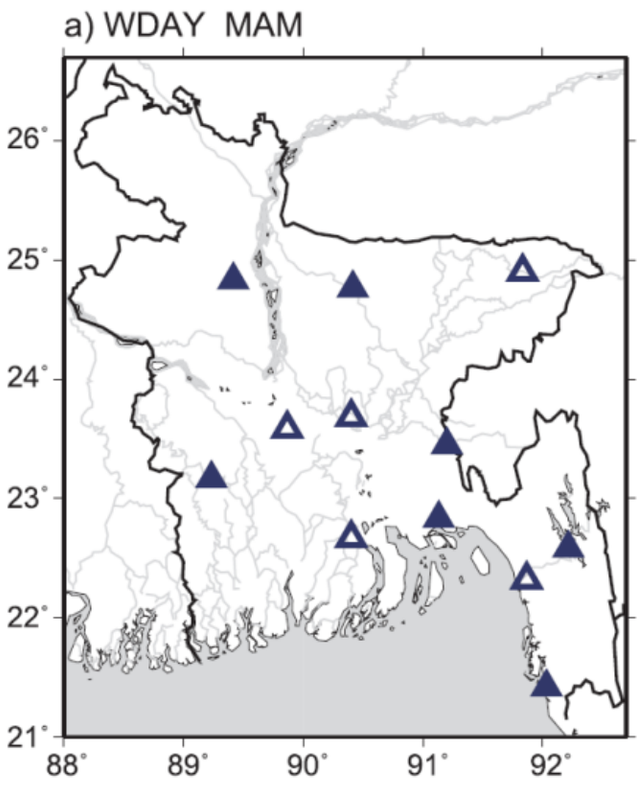


Fig. 3. Hourly frequency of severe local convective storms in Bangladesh from 1990 to 2005. BST means Bangladesh Standard Time (GMT + 6 h).

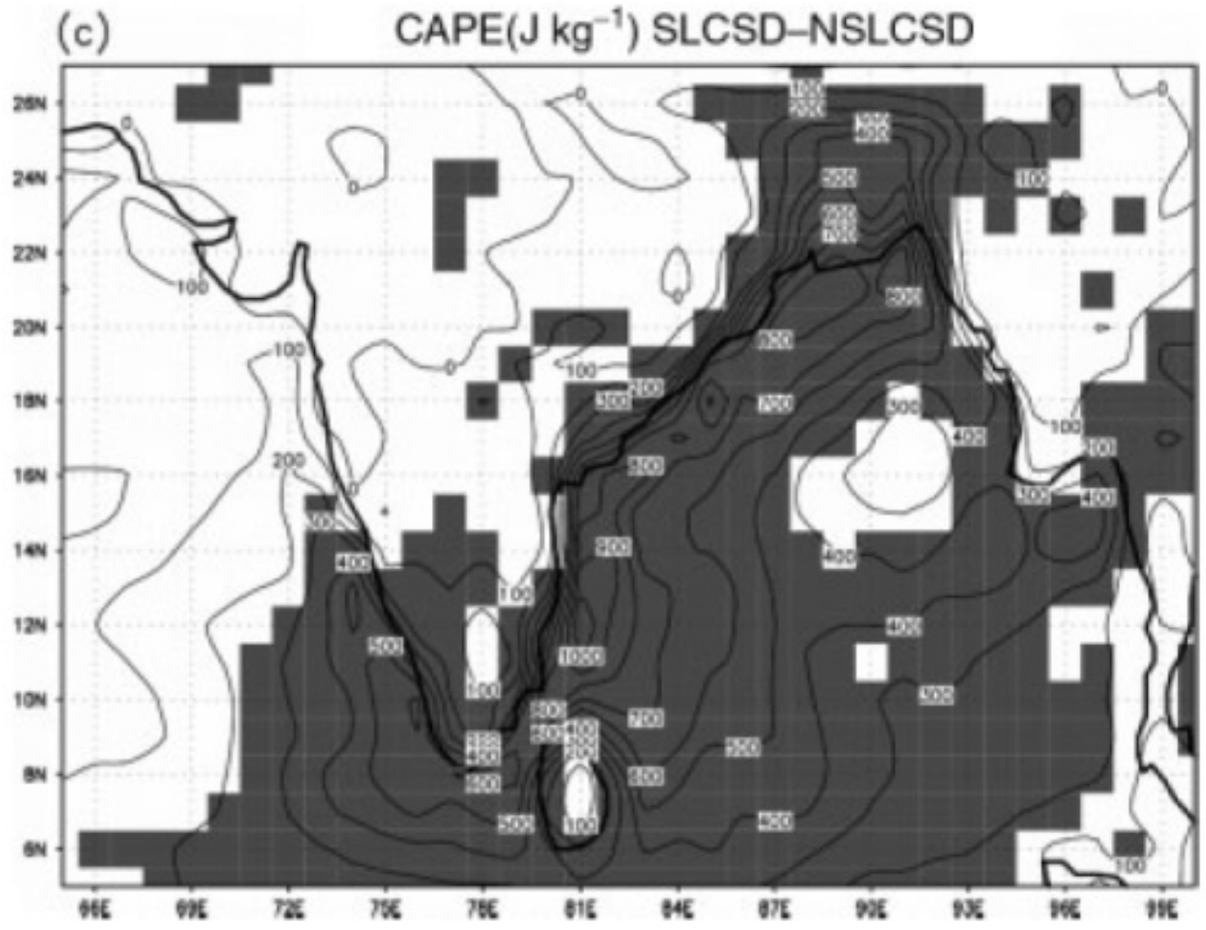
For Prediction of Severe Local Storm

- Severe Local Storms develop in larger CAPE condition

Increasing trend (1950-2008) of the premonsoon wet day



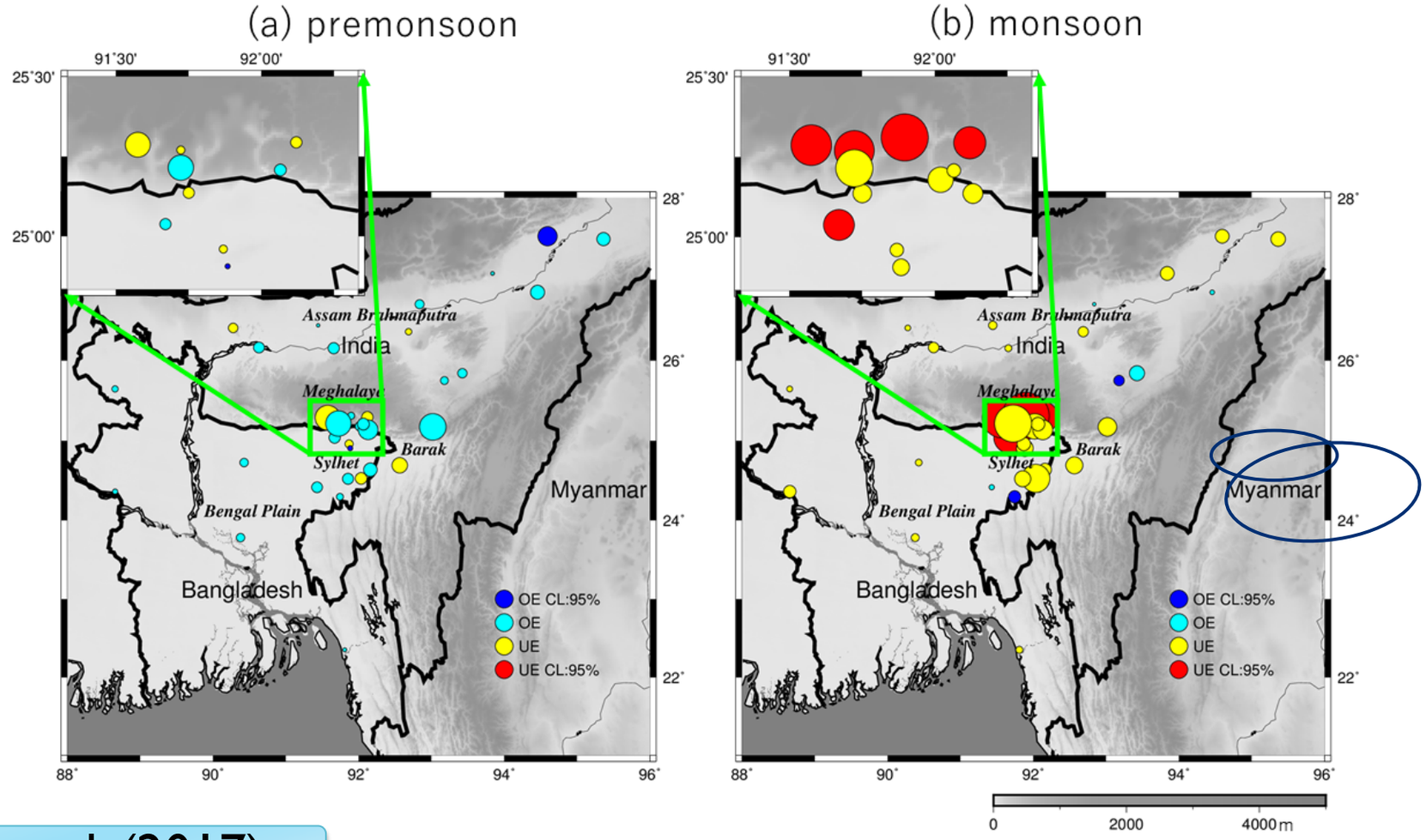
Endo et al. (2015)



Yamane et al. (2013)

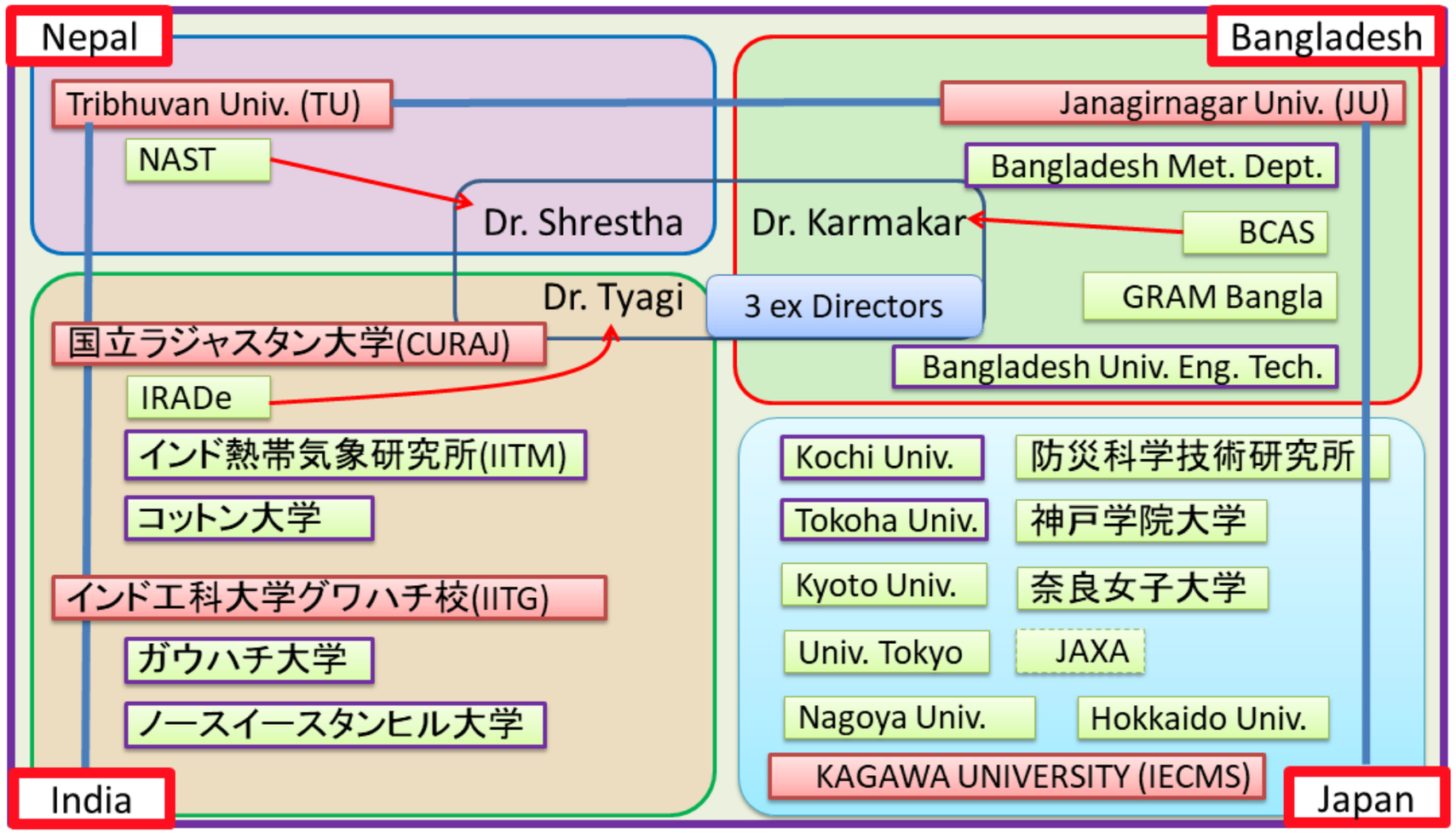
TRMM/PR validation by 36 TB-RGs

- Larger underestimations were found.
- Meghalaya and Sylhet-Barak region in monsoon season.



Terao et al. (2017)

International research community



Summary of MAHASRI-NEISC

- Scientific understandings
  - Importance of WNPM – NEI monsoon interaction
  - Mechanism of world record rainfall in Meghalaya Plateau
  - TRMM underestimation in the rainfall in Meghalaya Plateau
  - Premonsoon rainfall climatology and climate change
- Future Plan
  - Uniqueness in intraseasonal variation over NEISC
    - 7-25 day (submonthly variation) dominates (Fujinami et al. 2014)
    - Passive or active? / interaction with 30-60 day variation
  - Extreme heating over NEISC and its effect on monsoons
  - SA-WNP (or Indian/Pacific Ocean) combined monsoon system

south asia