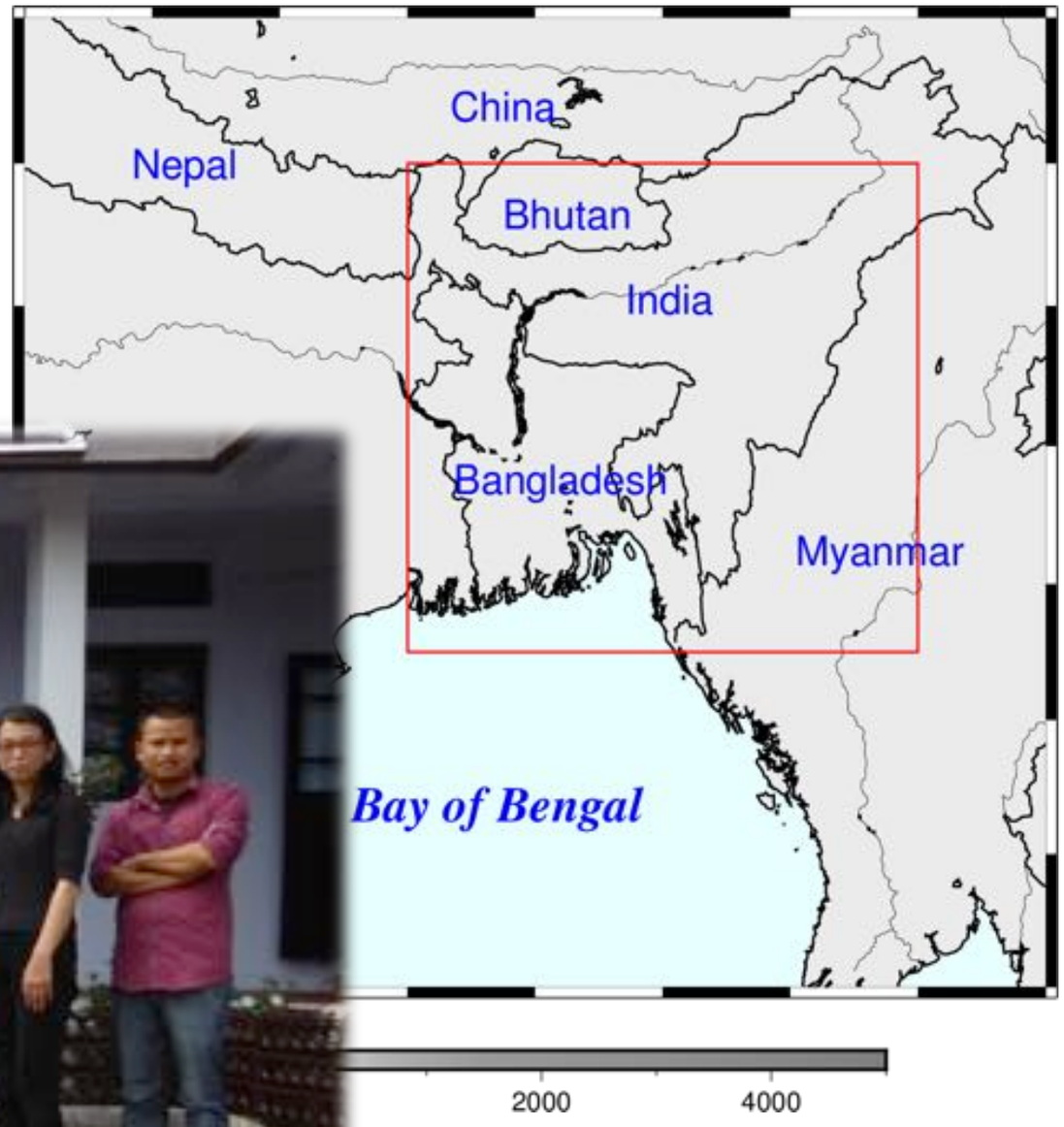
Towards Establishment of the Science plan of Post-MAHASRI RHP

Toru Terao (Kagawa Univ.), Shinjiro Kanae (Tokyo Inst. Tech.),
Jun Matsumoto (TMU & JAMSTEC)

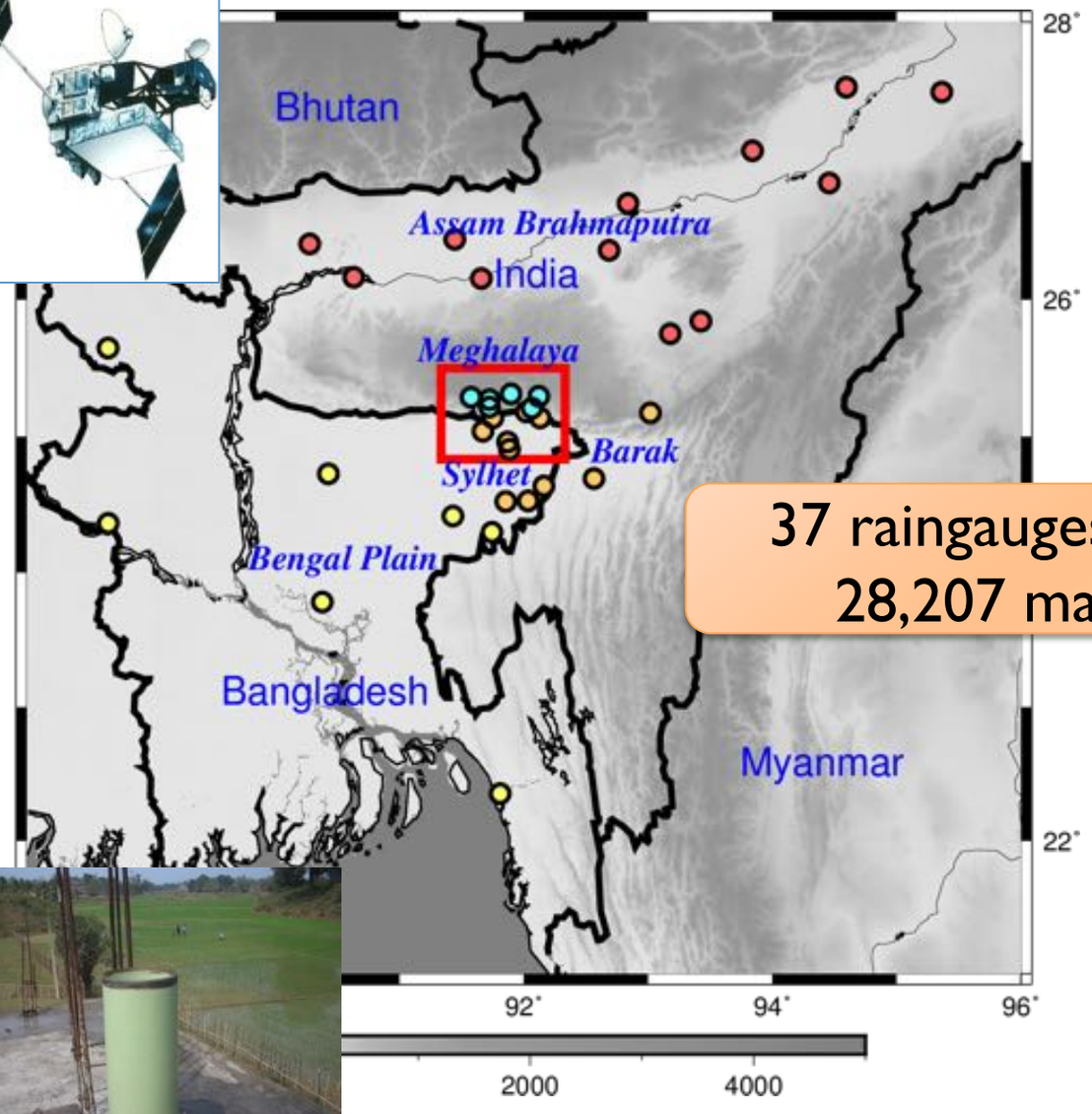
My Research Field: Hydrometeorology over the Northeastern Indian subcontinent



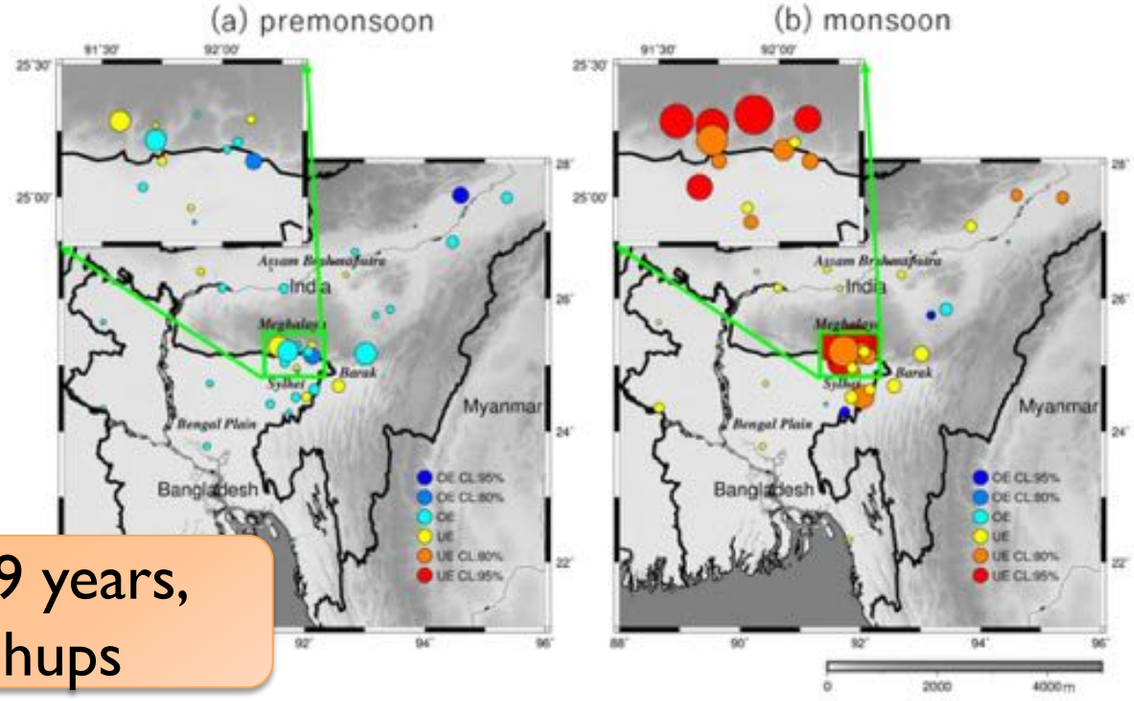
At Cherrapunjee, Meghalaya, India

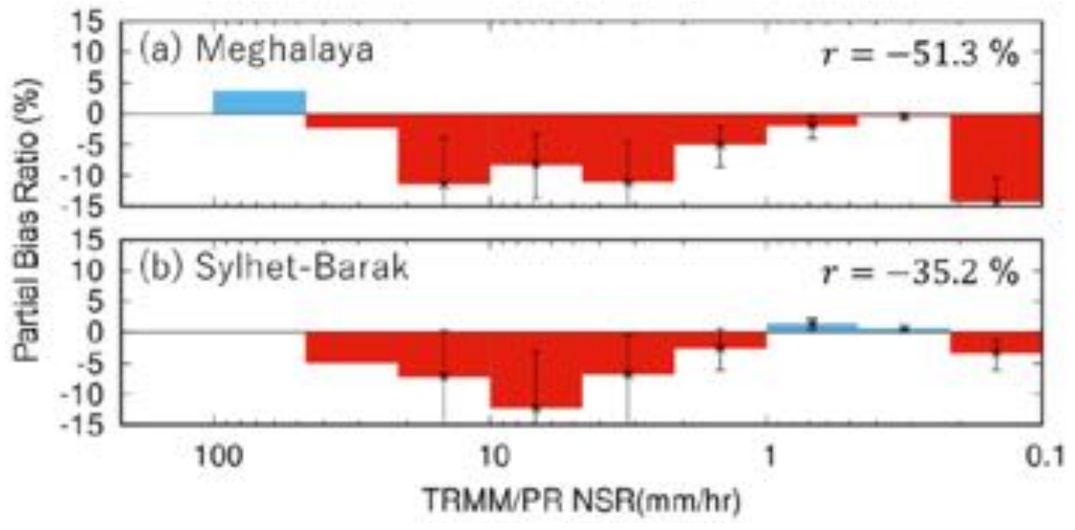
TRMM Validation by RG Network

- Monsoon (Jun.-Sep.): Underestimation around Meghalaya



37 raingauges, 9 years,
28,207 matchups





Terao et al. (2017/SOLA)

Outline

- Towards Establishment of the Science plan of Post-MAHASRI RHP
  - RHPs over the Monsoon Asia -- GAME / MAHASRI
  - Outcomes of MAHASRI
  - Recent Post-MAHASRI planning sctivities
  - Topics and collaboration

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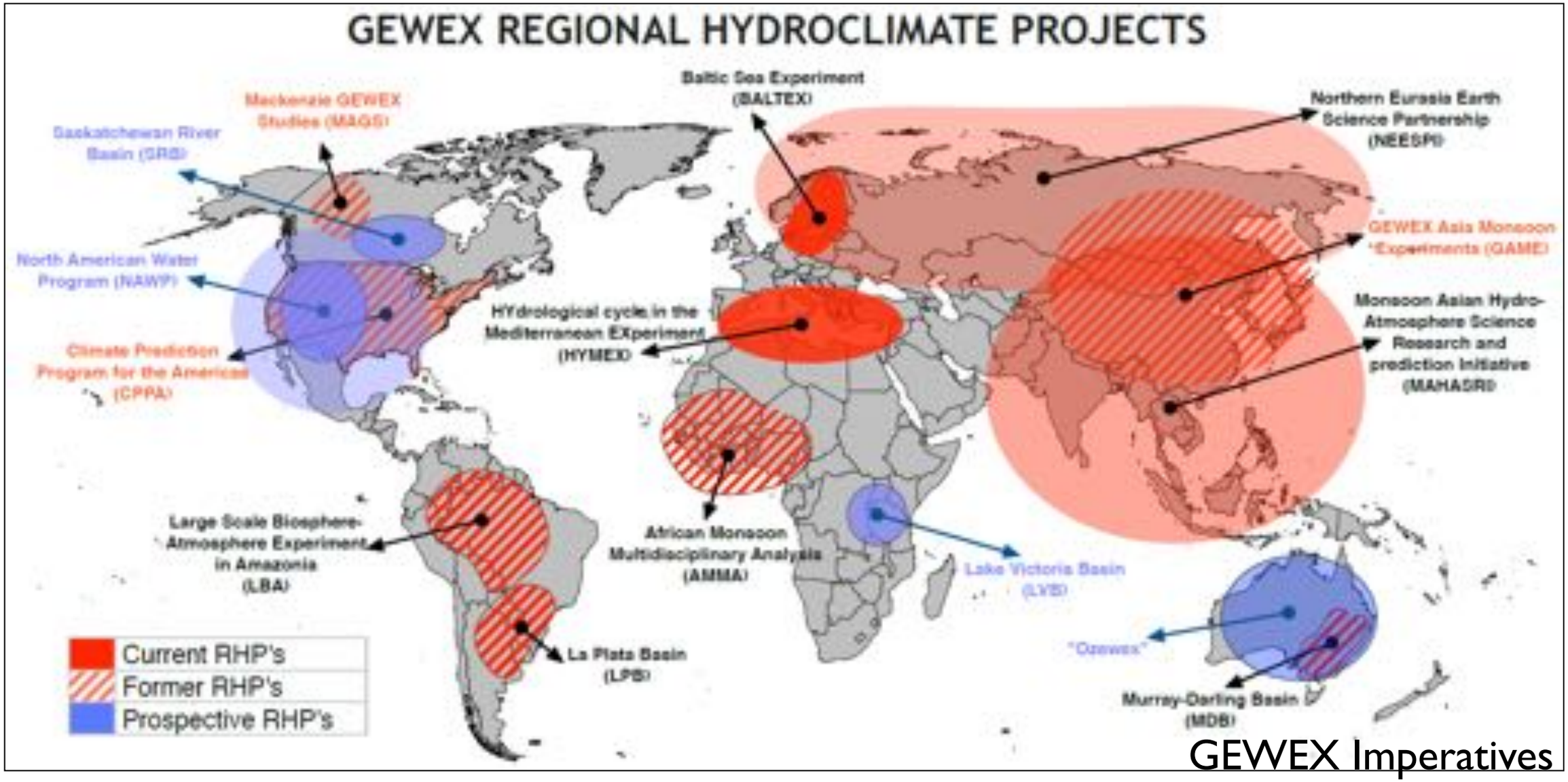
RHP's in Monsoon Asia

- Monsoon Asia Hydroclimatological Research have continued since 1995 under GAME and MAHASRI

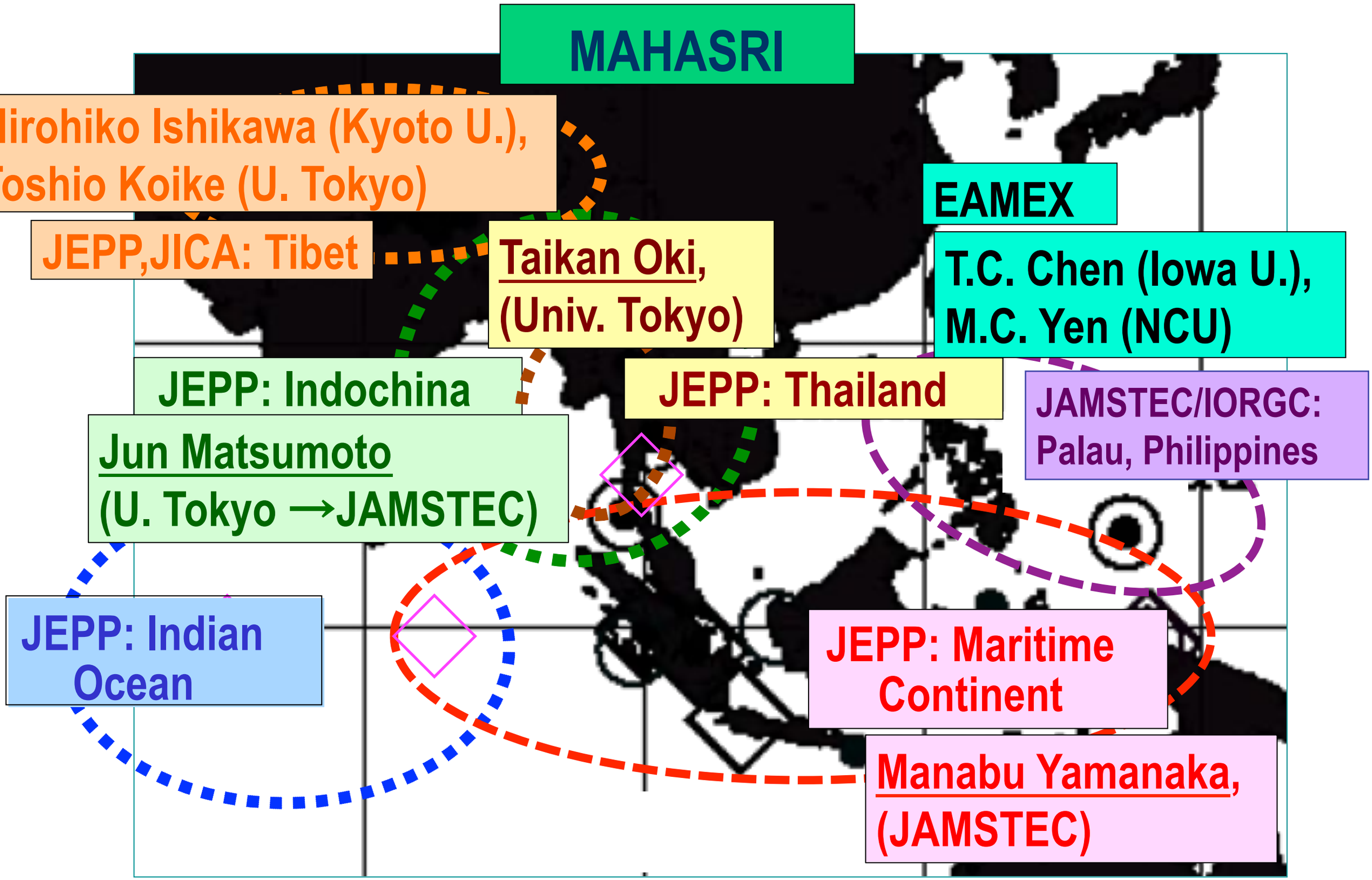


GEWEX Imperatives

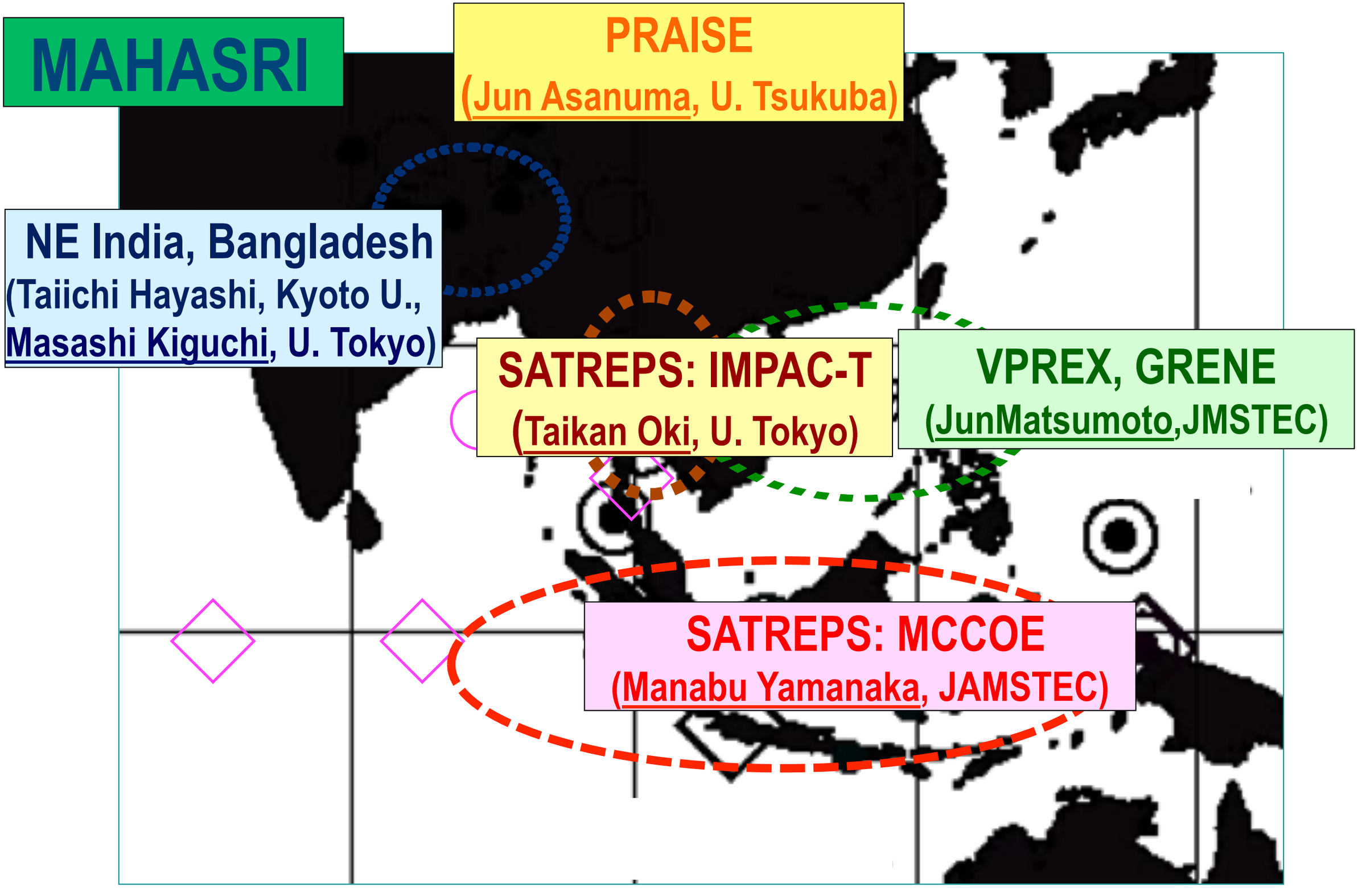
GAME/MAHASRI

- RHP of Asian Monsoon hydroclimate research
  - GAME (1996-2005): GEWEX Asia Monsoon Experiments
    - Atmoshere-land surface interactions
    - Four regional components => Cross cutting (2002-2004)
      - GAME-Siberia, GAME/HUBEX, GAME-Tibet, GAME-Tropics
  - MAHASRI (2006-2016): Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative
    - Hydro-meteorological prediction system, up to a season
    - Based on collaboration of several regional projects
      - Maritime Continent, Thailand, NE Asia, Vietnam, South Asia …
    - Major Funding Source: JEPP -> SATREPS

MAHASRI related Projects (JEPP, EAMEX, JAMSTEC) 2006-2010



MAHASRI related Projects for the JPFY2009-2013



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Outcomes / Impacts of MAHASRI

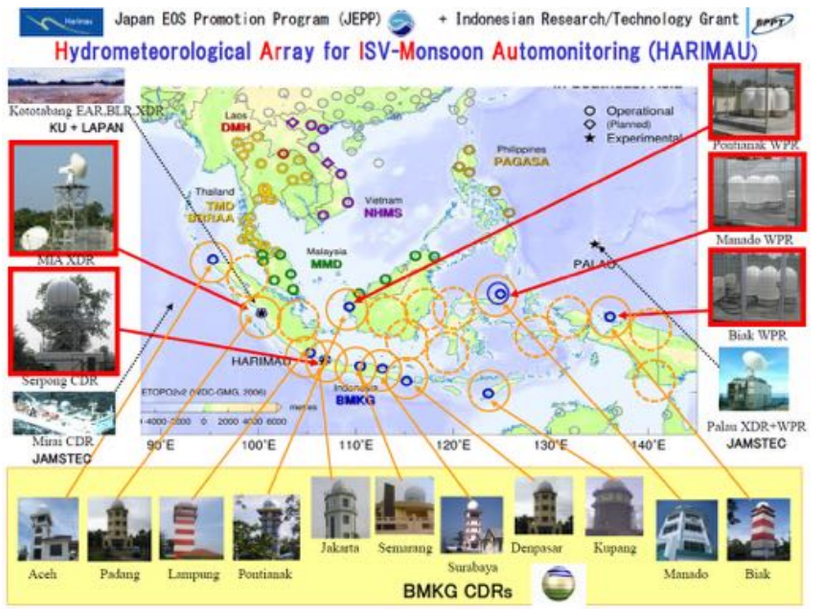
1. Since the GAME period, Asian operational agencies and research communities strongly stimulate research activities in monsoon Asia.
   - Local agencies and research inst. development in Asian countries
   - Education / capacity building / PhD / Co-authored papers
2. A real-time monitoring and flood prediction system have been developed in the Chao Phraya River Basin in Thailand.
3. Dynamics of autumn/winter extreme rainfalls in Indochina have been extensively investigated.
4. Collaboration with AMY community.
   - In-situ observation datasets (DIAS) in the Univ. Tokyo
   - AMY Re-analysis by MRI (Meteorological Research Institute)

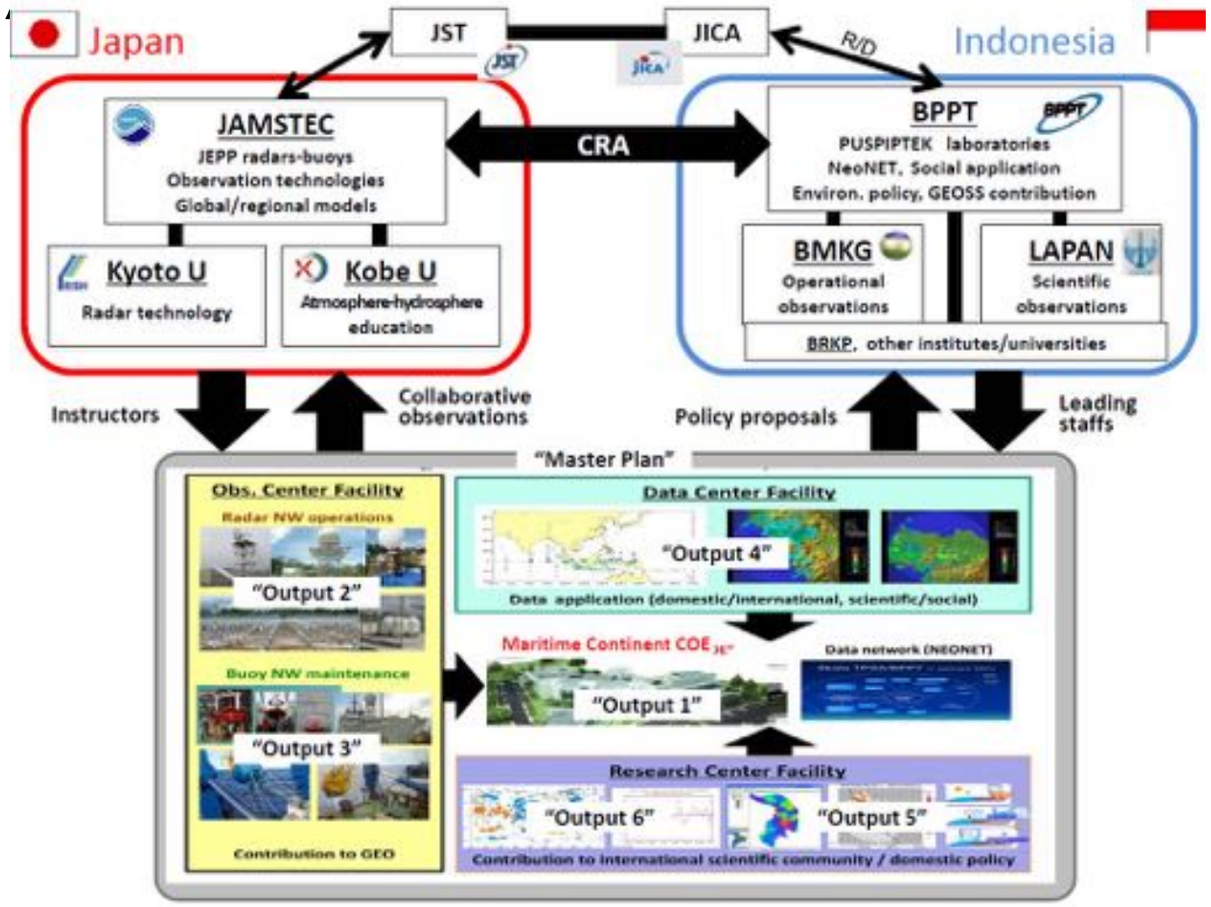
Outcomes / impacts of MAHASRI (1)-a

- Continuous research collaborations with monsoon Asian operational agencies and research communities since the GAME period strongly stimulate research activities in monsoon Asia.
  - Thailand (TMD, RID, RFD, KU…, IMPAC-T/Univ. Tokyo, TIT, Kyoto U….)
  - Indonesia (BPPT, BMKG, HARIMAU/JAMSTEC)
  - Vietnam (NHMS, HUS, JEPP/JAMSTEC, TMU)
  - Philippines (PAGASA, Ateneo U., JAMSTEC, TMU)
  - Bangladesh, NE India (BMD, IMD, IIT, NEHU…, Kyoto U., Kagawa U, Kochi U….)
  - Mongolia (IMH, Tsukuba Univ., Hokkaido Univ. JAMSTEC….)

Outcomes / impacts of MAHASRI (1)-b

- Local research developing efforts:
  - MCCOE, NEO-NET (Indonesia)

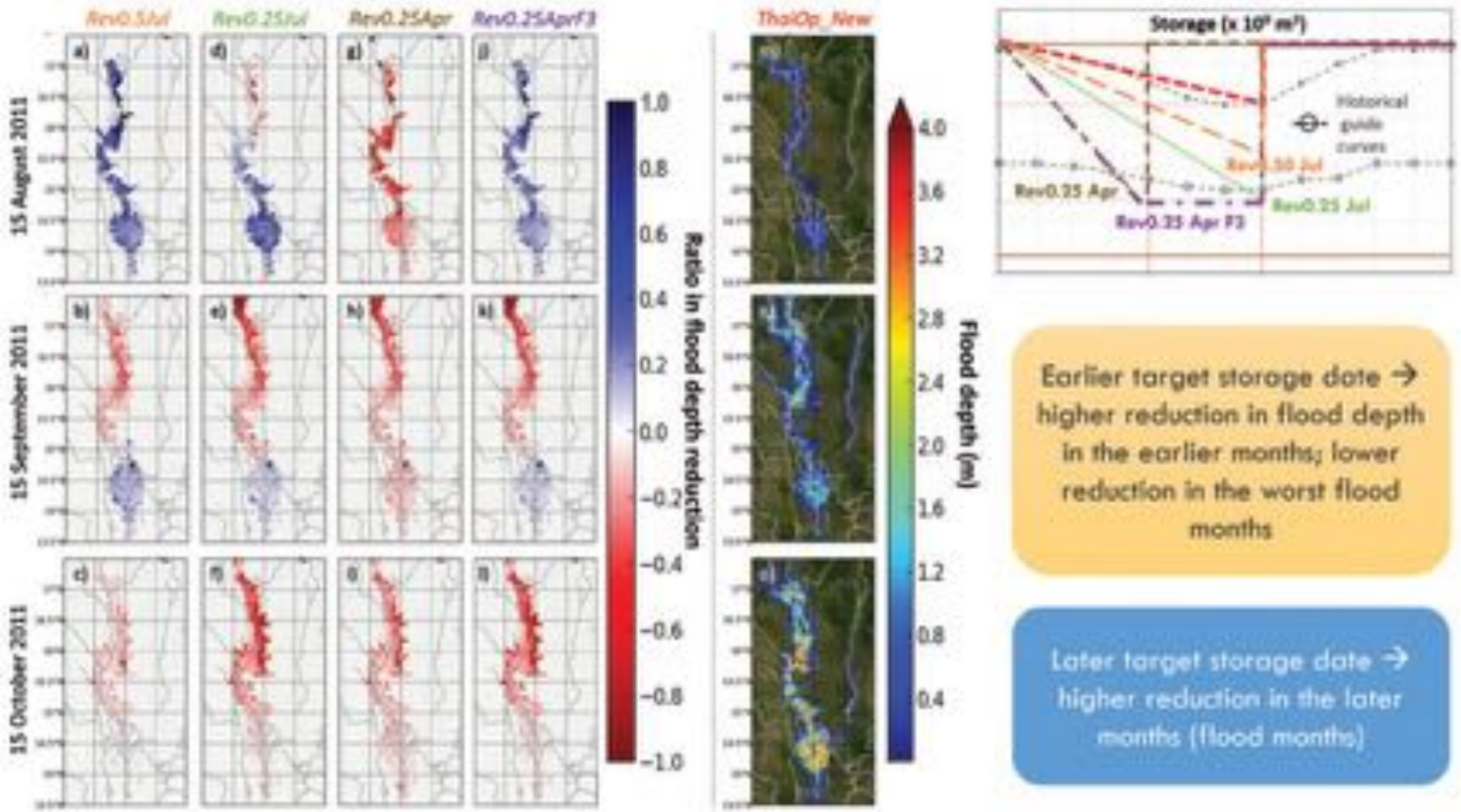




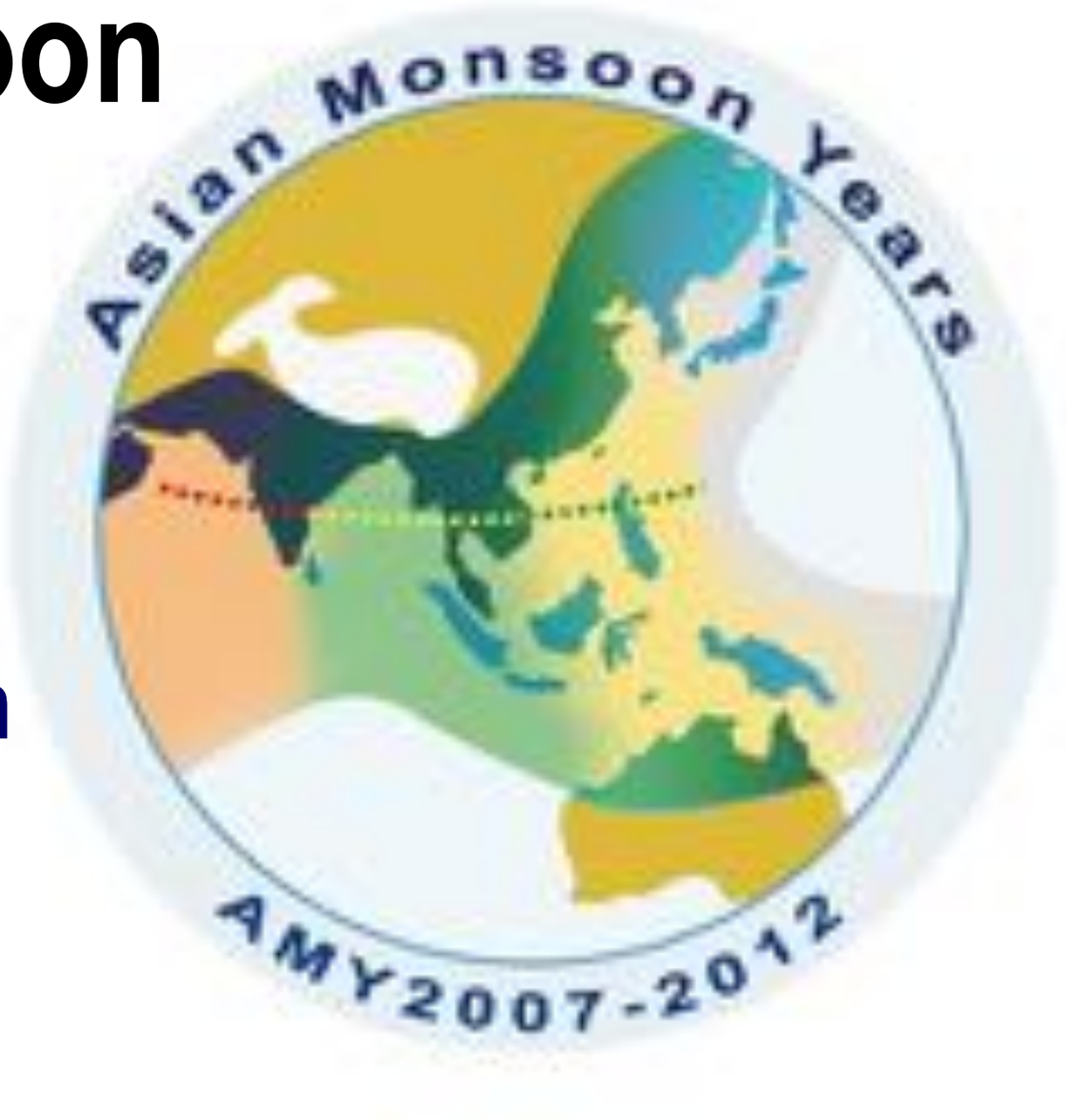
- Education / capacity building:
  - Co-authored papers with Asian scientists (Prof. Jun Matsumoto)
    - 1996-2005 (GAME): 5 / 22 (23%)
    - 2006-2015 (MAHASRI): 26 / 60 (43%) 4 PhD students in TMU

Outcomes / impacts of MAHASRI (2)

- Flood Monitoring / Prediction System
  - Chao Praya River Basin in Thailand
  - Mega Flood in 2011



AMY (Asian Monsoon Years 2007-2012)



Overarching Goal:

"To improve Asian Monsoon prediction for societal benefits through improving understanding of the variability and predictability of the Asian-Australian monsoon system"

http://www.wcrp-amy.org/


PRAISE
AAF/SMART-COMMIT
MAIRS
AMF-China
JEPP/Tibet
PHONE
GRL-HyARC
COBRA
JICA/Tibet
MAIRS
SAARC-STORM
CTCZ
AIPO
JAMSTEC/VPREX
SoWMEX
EAMEX
JEPP/NE India,
JEPP/SE Asia
JEPP/Thai
TMD
CEOP
JAMEX
TCS08
JAMSTEC/PALAU
AIPO, JEPP IO/HARIMAU, CPEA
JAMSTEC/TRITON Buoy

Mar. 2016

MAHASRI Final Conference

- Plenary presentations:
  - South Asia / Maritime Continent / Southeast Asian Winter Monsoon / Indian Monsoon / Southeast China / AMY Reanalysis
- Sessions:
  - Monsoon Precipitation / Atmosphere-Land-Ocean Interaction / Extreme / Climate
  - IMPAC-T & ADAP-T / Urban Climate in Jakarta
- S-SE-E Asian Countries:
  - Thailand / Philippine / Indonesia / Vietnam / Malaysia / India / Mongolia / China / Hong Kong
- Cross-cutting
  - Climate Modelling / GPM / AMY Reanalysis / DIAS / Isotopes
  - Diurnal / Intra-seasonal / WNP Monsoon-ENSO

SPEPS of JpGU are now in edition. More than 30 papers will be submitted.

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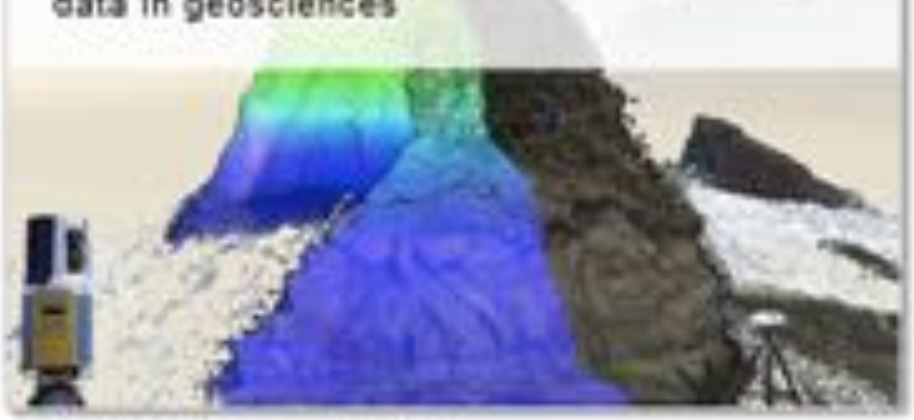
5. Asian monsoon hydroclimate

Started: August 15, 2018

4. High-definition topographic and geophysical data in geosciences



Started: February 7, 2017

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RHP Status

RHP: Regional Hydroclimatological Project

Active in 4 continents:

Europe: ***HymEx*** (2010-2020) =======> High-impact weather events, societal response
Baltic Earth (2016-) =======> Sea and land changes, biogeochemical processes
Australia: ***OzyWex*** (2015-) ========> Water and energy cycle in Australia
Africa: ***HyVic*** (2015-2024) =========> Hydroclimatic variability over Lake Victoria basin
North America: ***CCRN*** (2014-2018) => Cryospheric, ecological, hydrological interactions

Recently finished:

Asia: ***MAHASRI*** (2007-2016) =======> Asian Monsoon
Eurasia: ***NEESPI*** (2004-2015) ======> Northern Eurasian climate-ecosystem-societal interac

Prospective:

Europe: ***PannEx*** (end 2017?) ======> Agronomy, air quality, sustainability & water mgnt

In discussion:

Exploring possibilities
in the Americas and Asia.

GHP (Courtesy of Prof. Jason Evans, Co-chair of GHP) GEWEX

Post MAHASRI Planning Activities

- 17-19 Oct. 2017: GHP/TPE-WS (Kathmandu)
- 2 Nov. 2017: Meeting in Sapporo
  - Discussion of the collaboration with TPE for meso-scale modeling
- 20 Jan. 2018: PostMAHASRI Planning Workshop
  - Nagoya University, Japan
  - More than 40 researchers
- 15-16 Mar. 2018: International PostMAHASRI Planning Workshop
  - TMU (Tokyo Metropolitan University), Japan
  - 12 Asian researchers from 8 countries, Thailand, Vietnam, Philippine, Indonesia, China, Nepal, India, Bangladesh
  - Total 63 international researchers

Future Time Table for Science Plan

Entry of Key Sentences

- The 8th GEWEX Science Conference (6-11 May 2018 @Canmore Canada)

First Draft of Draft

- JpGU 2018, Post MAHASRI session (20 May 2018 @Makuhari Chiba)
- Post MAHASRI Science Plan International Workshop (Sep. or Oct. 2018)
- GHP/Andex Workshop (Oct. 2018)

Propose new RHP

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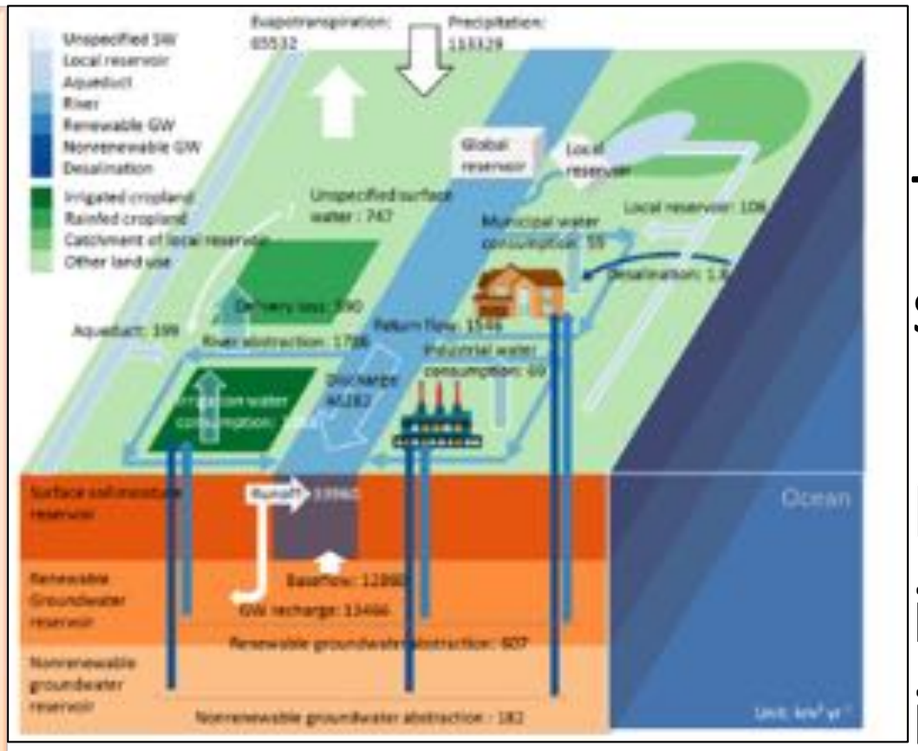
Validation and improvement of hydrological model which incorporates human water withdrawal.

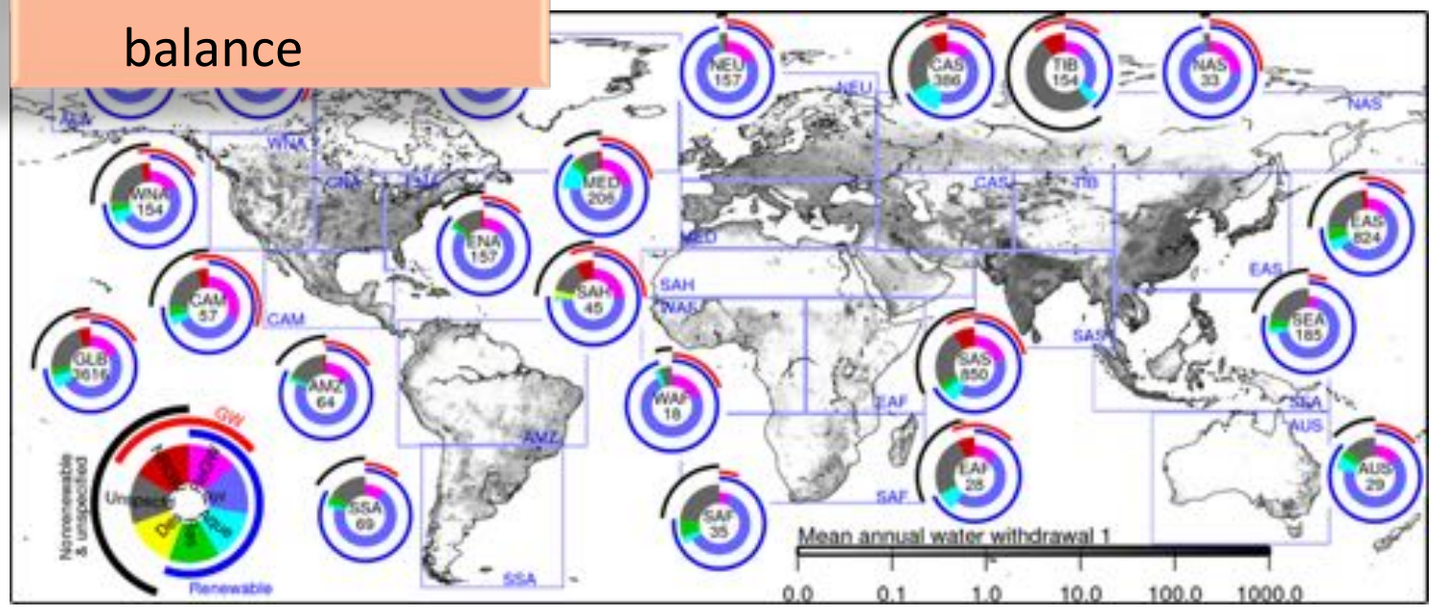
1. Groundwater recharge
2. Groundwater abstraction
3. Aqueduct water transfer
4. Local reservoirs
5. Seawater desalination
6. Return flow and delivery loss
7. Surface water balance



(Hanasaki et al. 2018, HESS)

There is still 21% 'Unspecified sources' in global water use.

Major part of unspecified is in Asia, probably from irrigation.

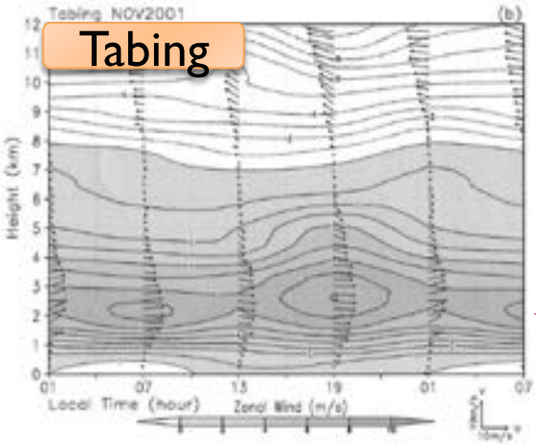


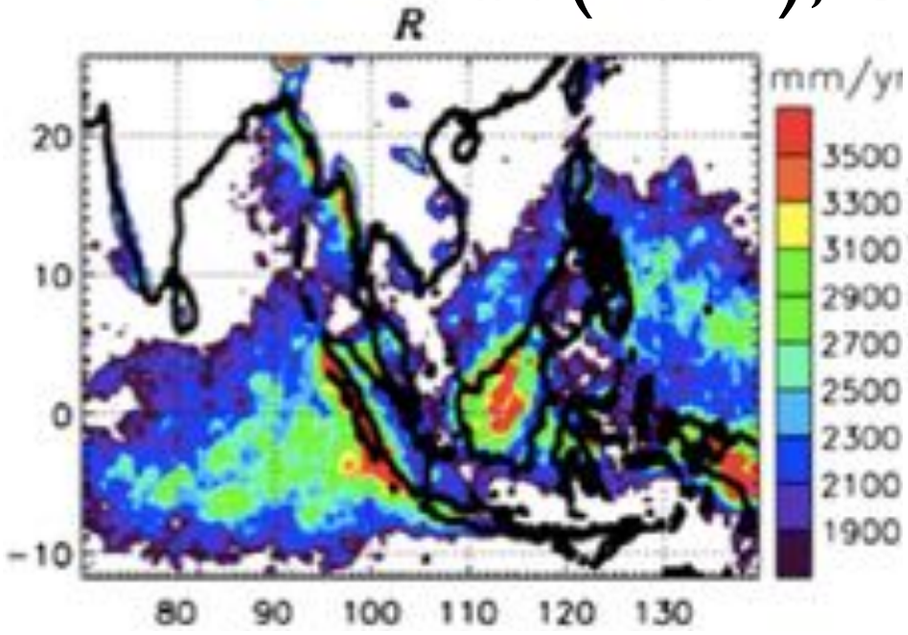
Water sources by region (Hanasaki et al., 2017)

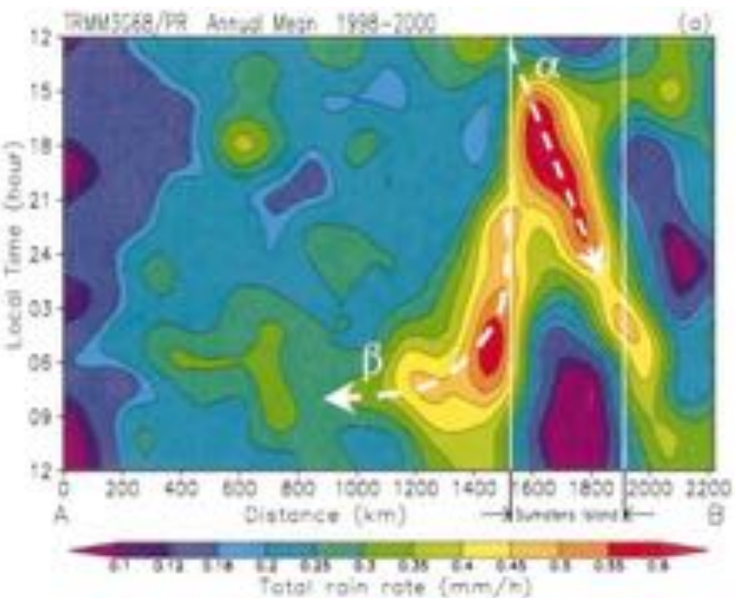
Validation and improvement by using various sources of information in Asia (e.g., satellite data, local data, assimilation?).

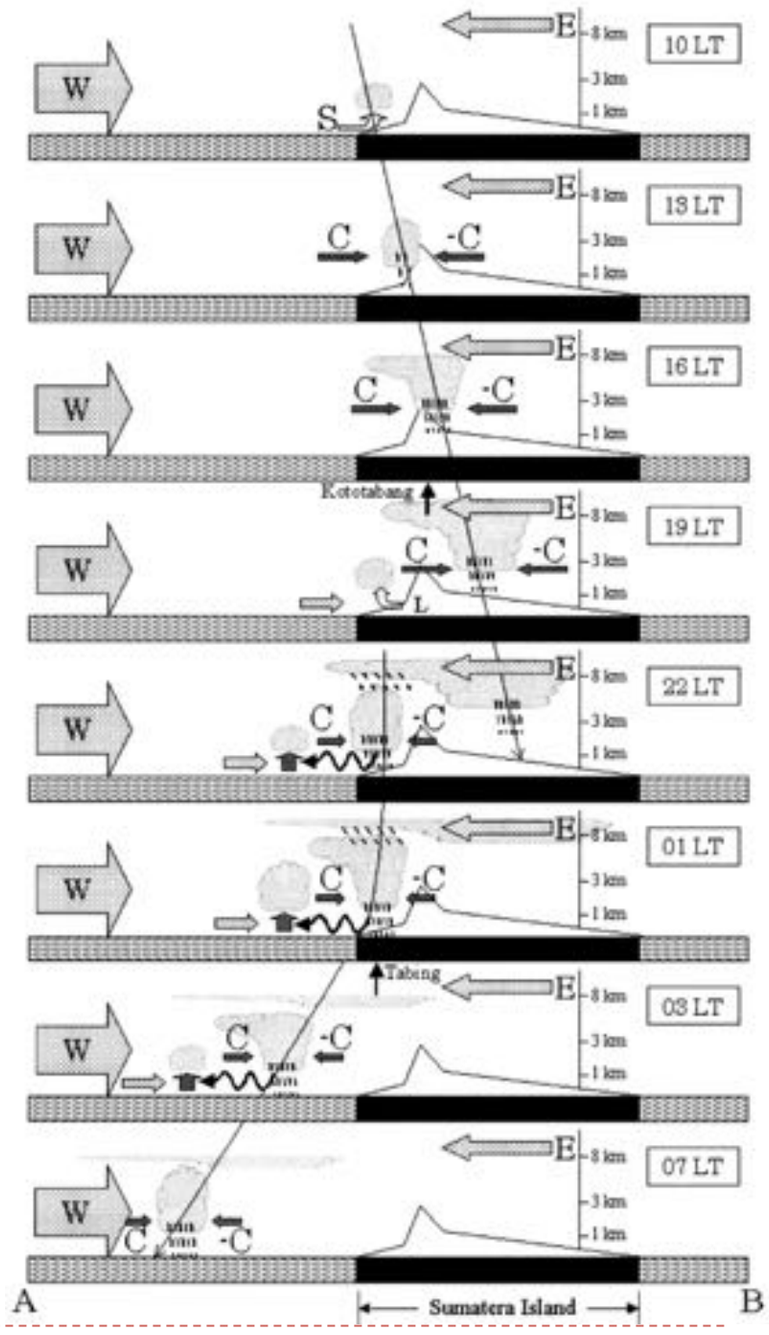
Coast Line and Water Budget

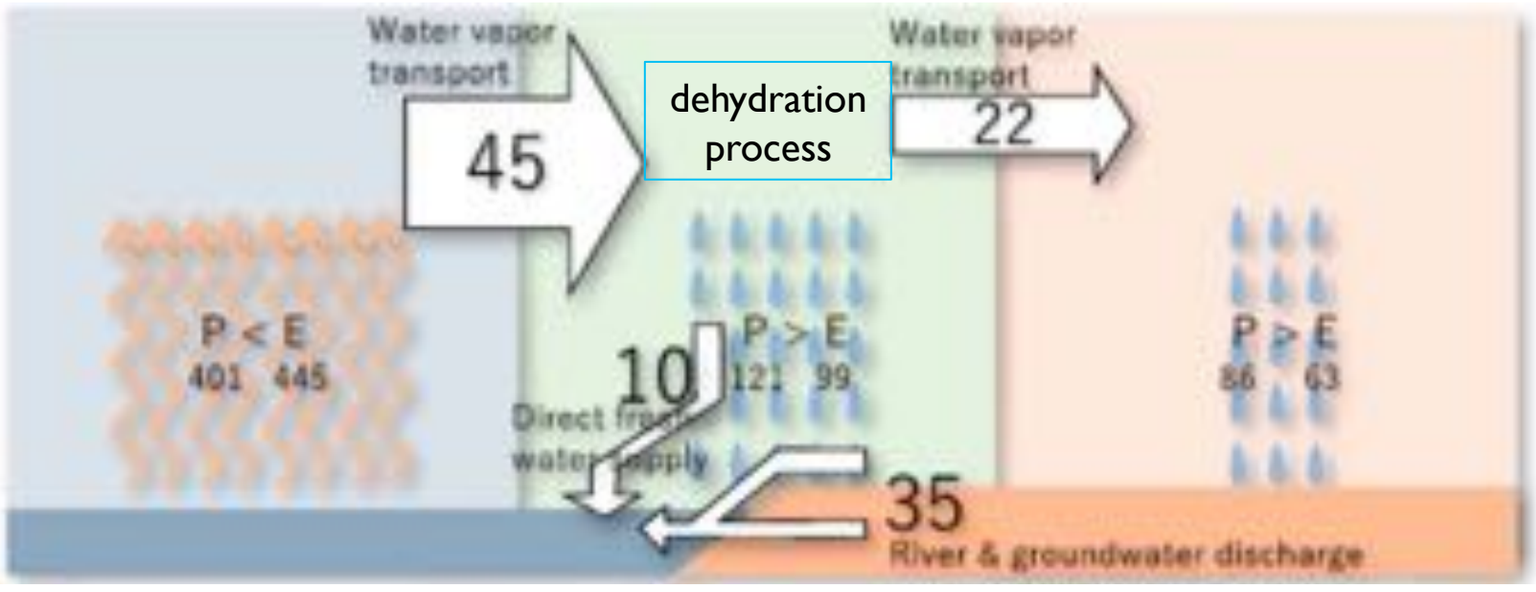
- Mori et al. (2004), Ogino et al. (2016, 2017)







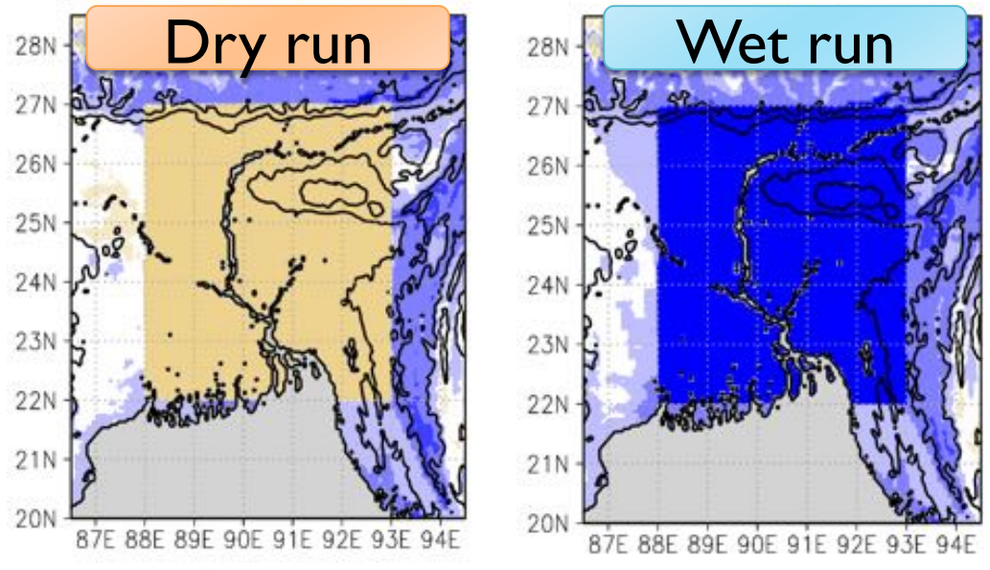


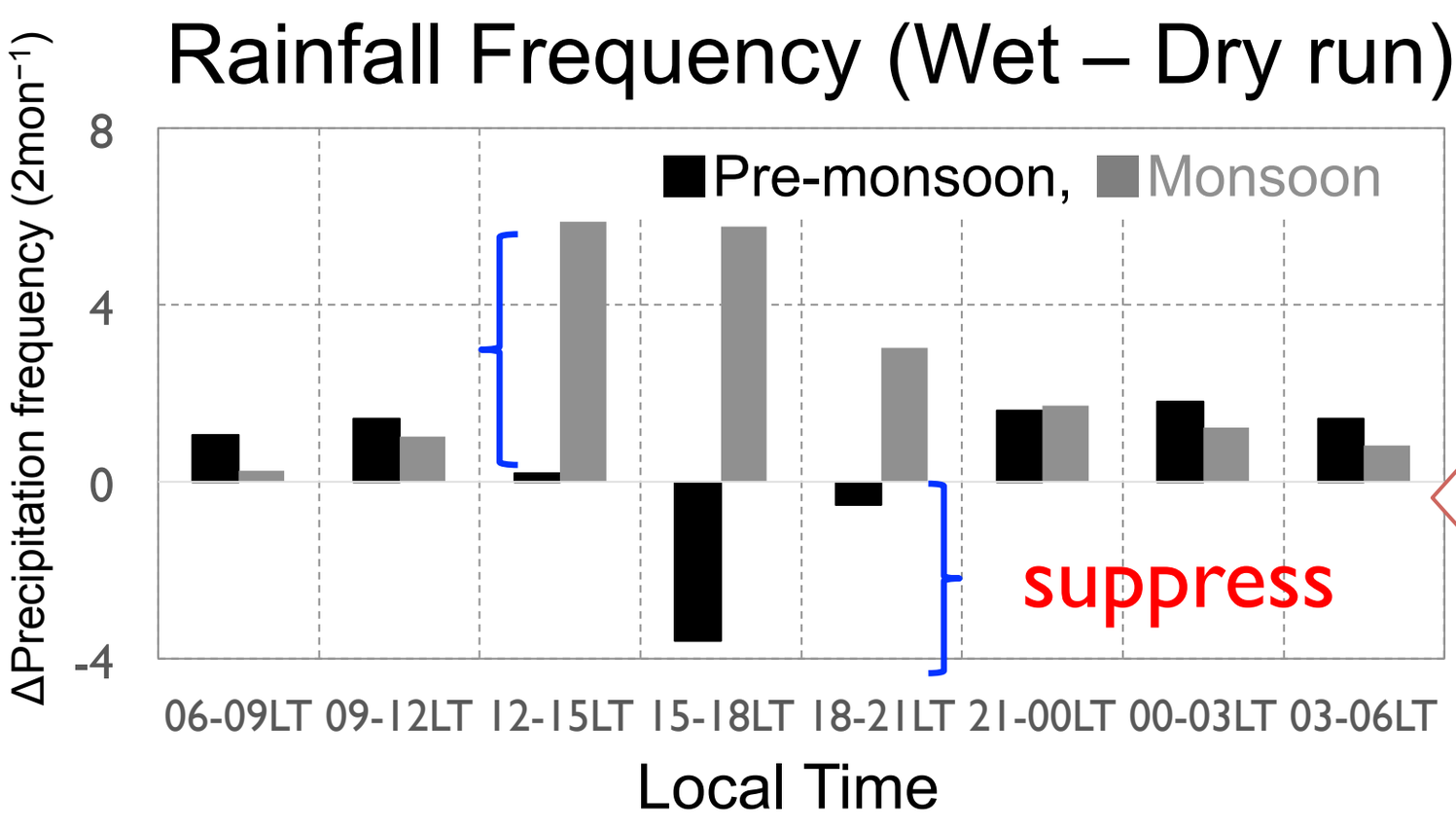


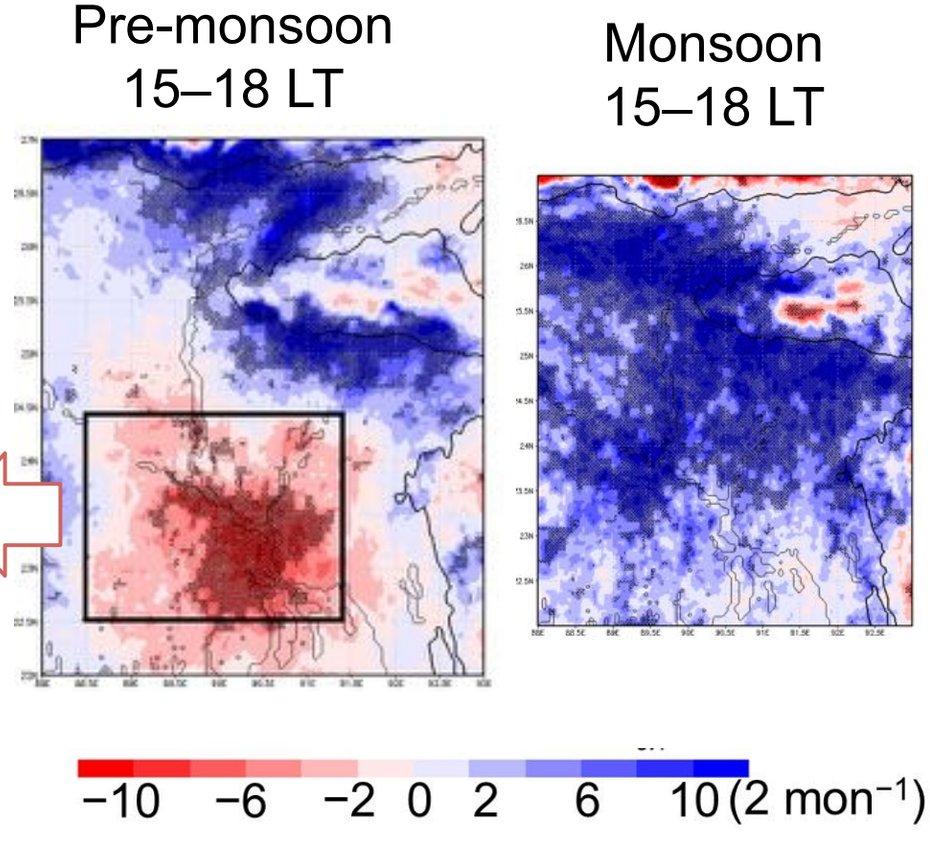
open ocean coastal region inland

Wet Land Suppresses Rain

- Sugimoto and Takahashi (2017)
  - Bangladesh / Premonsoon (MAM)
  - WRF run



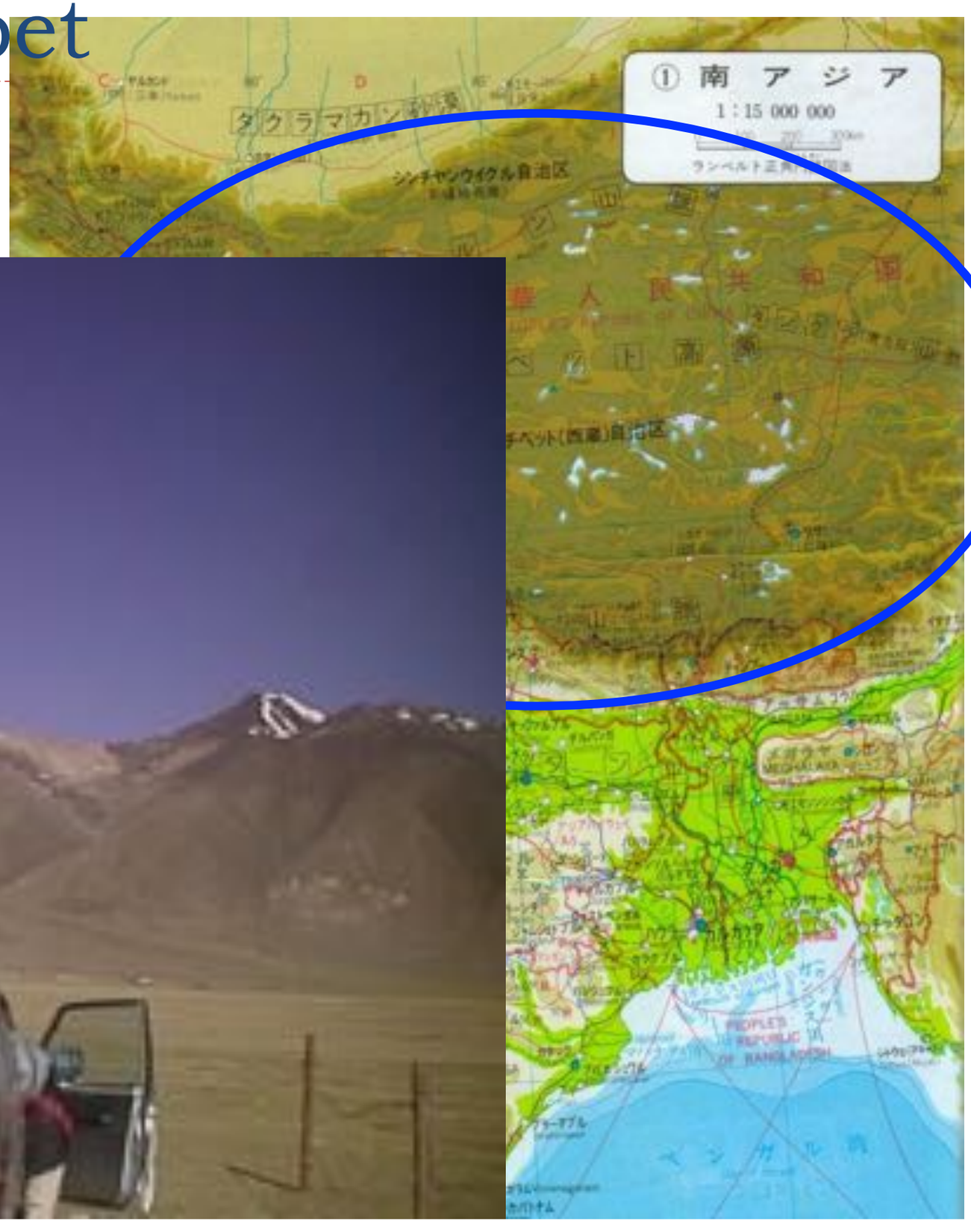




Post-MAHASRI and TPE

- Development of TPE project around Tibetan Plateau
  - TPE: Third Pole Environment
  - TPE will join as a cross cutting of GHP
    - 'TPE Water-Sustainability Crosscutting'
    - Collaboration of PostMAHASRI and TPE under GHP?
  - Post-MAHASRI and TPE is seeking collaboration
    - AMY-Reanalysis
    - Downscaling modeling research focused on southern slope of Tibet
- Southern slope of Tibetan Plateau is commonly important
- Collaboration including Cryosphere researchers is expected

Observation in Tibet

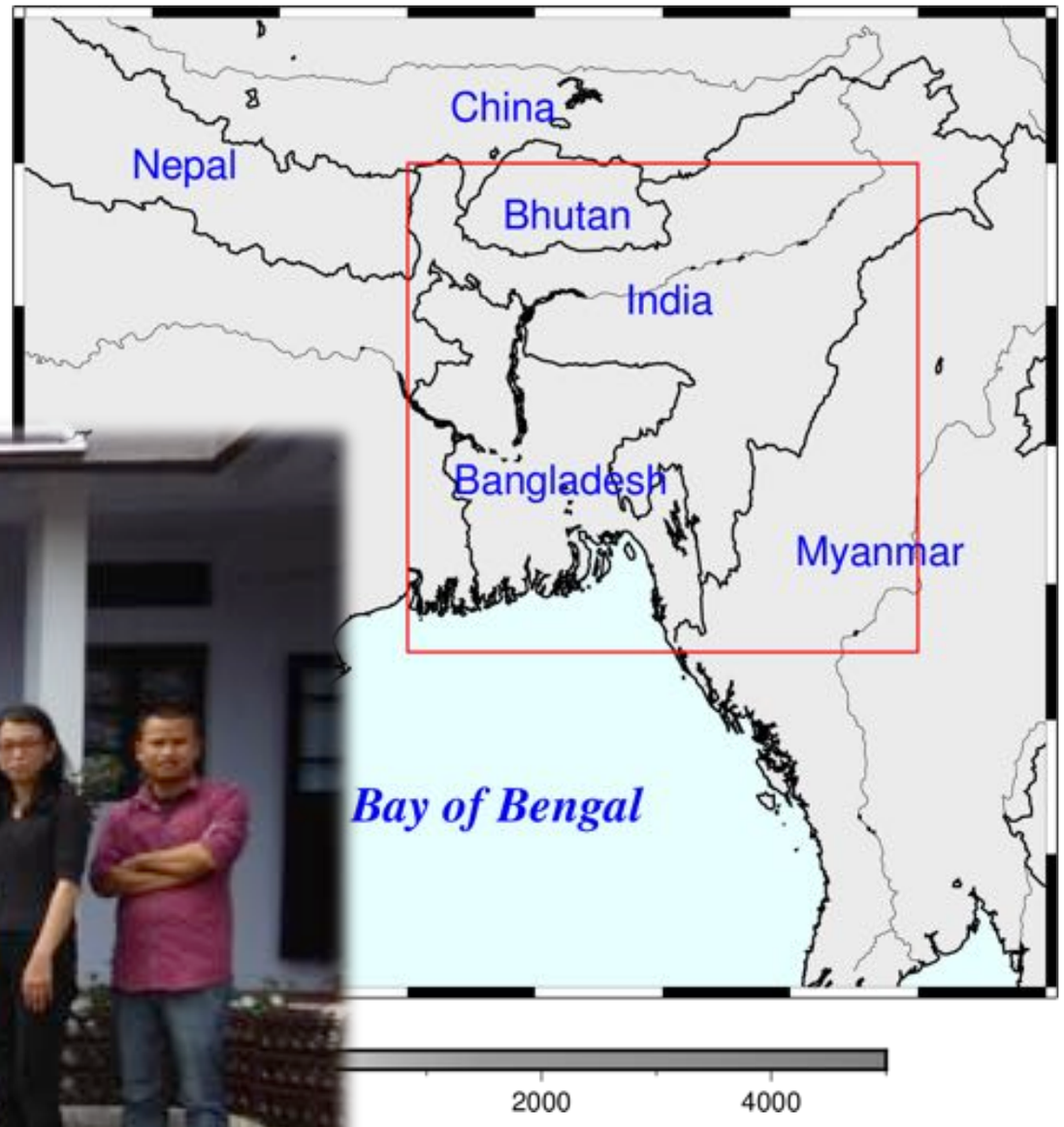


Changing in Tibet

Summary

- New platform for RHP activity over the Monsoon Asia is now in the beginning of the planning phase
- International mailing list for planning activity includes 93 international researchers
- Science Plan is targeted on the next GEWEX Panel on 22-26 Oct. @ Santiago, Chile
- Currently collecting ideas from participants
- The Third Pole Environment (TPE) will be one of the most important collaborators in the Post MAHASRI project

My Research Field: Hydrometeorology over the Northeastern Indian subcontinent



At Cherrapunjee, Meghalaya, India

Mega Floods in Bangladesh

- El Nino -> La Nina Transition Years, 1988 and 1998, corresponds with Mega Floods in Bangladesh

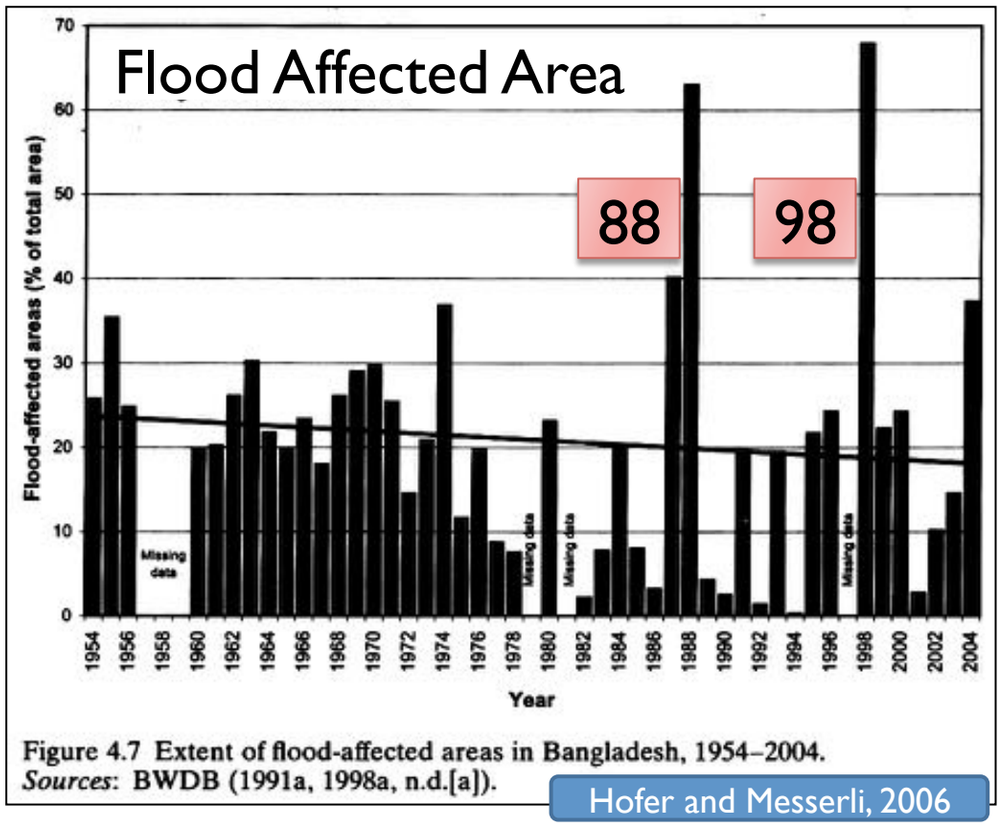
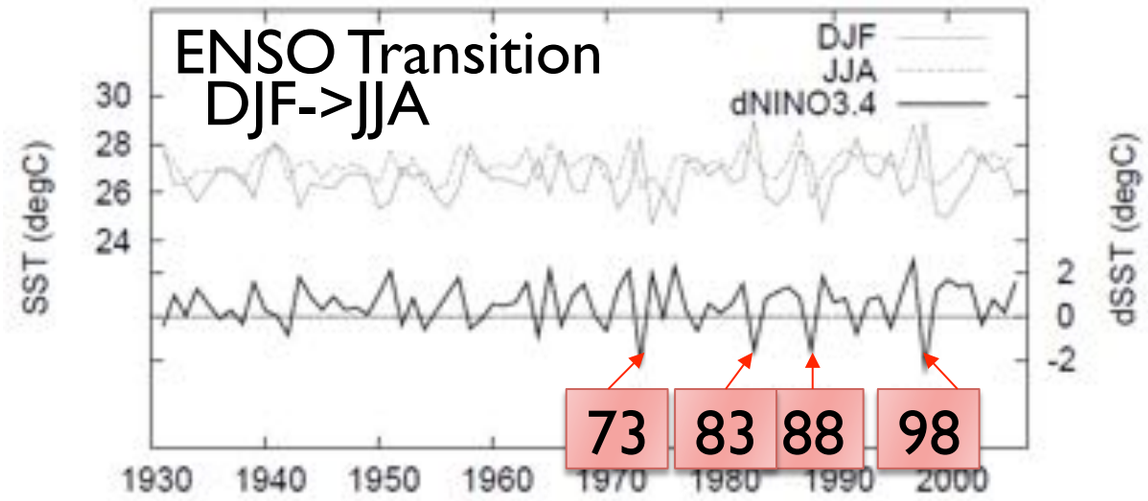
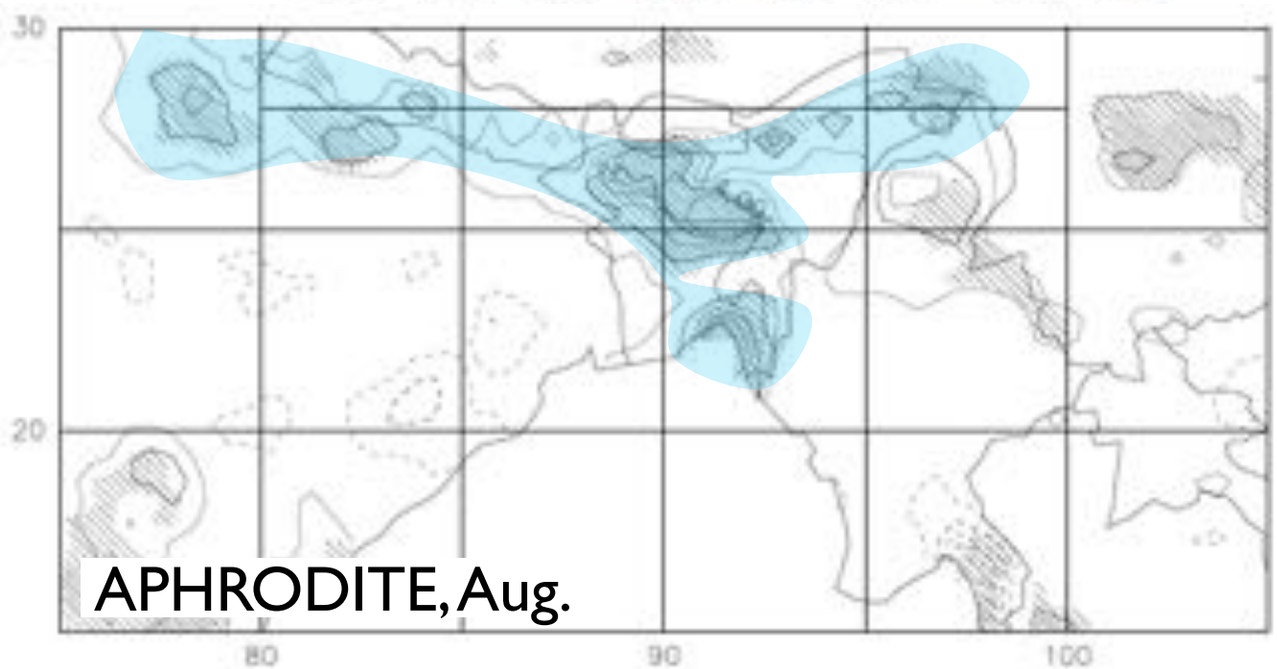


Figure 4.7 Extent of flood-affected areas in Bangladesh, 1954–2004.
Sources: BWDB (1991a, 1998a, n.d.[a]).

Hofer and Messerli, 2006



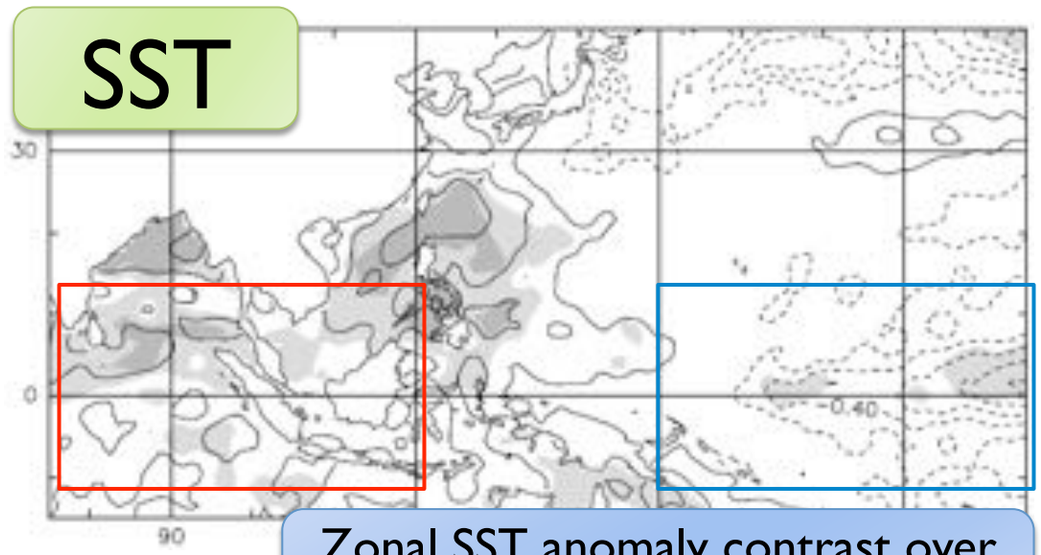


Terao and Kubota (2005/GRL)

Terao et al. (2013/JMSJ)

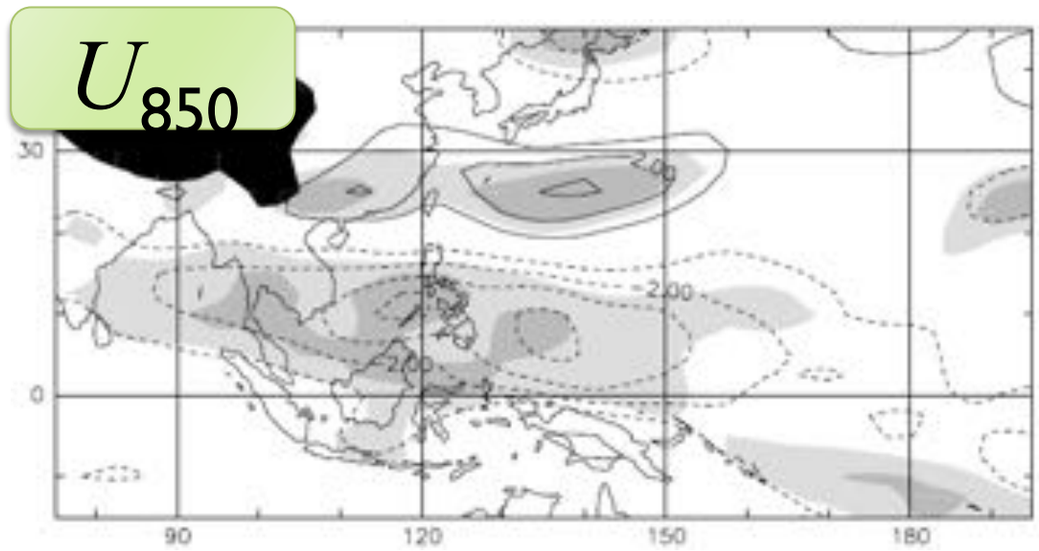
ENSO Impact on NE Indian Rain

SST

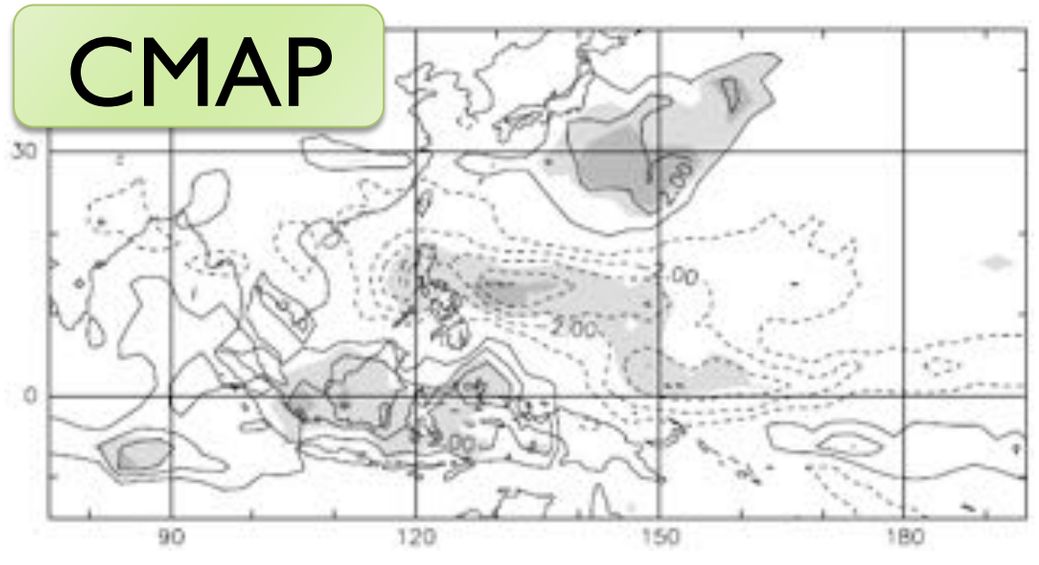


Zonal SST anomaly contrast over the Equatorial Oceans

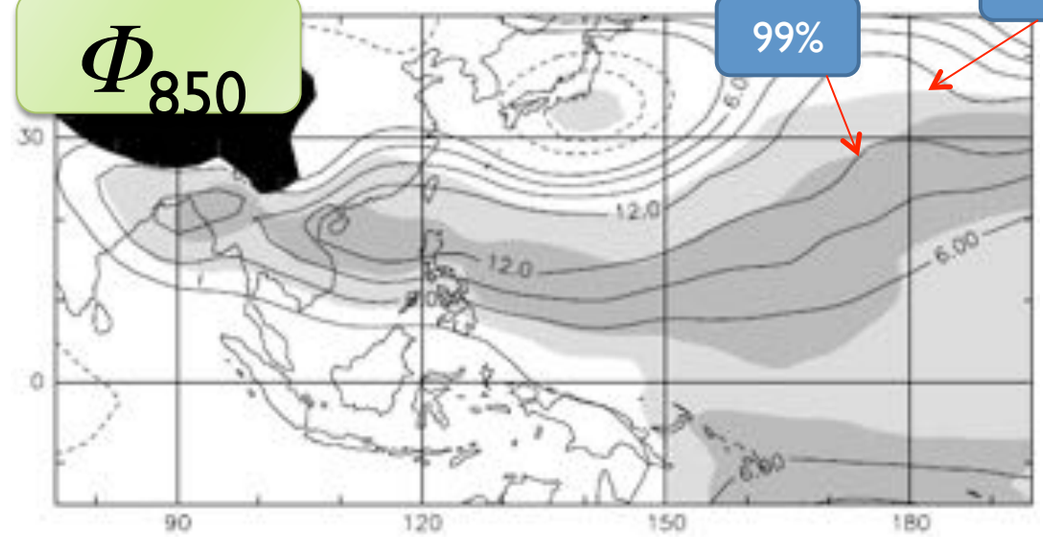
U_{850}



CMAP



Φ_{850}



95%

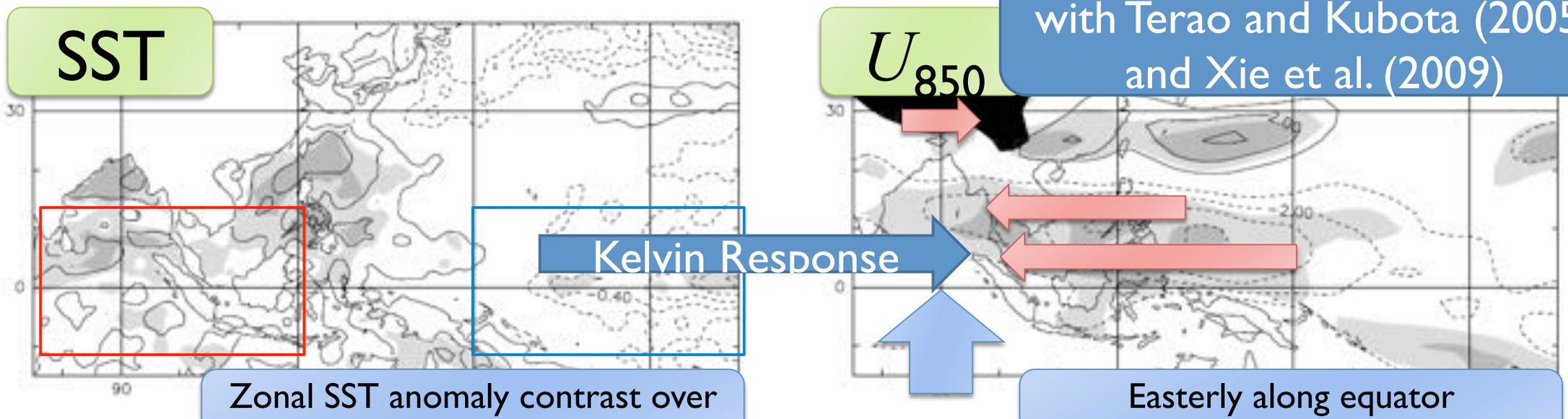
99%

ENSO Impact on NE Indian Rain

Overall pattern is consistent with Terao and Kubota (2005) and Xie et al. (2009)

SST

U_{850}



Kelvin Response

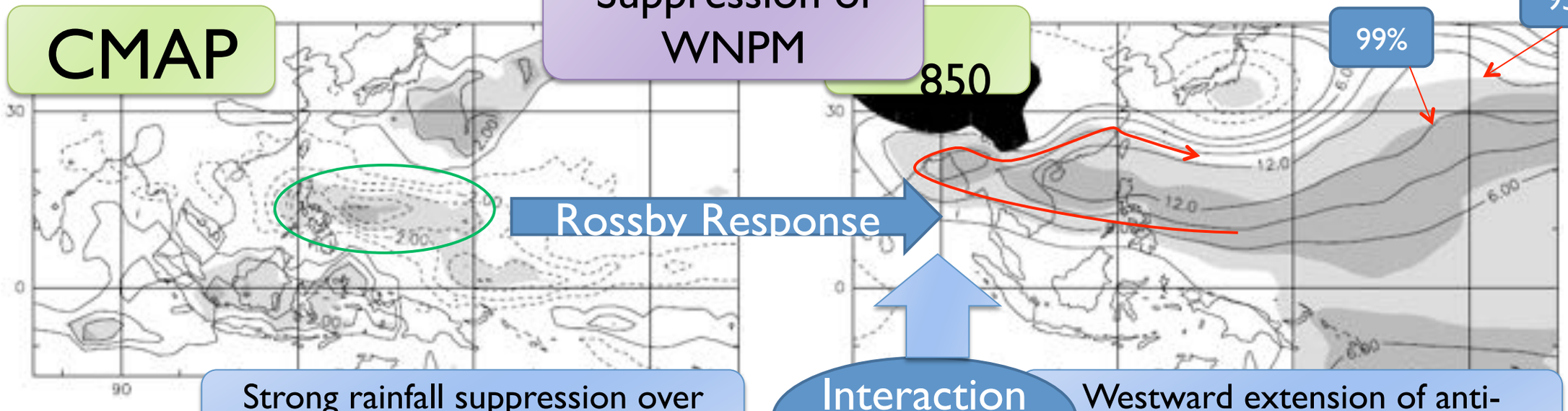
Zonal SST anomaly contrast over the Equatorial Oceans

Easterly along equator
Westerly over Bengal Plain

Suppression of WNPM

CMAP

850



Rossby Response

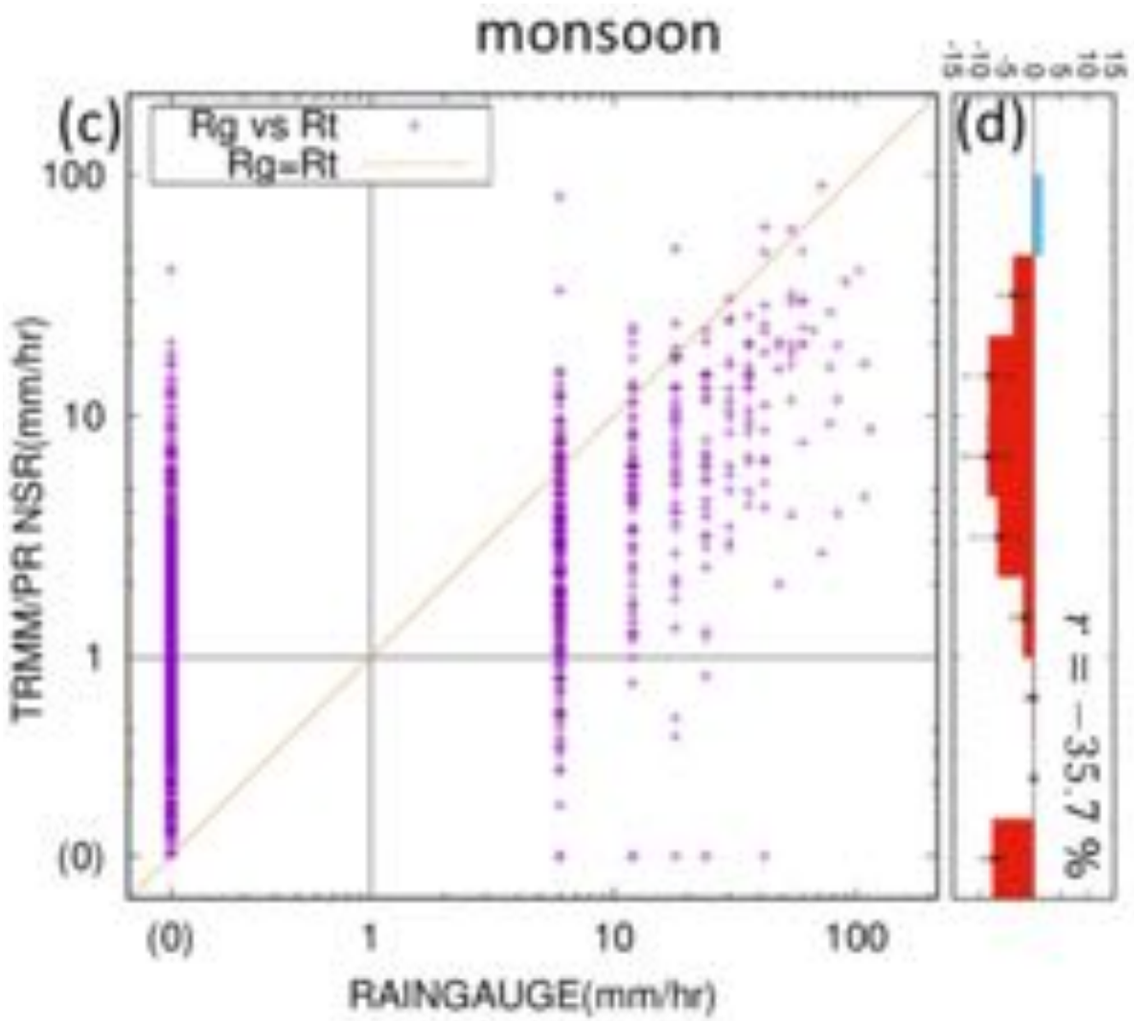
Strong rainfall suppression over the Philippine Sea

Interaction with NEIM?

Westward extension of anti-cyclonic circulation anomaly

TRMM Validation by RG Network

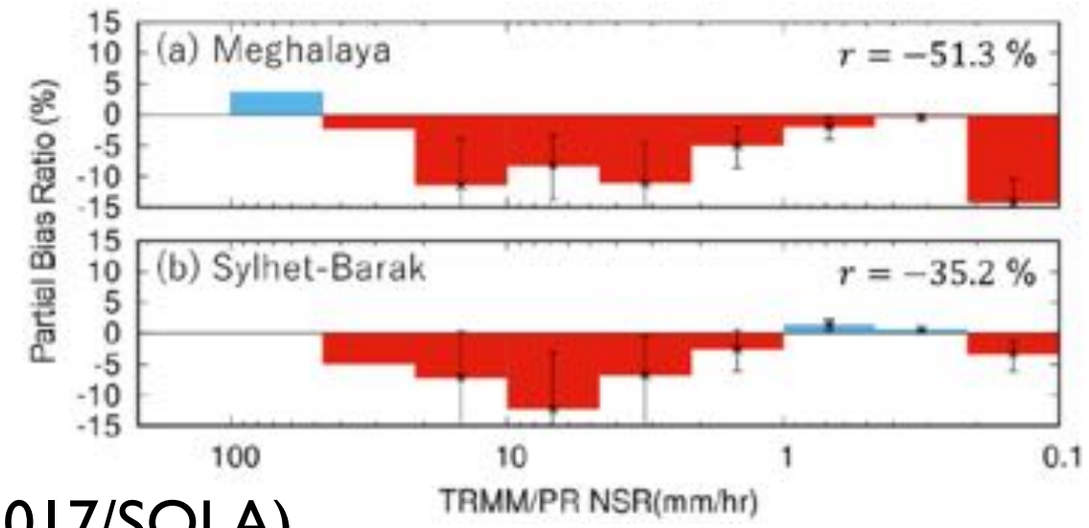
- Monsoon (Jun.-Sep.): Significant underestimation



Direct Validation of TRMM/PR Near Surface Rain over the Northeastern Indian Subcontinent Using a Tipping Bucket Raingauge Network

Toru Terao[1], Fumie Murata[2], Yusuke Yamane[3], Masashi Kiguchi[4], Azusa Fukushima[5], Masahiro Tanoue[4], Shamsuddin Ahmed[6], Sayeed Ahmed Choudhury[6], Hiambok Jones Syiemlieh[7], Laitpharlang Cajee[7], Abani Kumar Bhagabati[8], Prasanta Bhattacharya[8], Subashisa Dutta[9], Rahul Mahanta[10], and Taiichi Hayashi[11]

[1]*Faculty of Education, Kagawa University, Takamatsu, Kagawa, Japan*
[2]*Faculty of Science and Technology, Kochi University, Kochi, Japan*
[3]*Faculty of Education, Tokoha University, Shizuoka, Japan*
[4]*Institute of Industrial Science, The University of Tokyo, Tokyo, Japan*
[5]*Faculty of Humanity, Kobe Gakuin University, Kobe, Japan*
[6]*Bangladesh Meteorological Department, Dhaka, Bangladesh*
[7]*Department of Geography, North Eastern Hill University, Shillong, Meghalaya, India*
[8]*Department of Geography, Gauhati University, Guwahati, Assam, India*
[9]*Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati, Assam, India*
[10]*Department of Physics, Cotton University, Guwahati, Assam, India*
[11]*Center for Southeast Asian Studies, Kyoto University, Kyoto, Japan*



Terao et al. (2017/SOLA)