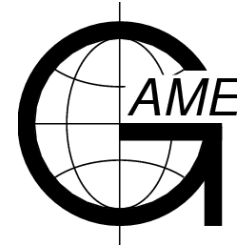


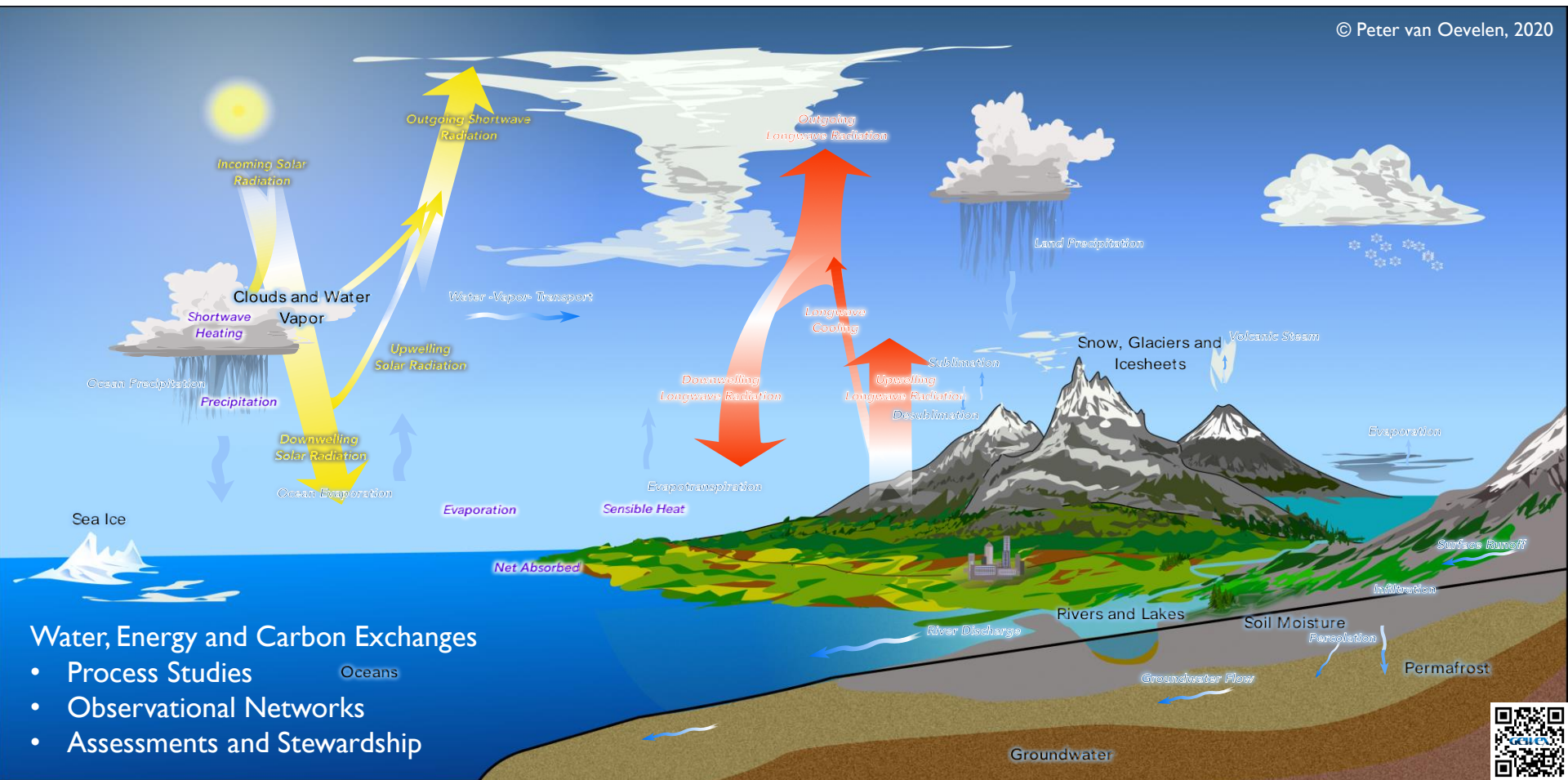
23 Mar. 2022: First Climate Research Forum
In the Southern Asia Region @Virtual Space



AsiaPEX

GEWEX AsiaPEX: Collaboration toward
Understanding of Multiscale Variability of
the Asian Hydroclimatological System

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



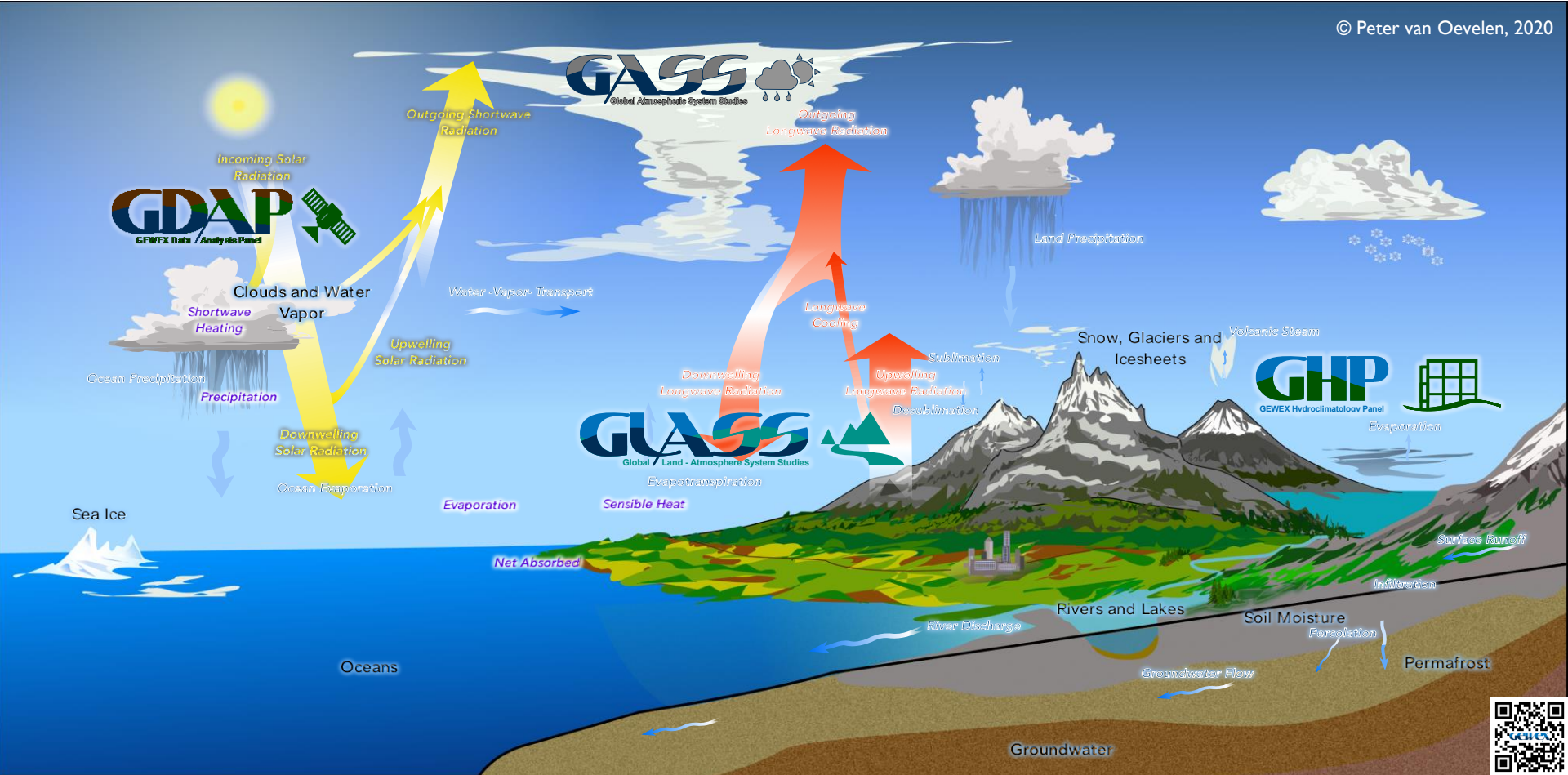
Water, Energy and Carbon Exchanges

- Process Studies
- Observational Networks
- Assessments and Stewardship



The GEWEX Core Activities as part of WCRP in Collaboration with CLIVAR, SPARC, CLIC, CORDEX, RIFS, ESMO, the new Light House Activities and many others.





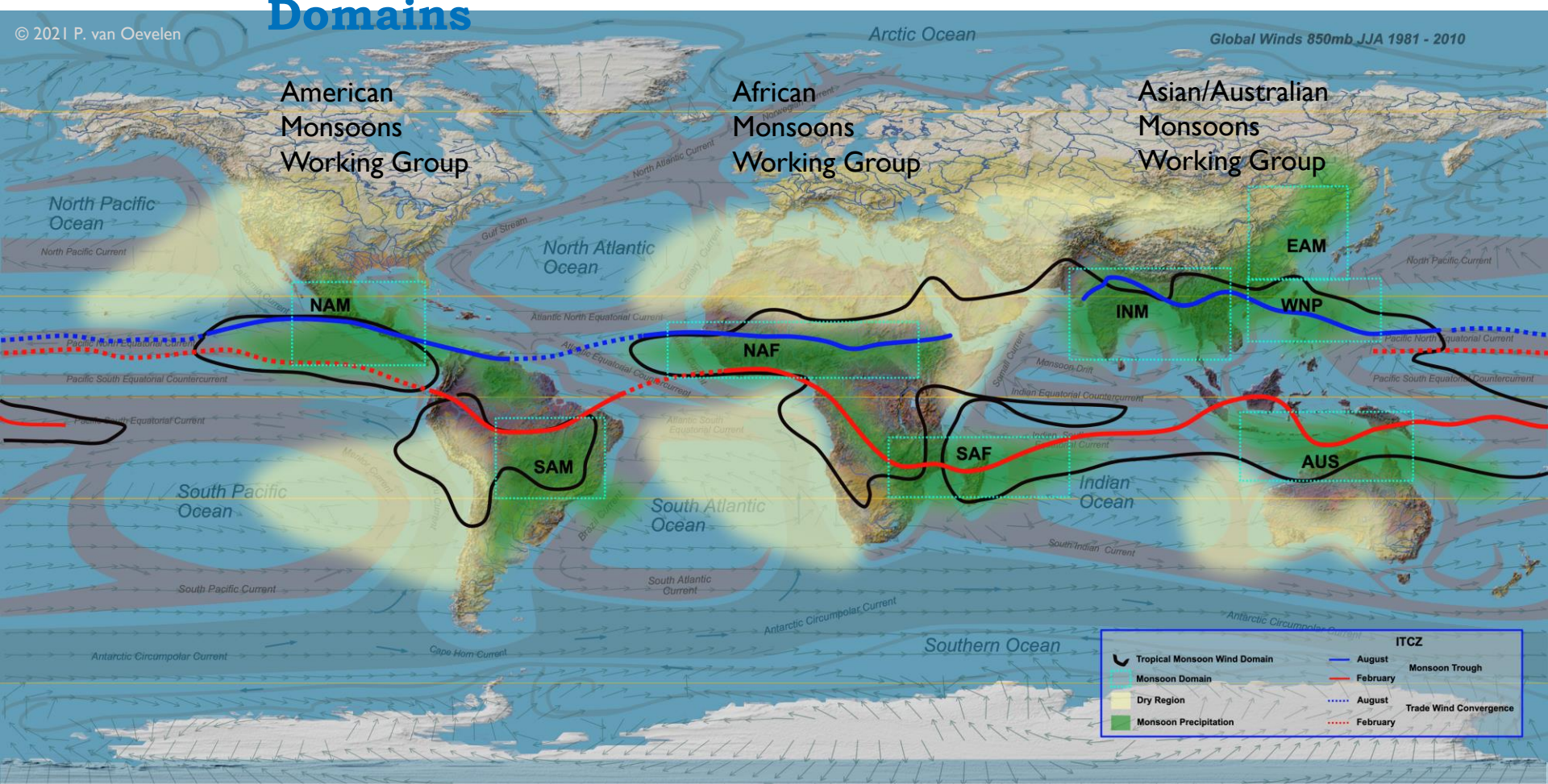
The GEWEX Panels:

- GEWEX Data Analysis Panel *Global Datasets Analysis and Assessments*
- Global Atmospheric System Studies *Atmospheric Processes - Dynamics*
- Global Land-Atmosphere System Studies *Land-Atmosphere Interactions and Processes*
- GEWEX Hydroclimatology Panel *Regional Focused Processes and Hydroclimate Projects*



Monsoon Regions & WCRP Monsoons Panel WG Domains

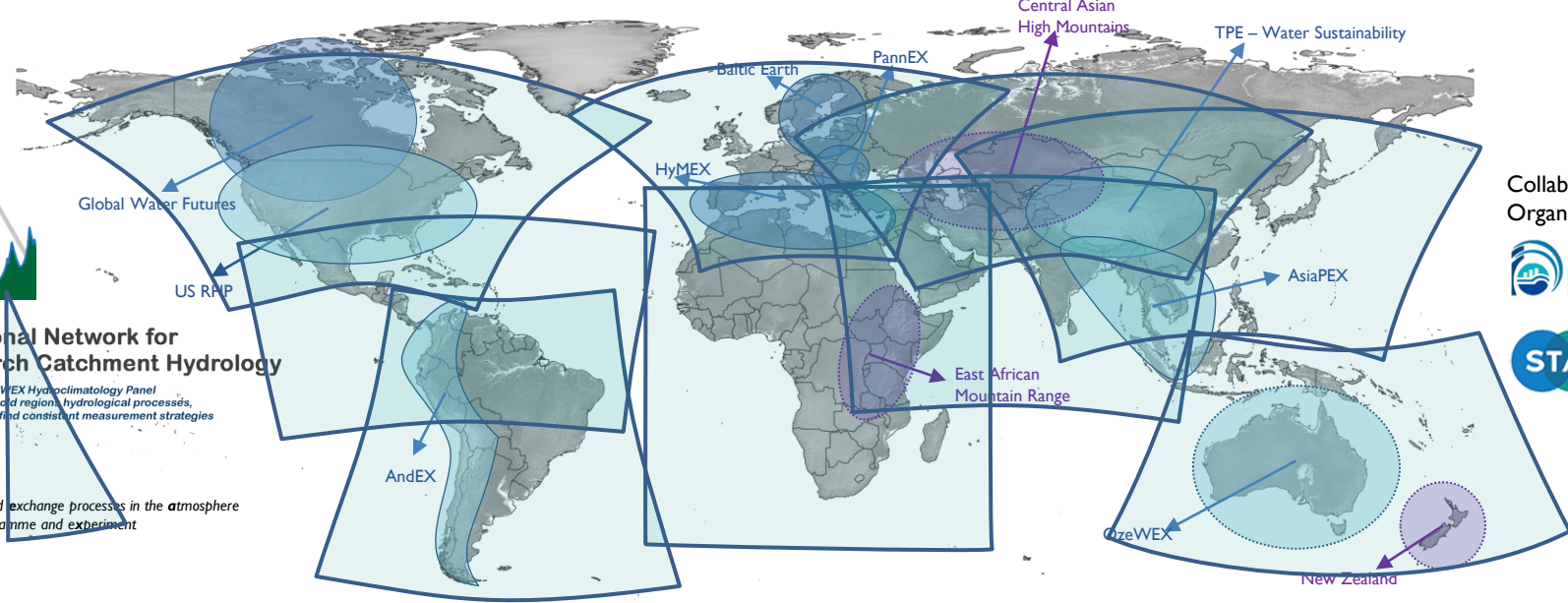
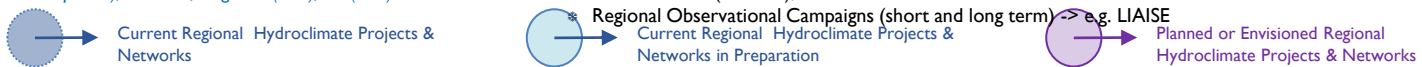
© 2021 P. van Oevelen



The GEWEX Regional Hydroclimate Projects in High Mountainous Terrains

- Regional Hydroclimate Projects (RHPs) & Networks
 - Modeling, Observations, Predictions and Projections, Impacts studies etc.
 - South America Affinity Group, OzeWEX as a regional network
- Crosscutting Activities
 - TeamX, Mounterrain (in development), INARCH, Irrigation (new), ET (new)

- Global Observational Data Sets Assessments and Analyses <-> e.g. with International Precipitation Working Group, International Soil Moisture Network, Global Runoff Data Center and Global Precipitation Climatology Center
- Process Studies -> "PROES" - Process Evaluation Studies and GEWEX Land Atmosphere Feedback Observatories (GLAFO), Monsoons
- Regional Observational Campaigns (short and long term) -> e.g. LIAISE



The International Network for Alpine Research Catchment Hydrology

A cross-cut project of the GEWEX Hydroclimatology Panel to better understand alpine cold region hydrological processes, improve their prediction and find consistent measurement strategies

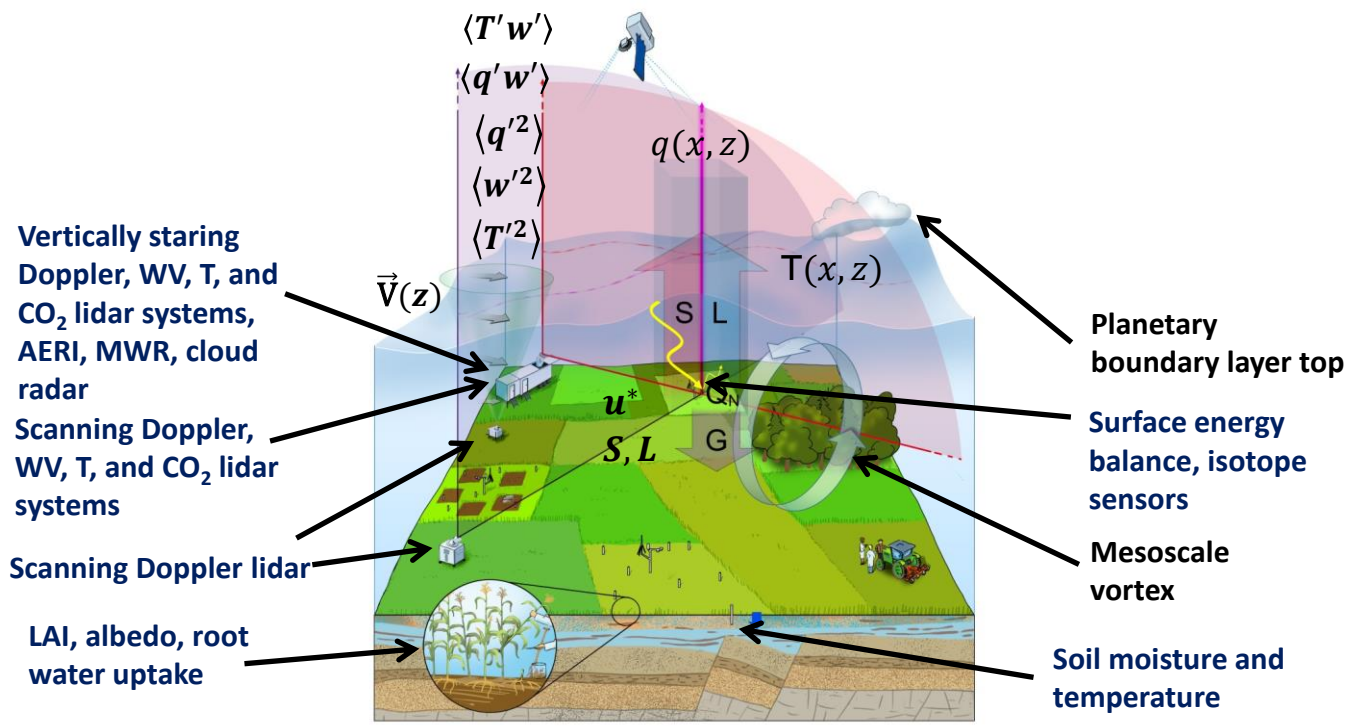
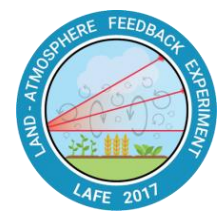


Multi-scale transport and exchange processes in the atmosphere over mountains - programme and experiment

Collaborating Organizations:



The GEWEX-GLASS Land-Atmosphere Feedback Observatory (GLAFO)



Vertically staring
Doppler, WV, T, and
CO₂ lidar systems,
AERI, MWR, cloud
radar

Scanning Doppler,
WV, T, and CO₂ lidar
systems

Scanning Doppler lidar

LAI, albedo, root
water uptake

Planetary
boundary layer top

Surface energy
balance, isotope
sensors

Mesoscale
vortex

Soil moisture and
temperature

**A combination of vertical staring instruments will be the starting point.
In a next step, scanning instruments will be added.**

Wulfmeyer et al. BAMS 2018, DOI:10.1175/BAMS-D-17-0009.1

Side courtesy: Volker Wulfmeyer



Objectives of the AsiaPEX

- ▶ **General Objective**

- ▶ **Understanding of Asian Land Precipitation over Diverse Hydroclimatological Conditions: For Better Prediction, Disaster Reduction and Sustainable Development**

- ▶ **Status: GEWEX Prospect RHP**



Science Highlight / Science Issues

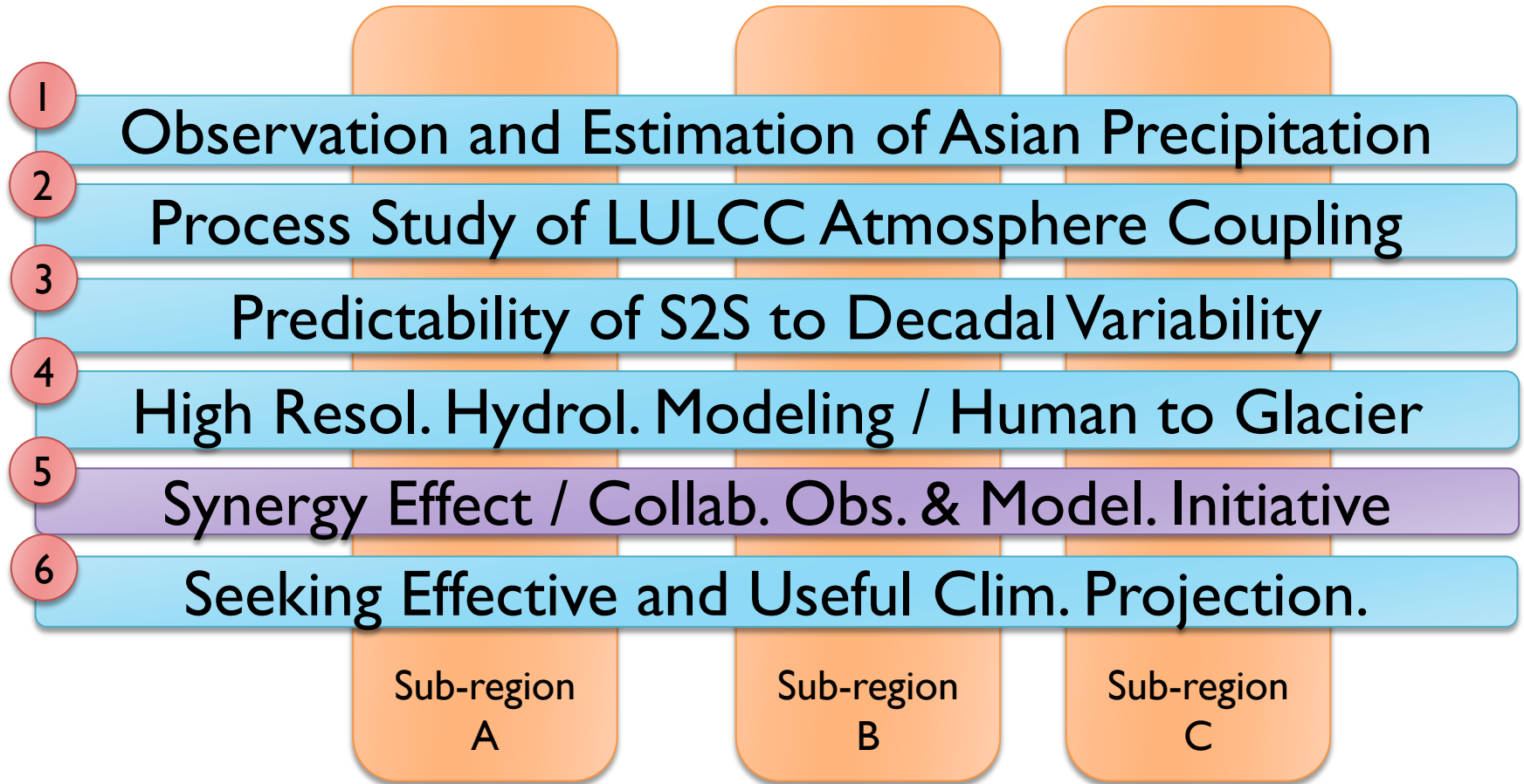
▶ Six approaches in Science Plan

- 1 Observation and Estimation of Asian Precipitation
- 2 Process Study of LULCC
Atmosphere Coupling
- 3 Predictability of S2S to
Decadal Variability
- 4 High Resol. Hydrol. Modeling / Human to Glacier
- 5 Synergy Effect / Collab.
Obs. & Model. Initiative
- 6 Seeking Effective and
Useful Clim. Projection.



Approach Oriented Research Plan

► Approach × Region



AsiaPEX Kick-off Conference

- ▶ Date: 28-30 August 2019
- ▶ Venue: Hokkaido University, Sapporo, Japan
- ▶ Participants: 72 from 10 countries
 - ▶ Philippine, Vietnam, Indonesia, Bangladesh, Mongolia, Nepal, USA, India, China, Japan
- ▶ 7 Sessions, 61 Presentations including 16 posters

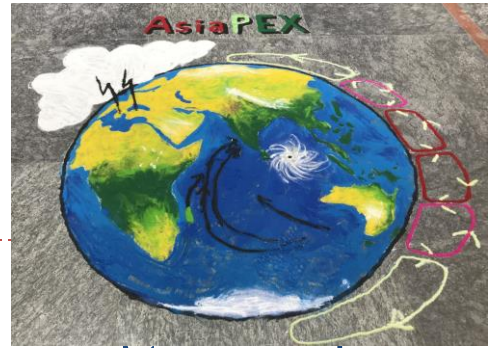


AsiaPEX International SSG Workshop

- ▶ “Decadal Challenges in Asian Monsoon Process Studies”
- ▶ Date: 2-5 September 2019
- ▶ Venue: Nagoya University, Aichi, Japan
- ▶ Participants: 25 from 6 countries
 - ▶ USA, Nepal, India, China, Korea, Japan

Planned A Review Paper
on AsiaPEX Project





Recent Activities

▶ Workshops

- ▶ **ESSDMS2 Workshop (2nd Workshop on the Extreme Severe Storm and Disaster Mitigation Strategy), 27-29 Feb. 2020, Central University of Rajasthan, Rajasthan, India.**
 - ▶ 20 research papers and more than 30 participated researchers, further concluded that the focus will be on discussion on implementation of near real-time rainstorm detection and early warning system (EWS) for extreme rainstorms
 - ▶ **AsiaPEX/SA Workshop, 1-2 Mar. 2020, Central University of Rajasthan, Rajasthan, India**
 - ▶ The ESSDMS community discussed about the South Asian part of the AsiaPEX project. This workshop concluded a recommendation draft based on discussions by 30 participants
 - ▶ **MSJ Spring Meeting 2021 / AOGS2021 session**
 - ▶ Preparation for a review paper on the AsiaPEX: Our paper proposal to BAMS has been accepted, and now preparing for the manuscript by researchers more than 20.
 - ▶ Science Plan: Under review, Will be revised and submitted to the GHP Panel Meeting in Nov. 2021.
-



Workshop AsiaPEX/South Asia

► 1-2 Mar 2020, CURAJ, India



AOGS2021 Top Conveners Award

- ▶ AS28 (AsiaPEX session) was selected as one of five most popular session. (28 papers!)

AOGS2021 VIRTUAL
18TH ANNUAL MEETING
Asia Oceania Geosciences Society

01 – 06 August 2021



Congratulations to the AOGS2021 Top Conveners!

<u>Session</u>	<u>Main Convener</u>	<u>Co-Convener(s)</u>
AS28 Asian Precipitation Experiment: Process and Predictability of Asian Hydroclimate System	Toru TERAO, <i>Kagawa University</i>	S DAS, <i>Central University of Rajasthan</i> Kyung-Ja HA, <i>Pusan National University</i> Shinjiro KANAE, <i>Tokyo Institute of Technology</i>





South Asian Meteorological Association (SAMA) Webinar on

Asian Precipitation Experiment (AsiaPEX)

4th Sep. 2021, 15:00 hrs IST

Keynote Speaker

Prof. Dr. Toru Terao, Kagawa University, Japan



Panel Discussion

Experts from South and East Asia

Live on SAMA YouTube channel

<https://www.youtube.com/channel/UCmQ51nXgvUydAG-xGLnoFew>

www.southasianmet.org



@southasianmet



South Asian Meteorological Association

Contact: sama03aug@gmail.com

Related Near Future Sessions

- ▶ JpGU2022 (22-27 May / 29 May-3 Jun. 2022)
 - ▶ A-AS08 :
 - ▶ Multiple scale structure and their interactions in Asian monsoon system
- ▶ AOGS2022 (1-5 Aug. 2022)
 - ▶ HS04 :
 - ▶ The Third Pole Environment and High Mountains of Central Asia - Hydrometeorological Processes and Human Dimension
 - ▶ Jointly with GEWEX/TPE



GHP / GEWEX Goals

- ▶ **Observation and Estimation:**
 - ▶ To observe and estimate precipitation pattern over the Asian landmass including high mountain region.
- ▶ **Process Studies**
 - ▶ To understand precipitation processes over diverse hydroclimatological conditions focusing on the complex topography, land surface, and convection coupling.
- ▶ **Predictability**
 - ▶ To improve predictability of variabilities of Asian land precipitation in the climate change to the S2S time scales.



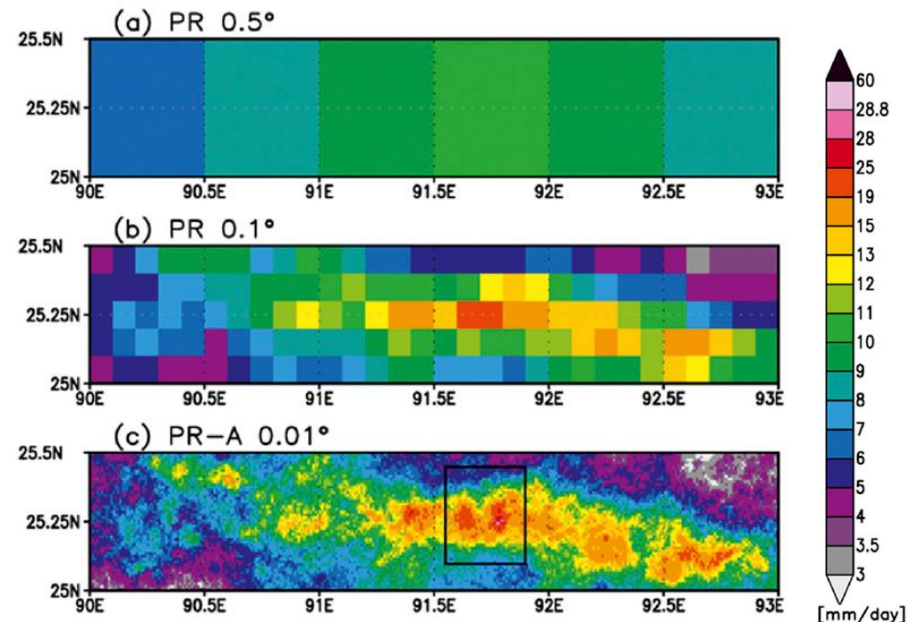
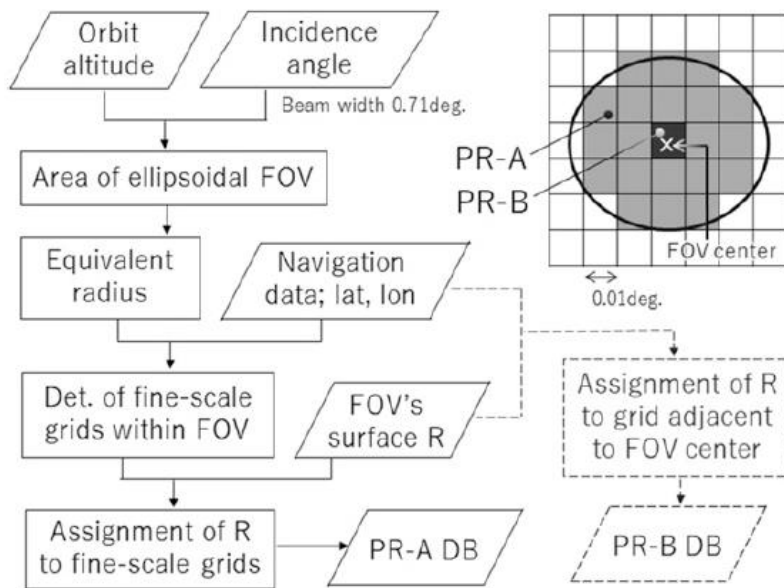
Observation and Estimation

- ▶ To observe and estimate precipitation pattern over the Asian landmass including high mountain region.
 - ▶ Ultra-high-resolution resolving TRMM PR climatology (Hirose and Okada 2018)
 - ▶ 4-year Climatology of global precipitation drop size distribution and its seasonal variability were observed by spaceborne dual frequency precipitation radar GPM/DPR (Yamaji et al. 2020).
 - ▶ Analysis of characteristics of the rain drop size distribution observed at Meghalaya Plateau, Northeastern India (Murata et al. 2020).
 - ▶ Database of the storm events in the Assam state in Northeastern India (Mahanta and Yamane, 2020).
-



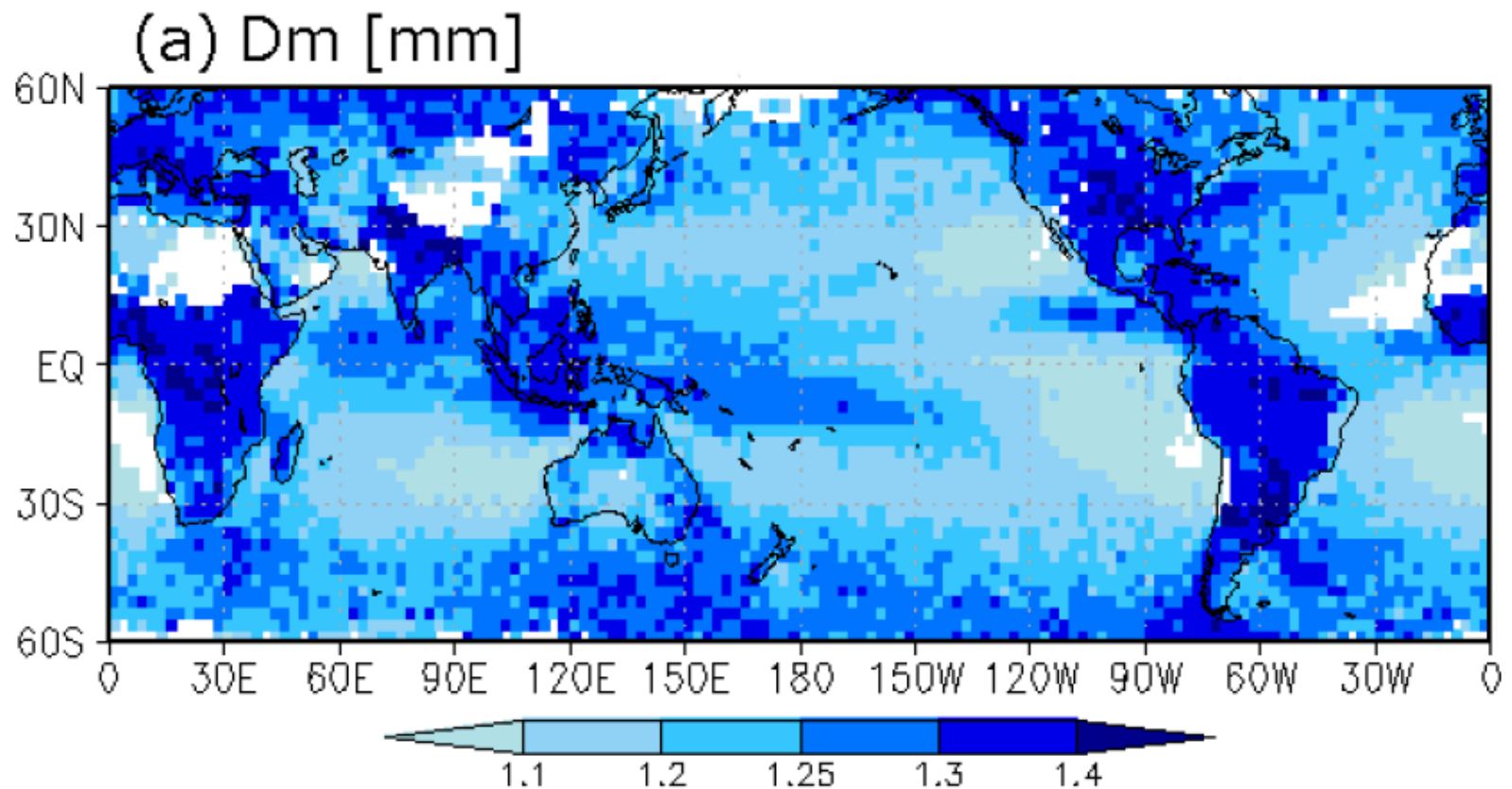
Hirose and Okada (2018)

- ▶ Ultra-high-resolution resolving TRMM PR climatology
 - ▶ Shown interesting applications resolving fine structure of topographic effect of rainfall pattern.
 - ▶ UHL TRMM PR climatology is now open from their web site.



Yamaji et al. (2020)

- ▶ Global climatological DSD variability using GPM/DPR



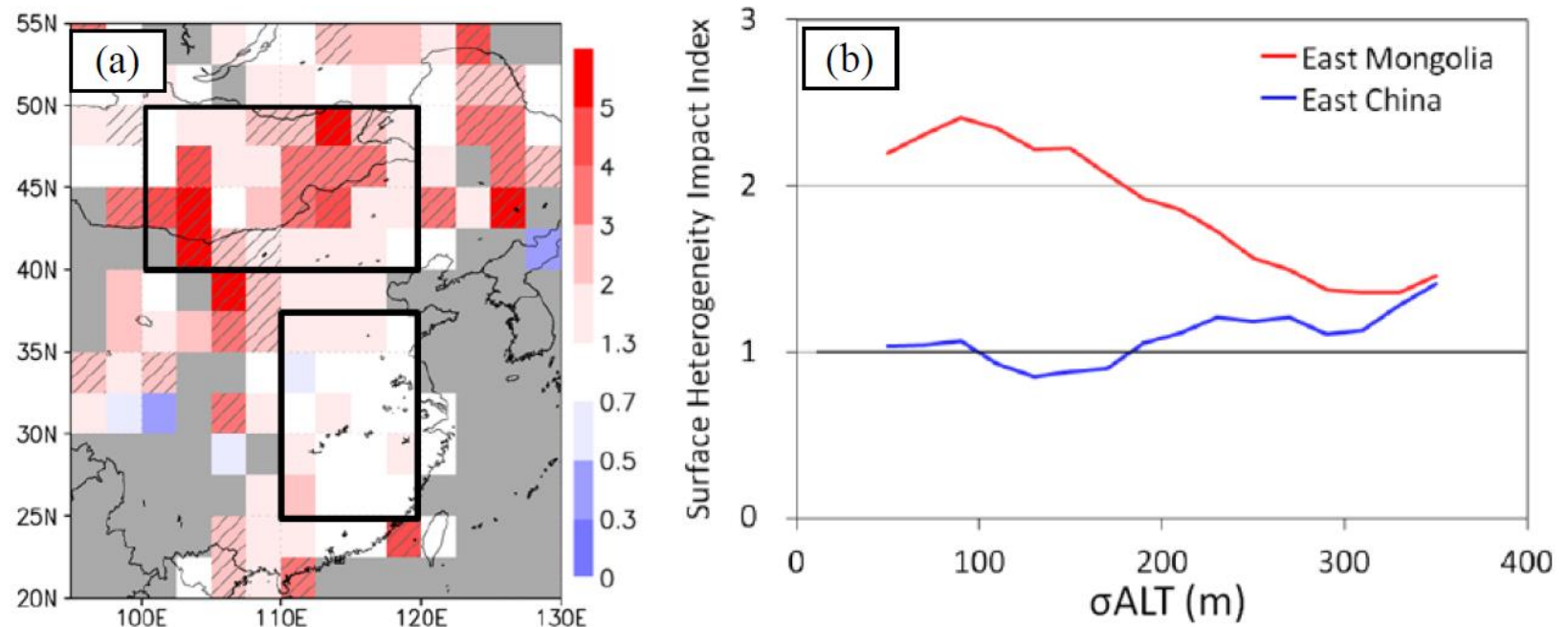
Process Studies

- ▶ To understand precipitation processes over diverse hydroclimatological conditions focusing on the complex topography, land surface, and convection coupling.
 - ▶ Detection of the impact of land surface heterogeneity on the mesoscale convective systems (Teramura et al. 2019)
 - ▶ Various kinds of synoptic scale disturbances have been found and analyzed associate with the precipitation events (Olaguera et al. 2020; Olaguera and Matsumoto 2020; Sugimoto 2020; Tamura and Sato 2020).
 - ▶ Important impacts of complex mountain topography on diurnal variation has been elucidated (Konduru and Takahashi 2020; Hilario et al. (2020)
-



Teramura et al. (2019)

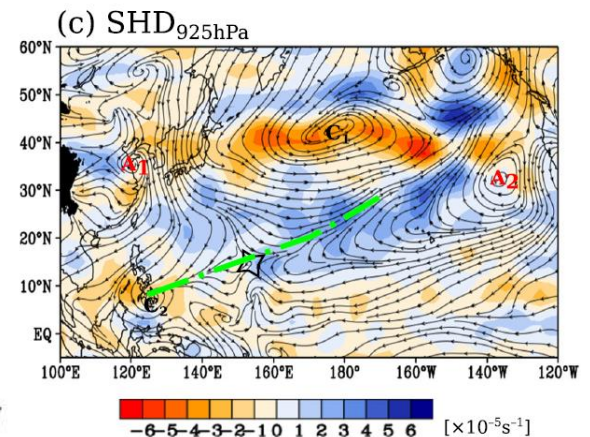
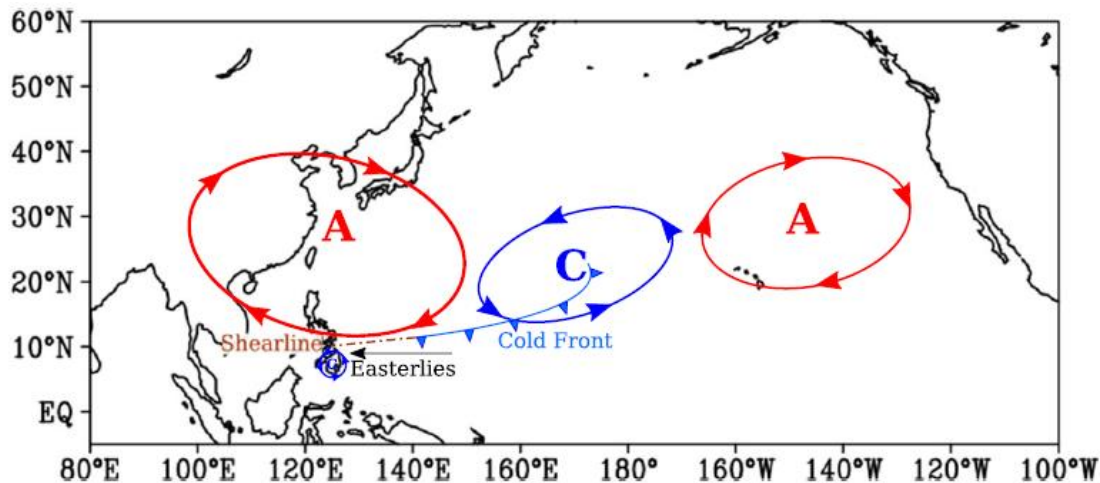
- ▶ Detection of the impact of land surface heterogeneity on the mesoscale convective systems
 - ▶ Surface temperature heterogeneity enhances MCS initiation.
 - ▶ Topography with scale $>300\text{m}$ hinders the T-heterogeneity effect.



Olaguera et al. (2020)

Winter rainfall

- ▶ Non-tropical Cyclone Related Winter Heavy Rainfall Events over the Philippines: Climatology and Mechanisms
 - ▶ Synoptic situation for HRF events over the Mindanao Island
- ▶ Based on cases in Dartmouth Flood Observatory archive from 1979 to 2017.



Predictability

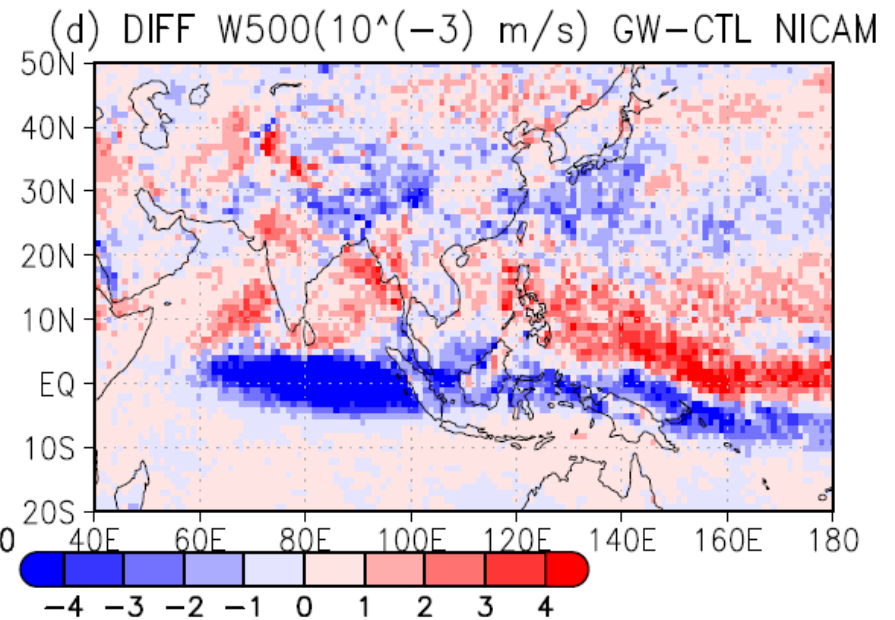
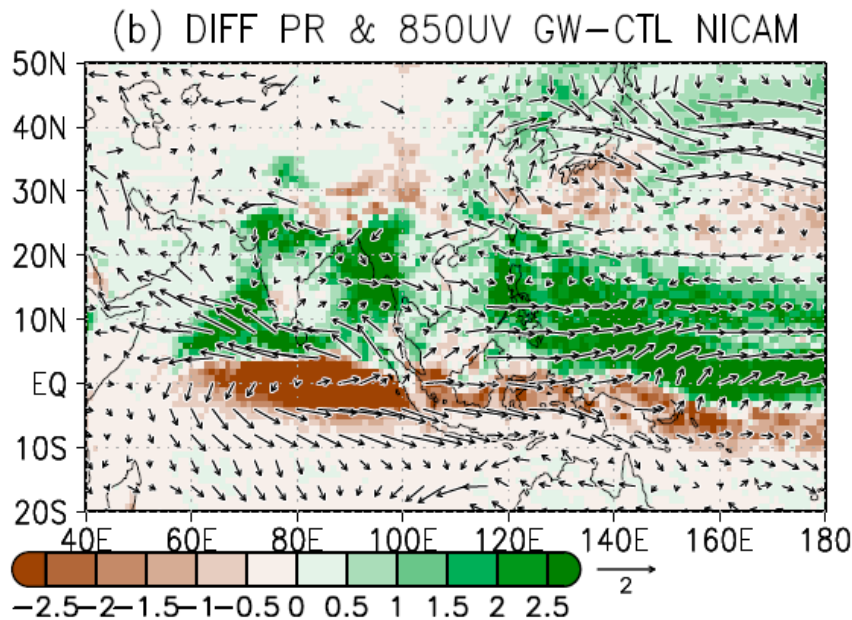
- ▶ To improve predictability of variabilities of Asian land precipitation in the climate change to the S2S time scales.
 - ▶ Impact of the global warming on the monsoon precipitation (Takahashi et al. 2020), where precipitation along the monsoon trough increases due to the increase of the precipitable water.
 - ▶ Takaya et al. (2020) showed extreme rainfall event in Meiyu-Baiu season in Japan and Central China in 2020 is connected with earlier IOD event. They further clarified that the climate model correctly predicted the event using the initial condition of April 2020.
 - ▶ Hatsuzuka et al. (2020) investigated future TC impact on rainfall extremes in Japan.



Takahashi et al. (2020)

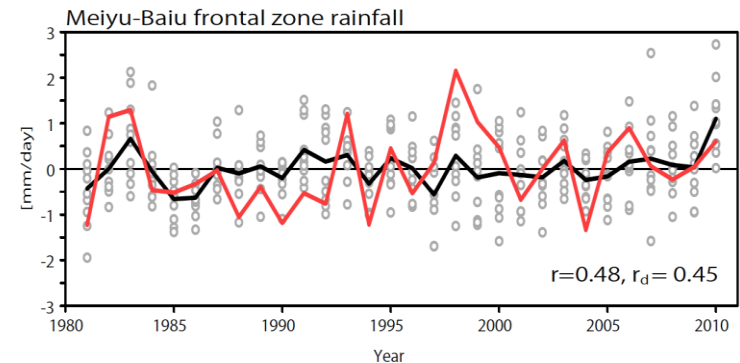
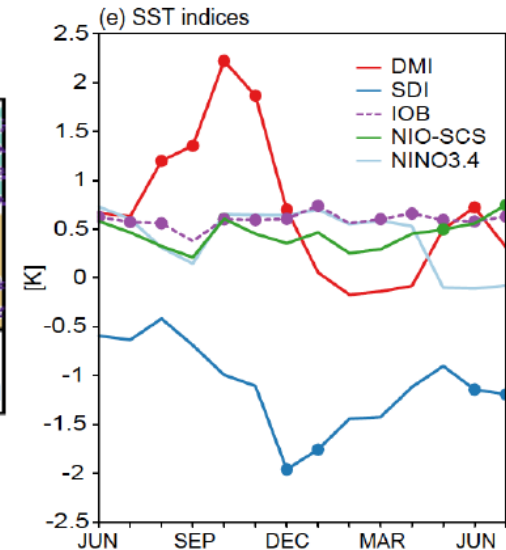
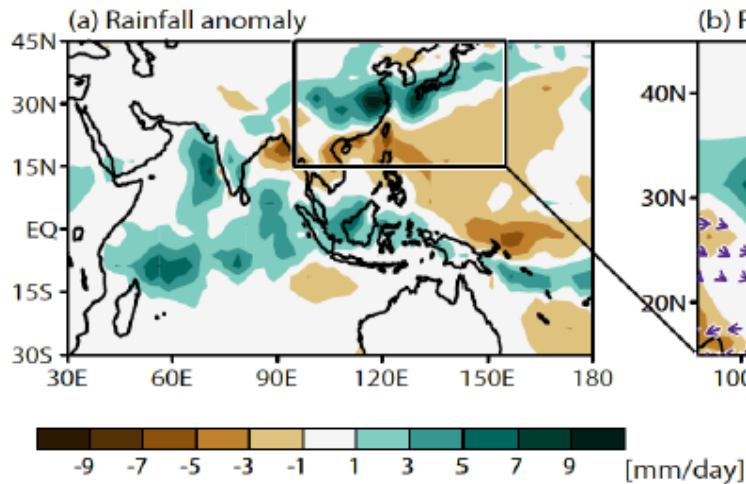
► Precipitation difference

- Increase along the monsoon trough due to the increase in PW.
- This enhancement can be explained by future changes in tropical disturbance activity, including weak tropical cyclones.



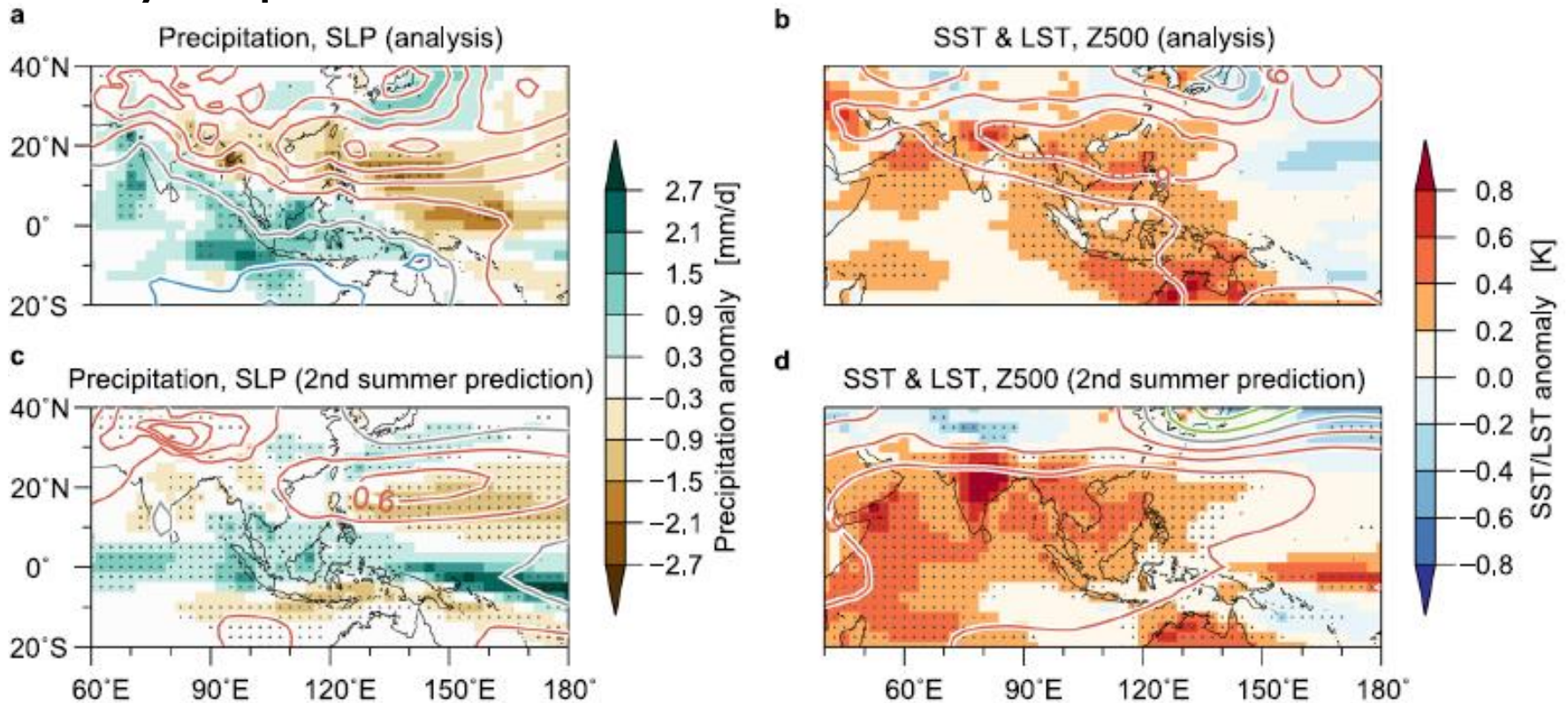
Takaya et al. (2020)

- ▶ Prediction from April can reproduce extreme rainfall in Baiu-Meiyu region in 2020.



Predictability of Climate Models

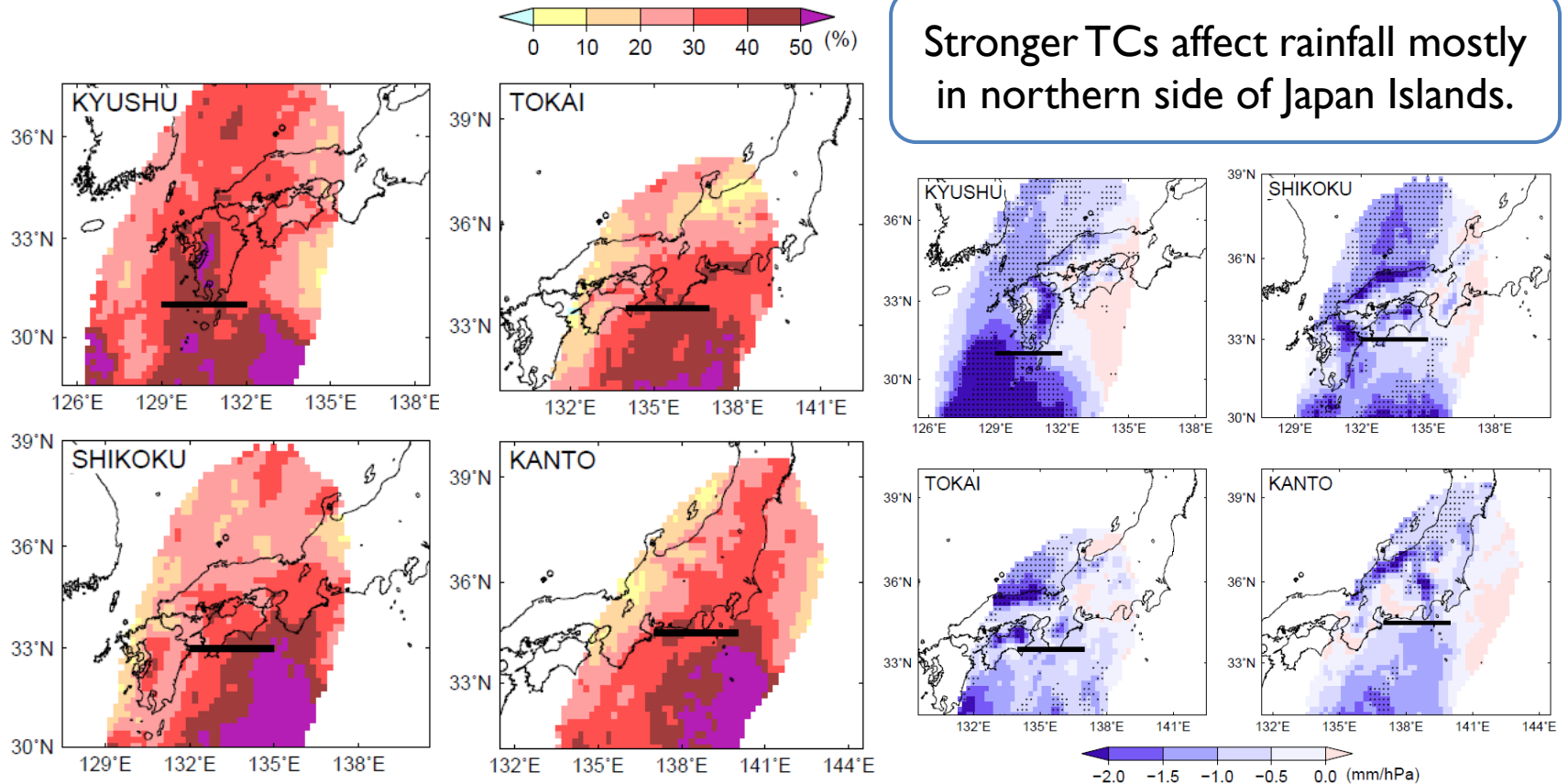
- ▶ One year ahead
- ▶ Key: Representation of ENSO – IPOC mode



Takaya et al. (2021)

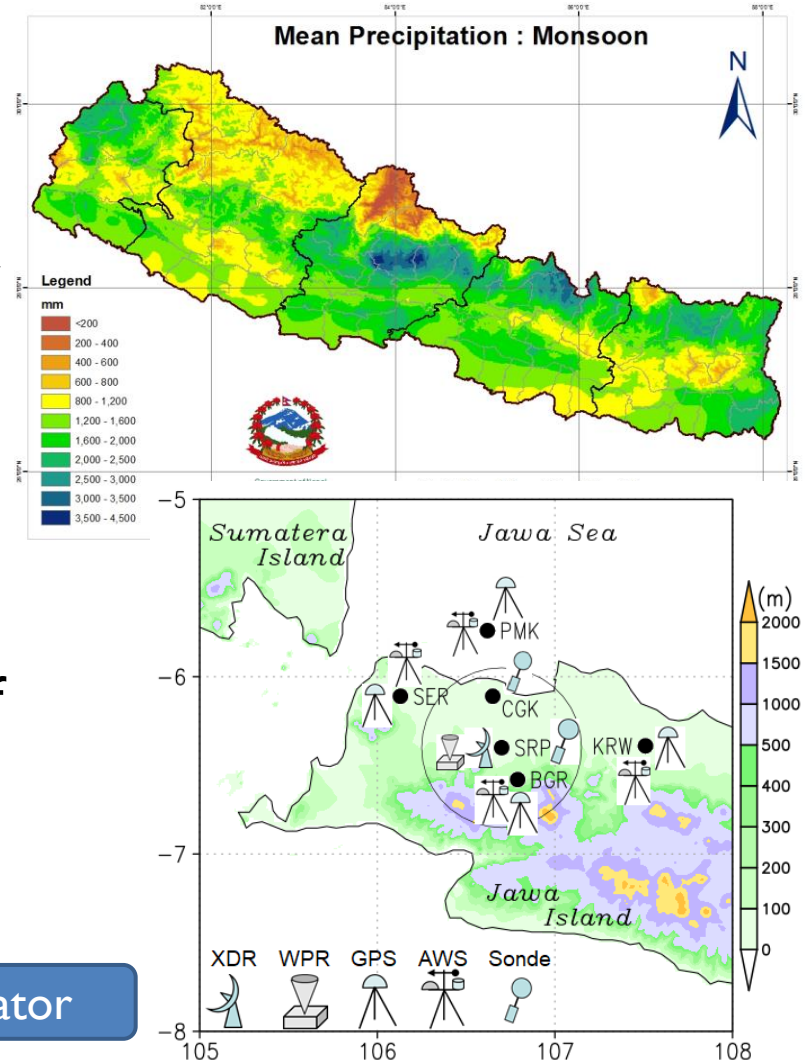
Hatsuzuka et al. (2020)

- ▶ Percentage increase in extreme TC rain (90 percentile, TCP90).



Observational Projects

- ▶ HiPRECS (Himalaya PRECipitation Study)
 - ▶ To investigate the mechanism of precipitation variability associated with the large-scale moist air flow over the complex terrain of the southern slope of Himalayan Range.
- ▶ JaHE (Jakarta Heavy precipitation Experiment)
 - ▶ To investigate the heavy rainfall along the northern coastal area of the Bali Island. They emphasized the Jakarta metropolitan area where severe floods attack every several years associated with the coastal rainfall.



Coastal Dehydrator

Observational Projects



- ▶ 2022-2026
 - ▶ BoB-Bengal/Assam
 - ▶ **HMSEA Production**

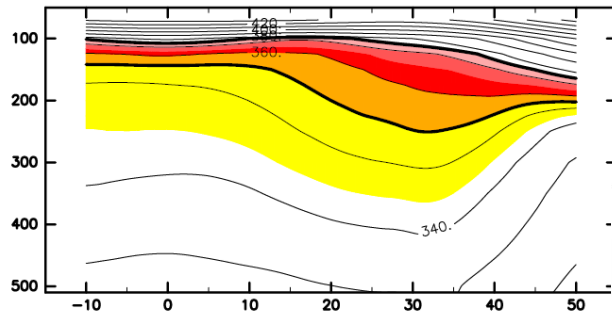
HDSEA: ($375\text{K} > \theta > 355\text{K}$)

High Dry Static Energy AirMass (upper trop.)

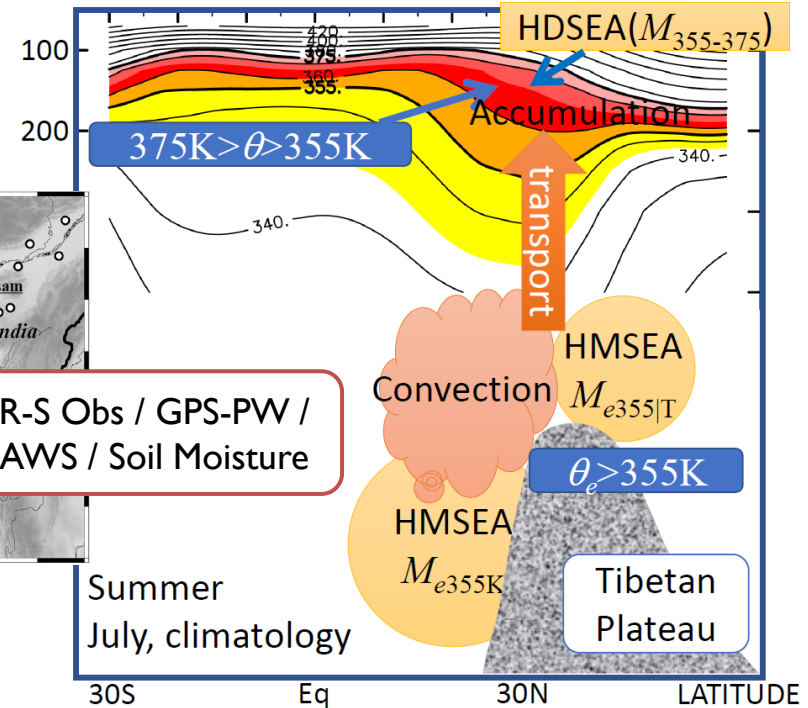
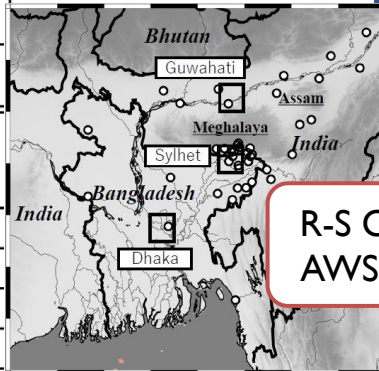
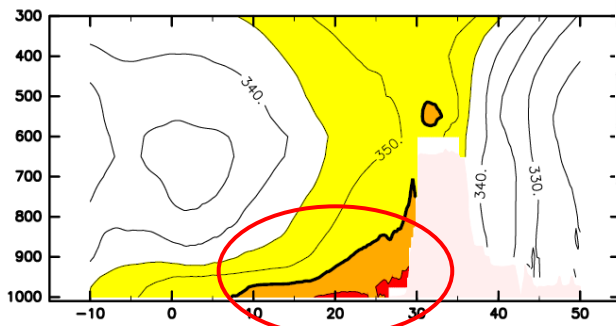
HMSEA: ($\theta_e > 355\text{K}$)

High Moist Static Energy AirMass (lower trop.)

(b) θ , 80-100°E, July



(d) θ_e , 80-100°E, July



Asian Monsoon Year-II

▶ Objective

- ▶ To obtain ground-based observational dataset to share, which will improve predictability in regional summer / winter monsoon precipitations and their extremes in the time scale longer than a week.

▶ IOP Year Targeting / POP, IOP

▶ Strategy

- ▶ Science in 6-approaches / Satellites and modeling
- ▶ Activation and exchange of sub-regional research activity
 - ▶ collaboration with local meteorological agencies.
- ▶ AMY-II Implementation Plan - IOP



Plan for AMY-II

- ▶ **Phase-I: 2023/24-24/25**
 - ▶ Recovery from COVID-19 world
 - ▶ Combination Effect
 - ▶ Facilitating lateral network among existing projects / networks
 - ▶ Small workshops (including virtual) to know each other
- ▶ **Phase-II: 2025/26-2026/27**
 - ▶ Intensive Observation Period
 - ▶ Synergy Effect
 - ▶ Planning Conference: 2023
 - ▶ Finding funding source for 2025-2027
 - ▶ Well defined common targets and observational hotspots
 - ▶ Organized implementation plan



Acknowledgements

Thank you !



Participants of the Kick-off Conference in Sapporo 2019 in front of the statue of Dr. Clark on Hitsujigaoka Observation Hill, Sapporo, Japan

- ▶ This research was supported by ..
 - ▶ Sumitomo Grant for Environmental Research Projects
 - ▶ JSPS KAKENHI Grand No. 20H02252 and 20H01523
 - ▶ ISEE, Nagoya-U., Joint Research Program / International Workshop
 - ▶ JAXA/EORC Precipitation Measurement Mission
 - ▶ Chiba-U., Joint Research Program