26 Oct. 2018: GHP Panel Meetong
@ Santiago / Chile

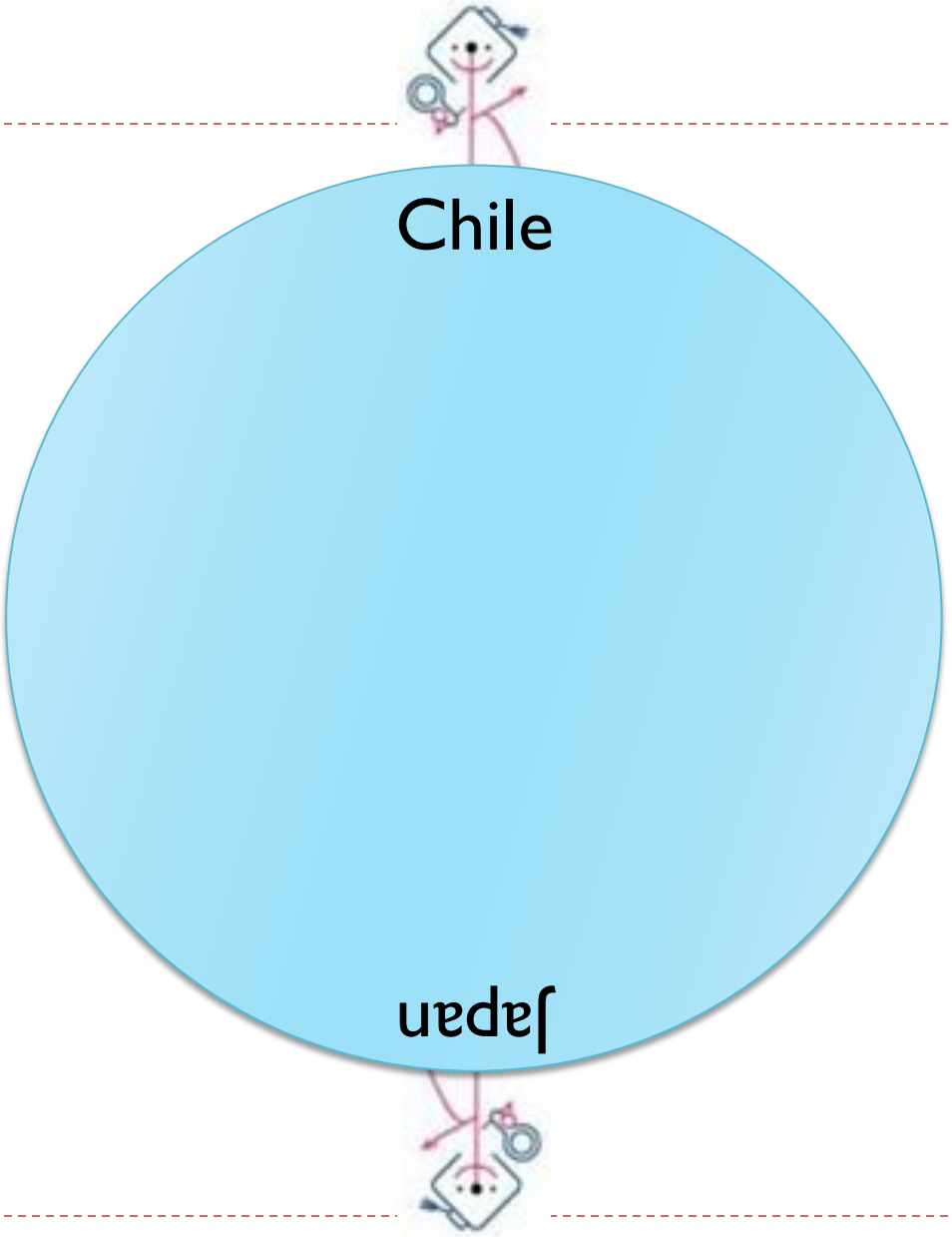
Post MAHASRI Science Plan

Toru Terao (Kagawa University)

Today's talk

Bottom up description of Science Plan

Individual Science Topics
Approaches / Regions
Questions
Mission / Objective



Top down description of Science Plan

Mission / Objective
Questions
Approaches / Regions
Individual Science Topics

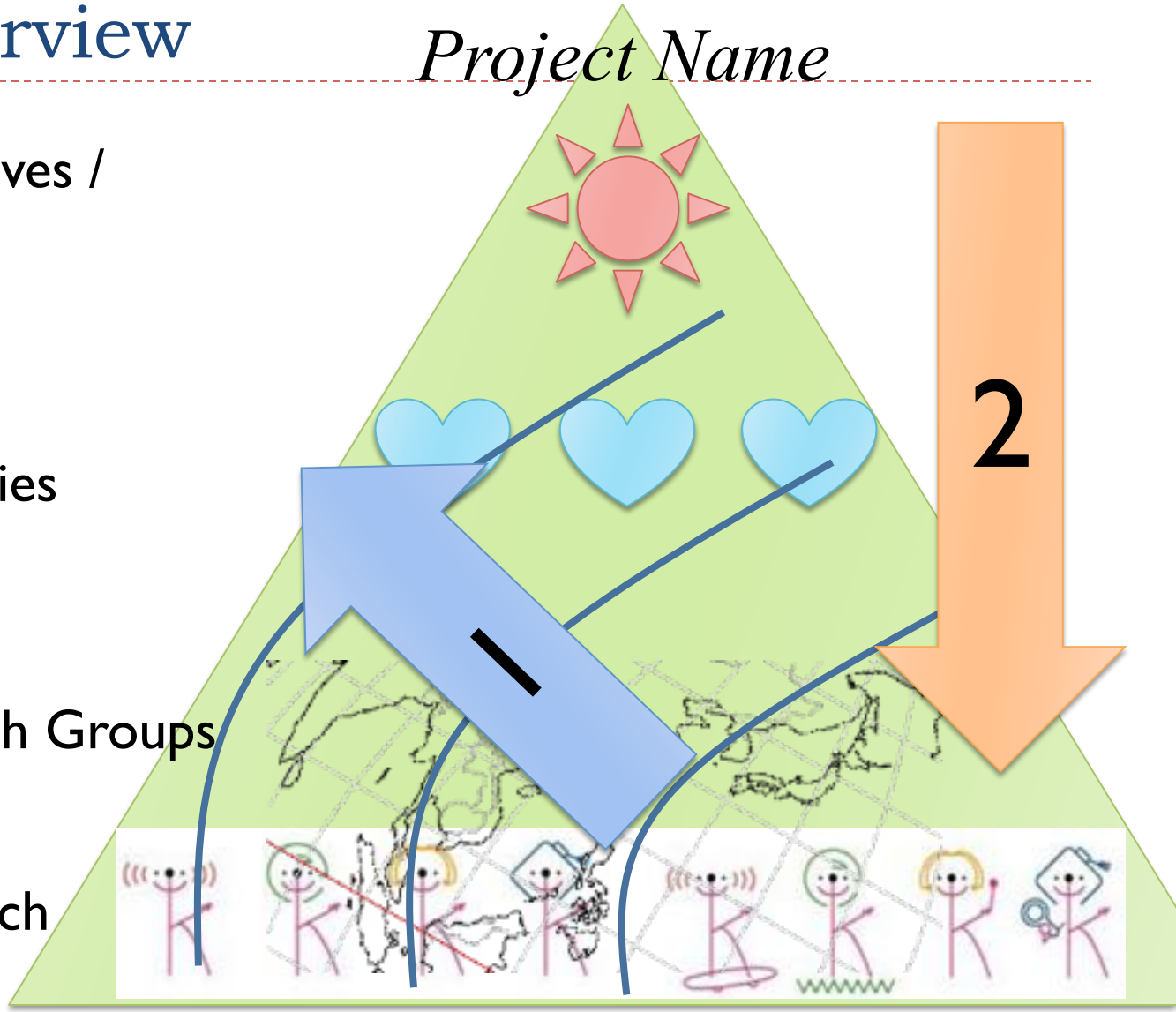
Project Overview

Mission / Objectives /
Project History

Key Questions /
Research Strategies

Approaches /
Regional Research Groups

Individual Research
Topics



Bottom up drafting process

- 20 Jan. 2018: PostMAHASRI Planning Workshop
  - Nagoya University, Japan / More than 40 researchers
- 15-16 Mar. 2018: Intern'l PostMAHASRI Planning WS
  - TMU, Japan / Total 63 international researchers

Scientific Approaches (6)

- 20 May 2018: JpGU 2018, Post MAHASRI session

Objectives & Missions | Research Strategies

- Organizing Drafting WGs (0-6)
- 6-7 Oct. 2018: 1st Drafting Core Meeting

Key Questions (5)

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Key Questions (5)

Scientific Approaches

Based on what we are doing

- To Understand Asian Monsoon Land Precipitation;
  1. Observation and Estimation of Variation and Extremes in Asian Land Precipitation and Important Variables
  2. Process Studies of Asian Land Precipitation Focusing on Diverse Land-Atmosphere Interactions
  3. Understanding and Prediction of Variability of Asian Monsoon from Subseasonal to Interdecadal Time Scales
  4. High Resolution Land Surface Hydrological Modeling and Monitoring Incorporating Impacts of Human Water Withdrawal, Agriculture, Vegetation and Cryosphere
  5. Coordinated Observation and Modeling Initiatives
  6. Detection and Projection of the Climate Change Impact on Regional Precipitation in the Asian Monsoon Region

要、総合目標・タイトル（以下、章立て）

マトリックス図　　キャパビルの要素

- 降水等観測　　**寺尾**、福島、一柳、野津、田上、上米良、荻野、森、村田、井上、
- データレスキュー　　**久保田**、松本、井上、
- 日～季節内変動～季節変化（空間）および大気陸面相互作用　　**佐藤**、**藤波**、杉本、**高橋**、上野、**横井**、
- 陸面水文・水資源（農業、氷河まで）
  鼎、**田中**、飯田、藤田、坂井、芳村、山田
- 温暖化予測気候情報および衛星情報、データ、その他
  樋口、**大楽**、**梶川**、**木口**、**相木**

各章２人ずつぐらい責任者?

Tentative Groups/Sections for drafting post-MAHASRI Science Plan

- Current and near-future in-situ observations and field campaigns
- Data rescue of old/historical observations
- Various spatio-temporal variability of Asian monsoon and its relation with land-atmosphere interaction
- Land surface hydrology and water resources, including agriculture and glaciers
- Research infrastructure such as Satellite, Climate change information such as CORDEX, Data and data-center, etc.

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Scientific Approaches (6)

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Objectives & Missions | Research Strategies

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Key Questions (5)

Objectives of the Post MAHASRI

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

Bottom up drafting process

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Scientific Approaches (6)

- 20 May 2018: JpGU 2018, Post MAHASRI session

Objectives & Missions

Research Strategies

- Organizing Drafting WGs (0-6)
- 6-7 Oct. 2018: 1st Drafting Core Meeting

Key Questions (5)

Research Strategies

- Impacts of Diversed Land Surface: Topography, Cryosphere, Vegetation, Land Use and Coast Lines on Diurnally Varying Precipitation Process in Multiple Time Scales from Sub-seasonal to Climate Change
- Hydrological Modeling which Incorporates Human Water Withdrawal and Impacts of Agricultural Activity and Biosphere in Monsoon Asia
- Targeted and Integrated Observation Projects Coordinated with New Generation High Resolution Dataset, Modeling, Radar Network, and Satellites / Coordinated Regional Process Studies
- Playing a Key Role in S2S (Sub-seasonal to Seasonal) Prediction Project
- Data Rescue for 200-Year Climate Change Detection: with ACRE
- Regional Climate Projection and Dynamic and Statistical Downscaling Collaborating with Modeling Community including CORDEX

Bottom up drafting process

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Scientific Approaches (6)

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Objectives & Missions | Research Strategies

- Organizing Drafting WGs (0-6)
- 6-7 Oct. 2018: 1st Drafting Core Meeting

Key Questions (5)

Chairs of each WG / Section in Chap. 3

- Sections in Chap. 3: Scientific Approaches

1. Observation and Estimation of Variation and Extremes in Asian Land Precipitation and Important Variables	Dr Fukushima Dr Kamimera
2. Process Studies of Asian Land Precipitation Focusing on Diverse Land-Atmosphere Interactions	Dr Takahashi Dr Sugimoto
3. Understanding and Prediction of Variability of Asian Monsoon from Subseasonal to Interdecadal Time Scales	Dr Fujinami Dr Takaya
4. High Resolution Land Surface Hydrological Modeling and Monitoring Incorporating Impacts of Human Water Withdrawal, Agriculture, Vegetation and Cryosphere	Dr Kanae Dr Iida
5. Coordinated Observation and Modeling Initiatives	Dr Yokoi Dr Nodzu
6. Detection and Projection of the Climate Change Impact on Regional Precipitation in the Asian Monsoon Region	Dr Sato Dr Kiguchi

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Scientific Approaches (6)

- 20 May 2018: JpGU 2018, Post MAHASRI session

Objectives & Missions | Research Strategies

- Organizing Drafting WGs (0-6)
- 6-7 Oct. 2018: 1st Drafting Core Meeting

Key Questions (5)

Overarching Key Questions

To be solved in 10 yrs

- What is convincing and useful Climate Projection?
- What coordinated Observation Initiative is needed?
- To what extent can we use up 200yr Rescued Data?
- How can we describe Extreme Weather?
- What is Mountain Precipitation and hydrological cycles?

Overarching Key Questions

To be solved in 10 yrs

- What is the convincing climate projection representations of Asian monsoon precipitation that can support policymakers to plan useful adaptation strategy for the changing climate?
- What is the possible coordinated observation initiative that advances our understanding of the Asian monsoon precipitation?
- To what extent can we use up rescued hydrometeorological data to reconstruct recent 200-year climate change?
- How can we find new scientific methods to describe, and to share information with Asian people, of the extreme weather embedded in multiple time scales in Asian monsoon hydroclimate?
- What is the role of mountain precipitation and subsequent land water process in the local and global hydrological cycles and water resources?

Chapters of Science Plan

- Chapter 1: Background and Objectives
  - Mission, Asian monsoon, History and Objectives
- Chapter 2: Key Questions
  - Strategies and Key Questions
- Chapter 3: Science Approaches
  - Individual Descriptions of Six Approaches
- Chapter 4: Regional Studies
  - Individual Descriptions of 10(?) Regional Studies
- Chapters 5-10
  - Applications, Data Sharing, Collaborations, Capacity Building and Technology Transfer, Funding, SSG/Conferences

Time Table for Science Plan

- GHP/Andex Workshop (Oct. 2018)
- 2nd Drafting Core Meeting (13 Nov. 2018)
- Dead line of Manuscripts: 10 Dec. 2018
- Adjustments
- Science Plan Ver. 1.0 (Dec. 2018)

Project Name

- English Proof Reading, Ver. 1.1 (Early Jan. 2019)
  - Submit to GEWEX/SSG
- GEWEX SSG Meeting (25 Sep.-1 Mar. 2019)

...

Approval as new RHP

Our Mission and Key Questions

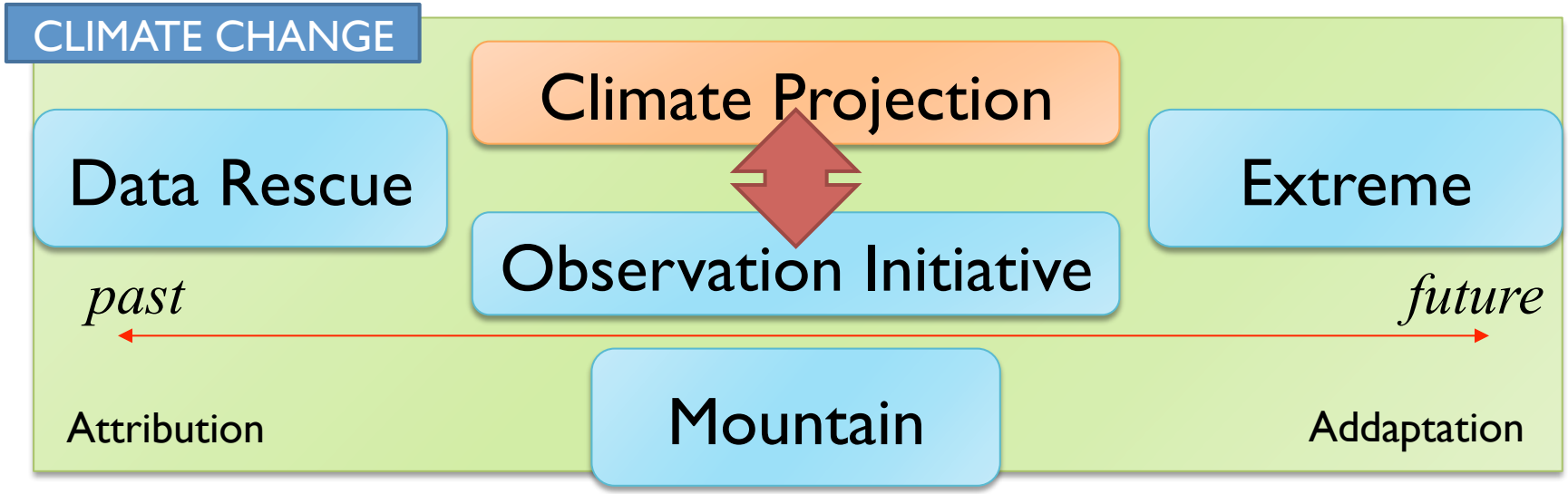
Huge Mission and Asian Monsoon

- Why Asian land precipitation?
  - Supporting Life of Huge Population (>4 Billion?) in Asia
  - Expected Impacts of Climate Change
    - Extremes and Disasters / Crisis in Water Resources / Food Basket / Human Health and Deseases / Sea Level Rise / Agricultural Production / ...
- Do we understand what is Asian monsoon?
  - Is it a huge land-sea breeze, or migrating ITCZ?
  - We can not even reproduce observed precipitation and complicated seasonal march of Asian monsoon using climate models
  - We should respond to demands of people and policimakers

Overarching Key Questions

To be solved in 10 yrs

- What is convincing and useful Climate Projection?
- What coordinated observation initiative is needed?
- To what extent can we use up 200yr rescued data?
- How can we describe extreme weather?
- What is mountain precipitation and hydrological cycles?



Overarching Key Questions

To be solved in 10 yrs

- What is convincing and useful Climate Projection?
- What coordinated observation initiative is needed?
- To what extent can we use up 200yr rescued data?
- How can we describe extreme weather?
- What is mountain precipitation and hydrological cycles?

Research topics to solve these questions

Synargy Effects are Already Emerging

Overarching Key Questions

To be solved in 10 yrs

- What is convincing and useful Climate Projection?

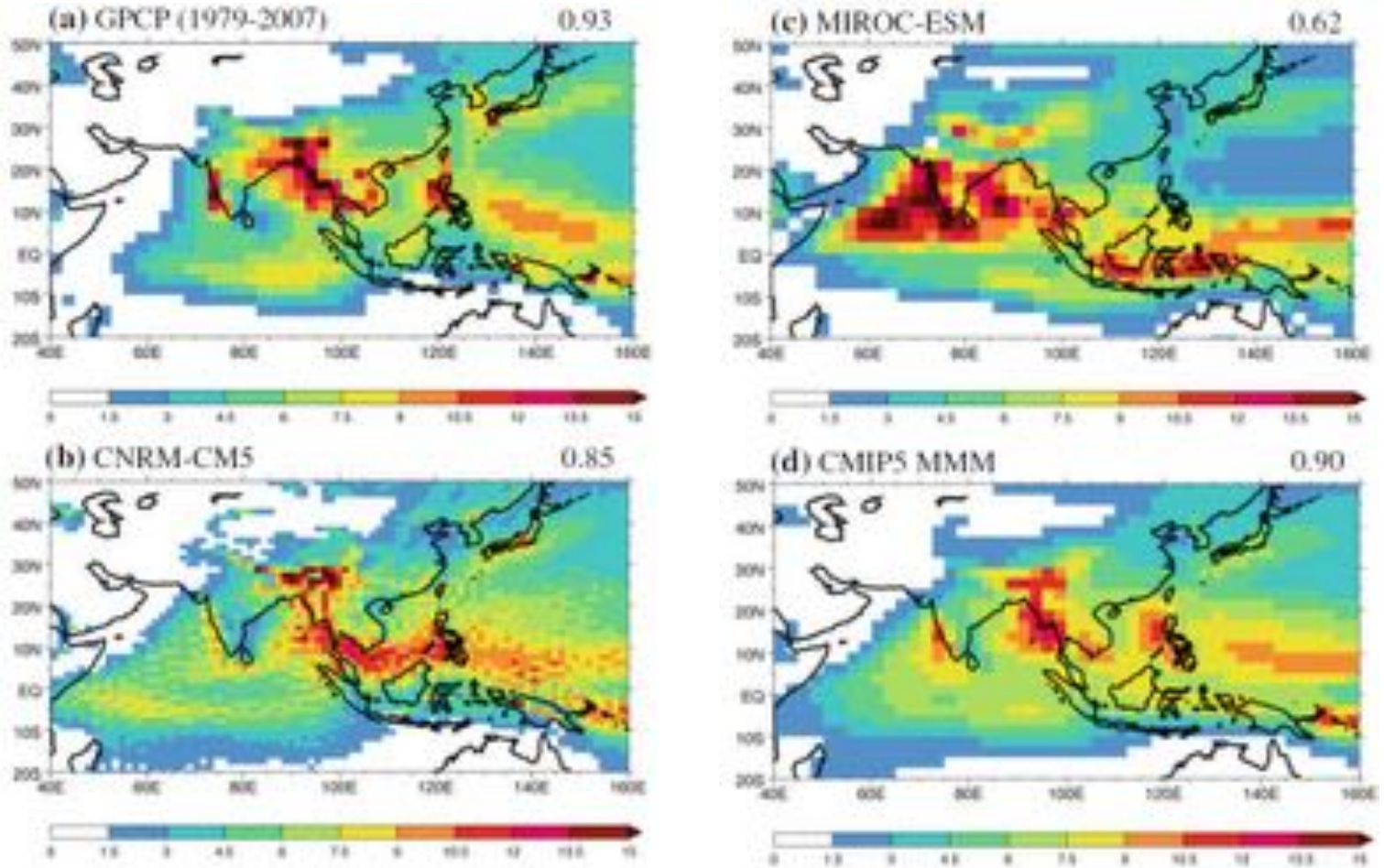
Question 1

- What coordinated observation initiative is needed?
- To what extent can we use up 200yr rescued data?
- How can we describe extreme weather?
- What is mountain precipitation and hydrological cycles?

Question 1

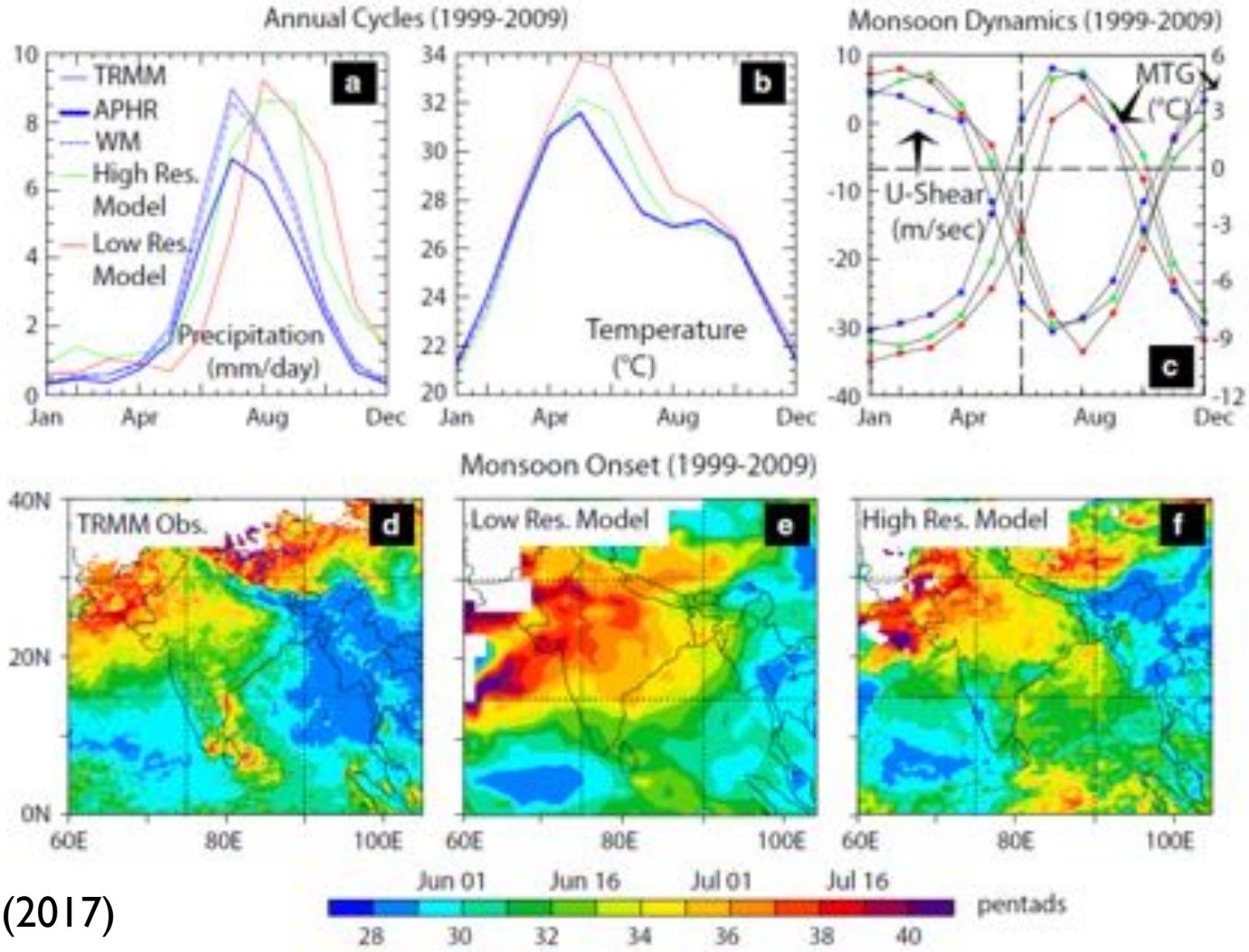
Annual Precipitation in Climate Models

- Sperber et al. (2013)



Question 1

Seasonal march in climate models

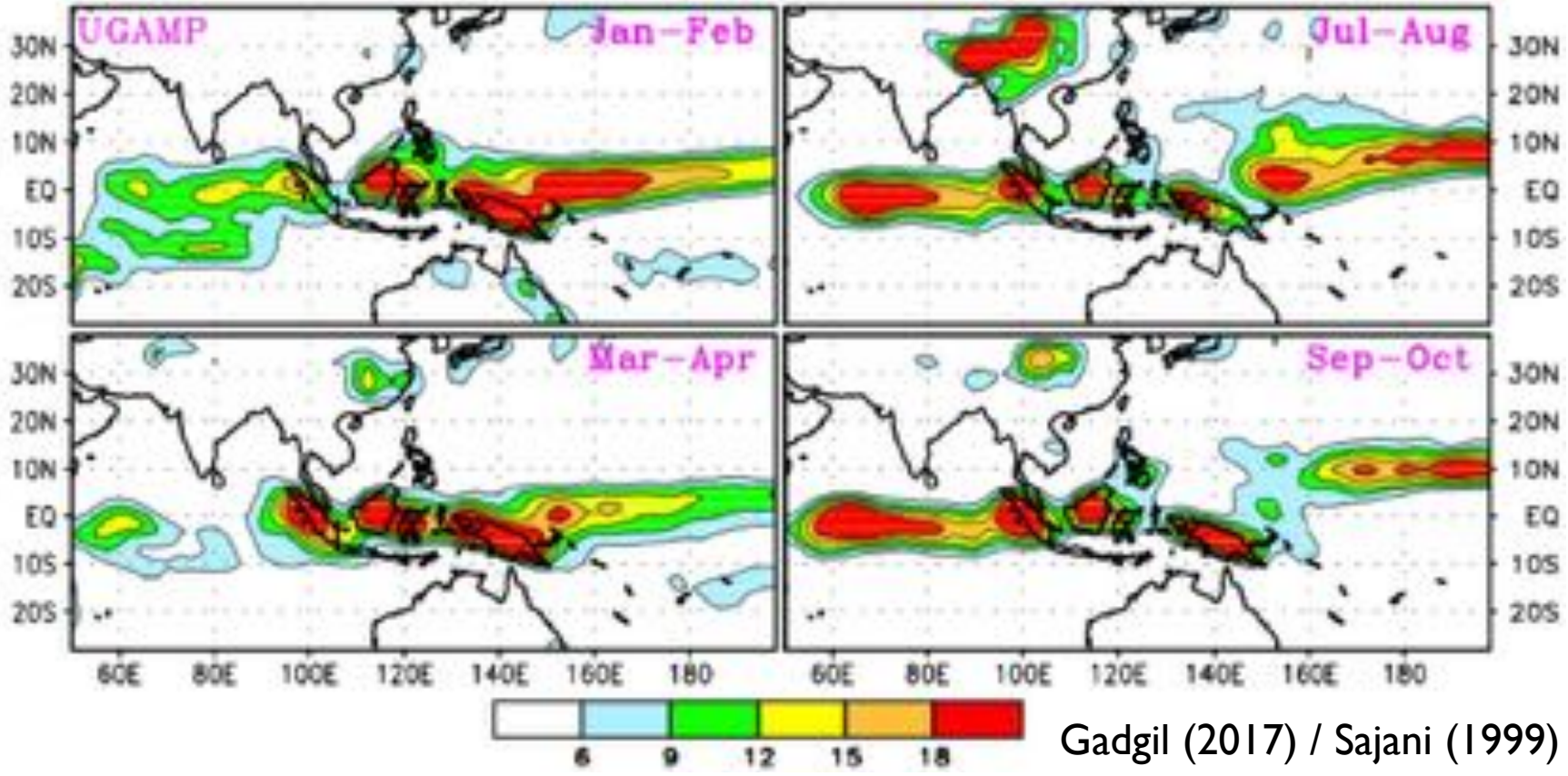


Asufaq et al. (2017)

Question 1

ITCZ in Early version of AMIP

- We do not know why later CMIPs can represent the northward migration of ITCZ in Asian monsoon region.



Gadgil (2017) / Sajani (1999)

S2S-Post MAHASRI collaboration in future hydrometeorological prediction research

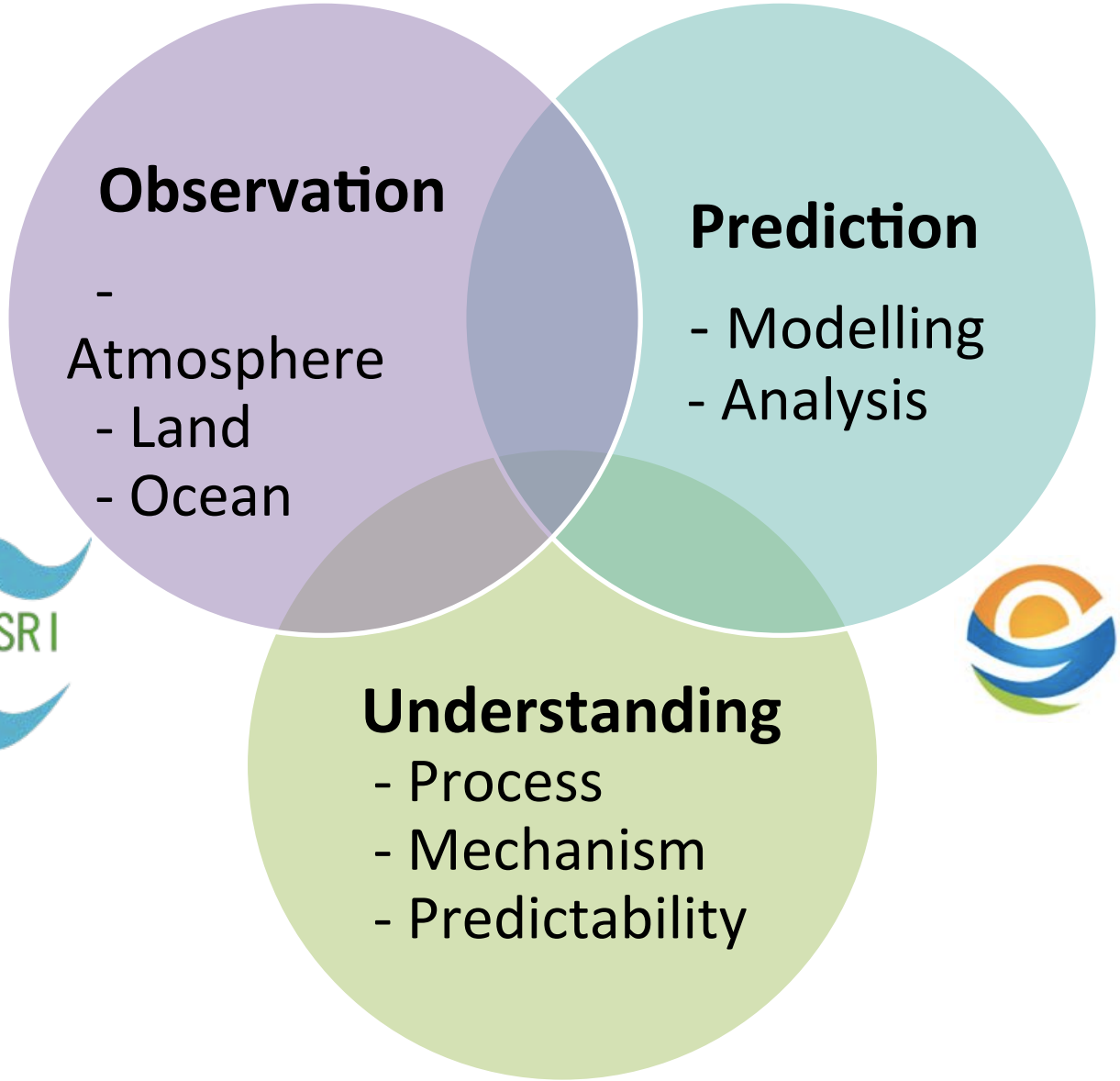
Yuhei Takaya[1], Toru Terao[2], Jun Matsumoto[3]

*1 Meteorological Research Institute
*2 Kagawa University
*3 Tokyo Metropolitan University

WMO S2S regional workshop for Asian countries, Gyeongju, 25-26 June 2018

국립기상과학
National Institute of Meteorological Scienc

Predictive understanding of Asian monsoon



AHASRI

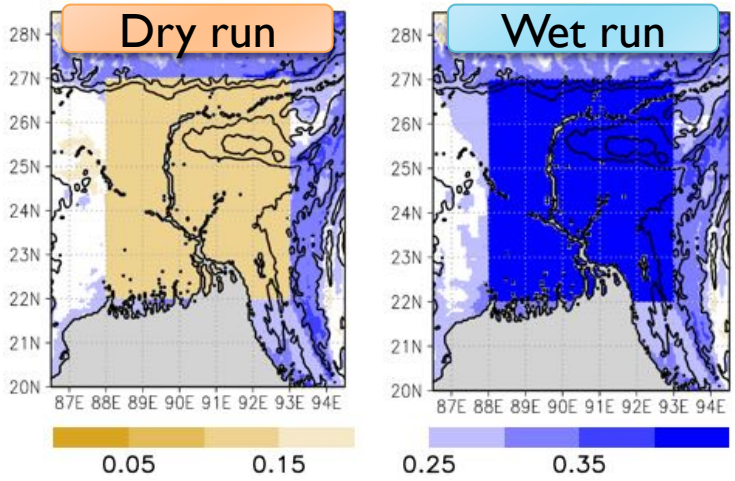
Subseasonal-to-Seasonal S2S Prediction Project

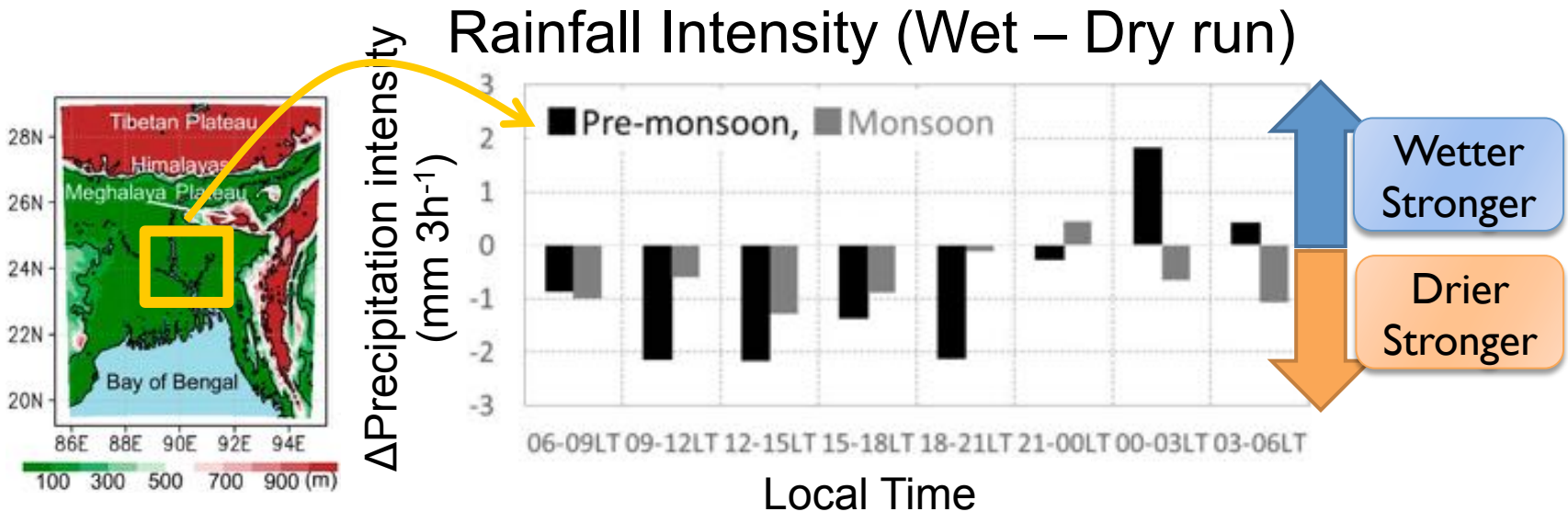
Question 1

Soil moisture impact on precipitation

- Impacts of Land Surface on Diurnally Varying Precipitation in Bangladesh Monsoon and Pre-monsoon Seasons

Sugimoto and Takahashi (2017)





Question 1

Convincing Climate Projection?

- Definition of convincing 'good' climate projection criteria
  - Understanding of Real Precipitation System
    - Collecting information of spatial structures of precipitation systems (ex. MCS) utilizing remote sensing data such as radar and satellites underpinned by in-situ obesrvations during upcoming 10 year period.
    - Explaining the variability of precipitation in the real atmosphere by the variability of frequency and strength of precipitation systems.
  - Assessment of Climate Models
    - Checking whether the models represent the frequency and strength of precipitation systems as well as the variability and trends of precipitation amount.
    - Cheking the model performance in modelled diurnally varying meso-scale systems embedded in larger scale variation.

Overarching Key Questions

To be solved in 10 yrs

- What is convincing and useful Climate Projection?
- What coordinated observation initiative is needed? Question 2
- To what extent can we use up 200yr rescued data?
- How can we describe extreme weather?
- What is mountain precipitation and hydrological cycles?

Question 2

AMY (Asian Monsoon Years 2007-2012)

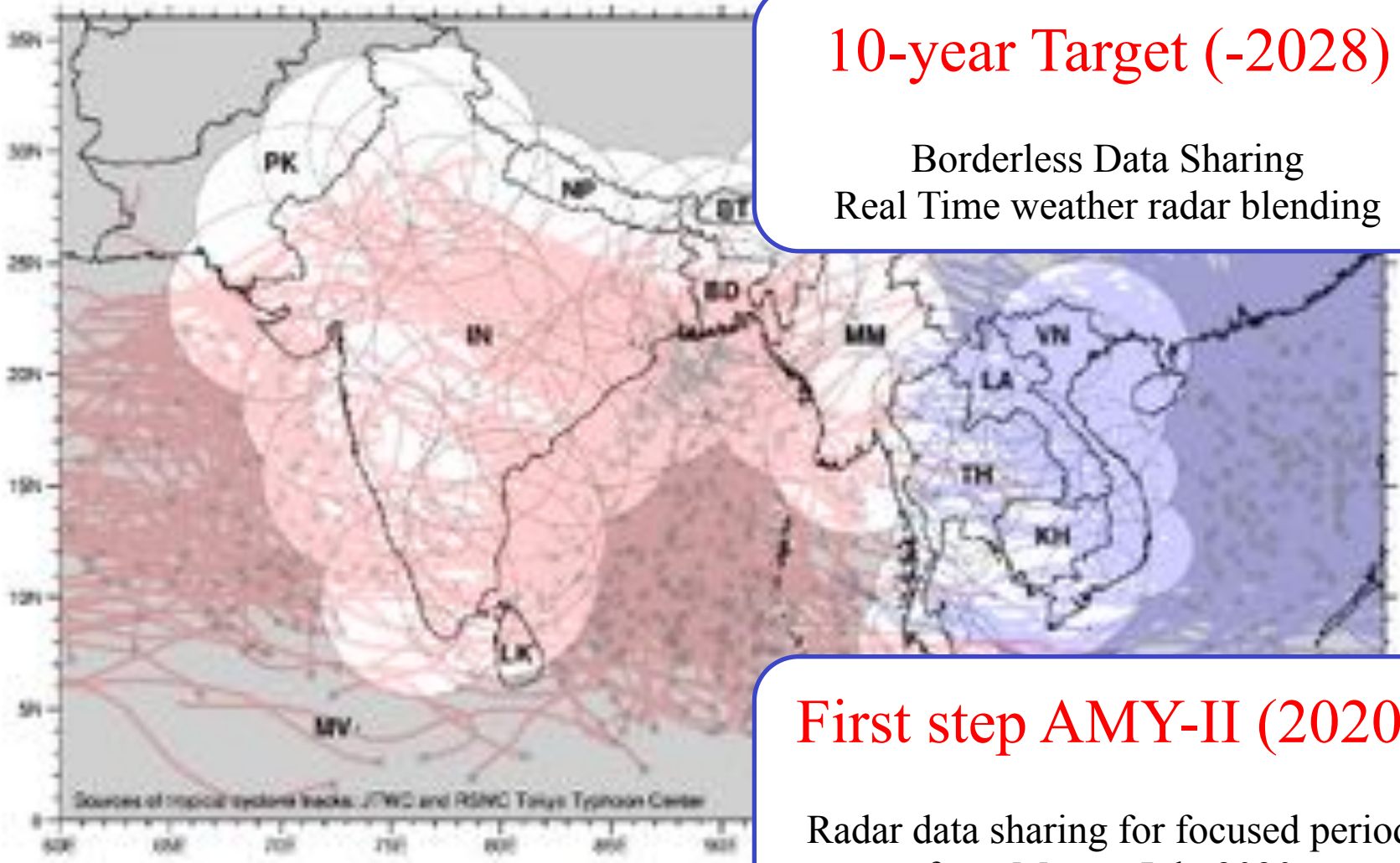
Overarching Goal:
"To improve Asian Monsoon prediction for societal benefits through improving understanding of the variability and predictability of the Asian-Australian monsoon system"

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

Question 2
PRAISE
AAF/SMART-COMMIT
MAIRS
AMF-China
JEPP/Tibet
PHONE
GRL-HyARC
COBRA
JICA/Tibet
MAIRS
SAARC-STORM
CTCZ
AIPO
JAMSTEC/VPREX
SoWMEX
EAMEX
CEOP
JAMEX
JEPP/NE India,
JEPP/SE Asia
JEPP/Thai
TMD
TCS08
JAMSTEC/PALAU
AIPO, JEPP IO/HARIMAU, CPEA
JAMSTEC/TRITON Buoy

BRAIN: Borderless Radar Information Networking over South and Southeast Asia

Question 2



10-year Target (-2028)

Borderless Data Sharing
Real Time weather radar blending

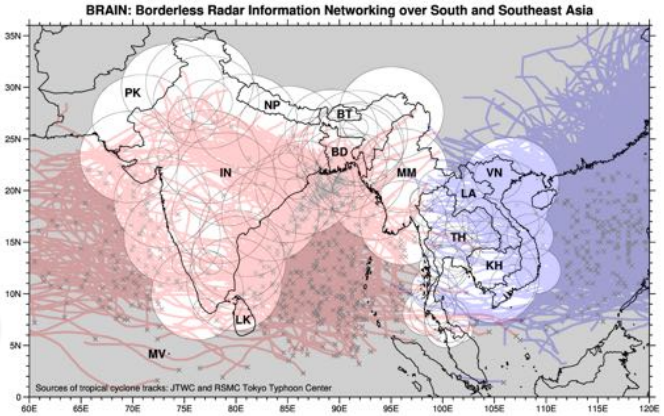
First step AMY-II (2020)

Radar data sharing for focused period
from May to July 2020

Hideyuki Kamimera,

AMY-II (2020) and Post MAHASRI

- Focus:
  - Construction of the BRAIN (Borderless Radar Information Network) within 10-year project period



10yr

- AMY-II (2020)
  - Sharing radar data among many Asian meteorological agencies during core observation period (May-July / 60days)
  - Coordinated observations
    - Pilot areas
    - Intensive R-S, PBL tower, Soil Moisture, Wind profiler, GPS-PW network, ...

2yr

Feacibility test of radar network

- Utilized for model validation

5yr

Question 2

AMY-II(2020) Planning Meeting

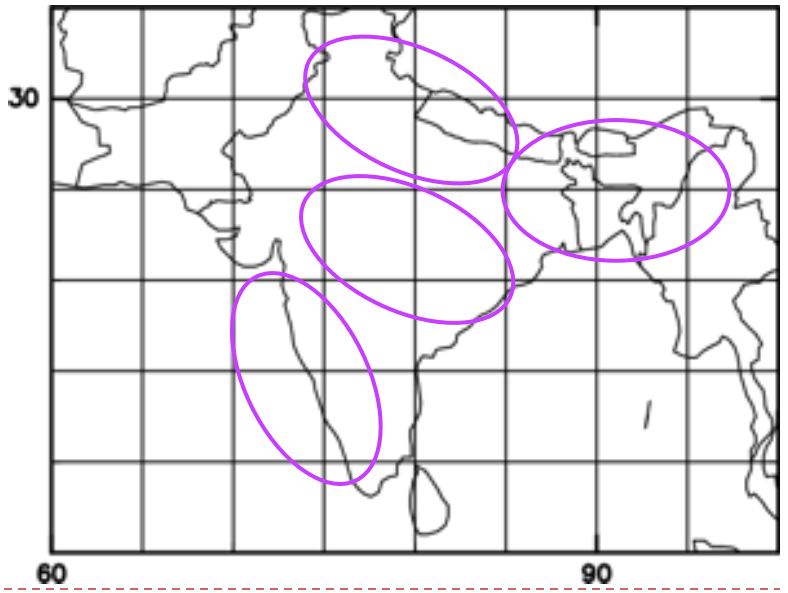
- Honolulu, 6 June 2018
  - 10 International Researchers (esp. Taiwan, China)
- Agenda
  - Background
  - Scientific Topics
    - Better understanding the processes of future Asian monsoon
    - Improvement of S2S prediction
  - Objectives
    - Aerosol-Monsoon/Tibetan Plateau and surrounding regions Land-Atmosphere interactions/Indian Ocean-Western Pacific Air-Sea / Future monsoon Asian climate

Question 2

AMY-II(2020) South Asian Project

- Focusing on Four Components in the Indian Subcontinent
  - Northeast, Northwest, Central India, Western Ghats
  - Different roles during seasonal transition and ISV?
    - Transition from pre-monsoon to monsoon and in A/B cycle
      - Different process in Northwest and Northeast and relathionship
      - Role in monsoon onset of Northeast severe local storms in premonsoon
      - Role of central India for onset
    - International Collaboration
      - Northeast-> Japan group
      - Northwest-> ?
      - Central India-> IITM
      - Western Ghats-> IITM
    - Modelling / RADAR

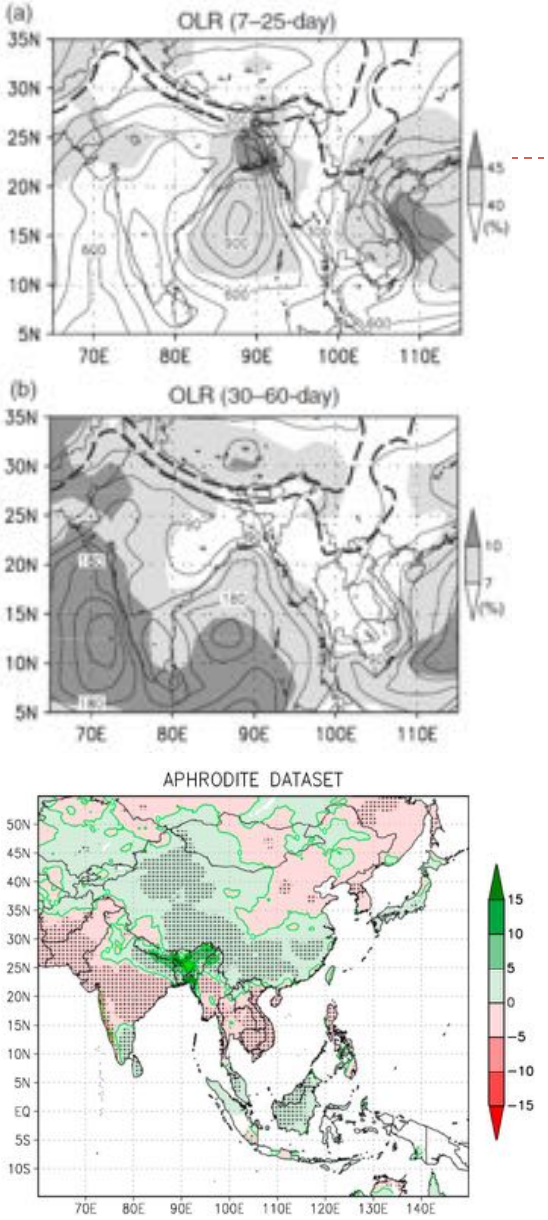
convection difference



Question 2

Active/Break cycle

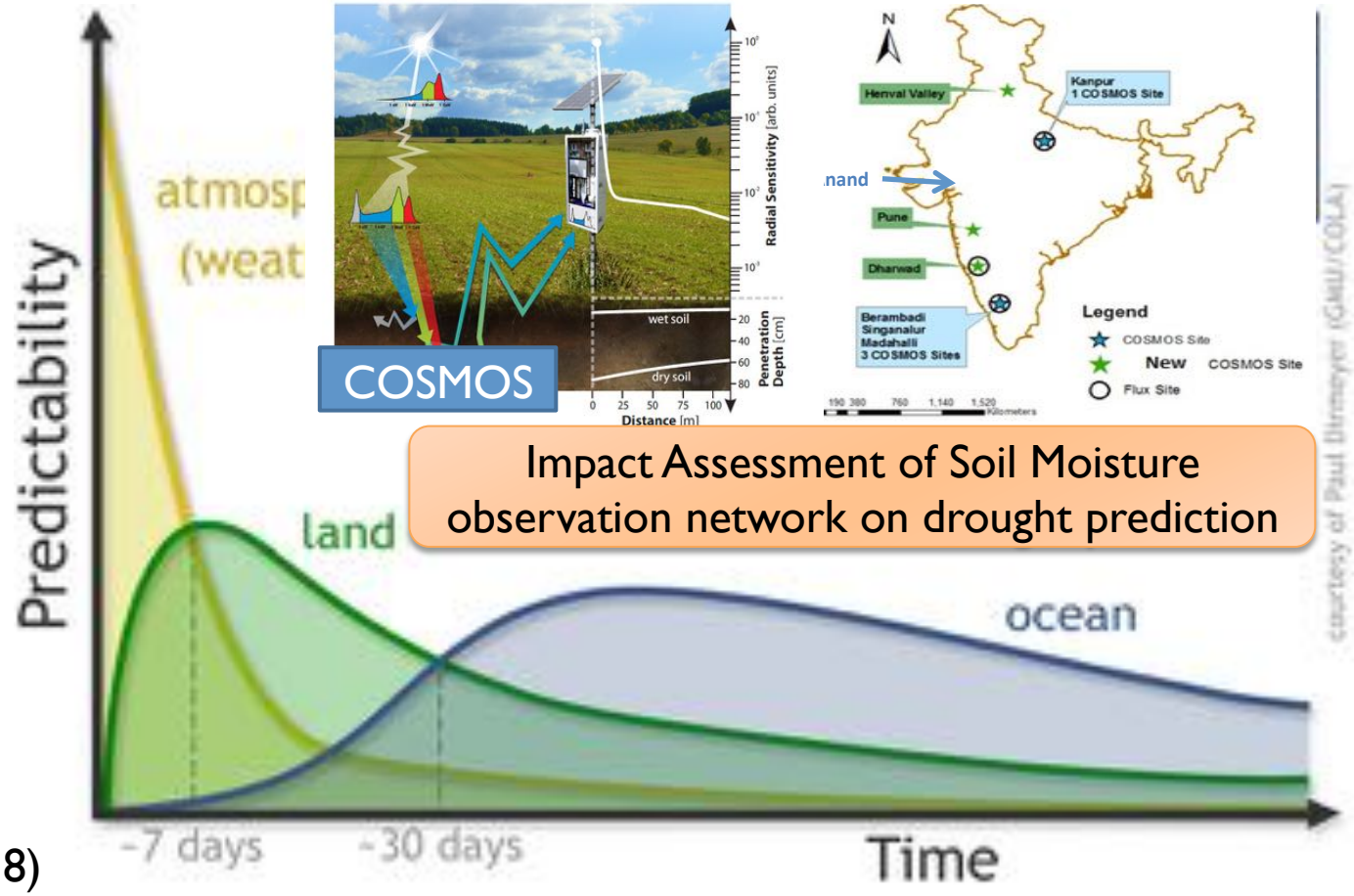
- Different frequency range
  - Fujinami et al. (2011)
  - Northeast/OLR, North/U: QBW
  - 30-60day variability in other area
- Correlation in A/B cycle
  - Murata et al. (2017)
  - Correlation with NE Rain
    - Negative in Central India and Western Ghats
    - Positive? in Northwestern India
- Interactive framework
  - LS-BL-Convection-UTLS



Approach 3

S2S Predictability and Land Surface

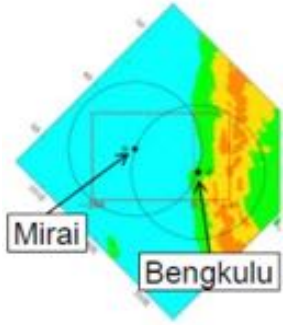
- Role of Land Surface for Predictability at different Time Scales

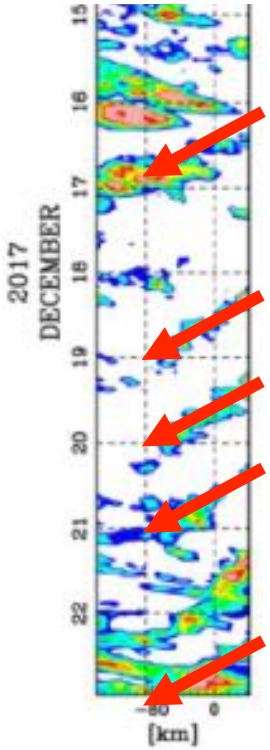


Mariotti et al (2018)

Question 2

Observation Supports Understandings

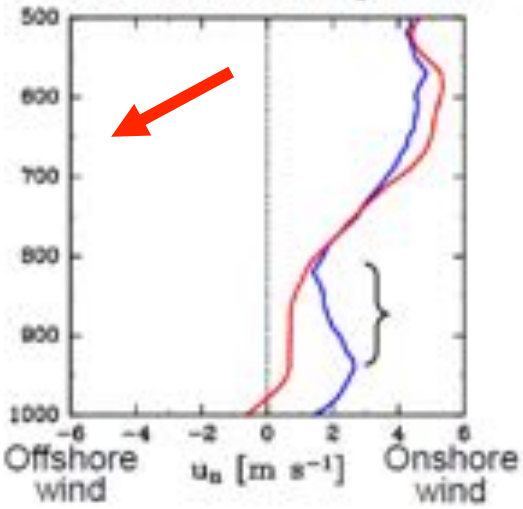


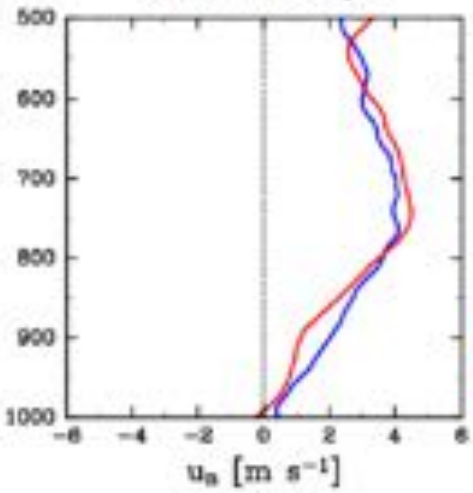


Mean wind profile perpendicular to the coastline

Composite for 8 days with clear offshore migration

Composite for other 19 days





Mirai
Bengkulu

Low-level offshore-ward vertical shear, which is important for regeneration of convective cells offshore, was observed only in days with clear offshore migration, **only over coastal waters**.

Overarching Key Questions

To be solved in 10 yrs

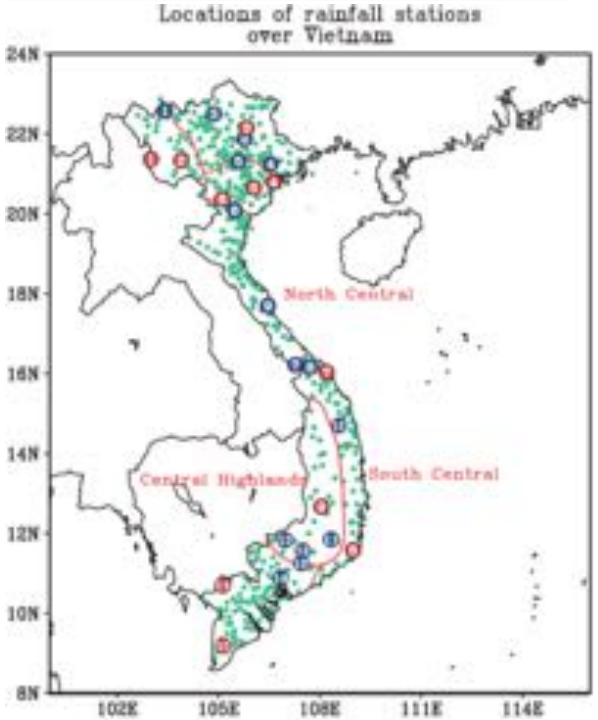
- What is convincing and useful Climate Projection?
- What coordinated observation initiative is needed?
- To what extent can we use up 200yr rescued data? Question 3 Question 4
- How can we describe extreme weather?
- What is mountain precipitation and hydrological cycles?

Question 3 | Question 4

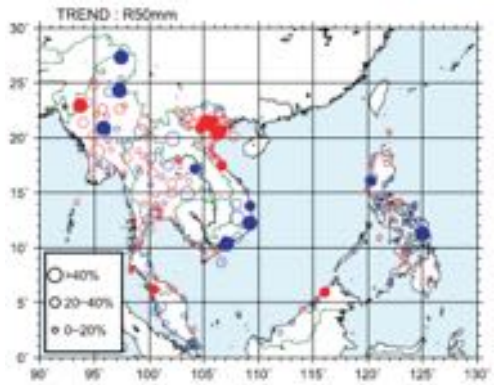
Grid-rain / Long-term Extreme Trend

VnGP: Gridded rainfall data over Vietnam

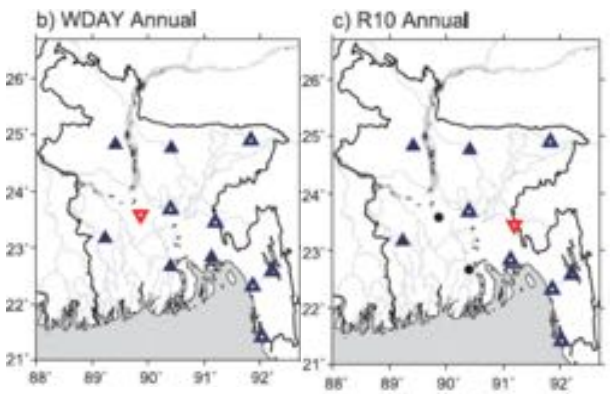
481 gauges, daily, 0.25 deg resolution, 1980-2010



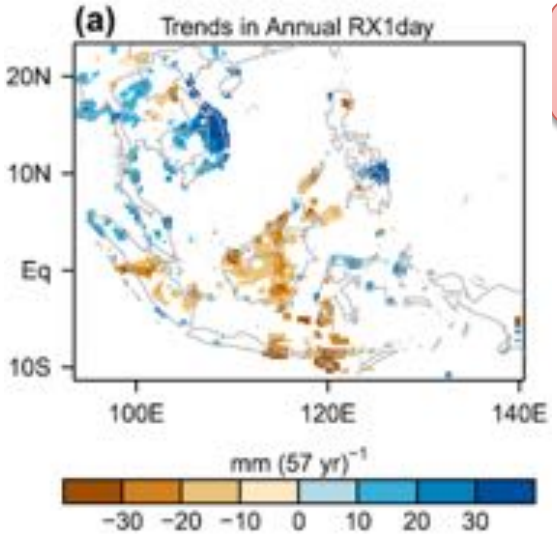
Nguyen-Xuan et al. (2016)



Endo et al. (2009)



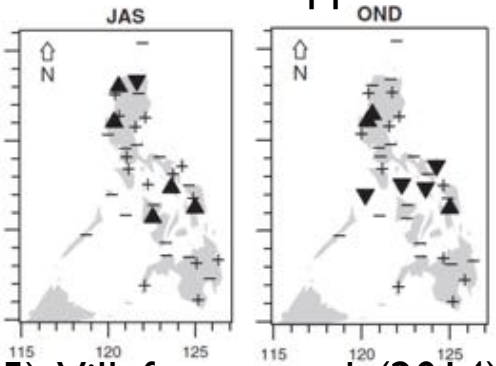
Endo et al. (2015)



Villefuerte and Matsumoto (2015)

Long-term Extreme Trends

RX5d / Philippines

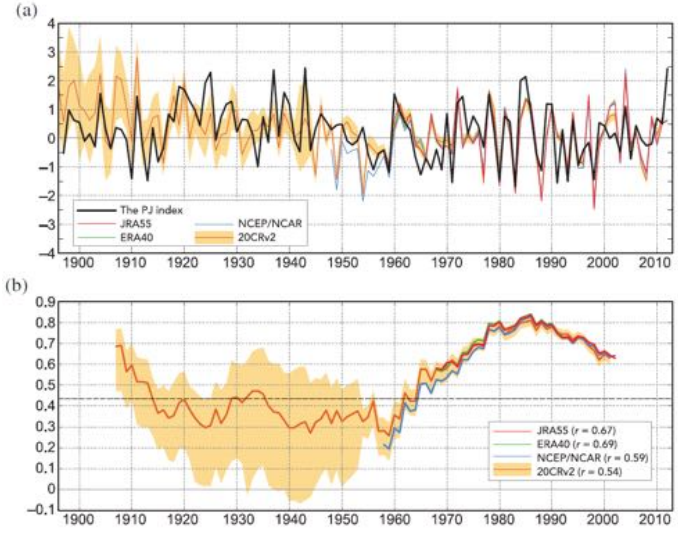


Villefuerte et al. (2014)

Question 3

Impact of historical data rescue

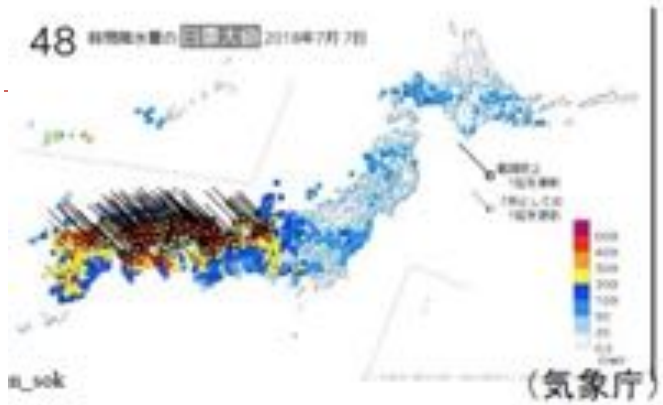
- Kubota et al. (2016)
  - PJ (P-J pattern) index from 1897 to 2013 was developed by use of historical station-based pressure data in Philippine, Taiwan and Japan, and compared with reanalyses (JRA55, ERA40, 20CRv2 and NCEP/NCAR.
  - PJ-ENSO correlation was found to change in interdecadal time scale.



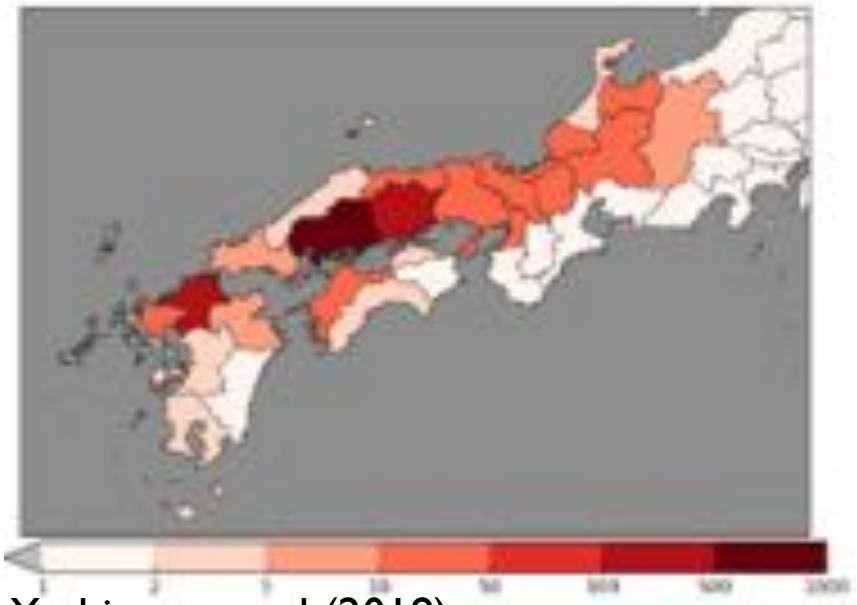
Question 4

Extremity and casualties

- West Japan heavy rain in 2018
  - NOT extreme in each obs.
  - Extreme in area integrated rainfall

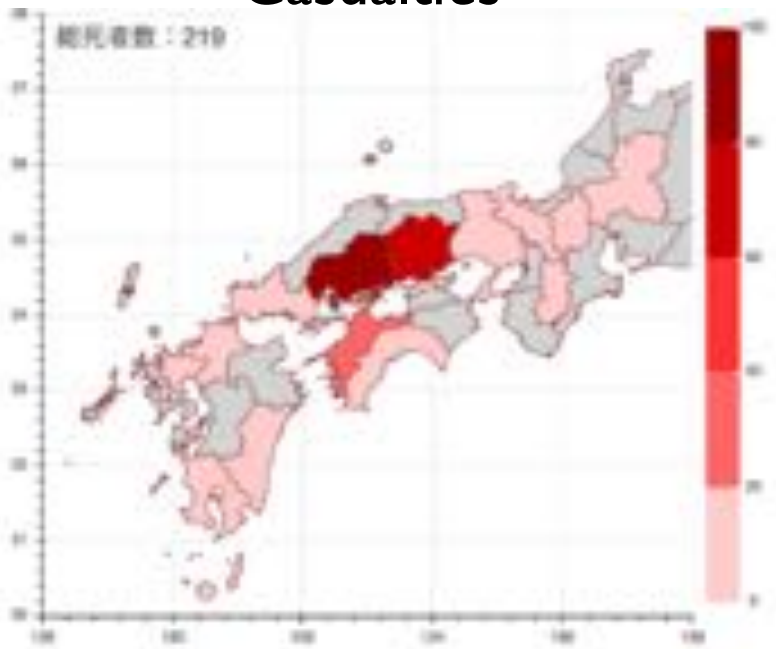


Extremity (Return Period)



Yoshimura et al (2018)

Casualties



Overarching Key Questions

To be solved in 10 yrs

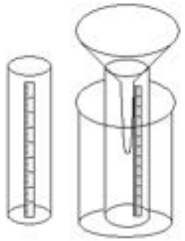
- What is convincing and useful Climate Projection?
- What coordinated observation initiative is needed?
- To what extent can we use up 200yr rescued data?
- How can we describe extreme weather?
- What is mountain precipitation and hydrological cycles?

Question 5

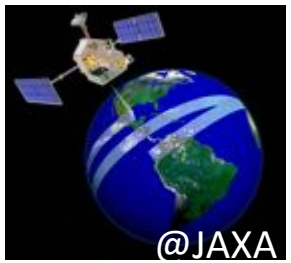
Question 5

Development of multiple data based on satellite image in Asian mountain glacier

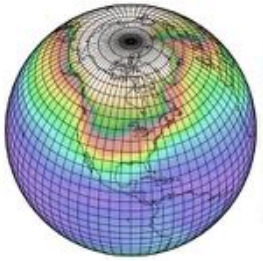
◎Sparse in-situ observation (Precipitation data)



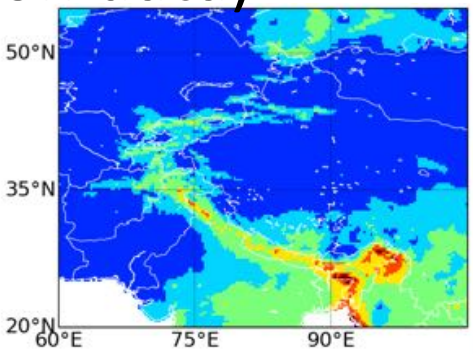
Gauge



Satellite
(e.g., TRMM/PR; GPM/DPR)

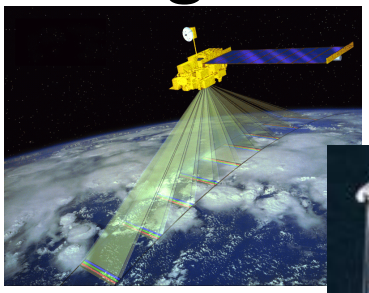


Reanalysis
(e.g., ERA-Interim)

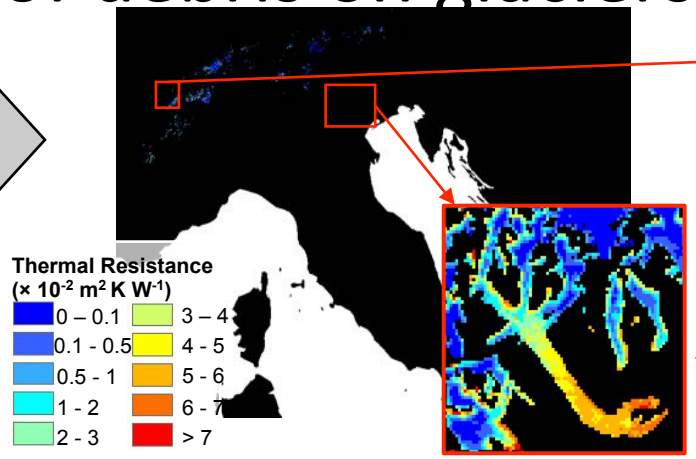


Merged

◎High-resolution map of debris on glaciers



Satellite
(e.g., ASTER, CReS)



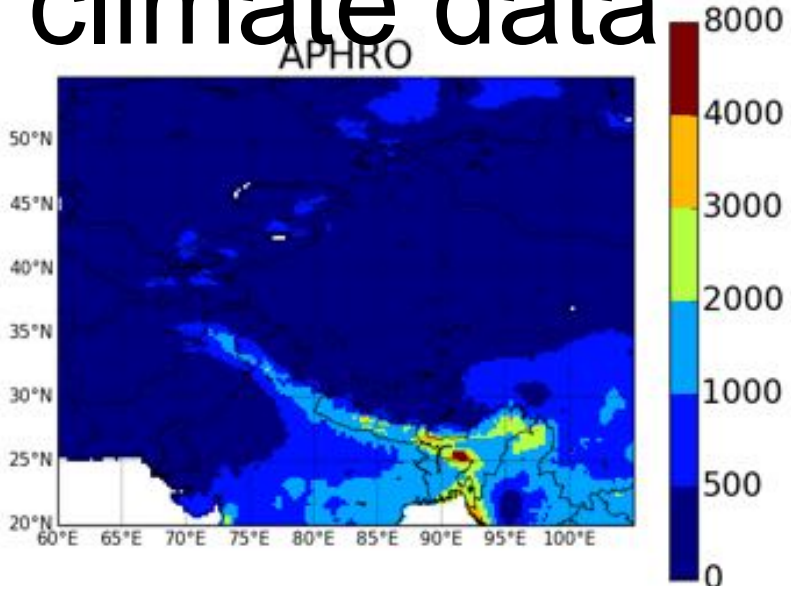
Thermal resistance of glacier

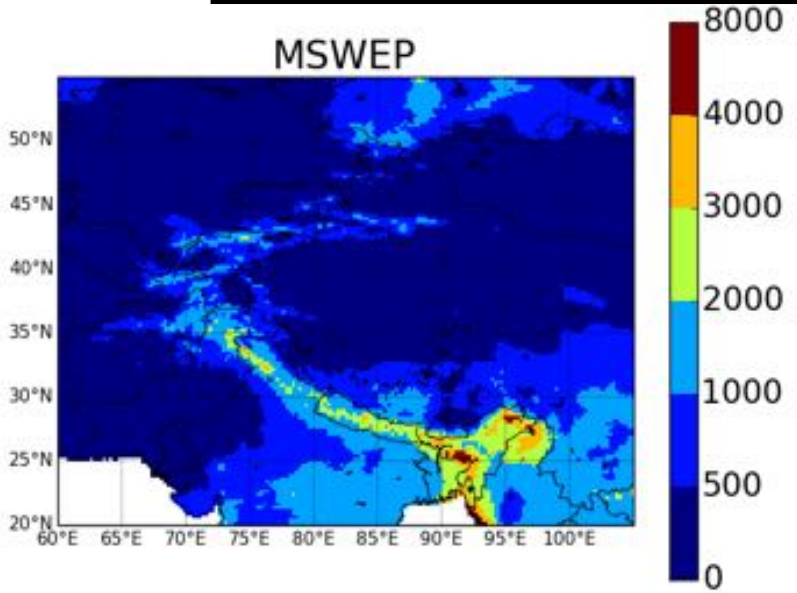
Google Map

Uncertainty of climate data

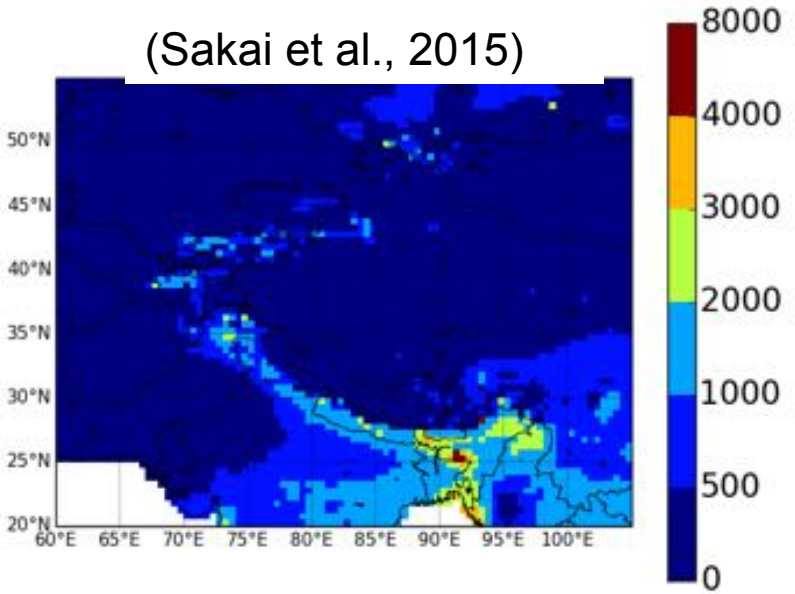
Question 5

Past: Sparse Observation

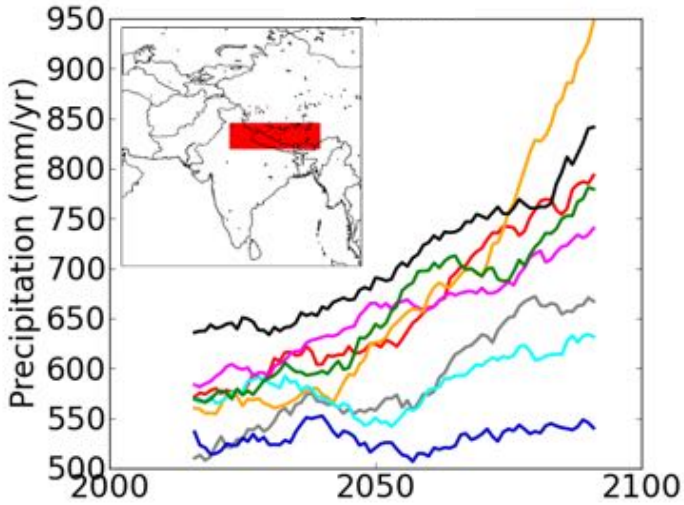




(Sakai et al., 2015)

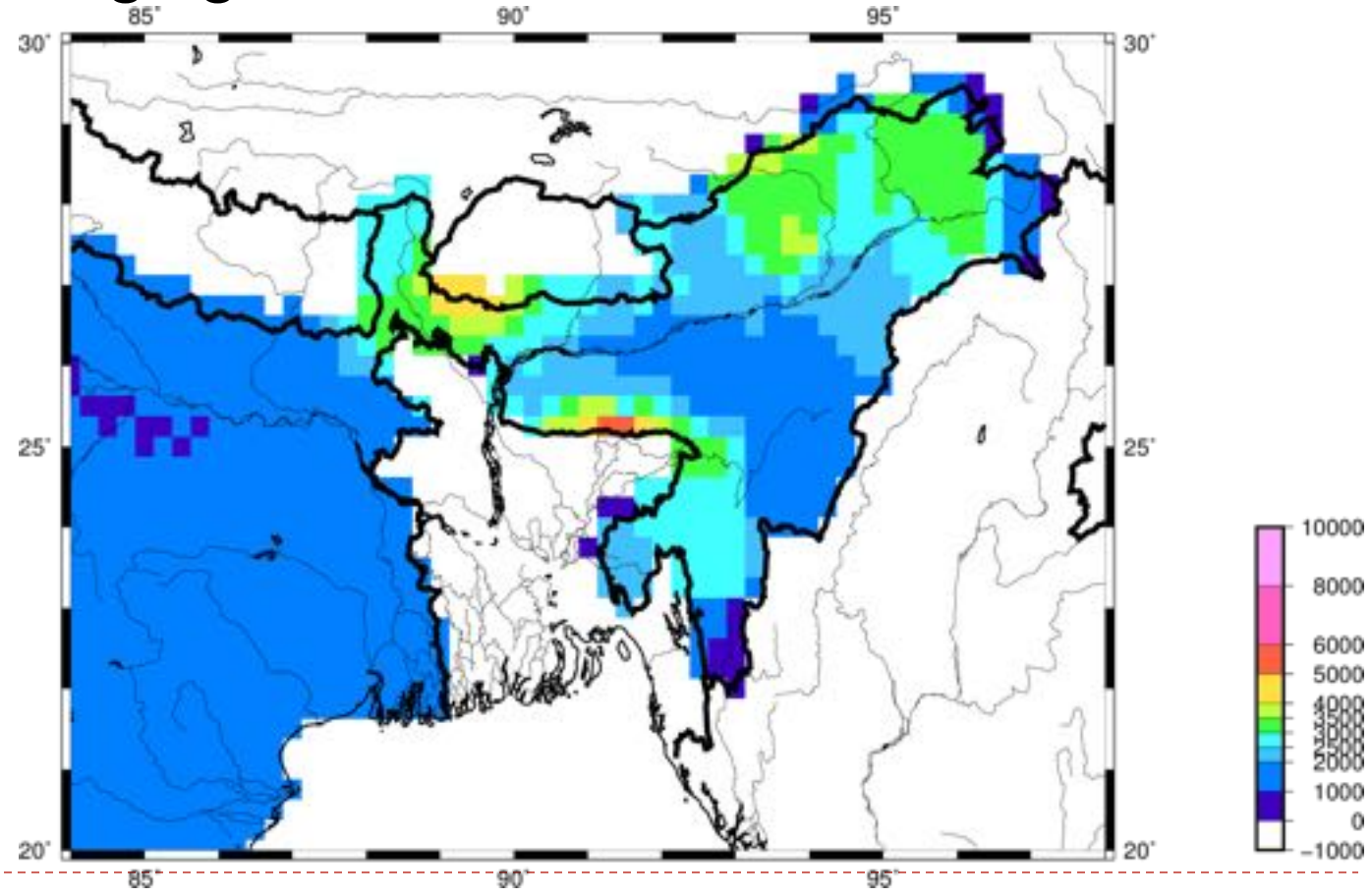


Future



Rainfall estimation

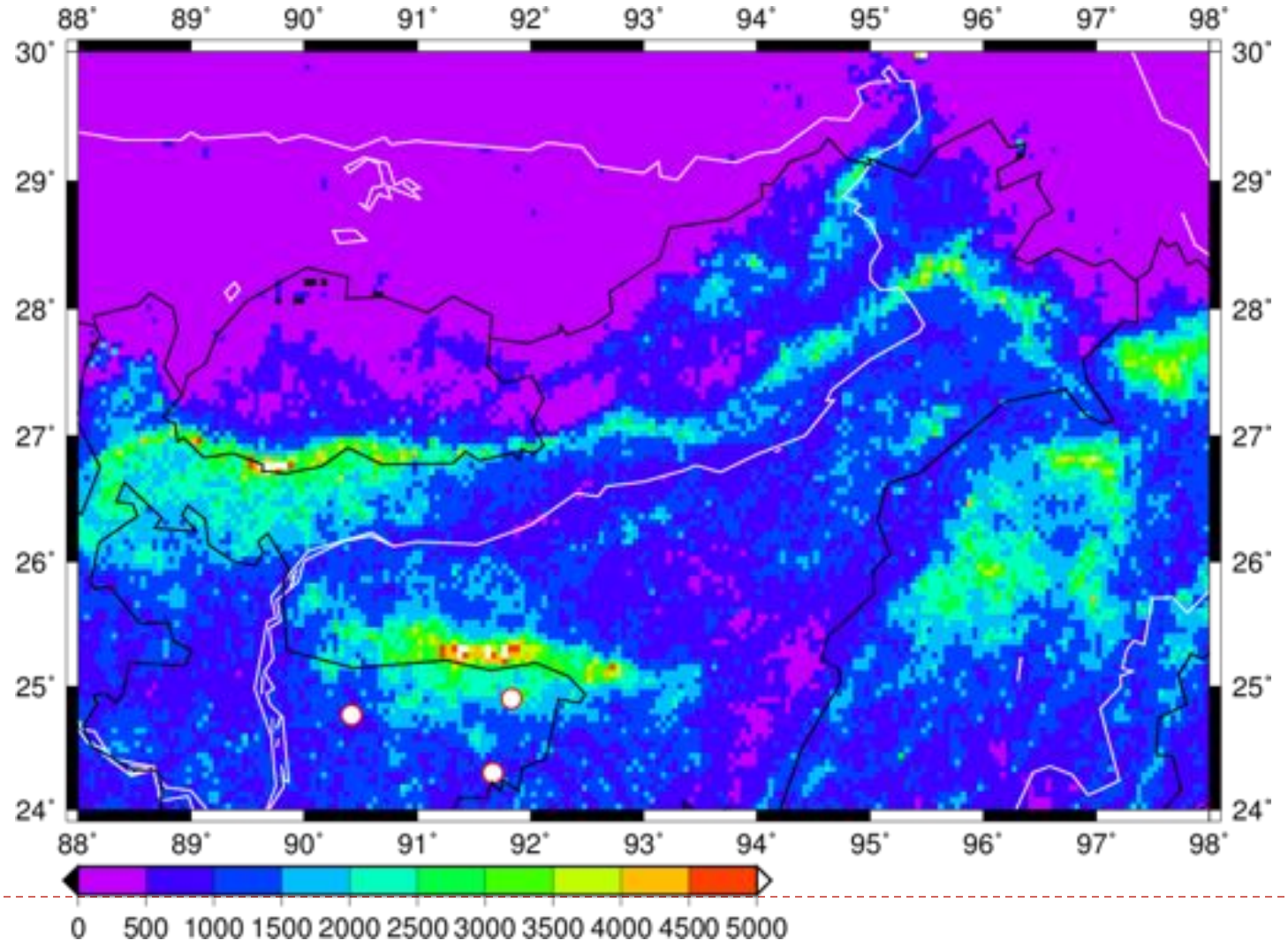
- IMD4 Gridded Rainfall (0.25deg x 0.25deg), 1901-
- Based on raingauge observations



1901-2013 ave

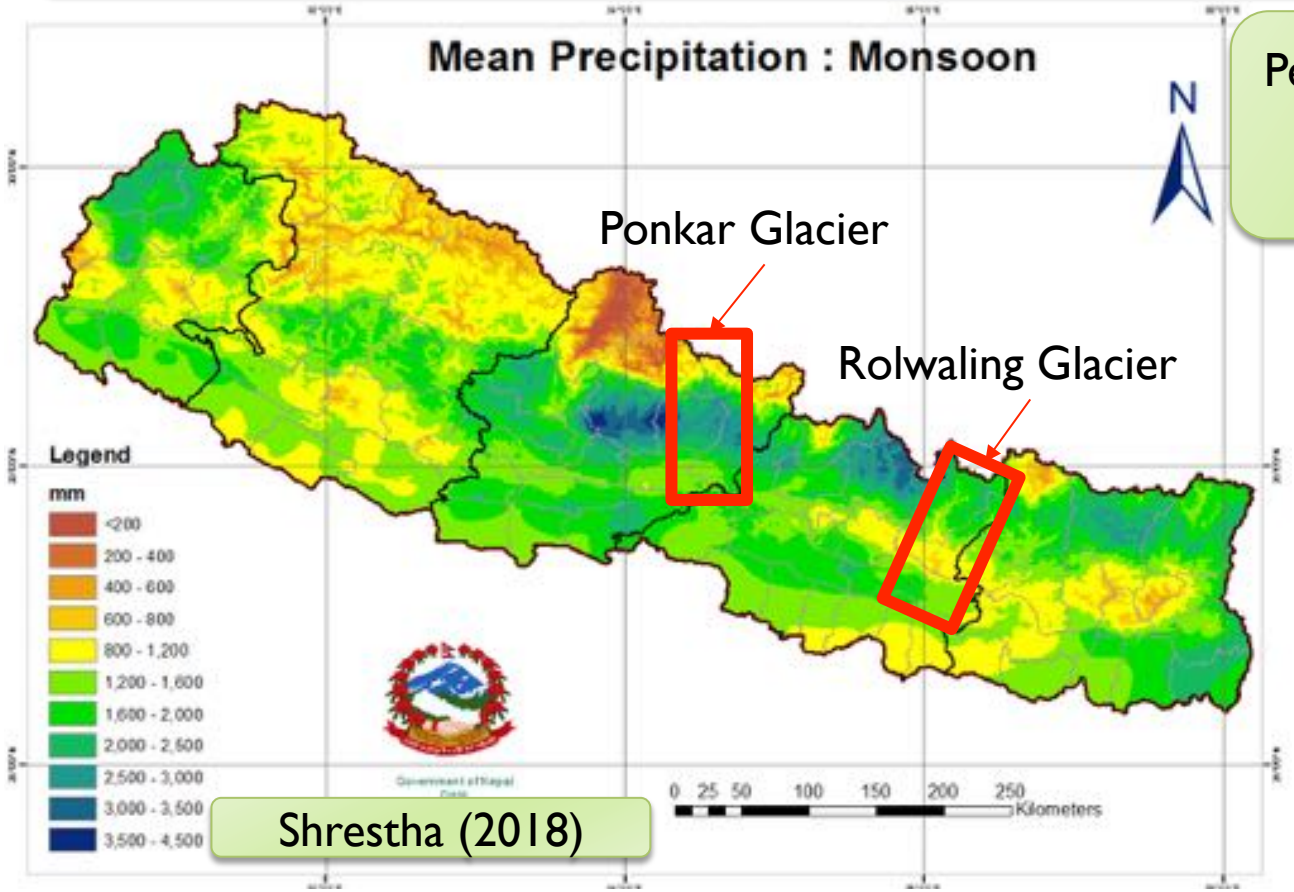
Monsoon TRMM NSR Climatology

1998-2011 Jun.-Sep.



New Project was Approved by JSPS

Mechanism of Rainfall Variability dur to Complex Topographhy and Large Scale Moist Atmospheric Flow over the Himalayan Range



Shrestha (2018)

Period: Oct. 2018-2021
PI: Dr. Fujinami
(Nagoya University)

RHP Criteria

- Central Science and Application Questions
- Contribution to
  - GEWEX Imperatives
  - important WCRP Grand Challenges
  - GEWEX Science Questions
- Coorination Mechanism (WGs/chairs)
- End Date and Exit Plan (In Chapter 2)
- Resources and personnel
- Mechanism for access to hydrometeorlogical data sets

GEWEX Science Imperatives

- Data Sets: Foster development of climate data records of atmosphere, water, land, and energy--related quantities, including metadata and uncertainty estimates.
- Analysis: Describe and analyze observed variations, trends, and extremes (such as heat waves, floods, and droughts) in water and energy--related quantities.
- Processes: Develop diagnostic approaches to improve process-level understanding of energy and water cycles in support of improved land and atmosphere models.
- Modeling: Improve global and regional simulations and predictions of precipitation, clouds, and land hydrology, and thus the entire climate system, through accelerated development of models of the land and atmosphere.
- Applications: Attribute causes of variability, trends, and extremes, and determine the predictability of energy and water cycles on global and regional bases in collaboration with the wider WCRP community.
- Transfer: Develop diagnostic tools and methods, new observations, models, data management, and other research products for multiple uses and transition to operational applications in partnership with climate and hydrometeorological service providers.
- Capacity Building: Promote and foster capacity building through the training of scientists and outreach to the user community.

WCRP Grand Challenges

- Melting Ice and Global Consequences
- Clouds, Circulation and Climate Sensitivity
- Carbon Feedbacks in the Climate System
- Weather and Climate Extremes
- Water for the Food Baskets of the World
- Regional Sea-Level Change and Coastal Impacts
- Near-term Climate Prediction

Next 5 to 10 years

GEWEX Science Questions (2013)

- Observations and Predictions of Precipitation:
  - How can we better understand and predict precipitation variability and changes?
- Global Water Resource Systems:
  - How do changes in land surface and hydrology influence past and future changes in water availability and security?
- Changes in Extremes:
  - How does a warming world affect climate extremes, esp. droughts, floods, and heat waves, and how do land area processes, in particular, contribute?
- Water and Energy Cycles and Processes:
  - How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

ありがとうございます！
Arigato- Gozaimasu!

Thank you very much!

Climate Change Research

- Data rescue toward 200 yrs under ACRE
- Trends in extremes and future prediction
- Mountain precipitation
  - High vulunerabilities
  - Already climate change impact appears

Mountain Rainfall (NE India)

- TRMM / IMD4 / d4pdf

Introduction to Post MAHASRI Science Plan

Objectives of the Post MAHASRI

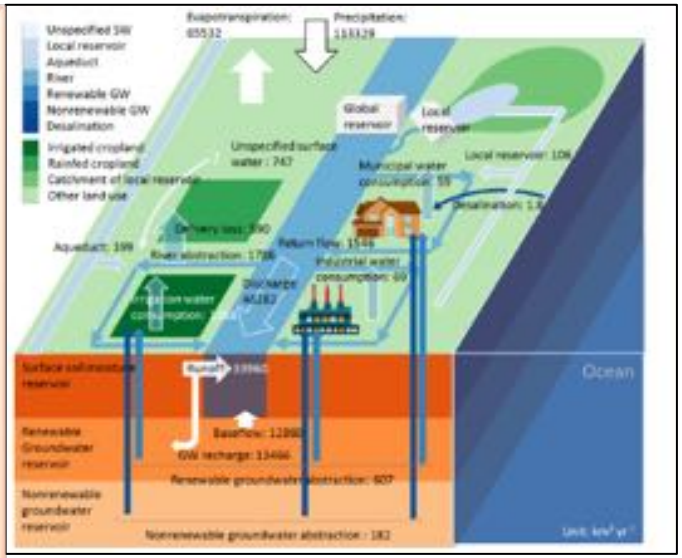
- General Objective
  - Understanding of Asian Land Precipitation over Diverse Hydroclimatological Conditions: For Better Prediction, Disaster Reduction and Sustainable Development.

Introduction to Post MAHASRI

- Why Asian land precipitation?
  - Huge population / climate change / disasters / human life / food basket depend on Asian land precipitation
- What is major unknowns to be solved?
  1. Insufficient representation of climate models
  2. Impact of human water withdrawal
  3. Land surface-planetary boundary layer impact on convection
  4. Precipitation prediction in S2S to interdecadal scales
  5. Highland precipitation and hydrological processes
  6. Evaluation and prediction of extremes
  7. Change of precipitation during recent 200 years

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

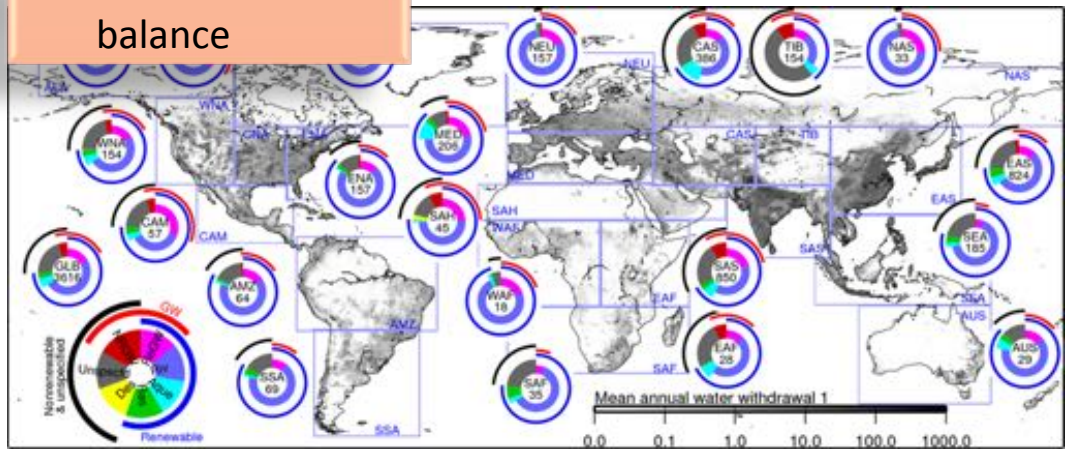
1. Groundwater recharge
2. Groundwater abstraction
3. Aqueduct water transfer
4. Local reservoirs
5. Seawater desalination
6. Return flow and delivery loss
7. Surface water balance



(Hanasaki et al. 2017, HESSD)

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)

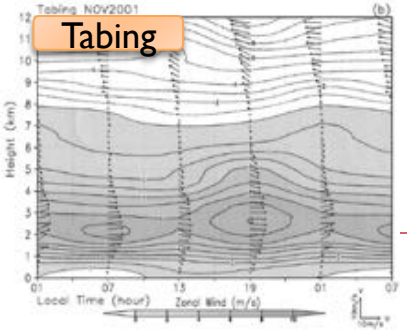
Validation and improvement by using various sources of information in Asia (e.g., satellite data, local data, assimilation?)

Scientific Approaches

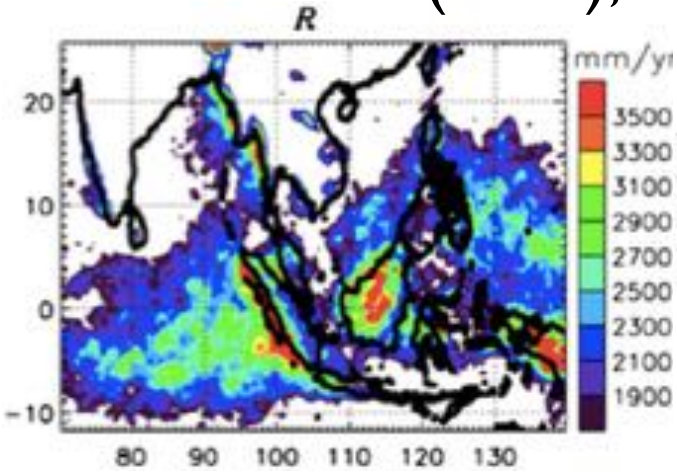
- To Understand Asian Monsoon Land Precipitation,
  1. Observation and Estimation of Variation and Extremes in Asian Land Precipitation and Important Variables
  2. Process Studies of Asian Land Precipitation Focusing on Diverse Land-Atmosphere Interactions
  3. Understanding and Prediction of Variability of Asian Monsoon from Subseasonal to Interdecadal Time Scales
  4. High Resolution Land Surface Hydrological Modeling and Monitoring Incorporating Impacts of Human Water Withdrawal, Agriculture, Vegetation and Cryosphere
  5. Coordinated Observation and Modeling Initiatives
  6. Detection and Projection of the Climate Change Impact on Regional Precipitation in the Asian Monsoon Region

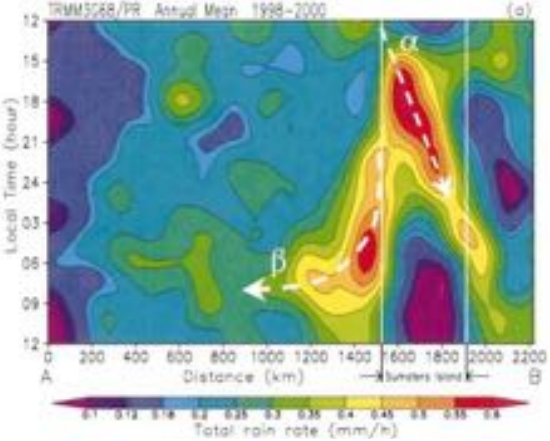
Approach I

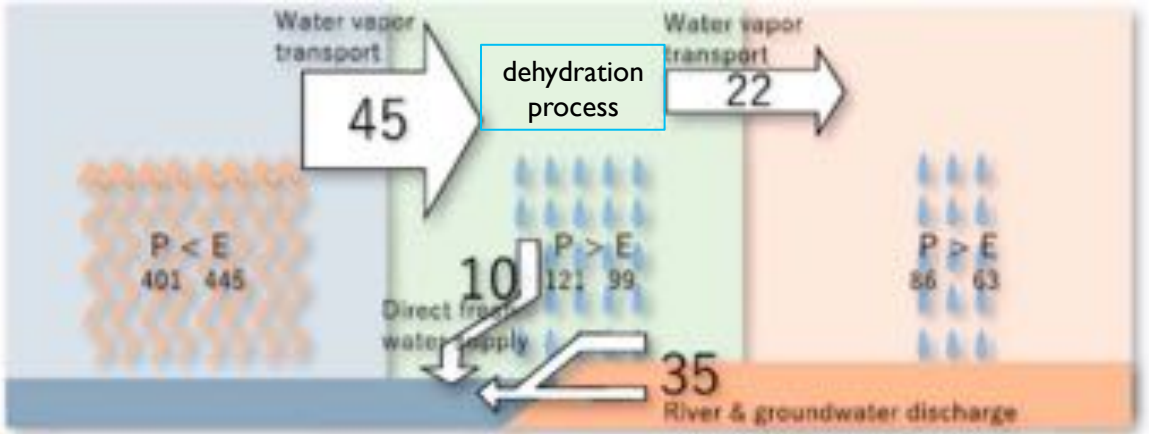
Coast Line and Water Budget

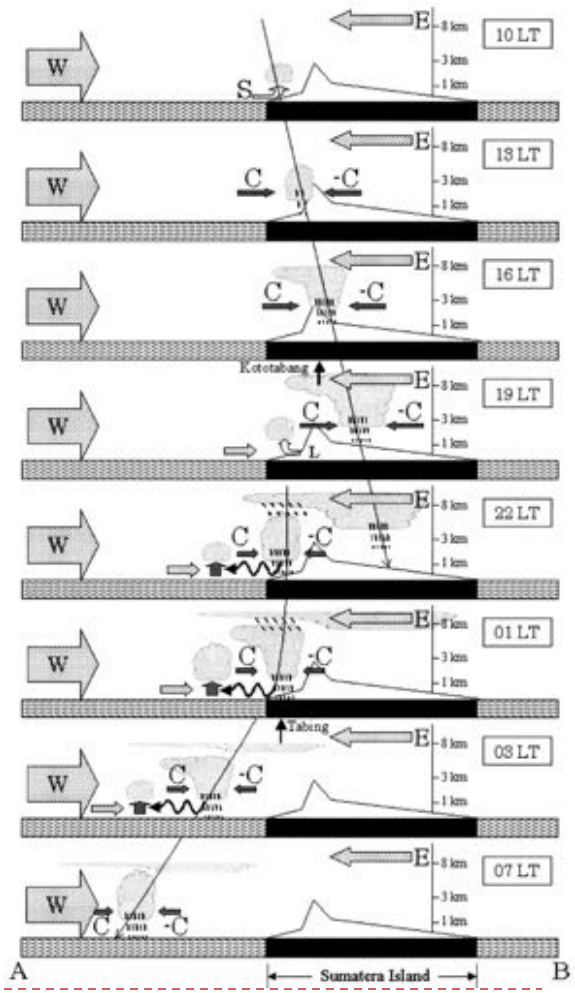


- Mori et al. (2004), Ogino et al. (2016, 2017)









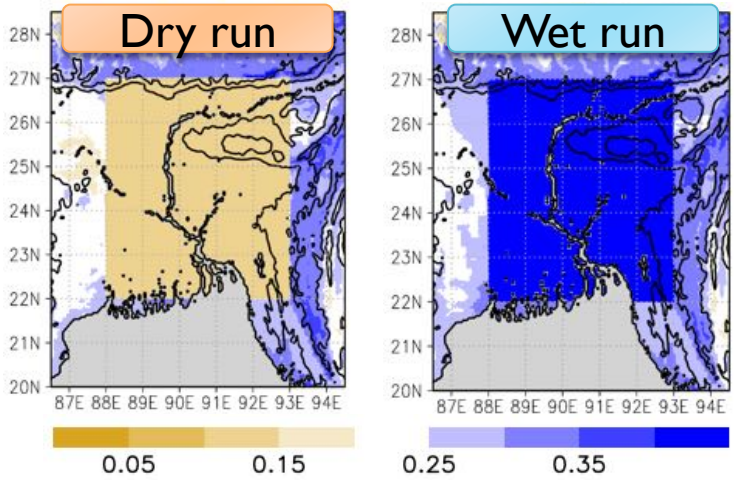
open ocean coastal region inland

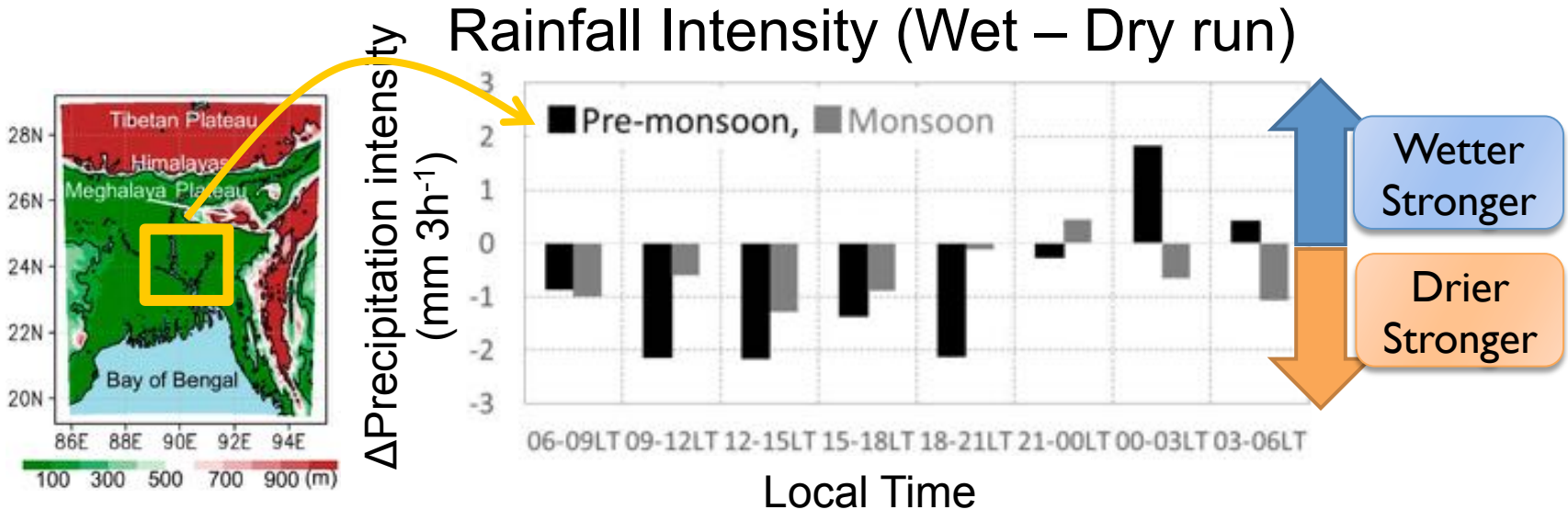
Approach 2

Soil moi Impacts of Scientific Understanding precipitation

- Impacts of Land Surface on Diurnally Varying Precipitation in Bangladesh Monsoon and Pre-monsoon Seasons

Sugimoto and Takahashi (2017)

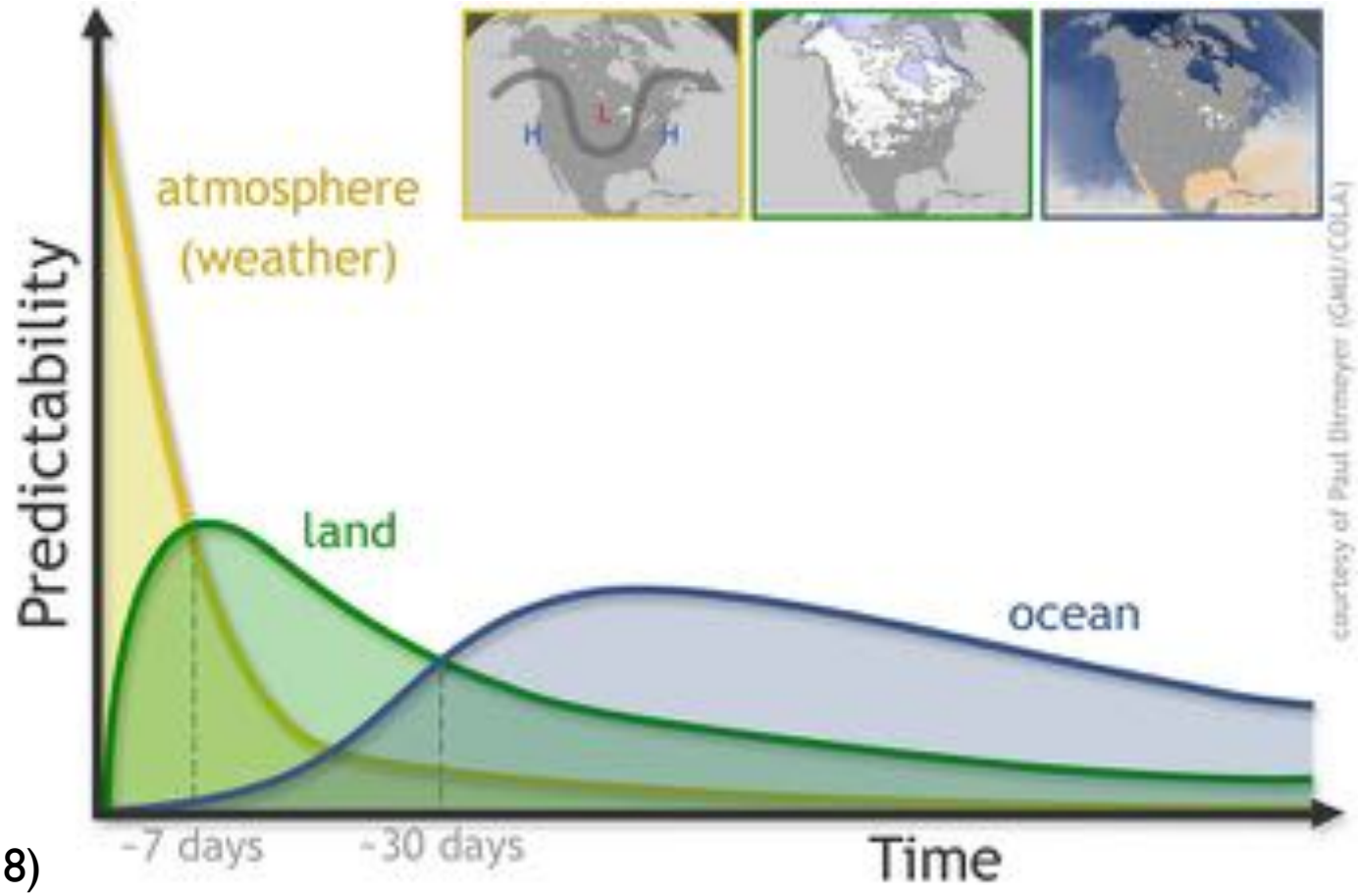




Approach 3

S2S Predictability and Land Surface

- Role of Land Surface for Predictability at different Time Scales



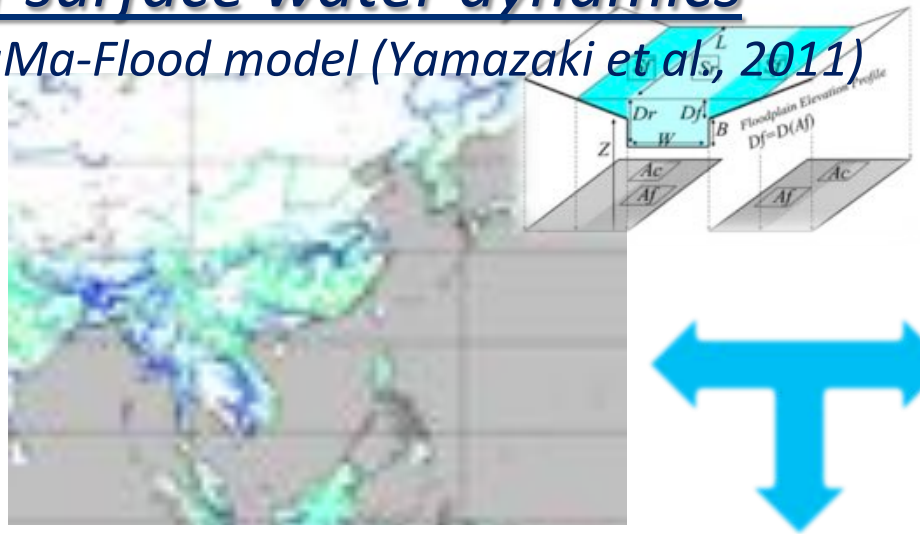
Mariotti et al (2018)

Approach 4

Integration of satellite observations and model simulations for exploring surface water dynamics

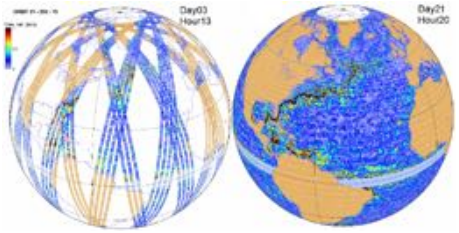
Very high resolution modeling of surface water dynamics

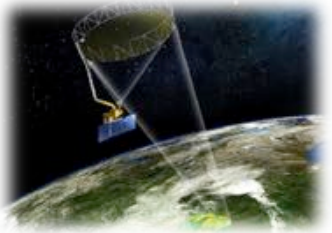
CaMa-Flood model (Yamazaki et al., 2011)



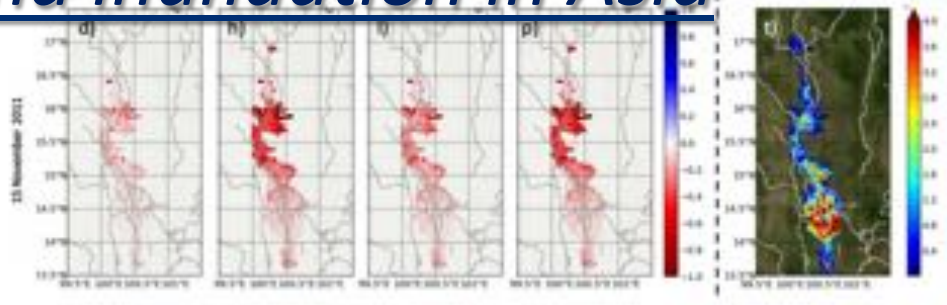
Altimeter, Microwave

SWOT, SMAP, GCOM etc.





Assimilation and Prediction of flooding and inundation in Asia



Overarching Science Questions

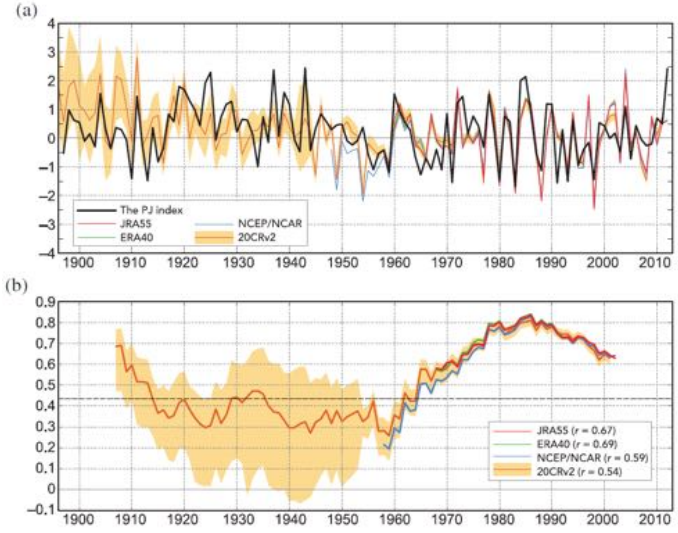
10yr

- What is the convincing climate model representations of Asian monsoon precipitation that can support policymakers to plan useful adaptation strategy for the changing climate?
- What is the possible coordinated observation initiative that advances our understanding of the Asian monsoon precipitation?
- To what extent can we use up rescued hydrometeorological data to reconstruct recent 200-year climate change?
- How can we find new scientific methods to describe, and to share information with Asian people, of the extreme weather embedded in multiple time scales in Asian monsoon hydroclimate?
- What is the role of mountain precipitation and subsequent land water process in the local and global hydrological cycles and water resources?

Question 3

Impact of historical data rescue

- Kubota et al. (2016)
  - PJ (P-J pattern) index from 1897 to 2013 was developed by use of historical station-based pressure data in Philippine, Taiwan and Japan, and compared with reanalyses (JRA55, ERA40, 20CRv2 and NCEP/NCAR.
  - PJ-ENSO correlation was found to change in interdecadal time scale.



Question 4

Extremes

- Unprecedently severe hydrometeorological disasters took place in West-Japan, Kerala, Laos
  - Daily rainfall is not enough to describe the extreme
  - People's perception on extreme may have to be updated
  - We can develop new method to describe, and to share information with people, the concept of Extreme in multiple time scales

Question 5

Mountain precipitation

- Many questions:
  - How glacier increases/decreases?
  - What is distribution and variation of montain precipitation?
  - Impacts of climate change appears earlier?
  - Glacier lakes?
- Scientific interest
  - Topographic impact on convective systems
  - Impact of Tibetan Plateau on global circulation
- Expected outcomes
  - Improved precipitation griddata in Asiatic mountain area
  - Reliable estimation of net reduction of glacier

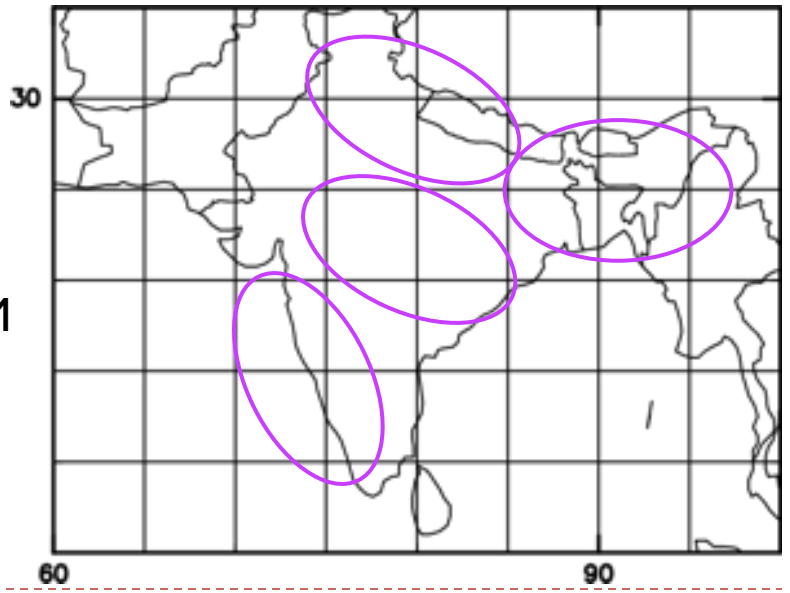
AMY-II (2020) in Post MAHASRI Project

- RADAR data exchange for 60-day (May-July) period
  - A sweet 'experience' of borderless radar data exchange
- Field Campaign covering the same period
  - Soil moisture observation (Remote sensing + ground truth)
  - Intensified R-S observations
  - Special instruments
    - wind profiler, micro rain radar, disdrometers
  - GPS-Precipitable Water measurement network
  - Surface Flux observation network
- Modelling and remote sensing
  - Impact study / Ex. Soil moisture impact on S2S predictability
- Possible outcomes by 2023? -> Later half of PMP

AMY-II(2020) South Asian Project

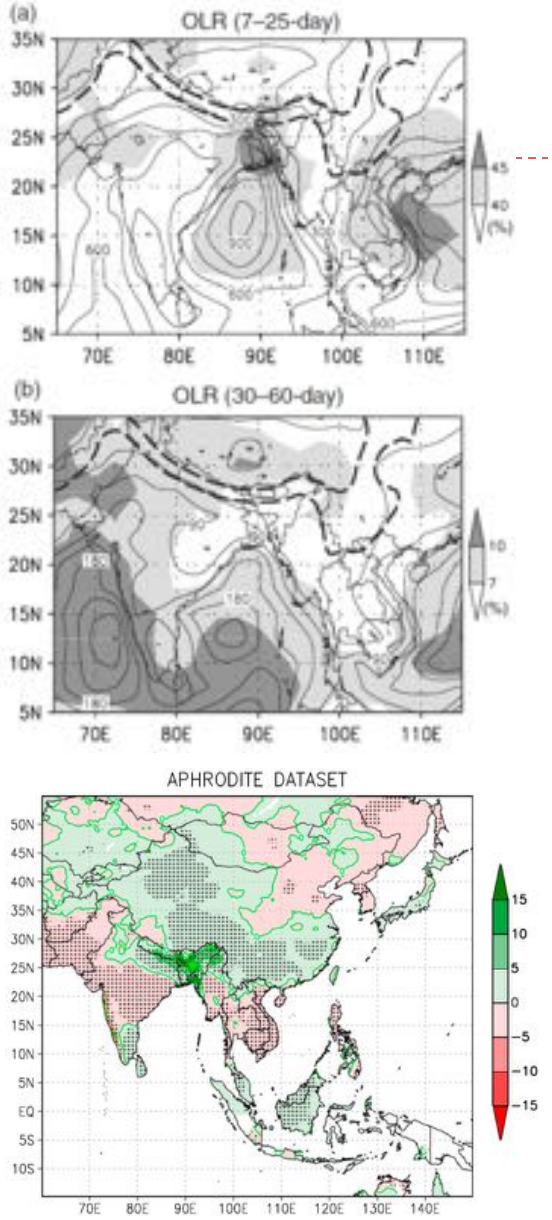
- Focusing on Four Components in the Indian Subcontinent
  - Northeast, Northwest, Central India, Western Ghats
  - Different roles during seasonal transition and ISV?
    - Transition from pre-monsoon to monsoon and in A/B cycle
      - Different process in Northwest and Northeast and relathionship
      - Role in monsoon onset of Northeast severe local storms in premonsoon
      - Role of central India for onset
    - International Collaboration
      - Northeast-> Japan group
      - Northwest-> CURAJ
      - Central India, Western Ghats-> IITM
    - Modelling? / RADAR?

convection difference



Active/Break cycle

- Different frequency range
  - Fujinami et al. (2011)
  - Northeast/OLR, North/U: QBW
  - 30-60day variability in other area
- Correlation in A/B cycle
  - Murata et al. (2017)
  - Correlation with NE Rain
    - Negative in Central India and Western Ghats
    - Positive? in Northwestern India
- Interactive framework
  - LS-BL-Convection-UTLS



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

Time Table for Science Plan

- The 8th GEWEX Science Conference (6-11 May 2018 @Canmore Canada)
- JpGU 2018, Post MAHASRI session (20 May 2018 @Makuhari Chiba)

Drafting / Work Groups 0-6

- Post MAHASRI Science Plan Core Workshop (Oct. 2018)
- GHP/Andex Workshop (Oct. 2018)
- Science Plan Ver. 1.0 (Dec. 2018)

Propose new RHP

- GEWEX SSG Meeting (25 Sep.-1 Mar. 2019)

Approval as new RHP

Introduction to Post MAHASRI

- Why Asian land precipitation?
  - Huge population / climate change / disasters / human life / food basket are depend on Asian land precipitation
  - Huge unknown --- Science is needed
    - Insufficient representation of monsoon prec. in climate models
    - Impact of human water withdrawal
    - Land surface impact on precipitation
    - Precipitation prediction in S2S to interdecadal scales
    - Highland precipitation
- Inconsistencies in the Understanding of Asian monsoon
  - Huge land-sea breeze system or migrated ITCZ?
    - Key process: Land surface process / convection
  - Multiple time scales and diverse land impact on the atmosphere

Introduction to Post MAHASRI

- Why Asian land precipitation?
  - Huge population / climate change / disasters / human life / food basket are depend on Asian land precipitation
  - Huge unknown --- Science is needed
    - Insufficient representation of monsoon prec. in climate models
    - Impact of human water withdrawal
    - Land surface impact on precipitation
    - Precipitation prediction in S2S to interdecadal scales
    - Highland precipitation
- Inconsistencies in the Understanding of Asian monsoon
  - Huge land-sea breeze system or migrated ITCZ?
    - Key process: Land surface process / convection
  - Multiple time scales and diverse land impact on the atmosphere

- We cannot even reproduce current Asian climate and precipitation using climage models.
- For the policymakers including people, convincing result of climate models are needed.
- We cannot go further without advancement of scientific understanding of hydrometeorological processes.
- What can we do during upcoming 10 years?
  - Concrete individual research plan for scientific approaches

    ⇒ 6 Approaches
  - Croscutting questions that lead entire research project

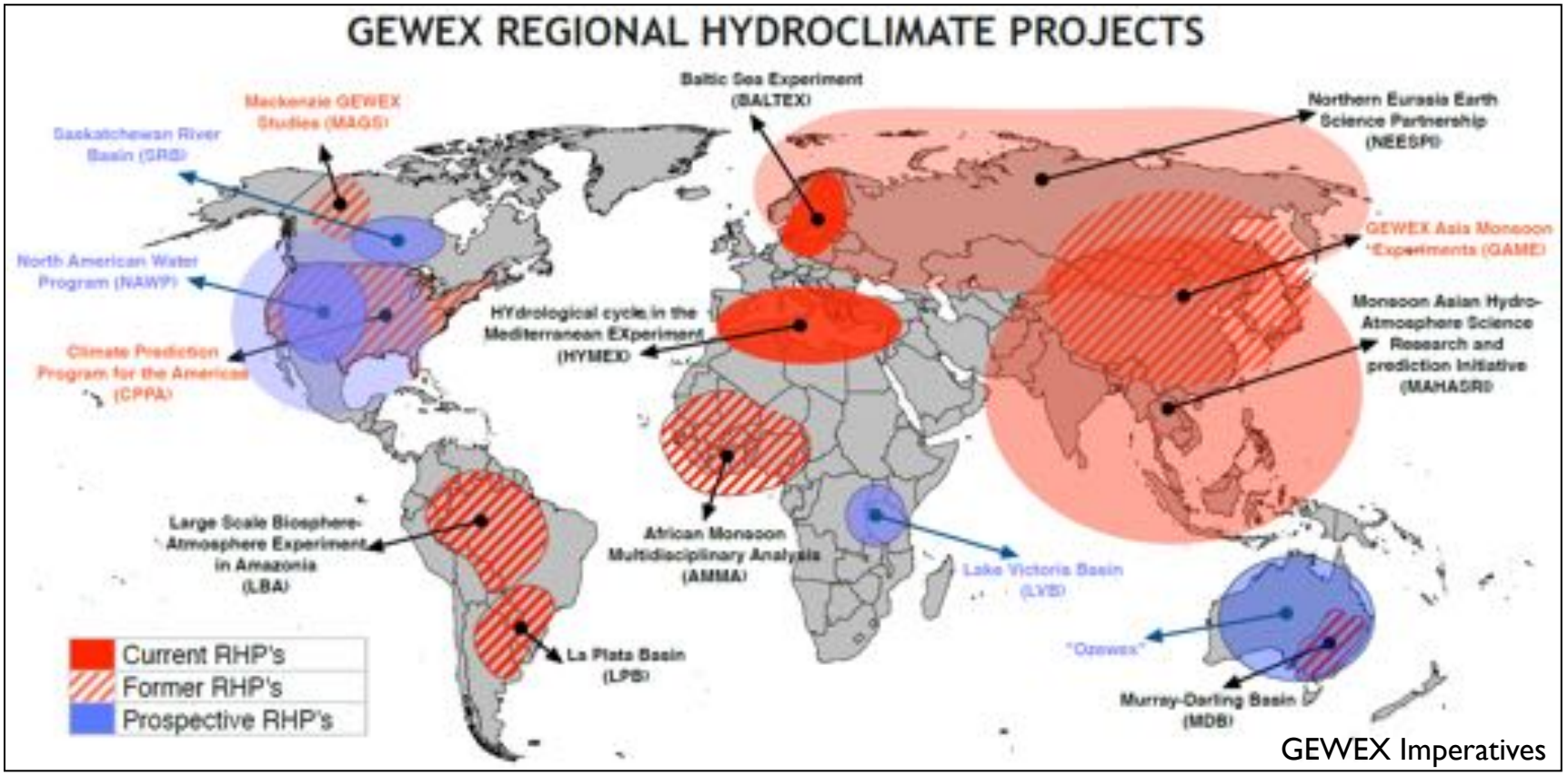
    ⇒ 5 Questions

History of Asian monsoon RHPs

- Pre-GAME
- WCRP / GEWEX / GHP / RHP Framework
- GAME / Focus and outcome
- MAHASRI / Focus:
  - Outcome
    - Rainfall data (gauge based gridded datasets, GPM validation, historical)
    - High-resolution hydrological modeling
    - Process studies
    - Autumn/winter monsoon, monsoon onset/withdrawal
    - AMY and Collaboration and capacity building in Asian countries
- It is the time to launch post MAHASRI!

RHP's in Monsoon Asia

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



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, Mongolia, Vietnam, Philippines, India, Bangladesh, …

Overview of MAHASRI

Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative(2006-2015)

http://mahasri.cr.chibau.ac.jp/

"To establish hydro-meteorological prediction system, particularly up to seasonal time-scale, through better scientific understanding of Asian monsoon variability".

Jun Matsumoto

Department of Geography, Tokyo Metropolitan University, JAMSTEC/ DCOP

International Science Conference on MAHASRI , March 2, 2016
at Tokyo Metropolitan University, Japan

Objectives:

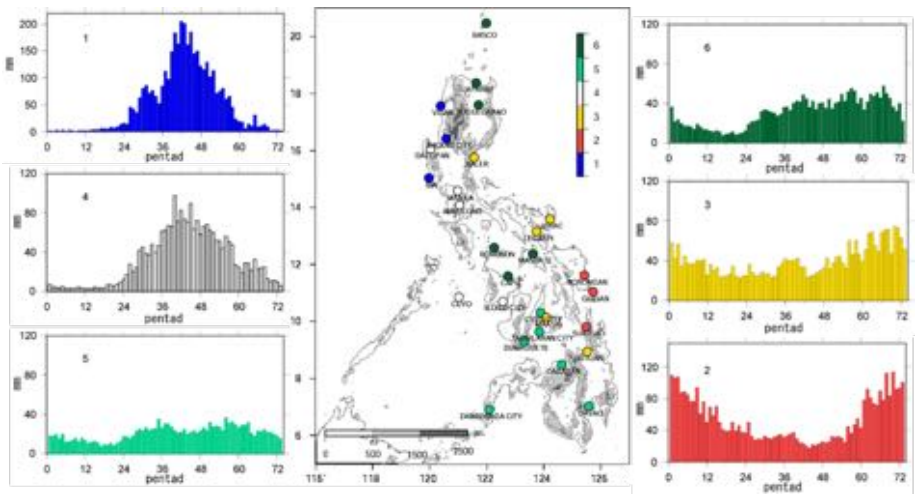
- Determining the predictability and key components of Asian monsoon variability with a time scale up to a season for the development of a hydro-meteorological prediction system.
- Developing a real-time monitoring capability for hydro-meteorological observations.
- Developing an integrated hydro-meteorological database including data rescue.
- Examining and improving the hydro-meteorological models in some specific river basins.

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. Rainfall data collection and satellite validation was developed including data rescue.
5. Collaboration with AMY community.
   - Integrated Database (DIAS) in the Univ. Tokyo
   - AMY Re-analysis by MRI (Meteorological Research Institute)

Diverse monsoon season

Monsoon onset / withdrawal of Philippine and their interannual variability



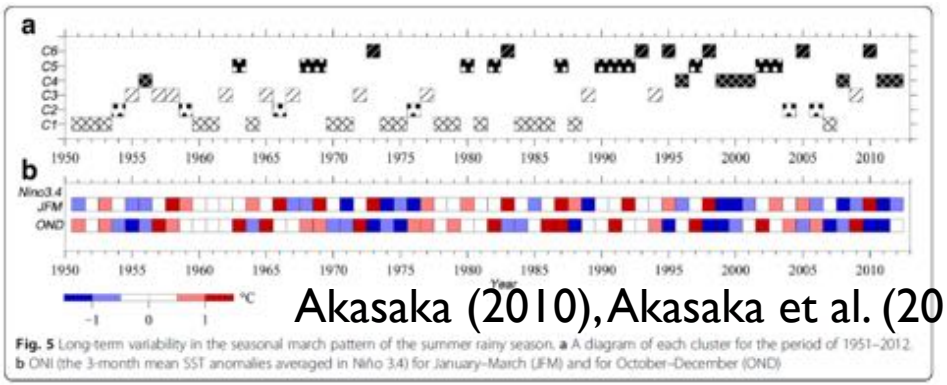
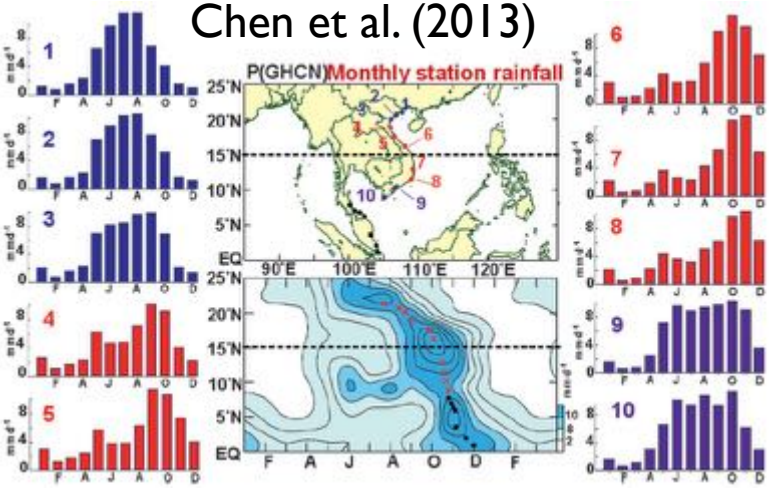


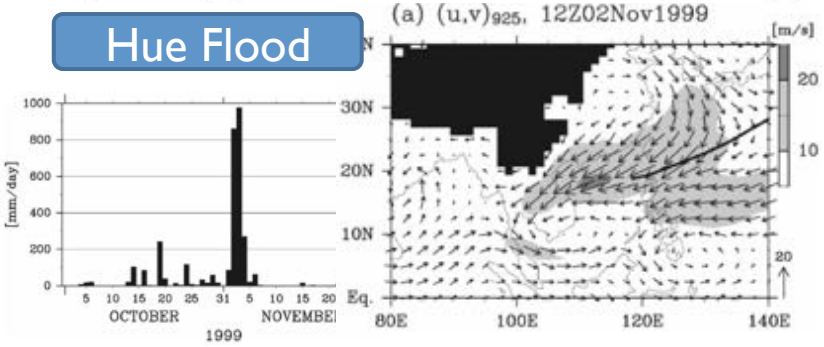
Fig. 5 Long-term variability in the seasonal march pattern of the summer rainy season. **a** A diagram of each cluster for the period of 1951–2012. **b** ONI (the 3-month mean SST anomalies averaged in Niño 3.4) for January–March (JFM) and for October–December (OND)

Akasaka (2010), Akasaka et al. (2018)

Chen et al. (2013)



Hue Flood



Yokoi and Matsumoto (2008)

Autumn / winter monsoon in Vietnam

Objectives of the Post MAHASRI

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

What is scientific understanding?

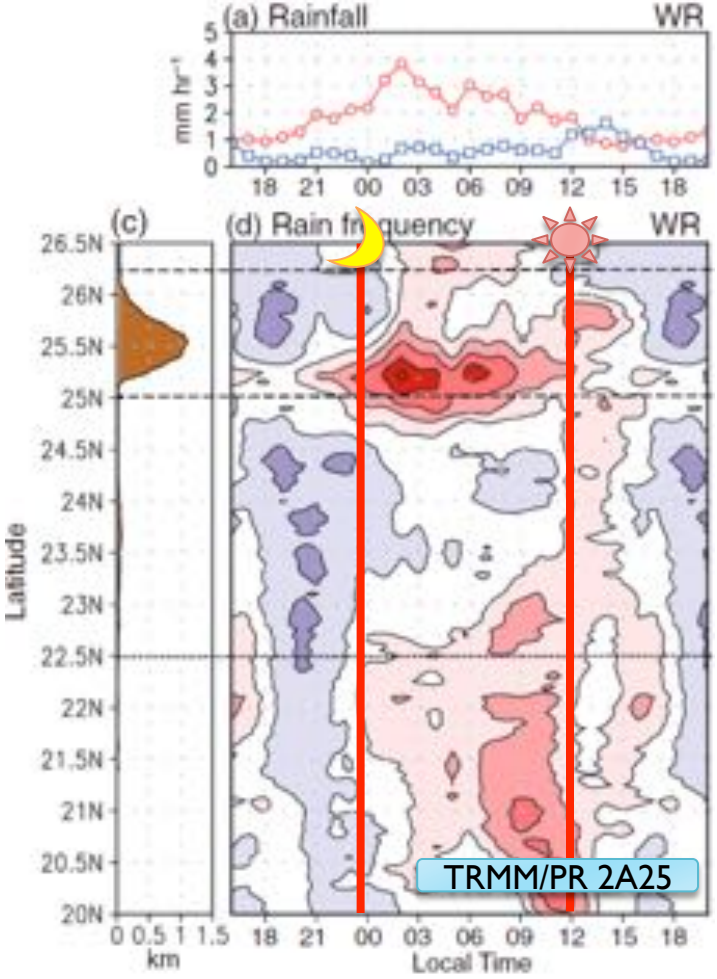
Rainfall data and satellite validation

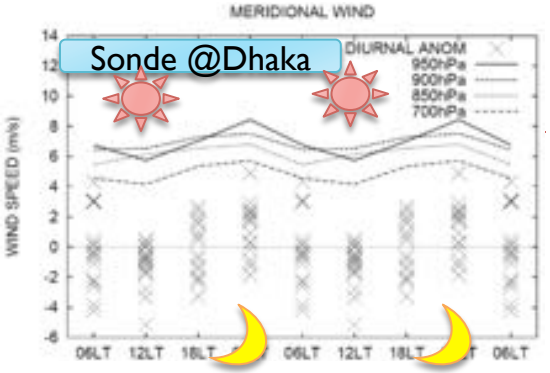
- Observation and gauge-based gridded data
  - Vietnam/0.1degs (VnGP)
  - Lowlands of Thailand/0.05degs
- Satellite (GPM) validation
  - Many validation works
  - Uncertainties in orogiraphic precipitation estimations
- Historical data reconstruction (under ACRE)

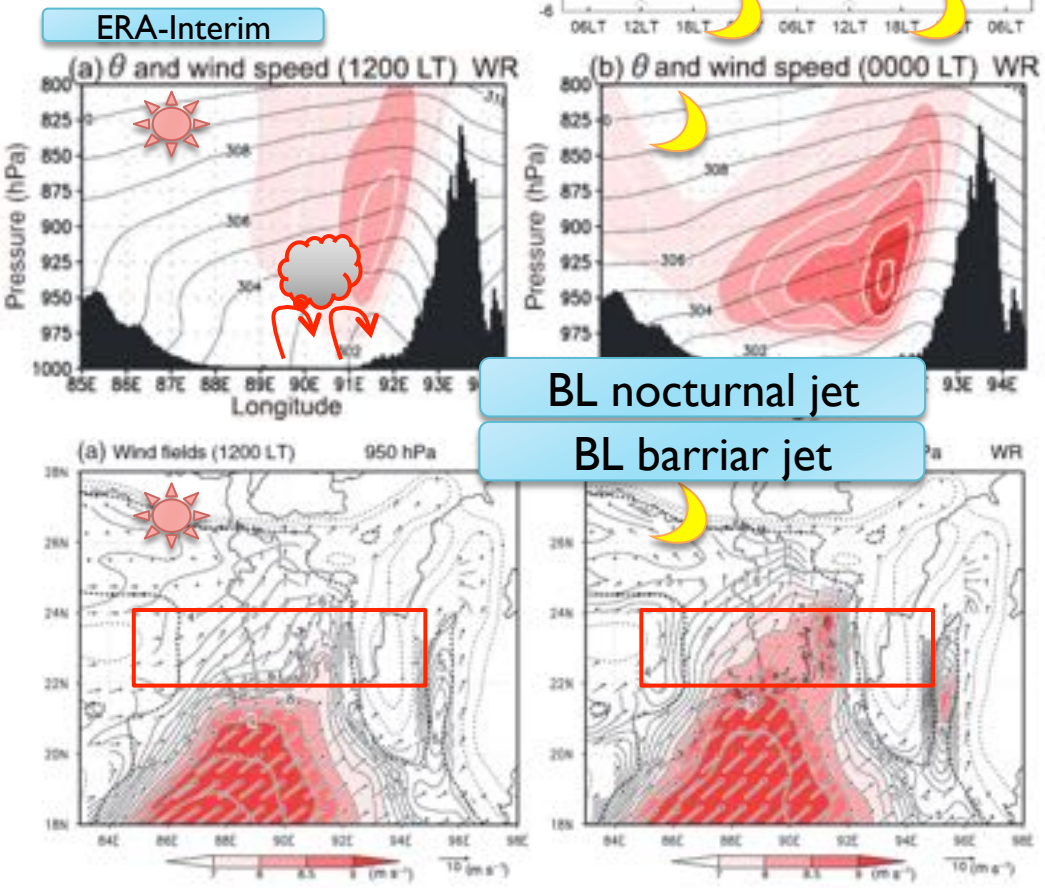
Impacts of Scientific Understanding

Nocturnal LLJ

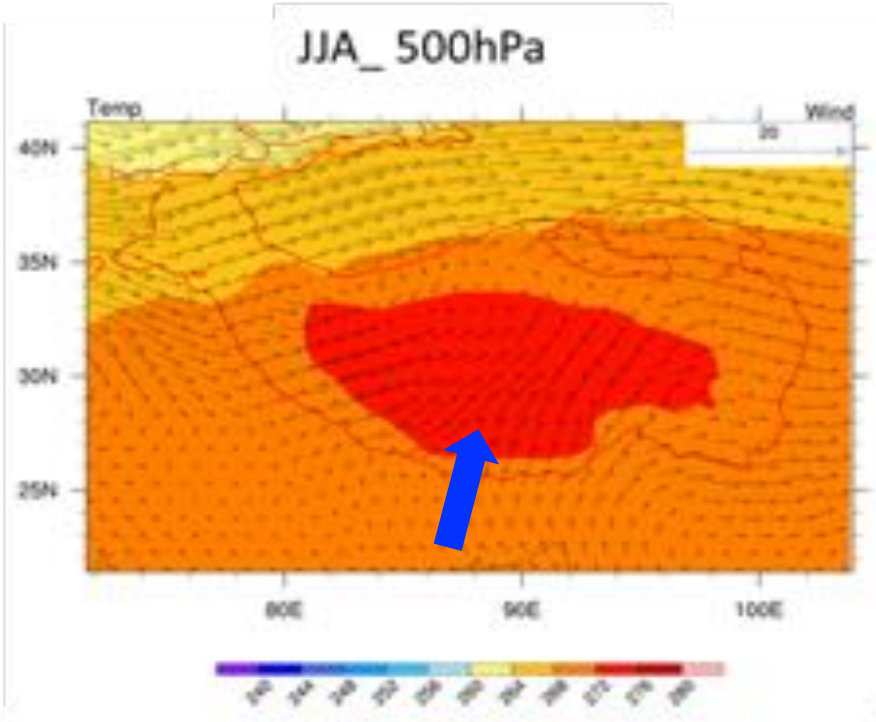
- Fujinami et al. (2017), Terao et al. (2006)

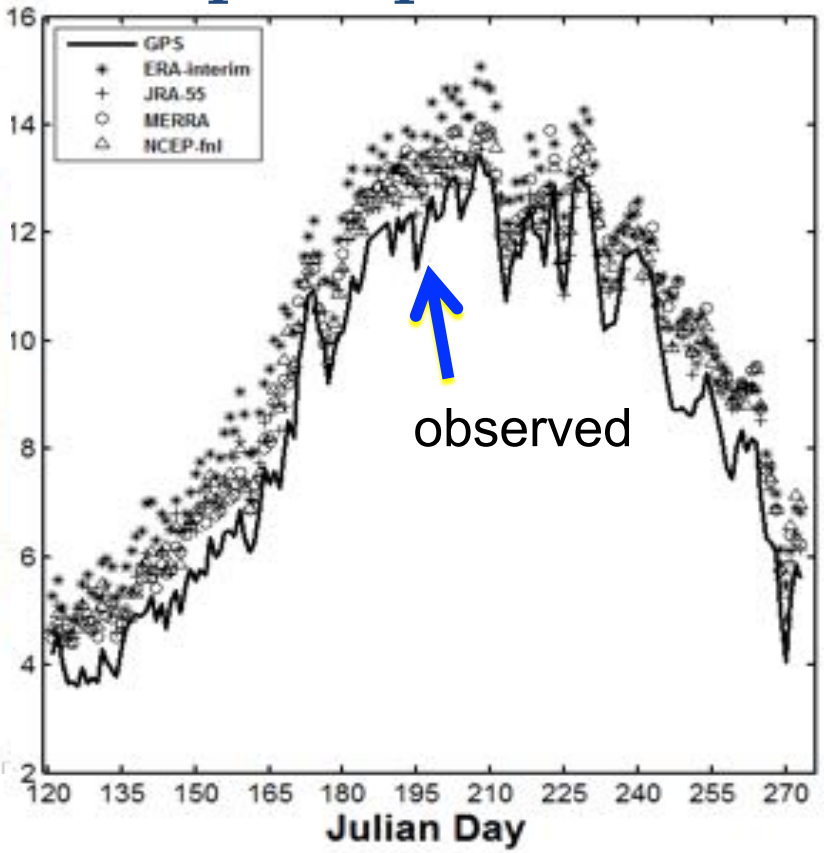






All models over-estimated precipitable water



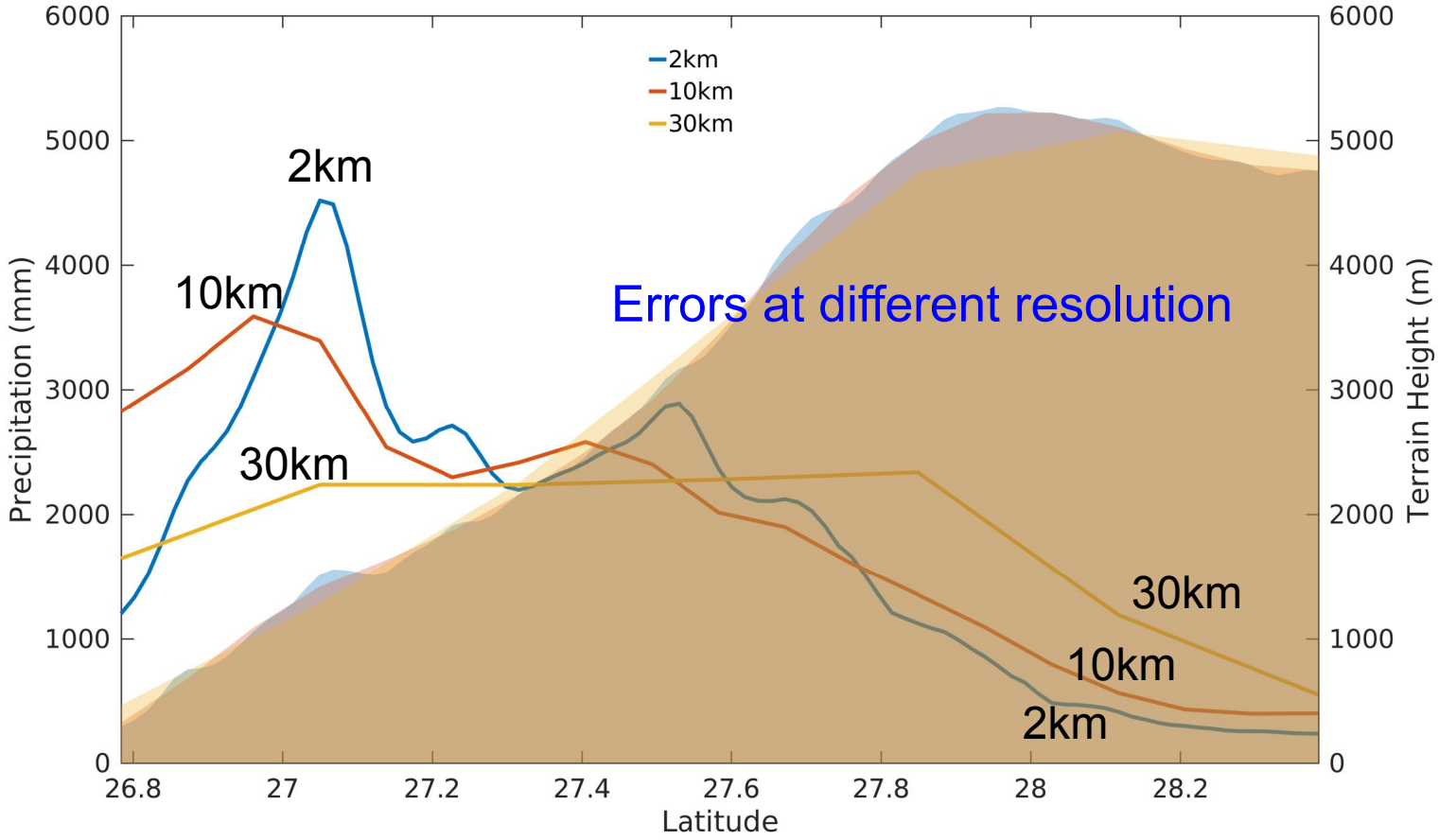


Seasonal cycle between observation and reanalyses, averaged at 9 GPS stations during 2007~2013

(Wang, Yang et al., 2017, JC)

Impacts of Scientific Understanding

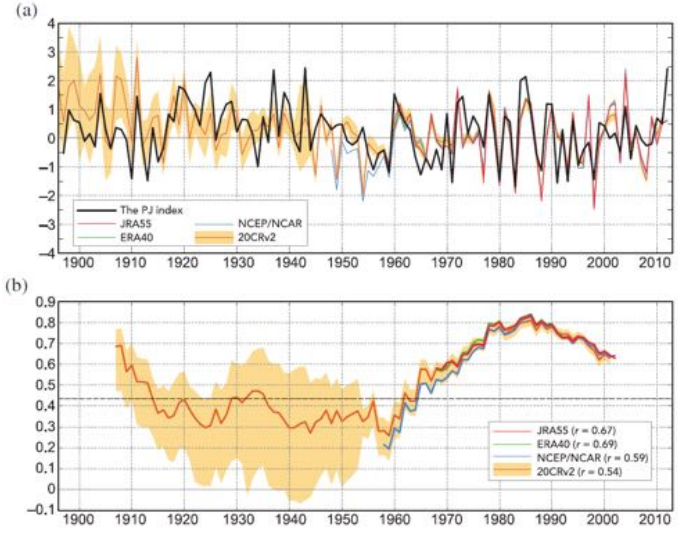
Positive biases in vapor flux results in much more precipitation in the Plateau and less in south slope



Newly emarging sceince waves

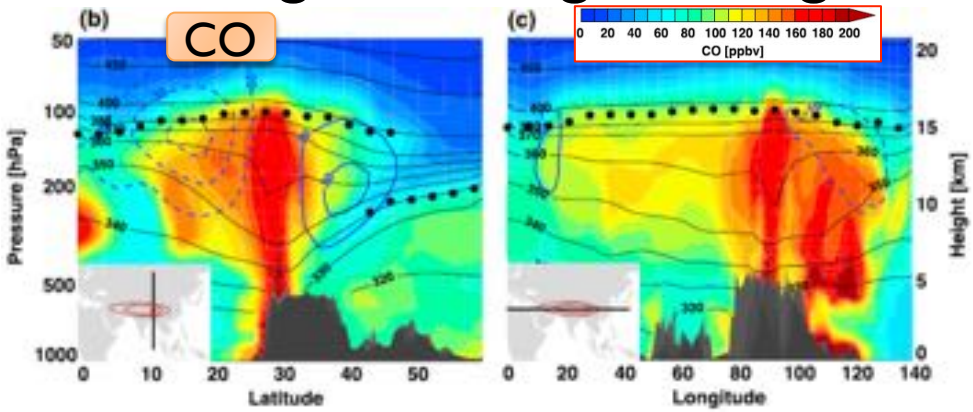
Impact of historical data rescue

- Kubota et al. (2016)
  - PJ (P-J pattern) index from 1897 to 2013 was developed by use of historical station-based pressure data in Philippine, Taiwan and Japan, and compared with reanalyses (JRA55, ERA40, 20CRv2 and NCEP/NCAR.
  - PJ-ENSO correlation was found to change in interdecadal time scale.



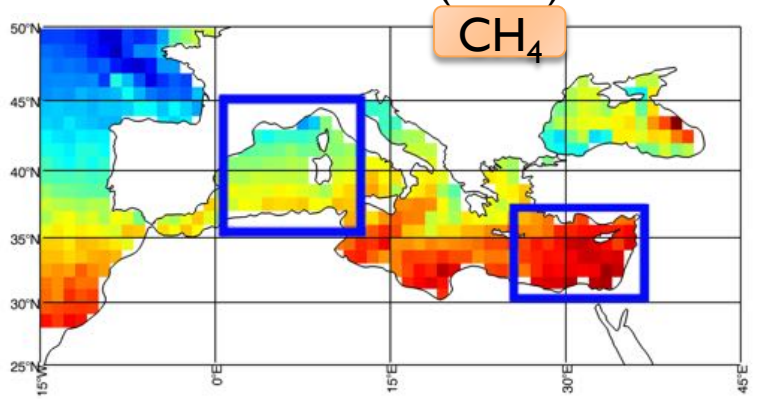
Boundary Layer -> Tropopause (UTLS)

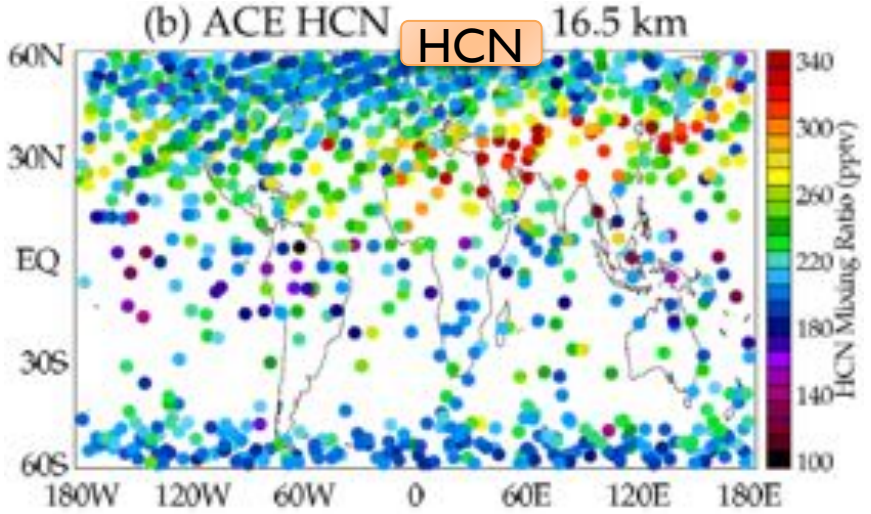
- Investigated using tracer gas



Pan et al. (2016)

Ricaud et al. (2014)





Park et al. (2008)

Science Strategies

- Impacts of Diversed Land Surface: Topography, Cryosphere, Vegetation, Land Use and Coast Lines on Diurnally Varying Precipitation Process in Multiple Time Scales from Sub-seasonal to Climate Change
- Hydrological Modeling which Incorporates Human Water Withdrawal and Impacts of Agricultural Activity and Biosphere in Monsoon Asia
- Targeted and Integrated Observation Projects Coordinated with New Generation High Resolution Dataset, Modeling, Radar Network, and Satellites / Coordinated Regional Process Studies
- Playing a Key Role in S2S (Sub-seasonal to Seasonal) Prediction Project
- Data Rescue for 200-Year Climate Change Detection: with ACRE
- Regional Climate Projection and Dynamic and Statistical Downscaling Collaborating with Modeling Community including CORDEX

Applications

- SDGs
- Disaster
- Food
- Environment
- Health

Scientific Approaches

- To Understand Asian Monsoon Land Precipitation,
  1. Observation and Estimation of Variation and Extremes in Asian Land Precipitation and Important Variables
  2. Process Studies of Asian Land Precipitation Focusing on Diverse Land-Atmosphere Interactions
  3. Understanding and Prediction of Variability of Asian Monsoon from Subseasonal to Interdecadal Time Scales
  4. High Resolution Land Surface Hydrological Modeling and Monitoring Incorporating Impacts of Human Water Withdrawal, Agriculture, Vegetation and Cryosphere
  5. Coordinated Observation and Modeling Initiatives
  6. Detection and Projection of the Climate Change Impact on Regional Precipitation in the Asian Monsoon Region

Science Questions

10yr

- What is the convincing climate model representations of Asian monsoon precipitation that can support policymakers to plan useful adaptation strategy for the changing climate?
- What is the possible coordinated observation initiative that advances our understanding of the Asian monsoon precipitation?
- To what extent can we use up rescued hydrometeorological data to reconstruct recent 200-year climate change?
- How can we find new scientific methods to describe, and to share information with Asian people, of the extreme weather embedded in multiple time scales in Asian monsoon hydroclimate?
- What is the role of mountain precipitation and subsequent land water process in the local and global hydrological cycles and water resources?

Q1: Climate models

- Asian Land Precipitation is controlled by
  - multiple scale meteorological disturbances interacting each other (MISO, BSISO, QBW, WD, TD, SilkRoad, IOD, ENSO, Diurnal, ...)
  - land surface impact on the atmosphere through the planetary boundary layer (Soil Moisture, Land Surface Flux, BL, Convection, UTLS process, ...)
- We will test huge amount of climate projections (many MIPS, CORDEX, S2S database, d4pdf, ...) to check if
  - they can reproduce multiple scale meteorological disturbances in their model results
  - they can express impact of land surface properly
- For example:
  - http://cola.gmu.edu/dirmeyer/

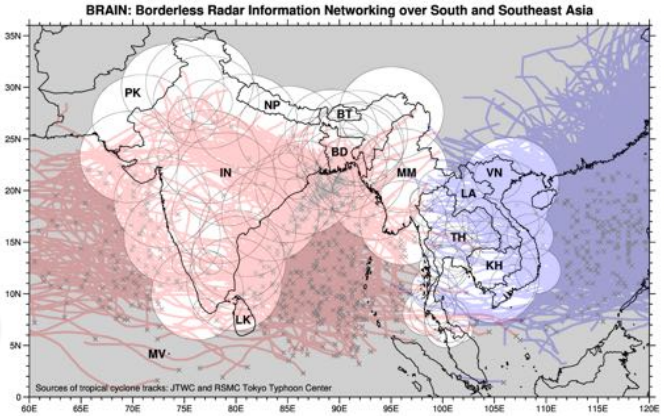
5yr

we will make it appealing single slide

Q2: Observation Initiatives

- Focus:
  - Construction of the BRAIN (Borderless Radar Information Network) within 10-year project period

10yr



- AMY-II (2020)
  - Sharing radar data among many Asian meteorological agencies during core observation period (May-July / 60days)
  - Coordinated observations
    - Pilot areas
    - Intensive R-S, PBL tower, Soil Moisture, Wind profiler, GPS-PW network, ...

2yr

Feacibility test of radar network

- Utilized for model validation

5yr

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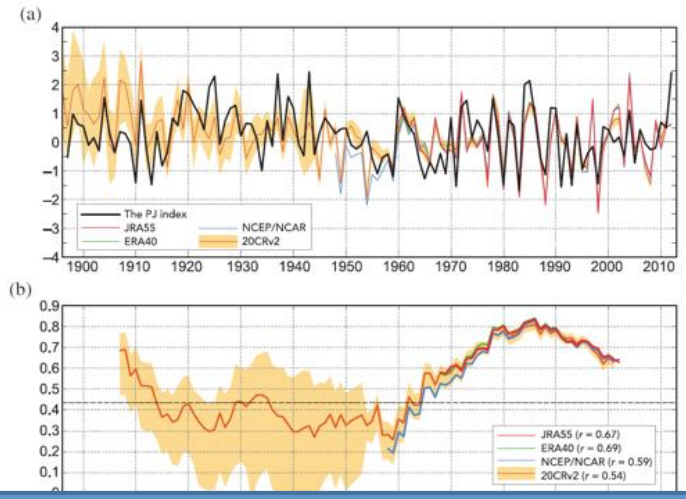
Q3: Rescued dataset

- Innovation on methodology to use up rescued data
  - knowledge of climate systems and processes
  - 20-century reanalysis projects
  - activities for further data rescue
- 200yr Climate Reconstruction

10yr



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Q4: Extremes

- Unprecedently severe hydrometeorological disasters took place in West-Japan, Kerala, Laos
  - Daily rainfall is not enough to describe the extreme
  - People's perception on extreme may have to be updated
  - We can develop new method to describe, and to share information with people, the concept of Extreme in multiple time scales

we will make it appealing single slide

Q5: Mountain precipitation

- Many questions:
  - How glacier increases/decreases?
  - What is distribution and variation of montain precipitation?
  - Impacts of climate change appears earlier/
  - Glacier lakes?
- Scientific interest
  - Topographic impact on convective systems
  - Impact of Tibetan Plateau on global circulation
- Expected outcomes
  - Improved precipitation griddata in Asiatic mountain area
  - Reliable estimation of net reduction of glacier

we will make it appealing single slide

South Asian Component of Asian Mosoon Year (AMY)-II

Section 3

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
CEOP
JAMEX
JEPP/NE India,
JEPP/SE Asia
JEPP/Thai
TMD
TCS08
JAMSTEC/PALAU
AIPO, JEPP IO/HARIMAU, CPEA
JAMSTEC/TRITON Buoy

What can we observe in AMY-II?

- RADAR data exchange for 60day period
  - Intensive continuous observation in Bangladesh?
- Field Campaign
  - Soil moisture observation (Remote sensing + ground truth)
  - Intensified R-S observations
  - Special instruments
    - wind profiler, micro rain radar, disdrometers
  - GPS-Precipitable Water measurement network
  - Surface Flux observation network
  - ...
- Modelling and remote sensing
- Possible outcomes by 2023?

Message

- We are launching new hydroclimatological research initiative on Asian monsoon under GEWEX/GHP. It will be approved in GEWEX/SSG in Feb-Mar 2019.
- We tentatively concluded five major Scientific Questions: Climate Models, Coordinate Observations, Data Rescue, Extremes, and Mountain Precipitation
- AMY-II is planned in 2020. We will promote people to conduct AMY-II jointly.
- For South Asian monsoon area, we proposing a framework based on the concept of interaction of four major regional hydroclimate systems: Northeast, Northwest, Central India, and Western Ghats.

ありがとうございます！
Arigato- Gozaimasu!

Thank you very much!

1 Precipitation Estimation

2 Process studies

3 Understanding and Prediction S2S<=

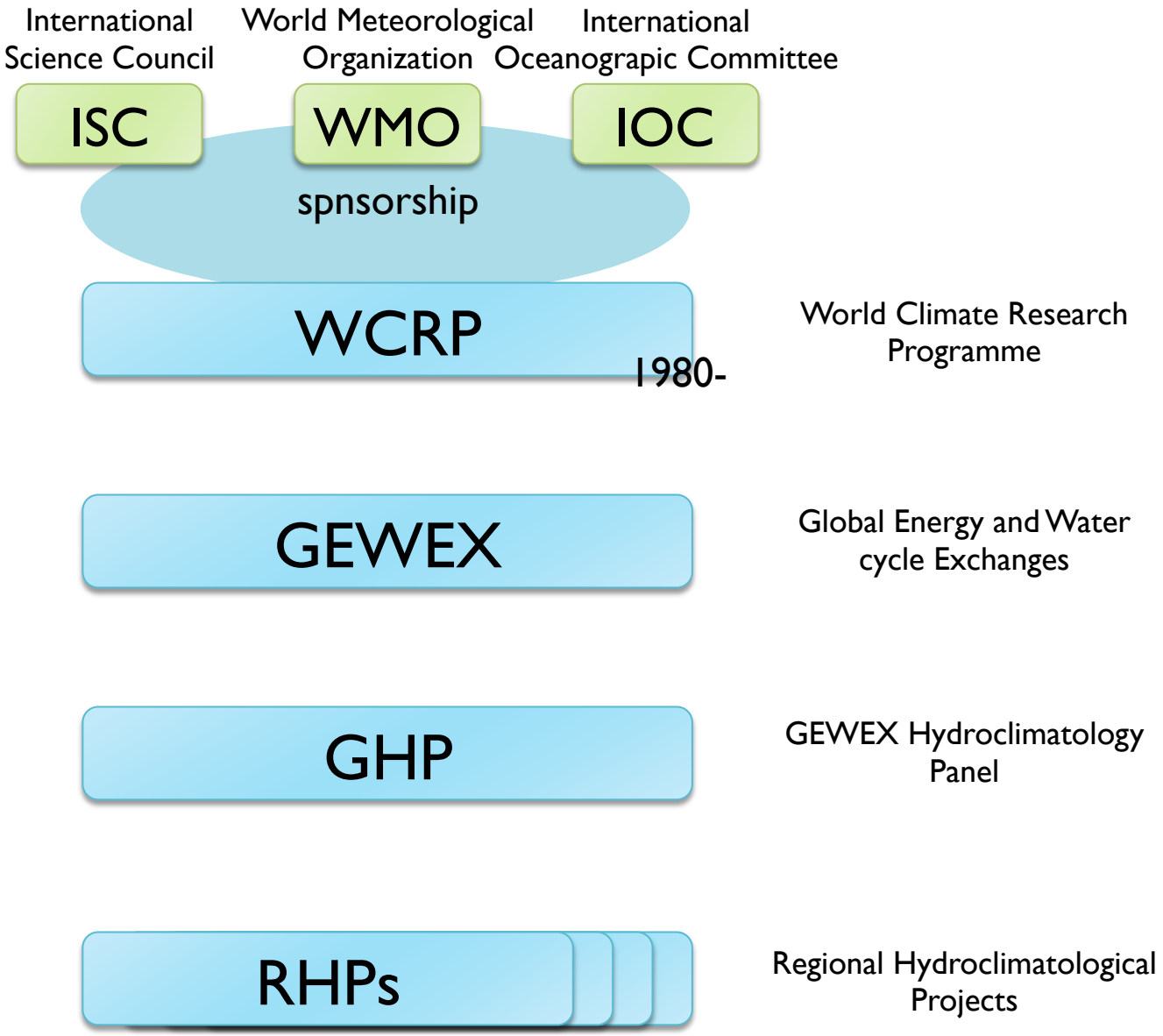
5 Integrated Observation

6 What is Reliable Climate Projection

- What can we do for that!?

What is RHP (Regional Hydroclimatological Project)?

Section 1


International Science Council
World Meteorological Organization
International Oceanograpic Committee
ISC
WMO
IOC
spnsorship
WCRP
1980-
World Climate Research Programme
GEWEX
Global Energy and Water cycle Exchanges
GHP
GEWEX Hydroclimatology Panel
RHPs
Regional Hydroclimatological Projects

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

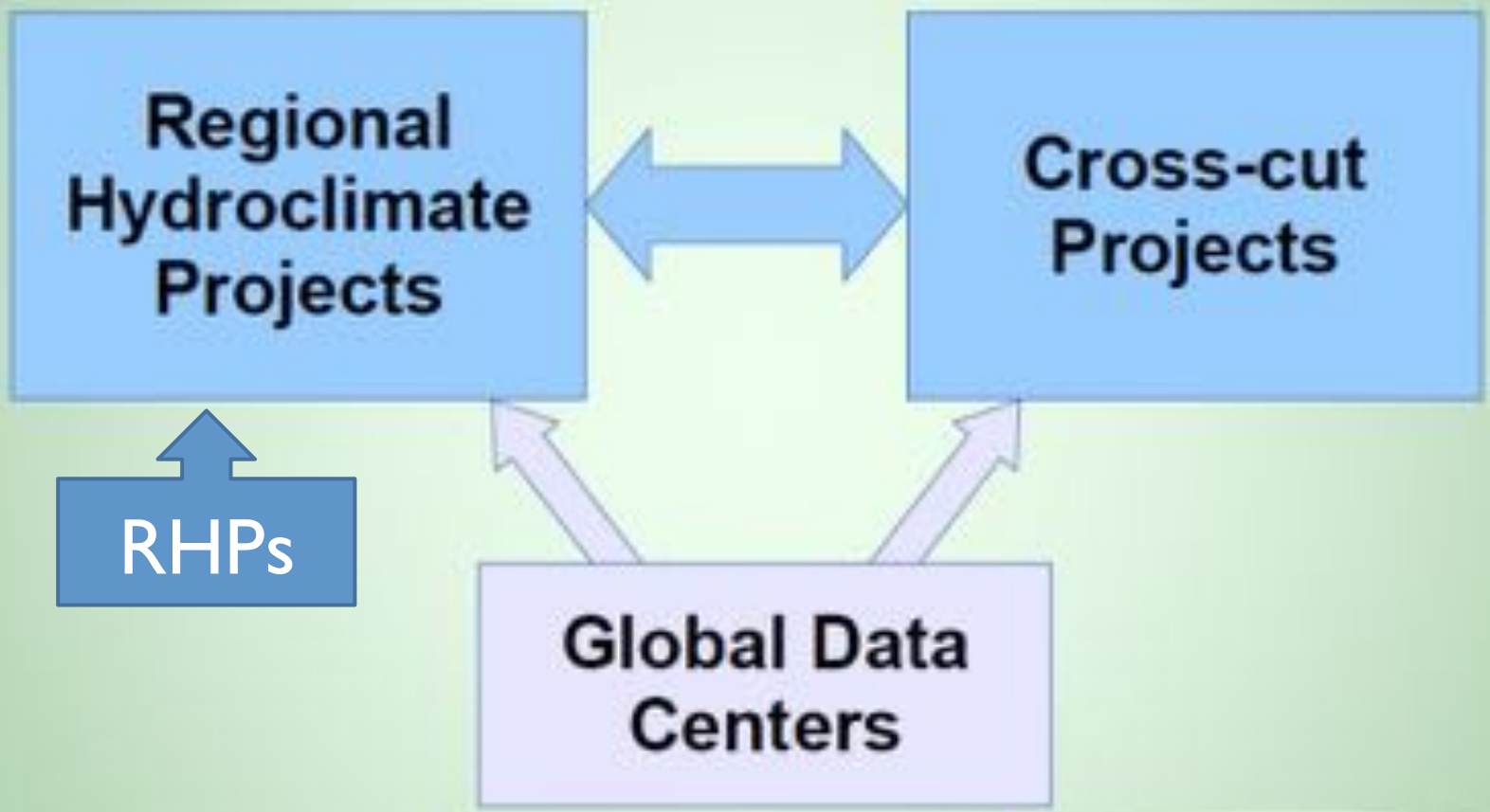
In discussion:

Exploring possibilities
in the Americas and Asia.

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

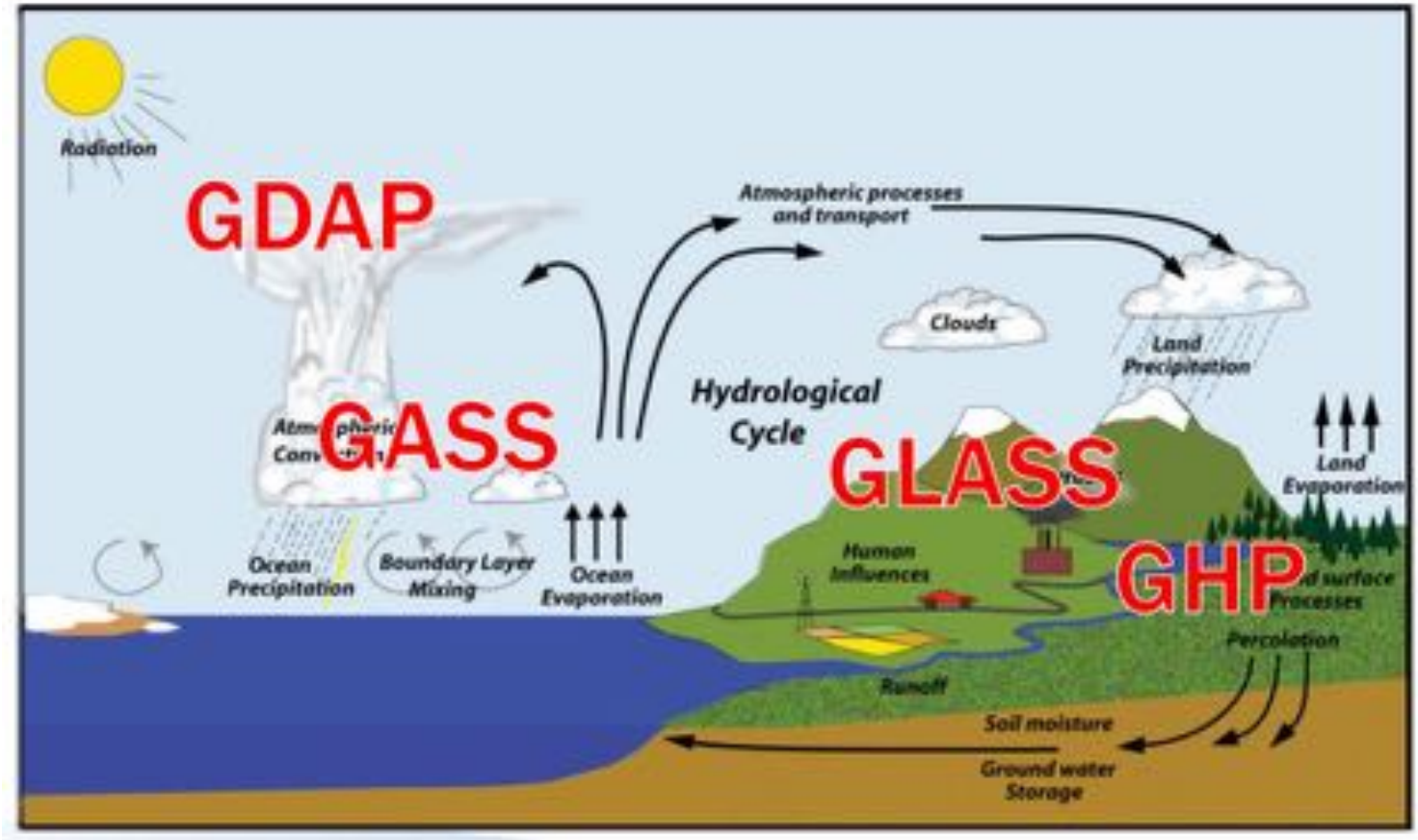
GHP Structure

GHP: GEWEX Hydroclimatology Panel



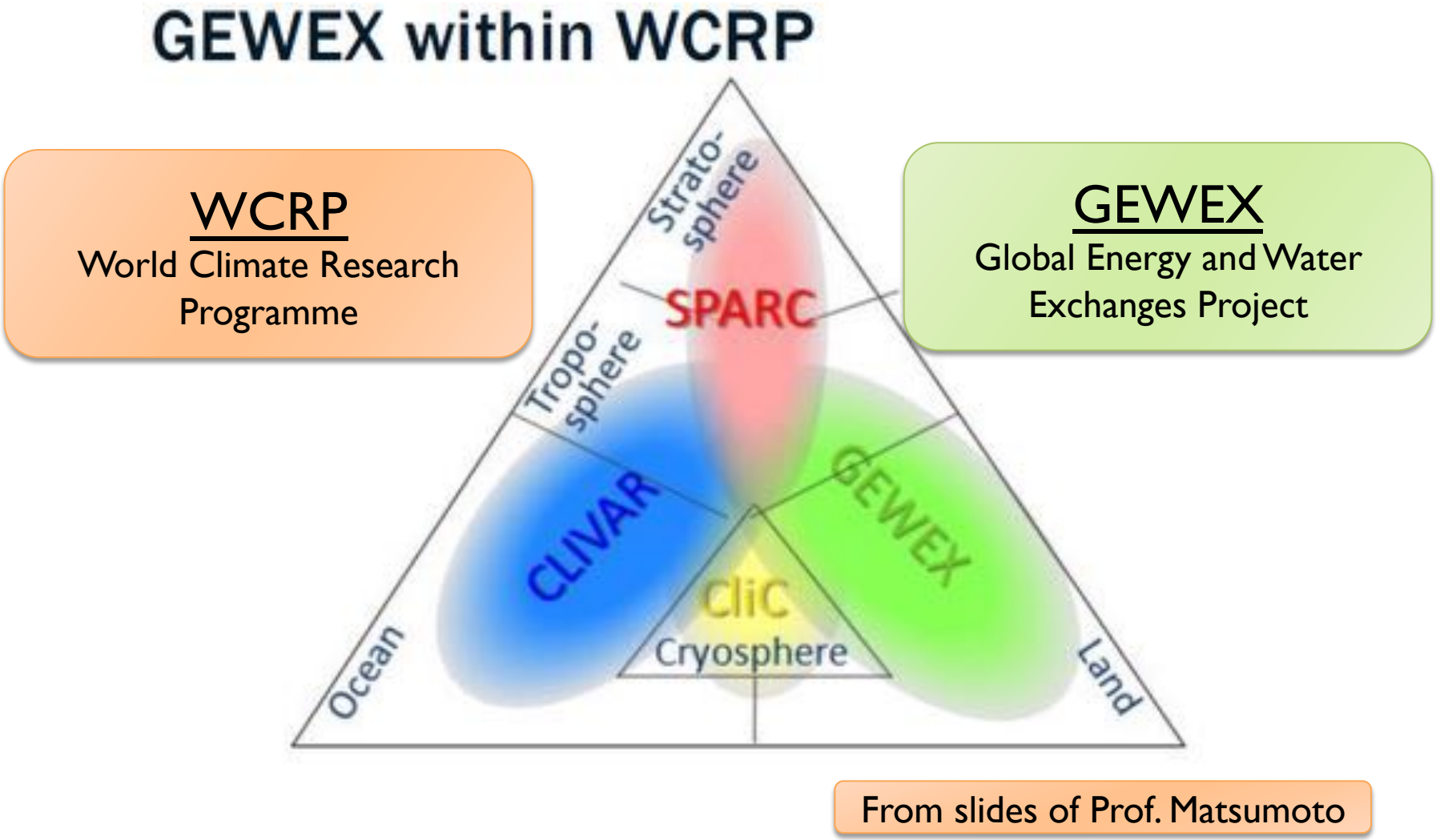
(Courtesy of Prof. Jason Evans, Co-chair of GHP)

Sub-components of GEWEX



From slides of Prof. Matsumoto

WCRP / GEWEX



From slides of Prof. Matsumoto

RHP Criteria (Sep. 2013)

- GEWEX Scientific Steering Group (SSG)
  - Assesses and approves Project Plans
- RHPs should state
  - the central science and applications questions, and
  - how to contribute the seven "GEWEX Science Imperatives",
    - Data sets, Analysis, Processes, Modeling, Applications, Technology Transfer, and Capacity Building
  - "WCRP Grand Challenges" & "GEWEX Science Questions"
- RHPs should include
  - …

Next Feb.-Mar.

RHP's Science Plan