



United Nations  
Educational, Scientific and  
Cultural Organization

# Change Identification (Example)

## Program for Generation of Climate Change Risk Information (SOUSEI Project)

10 Jan. 2017

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Deputy Director, ICHARM



Research project/plan by ICHARM (i-e)

**Development of the basic technology for affect evaluation in the river basin scale**

Development of the methodology for the local application of the predicted values of flood/drought hazard

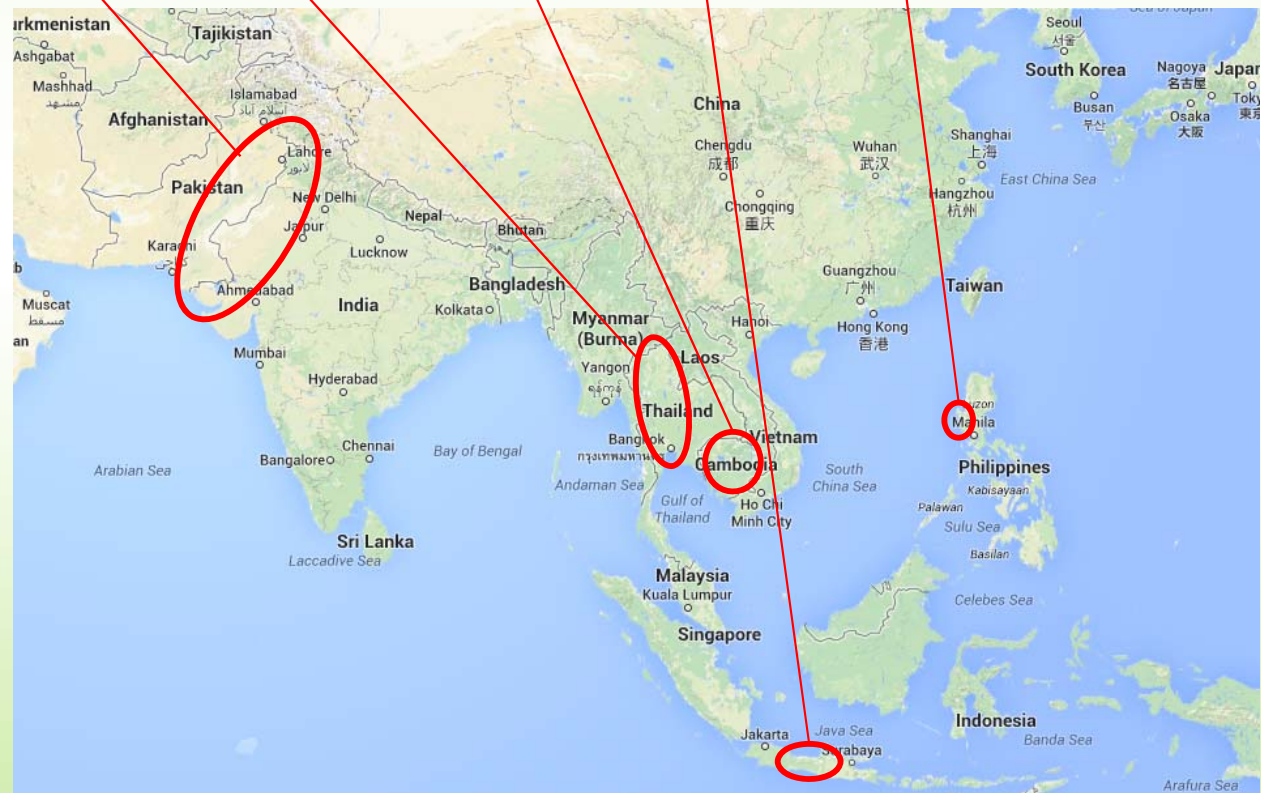
- Local customizing with hazard assessment
- Uncertainty assessment (CMIP5)
- Socio-economic impact assessment (Flood and drought)
- Vulnerability monitoring system

Development of the basic technology for the socio-economic risk assessment

- Response framework of hazard, socio-economic impact
- Socio-economic impact assessment including uncertainty
- Necessary information for local adaptation

**Affect evaluation in the special prone area**

Indus    Chao Phraya    Mekong    Solo    Pampanga



**Collaborative organization**

Kyoto Univ.

Yamanashi Univ.

Government of Pakistan

Government of Thailand

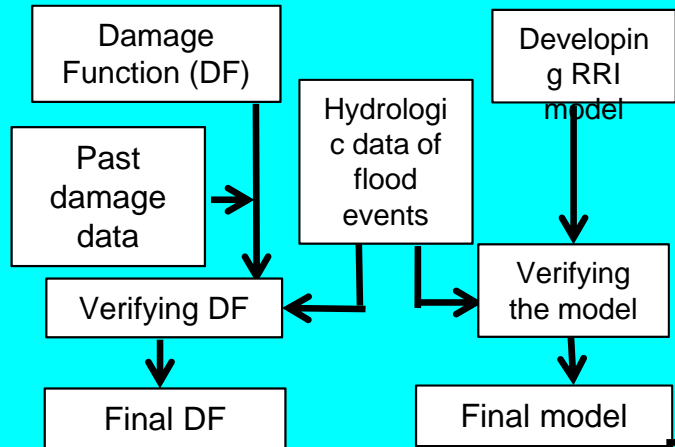
Government of Cambodia

Government of Indonesia

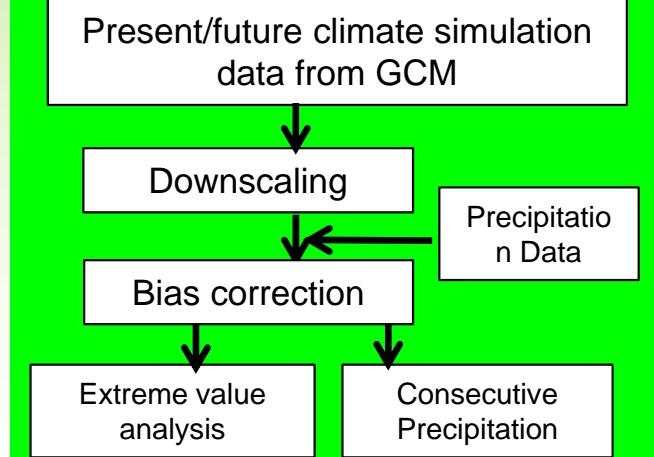
Government of the Philippines

# Risk Assessment Methodology

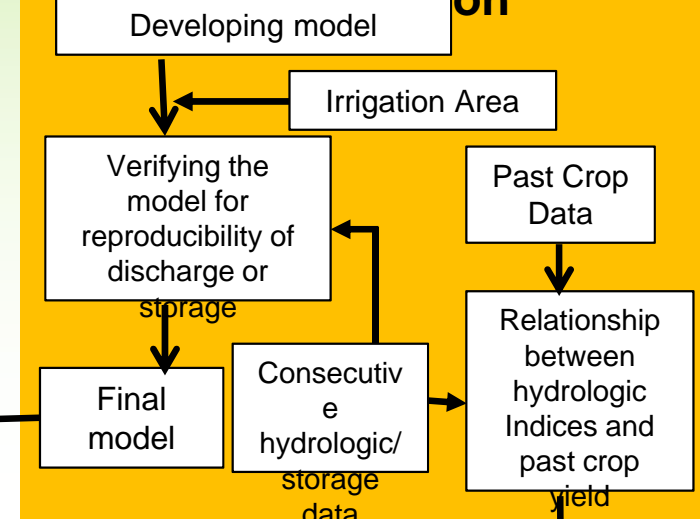
## Flood Risk Assessment Model Formulation



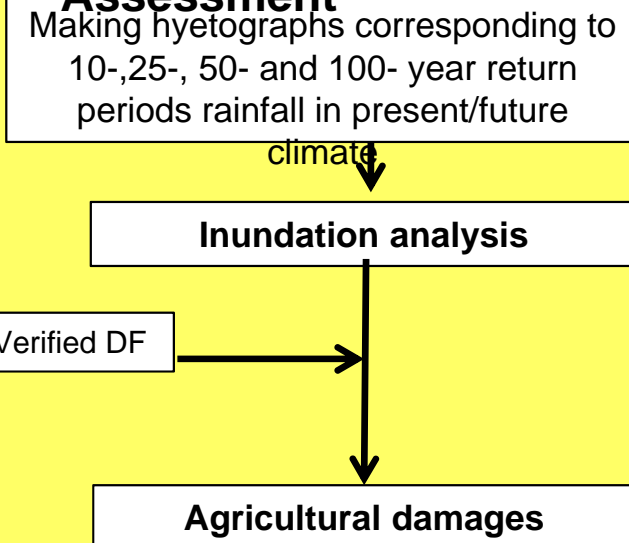
## Rainfall Analysis in Present/Future



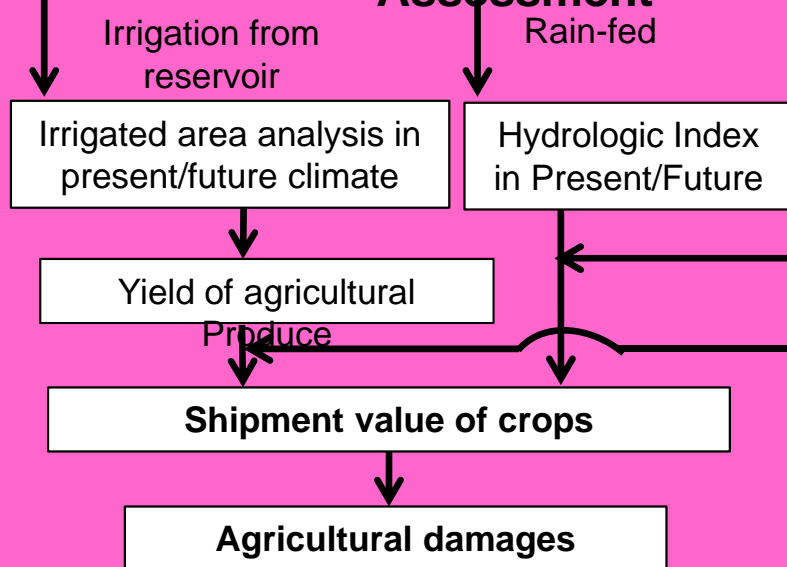
## Drought Risk Assessment Model Formulation



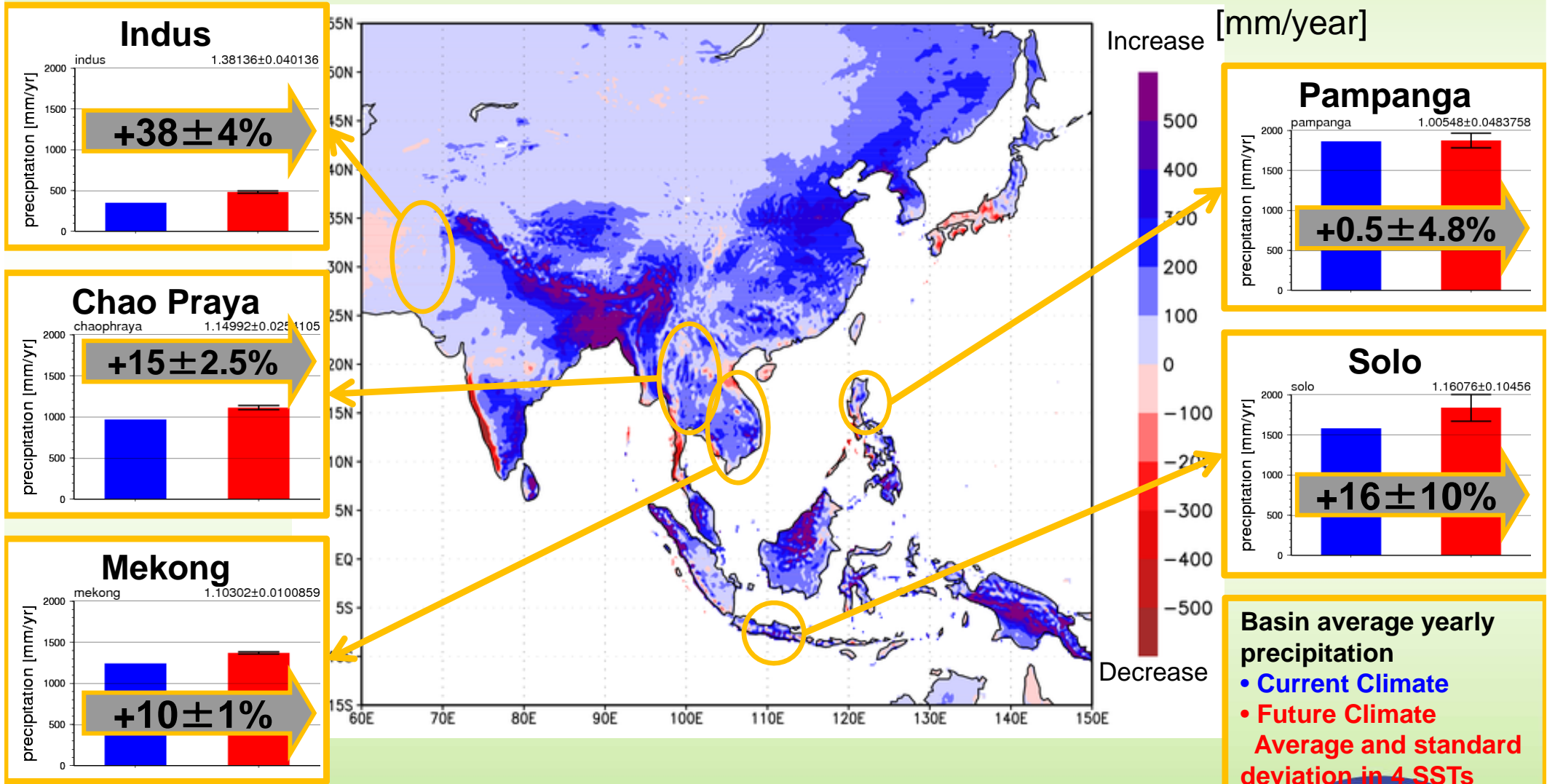
## Flood Risk Assessment



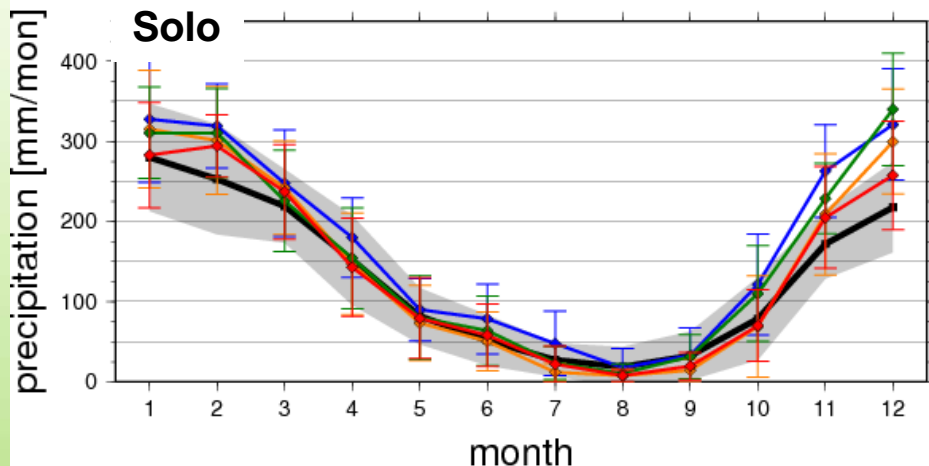
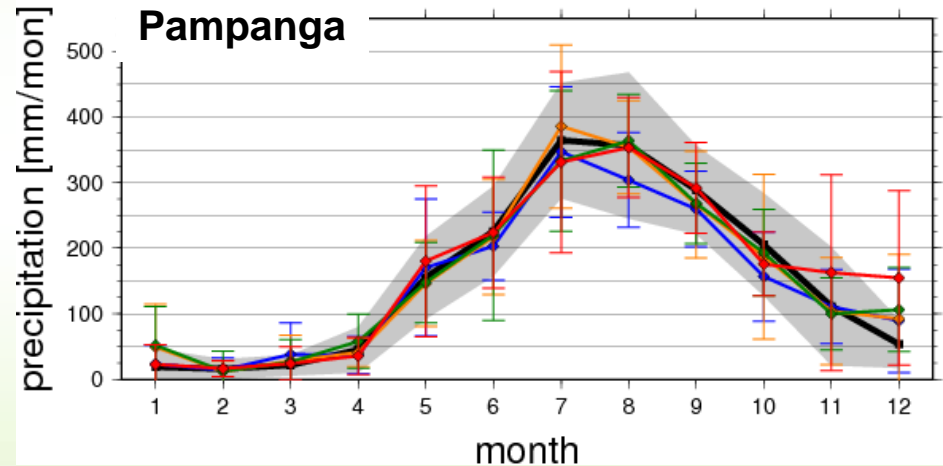
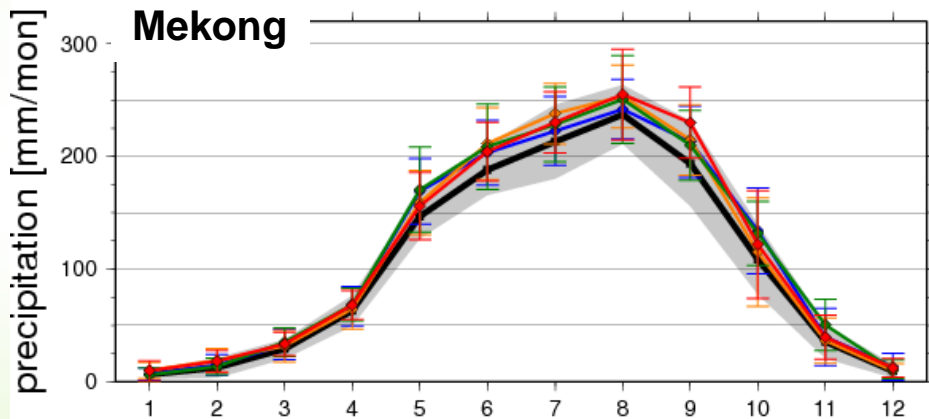
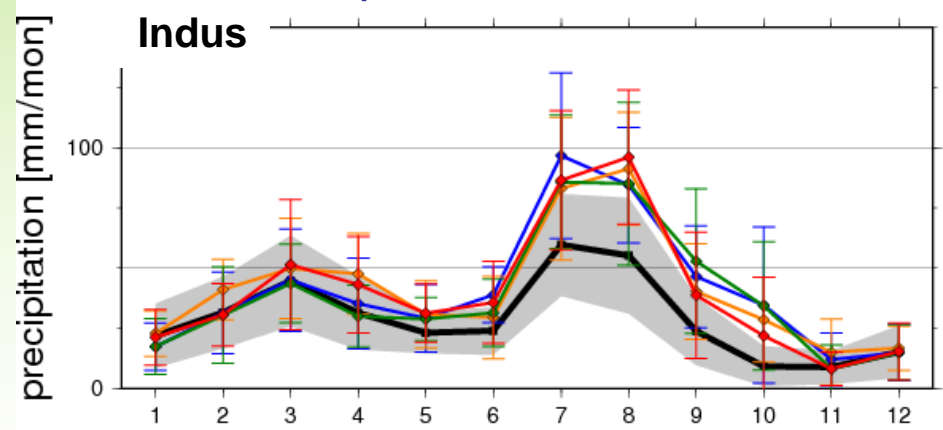
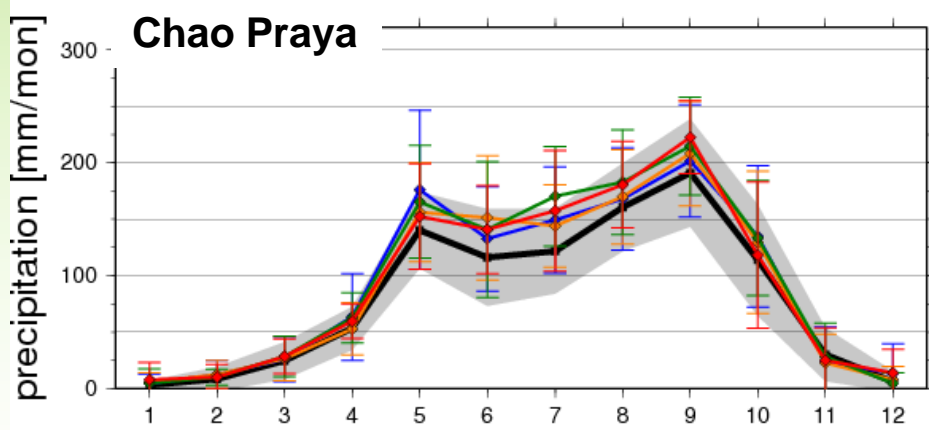
## Drought Risk Assessment



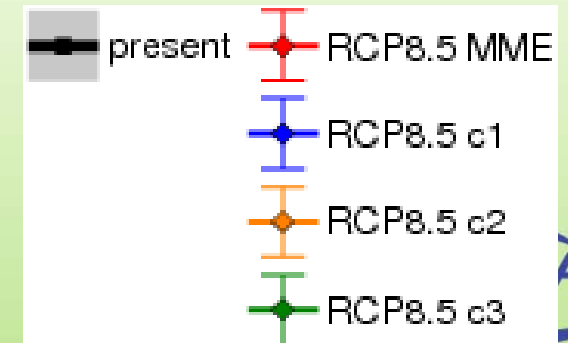
# Difference in average yearly precipitation between present and future climate by MRI-AGCM3.2S for 4 Sea Surface Temperature (SST) patterns,



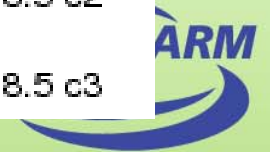
# Comparison of average monthly precipitation between present and future climate for 4 SSTs (MRI-AGCM3.2S)



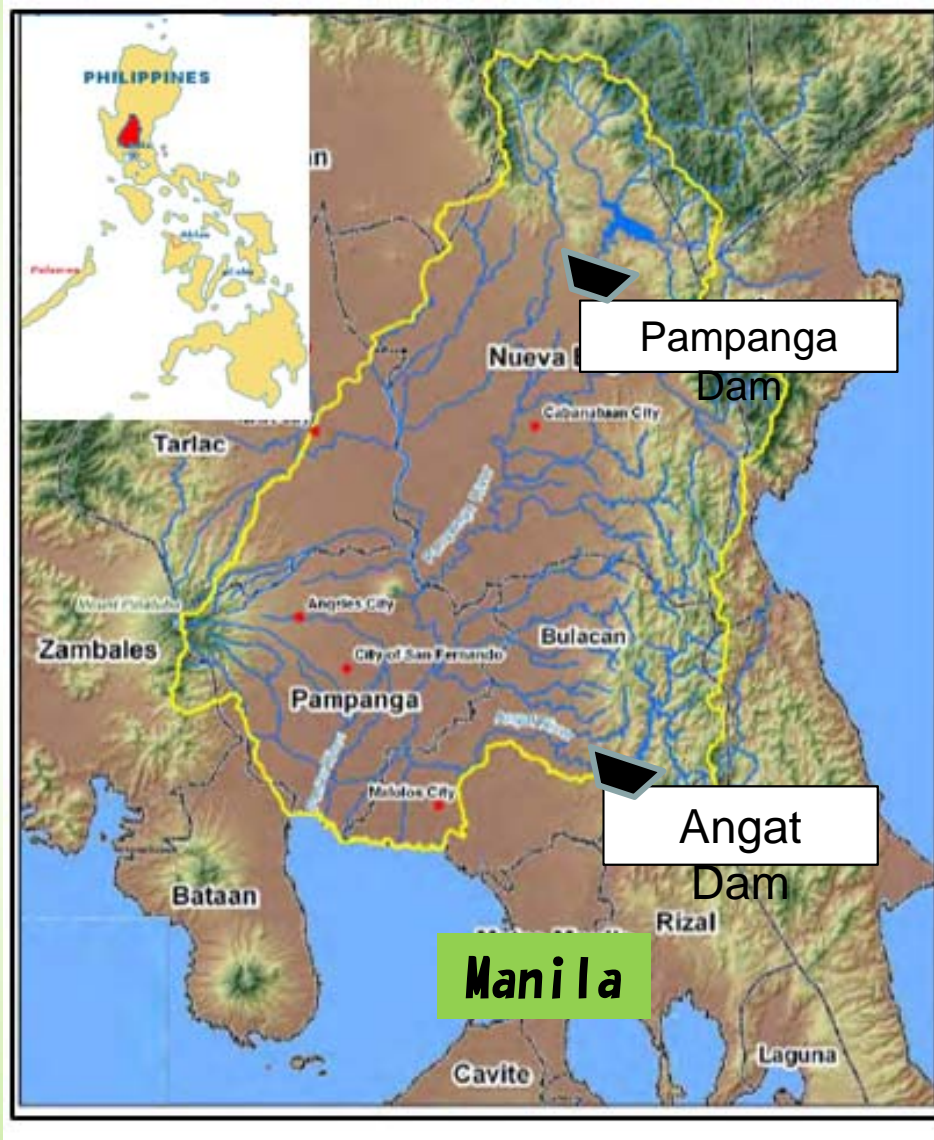
MRI-AGCM3.2S after B.C.



Iwami et al (2016)  
HRL, accepted



# Pampanga River Basin, the Philippines



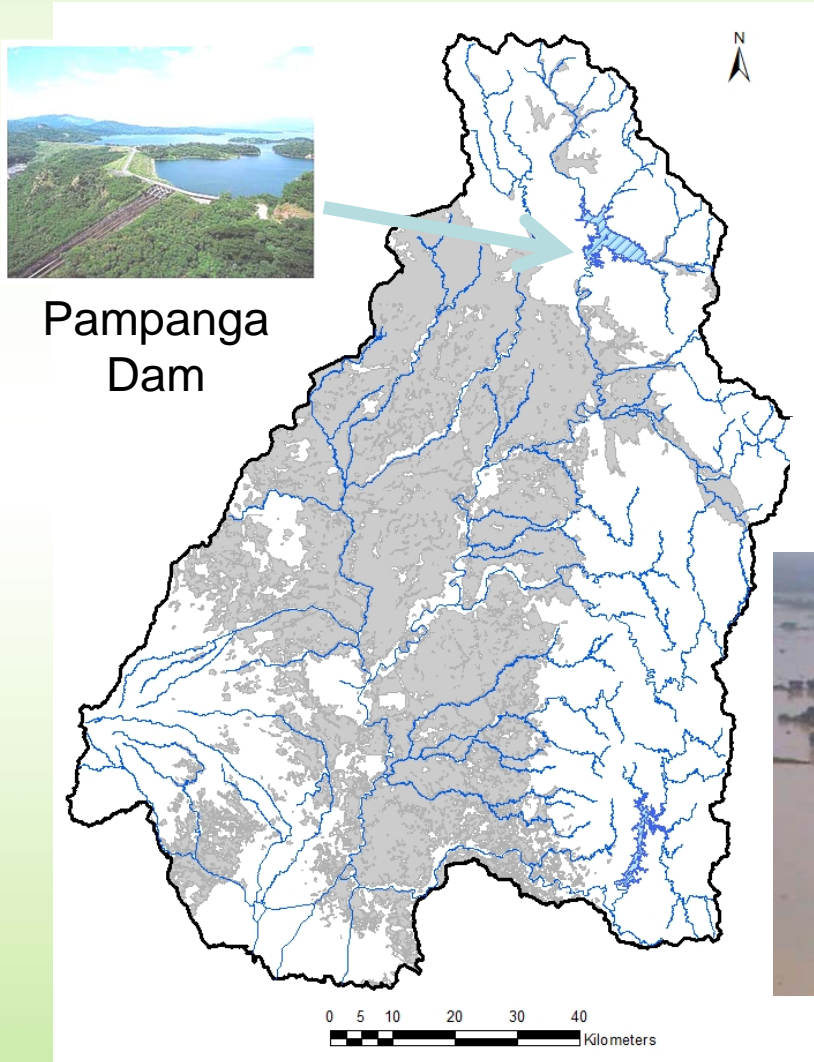
- Catchment Area : 10,434 km<sup>2</sup>
- River Length : 265 km
- Annual Precipitation : 2,155 mm
- Pampanga Dam (Capacity: 3 bn m<sup>3</sup>: Irrigation, Generation, Flood control and other purposes)
- Swamp in middle reach areas
- The Grain Belt of the Philippines
- Large-scale irrigation from Pampanga dam



Housings in floodplain

# Water Disasters in the Pampanga River Basin

**Paddy Field: arrox. 400,000ha**



## Flood Risk

Heavy rain by typhoon  
↓  
Flooding

↓  
Inundation damage

## Drought Risk

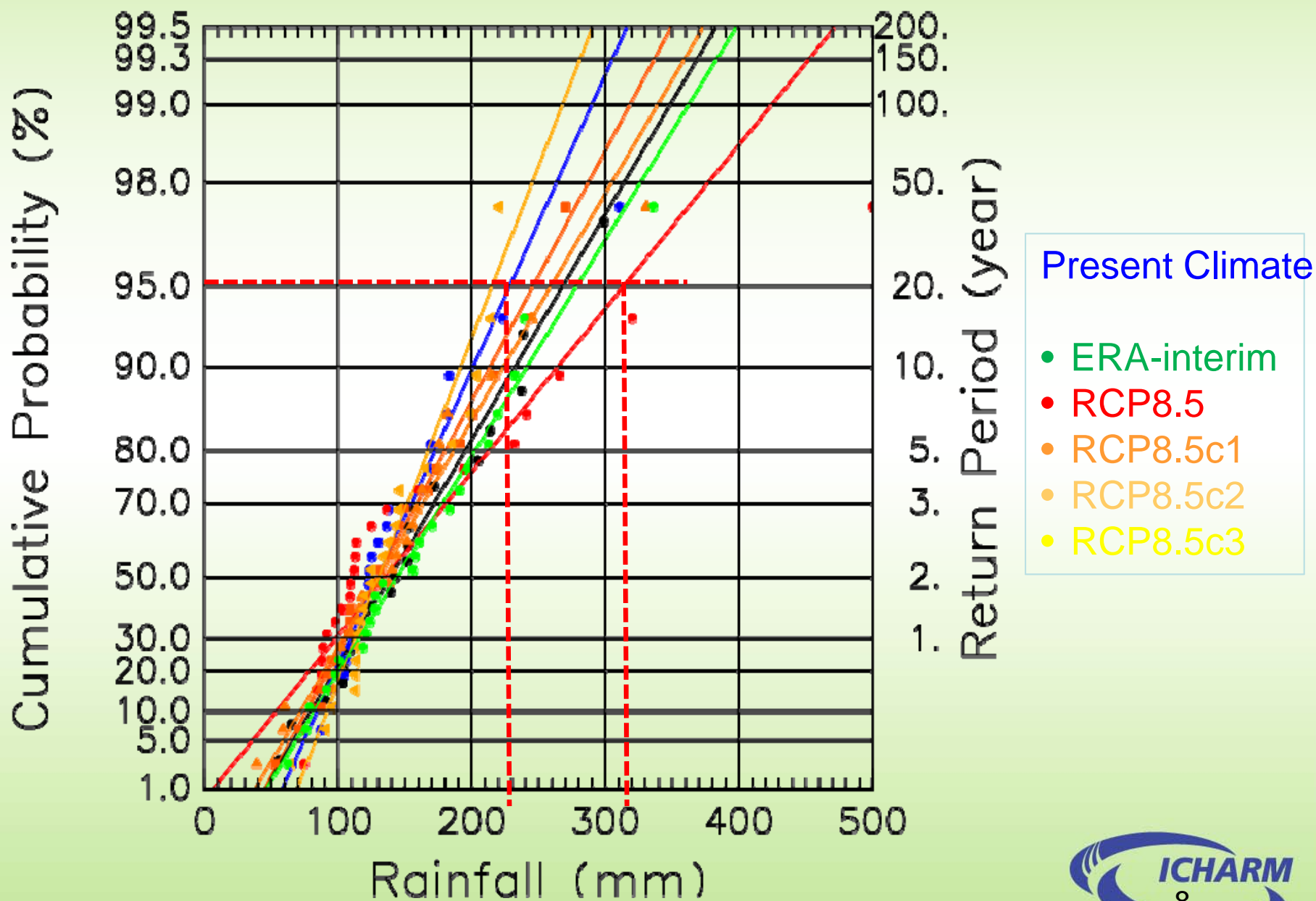
Less rainfall through years  
↓  
Scarce irrigation water

↓  
Less crops



# Rainfall Analysis: Pampanga River Basin averaged 48-h rainfall

MRI-AGCM3.2S DDS nKF



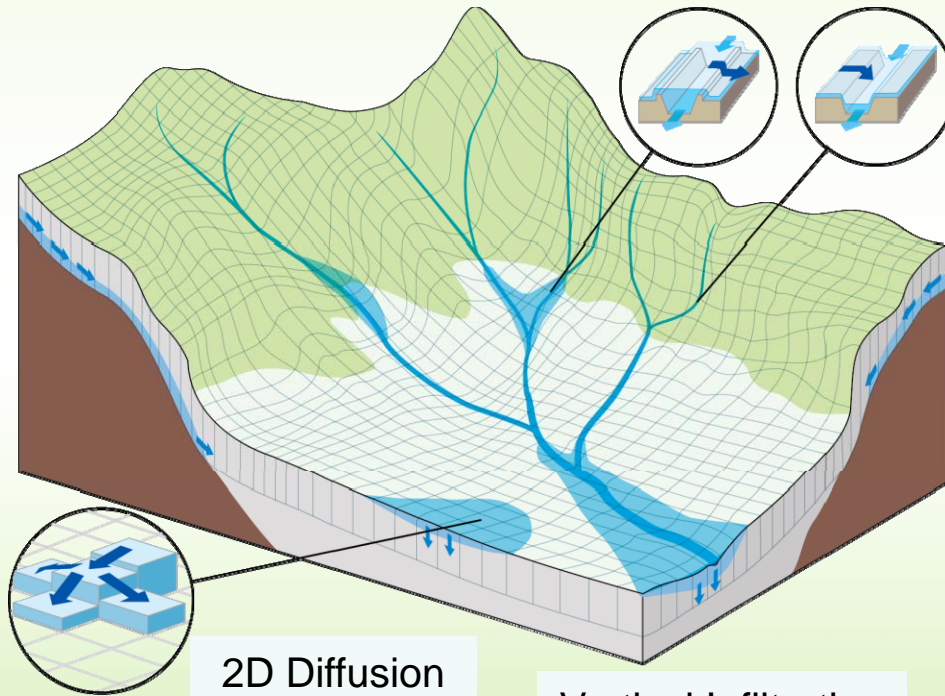
MRI-AGCM3.2S/3.2H DDS New KF



# Flood Risk: Flooding Simulation by RRI model

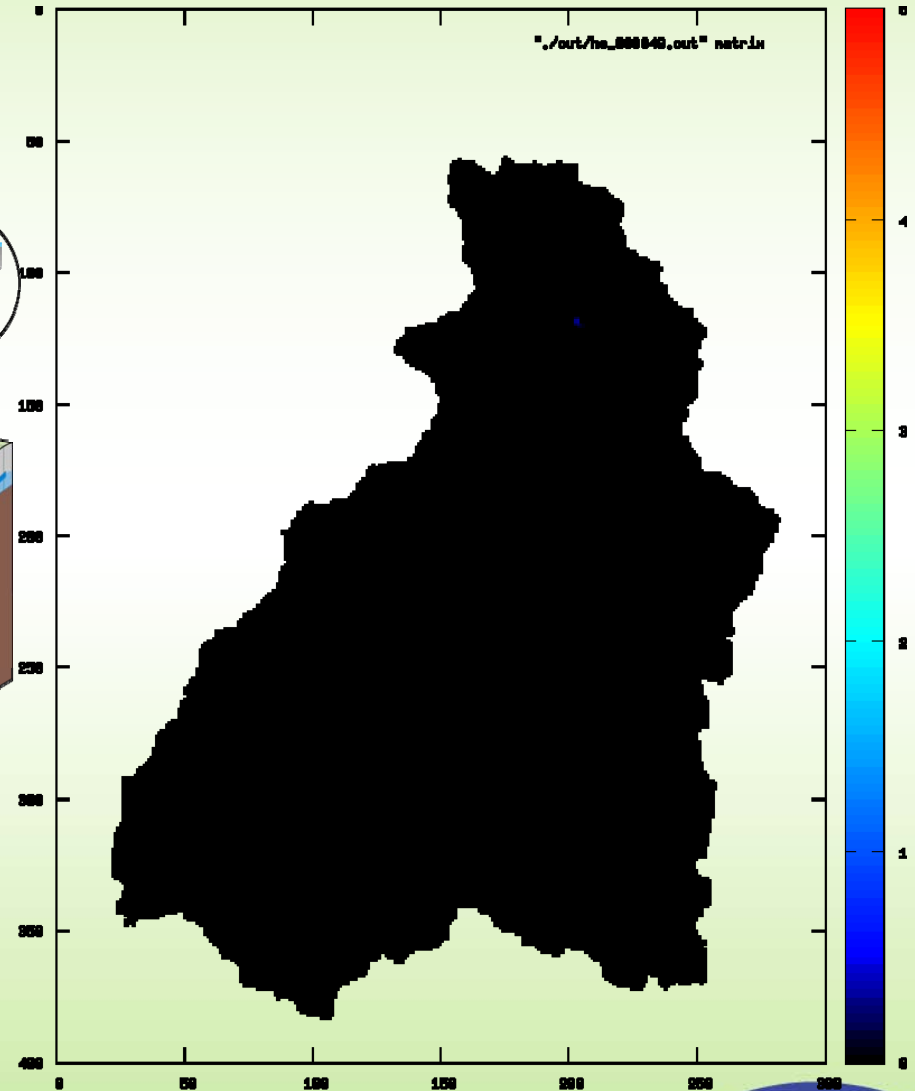
Subsurface + Surface

1D Diffusion  
in River



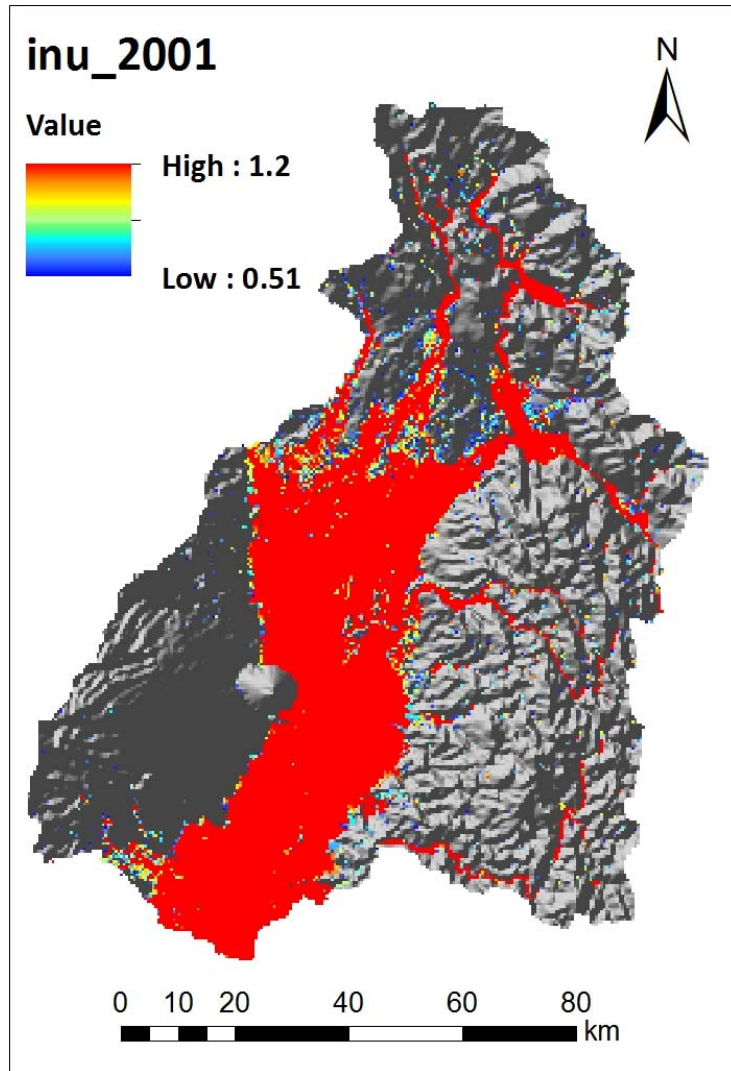
2D Diffusion  
in Catchment

Vertical Infiltration

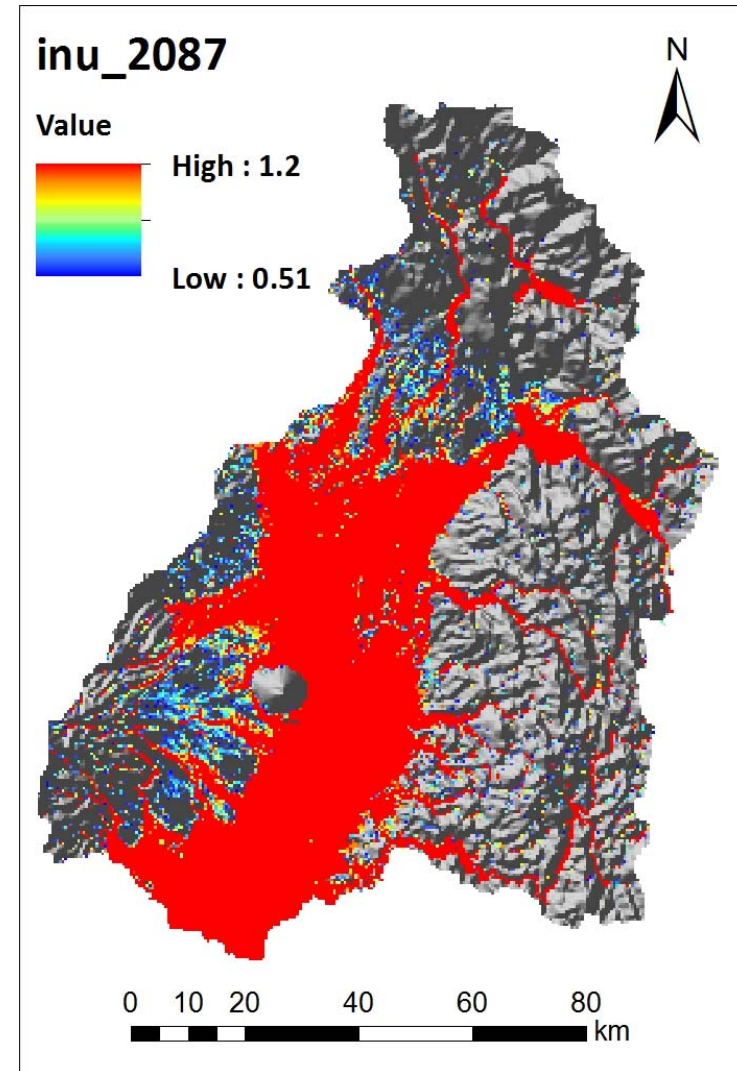


# Flood Risk: Change in Flooding Areas (approx. 1/50)

## Present Climate



## Future Climate (AGCM3.2S RCP8.5)

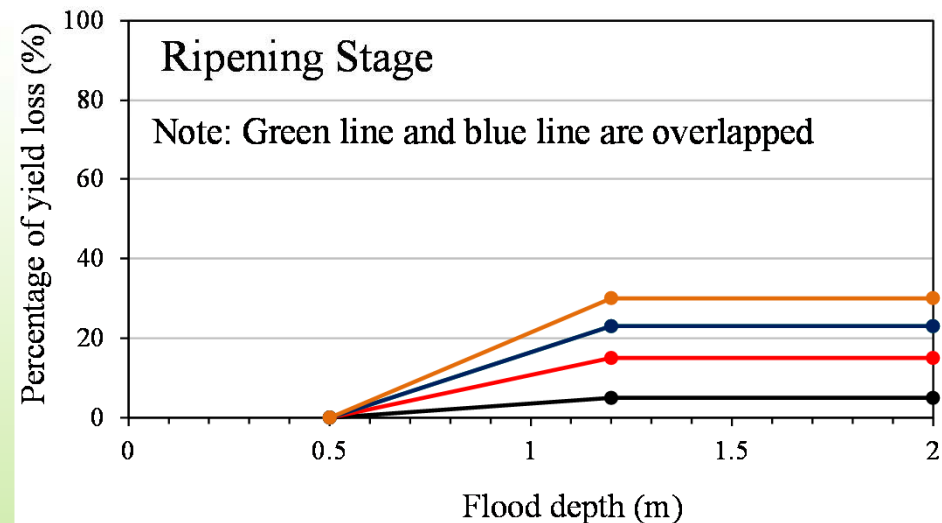
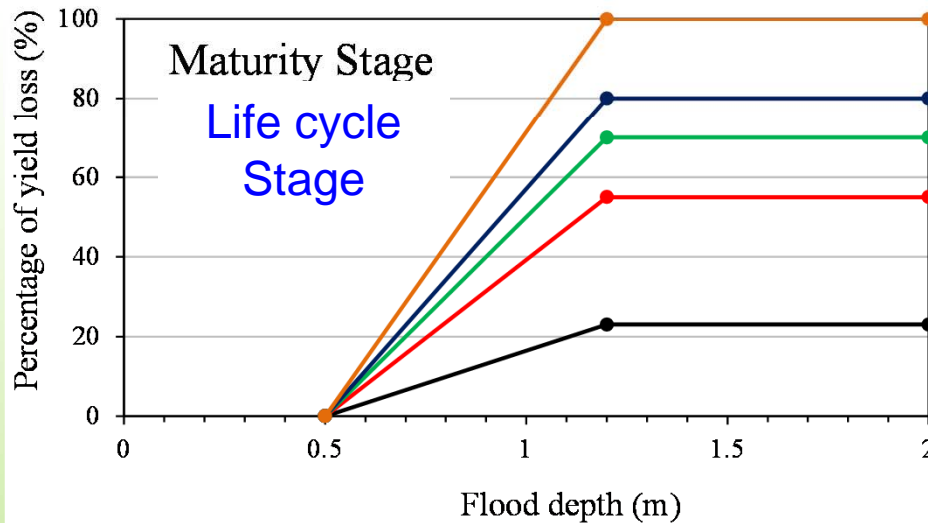
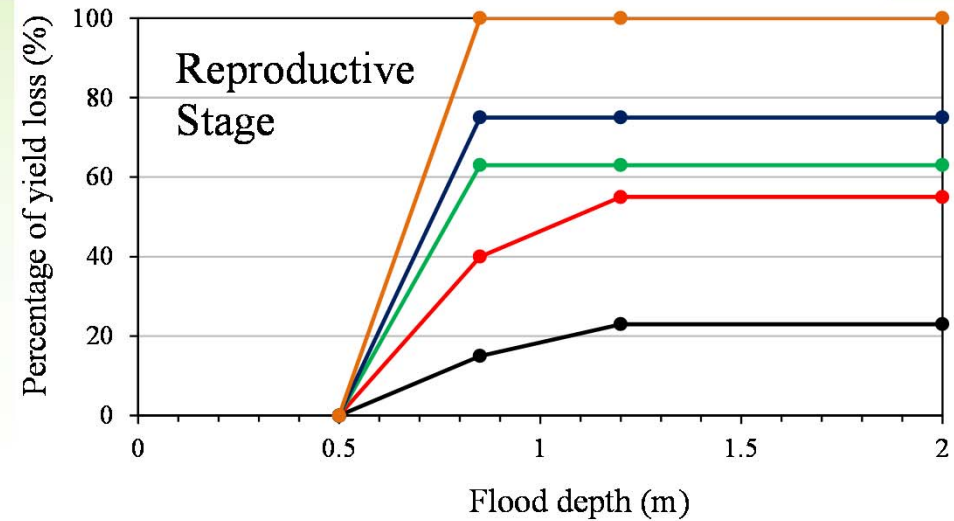
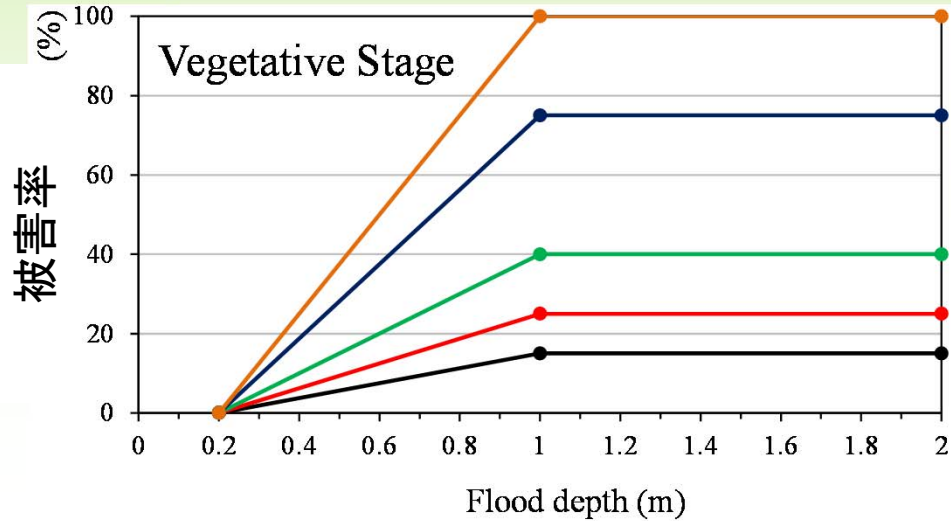


Flooding area: 3,211km<sup>2</sup> (31.7% of C.A.)

Flooding area: 4,354km<sup>2</sup> (43.0% of C.A.)

# Flood Risk: Crop Damage Function

● Flood duration= 1-2 days   ● Flood duration= 3-4 days   ● Flood duration= 5-6 days  
 ● Flood duration= 7 days   ● Flood duration >7 days   **Floded duration (day)**

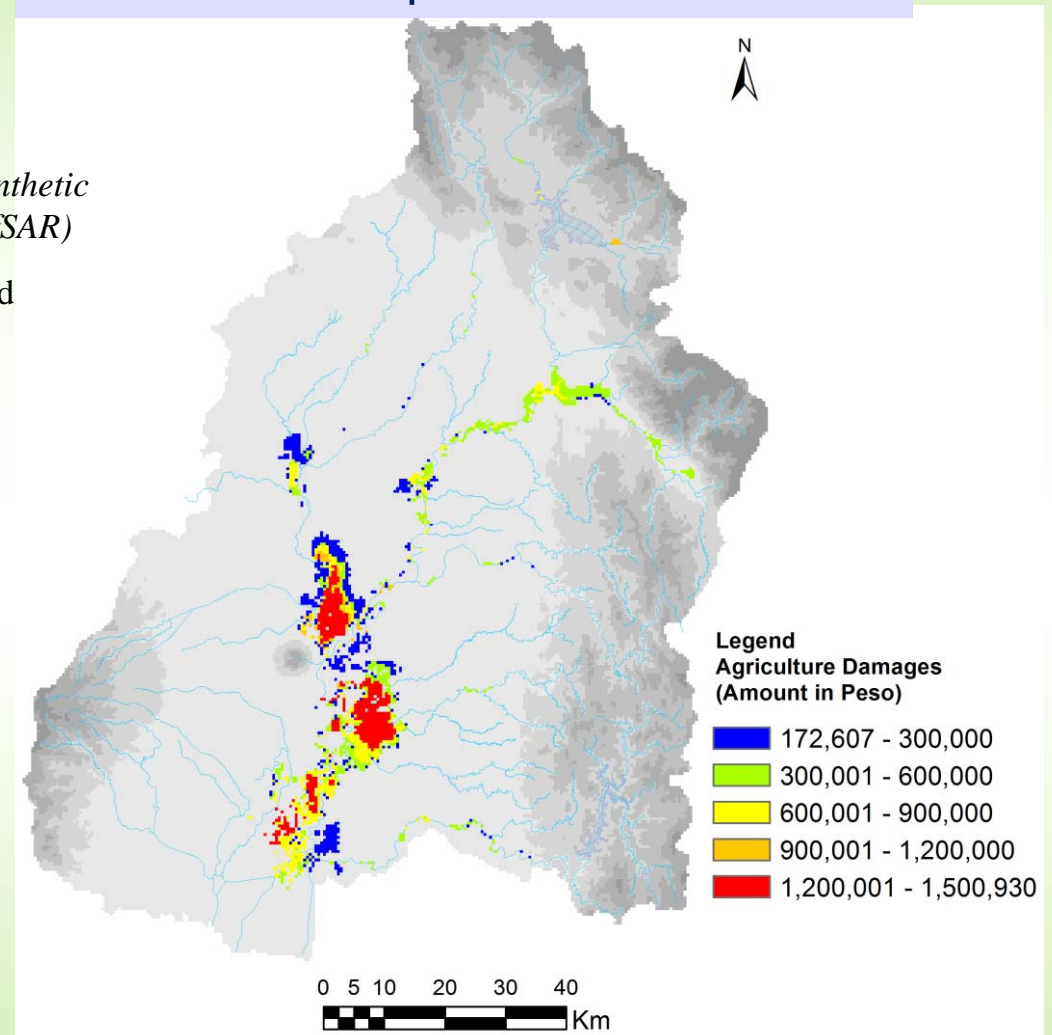
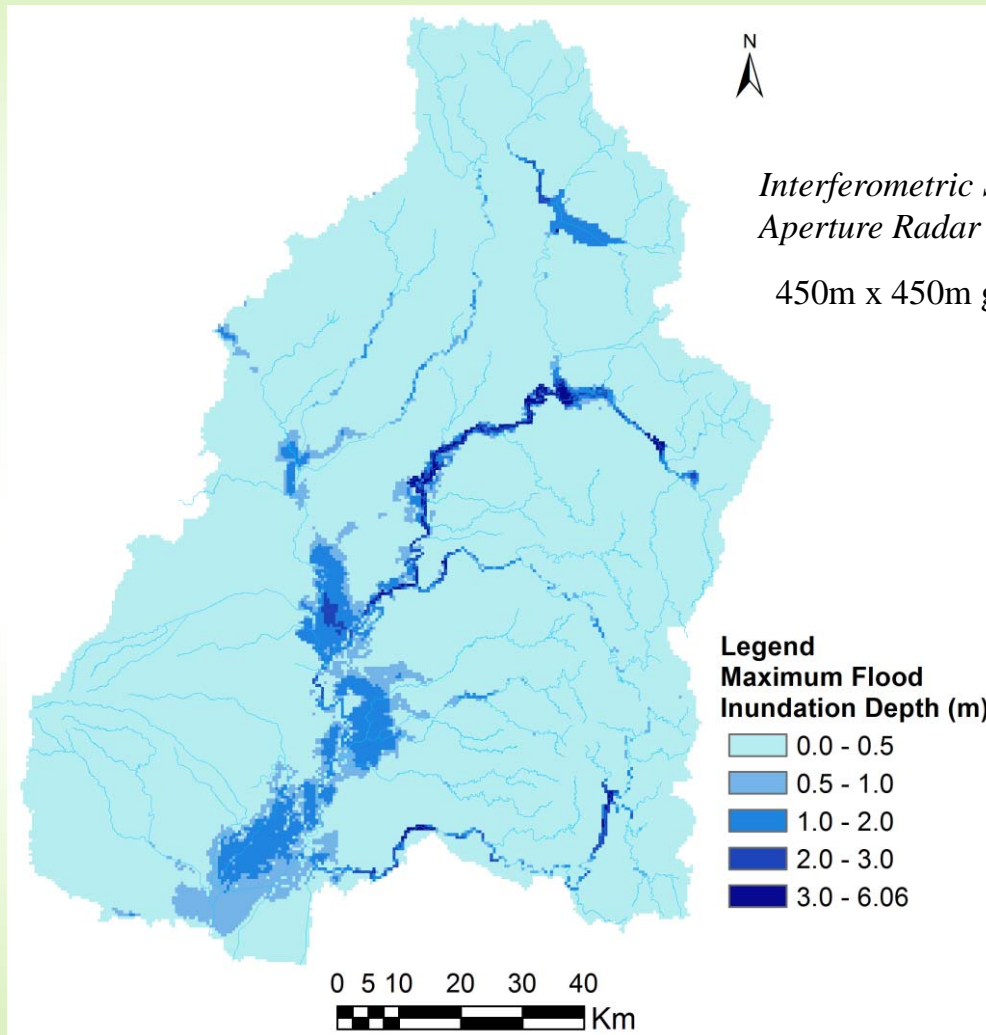


Developed based on flood damage matrix published by the Philippines Bureau of Statistics (2013) and considering height of rice plant



# Flood Risk: Damage estimation from depths and others

Flood event: September 2011 Flood



Flooded areas (>0.5m depth) = 45,056.25 ha

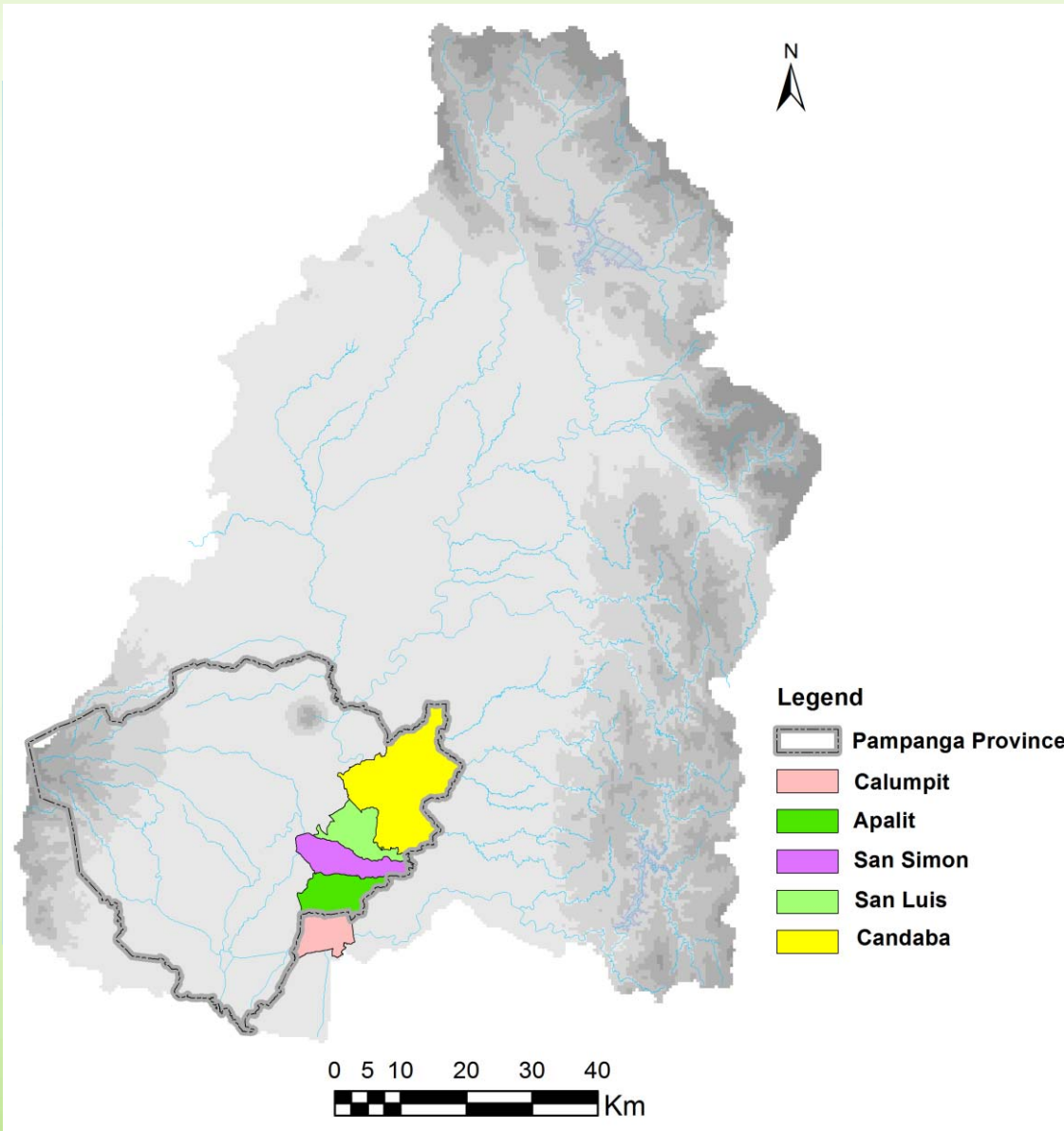
**Damages: 1,475.78 million Peso**

Rice Yield = 4360 kg/ha

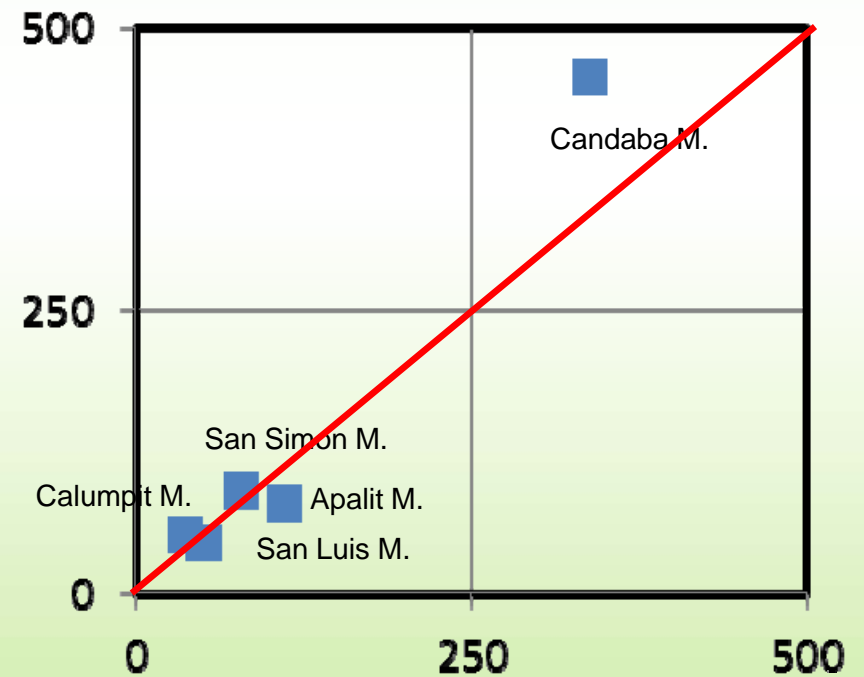
Farm gate price of rice = 17 Peso/kg

# Flood Risk: Verification of flooding model and damage function

Flood event: September 2011 Flood



Estimated Damages (mil Peso)

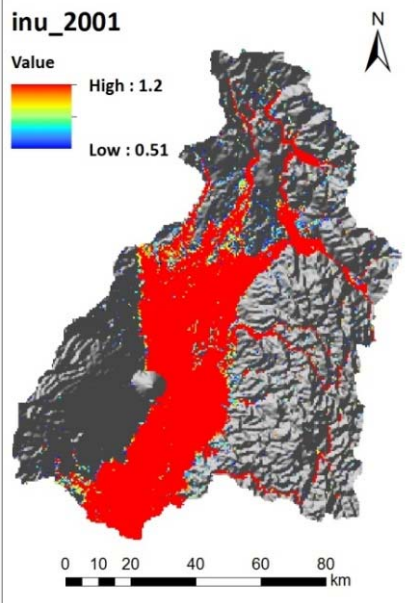


Reported Damages (mil  
Peso)

# Estimated changes in Inundation Area and Crop Damage

Worst case in 25 years between present and future climate:  
1/100 year event

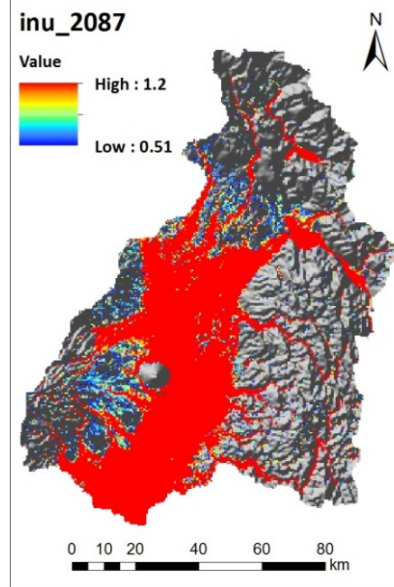
## Present Climate



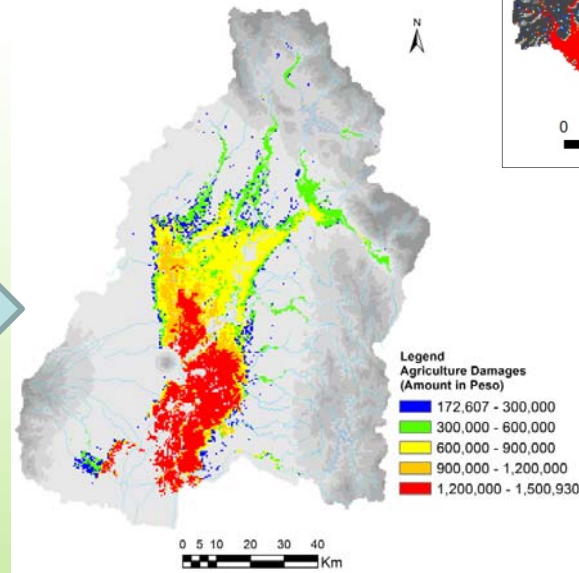
**Inundation area (>50cm)**  
**3,211km<sup>2</sup>**

**App. 40% increase**

## Future Climate (AGCM3.2S RCP8.5)

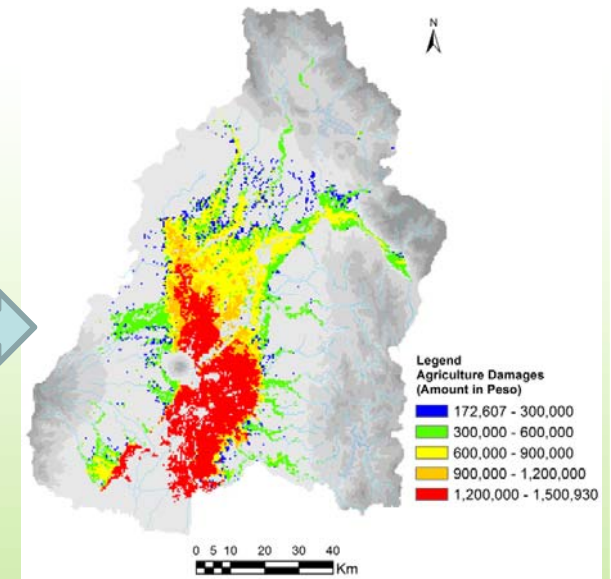


**Inundation area (>50cm)**  
**4,354km<sup>2</sup>**



**Crop Damage**  
**8882.96 Mil. Peso**

**App. 20% increase**



**Crop Damage**  
**10684.02 Mil. Peso**

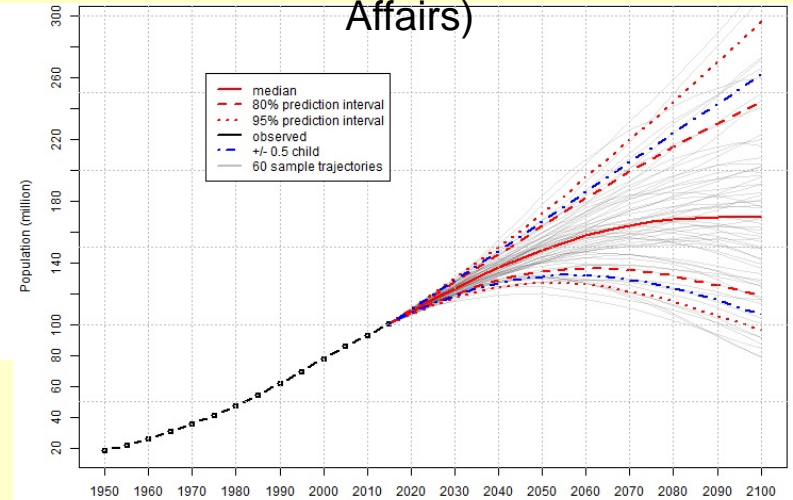


# Estimated affected people by a 100-year return period flood in future

## Calculation condition:

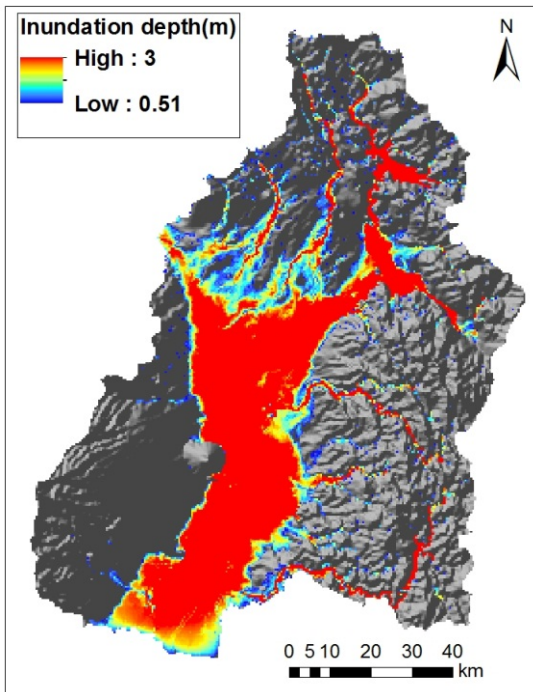
GCM: MRI-AGCM3.2S (20km, SST: MME)  
 Downscaling (5km): WRF (Grell 3D ensemble scheme)  
 Runoff and Inundation model: RRI 450m grid  
 Input data: 48-hour precipitation, maximum pattern  
 (100-year probability)  
 Population distribution: LANDSCAN 1km grid data (2013)  
 Future population projection:  
 (UN Department of Economic and Social Affairs)

## Future population projection (Philippines) (UN Department of Economic and Social Affairs)

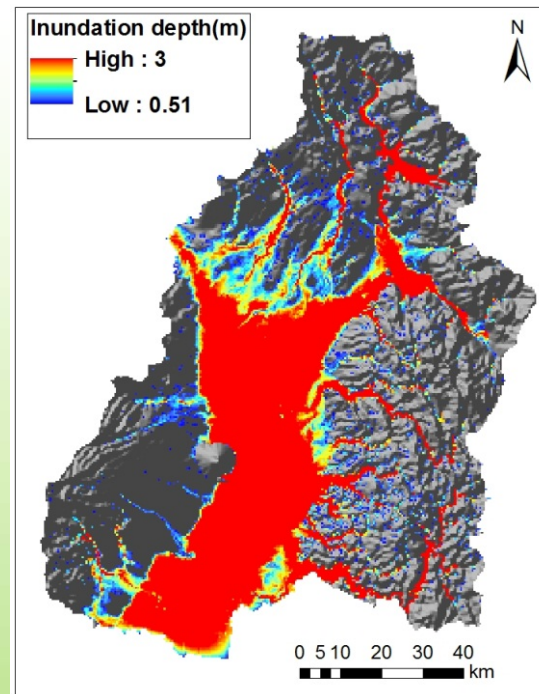


Source: United Nations, Department of Economic and Social Affairs, Population Division (2015).  
 World Population Prospects: The 2015 Revision. <http://esa.un.org/unpd/wpp/>

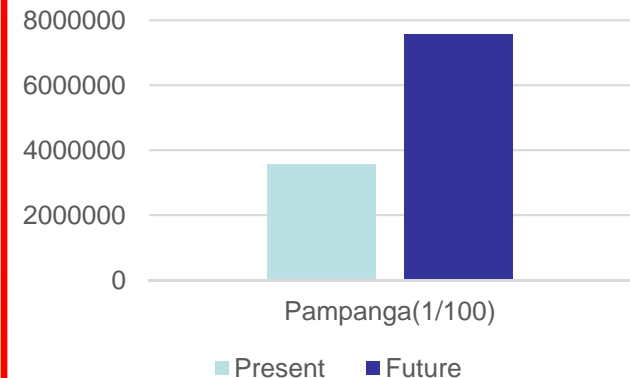
## Flood inundation (1/100) in present climate



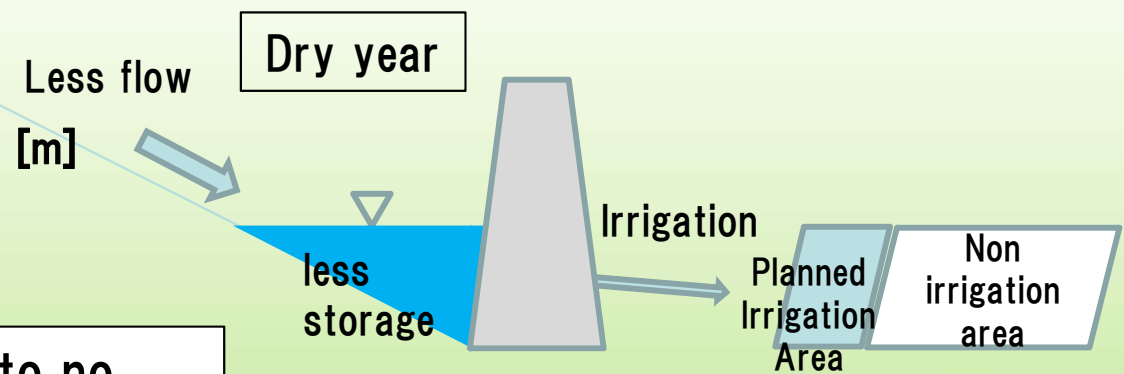
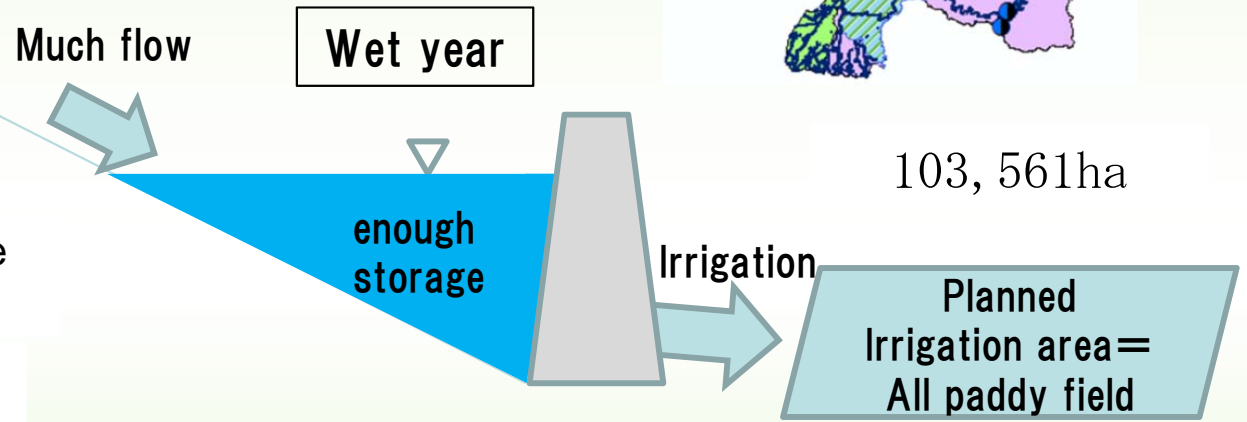
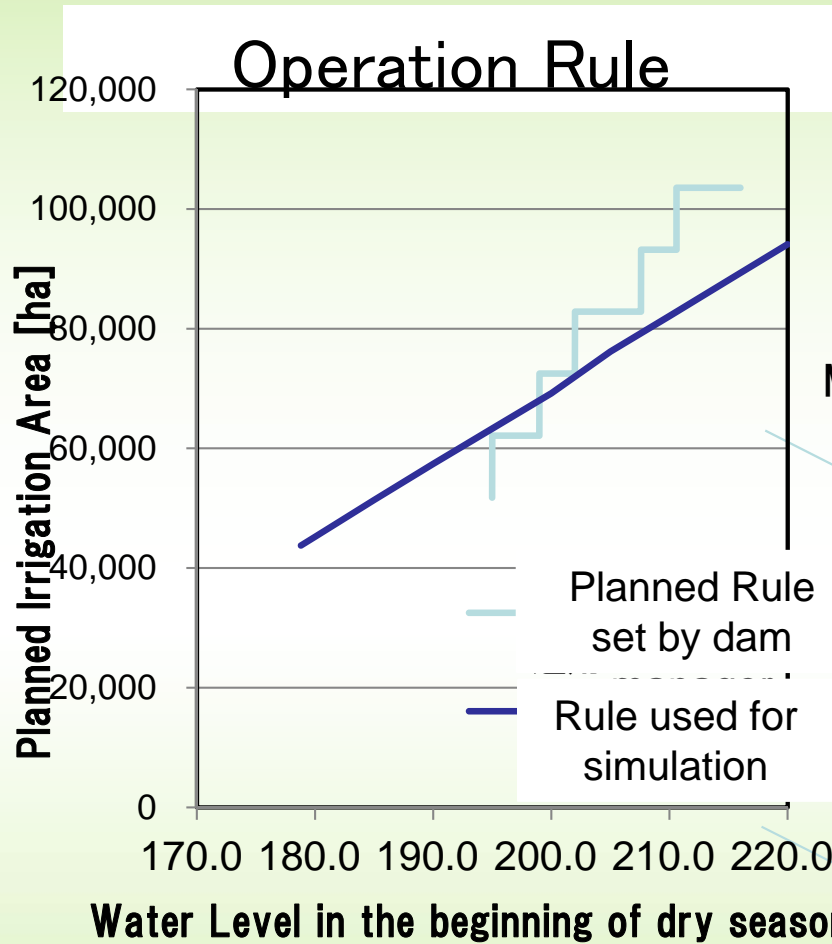
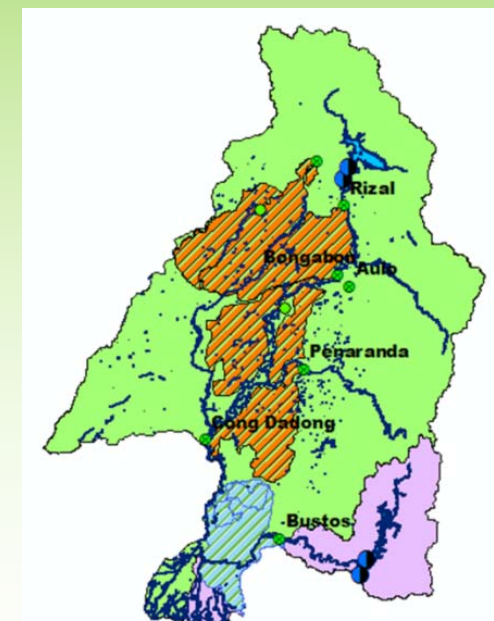
## Flood inundation (1/100) in future climate



## Change of affected people in the maximum inundation area



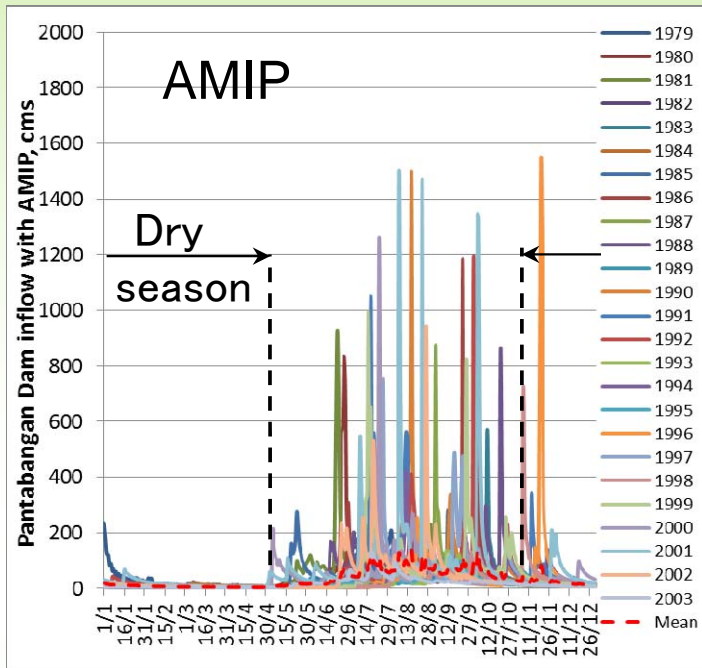
# Drought Risk: Method



**Drought Risk = Crop Loss due to no irrigation**

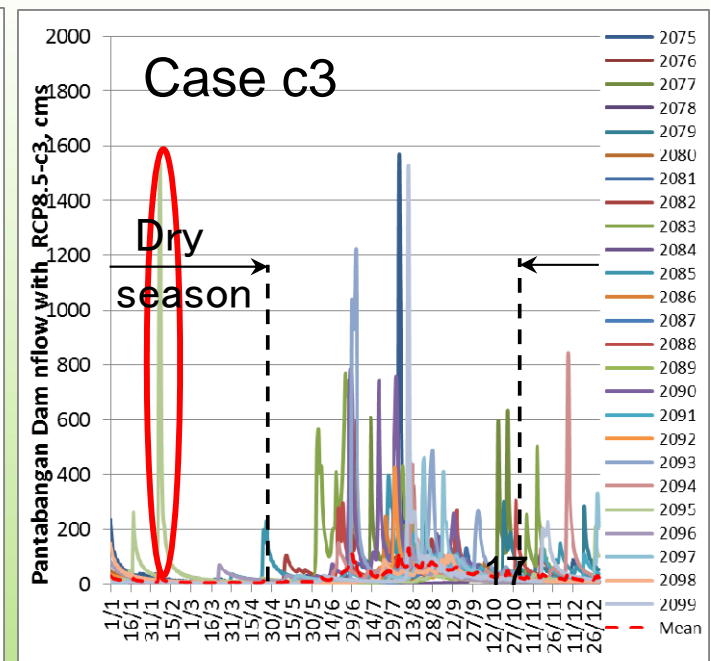
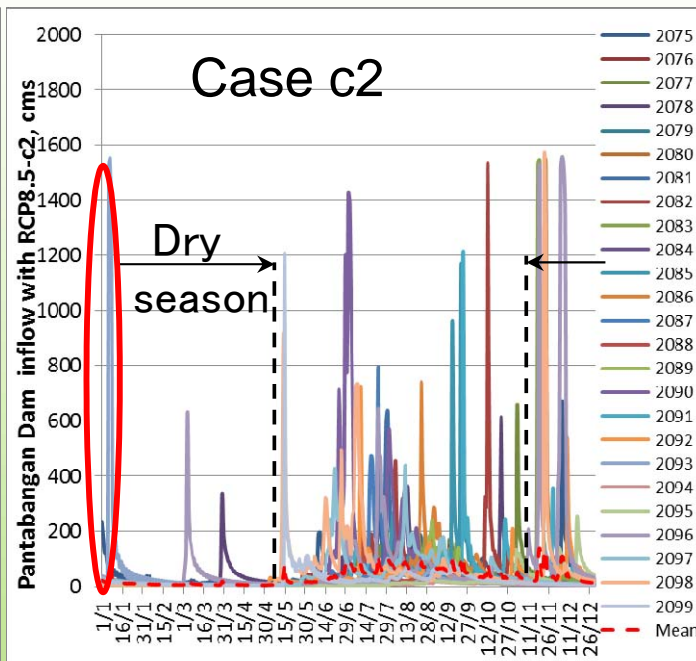
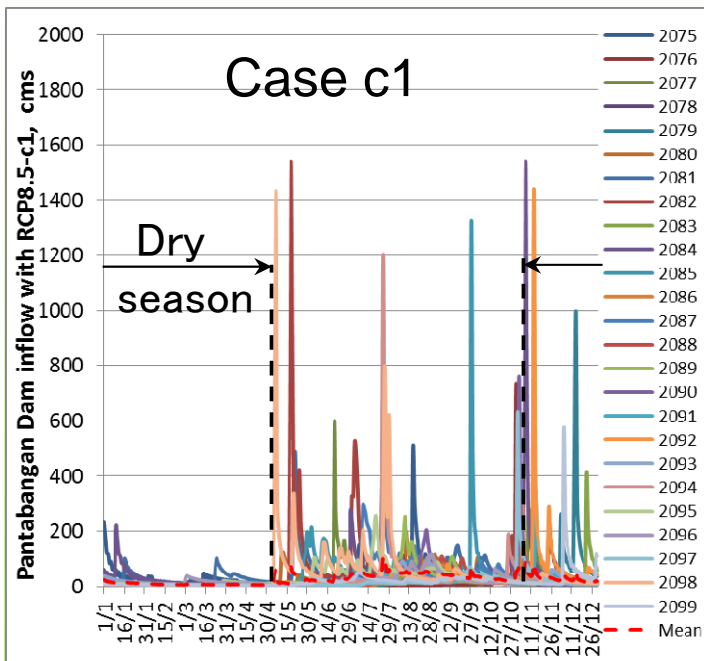


# Comparison bet. Present and future climate Changes of inflow into the Pantabamgan Dam



**【Characteristics of projected inflow in the future climate】**

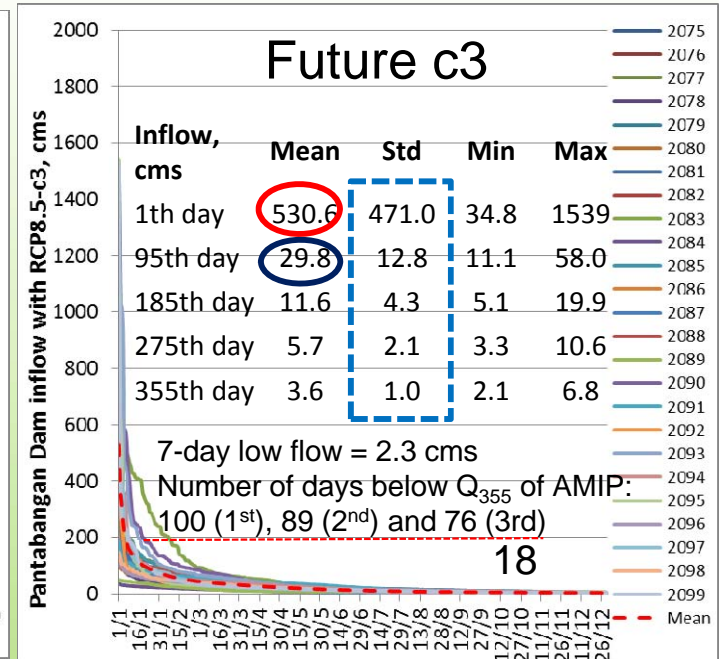
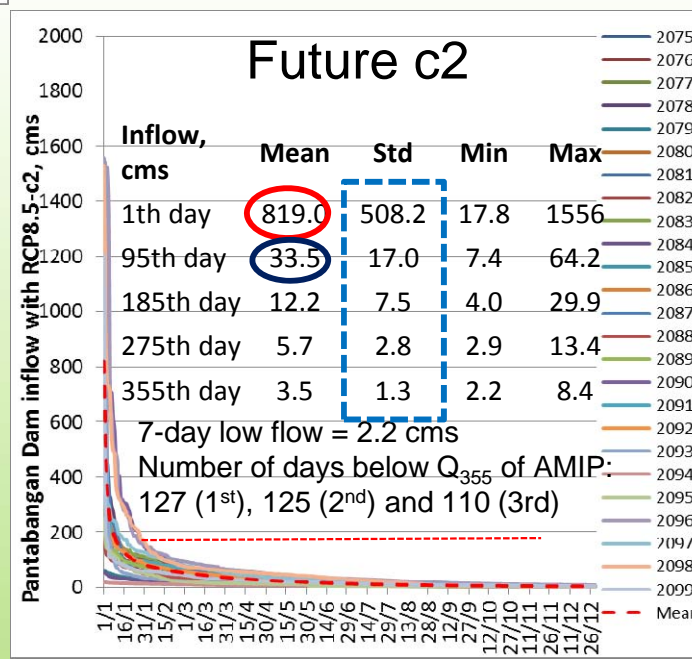
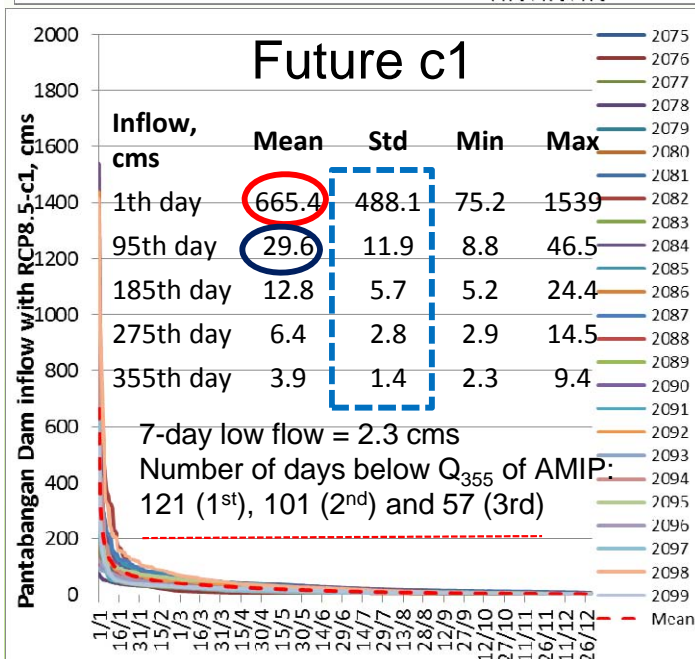
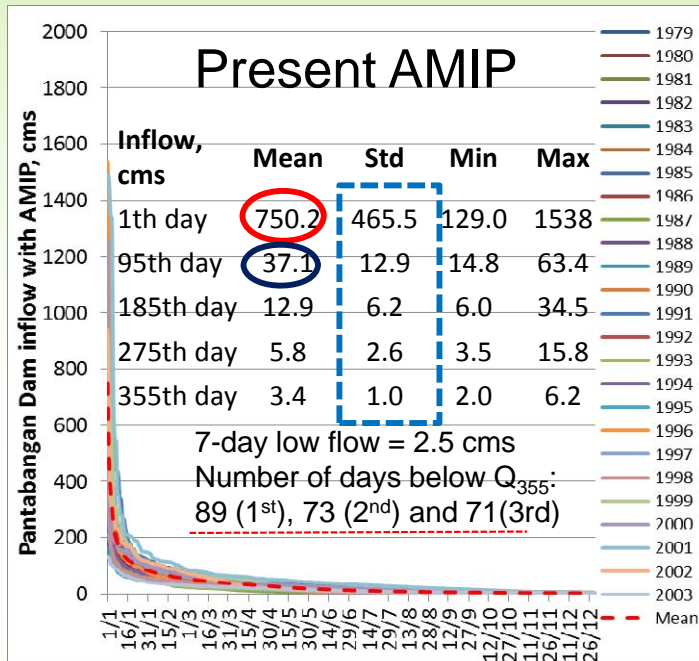
- Delay in end of rainy season, dry season may become shorter
- Heavy inflow may occur in the middle of (current) dry season



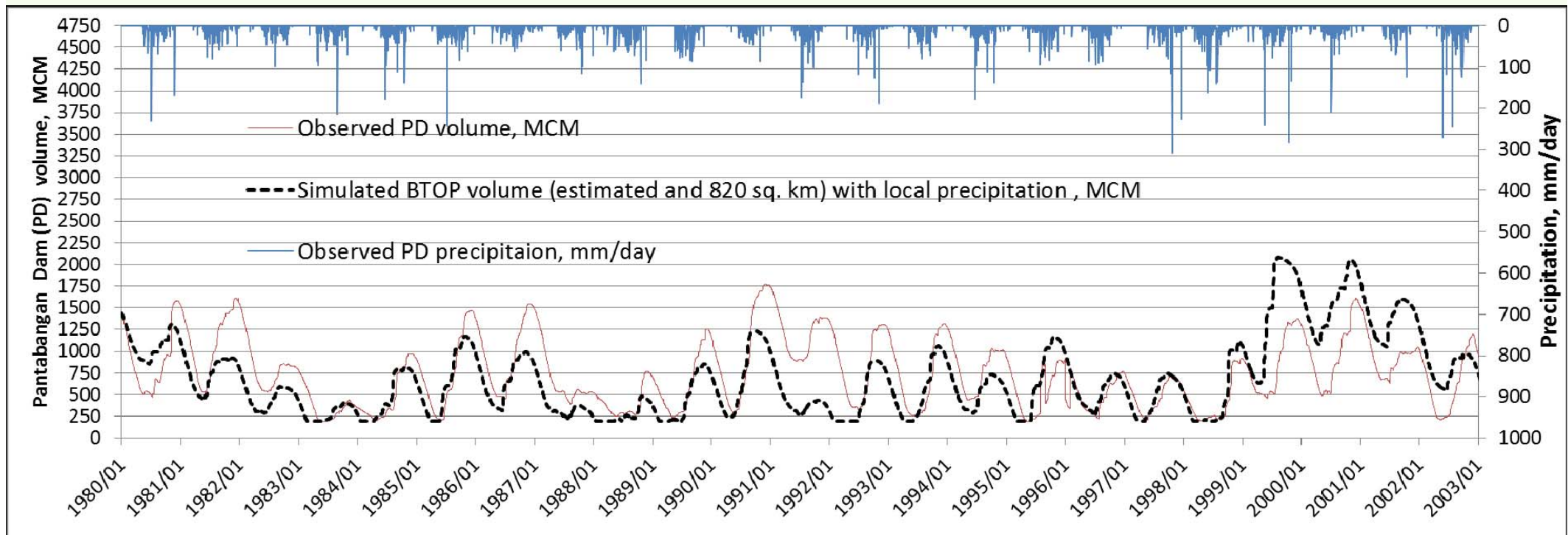
# Projected changes in the inflow into Pantabangan Dam

## 【Characteristics of future climate】

- Average of maximum yearly inflow may be decreased for C1 and C3 case, but may be increased for C2 case
- Severe drought may be intensified in the future climate

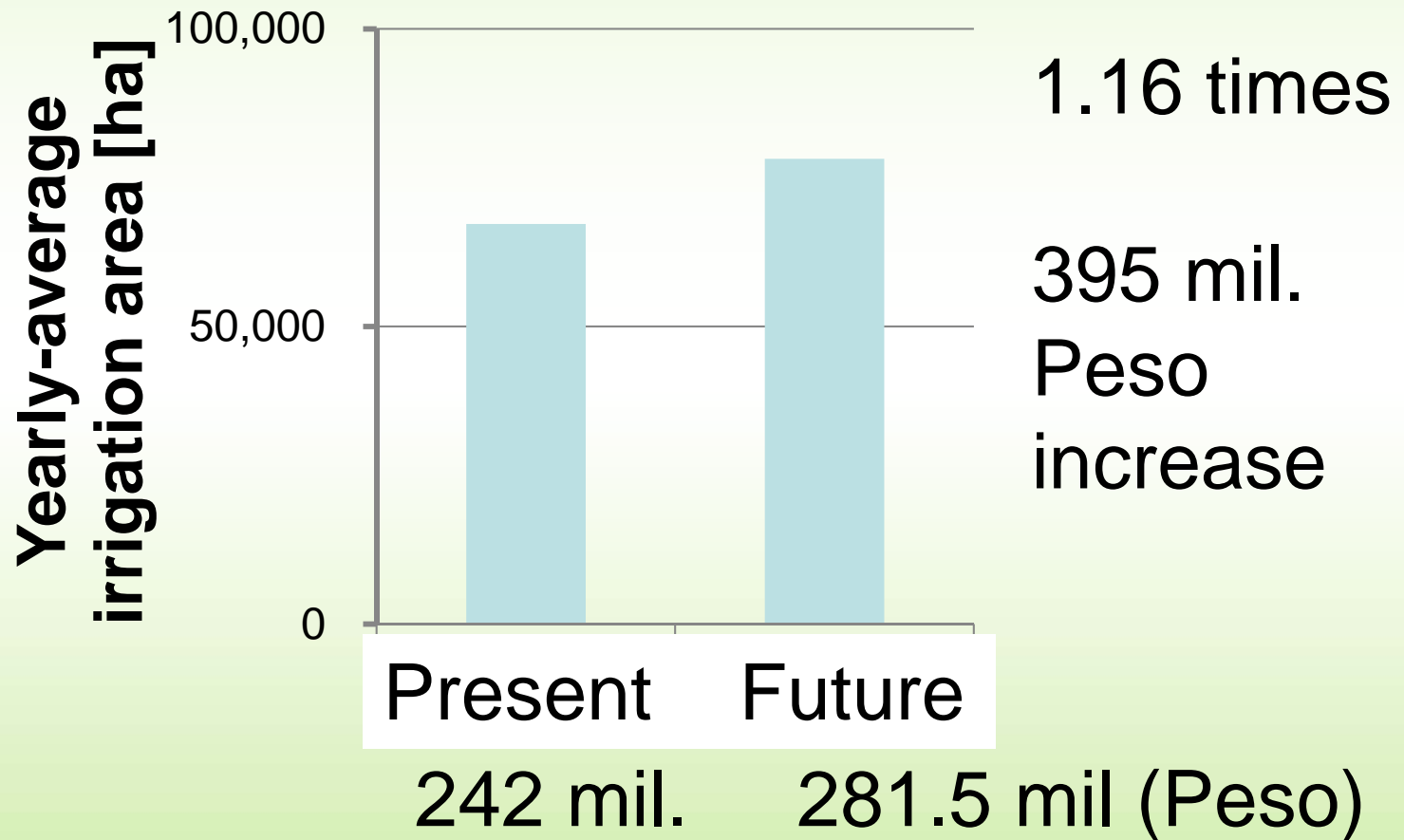


# Drought Risk: Verification of Runoff-reservoir model



Simulated successive change in storage of Pampanga dam reservoir in the past

# Expected yearly-average rice crop yield in dry season





***Thank you  
for your kind attention***