SOUSEI

Climate change signal got from co-working between climate modelers and impact study researchers

- Examples of Japanese domestic projects -

Izuru Takayabu et al.

8th Mar. 2016 @ 2016TCCIP-WS

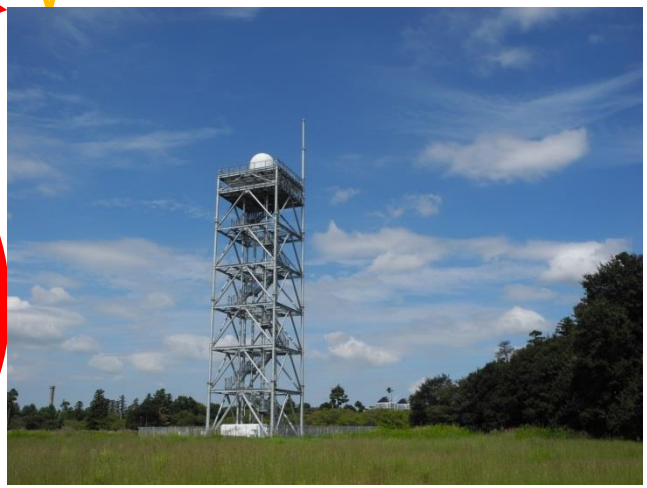
What is Down-scaling ?

Demand from end-users

Down-scaling is the procedure how to bridge suppliers and users

What we can grasp from CGCM (data suppliers)

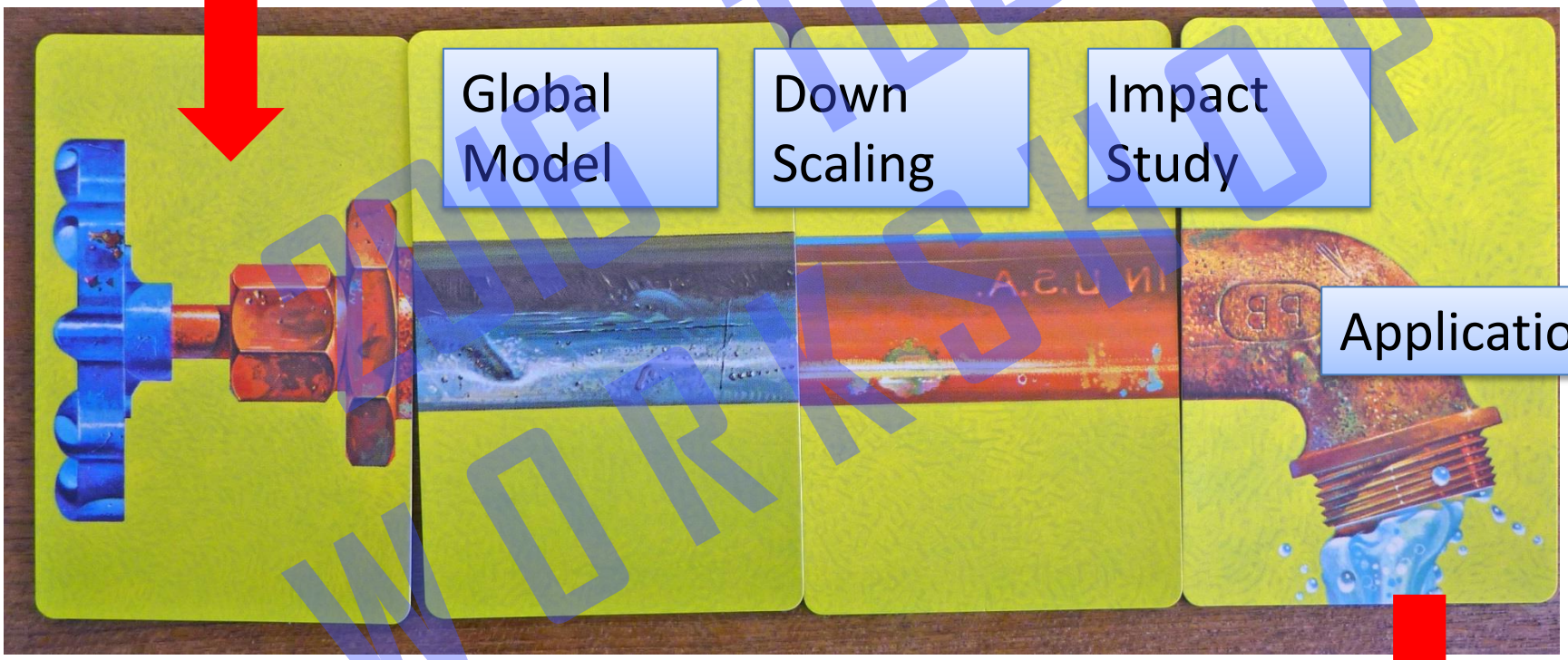
There is a large gap between them



The “linear model” of science and society

Research funding

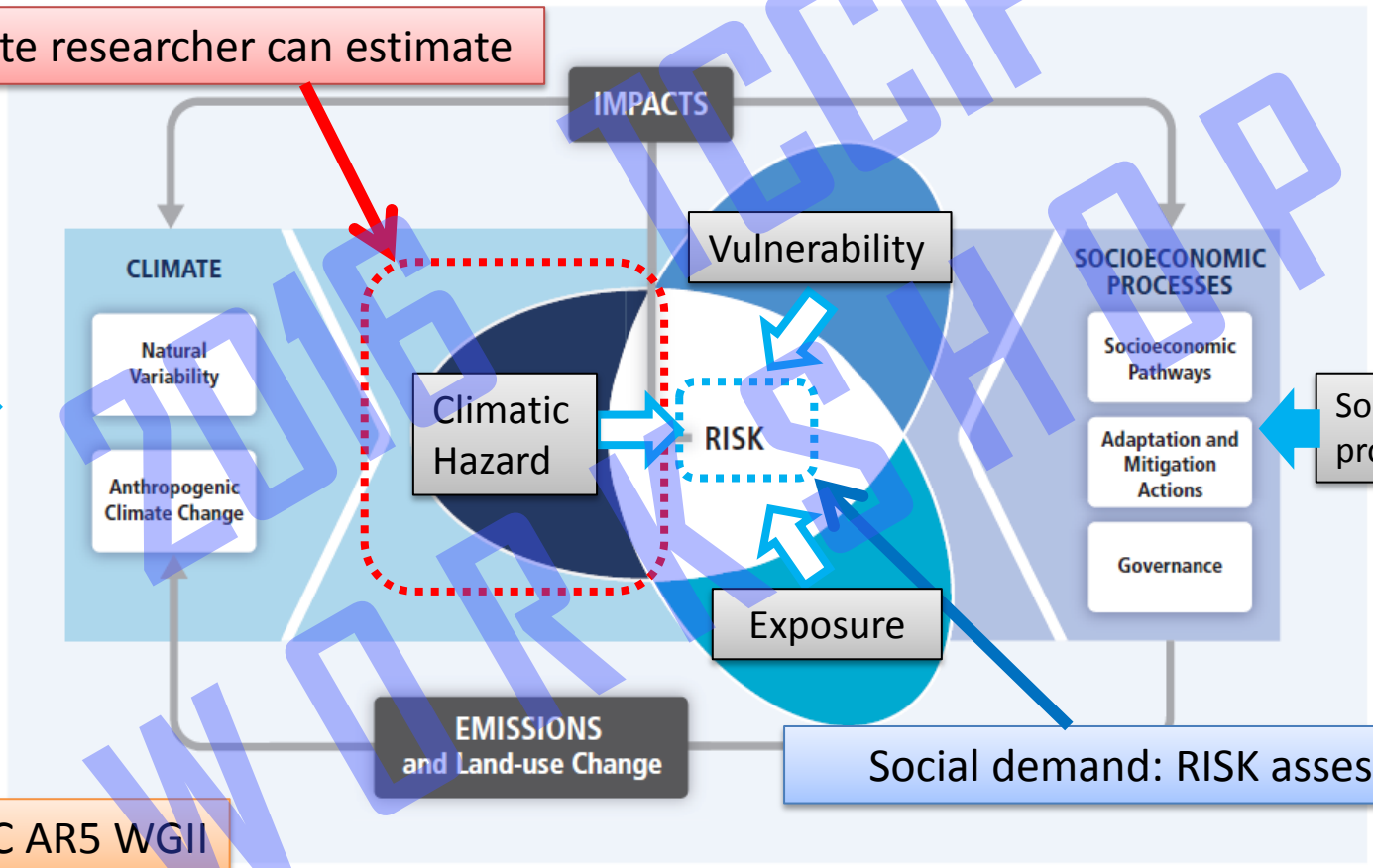
It works when these processes are perfect !



Social benefits

Climatic Hazards and Risk Assessment

What climate researcher can estimate



Climate

Socioeconomic processes

Social demand: RISK assessment

Figure of IPPC AR5 WGII

Situation is much more complicated

There are two kinds of approaches

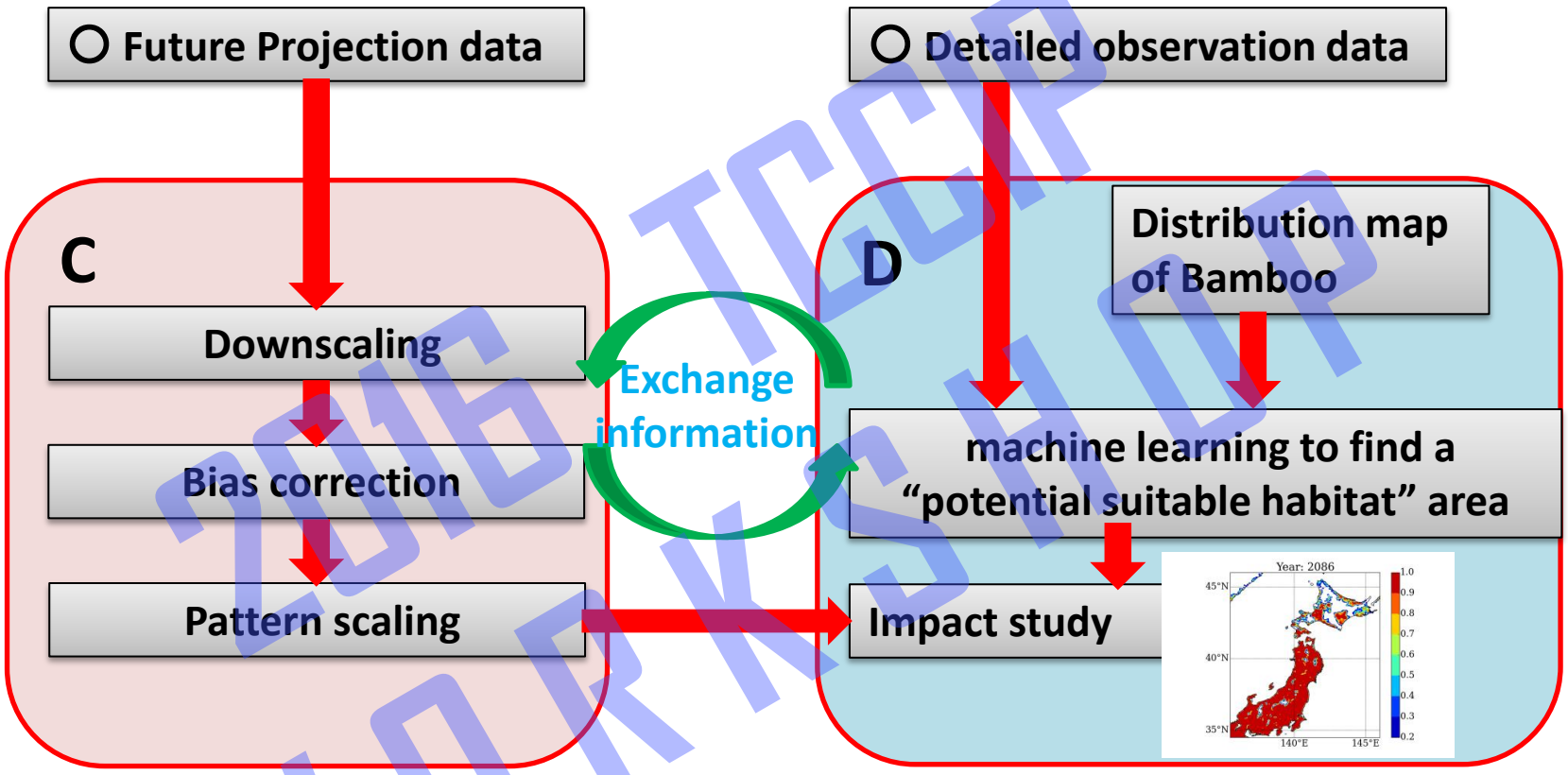
- (i) Look whole Japan Islands with a moderate resolution model
  - Here we can make an ensemble experiments, to increase the robustness of the result.
    - **Habitable zone of Bamboo groves, and Rice Blast occurrence**
- (ii) Find the worst case scenario by using very high resolution model.
  - By using very high resolution model, we can represent the details of the phenomena.
    - **Inundation caused by a super typhoon**

The change in “potential suitable habitat” area of Bamboo groves in Japan Islands

- Bamboo grows very first, and it becomes 5 to 25 m high within 2-4 months.
- Here we focus on Japanese Bamboo. This species is an invader in Japan.
- Bamboo groves, which are not controlled by farmers would break the ecosystem in Japan.

Now it restricts to the southern part of Japan Islands

To estimate the change in “potential suitable habitat” area of Bamboo groves in Japan Islands

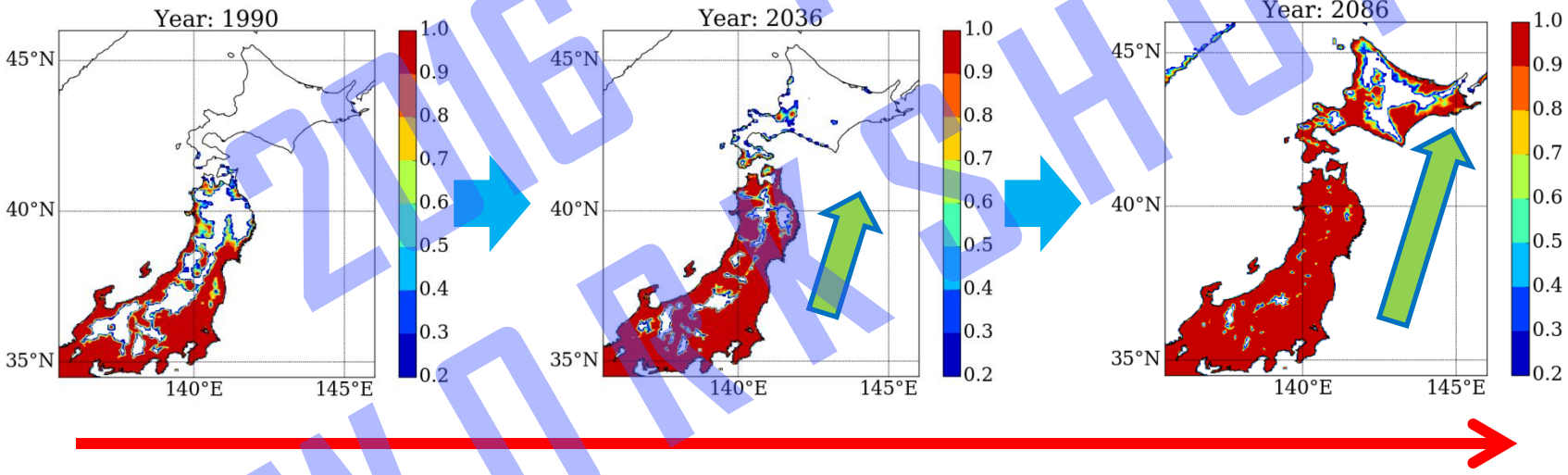


C. C. data suppliers

Impact Study Researchers

Change of habitable zone of Bamboo （RCP8.5 scenario）

1990 2036 2086



※ “Potential suitable habitat” area of Bamboo (red area) expand northward as time passed

Takano and Hibino in preparation

Rice Blast

An abundant crop of rice

To estimate the change Leaf Wetness of Rice in Japan Islands

○ Future Projection data

○ Detailed site observation data at some rice fields

SOUSEI

Select three models

Dynamical downscaling

Characteristics of precipitation

MEA FRE INT

Exchange information

RECCA

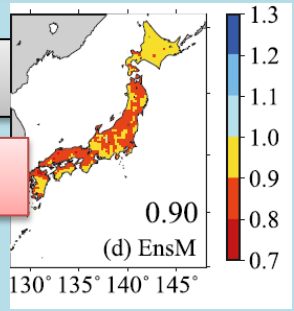
Validation

drive 2LM model

$$\frac{dM_i}{dt} = P_i - D_i - \frac{E_i}{\rho}$$

Impact study

LW



C. C. data suppliers

Impact Study Researchers

○ Mean precipitation increase

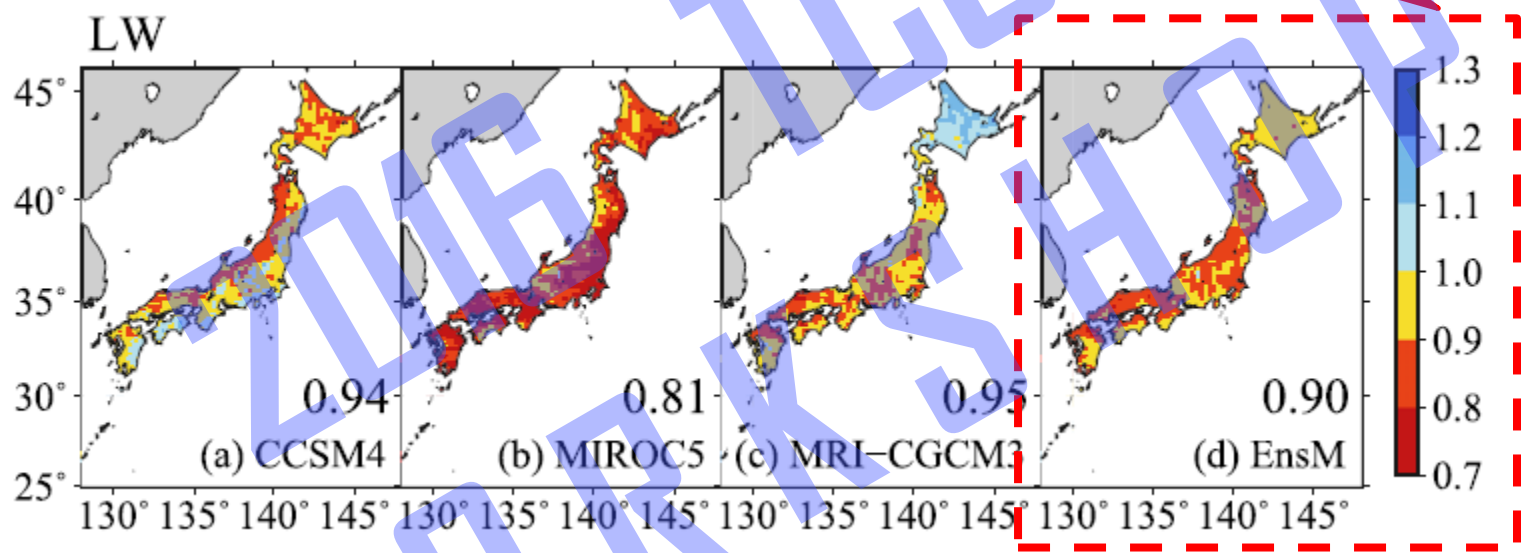
↓

○ Frequency decrease and intensity increase

↓

○ Leaf Wetness decrease

Mean value



↓

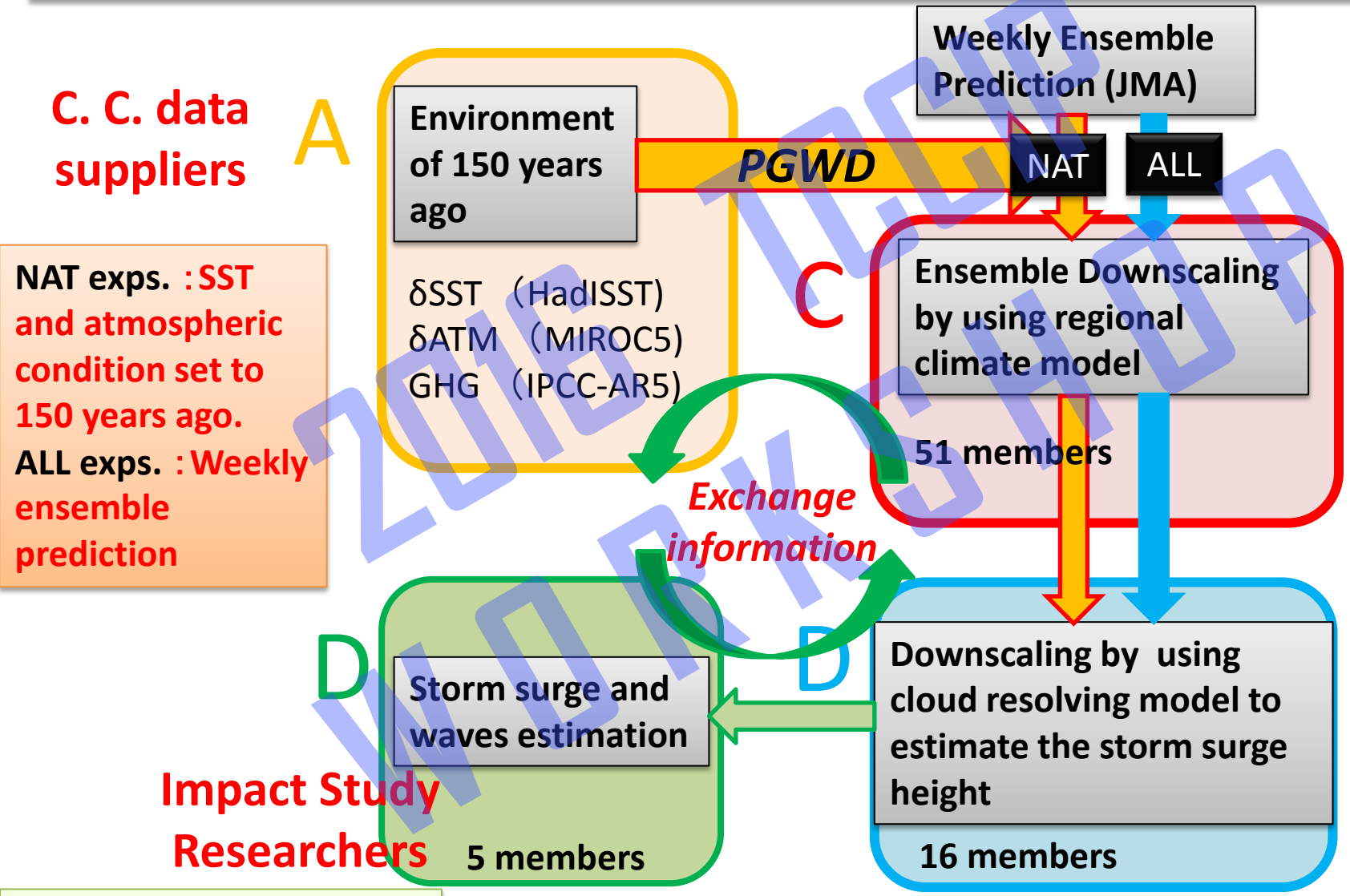
○ Reduce the Risk of Rice Blast in Japan

Yoshida et al., (2015) JAMC

“Conditional Event Attribution” to estimate the influence of C.C. to the storm-surge height of a super typhoon

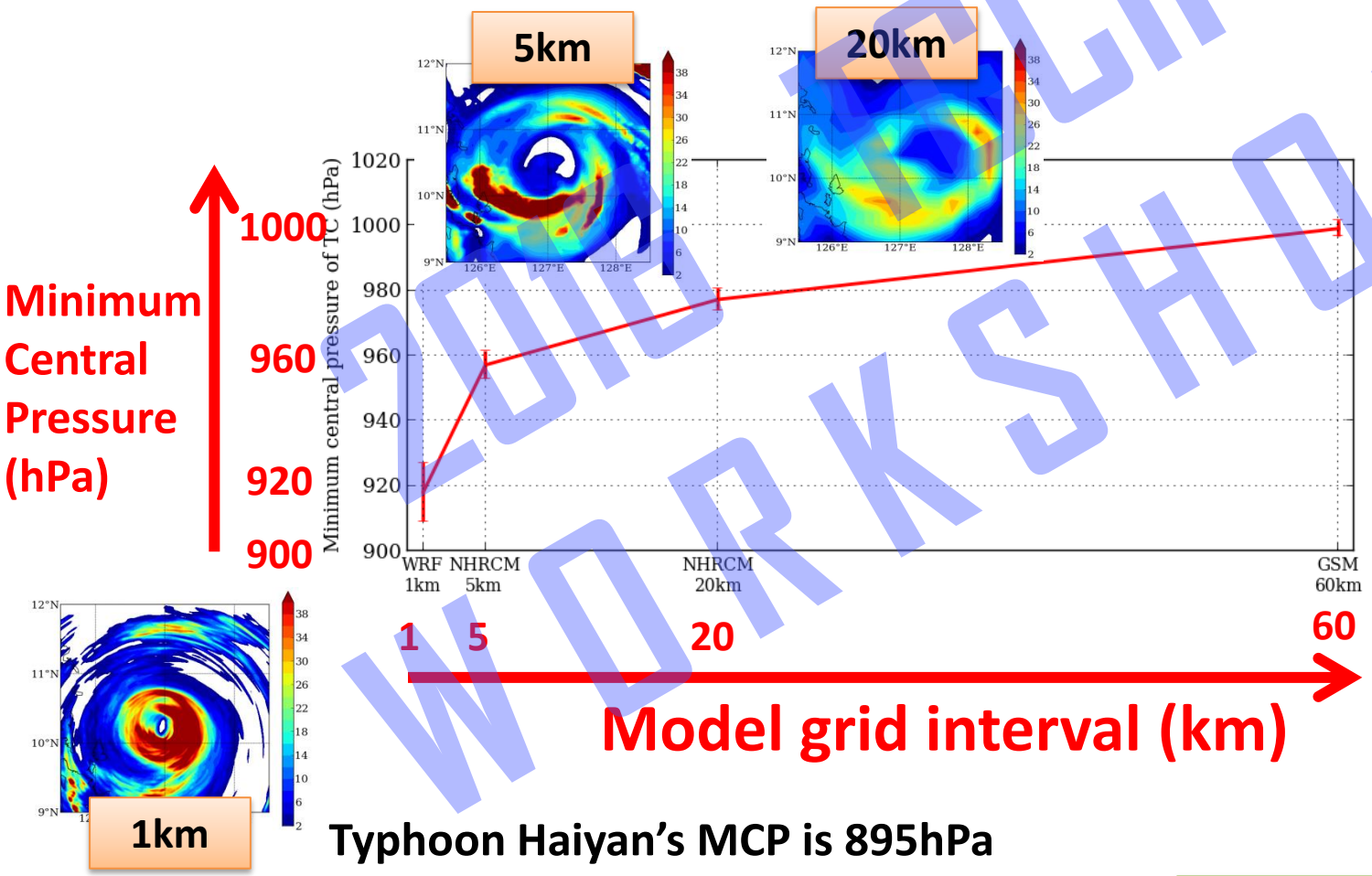
Takayabu et al., (2015ERL)

Climate change effects on the worst-case storm surge: A case study of Typhoon Haiyan



(Takayabu et al., ERL2015)

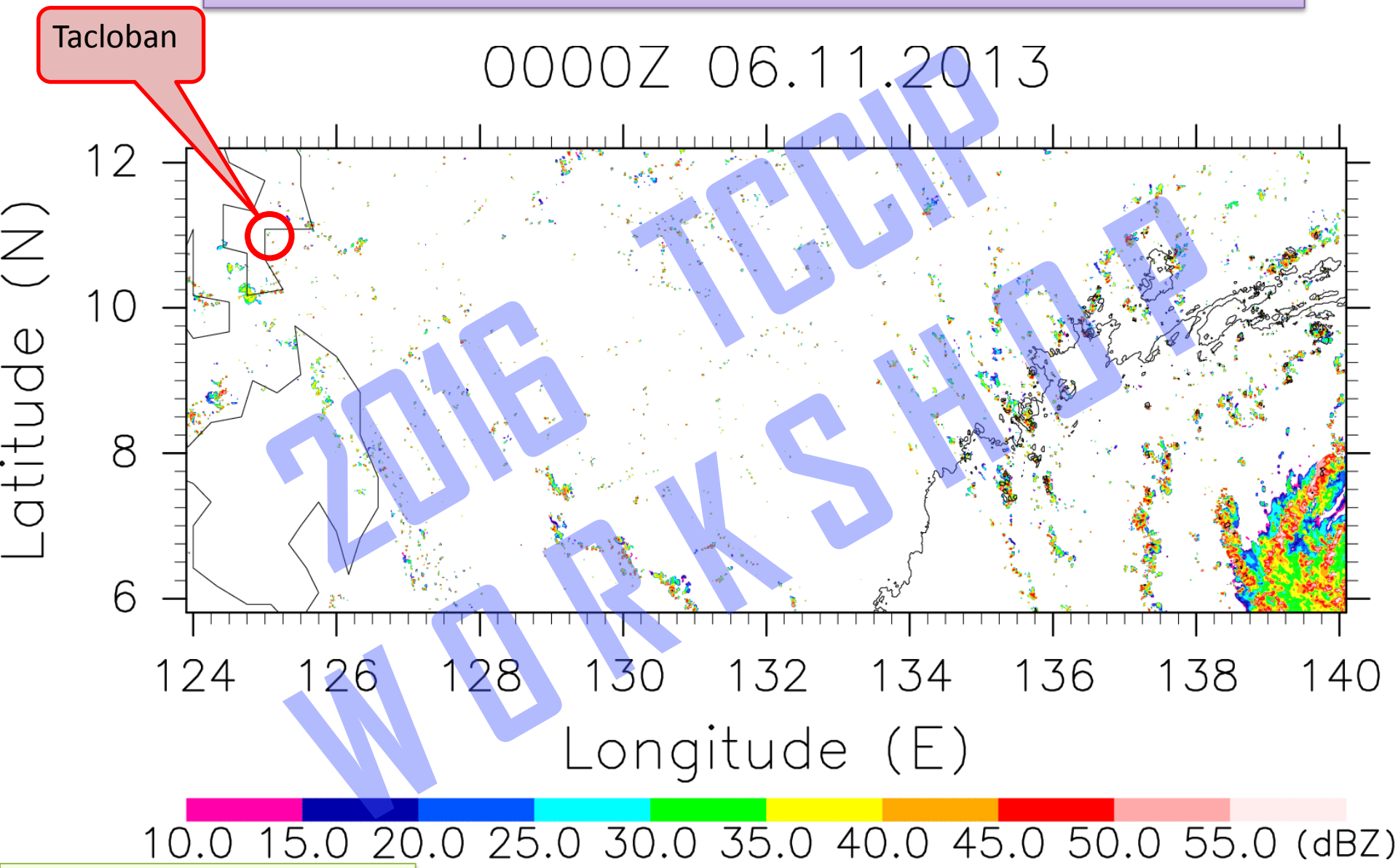
Minimum Central Pressure depending on the model resolution



Typhoon Haiyan's MCP is 895hPa (Estimated from Dvorak method))

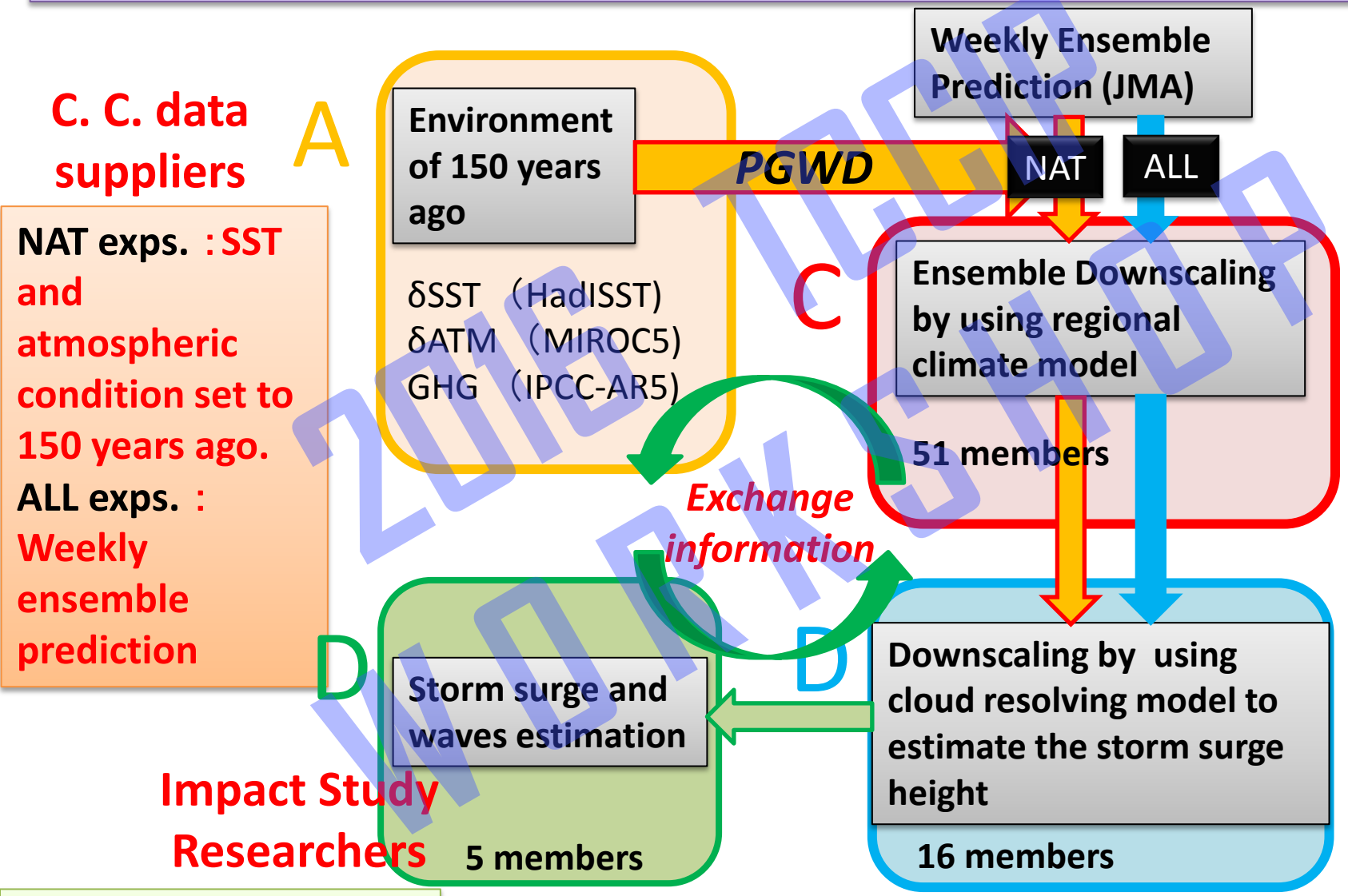
(Takayabu et al., 2015 ERL)

Typhoon Haiyan simulation (ALL 1km grid WRF)



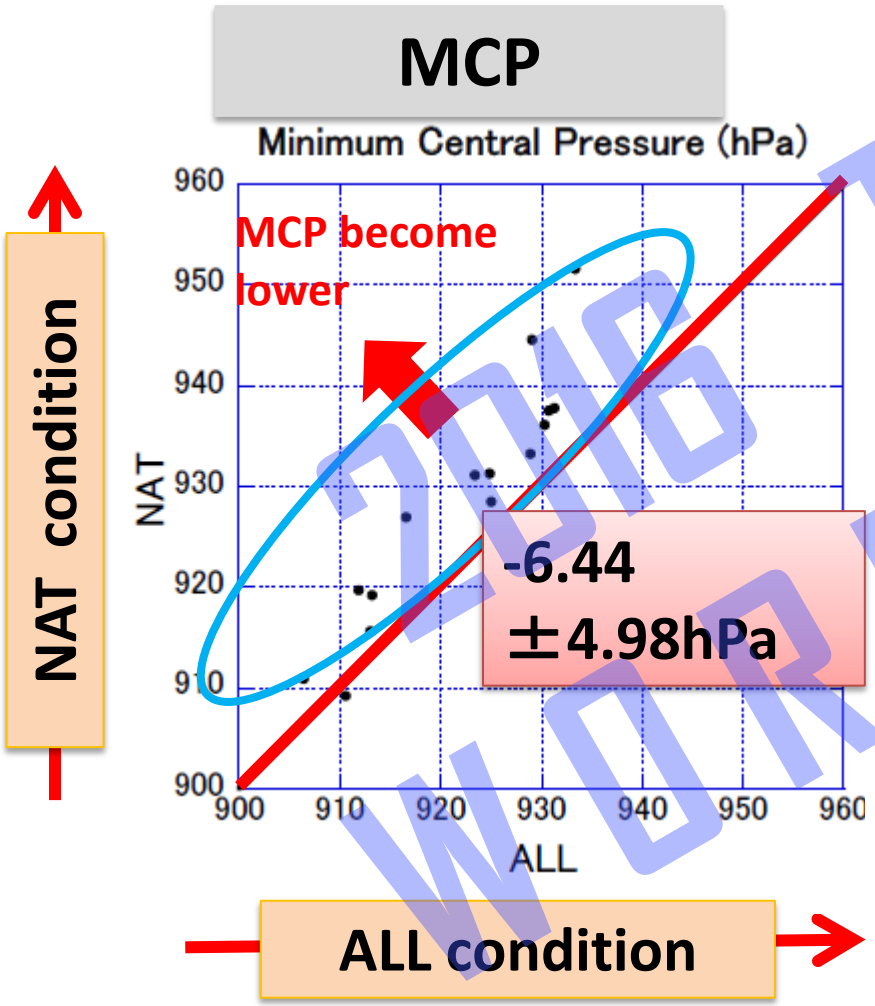
Takayabu et al., (2015) ERL

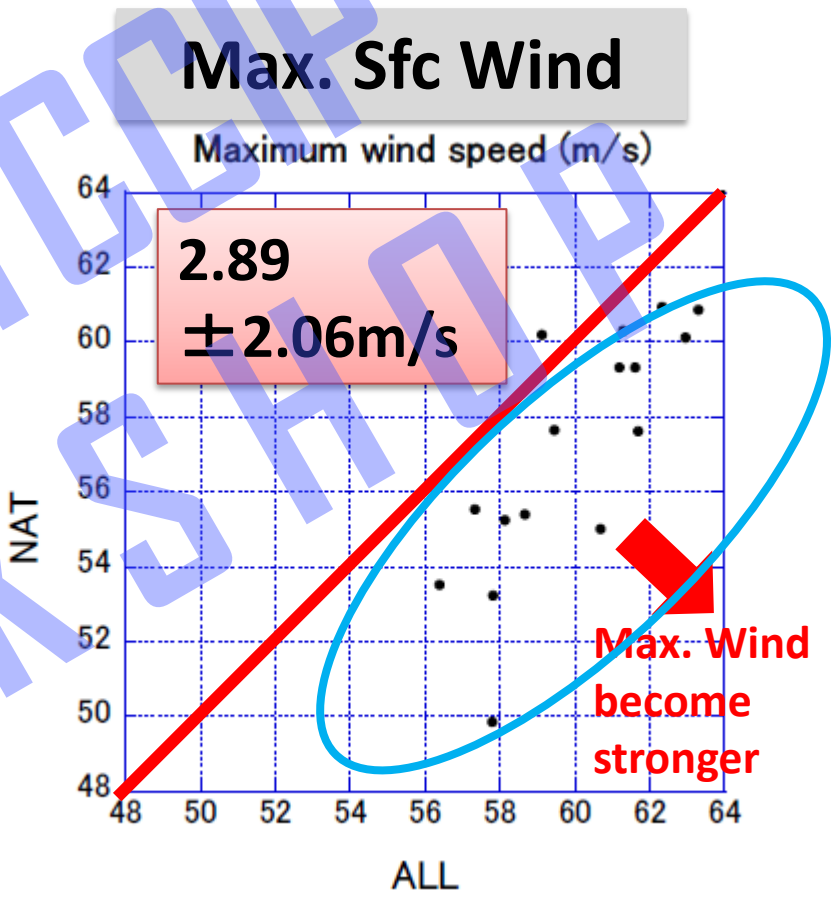
Climate change effects on the worst-case storm surge: A case study of Typhoon Haiyan



(Takayabu et al., ERL2015)

Comparison of MCP & Max. Surface Wind

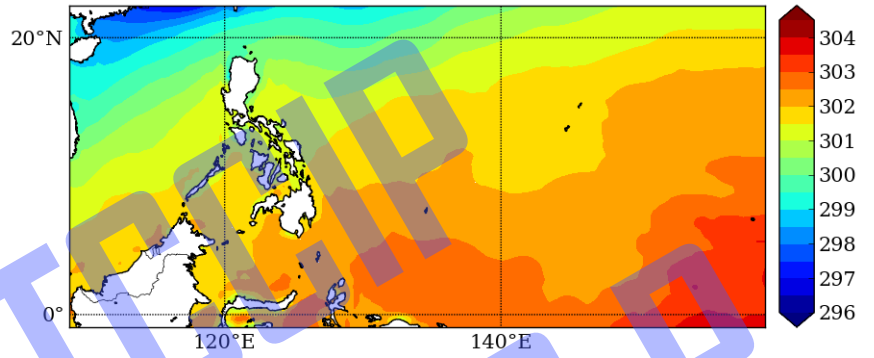




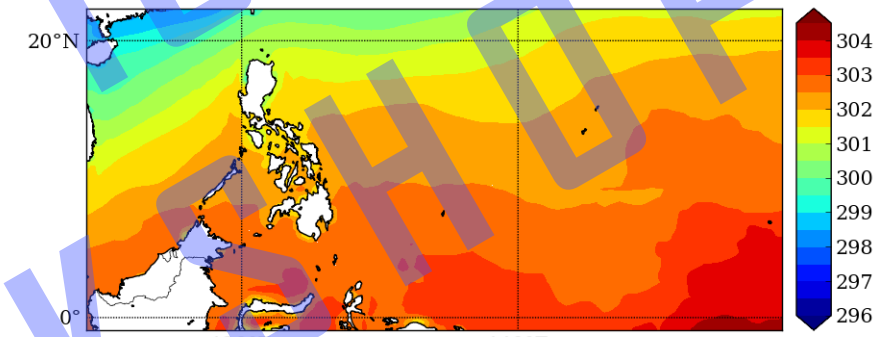
Takayabu et al., (2015) ERL

SST (HadISST)

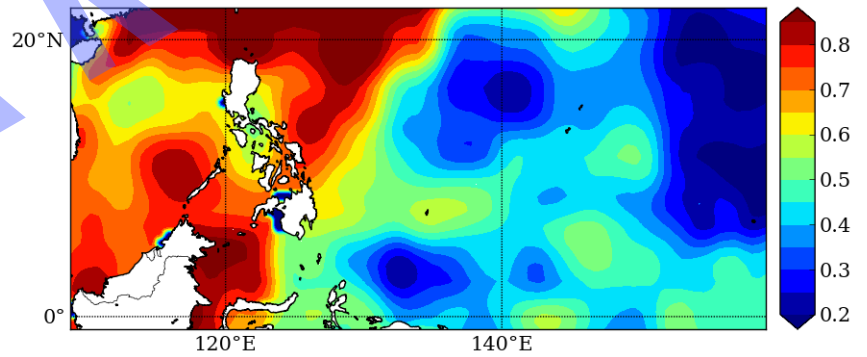
NAT



ALL



ALL - NAT



Takayabu et al., (2015) ERL

Numerical Model to estimate inundation

Forcing data

- Atmospheric field
  - MRI Model+WRF Downscaling

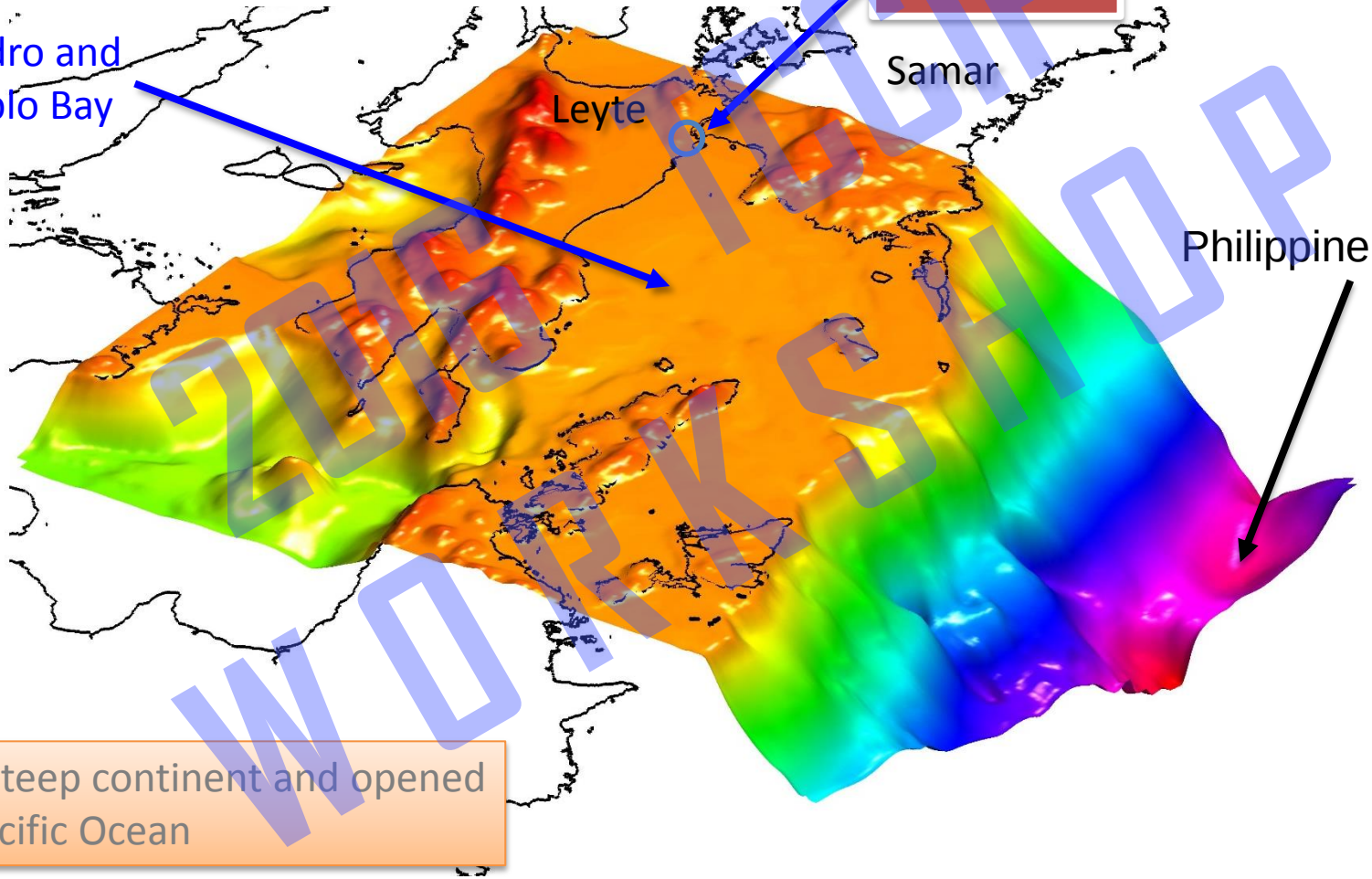
Storm surge and waves estimation

- Storm surge
  - Nonlinear shallow water equation (NSWE)
  - NSWE+SWAN coupling (SuWAT model; Kim et al., 2008)
  - ROMS-SWAN coupling model (Warner et al., 2010)
- Waves
  - Delft SWAN version 40.91

Takayabu et al., (2015) ERL

Bathymetry near Eastern Visayas

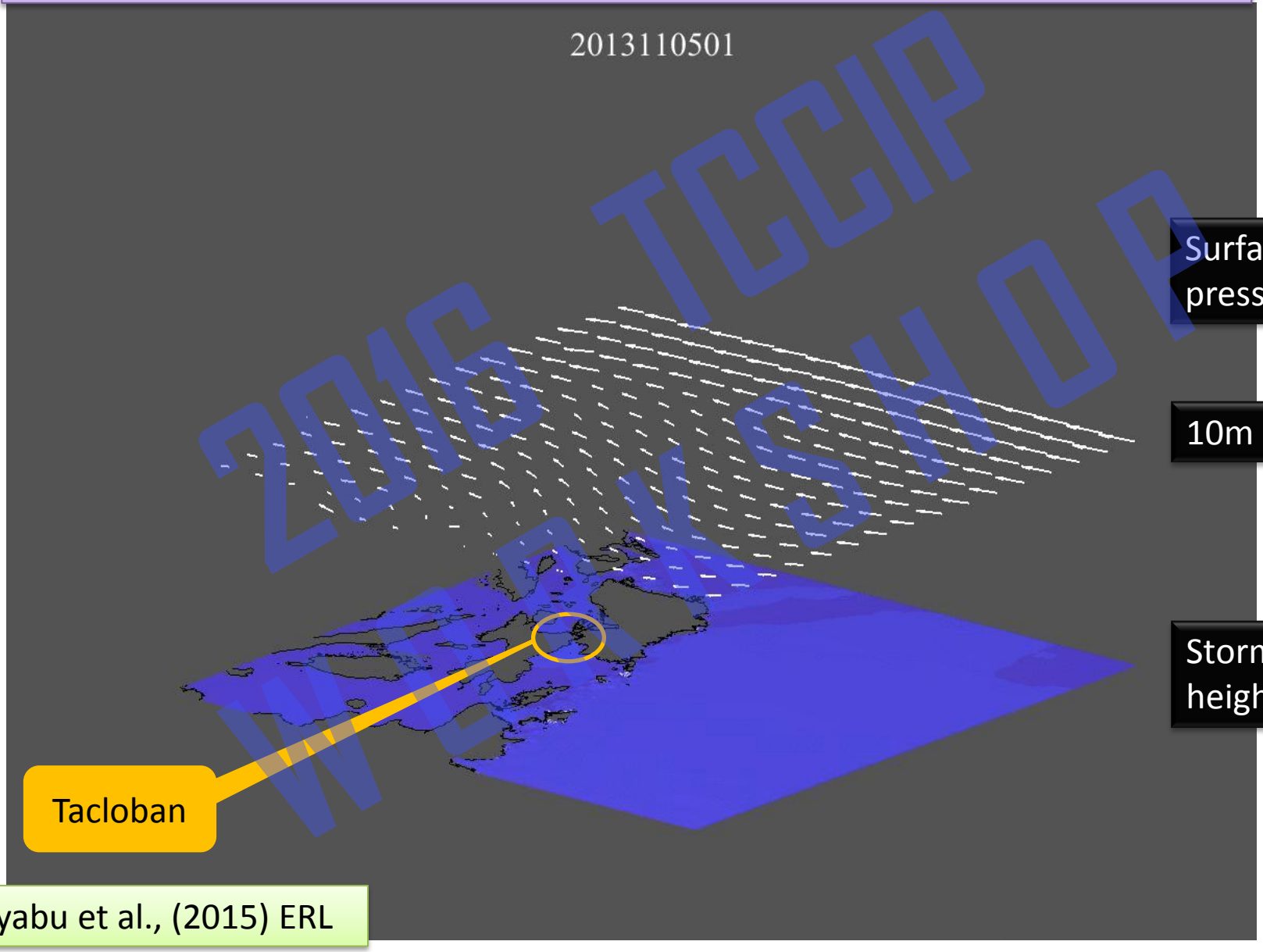
GEBCO_08 (30sec resolution) smoothed



Very steep continent and opened for Pacific Ocean

(Mori et al., 2014)

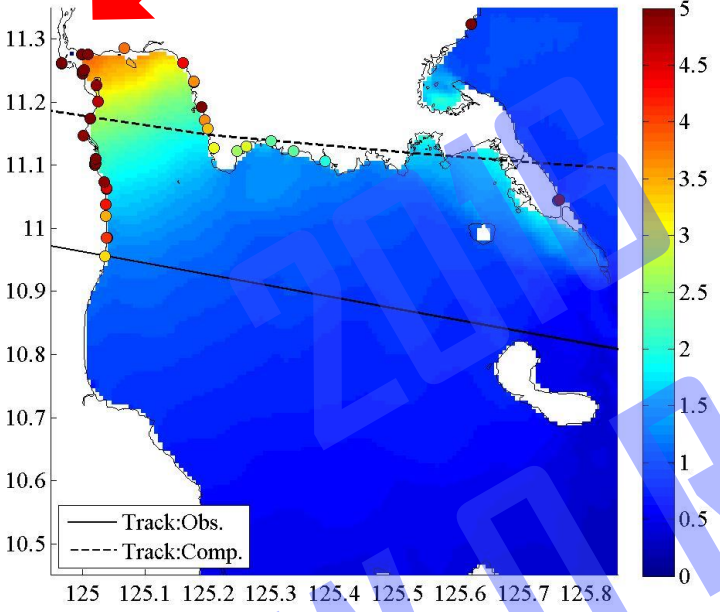
Storm surge caused by Haiyan
（ALL, case m02） SuWAT



Takayabu et al., (2015) ERL

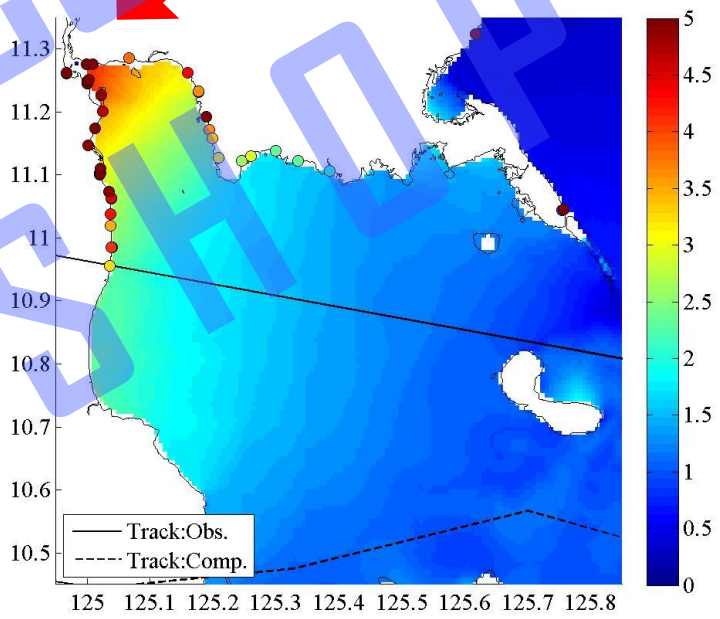
Change in strom surge height

Max. 3.8m
（Mean 2.19m）



NAT condition

Max. 4.27m
（Mean 2.60m）



ALL condition

Surge wave heights are higher in ALL experiments. (20%)

Takayabu et al., (2015) ERL

Climate change effects on the worst-case storm surge: a case study of Typhoon Haiyan

We can estimate the change in the worst case scenario in future, from these results

Pictures: Disaster caused by the storm surge of Typhoon Haiyan @Mori

※ It should be noted that changes in frequency of such events are not accounted for here

Summary

Climate Research

Look whole Japan Islands with a moderate resolution model

Find the worst case scenario by using very high resolution model

① The accuracy of the model results

② The data lists which can be delivered

Exchange Information

Impact Study Research

Estimate habitable zone etc.

Draw a hazard map etc.

①Who needs the information?

②What kind of information they need?

③What kind of impact study is needed?

④What kind of climatic information we need?