Downscaling of climate projections in Japan

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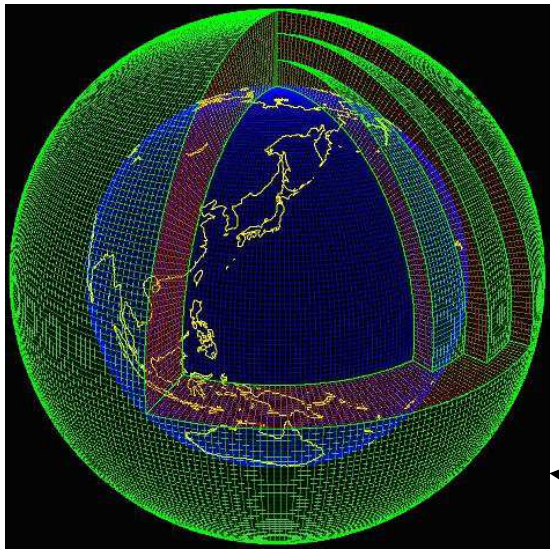
What is downscaling?

AO-GCMs



Bridging between the global climate model results and the impact studies

（1） Prepare fine scale data

（2） Prepare the data applicable for the impact study

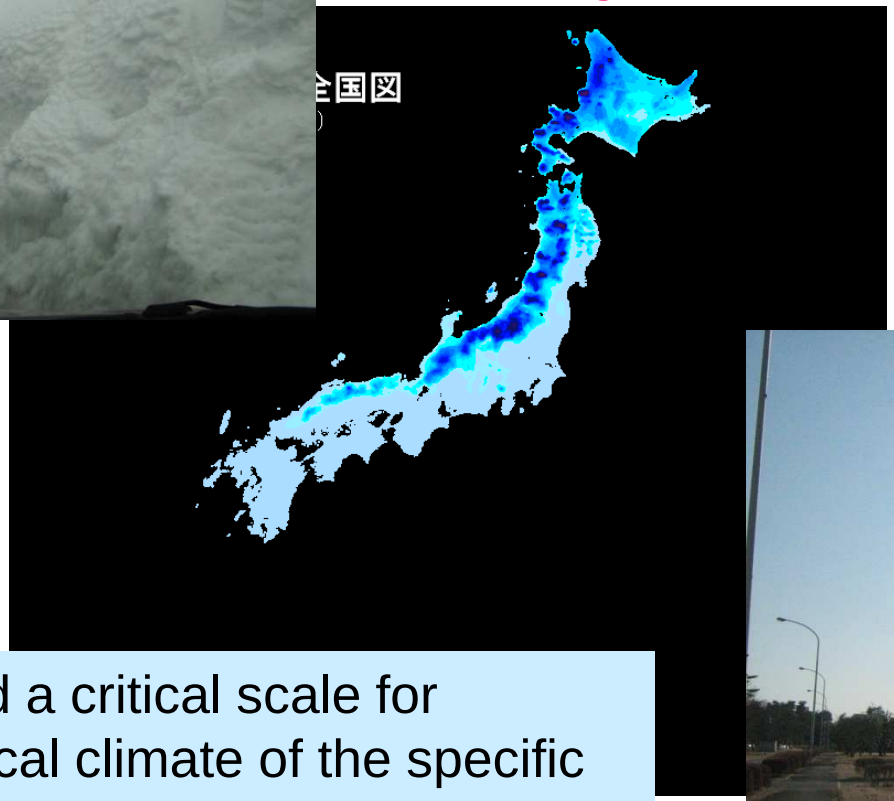
Downscaling by using RCM

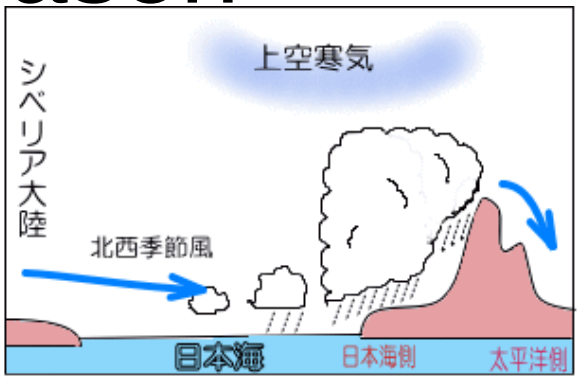
① Prepare fine scale data

Local climate around Japan of winter monsoon season

(@NIED)

Snow depth on February



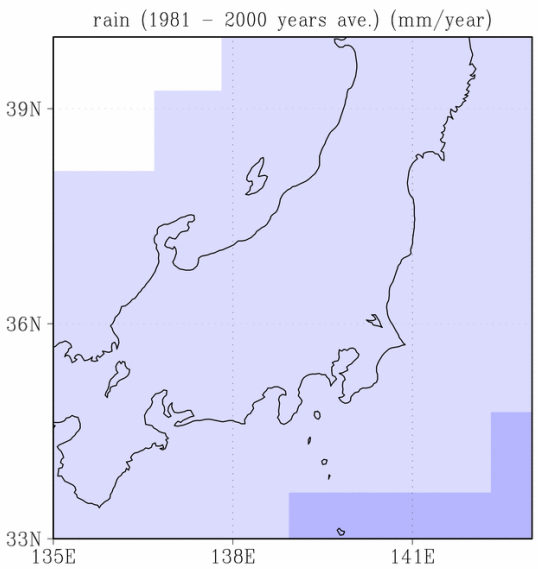


(Iizuka, 2008)

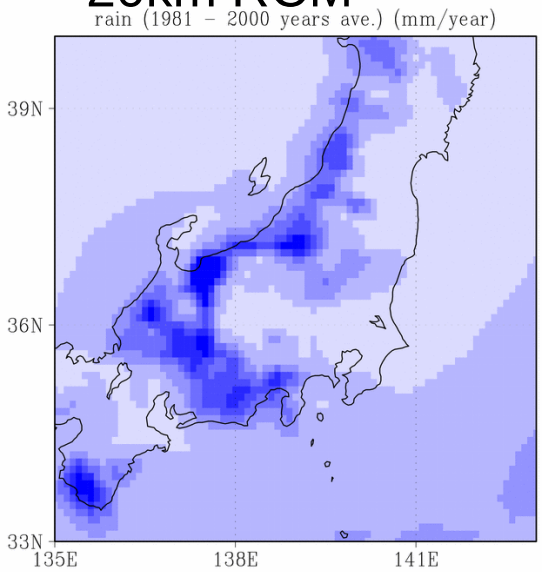
We need to find a critical scale for representing local climate of the specific region.

Influence of horizontal resolution on the representation of annual total precipitation

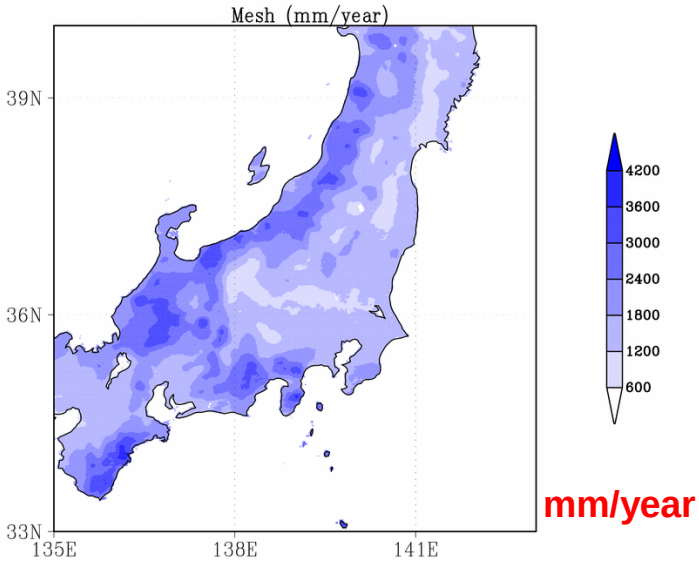
Global re-analysis data (JRA-25) (grid size is about 100km)



DDS by using 20km RCM



Observation



mm/year

We need at least 20km grid model to represent the local climate contrast of Japan Islands.

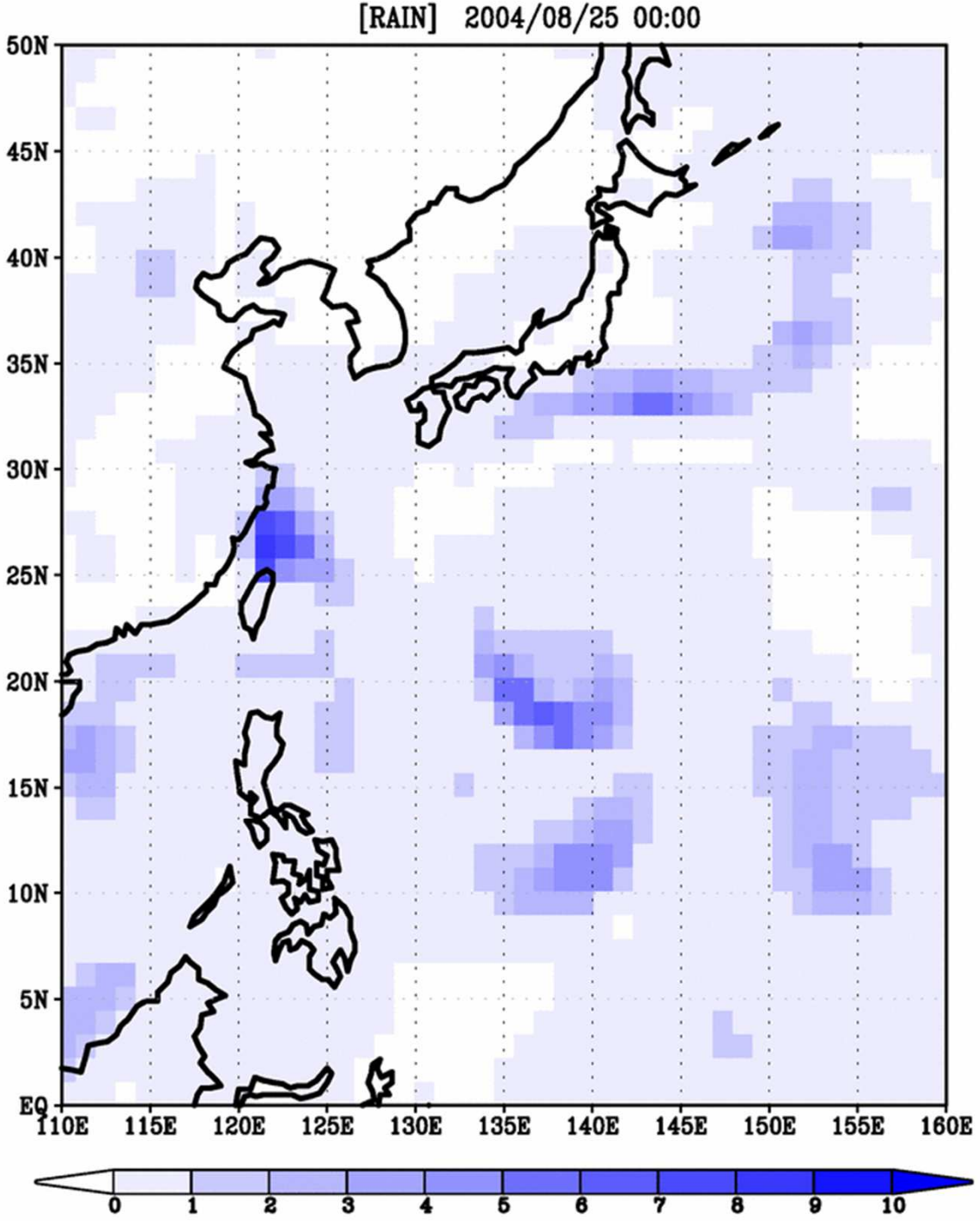
Representation of meso-scale phenomena through dynamical downscaling

∗ Re-analysis data

∗ prec. mm/hr)

∗ A typhoon is approaching to Japan

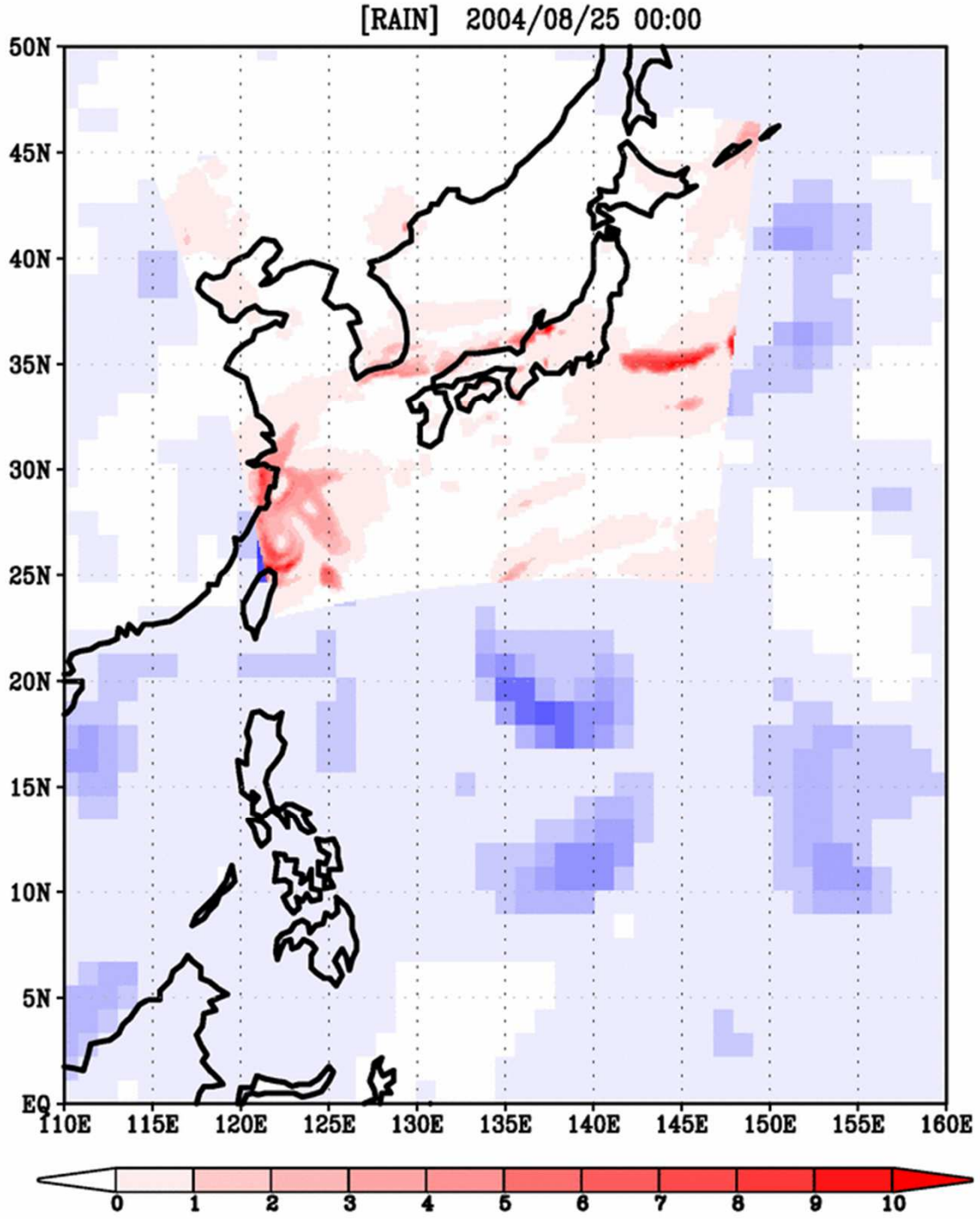
Fine mesh model has potential of representing meso-scale phenomena. This is another advantage of applying dynamical downscaling method.



Representation of meso-scale phenomena through dynamical downscaling

＊Red area indicate the DS area
＊rec.(mm/hr)
＊A typhoon is approaching to Japan

Here, fine structure of a typhoon crossing the Japan Islands is represented by using dynamical downscaling method.

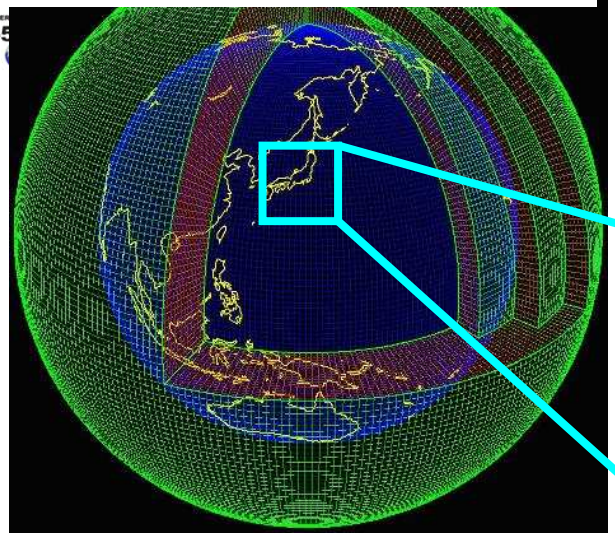


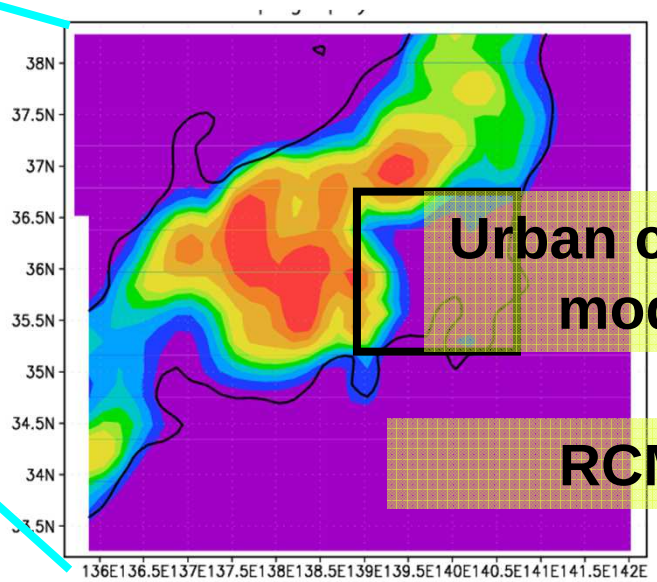
Downscale
in the urban / rural area

② Prepare the data applicable
for the impact study

Multi level downscaling

Global model result

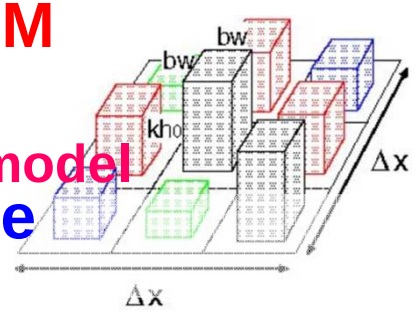




We nested the fine scale model into a coarse mesh model if we want to see much more fine scale !

RCM

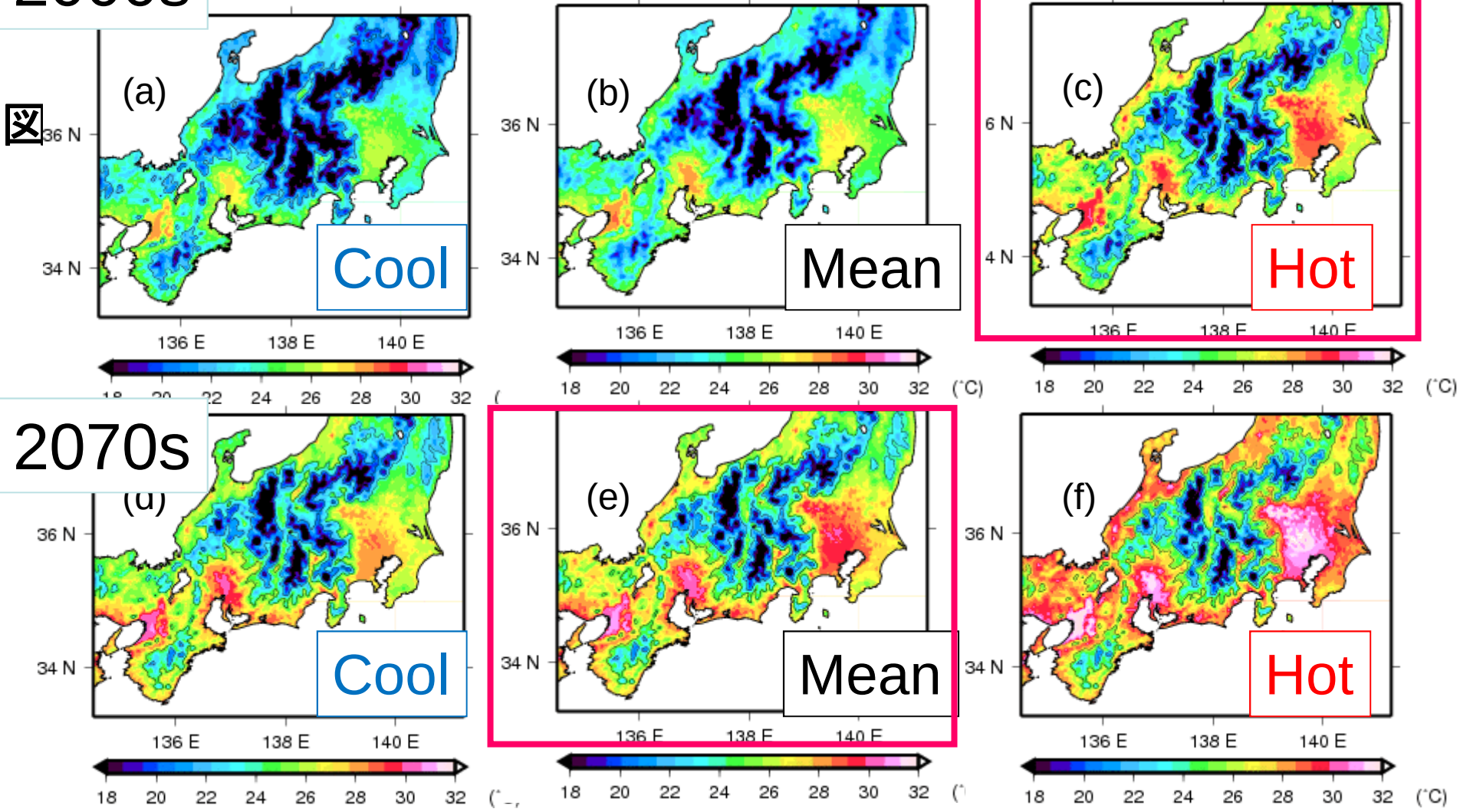
UC model



◎ This method is valuable for downscale the urban climate

Cool・Mean・Hot Summer in the model

2000s



The mean value of the 2070s is about the same with the hottest year in 2000s

Kusaka et. al., 2012

How to apply these data ?

- The impact studies of
  - Heat disease
  - Infectious disease
  - Food poisoning

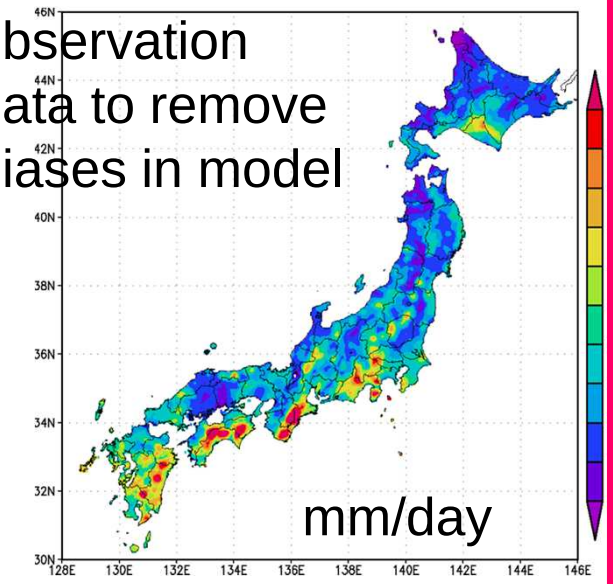
  etc.

  around the urban area

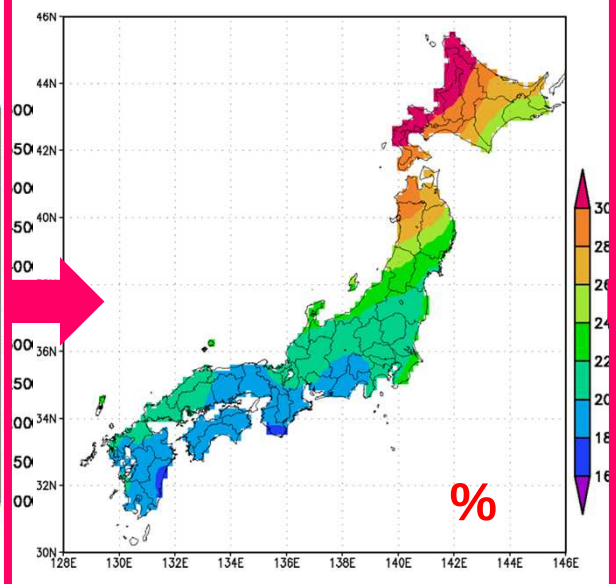
Extreme rainfall amount (return period 100 years)

APHRO-JP
(Present value)

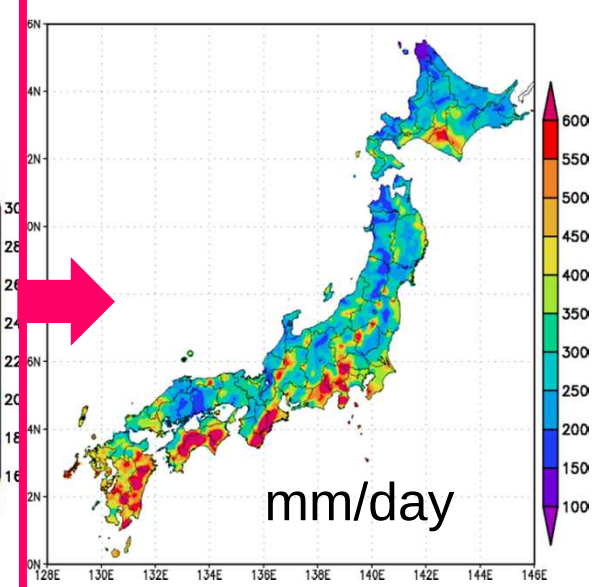
Use observation data to remove biases in model



Change of ratio in 60km AGCMs data



Future projection



Take average over 10 grids by 10grids to get enough accuracy

(Kamiguchi, 2012)

KAKUSHIN

What we need to do when we apply the DS data for the impact study are･･･

- To remove biases as will be done in SDS.
- To handle the extreme value with the coarser resolution.
- To handle the data statistically only, not to handle them as a case study.

Conclusion

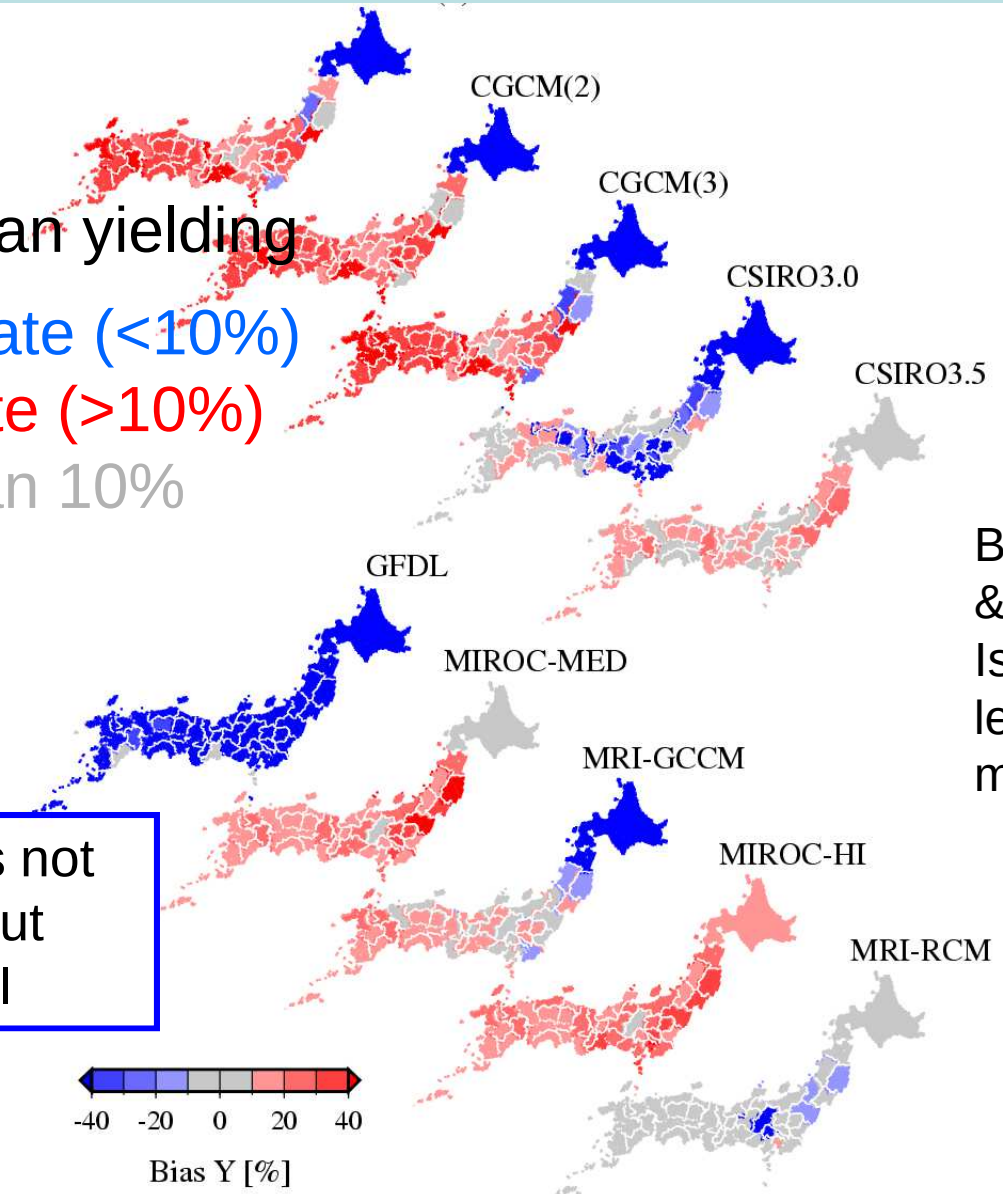
Downscaling project aims to bridge between the projection results and the impact studies

For this purpose, we have done the following two things

① **Prepare fine scale data**

② **Prepare the data applicable for the impact study**

Needs of correct bias, to use the data for crop yielding model (PRYSBI).



RowT_RowS

20 years mean yielding

Under estimate (<10%)

Over estimate (>10%)

Bias less than 10%

Biases less than 1C in T & less than 5% in S
Is required for the error less than 5% in PRYSBI model

Row data looks not work as the input data of PRYSBI

Iizumi, Nishinori and Yokozawa (2009) @ NIAES (National Institute for Agro-Environment Sciences)

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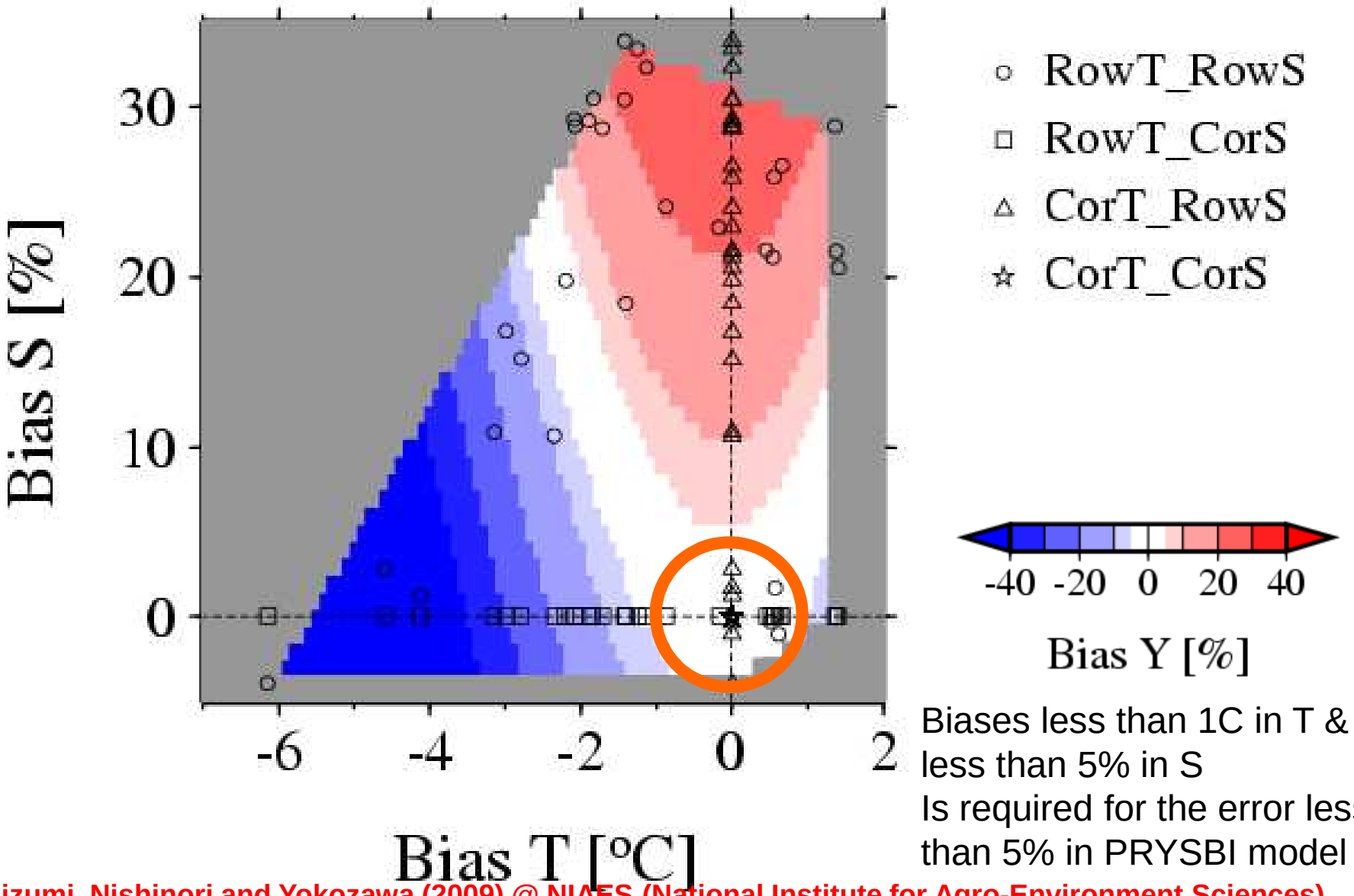

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Hybrid system using DDS and SDS

- In some cases, it is more reliable to apply SDS rather than DDS (Dynamical Down Scaling). In such cases, we have to think of the parallel, or the hybrid system of DS.
- To do SDS (Statistical Down Scaling), we need the observation data of the strict point.