Thursday, March 24
Session4:Localizing Climate Information

Introduction of Dynamical Regional Downscaling (DSJRA-55) Using the JRA-55 Reanalysis and Discussion for Possibility of its Practical Use

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Introduction

The Japan Meteorological Agency (JMA) has conducted a dynamical regional downscaling for the period of 1958-2012, called DSJRA-55, based on JMA's operational mesoscale model with 5-km horizontal resolution and global atmospheric reanalysis (the Japanese 55-year Reanalysis ; JRA-55).

DSJRA-55 reproduces extreme weather events caused by the topography and their long-term changes in Japan.

We will discuss possibility of practical use of the data in agricultural and various industrial fields.

KEYWORD
Climate risk assessment and management,
Dynamical regional downscaling, Extreme weather events ,
Long-term changes of climate. Probable precipitation value

Outline

1. The DSJRA-55 system

2. Evaluation of DSJRA-55

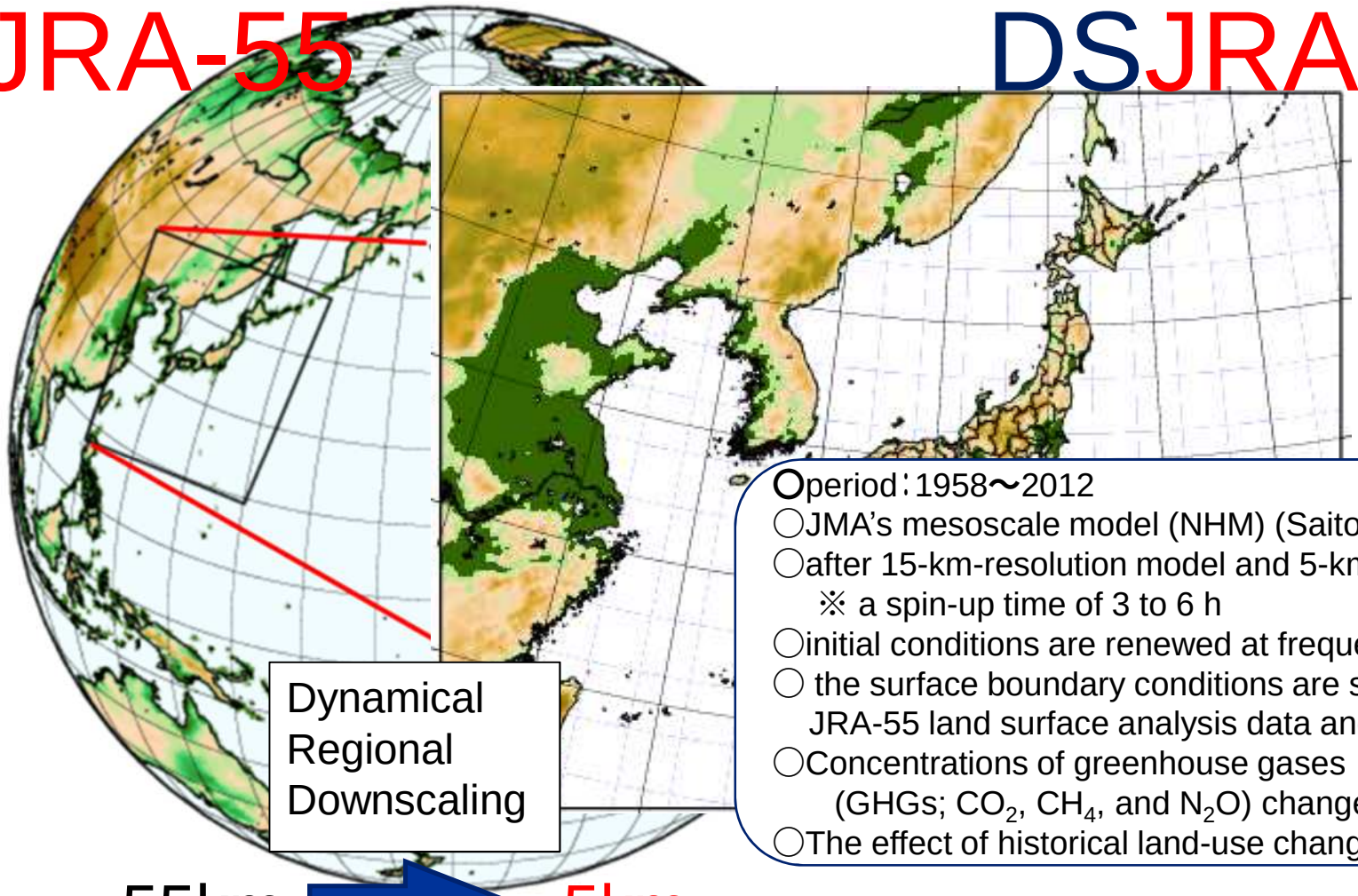
3. Application of DSJRA-55 to past events

4. Summary

The DSJRA-55 system

JRA-55

DSJRA-55



Dynamical Regional Downscaling

Resolusion:55km → 5km

- period：1958～2012
- JMA's mesoscale model (NHM) (Saito et al 2006)
- after 15-km-resolution model and 5-km-resolution
  ※ a spin-up time of 3 to 6 h
- initial conditions are renewed at frequent intervals
- the surface boundary conditions are set using JRA-55 land surface analysis data and COBE-SST
- Concentrations of greenhouse gases (GHGs; CO_2, CH_4, and N_2O) change over time.
- The effect of historical land-use changes

JRA-55

(The Japanese global reanalysis conducted by JMA)

JMA http://jra.kishou.go.jp/

DIAS http://dias-dss.tkl.iis.u-tokyo.ac.jp/acc/storages/filelist/dataset:204

NCAR Daily 3-Hourly and 6-Hourly Data http://rda.ucar.edu/datasets/ds628.0/

Monthly Means and Variances http://rda.ucar.edu/datasets/ds628.1/

JRA-55 data are available from Website

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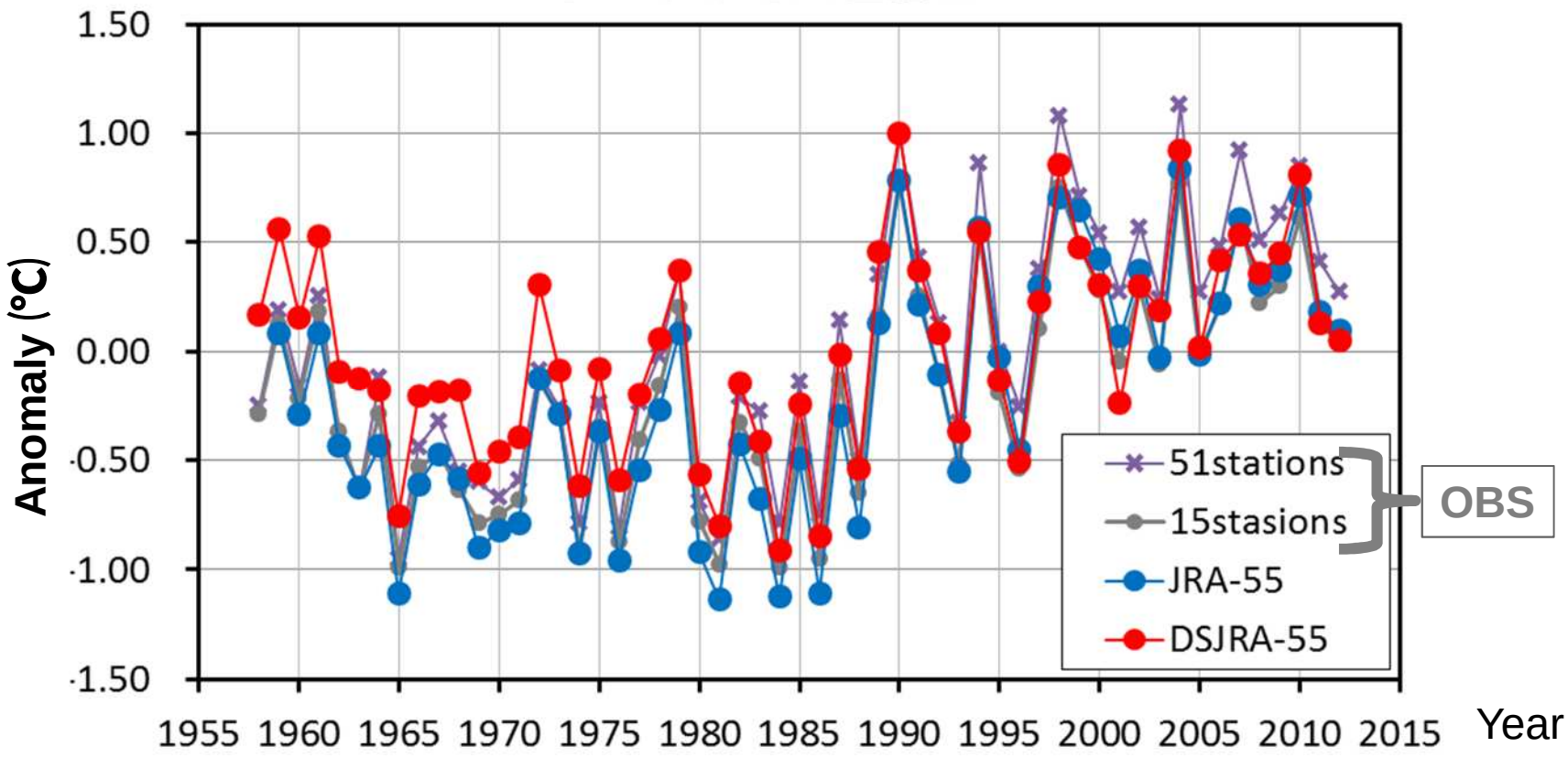
Annual mean temperature anomalies in Japan

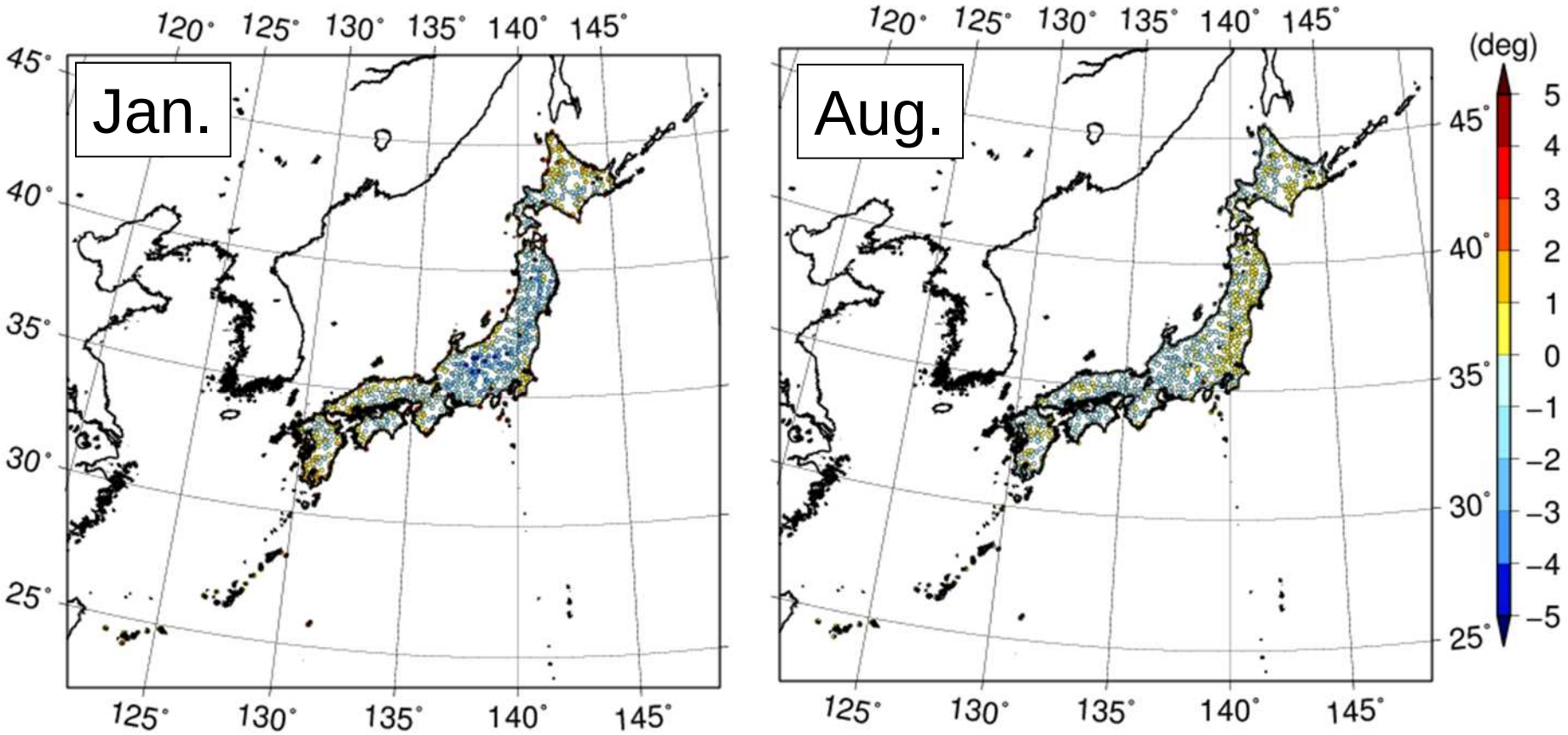


Time series of annual mean temperature anomalies of observation (gray), JRA-55 (blue), and DSJRA-55 (red).

The long-term trend is captured well and is similar in those datasets.

◯51 stations : Average of 51 stations obs. used for monitoring global warming
◯15 stations : Average of 15 stations obs. used for monitoring global warming with little effect of urbanization
◯JRA-55 : Latitude weighted average for grids (ratio land/(land+sea) > 0.5) in Japan
◯DSJRA-55: Average of 14080 land grids in Japan

Monthly mean temperature biases compared with the climatology

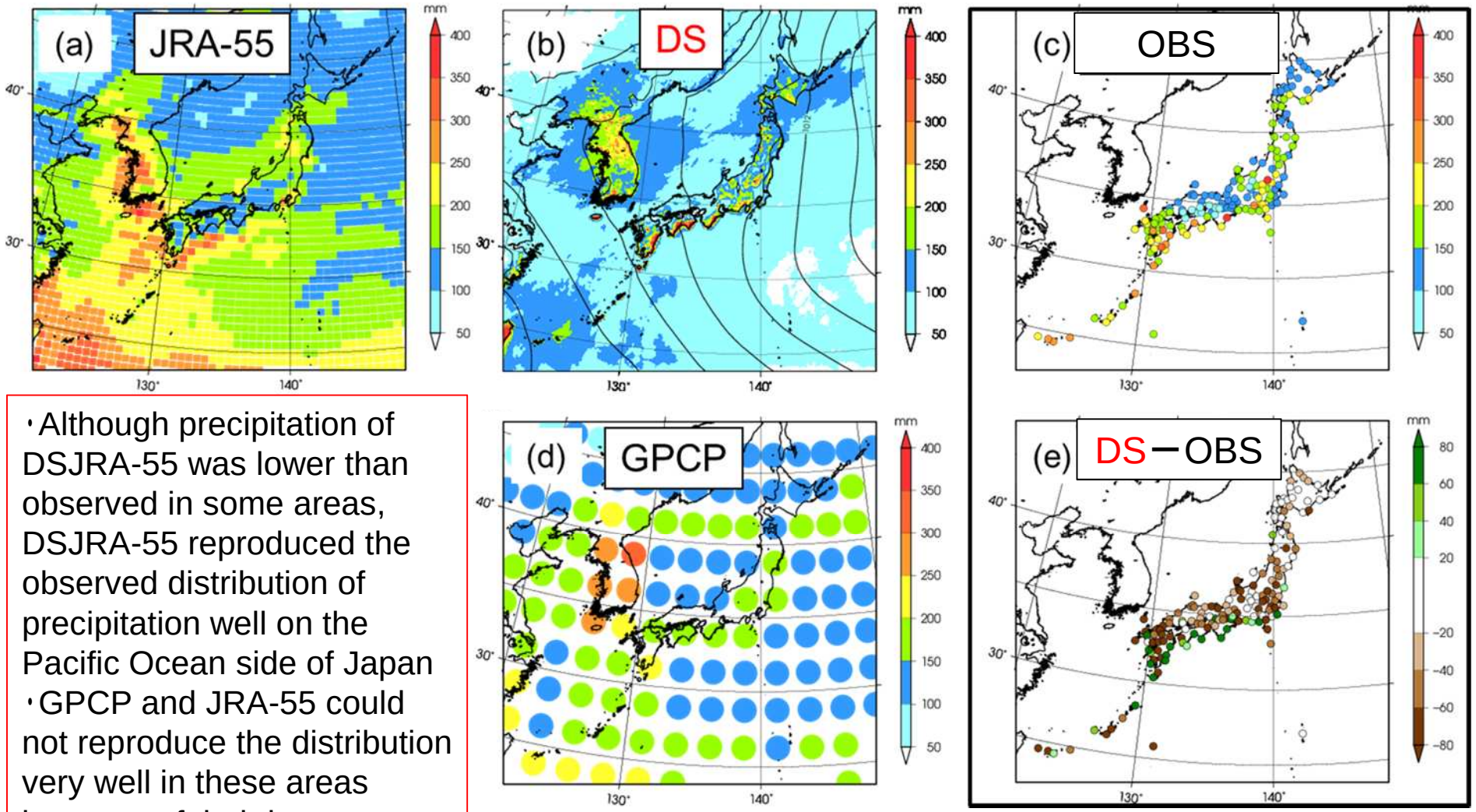


Monthly DSJRA-55 temperature biases (DSJRA-55 – observations) in Japan

These biases may reflect a systematic bias of the mesoscale model we used or boundary conditions such as SST and so on.

Climate: 30-year mean from 1981 to 2010

Monthly mean precipitation biases compared with the climatology（August）

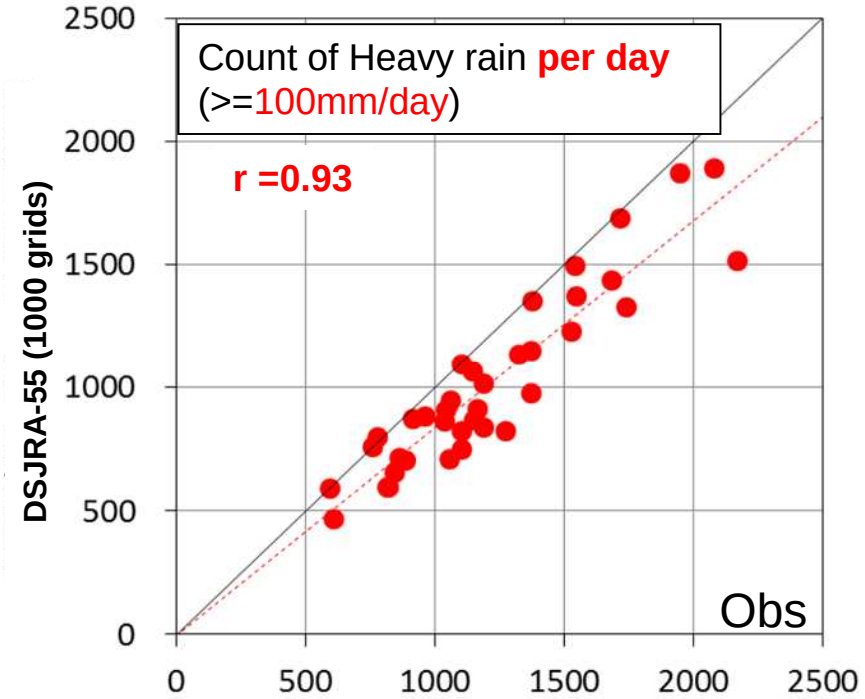


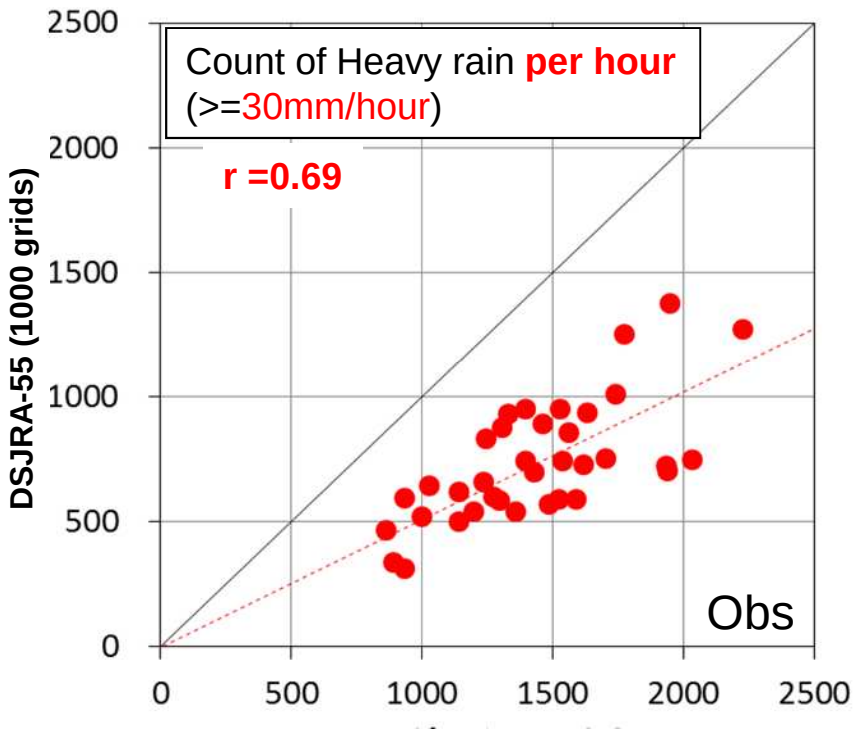
・Although precipitation of DSJRA-55 was lower than observed in some areas, DSJRA-55 reproduced the observed distribution of precipitation well on the Pacific Ocean side of Japan
・GPCP and JRA-55 could not reproduce the distribution very well in these areas because of their low resolutions.

(a) JRA-55; (b) DSJRA-55; (c) observations; (d) GPCP estimations;
(b) and (e) difference between DSJRA-55 and observed.

GPCP ;the Global Precipitation Climatology Project (Adler et al. 2003)

Evaluation of the reproducibility of extreme precipitation events





frequencies of 1300 observational stations per 1000 and DSJRA-55 14080 land grid cells per 1000 are compared during 1976–2012.

DSJRA-55 reproduced the observed distribution of extreme precipitation events well. But it may underestimate orographic precipitation, especially the frequency of heavy rain per hour.

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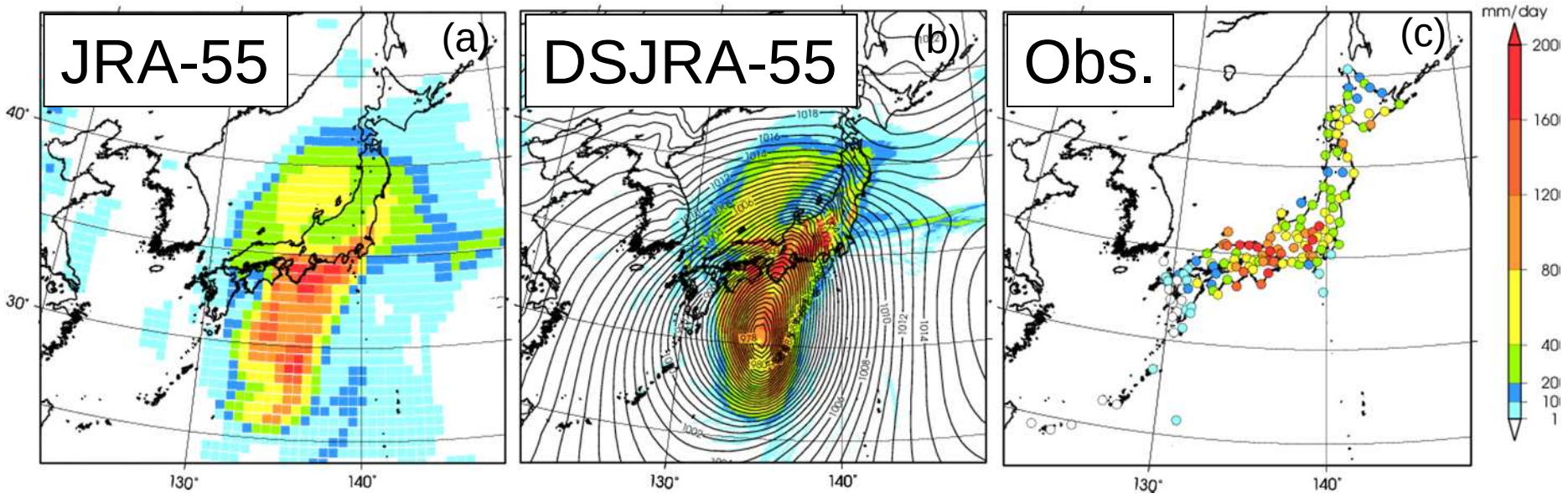
Reproducibility of an extreme event



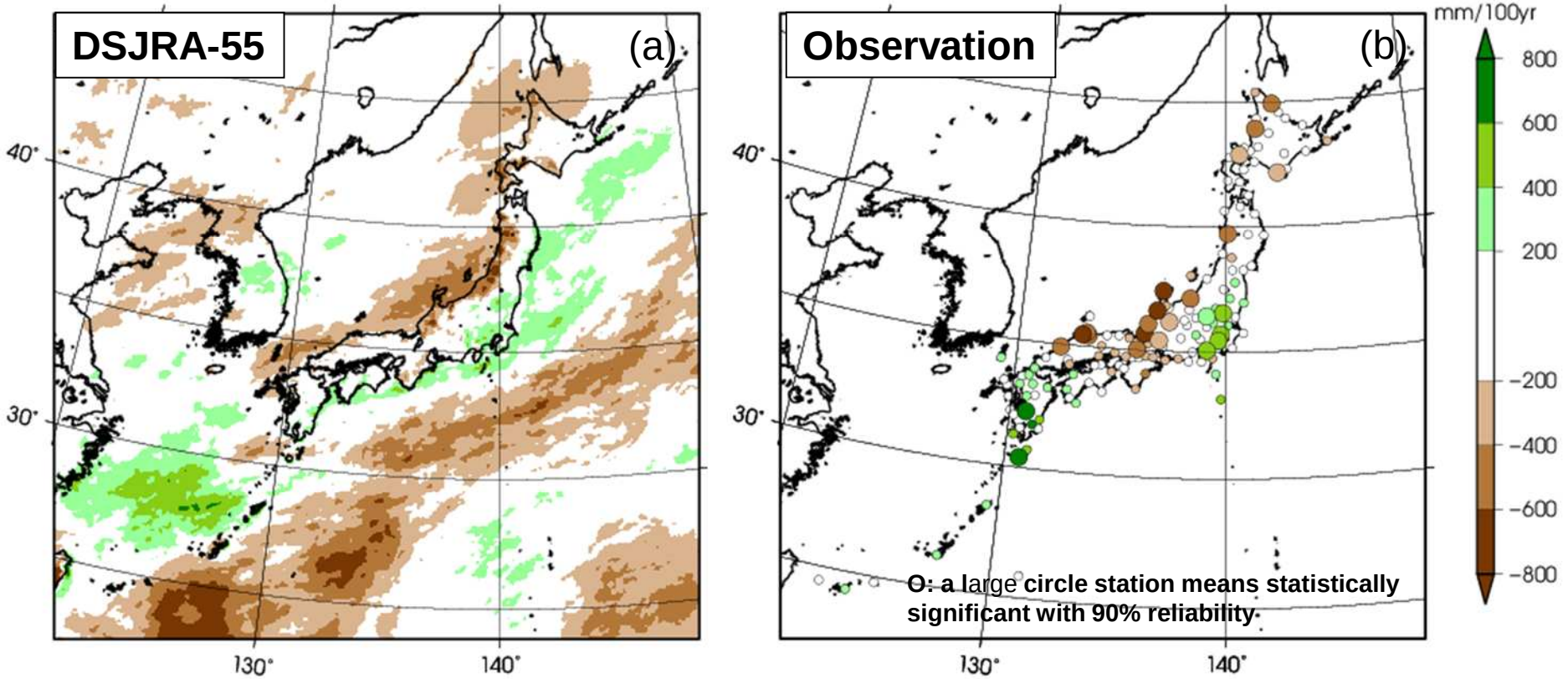
Distribution of mean precipitation on 26 September 1959:
(a) JRA-55 (b) DSJRA-55 (c) observations.

DSJRA-55 reproduced the high observed precipitation with a realistic distribution in inland mountainous areas, and so on.

DSJRA-55 makes it possible to reproduce and evaluate small-horizontal-scale phenomena such as small-scale orographic precipitation.
Thus, application of this high-temporal (every hour) and high-spatial-resolution (5 km horizontal) dataset is expected to both statistical climate studies and studies of particular events

Other applications (1)

Long-term trend of changes per 100 years in annual precipitation

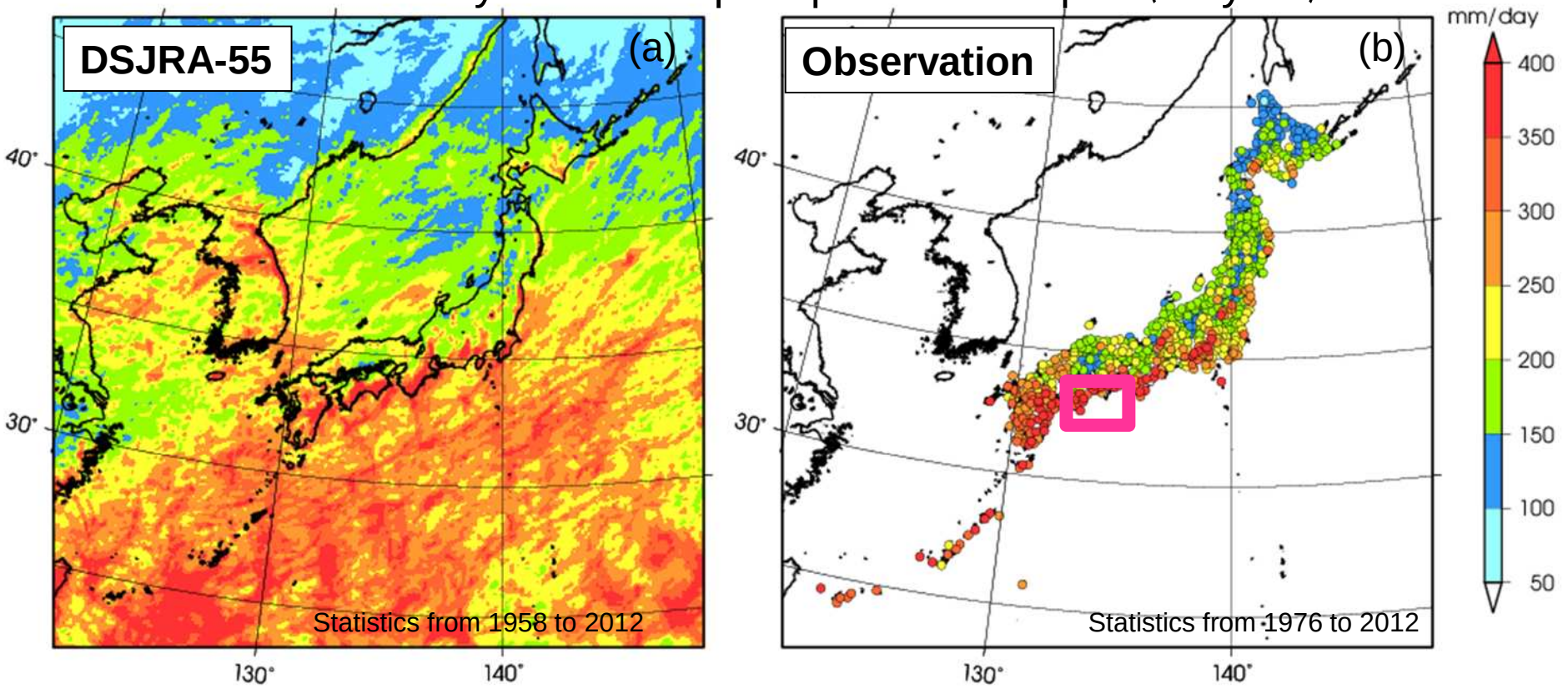


Changes in the annual mean precipitation (mm/100 years) from 1958 to 2012

Further investigation on the distribution between atmospheric circulation and its causing factor are expected by using DSJRA-55 along with observational data.

Other applications (2)

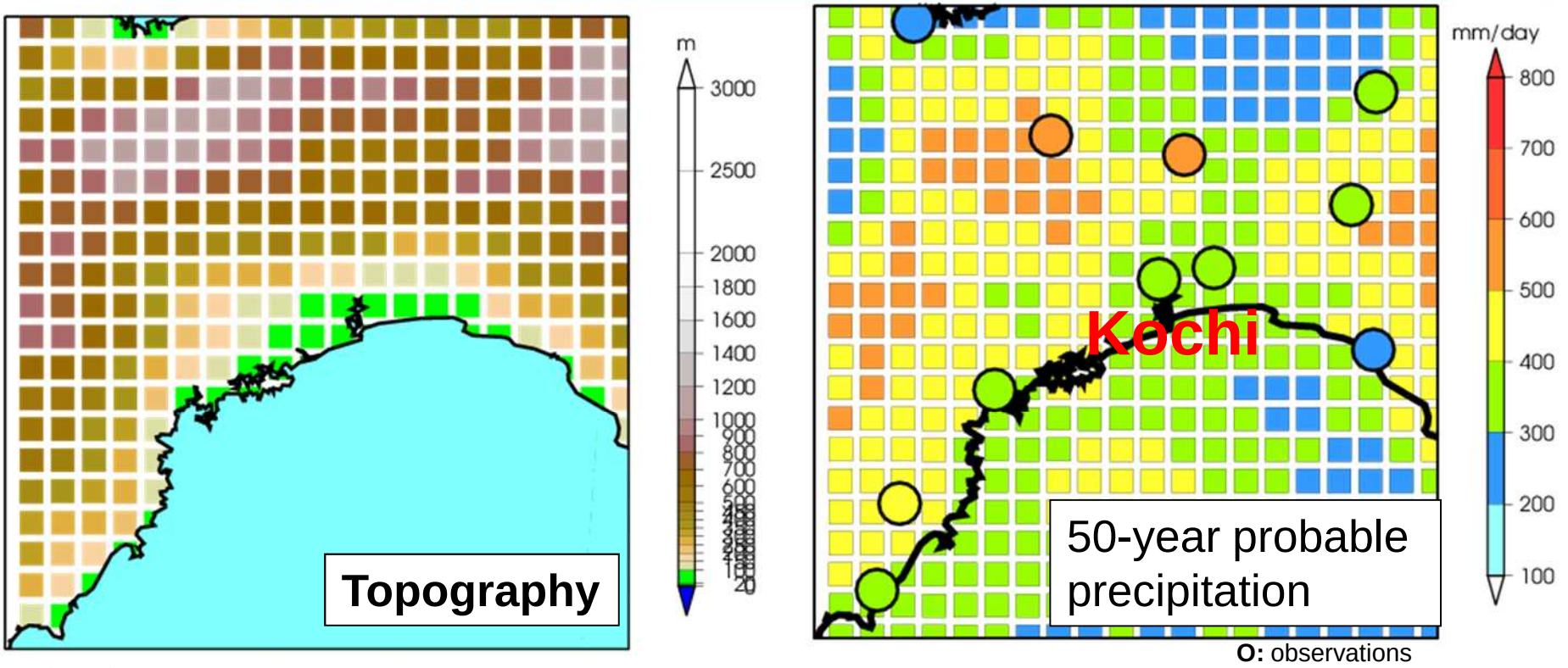
Probable daily maximum precipitation in Japan (50-year)



Probable daily maximum precipitation (mm/day) estimated by using the generalized extreme value (GEV) distribution

Other applications (2)

Probable maximum precipitation around Kochi city

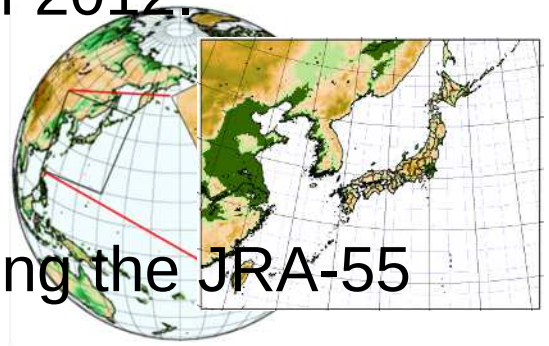


(left) Topography of south central Shikoku Island.
(right) Probable daily maximum precipitation around Kochi city on Shikoku Island estimated by using DSJRA-55 (mesh) and observation (circle) .

Summary

DSJRA-55

- Dynamical Regional Downscaling using JRA-55
- 5km resolution, around Japan region, using JMA's operational mesoscale model (NHM) as of 2012.
- 55 years from 1958 to 2012
- Reference



Dynamical Regional Downscaling Using the JRA-55 Reanalysis (DSJRA-55)

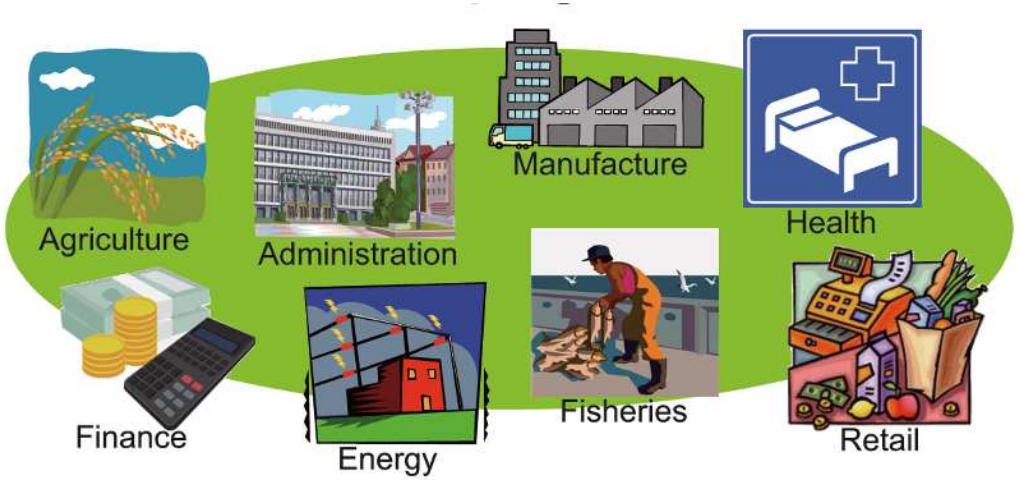
Kayaba,N., T.Yamada, S.Hayashi, K.Onogi, S.Kobayashi, K.Yoshimoto, K.Kamiguchi, and K.Yamashita 2016

SOLA, 12, 1-5, doi:10.2151/sola.2016-001

https://www.jstage.jst.go.jp/browse/sola/

(**S**cientific **O**nline **L**etters on the **A**tmosphere)

discuss possibility of practical use



DSJRA-55 is high-temporal (**every hour**) and high-spatial-resolution (**5 km horizontal**) dataset. It is useful to analysis the regional climate by case study of extreme events and statistic study. We expected to be used practically in agricultural and several industrial fields to **assess** the influence of extreme weather and climate for the **adaptation**.

- hazard map (flood, storm, typhoon, extreme-hot-day…)
- infrastructure development (construct the dam and build a breakwater…)
- agricultural land suitability evaluation for crop production, the cultivation for rice field, vineyard, apple orchard etc.

Climate risk management process

Thank you!