Evaluation of errors in precipitation over Japan reproduced by the non-hydrostatic regional climate model (NHRCM)

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1. Introduction

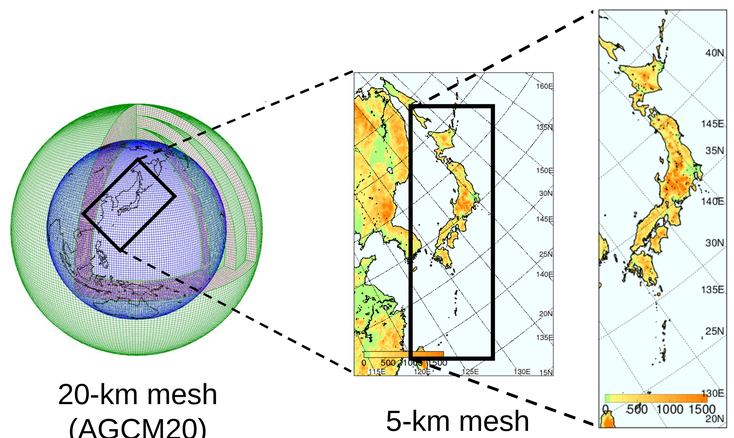
- **Background**: Increase in horizontal resolution of Regional Climate Models (RCMs)
- **Goal**:
  Evaluate the performance of a convection-permitting RCM, called NHRCM, in simulated precipitation in the present climate of Japan

2. Model and experimental design

NonHydrostatic Regional Climate Model (NHRCM; Sasaki et al. 2008),
based on Japan Meteorological Agency NonHydrostatic Model (JMA-NHM; Saito et al. 2006)

- Horizontal grid spacing: 2km (without cumulus parameterization)
- Square Prism Urban Canopy (SPUC: Aoyagi and Seino 2011)

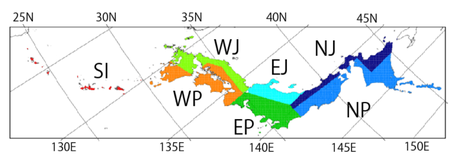
Integration period: Sep 1980 – Aug 2000
(1-year time slice: Sep – next Aug)



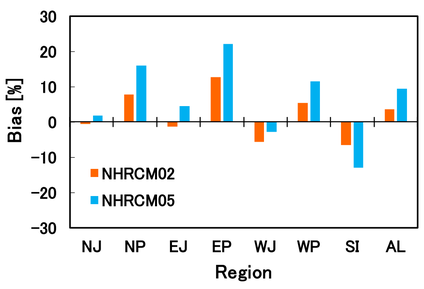
3. Annual precipitation

- Calculate bias and RMSE
  - Samples: Data over a region
  - Compare errors between NHRCM02 and NHRCM05

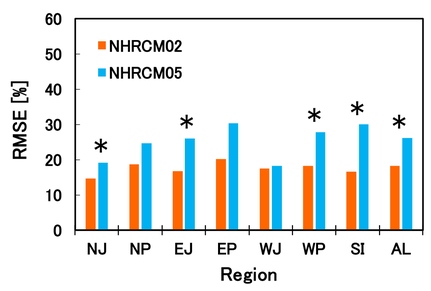
Regions



Bias



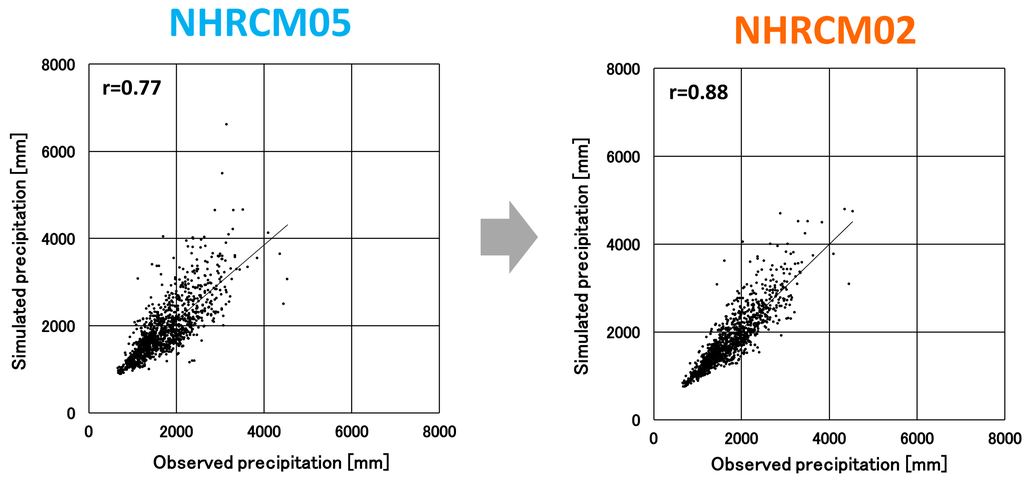
RMSE



* : statistically significant at 5% level

- In most regions, bias and RMSE for NHRCM02 are smaller than those for NHRCM05, although differences in bias are not statistically significant.

Model vs. Obs

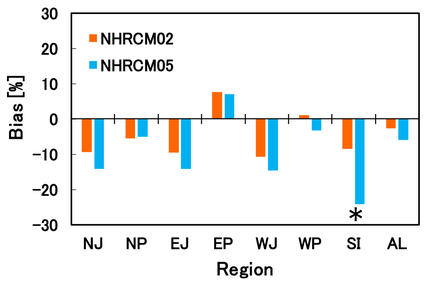


- NHRCM02 simulation results have
  - A larger correlation coefficient
  - No outliers

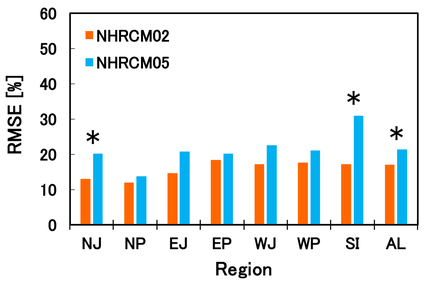
4. Heavy precipitation

- Definition of heavy precipitation
  - The 99th percentile of hourly precipitation averaged over 20 years (Integration period)

Bias



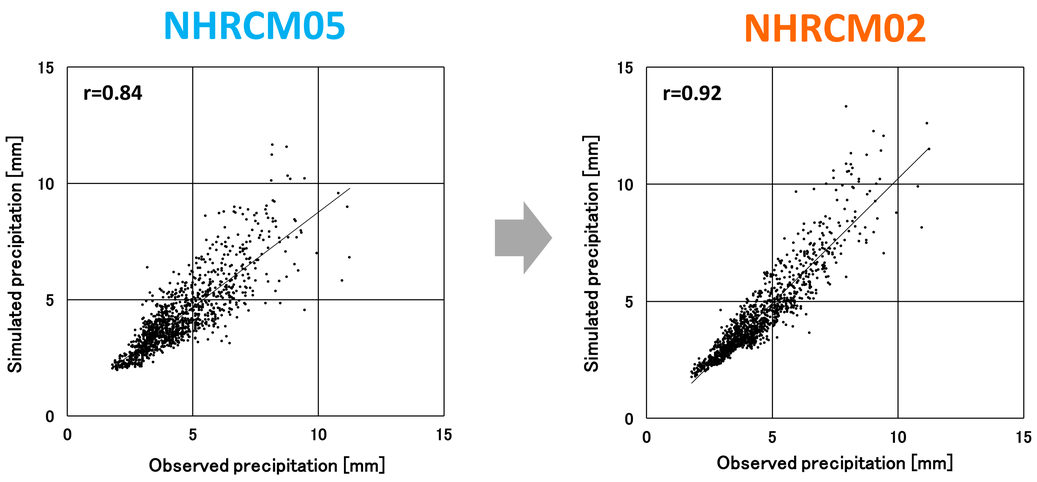
RMSE



* : statistically significant at 5% level

- In most regions, bias and RMSE for NHRCM02 are smaller than those for NHRCM05.
  - Differences in RMSE are statistically significant in some regions

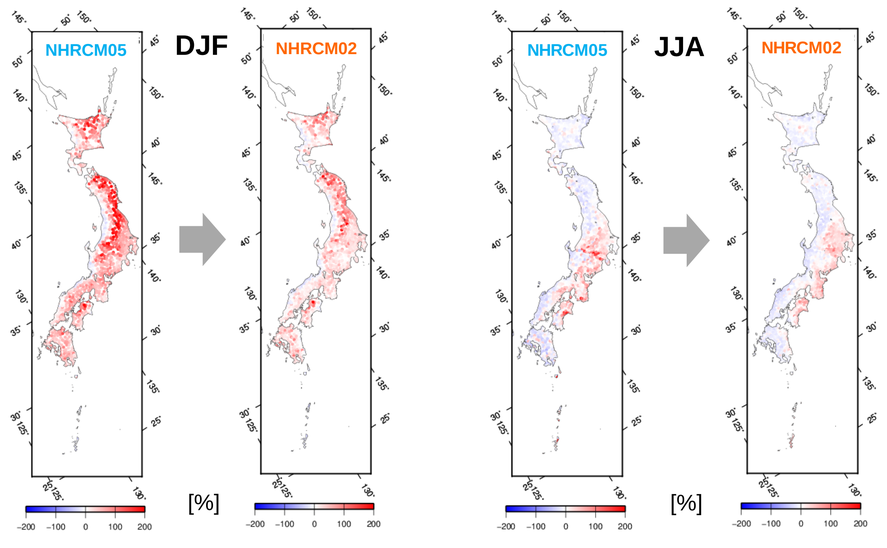
Model vs. Obs



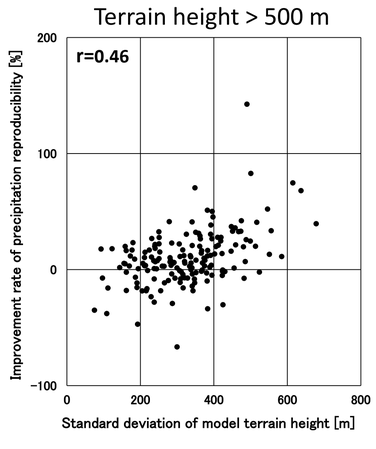
- NHRCM02 simulation results have
  - A fitted line showing no underestimates nor overestimates
  - A larger correlation coefficient

5. Topographic effects

Bias for each location



Annual precipitation
Terrain height > 500 m



- Increase in the index of the improvement in the simulated precipitation with growing terrain complexity

6. Summary

- Evaluation of precipitation in the present climate reproduced by a convection-permitting regional climate model over Japan
  - Horizontal grid spacing: 2 km
- Improved reproducibility in precipitation, compared with the 5-km mesh model
  - Annual and heavy (99%ile of 1-h) precipitation
- Effects of topography
  - Improved reproducibility in precipitation in areas of complex topography

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