

Future Weather Data for Building Thermal Load Calculation Using Regional Climate Model

Research background: Weather data for climate change and building thermal load calculation

Building heat load calculation using meteorological data is implemented to realize design suitable for climate. Weather data for building heat load calculation is created based on observation weather data from past to present. However, buildings have been in use for decades, and **climate change** progresses during that period. In pursuit of energy savings over the building's lifecycle, designing a building adapted to climate change in order to maintain comfort in the future. To that end, future weather data for building thermal load calculation based on future prediction is indispensable.

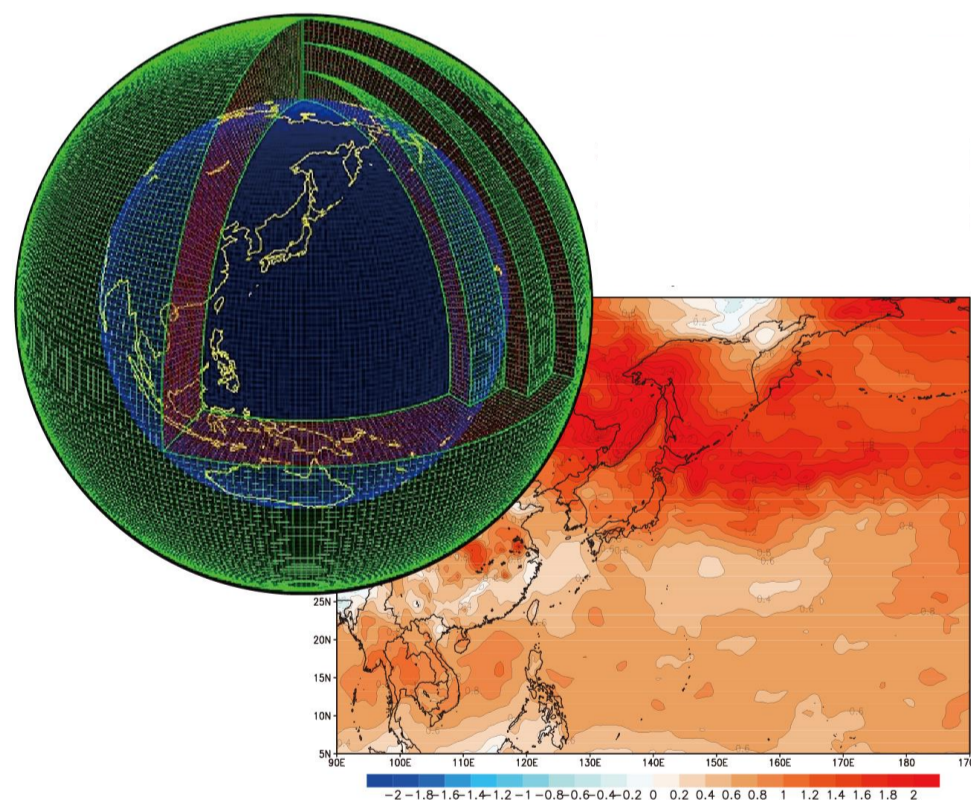
Research purpose: Creation of future weather data for building heat load calculation

The purpose of this research is to prepare **future weather data for building thermal load calculation**. To aim at realization of architectural design adapted to the future climate.

Research method: Utilization of dynamical downscaling

We will prepare future weather data for building thermal load calculation by **dynamically downscaling** future climate data by the global climate model (GCM) by the regional climate model (RCM). In this research, GCM MIROC (Model for Interdisciplinary Research on Climate) 4h, and WRF (Weather Research and Forecasting model) as the regional climate model.

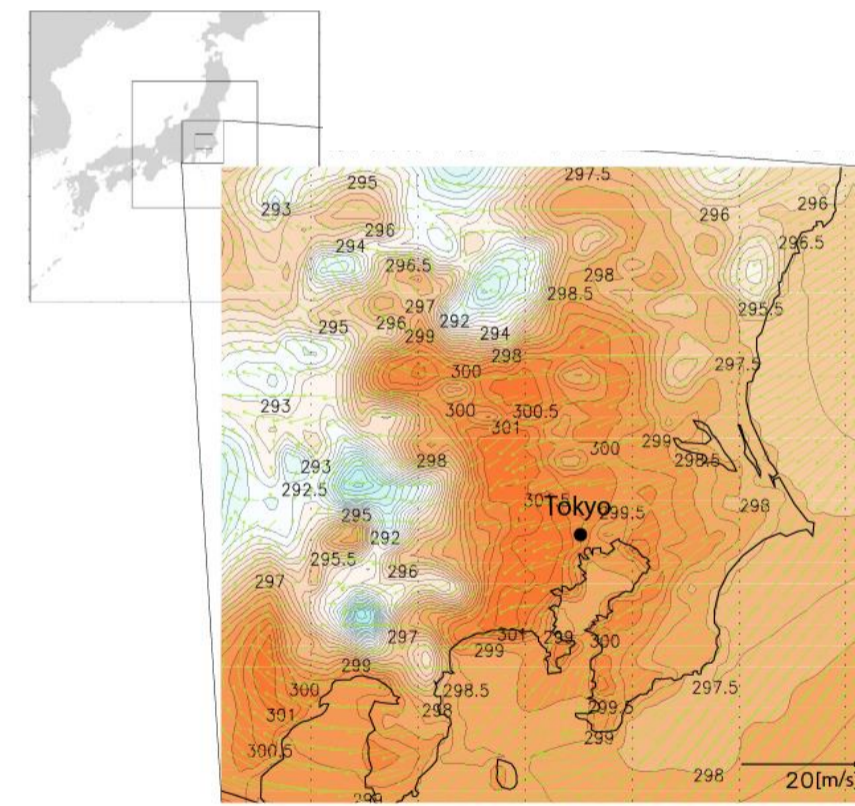
Global climate model: GCM



A mathematical model that reproduces and predicts the climate of the earth by solving the governing equations of each meteorological factor such as wind speed / wind direction, temperature, humidity, solar radiation amount, etc. with the whole earth as the analysis area. Macroclimate such as global warming is reproduced. However, because lattice resolution is coarse, it is difficult to reproduce meteorological fields of urban scale.

(MIROC 4 h is provided by Kimoto Lab., The University of Tokyo, Atmosphere and Ocean Research Institute)

Regional climate model: RCM



A mathematical model that can arbitrarily set the analysis region, reproduce / predict (meteoric downscaling) the meteorological field in the region by giving initial value / boundary value. It is possible to analyze as high as 1 km, Detailed meteorological field can be reproduced while considering the influence of urban · building scale.

Future climate predicted by global climate model

- Prediction of global climate change
- Lattice resolution is coarse · Meteorological field of urban · building scale is difficult to reproduce



Mechanical down scaling

- High resolution analysis
- Consider detailed terrain data



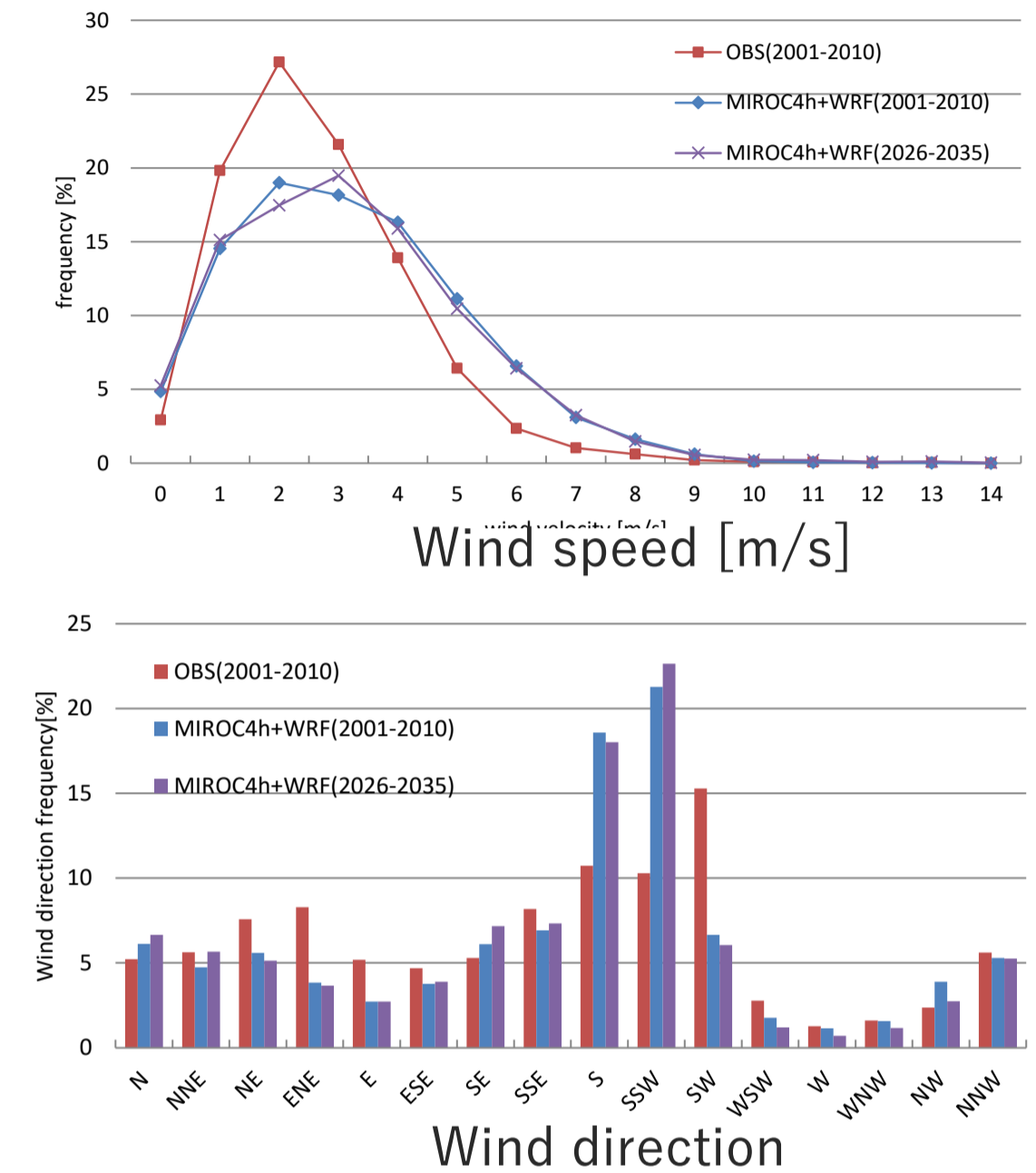
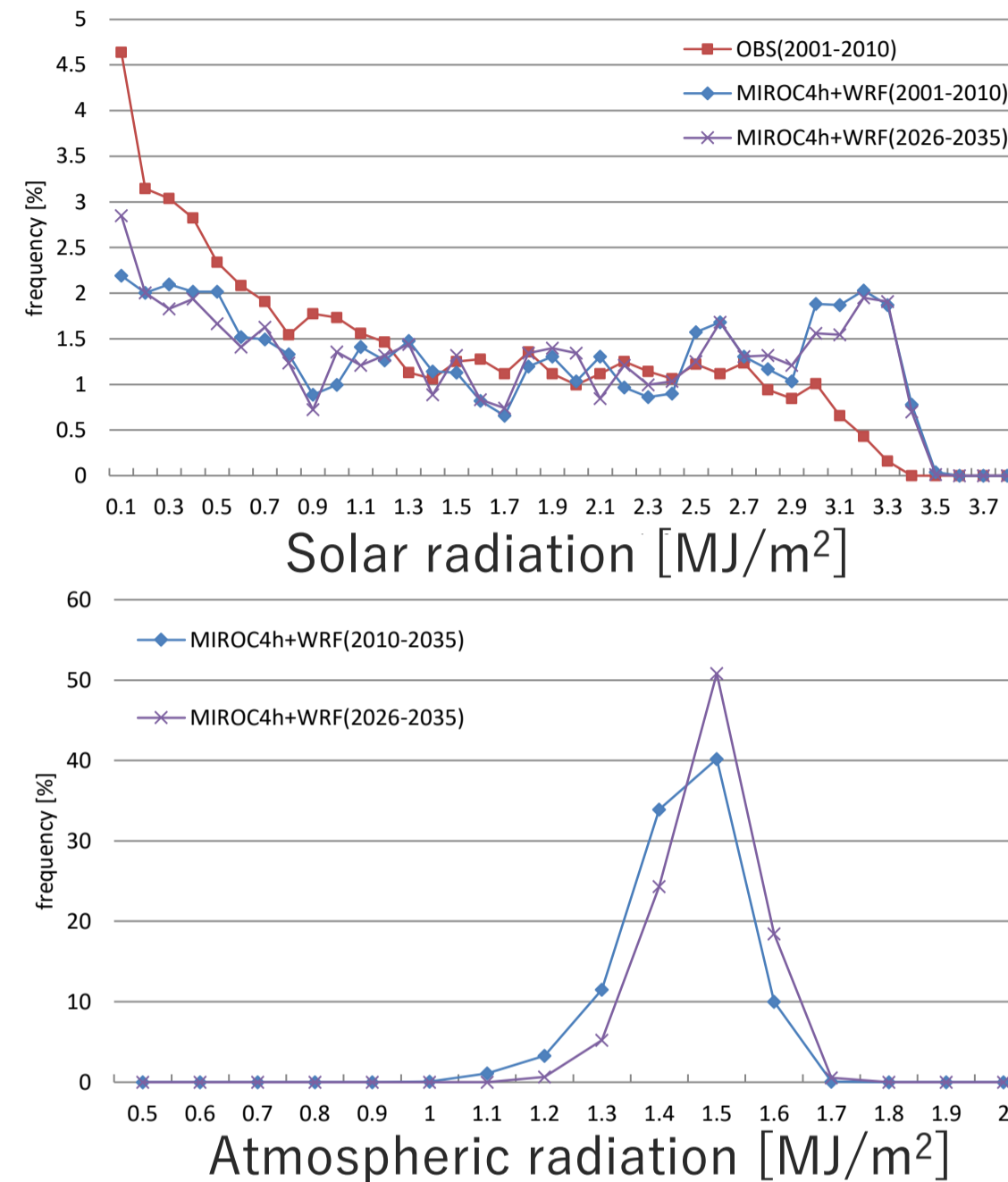
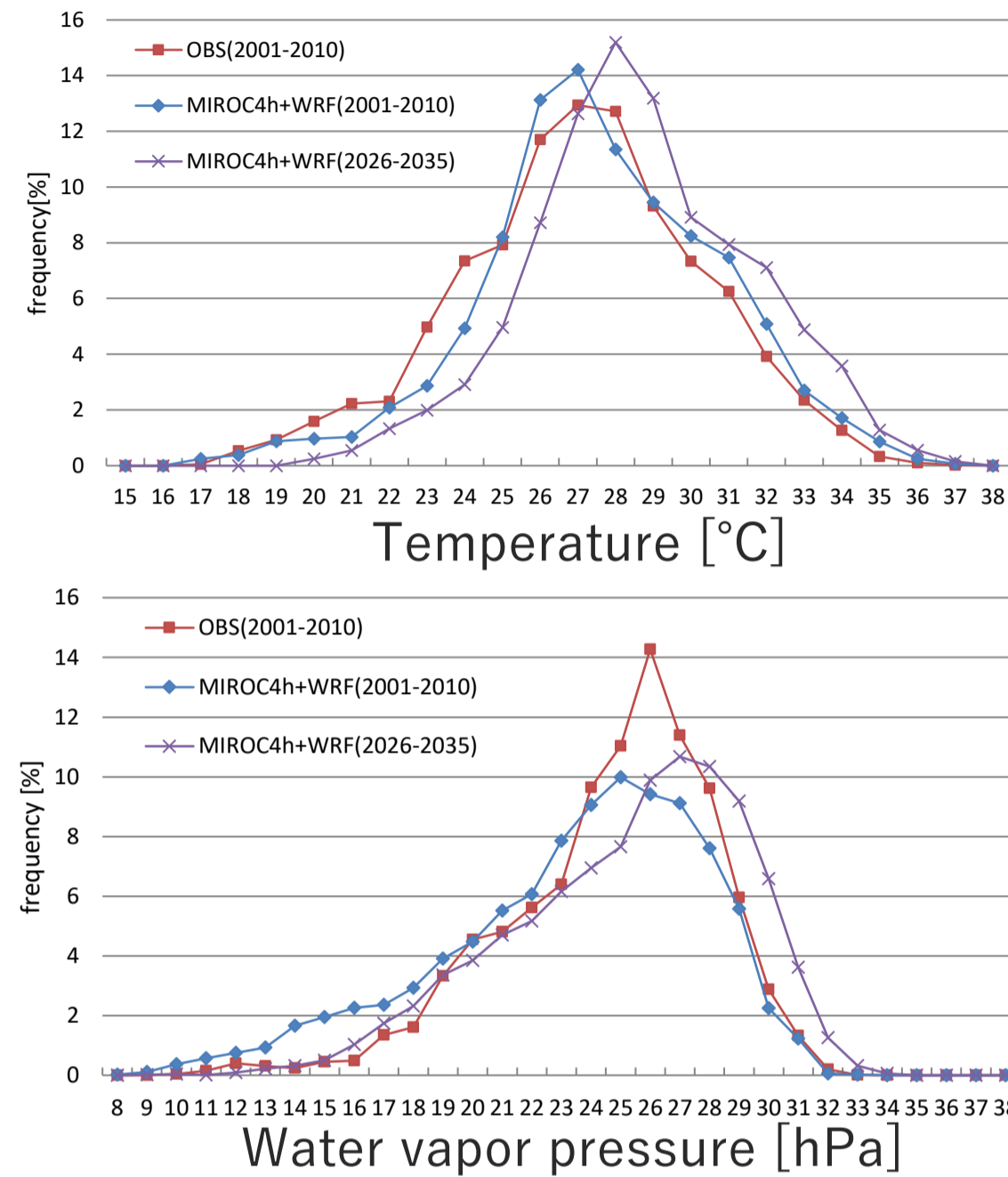
Future coming weather data for building thermal load calculation

- Reflecting global climate change
- Consider local weather of architecture · city scale

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Analysis by dynamic downscaling Obtaining meteorological data

It is possible to obtain data on all weather elements necessary for building thermal load calculation by mechanical down scaling.



Frequency distribution of each weather element (August 2001 - August, Tokyo)

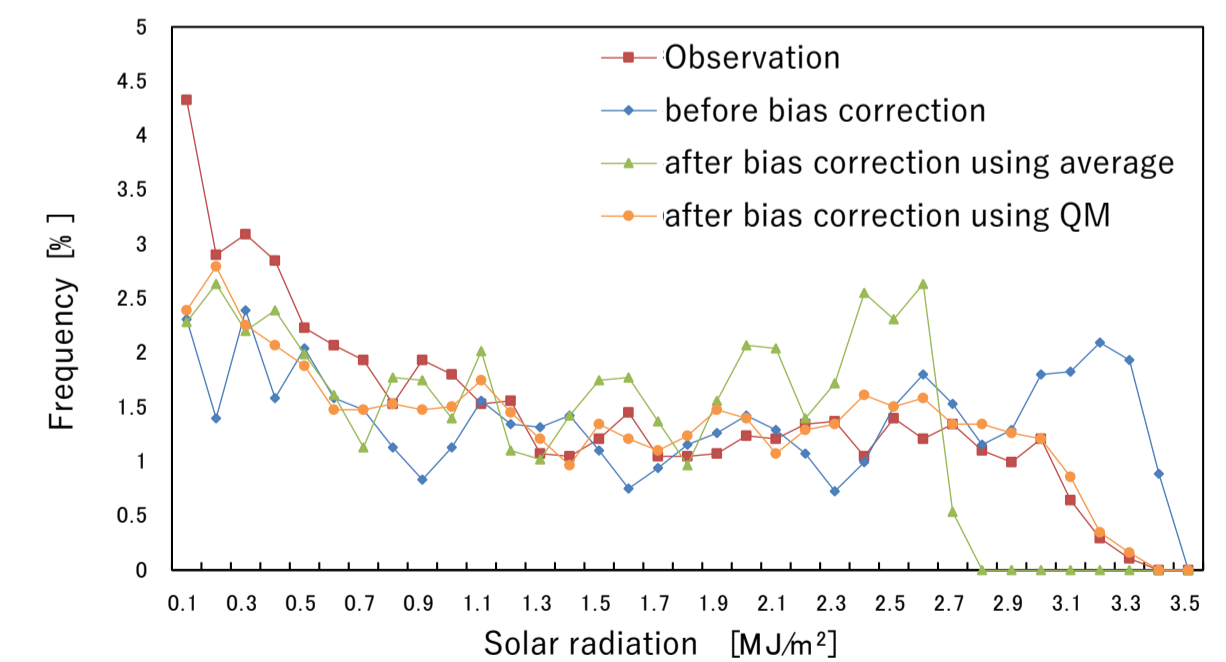
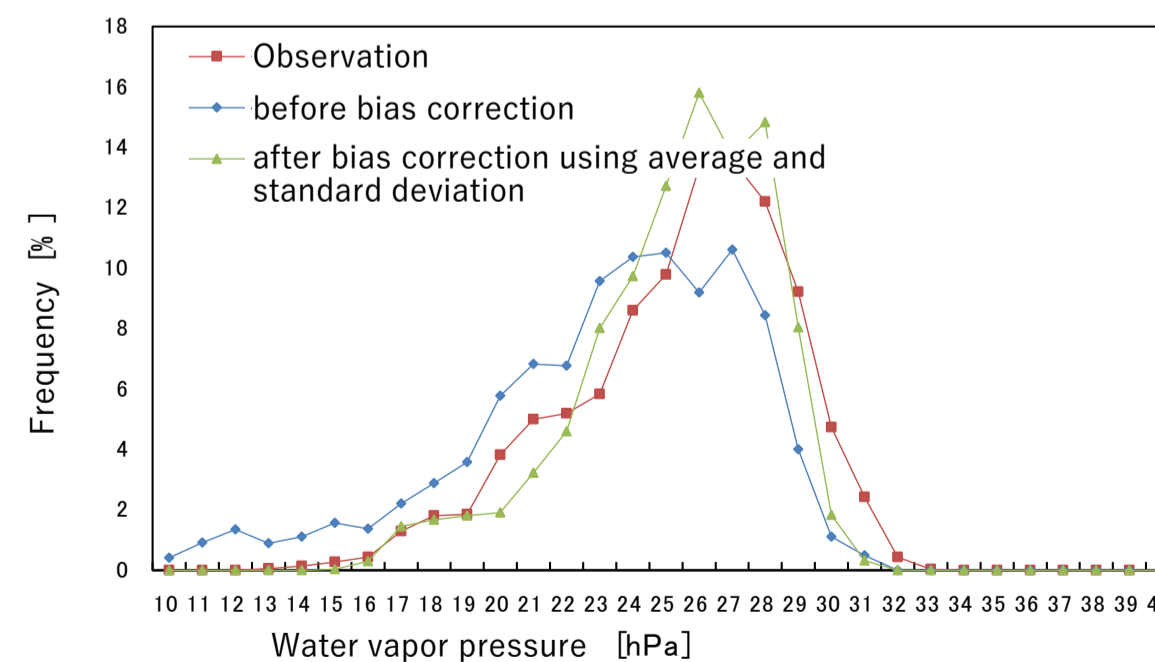
Development of suitable bias correction method

Since the analysis value of the climate model necessarily includes systematic error (bias) due to roughness of resolution and inaccuracy of parameterization, bias correction using observation weather data was carried out.

$$X_{modi} = \overline{X_{obs}} + \frac{\sigma_{obs}}{\sigma_{model}} (X_{model} - \overline{X_{model}}) \quad (1)$$

$$X_{modi} = CDF_{obs}^{-1}(CDF_{model}(x_i)) \quad (2)$$

Bias correction of equation (1) based on average value and standard deviation assuming normal distribution and bias correction of equation (2) using quantile mapping are appropriate for temperature and humidity.



Frequency distribution before and after bias correction of water vapor pressure and total solar insolation amount (August, 2006 - 2010, Tokyo)