# A time-frequency bias correction approaches to correct raw climate model simulations for trend, variability, magnitude, and frequency

Cilcia Kusumastuti[1,2], Rajeshwar Mehrotra[1] and Ashish Sharma[1]

(1) *Water Research Centre, School of Civil and Environmental Engineering, The University of New South Wales, Sydney, NSW, Australia*
(2) *Department of Civil Engineering, Petra Christian University, Surabaya, Indonesia*

With advancement in our understanding of the physical characteristic of climate and computing capabilities, General Circulation Models (GCMs) continue to evolve. The latest available climate simulations of Coupled Model Intercomparison Project 6 (CMIP6), perform better compared to the earlier versions. CMPIP6 dataset includes a wide range of models' spatial resolutions for further use in hydrological studies and water resources planning. However, biases in the model output restrict direct use of model simulations in studies.

Numerous bias correction approaches are proposed to systematically bias correct a wide range of statistical attributes, i.e., the mean, standard deviation, persistence, distribution etc. The further advanced approaches also bias correct the time-varying trend. Notwithstanding these advancements, relationship of model spatial resolution and magnitude and nature of bias remains an unexplored area.

Here, we analyse the statistical biases in the sea surface temperature (SST) simulations of CMIP6. We employ the capability of discrete wavelet transform (DWT) and continuous wavelet transform (CWT) to disaggregate the time series to look at the biases in the models within sub-annual, interannual, and interdecadal time frames. Particularly, we focus on the trend, high- and low variability, and frequency of occurrence of events in the SST simulations. The spectral analysis is performed using CWT to quantify the biases in the magnitude and frequency of occurrence. The results show that unsystematic biases of long-term events are observed across the different resolutions of the models. The underlying trends of SST simulations obtain through DWT exhibit an unsystematically small increase across models' resolution. Despite the unsystematic biases across models' resolutions, the application of the wavelet-based bias correction approach improves the overall quality of models in the reproduction of statistical attributes of interest.

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