Artificial Neural Network Technique for Statistical Downscaling of Global Climate Model

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Introduction:

· GCMs are composed of many grid cells representing vertical and horizontal areas on earth surface. Each cell of GCM represents physical procedures in the air, sea, cryosphere, and land surface. Various parameters of hydrology are computed by these cells.

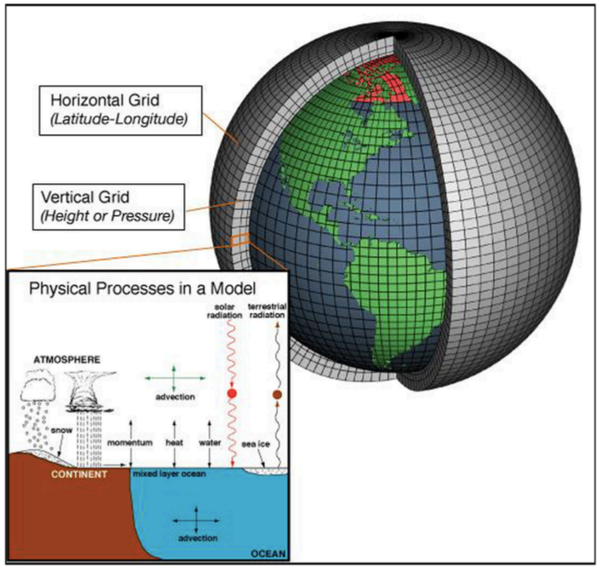

Fig. 1 GCM structure. *Source*: National Oceanic and Atmospheric Administration (NOAA), 2012

· Some assumptions of spatial downscaling are as follows:
1. The atmosphere features influencing the local climate shall be imitated by GCM.
2. Climate variable(s) which otherwise called as predictors shall not show large sub-grid-scale variations while the downscaling technique is adopted.
3. Climate variable is a direct model output of downscaling technique and shall not be the one based on parameterizations relating to other model variables.

· Among the wide range of regression models, ANN is the most popular approach.

Data and Study Area:

· OBS: metrological gauge station Nagoora, Karnataka

· GCM: CanCM4 (2.8° x 2.8°)

Table 1 GCM, CanCM4 model variables

Name	Id	Pressure levels in Mb	Units
Air temperature	ta	_200, _700, _850, _925	K
Zonal wind	Ua	_200, _700, _850, _925	m s^{-1}
Meridional wind	Va	_200, _700, _850, _925	m s^{-1}
Geopotential height	Zg	_200, _700, _850, _925	m
Precipitation	Pr	_200, _700, _850, _925	kg m^{-2} s^{-1}
Sea level pressure	Psl	_200, _700, _850, _925	Pa

· 1970-1995, 1996-2005, 2006-2035 (RCP4.5)

· Bhima Basin: warm summer and comfortable winter. Humidity is very low, and precipitation is relatively less and depends largely upon the S-W monsoon. The average annul rainfall is 736mm, and maximum temperature rises up to46°C.

· Water pollution and frequent droughts are the major issues, and ground water exploitation through over draft is the critical issue in this catchment.

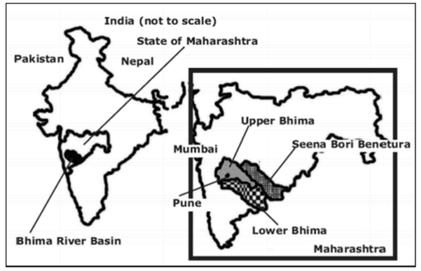

Fig. 3 Map of Bhima Basin. *Source*: Maharashtra Water and Irrigation Commission Report, Government of Maharashtra, Volume II, 1999 [24]

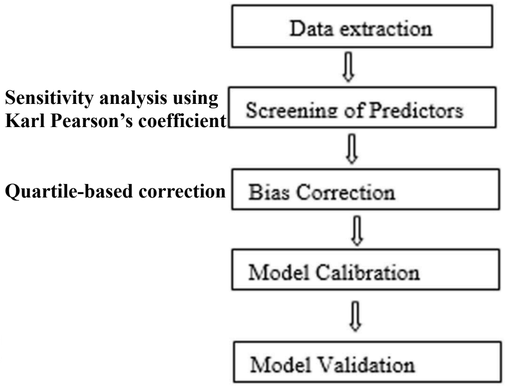

Fig. 4 Statistical downscaling flow chart

Results:

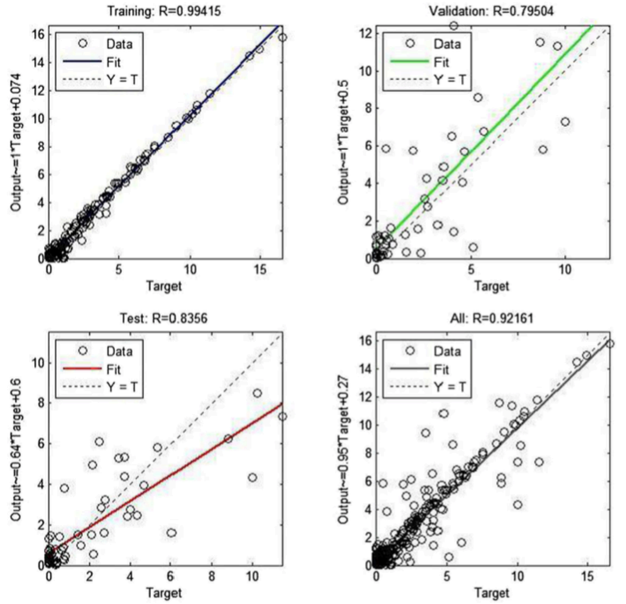

Fig. 6 Performance of ANN model

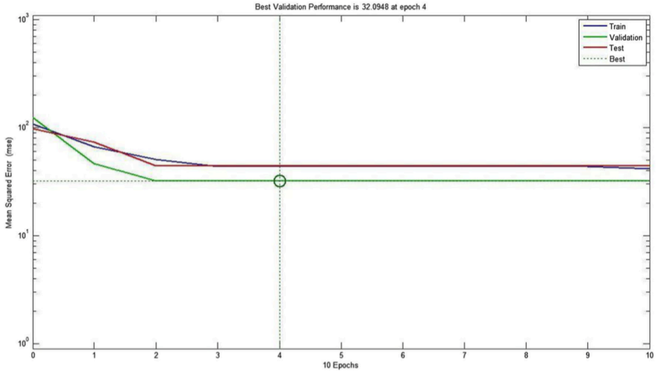

Fig. 7 Goodness of fit for rainfall downscale model for Nagoora station

Conclusion:

· ANN is classic and simple tool for downscaling technique.