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Short Communication

Evaluation of weather generators in foothills of western Himalayas

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Weather generators are statistical models used to generate near real daily sequences of meteorological variables- precipitation, maximum and minimum temperature, humidity *etc.* These are used for gap filling of missing data or for incorporation in long-term simulation models (Ray and Turakhia, 2008). The WGEN (Richardson and Wright, 1984) model is designed for use in generating daily values of precipitation, maximum temperature, minimum temperature and solar radiation that represents the weather at a specific site. The model is based on the procedure described by Richardson (1981); however, several assumptions have been made to simplify the use of the model. ClimGen (Arnold and Elliot, 1996), which includes some generation concepts adopted from WGEN, is a weather generation program with novel features and friendly and effective user interface. ClimGen has been evaluated and found to perform reasonably for a number of world locations. ClimGen generates precipitation, daily maximum temperature (Tmax) and minimum temperature (Tmin), solar radiation (SRAD), air humidity, and wind speed.

In this present work the weather generators, WGEN and ClimGen were used to generate weather parameters for Pantnagar (29° N latitude, 79.3° E longitude and 243.8 m MSL). This area lies in the '*Tarai*' belt located in the foot hills of Himalayas with annual rainfall of about 1400 mm, out of which 80 percent is received from mid June to September during SW monsoon.. Daily data of weather parameters *viz.* maximum temperature (T_{max}), minimum temperature (T_{min}), rainfall (RF), number of rainy days (RD) and solar radiation (SR) from 1998 to 2006 of Pantnagar (Uttarakhand) were used to generate daily weather scenario for the years 2007, 2008 and 2009. Detailed procedure of generating daily values of weather parameters by WGEN is explained in Richardson and Wright (1984) and by ClimGen in Arnold and Elliot (1996).

Performance of weather generators

Comparisons between observed weather and generated (from WGEN and ClimGen) weather parameters for different years have been presented in Table 1. The values of T_{max}, T_{min}, total rainfall and solar radiation generated by WGEN were very close to the values of observed weather parameters than ClimGen in the year 2008 and 2009. In the year 2007, close values of weather parameters, generated by ClimGen, for T_{max}, and T_{min} were found to be nearer to the mean of observed values, while SR and RF generated by WGEN was close to observed mean . Number of rainy days generated by WGEN (71 in 2008 and 41 in 2009) was found closer to observed (71 in 2008 and 41 in 2009) than ClimGen (68 in 2008 and 74 in 2009) in the years 2008 and 2009, while close prediction for number of rainy days, in the year 2007 showed by ClimGen (Table 1).

Based on the pooled data of three years weather parameters generated by WGEN was found higher correlation (R^2) values than ClimGen. Due to high inter-annual variability of the rainfall both the weather generators were unable to generate total rainfall precisely (Fig. 4). In spite of that, T_{max} (Fig. 2) and T_{min} (Fig. 3) were highly correlated between observed and generated parameters by both the weather generators followed by solar radiation (Fig. 1).

It is therefore, concluded that the values of different weather parameters *i.e.* maximum temperature (^{0}C), minimum temperature (^{0}C), total rainfall (mm), number of rainy days and solar radiation (MJ m^{-2} d^{-1}) generated by WGEN were very close to values of observed weather parameters than ClimGen. Weather parameters *i.e.* T_{max}, T_{min}, RF, SR and RD generated by WGEN were found almost higher correlation than ClimGen. Hence, it can be adopted for generation of substituting missing data and also can be used for climate change study in the '*Tarai*' belt of the foot hills of Himalayas.

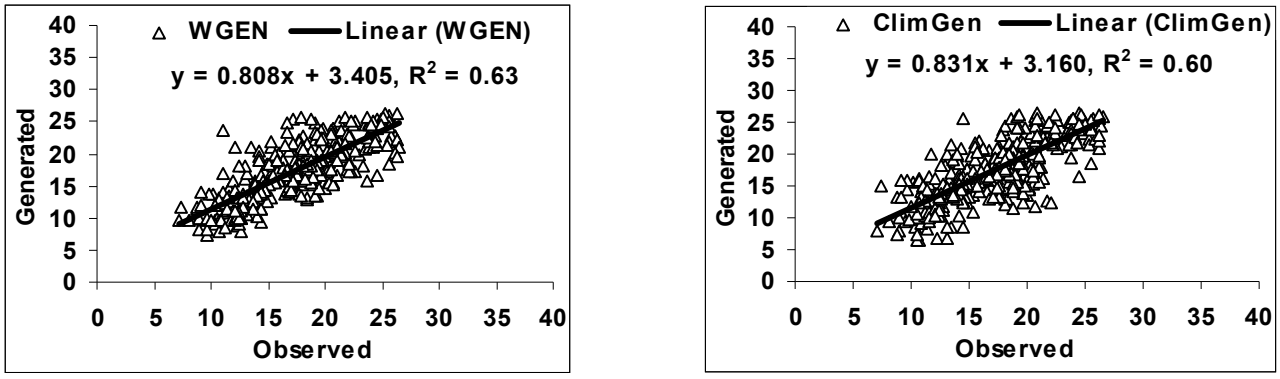

Fig. 1: Comparison between observed and generated solar radiation (MJ m^{-2} d^{-1}) from (a) WGEN and (b) ClimGen (Pooled data of 3 years)

Table 1: Comparison between observed and generated weather parameters for different years

Weather parameters	Mean values of weather 2007s			Mean values of weather 2008s			Mean values of weather 2009s		
	Observed	WGEN	ClimGen	Observed	WGEN	ClimGen	Observed	WGEN	ClimGen
SR (MJ m^{-2} d^{-1})	17.1	17.5	17.6	16.5	16.3	17.6	18.0	18.1	17.3
T_{max} (^{0}C)	29.0	29.9	28.9	29.0	29.0	29.8	30.7	30.7	28.7
T_{min} (^{0}C)	17.1	17.5	17.4	16.8	16.8	16.9	17.0	17.0	17.6
RF(mm)	1730.6	948.6	1698.8	2382.0	2382.0	2807.6	1109.6	1109.6	3217.0
Number of RD	61	51	65	71	71	68	41	41	74

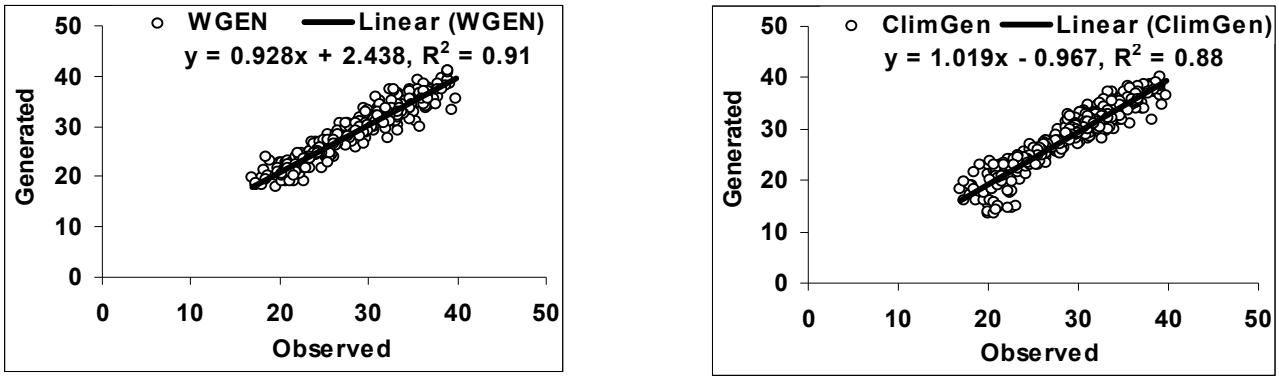

Fig. 2: Comparison between observed and generated T_{max} (°C) from from (a) WGEN and (b) ClimGen (Pooled data of 3 years)

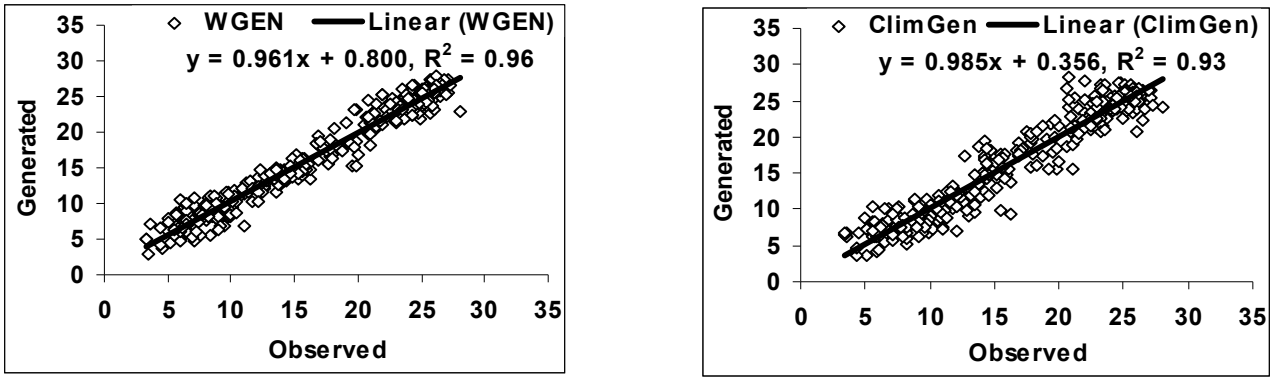

Fig. 3: Comparison between observed and generated T_{min} (°C) from from (a) WGEN and (b) ClimGen (Pooled data of 3 years)

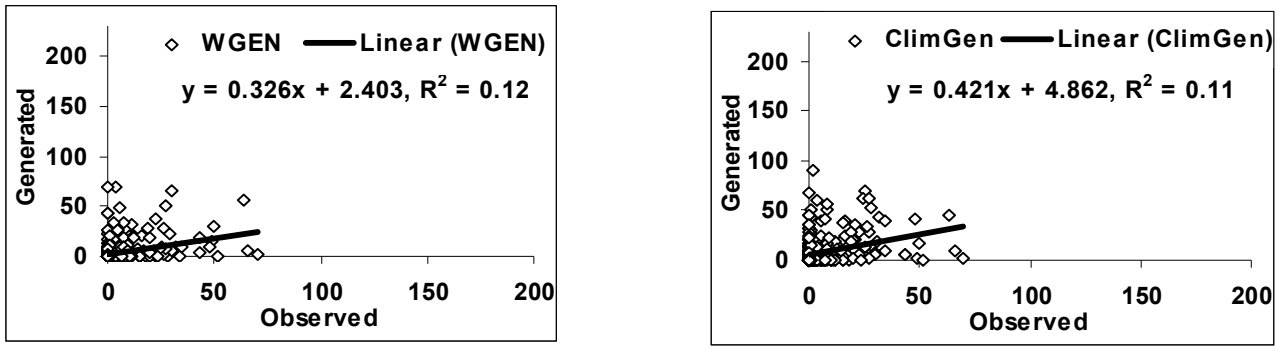

Fig. 4: Comparison between observed and generated rainfall (mm) from from (a) WGEN and (b) ClimGen (Pooled data of 3 years)

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