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Hydrology and Earth System Sciences
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Interactive Comment

Interactive comment on "Model study of the impacts of future climate change on the hydrology of Ganges–Brahmaputra–Meghna (GBM) basin" *by* M. Masood et al.

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Hydrology and Earth System Sciences (HESS) editorial@copernicus.org http://www.hydrol-earth-syst-sci.net/

Dear Editor,

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Please find enclosed our detailed point-to-point responses to Reviewers' comments on our manuscript entitled "Model study of the impacts of future climate change on the hydrology of Ganges-Brahmaputra-Meghna (GBM) basin". This manuscript has been submitted previously to HESSD as hess-2014-156 with the encouragement for resubmission from the Editor. We thank two anonymous Reviewers for their constructive comments, and accordingly we have revised our manuscript thoroughly, including rerunning all the previous model simulations. We also have validated model simulations at three more streamflow gauging stations located at the upstream of the GBM basins in addition to the original three stations at the outlets of three basins. Also, we have followed Reviewer's suggestion to correct the bias of GCM data based on the more accurate monthly scaling factors instead of using previous annual scaling factor.

A summary of the major revision tasks we have been done to address Reviewers' comments is given as follows:

1. We have improved the model simulations by the calibration of additional two sensitive model parameters (i.e., the meandering ration and the effective flow velocity) following the comments of both Reviewers #1 and #2. 2. We have validated model simulations at three more upstream stations following the suggestion of Reviewer #2. 3. Following the suggestion of Reviewer #1, we have corrected the bias of GCM data based on the more accurate monthly scaling factors instead of using the previous annual scaling factor. 4. We have included a new Table 1 describing the major characteristics of three GBM basins according to suggestion of Reviewer #2. 5. We have included a new Table 3 providing the basic information of all six streamflow gauging stations used for calibration and validation. 6. We have revised Table 2 (former Table 1), Table 4 (former Table 2), Table 5 (former Table 3) and Table 6 (former Table 4) to be of higher quality. 7. We have revised Fig. 1, Fig. 4 (former Fig. 5), Fig. 5 (former Fig. 6), Fig. 6 (former Fig. 7), Fig. 7 (former Fig. 8), Fig. 8 (former Fig. 9), Fig. 9 (former Fig. 10) and Fig. 10 (former Fig. 11). 8. We have removed a figure (former Fig. 4) mainly due to the concern of Reviewer #1. 9. We have corrected all technical

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and grammatical errors as pointed out by both Reviewers #1 and #2.

We believe this manuscript will be of great interest to the broad HESS readers since it investigates the impacts of future climate change on the hydrologic cycle of the GBM basin through hydrologic modelling and also accounting for the significant model parameter uncertainty. Climate change impact on these basins is a matter of high global concern because it is obvious that the risk of water disasters has been increasing over recent years, but only very few hydrologic modeling studies have been conducted in the GBM basins, mainly due to the lack of observed data to validate model simulations. This paper successfully applies hydrologic modeling together with the long-term observed daily streamflow data to fill this research gap, and it investigates not only the runoff change due to climate change but also the overall basin-scale hydrologic change including evapotranspiration, soil moisture and net radiation. Ultimately, the research presented in this paper can provide a sound scientific basis for decision making regarding the climate change adaptation in the GBH basin.

Please let us know if there are any further questions we need to provide additional information. We will respond promptly.

Thank you so much for your consideration.

Sincerely,

Muhammad Masood Pat J.-F. Yeh Naota Hanasaki Kuniyoshi Takeuchi

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/11/C3377/2014/hessd-11-C3377-2014-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 5747, 2014.

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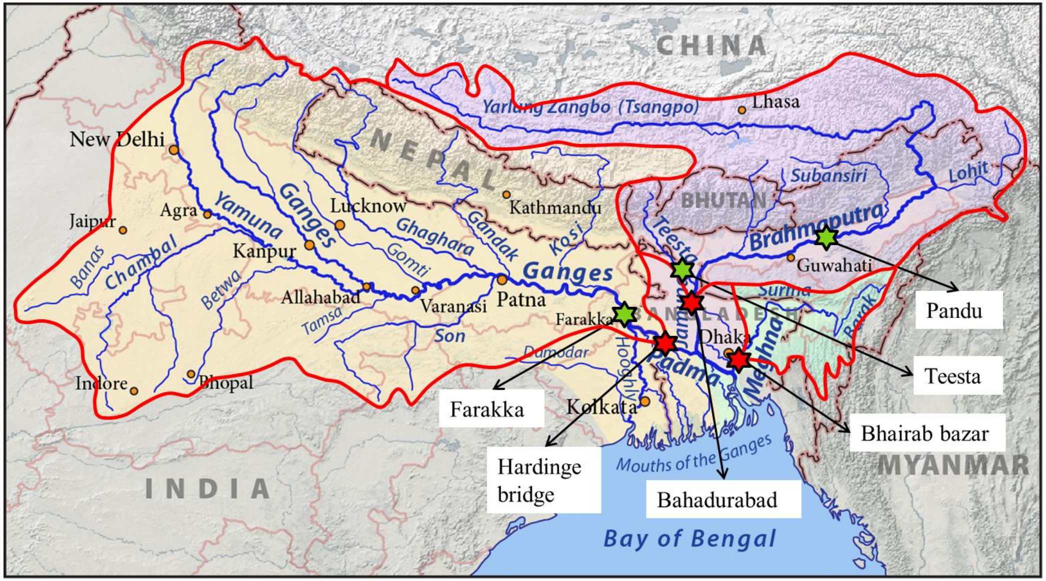

Fig. 1. Figure 1. Ganges-Brahmaputra-Meghna (GBM) river basin boundaries (thick red line), upstream of three outlets (red star); Hardinge bridge, Bahadurabad, and Bhairab bazar respectively. Green stars indic

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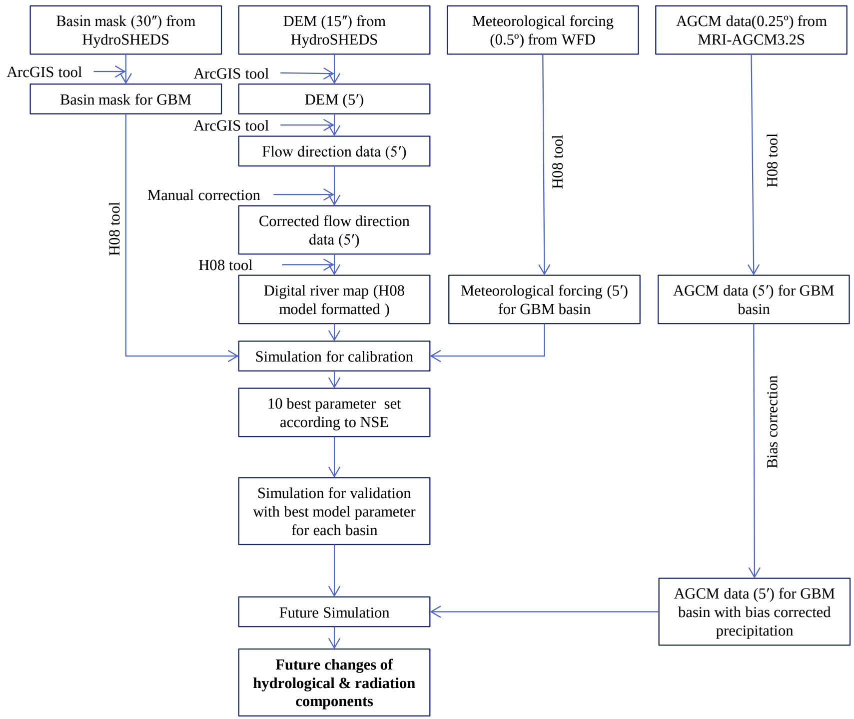

Fig. 2. Figure 2. Flow chart of methodology.

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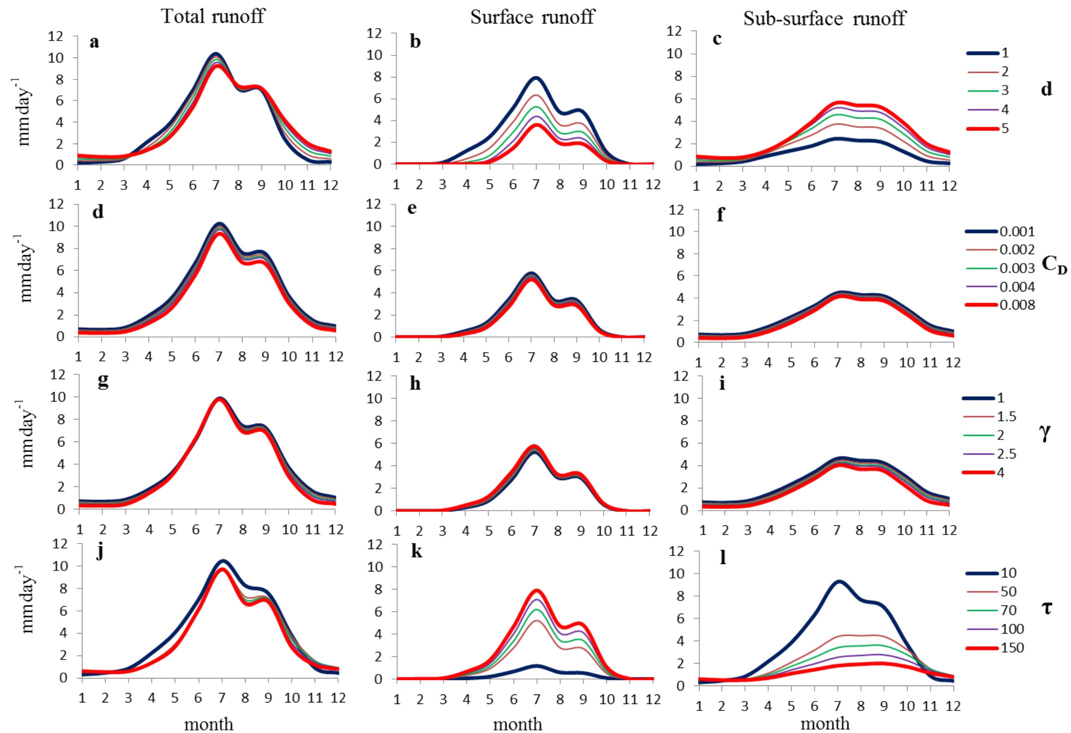

Fig. 3. Figure 3. The 11-year (1980–1990) long-term average seasonal cycles of the simulated total runoff, surface runoff and sub-surface runoff (unit: mm day-1) of Brahmaputra basin. Each of the five lines i

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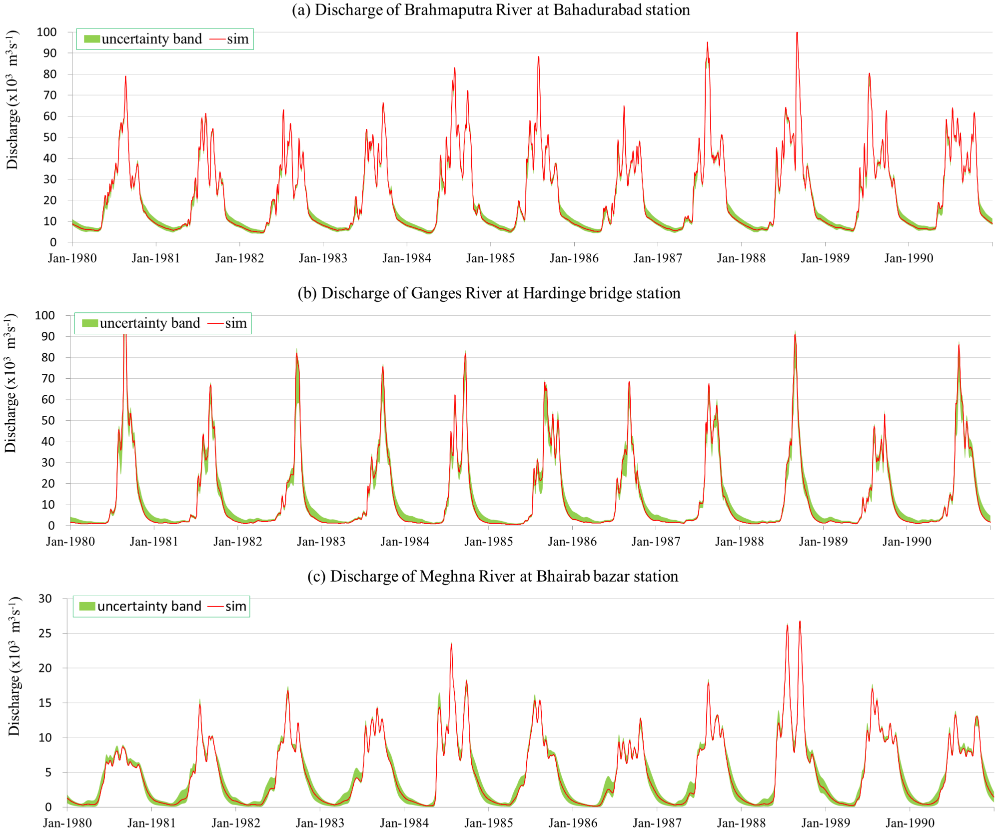

Fig. 4. Figure 4. Hydrograph of simulated discharge with optimal parameter set (red line) and uncertainty band of simulated discharge with top 10 optimal parameter combinations (green shading) during calibrat

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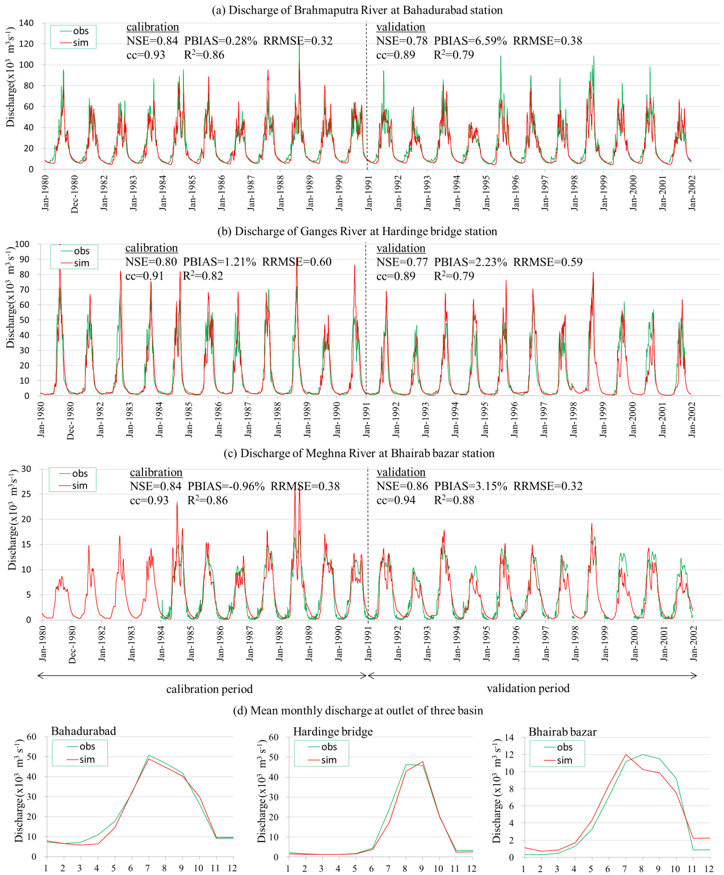

Fig. 5. Figure 5. (a)-(c) Hydrographs (both calibration and validation period) (d) mean monthly (1980-2001) discharge at outlet of three basins using the WFD forcing dataset. Nash–Sutcliffe efficiency (NSE),

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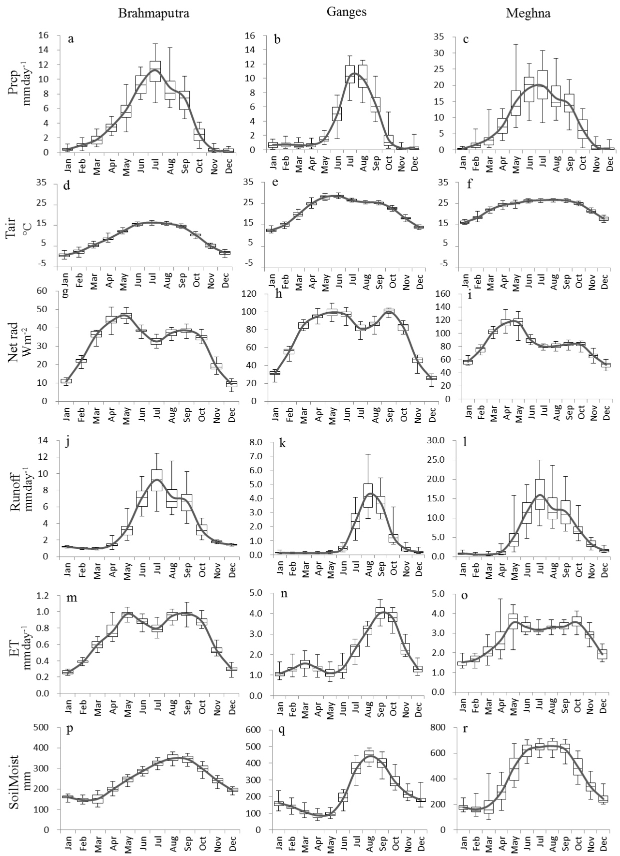

Fig. 6. Figure 6 (a)-(r). Seasonal cycle of climatic and hydrologic quantities during 1980-2001. Box-and-whisker plots indicate minimum and maximum (whiskers), 25th and 75th percentiles (box ends), and median

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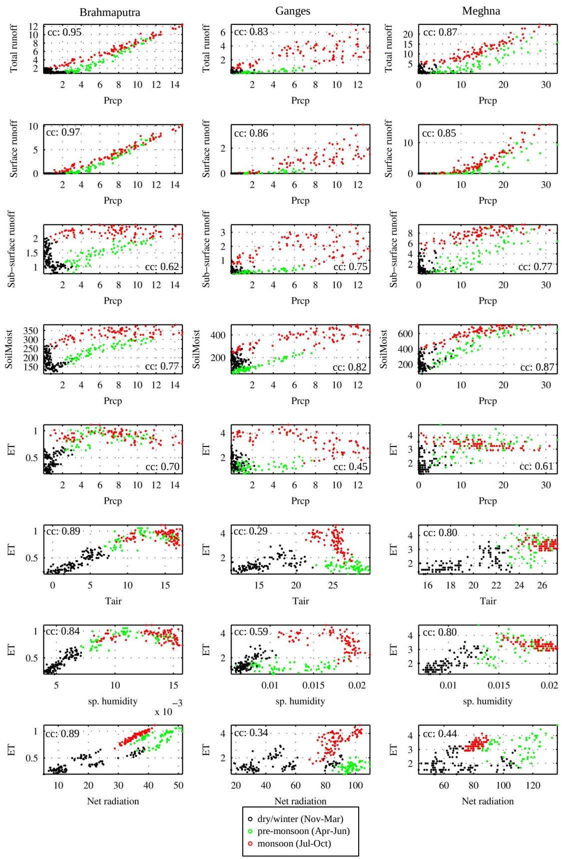

Fig. 7. Figure 7. Correlation between monthly means of meteorological variables (WFD) and that of hydrological variables for Brahmaputra, Ganges and Meghna. Three different color represent data of three diffe

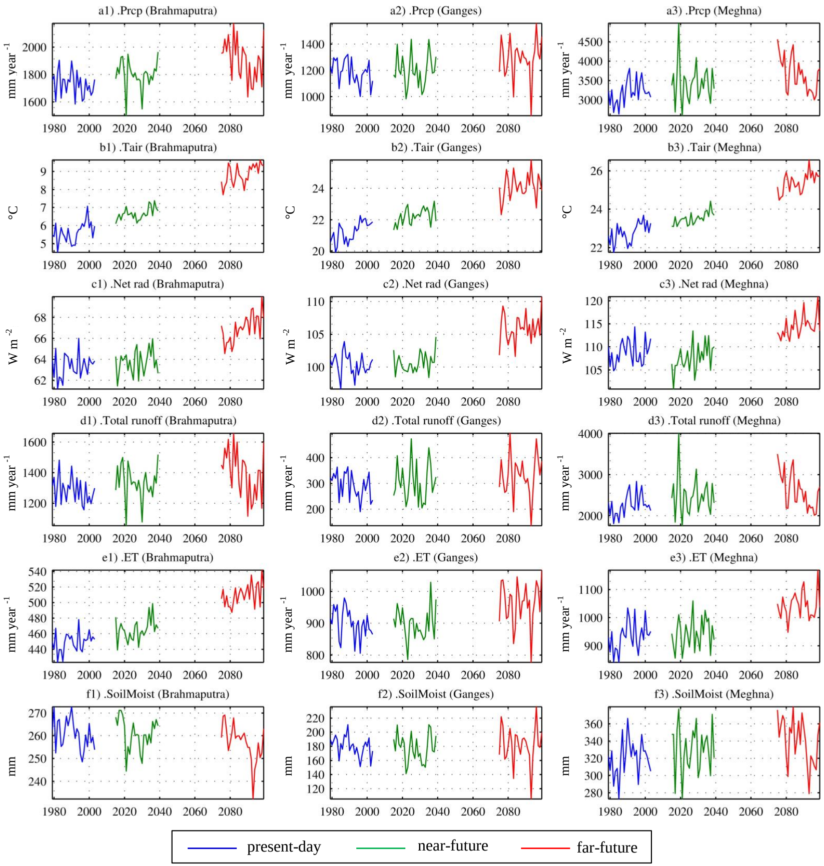

Fig. 8. Figure 8 (a1-f3). Inter-annual variation of mean of meteorological and hydrological variables for present-day (blue line), near-future (green line) and far-future (red line).

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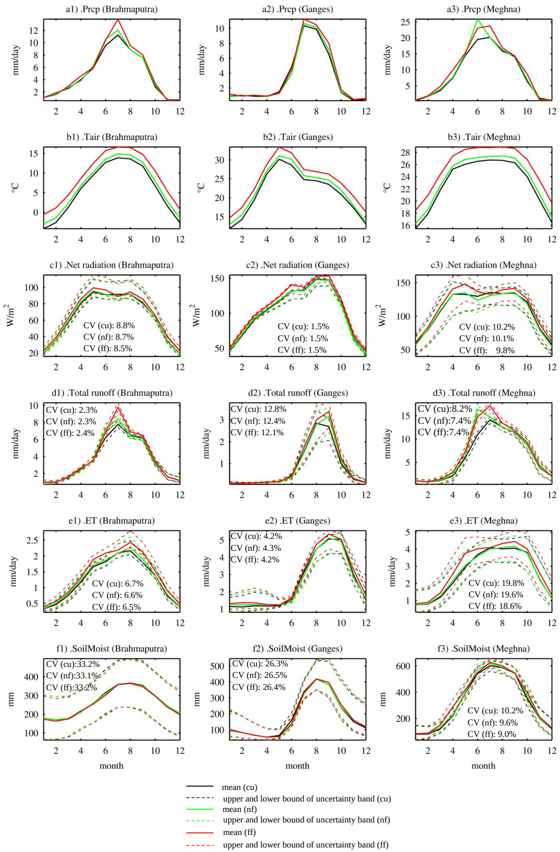

Fig. 9. Figure 9 (a1)-(f3). Mean (solid line), upper and lower bound (dashed line) of uncertainty band of hydrological quantities and net radiation components of present-day (black), near-future (green) and f

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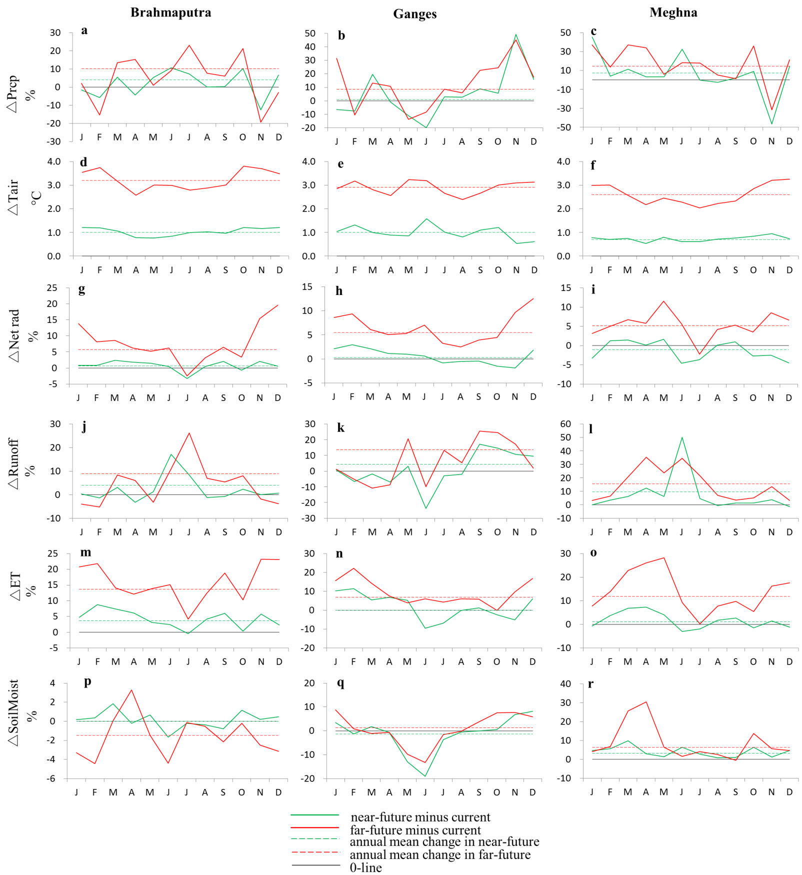

Fig. 10. Figure 10 (a)-(r). Percentage changes of monthly means of climatic and hydrological quantities of near-future and far-future periods from current periods. Dashed lines represent annual mean changes in

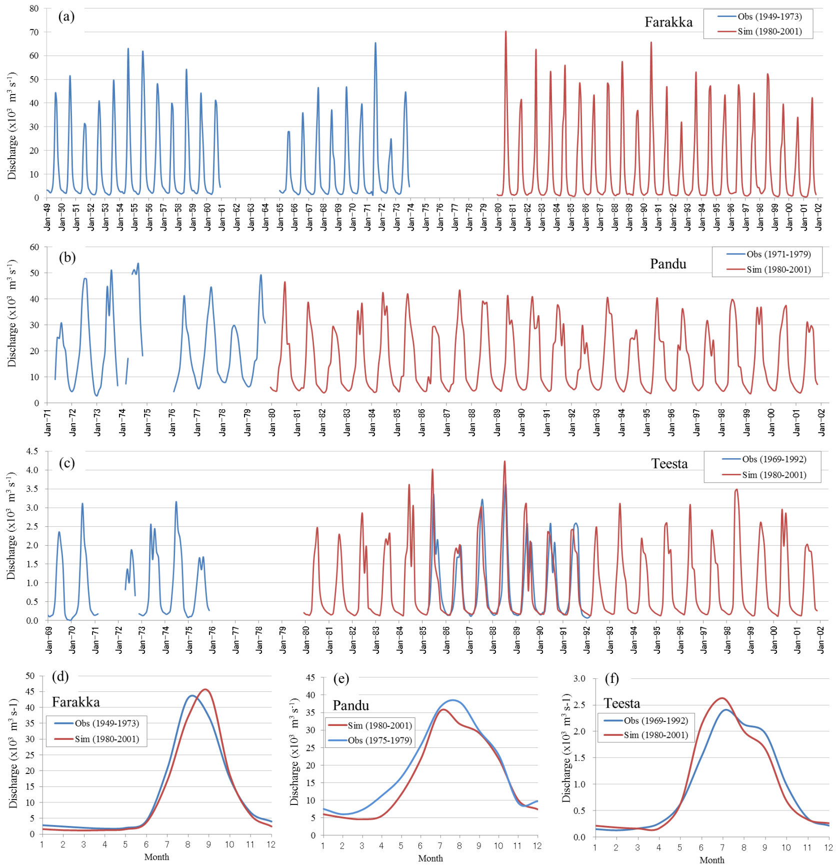

Fig. 11. Figure A1. (a-c) Hydrographs and (d-f) mean seasonal cycles at Farakka of Ganges basin, Pundu and Teesta of Brahmaputra basin respectively both for simulated (magenta line) and observed (data source:

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