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# Estimation of Uncertainty Contribution of Multiple Sources of GCMs in Hydrological Prediction.

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**Summary:**

- As we know the estimation of the impacts of climate change on hydrology at the local level comprises various sources of uncertainty from GCMs. Hence, it is important to identify for robust water resource planning and management.
- This study demonstrates the separate and multi-model ensemble GCMs uncertainty for the surface runoff projections for near, mid, and far future under RCP 4.5 (present condition) and RCP 8.5 (worst condition) at river sub-basins scale in the Western Ghats region of India.
- The results indicate that considered GCMs are not appropriate for use to prediction of peak surface runoff in the wet season.
- Uncertainty from ensemble GCMs is closer to actual data than individual GCM to the peak surface runoff for the near mid, and far future.
- Findings also suggest that make attention to rainfall data while projecting surface runoff for future time periods in the humid tropic regions.

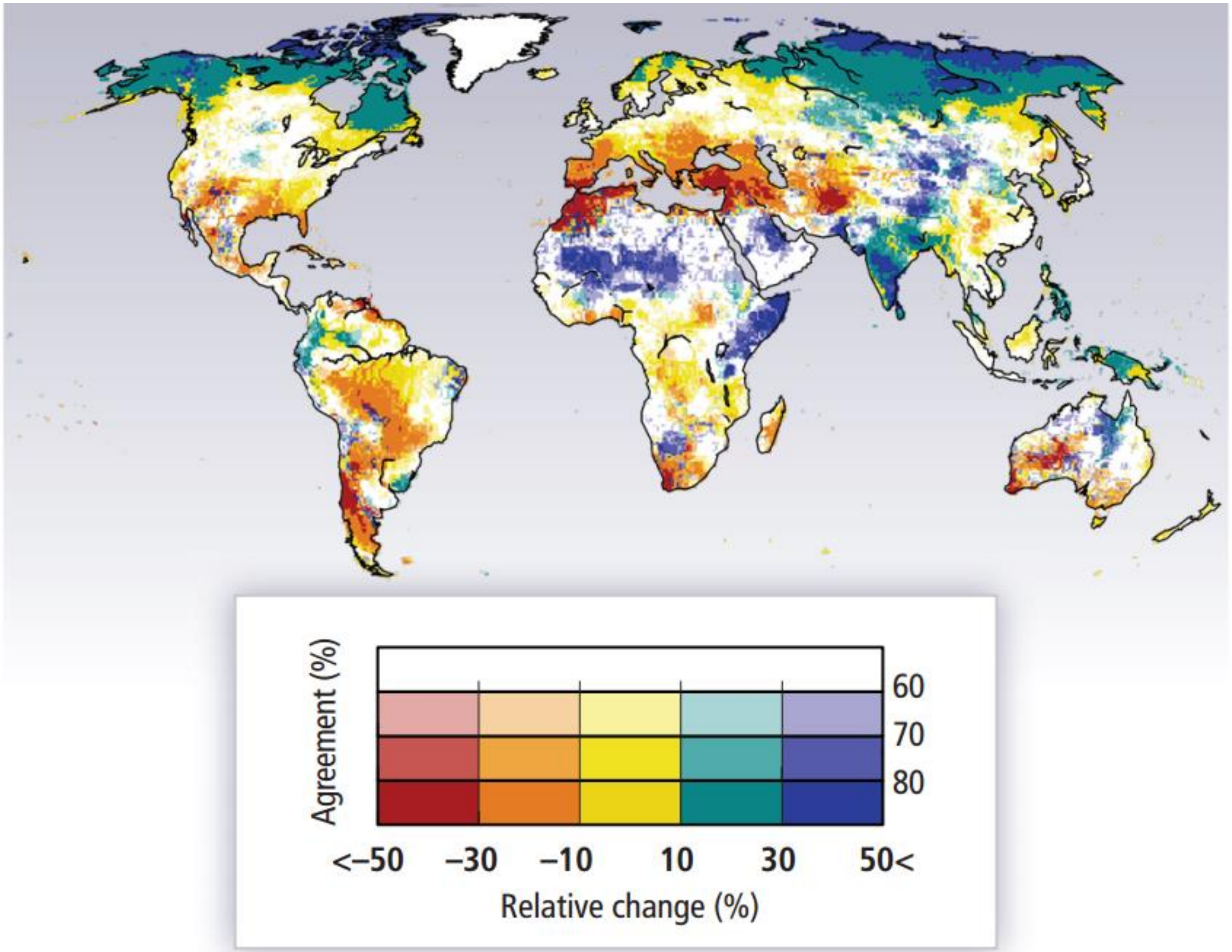


**Figure:** Percentage change of mean annual stream flow for a global mean temperature rise of 2°C above 1980–2010. (IPCC-AR5, 2014)

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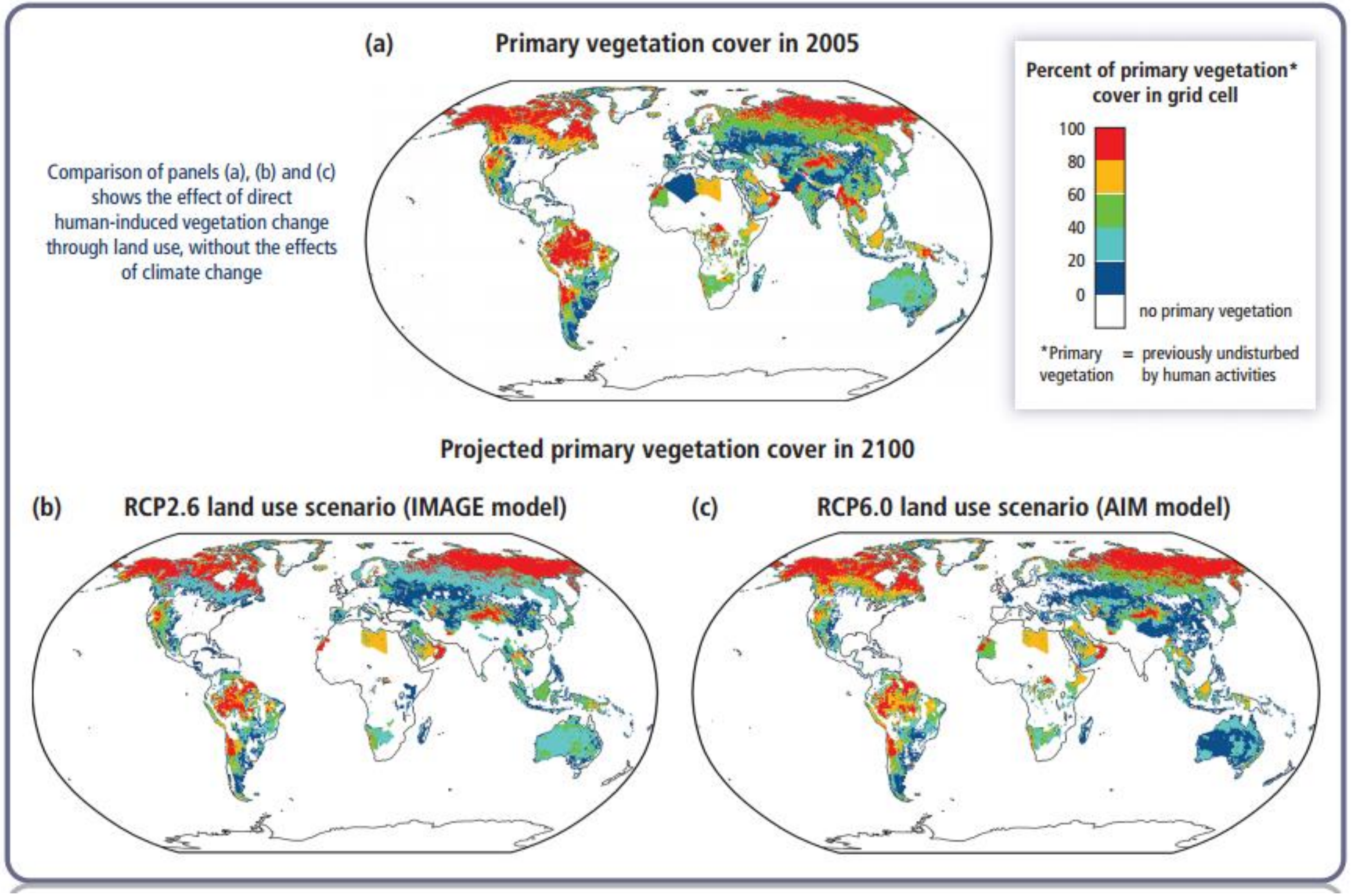


**Figure:** Projections of climate change-driven biome shifts in the context of direct human land use. (a) Fraction of land covered by primary vegetation in 2005. (b) Fraction of land covered by primary vegetation in 2100 under the RCP2.6 land use scenario, with no effect of climate change. (c) Fraction of land covered by primary vegetation in 2100 under the RCP6.0 land use scenario, with no effect of climate change (IPCC-AR5, 2014)

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# Study Area

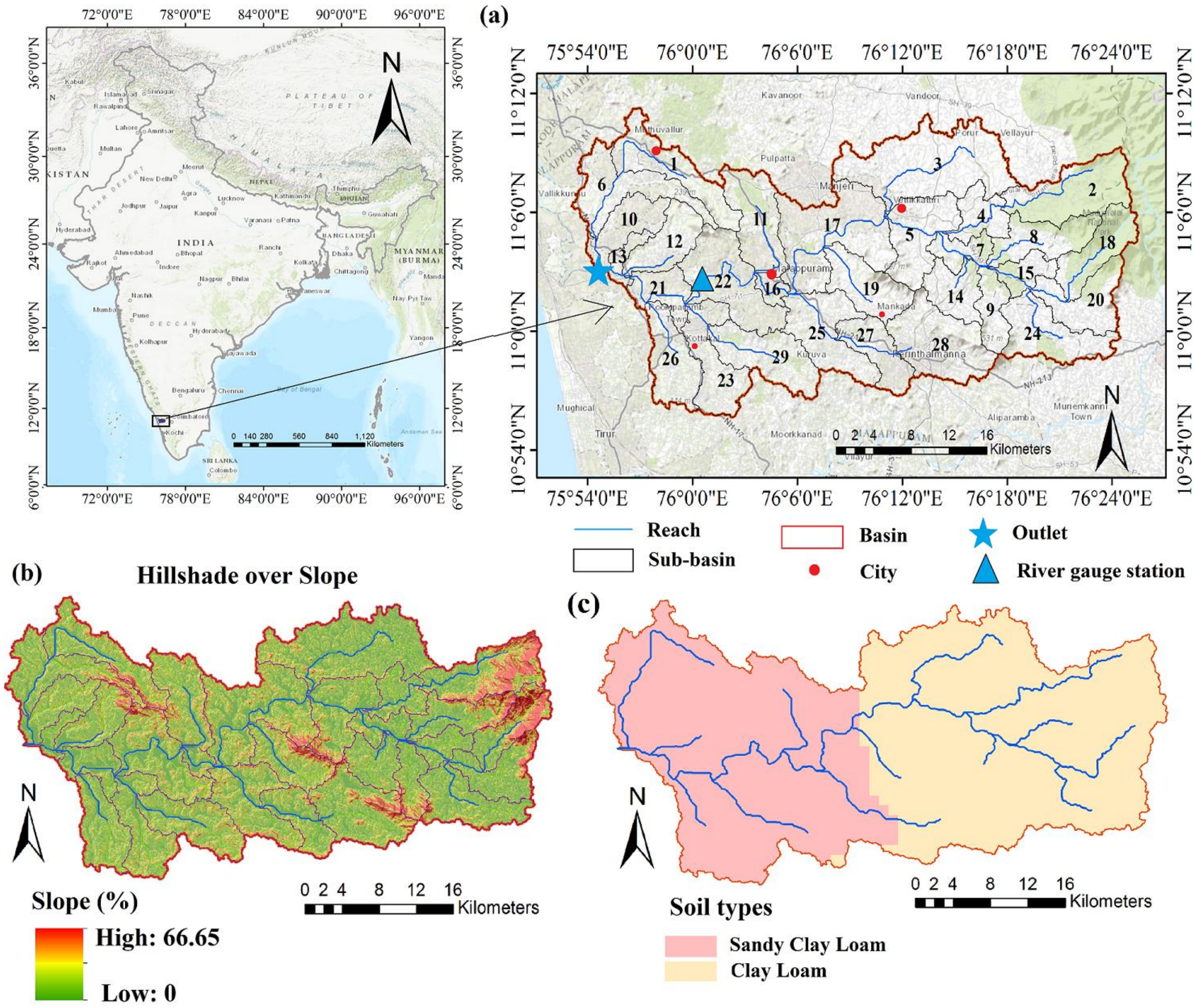


Figure: Study area (a) River basin with sub-basins level (b) Hillshade over slope (c) Soil classification

# Inputs Data

Table 1 Input data, resolution and source for the Kadalundi River Basin.

| Input data | Resolution | Source |
|---|---|---|
| Cartosat Digital Elevation Model (DEM) | 30 m | National Remote Sensing Centre (http://www.nrsc.gov.in/) |
| Land use map | 30 m | Landsat imageries (http://earthexplorer.usgs.gov/) |
| Soil type map | 1000 m | Food and Agriculture Organization of the United Nation (FAO) |
| Meteorological data (rainfall and min-max temperature) | 0.25º (daily) | Indian Meteorological Department (IMD) |
| Meteorological data (solar radiation, relative humidity, and wind velocity) | 0.25º (daily) | https://globalweather.tamu.edu |
| Observed Hydrological data (streamflow and sediment yields) | Daily | Central Water Commission (http://www.india-wris.nrsc.gov.in/) |

# GCMs

Table 2 GCMs from the CORDEX project used in the present study

| Modeling center experiment name | Driving GCM (abbreviation) | Institution |
|---|---|---|
| Commonwealth Scientific and Industrial Research Organization (CSIRO) Australia - CCAM | ACCESS1.0 | CSIRO |
| | CCSM4 | National Centre for Atmospheric Research |
| | CNRM-CM5 | Centre National de Recherches Météorologiques |
| | MPI-ESM-LR | Max Plank Institute for Meteorology (MPI-M) |
| | NorESM1-M | Norwegian Climate Centre |

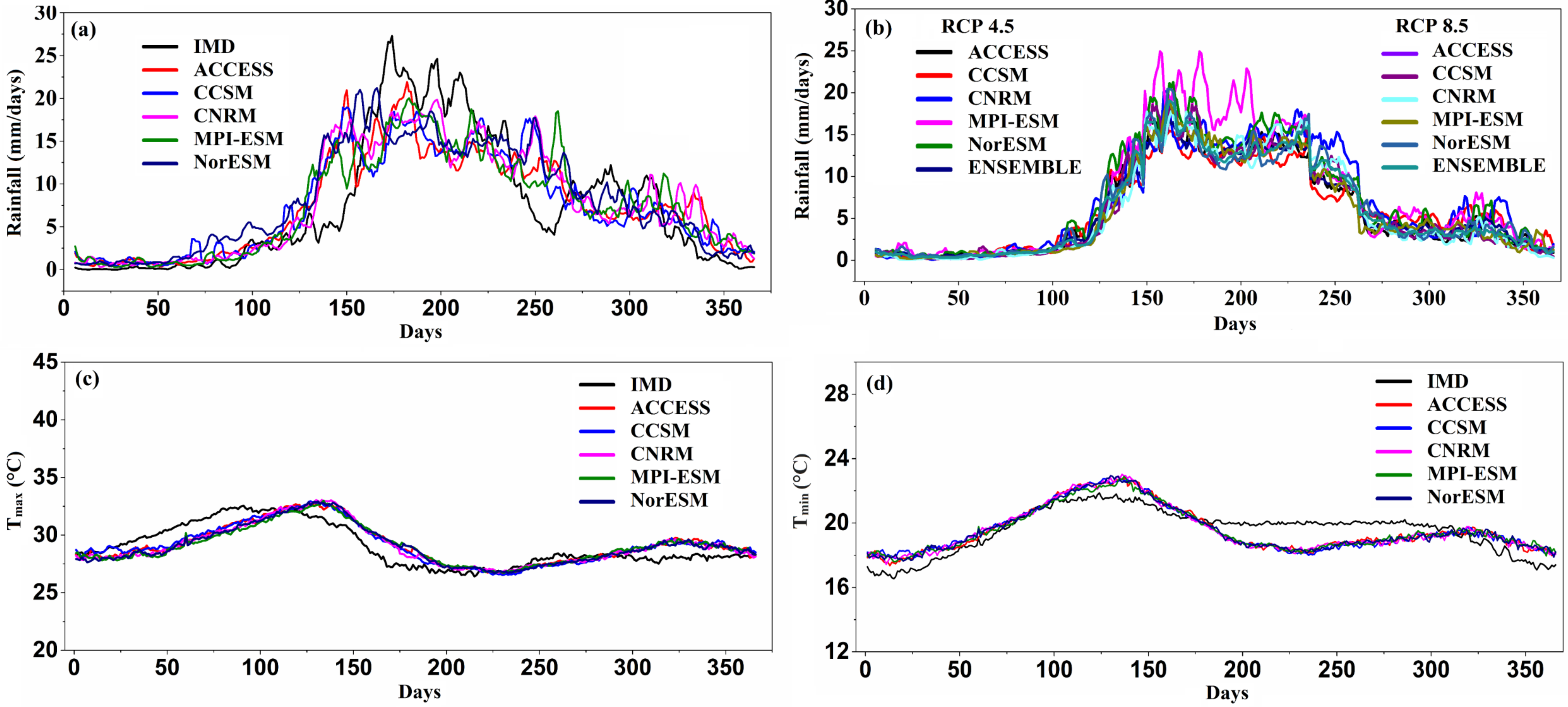


Figure: GCMs long-term average daily compared with observed long-term average daily (a) rainfall, (b) long-term daily average (2006 – 2099) future rainfall (c) GCMs long-term average daily compared with observed long-term average daily maximum temperature and (c) minimum temperature from 1971 to 2005.

Note: IMD = Indian Meteorological Department, ACCESS = Australian Community Climate and Earth System Simulator, CCSM = Community Climate System Model, CNRM = Centre National de Recherches Météorologiques, MPI-ESM = Max Plank Institute of Meteorology Earth-System Model, NorESM = Norwegian Earth System Model

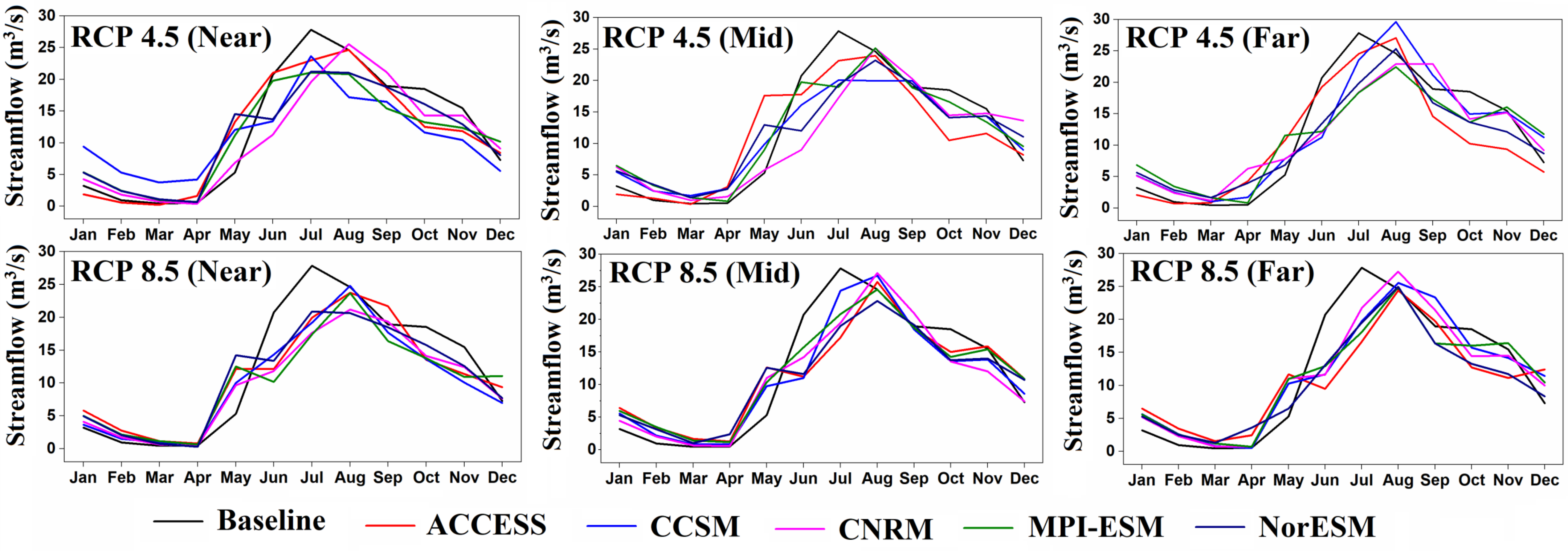


Figure: Mean monthly surface runoff of baseline (1981-2010) and each five GCM for near (2011-2040), mid (2041-2070) and far (2071-2099) future time periods for both RCP 4.5 and 8.5

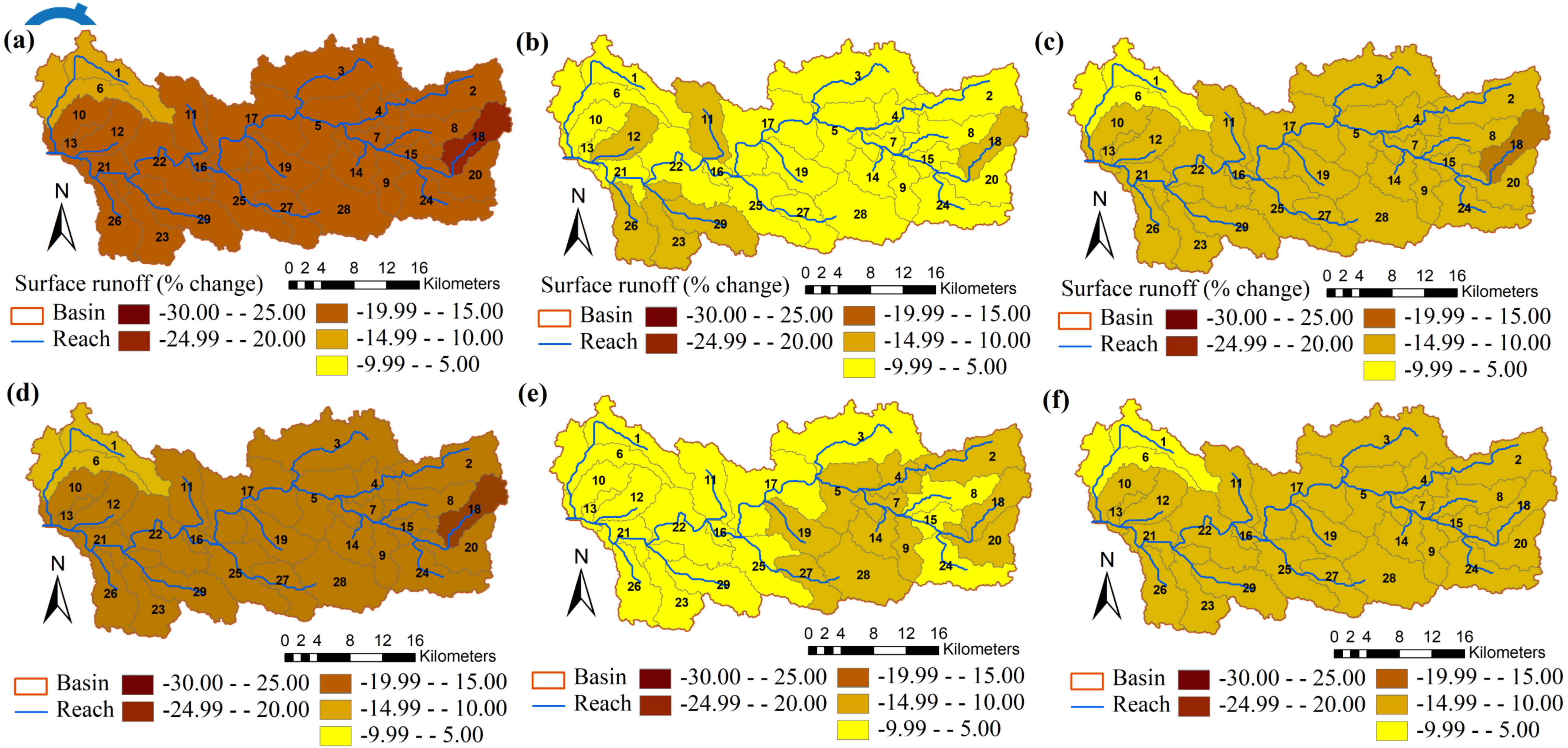


Figure: Spatial distribution of percentage change in surface runoff due to climate change under RCP 4.5 (a) near (2011–2040), (b) mid (2041–2070), and (c) far (2071–2099), and RCP 8.5 (d) for near (2011–2040), (e) mid (2041–2070), and (f) far (2071–2099) in comparisons to baseline time period (2081–2010)

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# Conclusions

- The impacts of climate change showed that surface runoff will decrease for all individual GCM and mean of all GCMs for both RCP 4.5 and RCP 8.5 emission scenarios for the future time period in comparison to baseline time period.
- This is because of decrease in mean annual rainfall and increase in mean temperature under both RCP 4.5 and RCP 8.5 emission scenarios in comparison to the baseline mean annual rainfall and temperature.
- The results indicate that considered GCMs are not appropriate for use to prediction of peak surface runoff in the wet season.
- Uncertainty from ensemble GCMs is closer to actual data than individual GCM to the peak surface runoff for the near mid, and far future.
- Findings also suggest that make attention to rainfall data while projecting surface runoff for future time periods in the humid tropic regions.

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# Thank you