Responses to Reviewer 1

General Comments The work displays a clear and replicable framework to assess variations in streamflows under the potential effect of climate changes. In this regard, the uncertainties associated to different elements of simulation chains (climate models, bias correction approaches) are properly taken into account. Finally, the findings are compared with those retrievable on the same area in an effective way. Nevertheless, some details should be clarified as reported in specific comments to permit the publication. In my opinion, they may contribute to define in clear way all the benefits and constraints associated to adopted framework and in which ways it could be improved.

Response: We would like to express our sincere thanks to the anonymous reviewer for the insightful and detailed comments on our submitted manuscript. We have revised the manuscript thoroughly based on these comments, and address them below on a point-by-point basis.

(1) L42: at the moment, several models provide data up to 12 km (e.g. EURO-CORDEX); please add details about them.

Response: Done. Thanks!

Climate simulations from GCMs can be dynamically downscaled with regional climate models (RCMs) to scales as fine as 4 km. Liu et al. (2016) presented a high resolution climate change simulation at 4-km grid using the Weather Research and Forecasting (WRF) model spacing over much of North America. Jacob et al. (2014) established a new high-resolution regional climate change ensemble with a horizontal resolution of 12.5 km for Europe within the World Climate Research Program Coordinated Regional Downscaling Experiment (EURO-CORDEX).

(2) L49: please prefer "weather" to "climatic".

Response: Done. Thanks!

(3) L58: please mention also several works in which constraints and weaknesses of Bias

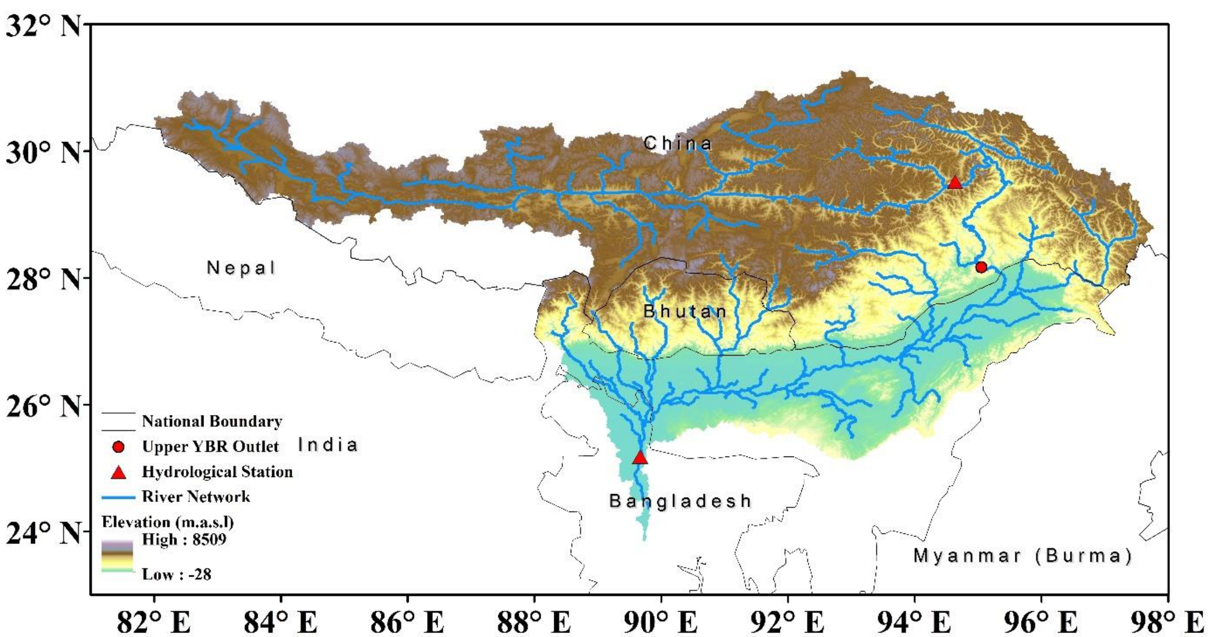
Correction approaches are clearly stressed (e.g. Ehret et al., 2012).

Response: Done. Thanks!

A more comprehensive review of the constraints of individual bias correction can be found in Ehret et al. (2012).

(4) Figure 1: please another colour for the borders.

Response: Done. Thanks!



(5) L108: I suggest you introducing in this context Figure 3 where observed monthly data are displayed.

Response: Done. Thanks!

(6) L111: please report the resolution of the dataset also in the text and not only in Table 1.

Response: Done. Thanks!

(7) L115: please report brief notes about how calculating PET.

Response: The Penman–Monteith equation was used for calculating *PET* in this dataset (Weedon et al., 2011). Thanks!

(8) L119: do you consider snow cover as an input data for the modelling?

Response: Yes. The MODIS snow covered area data were used. Daily snow cover data were obtained by linear interpolation of the 8-day data. Snow melt were simulated by a degree-day model with the degree-day factor. Details about snow cover as an input data for the modelling could be found in He et al. (2015). Thanks!

(9) L120: are you sure that land use is not strongly changed moving from reference period (1980-2001) to the period used for inputs?

Response: As we all know, land use influenced significantly by human activities and climate change (Cui and Graf, 2009). The YBR is one of the largest rivers originating from the TP in Southwest China at an elevation of about 3100 m above sea level (Goswami, 1985). Li et al. (2012) found that only 1 % of the land cover in the basin changed during 1985-2005. The high altitude and environmental policy of China made this study area little impacted by human activities. Thanks!

(10) L135: please refer to RCP as "concentration" and not "emission" scenarios.

Response: We changed all the "emission scenarios" to "concentration scenarios" in the revised manuscript. Thanks!

(11) L137: why do you use 16 years for the future? According WMO indications, 30 years should be the standard to properly taken into account interannual variability. Moreover, on the reference current period 20 years are used.

Response: We agree with the reviewer that a longer data period would be the most desirable. Comparing with 1986-2005, global average surface temperature would increase 0.3-0.7℃ under RCP2.6 during 2016-2035 (Ofipcc, 2013). However, the CORDEX experiment for the East Asia domain contained 5 models, which was shown in Table 1 in the manuscript. The time series of these 5 models were shown in Table I. 2006-2100 of HadGEM3-RA under RCP4.5 and 8.5, 2006-2050 of RegCM and YSU-RSM under RCP4.5 and 8.5, 2006-2049 of SNU-WRF under RCP4.5 and 8.5, 2006-2049 of SNU-MM5 under RCP4.5 while 2006-2035 of SNU-MM5 under RCP8.5. To compare more RCMs and more concentration scenarios (RCP4.5 and 8.5), the longest overlap time of these 5 RCMs under RCP4.5 and 8.5 was chosen, that from now to 2035. What's more, there were also some researches of projected climate change impacts using less than 30 years for the future (Immerzeel et al., 2010; Lutz et al., 2014). Thanks!

Table I The time series of these 5 RCMs.

Model	**HadGEM3-RA**	**RegCM**	**SNU-MM5**	**SNU-WRF**	**YSU-RSM**
History	1950-2005	1979-2005	1979-2005	1979-2005	1980-2005
RCP4.5	2006-2100	2006-2050	2006-2049	2006-2049	2006-2050
RCP8.5	2006-2100	2006-2050	2006-2035	2006-2049	2006-2050

(12) L141-145: the climate simulation chains are the only available under CORDEX initiative on the area of interest? What is the domain?

Response: The domain of East Asia could be found from http://www.cordex.org/domains/region-7-east-asia/. The model domain includes East Asia, India, the Western Pacific Ocean, and the northern part of Australia. Specifically, the region presented was defined by (a) parameters needed by an RCM using a rotated pole coordinate system and (b) parameters for RCM using other system coordinates (in non-rotated coordinates). Parameters of East Asia were shown in the link above. And East Asia domain of CORDEX covered the whole YBR Basin. Thanks!

(13) Equation (1): how PET0 is computed?

Response: *PET0* was the potential evapotranspiration data from 1980 to 2001 of WATCH forcing data. As mentioned in Response (7), the Penman–Monteith equation was used for calculating *PET* in this dataset (Weedon et al., 2011). We also added this information in the revised manuscript. Thanks!

(14) L163: brief details about the approach should be included for Hock (2003).

Response: For the simulation of snow and glacier melting processes which is important for the YBR Basin, we modified the original THREW model by incorporating the temperature-index method introduced in Hock (2003), that related ice or snow melt to air temperature using degree-day factors. Since air temperature was the most easily available data, this model had been the most widely used method of ice and snow melt computations for many purposes, e.g. hydrological modelling. Thanks!

(15) L176: please add references about the method for Bias Correction? Are they able to maintain the climate signal as provided by raw climate simulations?

Response: The reference was mentioned before in the manuscript: Quantile mapping (QM) with reference observations has been routinely applied to correct biases in RCM simulations (Maraun, 2013). According to the reference, this method might affect trends of data. Changes in future mean were likely to be misrepresented. To increase the signal-to-noise ratio, one often averages neighboring grid boxes. Thanks!

(16) L188: in which way, are they weighted?

Response: According to Hewitson and Crane (1996), Bayesian model averaging (BMA) mean prediction was a weighted average, with their posterior probabilities being the weights, of the individual model's predictions. Thanks!

(17) Table 3: the soil in unsaturated and saturated zones is the same or does it have only the same saturated hydraulic conductivity? Why soils characterized by very different porosities have the same hydraulic conductivities? Why do you assume that water table has fixed depth? Which literature method do you use for assessing infiltration and exfiltration capacities?

Response: In our opinion, it was the result of calibrating, that the soil in unsaturated and saturated zones had the same saturated hydraulic conductivity. Method of Reggiani et al. (1999) was used for assessing infiltration and exfiltration capacities. Similar to Reggiani et al.'s definition, the saturated zone is delimited by the water table on the top and by a limit depth reaching into the groundwater reservoir or by the presence of an impermeable stratum at the bottom. Thanks!

(18) Figure 3: according your view, why the findings after bias correction are not so good in several months for RCM5? JBCt approach returns in some cases poor performances (worse than the raw climate modelling chains). Given the relevance of precipitation in hydrological modelling, do you consider that it could affect in relevant way the analysis?

Response: The seasonal cycle of precipitation of RCM5 was not so obvious comparing with other RCMs, i.e. total precipitation of each month showed little differences. What's more, dry seasons and rainy seasons did not show significantly difference. As for JBCt approach, which corrects temperature first and then precipitation, would returned in some cases poor performances (worse than the raw climate modelling chains), e.g. RCM3 and RCM4 in rainy season. In line with previous studies (Li et al., 2014; Piani et al., 2010), we also see that bias correction may increase bias in some cases, particularly for wet season precipitation. This poor performances were also shown in hydrological modelling, Figure 6 (c1) – (d2) in the manuscript. Discharges of JBCt during these period were large than the others during the same period. Thanks!

(19) Figure 5 (a-b): in terms of peaks, the analysis is not able to properly reproduce them; in my view, it is due to use of gridded datasets at low resolution; what is your opinion? Are there some weaknesses in parameterizations for hydrological modelling inducing them?

Response: There is a tendency that the THREW model underestimates high peak flows (red vs. black lines in Figure 5). This is partly because of the use of the gridded forcing data which represent averaged values over a low resolution grid box. Such a tendency of underestimation indicates that the reported projections of future streamflow is less useful for assessing climate change impacts on the flood risk in this river basin. Thanks!

(20) Figure 5 (c-d) are missing.

Response: Done. We removed the sentence "and (c-d) seasonal time scales for both the calibration and validation periods" and Figure 5 (c-d) in the revised manuscript because these two figures didn't contain more information than Figure 5 (a-b). Thanks!

(21) L287: please prefer "weather" to "meteorological".

Response: Done. We changed all the "meteorological variables" to "weather variables" in the revised manuscript. Thanks!

(22) Figure 6: you should report also results by using WFD as input data for hydrological modelling; indeed, they represent your reference data to understand in which way climate simulation chains can affect the proper reproduction of observed patterns.

Response: We have completed Figure 6 as the Reviewer suggested in the revised manuscript. Thanks!

(23) Figure 8:for precipitation percentage anomaly could be added to have higher information content ; moreover anomalies detected by raw climate simulations should be included; indeed maintaining the signal provided by them represent a key issue when adopting bias correction approaches (the same also for temperature in Figure 9).

Response: We have completed Figure 8-9 as the Reviewer suggested in the revised manuscript. Thanks!

(24) Table 6: probably, as in many cases, raw data have performances comparable to BC ones; could they be included in BMA according your view?

Response: We found that precipitation was larger than observation before bias correction. While hydrological model tended to underestimate runoff when precipitation was large. So raw data might have good performances. But this was the effect of bias cancellation. Therefore raw data could not be included in BMA according our view. Thanks!

(25) L304: it should be stressed the most significant variations among scenarios are expected in the end of the century while you consider medium time horizon.

Response: Done. Thanks!

(26) L312: please use "projections" and not "predictions".

Response: Done. Thanks!

(27) L341-342: please add details on these issue (how snow and glacier melting processes can affect the processes.

Response: The proportion of glaciers covered were 2.7%, 5.2% and 3.5% for Nuxia, the upper YBR outlet, and Bahadurabad location, respectively. What's more, the study area was perennial snow area. Glacier melting and snow melting were the important component of runoff. Therefore, glacier and snow melting plays an important and essential part of streamflow. Thanks!

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