Geophysical Research Abstracts
Vol. 19, EGU2017-13986, 2017
EGU General Assembly 2017

Attribution of the response of the stream flows of the Brahmaputra river basin of a 1.5°C warmer world

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An increase in global average temperature due to climate change is likely to intensify the global hydrological cycle, which in turn will impact regional water resources. Changes of the frequency and magnitude of the precipitation patterns over a river basin will change the intensity of floods and droughts. It's still an active field of research to determine the impact of climate change on extreme events though the attribution community has been using large climate model ensembles to characterize the low signal to noise problems. After the Paris agreement of 2015, limiting the increase of the global temperature below 1.5°C was emphasized. However, it is not clear the benefits of additional half a degree reduction of temperature below 2°C which needs comprehensive scientific analysis. In this context, a collaborative effort of 39 academic and research institutions around the global is on-going to generate large ensemble simulations of climate projections under a project entitled, 'the Half a degree Additional warming, Prognosis and Projected Impacts (HAPPI)'. This study has made an attempt to conduct ensemble simulations of a hydrological model over a transboundary river basin (Brahmaputra) for estimating the changes in future extremes and mean discharges of the river forced by the climate projections generated under the HAPPI project.

The Brahmaputra is a transboundary river originating in China and ending in Bangladesh and it is the fourth largest river in the world in terms of average discharge of approximately 20,000 cms. It drains water from approximately 520,000 sq.km. area of China, India, Bhutan and Bangladesh. An estimated 66 million people depend on water from this river for their livelihood through subsistence agriculture and thus any change in the river's discharge due to climate change may have a negative impact on this large population. A decrease in discharge during the dry season when the basin requires water for irrigation systems translates into a threat to food security while an increase in discharge during monsoon season translates into increasing of major flooding events particularly in the lowermost riparian country, Bangladesh. About 67% of the total annual discharge of Bangladesh comes from the Brahmaputra River. In addition to a warming climate impacting the snow and glacier melt processes of the Brahmaputra River basin, the precipitation falling over the basin will also be affected because precipitation in this region is connected to the Indian summer monsoon and the Indian summer monsoon is projected to be impacted by climate change. Hence, increasing the likelihood that the discharges of the Brahmaputra River will change under the changing climate.

Given the importance of the Brahmaputra River to its riparian countries, this study estimates the changes in future extreme discharges. Results are compared for both the 1°C and 2°C worlds as prescribed by the Paris Agreement of 2015.