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# Seasonal reconstructions of Brahmaputra River discharge and applications for monsoon flooding risk

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The Ganges-Brahmaputra-Meghna river system is the third largest in the world with an annual discharge of approximately 40,000m3/s. The Brahmaputra alone contributes nearly half of the total discharge. Climatic controls on streamflow in the lower Brahmaputra basin are complex and vary seasonally, with glacial and snow melt from the Himalaya and Tibetan Plateau dominating in the fall, winter and spring, and Indian monsoon precipitation acting as the major contributor to summer flow. Here we present a suite of four seasonal and one annual reconstruction of past discharge at the Bahadurabad gauging station in north-eastern Bangladesh based on a careful evaluation of streamflow clustering across different months and streamflow and tree-ring predictor relationships. The spring transition season (May-June), monsoon season (July-September), post-monsoon season (October-December), and annual flow (January-December) reconstructions extend back six centuries from ∼1400 to 2014 C.E. The dry winter season reconstruction (January-April) is millennial length and spans ∼300 to 2014 C.E. These resulting reconstructions have little predictor overlap allowing us compare low frequency variability and recent trends if any across different seasons and the entire year. The short instrumental data (1956-2014 C.E.) shows increasing dry season flow and decreasing wet season flow, particularly since the 1990s. While these changes are likely associated with increased glacial melt and decreasing monsoon precipitation respectively, they lie within reconstructed paleo-discharge variability estimates. The deltaic flood plains of Bangladesh are extremely vulnerable to catastrophic seasonal floods caused by heavy summer monsoon precipitation. Major flooding events occurred in 1951, 1966, 1987, 1988, and 1998. Our reconstruction indicates unusually high summer discharge in all of these years. The single year highest discharge value over the length of the six-century long reconstruction occurred in 1998 suggesting that this event was highly unusual in the long-term context. Using our reconstructions, we find on average five single-year high discharge events related to flooding occur every century, but these events are more likely to occur during periods of decadal high flow. This suggests a potential to use our multi-centennial reconstruction for flood-hazard risk estimation.