Exploring the frequency of hydroclimate extremes on the Niger River using Monte Carlo methods

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Flooding and low flow events along the Niger River in West Africa can have a large impact on irrigated agriculture, regional food security and water resources. A statistical simulation framework is applied to explore the future frequencies of threshold-crossing events, focusing here on extreme streamflow values on the Niger River. The framework is based in large part on an earlier paper, (Siebert and Ward, 2011) that focused on low seasonal rainfall totals in the Millennium Villages Project. This methodology decomposes climate variability into global change (GC), multidecadal variability (MDV), and interannual variability (IV). Monte Carlo simulations are undertaken for various combinations of the above components through the early 21st century, and the authors evaluate the extent to which future event frequencies could be estimated.

Several Monte Carlo-based sensitivity studies are included to explore the impact of a range of statistical parameters on the frequency of extreme events. The framework developed permits quantification of how these statistical parameters can affect the magnitude and uncertainty surrounding future event frequencies: a finding that may have important implications for both the specific issue of index insurance and more broadly for optimal climate risk management.