

#### **4b.4 Anthropogenic footprint of climate change in the June 2013 northern India flood**

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During 13-17 June 2013, heavy rainfall occurred in northern India and led to one of the worst floods in history and massive landslides, resulting in more than 5,000 casualties. In this study, meteorological and climatic conditions leading up to this rainfall event in 2013 and similar cases were analyzed for the period of 1979-2012. Attribution analysis was performed to identify the natural and anthropogenic influences on the climate anomalies using the historical single-forcing experiments in the Coupled Model Intercomparison Project Phase 5 (CMIP5). In addition, regional modeling experiments were carried out using the Weather Research and Forecasting (WRF) model to quantify the role of the long-term climate trends in affecting the rainfall magnitude of the June 2013 event. It was found that (a) northern India has experienced increasingly large rainfall in June since the late 1980s, (b) the increase in rainfall appears to be associated with a tendency in the upper troposphere towards amplified short waves, and (c) the phasing of such amplified short waves is tied to increased loading of green-house gases (GHGs) and aerosols. In addition, sensitivity experiments with the WRF model attributed 60-90% of rainfall amounts in the June 2013 event to post-1980 climate trends.