Development of a global flood and drought catalogue for the 20th and early 21st centuries based on improved assessment of the global terrestrial water cycle and its extremes

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ABSTRACT

Introduction to the Problem: Globally, flood and drought losses have increased tenfold over the second half of the 20th century, to $300B. This is partly due to increases in population and economic exposure but may be partly due to climate variability and change. Understanding the risk of flood and drought, and the climate and anthropogenic factors that control it, requires long-term historic records of the hydrological cycle and its extremes. Observational data from precipitation and streamflow gauges are sparse over many parts of the world, are often short-term and usually tainted by anthropogenic influences. Consequently, where flood risk estimates do exist they are often short-term, limited to developed nations and do not take into account non-stationarity in climate. Consistent drought risk estimates are essentially absent due to lack of data and standardized methods for drought identification.

Rationale: Given observed changes in flood and drought occurrence and the expectation for large changes in the future, there is an urgent need to provide improved estimates of past changes globally. Much progress has been made recently in quantifying the global terrestrial water cycle through merging of observations, remote sensing and modeling, with potential to provide improved assessment of the global risk of extremes. However, large uncertainties remain among datasets and the attribution of changes, especially for floods and droughts, as summarized in the 2012 IPCC Special Report on Extremes. Nevertheless, there is scope to improve current estimates on several fronts. We propose to develop a flood and drought catalogue for the 20th and early 21st centuries by merging the latest versions of in-situ and remote-sensing datasets with state-of-the-art land surface modeling to provide a continuous and consistent dataset of the terrestrial water cycle and its extremes. The dataset will form the basis for an analysis of the changing risk of floods and droughts and attribution to climate and anthropogenic factors.

Summary of Work: *1. Evaluate current estimates of the global hydrological cycle and its extremes* by comparing existing observational, remote sensing and modeled datasets. *2. Develop a new sub-daily precipitation dataset for the 20th and early 21st centuries* by merging remote sensing, gridded global and regional products, and station data. *3. Develop enhanced global land surface model simulations* with the new precipitation dataset, new model processes, and higher spatial resolution. *4. Evaluate global flood and drought risk* based on changes in occurrence and characteristics, and generate risk maps, under assumptions of stationarity and non-stationarity.
5. Develop a flood and drought catalogue for 1901-2014.

Relevance: This work directly addresses the key competition requirements to develop and analyze long-term, high-resolution, climate quality datasets with a focus on extremes. The work will assess the current state of knowledge based on global variability and change in the terrestrial hydrological cycle and its extremes, and will deliver improved global datasets and analyses of flood and drought risk in the context of climate change, that are important to many sectors, including water, agriculture and food security, energy production, infrastructure and ecosystem health. As such, it adheres to NOAA's Next Generation Strategic Plan (NGSP) vision to "create and sustain enhanced resilience in ecosystems communities, and economies".