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On soil moisture, rain and flood extremes in a warming climate – using satellite remote sensing to define future antecedent conditions

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Floods are the largest natural disaster known to mankind, occurring every year and causing significant loss of human lives and incalculable economic damage. It has been speculated that floods will intensify under a warming climate due to spatiotemporal changes in two key factors: incident rainfall and the soil moisture conditions preceding rain. Recent research has shown that the rainfall distribution is likely to become more concentrated in time and space with each degree rise in temperature. This, by itself, will lead to peakier flood extremes, even without any change in the volume of rain that falls, which in itself is expected to increase as per the Clausius Clapeyron relationship. A contradicting evidence to this, however, was presented in a global study using observed flood records in more than 5000 anthropogenically unaffected catchments, which appeared to indicate an overall decrease in moderate flood peaks. This study seeks to investigate the reasons for this apparent anomaly, and seeks to use the power of satellite remote sensing and derived soil moisture to do so.

This study aims to examine the relation between flood extremes and soil moisture conditions over hundreds of catchments from the Australian Hydrologic Reference Stations (HRS) dataset. The HRS catchments have relatively long-term records of high quality stream flow data which are not impacted by anthropogenic factors such as river flow regulation and land use change. We assess how the pre-and post-storm soil moisture conditions are distributed in time and space with the temperature increases, using multidecadal rainfall, soil moisture and temperature data from satellite remote sensing and reanalysis products.

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