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Beyond extremes: Characterisation of the 2022 Northern Rivers flood

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Abstract: Between the end of February and the beginning of March 2022, the Northern Rivers region in NSW experienced an unprecedented flood event. The rainfall and water levels in many parts of the region exceeded historical records by a significant margin, leading to severe damage in towns like Lismore, Coraki, Wardell and Woodburn. In response, the Australian Government's National Emergency Management Agency commissioned CSIRO to undertake the "Northern Rivers Resilience Initiative" (NRRI) project covering the entire Northern Rivers region, including the Clarence, Richmond, Tweed, and Brunswick River basins. The first phase of the NRRI project, which has now been completed and is the topic of this abstract, included the characterisation of the 2022 flood event across the study region. This phase also involved consultations with local councils and stakeholders to identify and prioritise the most effective intervention options in the region. The findings of this phase are currently guiding the allocation of $150 million by the Australian Government to support the region's recovery and resilience efforts. The second phase of the NRRI project is focused on collecting high-quality DEM data across the region and bathymetry for the Richmond and Tweed rivers with the goal of building a comprehensive hydrodynamic model for the entire Richmond River catchment to investigate flood risk mitigation scenarios.

The characterisation of the 2022 flood is the first comprehensive analysis of the event based on a wide range of datasets including climate, ocean, surface and groundwater station data, radar images and gridded soil moisture simulations. The major factors that contributed to the generation of the event were reviewed including (1) initial catchment conditions, (2) locations and amplitude of rainfall peaks based on a comparison between multiple spatial rainfall estimation products, (3) hydrological and hydraulic conditions that resulted in record flooding levels, and (4) flood frequency analysis for 43 gauging stations.

The 2022 flood event was remarkable by many accounts. The antecedent conditions including rainfall totals, soil moisture and groundwater levels were significantly wetter than average across the Northern Rivers region. During the event, daily rainfall values between 23 February and 1 March were the highest on records for many parts of the Richmond, Tweed and Brunswick basins. The rainfall was centered on the mid-Richmond and Wilsons River catchment around Lismore and reached daily rainfall totals that are estimated to be significantly higher than a 1% annual probability of exceedance (AEP). Extreme rainfalls translated into record high streamflows, volumes and water levels for stations in the mid and lower Richmond, Wilsons River catchment, Tweed and Brunswick basins. Major flood levels were exceeded by more than 2m in several locations including in Lismore where the flood reached 14.37m, a level that exceeds the major flood level of 9.7m by 4.67m. The 2022 peak flow was estimated to be significantly higher than the 1% AEP event at seven gauging stations in the region and for the Lismore partial inflows (being a partial estimate of streamflow at Lismore based on the sum of flows at two upstream stations representing only 30% of the upstream catchment contributing flows at Lismore). A high degree of uncertainty is associated with these frequency estimates, which were found to vary between slightly less than a 1-in-100 year frequency (1% AEP) to 1-in-several thousand years (up to 0.01% AEP for one gauging station).

The findings of this study have led to several recommendations to enhance the region's resilience to flooding. These include improving the reliability of rain gauge and streamflow stations, developing a blended rainfall product by integrating ground stations and radar data, and acquiring additional streamflow data in the form of rating curves. Additionally, it is recommended to install a new streamflow station on Terania Creek.

REFERENCES

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