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Flood estimation for ungauged catchments in the Philippines using multiple archival data records

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Assessment of flood and drought risks, and changes to these risks under climate change, is a critical issue worldwide. Statistical methods are commonly used in data-rich regions to estimate the magnitudes of river floods of specified return period at ungauged sites. However, data availability can be a major constraint on reliable estimation of flood and drought magnitudes, particularly in the Global South. Statistical flood and drought magnitude estimation methods rely on the availability of sufficiently long data records from sites that are representative of the hydrological region of interest. In the Philippines, although over 1000 locations have been identified where flow records have been collected at some time, very few records exist of over 20 years duration and only a limited number of sites are currently being gauged. We collated data from three archival sources: (1) Division of Irrigation, Surface Water Supply (SWS) (1908-22; 257 sites in total); (2) Japan International Cooperation Agency (JICA) (1955-91; 90 sites); and, (3) Bureau of Research and Standards (BRS) (1957-2018; 181 sites). From these data sets, 176 contained sufficiently long and high quality records to be analysed. Series of annual maximum floods were fit using L-moments with Weibull, Log-Pearson Type III and Generalised Logistic Distributions, the best-fit of these being used to estimate 2-, 10- and 100-year flood events, Q_2 , Q_{10} and Q_{100} . Predictive equations were developed using catchment area, several measures of annual and extreme precipitation, catchment geometry and land-use. Analysis took place nationally, and also for groups of hydrologically similar regions, based on similar flood growth curve shapes, across the Philippines. Overall, the best fit equations use a combination of two predictor variables, catchment area and the median annual maximum daily rainfall. The national equations have R^2 of 0.55-0.65, being higher for shorter return periods, and regional groupings R^2 are 0.60-0.77 for Q_{10} . These coefficients of determination, R^2 , are lower than in some comprehensive studies worldwide reflecting in part the short individual flow records. Standard errors of residuals for the equations are between 0.19 and 0.51 (\log_{10} units), which lead to significant uncertainty in flood estimation for water resource and flood risk management purposes. Improving the predictions requires further analysis of hydrograph shape across the different climate types, defined by seasonal rainfall distributions, in the Philippines and between catchments of different size. The results here

represent the most comprehensive study to date of flood magnitudes in the Philippines and are being incorporated into guidance for river managers alongside new assessments of river channel change across the country. The analysis illustrates the potential, and the limitations, for combining information from multiple data sources and short individual records to generate reliable estimates of flow extremes.