New flood-duration-frequency models with a focus on estimation of sub-daily floods

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As floods become increasingly prevalent under climate change there is a growing need for relevant design flood values. Such values give estimates of flood magnitude within a given return period and are essential to making adaptive decisions around land use planning, infrastructure design, and disaster mitigation. Often practitioners need information about both flood peaks (i.e., for flood zone mapping) and flood volumes (i.e., for reservoir design). We implement an extension to traditional flood frequency analysis that establishes a parametric relationship between design floods from different flood durations. Such modeling is termed flood-duration-frequency, or QDF, modeling. QDF modeling enforces consistency between design floods of different durations and is especially advantageous in its ability to be extended to ungauged catchments and unobserved flood durations. However, statistically estimating design floods simultaneously across a range of durations is challenging and can lead to underestimation of return levels for peak floods. We develop a new QDF model that accounts for this by allowing the ratio between peak and daily values to be dependent on return period. The suitability of both the new QDF model and an established QDF model is assessed for twelve Norwegian catchments. The new model provides an improvement over the existing model when predicting shorter, sub-daily floods, while the established model performs better for longer flood durations. The duration-specific split in model preference is likely tied to underlying changes in flood properties as event duration increases and merits further investigation.