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Ensemble reconstructions of historic river flows for the island of Ireland.

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Long-term river flow data are instrumental in understanding the risks posed by fluvial flooding and drought events. They assist in providing greater understanding of the drivers of hydrological variability and are fundamental to contextualising extreme events and detecting emerging climate change signals. In many parts of the world, these insights are limited given the lack of long-term river flow records, which in turn limits the opportunity for robust planning decisions in the water sector. Here we link datasets that take advantage of data rescue efforts and paleoclimate reconstructions with rainfall-runoff modelling techniques, to develop river flow reconstructions at a monthly timestep. Using Ireland as an exemplar, gridded European temperature and precipitation datasets are used to reconstruct monthly flows from 1766 to present for 30 river catchments. Uncertainties in reconstructions from hydrological model structure and parameters are integrated using the Generalised Likelihood Uncertainty Estimation (GLUE) method. Reconstructions are validated through use of quality assured long-term precipitation series for selected catchments and an assessment of historical drought undertaken. We find that the methodology produces robust reconstructions of monthly flows that allow for detailed assessment of catchment responses to varying climatic conditions on monthly, seasonal and annual timescales. Despite the uncertainty associated with reconstructions, we find that the low flows signatures associated with notable historic drought events are identifiable in our reconstructions. Finally, we highlight that the datasets and methods used can be readily employed to reconstruct river flows in other European contexts.