



Disentangling Climate Change and Land Use Effects on UK River Flows: Policy and Flow interactions

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River systems provide essential natural services to communities around the world. Throughout human history, rivers have provided natural water filtration, water and food provision, transport, and recreational opportunities. However, rivers can also expose human systems to natural hazards such as floods and droughts, which are expected to increase in magnitude and frequency due to future climate change. Large scale land use change has the potential to compound the effects of climate change by further altering downstream river flows. This complex relationship, between climate change, land use policy, land use, and river flows, is poorly understood to date.

Due to its extensive and long-standing river monitoring network, the UK provides a good place to explore the evolution of river flows over the past few decades. This project aims to illustrate how land use policy and planning frameworks can affect catchment hydrology, potentially compounding the effects of climate change on river flows. We focus on policy and river flows in the Trent and Clyde catchments, two catchments with diverse land uses covering the two largest devolved nations in the UK (England and Scotland respectively).

Through semi-structured interviews, spatial data analysis, and statistical decomposition techniques, we investigate complex relationships between policy, practice, land use, and river flow metrics. We identify three main patterns of land use change which may have affected river flows through this period: afforestation, agricultural intensification, and urbanisation. We also compile a timeline of policies which have affected these three identified land uses in each study catchment. The policy analysis is then related to observed changes in river flows using our climate change attribution methodology for river flow changes (Wray et al., 2024). Our attribution method employs regressions analysis of historical precipitation and temperature against streamflow to derive probability density functions (PDFs) representing the proportion of changes in various streamflow metrics attributable to climate change. The resulting PDF, representing the climate change attribution, varied depending on the flow metric chosen, as well as temporally over the decades.

Our transdisciplinary work suggests that certain policies have the potential to exacerbate the effects of climate change on flood and drought risk, and these effects are currently insufficiently represented in the planning process. We hope that by linking previously disconnected knowledge and data, this work will inspire future improvements in land and water management policy.