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Open source data and software for understanding climate impacts on hydrological extremes- Dr Elizabeth Lewis

Introduction and context

Floods and droughts present a formidable challenge to public safety, life and the economy and are identified as the top and third priority risks, respectively, for the UK in the 2017 Climate Change Risk Assessment (CCRA 2017). The Environment Agency's third adaptation report to Defra (2021) states that "it is adaptation, preparing for climate shocks, that will save millions of lives". In their adaptation action plan, they call for "robust data-sets and tools that can be used to adapt to climate change" and "new methods and tools (to) improve the use of evidence on climate change impacts for water". In response to these needs, I have developed several freely-available sub-daily rainfall datasets and concurrent open-source quality-control and modelling software packages. Recent breakthroughs in our understanding of global trends in extreme rainfall events and the severe flash flooding that they cause would not exist without these products.

Open practices

I want my research to make a positive change in the world and as such I am committed to open research practises. Over the past few years, I have created several freely available datasets including: a gridded hourly rainfall dataset for Great Britain (Lewis et al. 2018a); A Global Sub-Daily Rainfall dataset (Lewis et al. 2019); A blended gauge/radar/satellite rainfall dataset (Yu et al. 2020). I have also developed several open-source software tools including: an hourly rainfall quality-control python package (Lewis et al. 2021); and a national physically-based hydrological modelling system (Lewis et al. 2018b). These tools are now being used as part of several larger research projects, such as PYRAMID, an open-source hyper-resolution near-real-time flood modelling system and the OpenCLIM tool, which is designed to provide an operational tool for the UK's 4th Climate Change Risk Assessment in 2026 and the National Adaptation Plan, as an open access platform that can be extended and applied by the UK scientific community and decision makers for decades to come.

I am a lecturer in Computational Hydrology and Deputy Director of Research and Innovation in the School of Engineering at Newcastle University. I teach my students to code in Python and demonstrate to them the value of open-source software and data. My research has led me to become an Early Career Expert in the NERC Constructing a Digital Environment Expert Network and a committee member of the British Hydrological Society.

Barriers, benefits and lessons

The datasets and software I create are all intentionally designed to be as accessible, useable and open as possible. This has involved years of painstaking work with meteorological services around the world, working around a myriad of licensing issues to ensure the data and tools created are available to the broadest possible community. Rainfall data is essential for a huge amount of industry and third sector applications but is often unavailable to them because of licensing issues or because it is too difficult to collect data from many different sources. I create new rainfall datasets by collating huge amounts of gauge data and using gridding and disaggregation techniques to obfuscate the raw data (which is not shareable) whilst preserving its key characteristics. This allows me to work around the original licensing restrictions and provide freely-available useful data to a huge number of stakeholders.

The other key barrier to open research is communication and advertising of the products developed. I therefore work closely with citizens, stakeholders and policy-makers to co-develop research outputs and to translate these into policy and practise. I lead the NetZero theme in the Insights North East Policy Hub. I also have experience of working in national and local government and I am a Policy Academy Fellow. Last year I worked as an embedded researcher at the Environment Agency. The projects that my tools are now being use in, involve Local councils, The EA, Climate Ready Clyde, The Broads Authority, Anglian Water, Arup, RMS, Mott MacDonald, Newcastle City Council and local community groups such as Action for Acomb.

These open community tools and networks have led to a host of new international, inter-disciplinary collaborations spanning meteorology, forestry, landslides and natural flood management.

Conclusions

The rainfall datasets, quality control software and modelling tools that I have developed are open source and freely available. As well as these products bringing world-leading advances in hydrological research, I have translated them into real-world impact across multiple sectors to address the pressing issue of climate impacts on flood risk.