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Large ensemble simulations for water resources planning

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The UK has experienced recurring periods of hydrological droughts in the past, including the recent 2022 drought. Different types of large ensemble simulations such as single model initial condition climate model simulations or weather hindcasts provide a large sample of seasonal to decadal simulations. They can help overcome challenges in understanding extreme droughts presented by limited observations, the multivariate nature of individual drought events and internal variability of the climate system. Here, we demonstrate how weather reforecasts can be used to create physical climate storylines to assist water resources planning and understand plausible worst cases.

Using the 2022 drought as a case study, event-based storylines of how the drought could unfold over winter 2022/23 and beyond can be created by using the SEAS5 hindcast dataset which consists of 2850 physically plausible winters since 1982 across three lead times and 25 ensemble members. Storylines were defined based on the possible combinations of ENSO, the North Atlantic Oscillation (NAO) and the East Atlantic Pattern (EA) (e.g. La Nina/NAO+/EA-). Storylines constructed in this way provide outlooks of ongoing events and supplement traditional weather forecasts to explore a wider range of plauasible outcomes. Circulation storylines can be used in hydrological/groundwater models to explore the possible ranges of river flow, groundwater and reservoir levels. Outlooks can be periodically updated as certain storylines may become implausible over time.