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Synthetic drought event sets: thousands of meteorological drought events for risk-based management under present and future conditions

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Droughts and related water scarcity can have large impacts on societies and consist of interactions between a number of natural and human factors. Meteorological conditions are usually the first natural trigger of droughts, and climate change is expected to impact these and thereby the frequency and intensity of the events. However, extreme events such as droughts are, by definition, rare, and accurately quantifying the risk related to such events is therefore difficult.

The MaRIUS project (Managing the Risks, Impacts and Uncertainties of drought and water Scarcity) aims at quantifying the risks associated with droughts in the UK under present and future conditions. To do so, a large number of drought events, from climate model simulations downscaled at 25km over Europe, are being fed into hydrological models of various complexity and used for the estimation of drought risk associated with human and natural systems, including impacts on the economy, industry, agriculture, terrestrial and aquatic ecosystems, and socio-cultural aspects.

Here, we present the hydro-meteorological drought event set that has been produced by weather@home [1] for MaRIUS. Using idle processor time on volunteers' computers around the world, we have run a very large number (10'000s) of Global Climate Model (GCM) simulations, downscaled at 25km over Europe by a nested Regional Climate Model (RCM). Simulations include the past 100 years as well as two future horizons (2030s and 2080s), and provide a large number of sequences of spatio-temporally consistent weather, which are consistent with the boundary forcing such as the ocean, greenhouse gases and solar forcing. The drought event set for use in impact studies is constructed by extracting sequences of dry conditions from these model runs, leading to several thousand drought events.

In addition to describing methodological and validation aspects of the synthetic drought event sets, we provide insights into drought risk in the UK, its meteorological drivers, and how it can be expected to change in the future. Finally, we assess the applicability of this methodology to other regions.

[1] Massey, N. et al., 2014, Q. J. R. Meteorol. Soc.