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How to identify a representative subset of hydro-climatic simulations for impact modelling studies?

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Uncertainties in hydro-climatic projections are (in part) related to different components of the modeling chain. Although a combination of numerous projections (ensemble) would be needed to characterize the overall uncertainty, in practice a small set of scenario combinations are constructed to provide users with a subset that is manageable for decision-making. Given that all projections are unavoidably uncertain, and that multiple projections are typically informationally redundant to a considerable extent, it would be helpful to be able to identify an informationally representative subset in a large model ensemble. The approach is based on a framework, rooted in the information theoretic Maximum Information Minimum Redundancy (MIMR) concept, for identifying a representative subset from an available large ensemble of hydro-climatic projections. We analyze an ensemble of 16 precipitation and temperature projections for Sweden, and use these as inputs to the HBV hydrological model to simulate river discharge until the mid of the 21st century. Representative subsets are judged in terms of different statistical characteristics for precipitation, temperature and discharge and the sensitivity of the identified subset is assessed for different seasons and future periods. Results indicate that a 20-35% subset of the available set of projections can represent a large fraction (more than 80%) of the ensemble range of hydro-climatic changes. We find that the identified representative subsets are sensitive to the regional hydro-climatic characteristics and the choice of variables, seasons and future periods of interest. Therefore we recommend that the identification should not be solely based on climatic variables but, rather, should also consider variables of the impact model.

Keywords:
Representative projections, information theory, climate change impacts, maximum information minimum redundancy, model ensembles