

EGU24-21687, updated on 06 Dec 2024

<https://doi.org/10.5194/egusphere-egu24-21687>

EGU General Assembly 2024

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Understanding the dynamics of multi-sector impacts of hydro-meteorological extremes: a methods overview

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Hydro-meteorological extremes, such as droughts and floods, often trigger a series of compound and cascading impacts due to interdependencies between coupled natural and social systems. However, studies typically only consider one impact and disaster event at a time, ignoring causal chains, feedback loops, and conditional dependencies between impacts. Analyses capturing these complex patterns across space and time are thus needed to inform effective adaptation planning. Here, we present a collection of methods that can be used for assessing the dynamics of the multi-sector compound and cascading impacts (CCI) of hydro-meteorological extremes. We discuss existing challenges, good practices, and potential ways forward. Rather than pursuing a single methodological approach, we advocate for methodological pluralism. We see complementary or even convergent roles for analyses based on quantitative (e.g. data-mining, systems modeling) and qualitative methods (e.g. mental models, qualitative storylines). The data-driven and knowledge-driven methods provided here can serve as a useful starting point for understanding the dynamics of both high-frequency CCI and low-likelihood but high-impact CCI.