EGU23-1645, updated on 19 Apr 2024
https://doi.org/10.5194/egusphere-egu23-1645
EGU General Assembly 2023

Sectoral water use responses to droughts and heatwaves: analyses from local to global scales from 1990-2019

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Water security is threatened by a growing global population and the associated increase in sectoral water demand. This condition is worsened by the occurrence of droughts and heatwaves, which mainly lead to a reduction in the available water, increasing water scarcity. The resulting threats to water security are expected to become more pertinent when considering that such extreme events are expected to increase both in frequency and severity. Nonetheless, little is known about the responses in sectoral water use during extreme hydroclimatic events.

This research therefore quantifies responses in water use for different sectors (i.e. irrigation, livestock, domestic, energy and manufacturing) during droughts, heatwaves and compound events at global, regional and local scales. To achieve this, the spatial extent, times of occurrence and durations of these hydroclimatic extremes were identified worldwide for the period 1990-2019. Next, sectoral water use responses were evaluated during these extreme events and compared to normal (non-extreme) periods for sectoral water withdrawal or consumption.

Our results show that extreme events affect water use responses differently per sector and region. At a global scale, the overall use of water for domestic and irrigation sectors increased while it decreased for thermoelectric and manufacture sectors during heatwaves. Also, water use response patterns show that irrigation and domestic sectors are prioritized over livestock, thermoelectric and manufacturing on a global level. Furthermore, stronger impacts are found for heatwaves and compound events compared with impacts during droughts. Finally, our analyses show that water use drivers -such as income level, use of alternative water sources, and regulatory water policies- impact the magnitude of change in sectoral water use under these extreme events.

These results set the foundation for the development of a new global sectoral water use model which will allow more accurate quantifications of sectoral water use responses and water scarcity during present and future projected droughts and heatwaves.