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Salt Intrusion in a salt wedge estuary under extreme drought conditions

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Deltas are home to billions of people and are often highly developed and engineered systems. Extreme weather events such as droughts are a threat to deltas worldwide. During droughts salt can intrude far inland and threaten the drinking, agricultural and industrial water supply of many people. Under climate change the frequency of extreme events is expected to increase and the threat of salt intrusion may intensify. Here we use data and models to explore salt intrusion in the Rhine-Meuse Delta (RMD) during the severe European drought in the summer of 2022. The RMD is one of the most highly managed deltas in the world, with numerous interconnected waterways and an open connection to the sea at the mouth of the Rotterdam Waterway. The outflow of the Rhine River through the Rotterdam Waterway generates the strongly stratified Rhine River plume. Under normal conditions a salt wedge intrudes about 16-18 km inland on every tide. In contrast, under drought conditions in summer 2022, observations show salt intruding over 42 km inland and the Rhine River plume diminished in size. We explore the changes in estuarine dynamics during the drought using velocity, salinity and temperature data from various field campaigns near the mouth of the Rotterdam Waterway and within the delta, together with numerical models. We also compare drought condition observations with data from prior field campaigns during normal discharge conditions. Shifts in the relative strength of the dominant mechanisms of landward salt flux throughout the drought are explored and linked to the changes in estuarine response.

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