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Spatiotemporal patterns of water volume and total organic carbon concentration of agricultural reservoirs over South Korea

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Understanding the dynamics of organic carbon load in lakes and reservoirs is vital for comprehending the potential impact of human disturbance on the hydrological and carbon cycle. This study investigates the spatial and temporal variability of water volume and total organic carbon (TOC) concentration and examines changes in the TOC load during a drought year. We conducted a systematic analysis of water volume and TOC concentration data from 2,484 agricultural reservoirs in South Korea, covering 2020 to 2022 at both provincial and county levels. At the national level, the yearly TOC loads range between 1387 tons and1464.84 tons. This study conducts the rotated Principal Component Analysis (rPCA) of water volume and TOC concentration. The first rPCA mode showed a decreasing trend of water level (38% of the explained variance) and increasing trend of TOC concentration (23%) over the southern Korea region. The second rPCA mode is related to interannual variability of water level (23.5%) and TOC concentration (20%) over the central Korea region. In 2022, the southern and central Korea regions have a noticeable difference in water volume and TOC concentration. These variations were closely associated with a prolonged meteorological drought event in the southern Korea region, causing increased TOC levels and reduced water volume and thus changing a role of reservoirs from a carbon sink to a carbon source. This study provide insight about how organic carbon interacts with an extreme hydroclimatic condition in agricultural reservoirs.