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Evaporation dynamics from flowing water surfaces

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In contrast to the wealth of information on evaporation dynamics from placid water surfaces such as lakes and reservoirs, estimating water evaporation from turbulent surfaces of streams remains a challenge. Evidence suggests a considerable change in evaporation from flowing surfaces relative to placid surfaces with local modifiers such as chemical, physical and biological processes that alter the energy budget and water temperature. While the studies on evaporation from wavy surfaces of oceans offer valuable insights, significant differences in hydrodynamics and heat exchange processes distinguish evaporation in oceans from that in rivers. Here we experimentally investigate how water flow characteristics (velocity and turbulence) and atmospheric boundary conditions (wind and radiation) affect evaporation rates and temperature dynamics in a flume. A closed flume (7.6 m length, 0.31 m width, and 0.5 m depth) is used to impose different boundary conditions over a test section of the flume (length of 1.5 m) while other parts of the flume are covered to reduce evaporative losses. Our preliminary findings show significant enhancement in evaporation rates, reaching 2-5 times that of placid water surfaces, driven by increases in surface velocity and turbulence characteristics. Furthermore, we observe that radiative and aerodynamic factors contribute nonlinearly to evaporation enhancement and affect temperature distribution in the water body. The study offers novel insights into evaporation from wavy and turbulent flowing water surfaces for better prediction of evaporation from riverine networks across flow regimes and climatic conditions.