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Atmospheric rivers impact California's coastal water quality via extreme precipitation

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Highlights

- Atmospheric rivers (ARs) are the meteorological mechanism driving coastal water pollution spikes.
- About 75% of water pollution spikes were associated with ARs via extreme precipitation.
- The above association was strongest in densely populated Southern California.
- Impairment of coastal waters could further increase as ARs are projected to intensify.

Abstract

Precipitation in California is projected to become more volatile: less frequent but more extreme as global warming pushes midlatitude frontal cyclones further poleward while bolstering the atmospheric rivers (ARs), which tend to produce the region's extreme rainfall. Pollutant accumulation and delivery to coastal waters can be expected to increase, as lengthening dry spells will be increasingly punctuated by more extreme precipitation events. Coastal pollution exposes human populations to high levels of fecal bacteria and associated pathogens, which can cause a variety of health impacts. Consequently, studying the impact of atmospheric rivers as the mechanism generating pulses of water pollution in coastal areas is relevant for public health and in the context of climate change. We aimed to quantify the links between precipitation events and water quality in order to explore meteorological causes as first steps toward effective early warning systems for the benefit of population health in California and beyond. We used historical gridded daily precipitation and weekly multiple fecal bacteria indicators at ~500 monitoring locations in California's coastal waters to identify weekly associations between precipitation and water quality during 2003–09 using canonical correlation analysis to account for the nested/clustered nature of longitudinal data. We then quantified, using a recently published catalog of atmospheric rivers, the proportion of coastal pollution events attributable to ARs. Association between precipitation and fecal bacteria was strongest in Southern California. Over two-thirds of coastal water pollution spikes exceeding one standard deviation were associated with ARs. This work highlights the importance of skillful AR landfall predictions in reducing vulnerability to extreme weather improving resilience of human populations in a varying and changing climate. Quantifying the impacts of ARs on waterborne diseases is important for planning effective preventive strategies for public health.