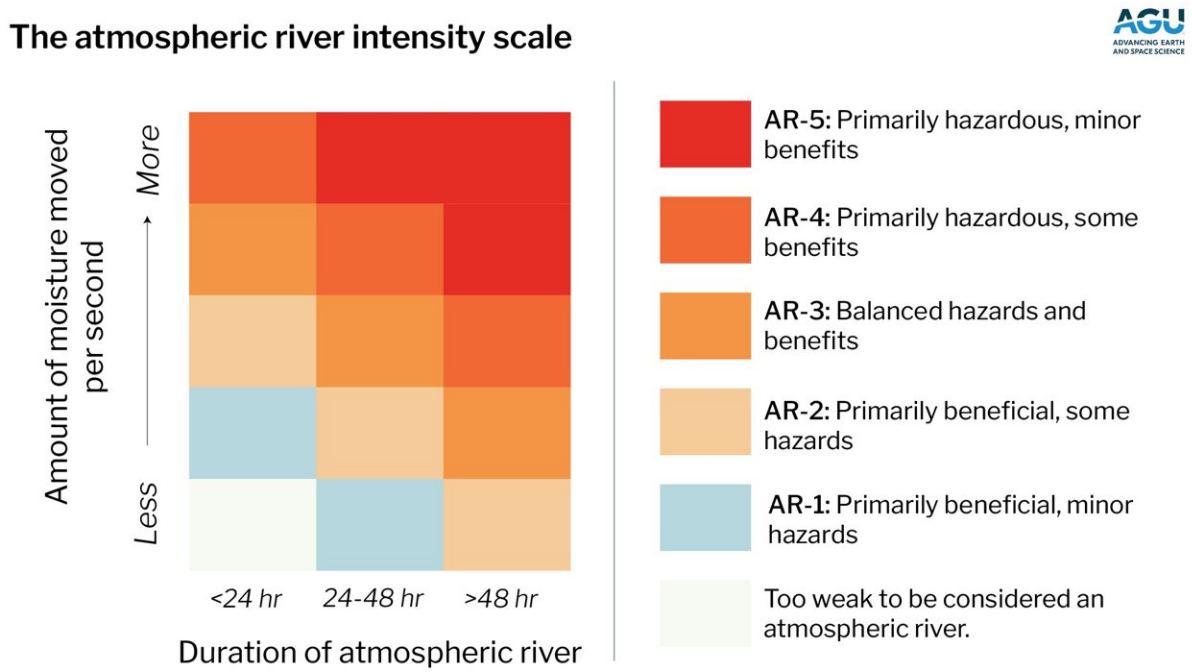
# The world's atmospheric rivers now have an intensity ranking like hurricanes

March 9 2023




The intensity of an atmospheric river depends on how long it lasts (typically 24 to 72 hours; horizontal axis) and how much moisture it moves over one meter each second (measured in kilograms per meter per second; vertical axis). While weaker atmospheric rivers can deliver much-needed rain, more intense storms are more damaging and dangerous than helpful. Credit: AGU, after Ralph et al. 2019 (DOI: 10.1175/BAMS-D-18-0023.1)

Atmospheric rivers, which are long, narrow bands of water vapor, are

becoming more intense and frequent with climate change. A new study demonstrates that a recently developed scale for atmospheric river intensity (akin to the hurricane scale) can be used to rank atmospheric rivers and identify hotspots of the most intense atmospheric rivers not only along the U.S. West Coast but also worldwide.

The study is published in the *Journal of Geophysical Research: Atmospheres*.

Atmospheric rivers typically form when warm temperatures create moist packets of air, which strong winds then transport across the ocean; some make landfall. The intensity scale ranks these atmospheric rivers from AR-1 to AR-5 (with AR-5 being the most intense) based on how long they last and how much moisture they transport.

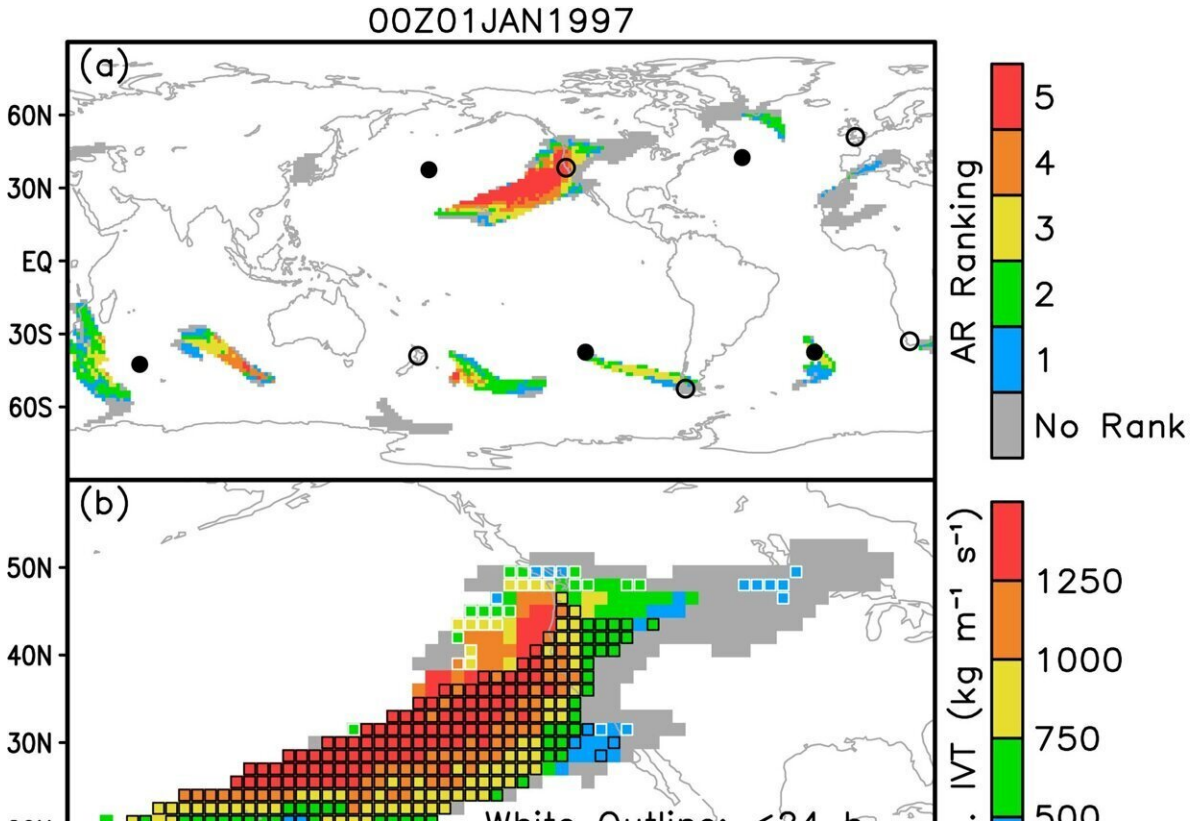
In part because some West Coast weather outlets are using the intensity scale, "atmospheric river" is no longer an obscure meteorological term but brings sharply to mind unending rain and dangerous flooding, the authors said. The string of atmospheric rivers that hit California in December and January, for instance, at times reached AR-4. Earlier in 2022, the atmospheric river that contributed to disastrous flooding in Pakistan was an AR-5, the most damaging, most intense atmospheric river rating.

The scale helps communities know whether an atmospheric river will bring benefit or cause chaos: The storms can deliver much-needed rain or snow, but if they're too intense, they can cause flooding, landslides and power outages, as California and Pakistan experienced. The most severe atmospheric rivers can cause hundreds of millions of dollars of damage in days in the western U.S.; damage in other regions has yet to be comprehensively assessed.

"Atmospheric rivers are the hurricanes of the West Coast when it comes

to the public's situational awareness," said F. Martin Ralph, an atmospheric scientist at Scripps Institution of Oceanography and a co-author on the new study. People need to know when they're coming, have a sense for how extreme the storm will be, and know how to prepare, he said. "This scale is designed to help answer all those questions."

Ralph and his colleagues originally developed the scale for the U.S. West Coast. The new study demonstrates that atmospheric river events can be directly compared globally using the intensity scale, which is how the researchers identified where the most intense events (AR-5) form and fizzle out, and how many of those make landfall.




(a) Examples of atmospheric river (AR) ranking (color shading) based on all ARs detected by tARget version 3 (referred to as the algorithm method) at an

arbitrary 6-hr time step of the MERRA-2 reanalysis. Each contiguous area indicates a unique AR. Gray shading indicates grid cells that fall within the boundary of ARs detected by the algorithm, but did not receive an AR rank due to failing integrated water vapor transport (IVT) intensity and/or event duration thresholds; see Section 2 for details. The unfilled (filled) circles mark selected coastal (oceanic) areas used in subsequent analysis. (b) A specific AR from panel (a). Color shading shows the maximum IVT of the event at each grid cell, with the color corresponding to the AR rank if the event duration is between 24 and 48 hr. White (black) outlines show locations where the event is