Linking inter-annual variations of atmospheric river landfalls to vegetation responses in the southwestern United States

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In the southwestern US, atmospheric rivers (ARs) have gained increasing attention given their strong connection to snowpack and water supplies in California. To date, relatively less attention has been paid to the ecological implications of such events, particularly in the interior southwest, where AR storms are less frequent but have the potential to produce significant precipitation when they do occur. To address this gap, we compared Rutz et al.'s (2013) 24-year chronology of AR landfalls from latitudes 25-42.5N, annual metrics of the normalized difference vegetation index (NDVI; an indicator of vegetation productivity), and daily-resolution meteorological data to analyze the influence of AR-derived winter precipitation on vegetation productivity across the southwestern US. We calculated coefficient-of-determination (R^2) values between annual winter AR precipitation generated from landfalling ARs at 2.5-degree latitudinal increments and 1) annual maximum NDVI over the study period for each 1-km grid cell across the study region and 2) area burned by large (> 400 ha) wildfires within each ecoregion during the same and subsequent years. Inter-annual variations of AR precipitation strongly influenced NDVI in semi-desert ecosystems, explaining 30-50% of the variation in both NDVI and area burned in some western Mojave and Great Basin ecoregions. The influence of ARs on semi-desert vegetation varied significantly depending on the latitude of landfall, with those ARs making landfall below 35N latitude more strongly influencing these systems. As climatologists' understanding of the synoptic patterns associated with the occurrence of ARs continues to rapidly evolve, an increased understanding of how these events, in aggregate, influence variation in vegetation productivity and associated wildfire activity in water-limited ecosystems may provide opportunities to also better anticipate ecological variations on intra-to inter-annual time scales.