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The role of hydrological initial conditions on Atmospheric River floods along the U.S. West Coast in a warming climate

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Atmospheric Rivers (ARs) are responsible for most of the storm events leading to extreme precipitation and runoff along the U.S. West Coast. Although both the number of AR days and AR-related heavy precipitation are projected to increase as the climate continues to warm, the frequency of low- and medium-intensity precipitation is projected to decrease mostly due to the weakening contribution of non-AR events. Antecedent hydrological conditions play an important role in the linkage between extreme precipitation and flooding. This is especially so along the U.S. West Coast where precipitation is strongly winter-dominant, and many potentially flood-inducing events occur relatively early in the wet season when relatively dry soil moisture may (or may not) persist from the previous dry season. Although the number of AR-related extreme precipitation events is projected to increase in a warmer climate, antecedent soil moisture conditions can have a large impact on AR-related floods especially if decreased pre-storm low- or medium-intensity precipitation and increased antecedent evaporative demand results in reduced soil moisture at the onset of extreme precipitation events. We examine the role of hydrological initial conditions on Atmospheric River floods along the U.S. West Coast in a warmer climate. We also examine the relative role of precipitation and temperature on the changes in hydrological initial conditions. We focus on three river basins that form a transect along the U.S. Pacific Coast, including the Chehalis River Basin in Washington, the Russian River Basin in Northern California, and the Santa Ana River Basin in Southern California. We run the Distributed Hydrology-Soil-Vegetation Model (DHSVM) over each of the three river basins using historical forcings during 1950-2000 and projected forcings during 2050-2010 downscaled from a group of General Circulation Models (GCMs) in the CMIP5 archive that best reproduce historical AR events.