A Survey of the Hydrological and Ecological Effects of Landfalling Atmospheric Rivers

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A wide range of hydrological and ecological effects attend or follow the landfall of atmospheric-river (AR) storms on the land areas of the world, some beneficial and others not. AR storms are sources of extreme precipitation and heavy rains and snows (depending on settings and seasons) and sometimes strong winds. They can yield floods, erosion and landslides, groundwater recharge, significant water resources, estuarine variability, and vegetation variations and change, with the intensity and frequency of such outcomes depending on a variety of conditions in the storms and of the landscapes involved. Meteorological characteristics of ARs that most strongly determine hydrologic consequences of their landfalls and inland penetrations will be summarized here, with some examples drawn from representative settings around the world. These characteristics include IVT rates, IWV amounts, the speed at which the ARs move across the landscape, air temperatures, stability of the atmosphere, dynamic vs. orographic uplift, elevation of the AR jet, presence or absence of associated barrier jets in orographic settings, and presence or absence of aerosols and cloud condensation (or deposition) nuclei. Land-surface conditions and characteristics that influence or determine how the effects of landfalling ARs play out will also be summarized, including topographic slopes and orientations, rain shadowing, antecedent soil moisture or snow cover conditions, bedrock and soils, land uses, drainage patterns and geometries, elevation and temperatures, and vegetation types and densities. This overview is intended as a foundation that sets the stage for regional or more specialized research results presented elsewhere in this session on AR Effects, and is an opportunity to feedback on some of the basic findings being reported in the upcoming AR-science monograph.