

The Role of Inland-Penetrating Atmospheric Rivers in Arizona's Heterogeneous Flood Environment

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Atmospheric river events (ARs) can produce extremely large floods in extratropical locations around the world and have been shown to be the dominant flood-producing mechanism in some areas, such as Pacific coastal regions of western North America. However, when North Pacific Ocean ARs penetrate into southwestern United States, in addition to being modified by land surface and topographic features, they enter a strikingly heterogeneous flood-producing environment. Flood-related precipitation in Arizona is delivered by synoptic-scale disturbances (extratropical cyclones and fronts – including ARs), convective thunderstorms, and moisture influxes from occasional tropical cyclone events. The dominance of these different mechanisms as flood-producers varies geographically, physiographically, seasonally, and interannually. Catchment size also plays a role.

Given the complexity of flooding in Arizona: “What is the importance of atmospheric rivers within this heterogeneous mix of flood producing mechanisms?” To address this question we cross-referenced the occurrence of inland-penetrating atmospheric rivers affecting Arizona during the period WY 1988-2011 with peaks-above-base streamflow discharge (annual and partial duration peaks) at 33 selected gauging stations in Arizona. Each peak in the database had previously been classified in terms of the flood-producing storm type or circulation pattern that generated the event (e.g. winter synoptic-scale precipitation, summer convective precipitation, tropical storm-enhanced synoptic-scale or convective precipitation). As expected, the flood peaks in the database that cross-referenced with an AR event were winter synoptic floods. However, numerous winter synoptic floods occurred that were *not* associated with an AR. In addition, although AR events affecting Arizona were observed in every year of the study period, not all of them produced floods.

A key finding of our study is that although ARs play an important role in Arizona flooding, their importance is not universal. Unlike AR events that affect California and the other western Pacific Coast states, Arizona AR events do not necessarily produce the largest floods. Other results we will address include: regional differences in flood type dominance, the role of orography in areas of AR flooding dominance, a comparison of magnitudes and frequencies of AR floods with floods produced by other mechanisms, interannual variability in AR flooding, and the importance of the trajectory of the inland-penetrating ARs as a factor in subsequent flood occurrence.