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Global assessment of subseasonal prediction skill of atmospheric rivers

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Atmospheric rivers (ARs) are global phenomena that are characterized by long, narrow plumes of water vapor transport. They are most often observed in the midlatitudes near climatologically active storm track regions. Because of their frequent association with floods, landslides, and other hydrological impacts on society, there is significant incentive at the intersection of academic research, water management, and policymaking to understand the skill with which state-of-the-art operational weather models can predict ARs weeks-to-months in advance. We use the newly assembled Subseasonal-to-Seasonal (S2S) database, which includes extensive hindcast records of eleven operational weather models, to assess global prediction skill of atmospheric rivers on S2S timescales. We develop a metric to assess AR skill that is suitable for S2S timescales by counting the total number of AR days which occur over each model and observational grid cell during a 2-week time window. This "2-week AR occurrence" metric (AR2wk) is suitable for S2S prediction skill assessment because it does not consider discrete hourly or daily AR objects, but rather a smoothed representation of AR occurrence over a longer period of time. AR2wk forecast skill in the ECMWF hindcast system outperforms a reference forecast based on monthly climatology of AR2wk at 1-week (7d-21d) lead over a number of subtropical to midlatitude regions, with slightly better skill evident in wintertime. AR2wk is modulated during certain phases of the El Niño-Southern Oscillation (ENSO), Arctic Oscillation (AO), Pacific-North America (PNA) teleconnection pattern, and Madden-Julian Oscillation (MJO), and statistically significant differences in AR2wk forecast skill are shown during +PNA relative to –PNA at 0-week and 1-week lead over the North Pacific/West U.S.; during +AO relative to –AO at 3-week lead over the North Atlantic/U.K.; during El Niño relative to La Niña at 2-week lead over South Pacific/Australia and at 0-week lead over South Pacific/Chile region, respectively; and during particular phases of MJO over each region. We also present results from an experimental forecast of S2S AR prediction skill using the ECMWF and NCEP models.