

Evaluation of Forecasts of the Water Vapor Signature of Atmospheric Rivers in Operational Numerical Weather Prediction Models

GARY A. WICK, PAUL J. NEIMAN, F. MARTIN RALPH, AND THOMAS M. HAMILL
NOAA Earth System Research Laboratory, Physical Sciences Division, Boulder CO

Atmospheric rivers (ARs) play a key role in both extreme precipitation and water supply along the U.S. West Coast and understanding how well they are forecast in weather models has important implications for issuance of flood warnings and guidance. The ability of five operational ensemble forecast systems to accurately represent and predict ARs is evaluated as a function of lead time out to 10 days over the northeastern Pacific Ocean and west coast of North America. The study employs the recently developed Atmospheric River Detection Tool to compare the distinctive signature of ARs in integrated water vapor (IWV) fields from model forecasts and corresponding satellite-derived observations. The model forecast characteristics evaluated include the frequency of occurrence of ARs, the width of the IWV signature of ARs, their core strength as represented by the IWV content along the AR axis, and the occurrence and location of AR landfall.

Analysis of three cool seasons shows that while the overall occurrence frequency of occurrence of ARs is well forecast out to 10-day lead, forecasts of landfall occurrence are poorer and skill degrades with increasing lead time. Average errors in the position of landfall are significant, increasing to over 800 km at 10-day lead time. Also, there is a 1-2° southward position bias at 7-day lead time. The forecast IWV content along the AR axis possesses a slight moist bias averaged over the entire AR but little bias near landfall. The IWV biases are nearly independent of forecast lead time. Model spatial resolution is a factor in forecast skill. Model differences are greatest for forecasts of AR width. This width error is greatest for coarser-resolution models which have positive width biases that increase with forecast lead time. Although position errors decrease as landfall approaches, errors on the order of hundreds of kilometers pose a serious problem for water managers and flood forecasters whose watersheds are smaller than that error.