Quantification of Atmospheric River Landfall Errors at Bodega Bay, California in the Global Forecast System and West-WRF

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Atmospheric Rivers (AR) are known to produce heavy precipitation when making landfall along the U.S. West Coast. The precise location of AR landfall can greatly influence the amount and distribution of precipitation. Previous studies have shown that operational forecast systems can generate large temporal and spatial errors when predicting the landfall of an AR, leading to significant challenges for river and reservoir forecast operations. This study investigates the landfall error associated with twelve ARs that made landfall and produced heavy precipitation over the Russian River watershed in northern California. This watershed includes two reservoirs operating for water supply and flood control purposes, making accurate forecasting imperative to reservoir management. AR conditions are detected and measured at Bodega Bay, CA by an Atmospheric River Observatory (ARO) as part of the Hydrometeorology Testbed (HMT). This unique set of instrumentation allows for the detection of AR conditions using measurements of Integrated Water Vapor (IWV) as well as upslope water vapor flux in the controlling layer (0.75-1.25 km MSL). Using the methodology from the Ralph et al. (2013) AR catalog, the times when AR conditions (IWV >2 cm and upslope flux >15 cm (m s^{-1})) were first met at Bodega Bay for each of the twelve ARs were identified. The time when AR conditions started was then used for comparisons against two forecast systems, the Global Forecast System (GFS) and the West-WRF, a mesoscale model run at the Center for Western Weather and Water Extremes (CW3E). The Modern-Era Retrospective Analysis for Research and Applications (MERRA) reanalysis data set was used to determine the location of the AR at the start of ARO observed AR conditions based on the AR definition of IWV >20 mm and Integrated Water Vapor Transport (IVT) >250 kg m^{-1} s^{-1}. The location of the AR at the MERRA landfall time was then compared to the GFS and West-WRF forecasts with varying forecast lead times out to ten days. Errors in AR location and timing of AR conditions reaching Bodega Bay are presented as a function of lead time and comparisons are made between the two models. Initial results indicate that errors increase significantly as a function of lead time with larger errors in the coarser-resolution GFS model.