Atmospheric Rivers in Reanalysis products: A six-event comparison with aircraft observations of Water Vapor Transport

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Atmospheric water vapor transport is a critical component of the global water cycle and in precipitation formation and prediction. Over roughly the last 15 years research efforts have identified atmospheric rivers (AR) as the primary mechanism for transporting water vapor in the mid latitudes, and possibly from the tropics into the midlatitudes. Numerous studies have used either satellite observations of vertically integrated water vapor (IWV) over the ocean or numerical models to examine AR-related water vapor transport. Some studies have been able to take advantage of vertical profiling information at the coast, and a handful of other studies have been able to carry out aircraft observations over the oceans.

This study will compare observed characteristics of AR water vapor transport (specific humidity, along-front winds, along-front water vapor transport, IWV, and total integrated water vapor transport across the depth and width of the AR) with six reanalysis datasets: the Climate Forecast System reanalysis (CFSR), the North American Regional Reanalysis (NARR), NASA's Modern Era Retrospective-Analysis For Research And Applications (MERRA), ECMWF's ERA Interim reanalysis (ERA-I), the 20th Century Reanalysis (20CR), and the NCEP-NCAR Reanalysis (NNR). This analysis will quantify the vertical and cross-AR structure of 6 AR events over the Pacific Ocean as well as document the total water vapor transport within each event. These unique observations are then compared with the reanalysis data sets to assess uncertainties in the representation of ARs and their associated water vapor transport in these heavily used reanalyses. This work addresses research objectives of the "CalWater" experiment associated with ARs, a multiyear experiment led by the California Energy Commission, NOAA, and Scripps Institution of Oceanography.

The analysis includes observations from 3 flights of the NASA Global Hawk unmanned aircraft in the NOAA-led Winter Storms and Pacific Atmospheric Rivers (WISPAR) field campaign. WISPAR was a demonstration project of the NOAA dropsonde system on the NASA Global Hawk (GH) unmanned aircraft system. The GH flew three research flights for a total of almost 70 hours in February–March 2011 deploying 177 dropsondes from near 60,000 feet altitude into atmospheric rivers (ARs), midlatitude cyclones, and the Arctic atmosphere. The dropsonde data provide high-resolution thermodynamic and wind data between the lower stratosphere and the surface of the ocean. Observations from 4 different AR transects during this campaign have provided important new information on the structure and evolution of ARs and characterized how well reanalysis data products represent AR conditions.

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