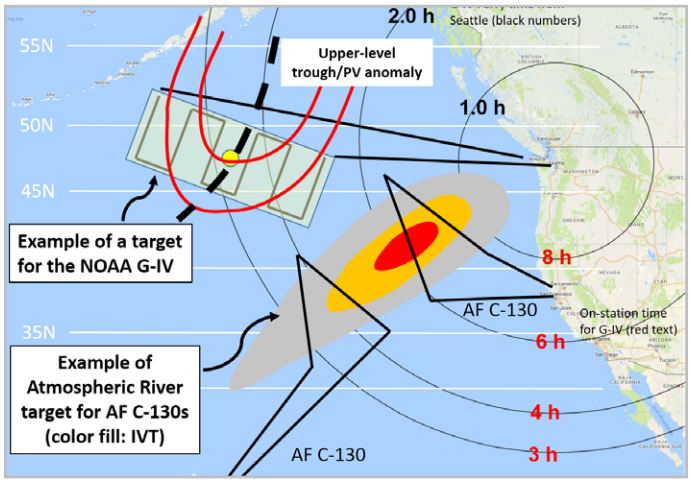
Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

ATMOSPHERIC RIVER RECONNAISSANCE

CHALLENGE

Atmospheric rivers (ARs) are the primary storms that produce both beneficial water supply (up to 50% on average) and floods (over 90% of major floods). Yet AR landfall forecasts can be off by 200-300 miles, even just 3 days before impact. AR reconnaissance (AR Recon) uses aircraft to gather data offshore to improve forecasts of landfalling ARs on the US West Coast. The Western States Water Council has recommended AR Recon for improving forecasts.[1]



Example of a flight strategy for AR Recon with the NOAA G-IV and two Air Force C-130s.

ACCOMPLISHMENTS

CW3E is the leader and catalyst for this effort, having led the deployment of a U.S. Weather Recon fleet to monitor ARs off the west coast, with 3 and 6 missions in 2016 and 2018, respectively. These campaigns serve to promote an understanding of how specific AR characteristics and forecasting methodologies affect precipitation forecasts.

AR Recon has brought together a wide range of agencies and academics, including NOAA (NWS' NCEP and Western Region, OMAO/Aircraft Operations Center), Naval Research Lab (NRL), the Air Force 53rd Weather Reconnaissance Squadron, Plymouth State University, the National Center for Atmospheric Research, the State University of New York at Albany, the University of Arizona, and the European Centre for Medium-Range Weather Forecasts. This collaborative effort demonstrates the importance of AR Recon to California and the entire West Coast of the US.

The California Department of Water Resources (DWR) supports AR Recon through funding for dropsondes (the instruments released from aircraft to obtain temperature, wind, and relative humidity). DWR's support heavily leverages

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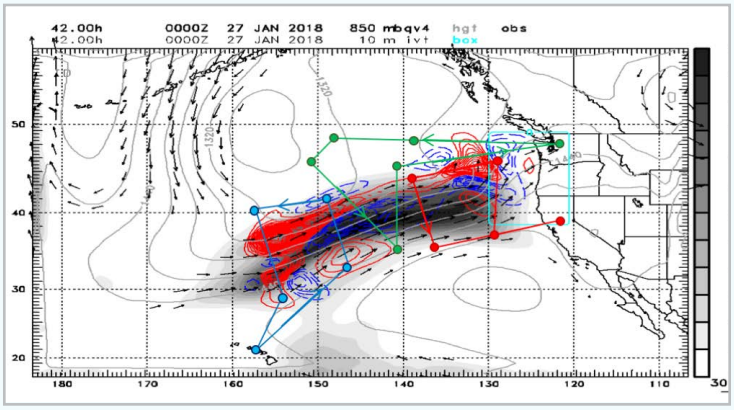

Uncertainties in atmospheric river conditions offshore impact forecasts at landfall. A model developed and run at NRL can pinpoint areas where these uncertainties have the highest impact on forecasts. In this example from 27 January 2018, the model identified locations (red and blue contours) where even a very small error in the integrated vapor transport (grey shading) can cause a significant difference in forecast precipitation in a given area (light blue box). Proposed flight tracks to sample these targeted areas are overlaid for the three aircraft (NOAA G-IV, green; Air Force C-130s, blue and red) used in AR Recon 2018. (Figure courtesy of James Doyle and Carolyn Reynolds, Naval Research Laboratory.)

funds from the US Army Corps of Engineers in support of forecast informed reservoir operations and participation of U.S. Air Force and NOAA aircraft and staff. The aircraft used for AR Recon include two C-130s and NOAA's Gulfstream IV(G-IV) jet, both of which are used for hurricane reconnaissance in the Eastern U.S.

AR field campaigns have developed new forecasting tools including the AR landfall tool and plume diagrams. These tools, available on the CW3E website, were first tested during CalWater.[2,3] Recent AR recon efforts have developed new flight planning tools and incorporated new methods to better understand what causes the greatest forecast uncertainty.

NEXT STEPS

Future AR Recon is needed to understand how observational data can improve AR forecasts, particularly the largest storms, to more accurately predict where, when and how much rain will fall. Three aircraft in each of nine storms in 2019 will provide enough cases for evaluation and refinement of the method, and for careful testing of the impact of the data on numerical weather prediction models. Additionally, new data assimilation methods are being developed and tested to optimize use of the dropsondes in regional and global weather forecast models. These efforts require large supercomputer commitments, coordination and support of a diverse team of experts, and development of forecast skill performance metrics.

Dr. Marty Ralph holding a dropsonde on the NOAA G-IV aircraft.

References

[1] Ralph et al. 2014, J. Contemporary Water Resources Research and Education, Universities Council for Water Resources.

[2] Ralph et al., 2016, Bull. American Meteorological Society.

[3] Cordeira et al., 2017, Bull. American Meteorological Society.