Data Impact Assessment of Atmospheric River Reconnaissance Dropsondes in NCEP GFS Operational Forecasts

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Since the winter of 2020, observations from Atmospheric River Reconnaissance (AR Recon) have been integrated into the U.S. National Winter Season Operations Plan (NWSOP) as a key operational component. This initiative aims to improve weather forecasting, particularly for regions impacted by atmospheric rivers (ARs), which play a critical role in precipitation patterns and water supply, especially along the U.S. West Coast. During the winters of 2022-2023 and 2023-2024, the AR Recon campaign conducted a total of 79 intensive observing periods (IOPs), a significant increase from previous years. These IOPs combined dropsonde observations with high-density flight-level data collected from NOAA and Air Force aircraft missions, providing valuable atmospheric profiles. These profiles offered measurements of water vapor, temperature, and wind within and around ARs, enabling a better understanding of their structure and dynamics, particularly their role in moisture transport and precipitation.

To assess the impact of these observations on forecast accuracy, near real-time data impact experiments were conducted using the NCEP operational Global Forecast System (GFS) version 16 (GFSv16). These experiments focused on evaluating how dropsonde data influenced GFS forecasts, with particular attention to landfalling ARs and associated precipitation. The results of these experiments showed that dropsonde data helps improve GFS initial conditions, leading to more accurate precipitation forecasts, particularly along the U.S. West Coast, where ARs significantly impact rainfall and flooding events. In addition to improvements along the U.S. West Coast, the experiments revealed enhancements in the Pacific North American region (180E-320E, 20N-75N), also driven by improved GFS analysis. These improvements were observed in both forecast accuracy and the representation of key atmospheric variables.

A detailed analysis of how dropsonde data influenced GFS forecasts during the AR Recon missions of 2022-2023 and 2023-2024 will be presented. This analysis will provide deeper insights into the operational benefits of AR Recon data, highlighting the improvements in forecast skill achieved through the integration of dropsonde observational data. As the AR Recon campaign progresses, we anticipate further advancements in real-time forecasting capabilities and reductions in forecast uncertainty for AR-related precipitation events.