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On the impact and benefits of AMDAR Water Vapor Observations to forecasts of hazardous weather events

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Wind and temperature observations provided from commercial aircraft have been shown to be very important in improving operational Numerical Weather Prediction on global (3rd highest impact of all data types) and regional scales (greatest impact on any data set in areas of ample data), as well as being much more cost effective than other data sources. The quality and potential importance of newly available moisture observations are less well recognized.

Because moisture changes often occur at much smaller scales than wind and temperature variations, these temporally, vertically and spatially frequent moisture observations can have exceptionally large impacts on forecasts of disruptive weather events (both for NWP applications and direct forecaster use). The mobility of the observations may help offset the dwindling number of global moisture observations made using rawinsondes.

Currently, more than 115 (112 in the US and 3 in Europe) aircraft-based Water Vapor Sensing Systems (WVSS-II) provide specific humidity observations en-route and during takeoff and landing. Results of a series of assessments comparing data from WVSS-II sensors initially installed on 25 UPS Boeing 757 aircraft with co-located rawinsonde (RAOB) observations show agreement to within 0.5 g/kg in specific humidity, with minimal biases. Inter-comparisons of observations made amongst nearby aircraft agree to better than 0.2 g/kg, suggesting that the WVSS-II measurements are at least as accurate as high-quality RAOB water vapor observations. Information derived regarding observed spatial and temporal moisture variability could be important in optimizing the use of these observations in future mesoscale assimilation systems.

WVSS-II observations taken throughout the day have proven useful to forecasters in predicting details of a variety of weather events, including forecasts of the formation (and non-formation) of convection. Examples will be shown of forecasts made by NWS and airline personnel that demonstrate the benefits obtained from combined profiles of temperature, moisture and wind acquired during aircraft ascents and descents in a variety of hazardous weather forecasting situations. Finally, results of initial regional NWP impact studies are discussed which show equal or greater influence when compared with RAOB observations in 1-2 day NWP forecasts over the US, including recent efforts to include these data in global NWP systems.