



# Using AMDAR Aircraft Observations at the National Weather Service Forecast Office Raleigh, North Carolina



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## The Problem

Traditional observations of the troposphere via the National Weather Service (NWS) radiosonde network often lack the spatial and temporal density that operational meteorologists at the local Weather Forecast Office (WFO) desire.

## AMDAR Soundings Can Provide Much Needed Data

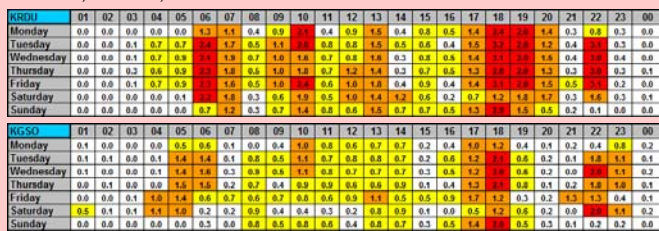
Aircraft Meteorological Data Relay (AMDAR) is an international effort within the World Meteorological Organization to coordinate the collection of environmental observations from commercial aircraft. There are several overlapping subsets of AMDAR data including ACARS, MDCRS, TAMDAR, Canadian, and E-AMDAR which are differentiated based on sensor type and communication system. Meteorological instrumentation of aircraft and the dissemination of that data can provide forecasters with a tremendous increase in the number and location of observations of the troposphere which often result in improved forecasts and greater forecast confidence.

## AMDAR Benefits

- Real observations of temperature, wind direction, wind speed, and at times moisture
- Increase in temporal frequency of observations vs. radiosondes
- Increase in horizontal frequency of observations vs. radiosondes and profilers
- Availability of data at asynoptic times

Hourly statistics of AMDAR observations at the Raleigh-Durham International Airport (KRDU) and the Piedmont-Triad International Airport in Greensboro (KGSO) were collected and analyzed. During the 12 month period from June 1, 2008 through May 31, 2009 over 6,400 AMDAR observations were recorded at KRDU and over 4,000 AMDAR observations were recorded at KGSO.

The two charts below show the average number of AMDAR soundings during each hour of every day of the week at KRDU and KGSO. The times shown have been adjusted to local time. The greatest frequency of observations generally occurs from Tuesday through Saturday at 600 AM, 1000 AM, 600 PM, and 1000 PM local time.



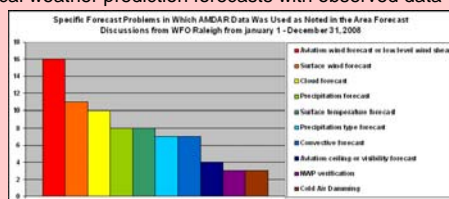
## AMDAR Challenges

- Many AMDAR soundings lack dew point data
- Sounding availability is limited and can be irregular due to flight schedules
- Data impacted by mesoscale or microscale phenomenon
- Data interpretation for a sounding location can be complicated by varied flight and landing patterns
- Hazardous weather can impact flight schedules and data availability
- Height of data is not measured directly but based on standard atmosphere
- Data availability is restricted to NOAA and other specific user groups

## Asset for Numerous Forecast Problems

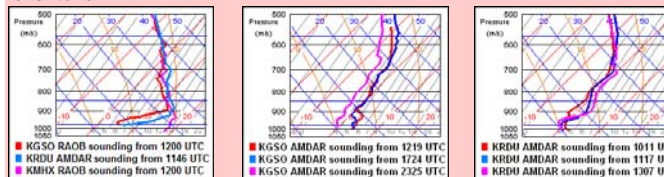
- Precipitation-type forecasts
- Evaluating environment for near term severe convection
- Aviation forecasts of cloud coverage and height
- Determining potential for low level wind shear
- Forecast of surface temperatures and dew points
- Examining cold air damming events
- Fire weather forecast parameters including mixing height, winds, and boundary layer moisture
- Forecast of fog and low cloud decks
- Hazardous materials events and decision support services
- Comparison of numerical weather prediction forecasts with observed data

Area Forecast Discussions from WFO Raleigh were examined during a 12 month period from January 1, 2008 through December 31, 2008. A total of 77 unique cases were identified in which AMDAR data was used or mentioned.



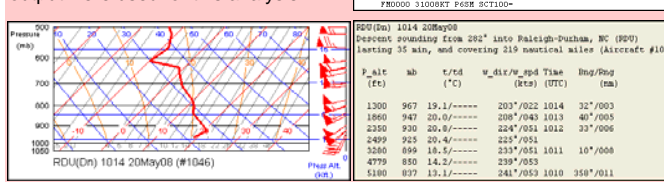
## Precipitation-Type Examples

AMDAR soundings can be used to determine and monitor the depth of the cold air near the surface especially in cold air damming events such as April 4, 2008 (lower left). The soundings can also be used to monitor the degree of cooling aloft due to melting snow. On January 19, 2008 (center), melting snow gradually cooled the above freezing temperatures at KGSO eventually allowing snow to be observed at the surface. On January 17, 2008 (right), forecasters used AMDAR soundings to verify model guidance which indicated that warming near 900 hPa would increase changing light snow over to rain.



## Aviation Example

The AFD for the 12 UTC TAF issuance on May 20, 2008 notes that AMDAR observations were used to assess and include the threat of low level wind shear (LLWS) conditions. Both the Skew-T-log P diagram and the text output were used for this analysis.



## Severe Convection Example

Severe thunderstorms were not expected across central NC late on May 9, 2008 because of a capping inversion near 700 hPa. The Skew-T plot below shows the erosion of the cap via the 2147 UTC AMDAR aircraft sounding at KGSO (red line), the KGSO RAOB released at 2315 UTC (blue line), and an 0229 UTC AMDAR aircraft sounding at KGSO (purple line). AMDAR data was used to verify the model forecasts and anticipate an increase in convection.



## Interpretation Example

Differences between the temperature profile in the RAOB (red line) and the AMDAR sounding (light blue line) are noted in the Skew-T-log P diagram below despite the fact that the two instruments sampled the atmosphere within 20 minutes of each other – likely from diabatic cooling from precipitation.



## How AMDAR Usage was Increased at WFO Raleigh

- Ensure as many AMDAR observations as possible are available in AWIPS via the GSD LDM feed
- Demonstrate the utility and added value of AMDAR data at shift briefings, case studies and post mortems
- Provide training on accessing the data, using it properly, and its limitations
- Developed a local application to alert forecasters of the arrival of AMDAR data when it becomes available in AWIPS
- Examine the frequency of observations and build awareness of days and times in which the data is likely to be available
- Note the utility of AMDAR in Area Forecast Discussions

## Acknowledgements

Special thanks to Kevin M. Smith for the analysis of the AFD's from WFO RAH and Russ Johnson for the hourly analysis of AMDAR observations at KRDU and KGSO. Thanks to the airlines and all of those involved in getting AMDAR data to the WFO. Thanks to ESRL/GSD for the AMDAR plots and NWS Eastern Region Headquarters for support and printing services. Appreciation is also expressed to the WFO Raleigh staff who continue to embrace this dataset and note the utility in Area Forecast Discussions.

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