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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Reconstructing trajectories of aircraft transmitting AMDAR weather reports

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Aircraft-based meteorological measurements in general exhibit typical systematic errors depending on various flight dynamic parameters. It is widely assumed that operational AMDAR (aircraft meteorological data relay) weather reports by commercial aircraft are affected in a similar way. Such systematic errors are however difficult to determine since datasets that contain both AMDAR reports and flight dynamic variables are not available.

In order to determine the flight dynamic state of aircraft taking AMDAR measurements, a method was developed to reconstruct the flight trajectories of these aircraft from just the aircraft type and operational AMDAR reports. Trajectory solver – as used by air traffic control – cannot be used for this task, since AMDAR reports do not contain information on flight plan, origin, destination, or the motion vector of the aircraft. Instead, the method presented uses groups of trajectory templates and fits them to the time-space position of AMDAR data taken during approach or departure. To describe the aerodynamic and engine characteristics of each aircraft type, the Eurocontrol BADA (Base of aircraft data) database together with a modified total energy model (TEM) is used.

This algorithm allows for estimation heading, aircraft mass, true airspeed, and attitude angles roll (state), pitch, and heading and the angle of attack. For verification, the algorithm was applied to navigation data gathered from two Airbus-manufactured aircraft, of which one is in commercial service and one is used for aviation research. From a total of 48 profiles, a very good agreement of reconstructed and measured values was found.