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A low-cost approach to derive upper-air wind measurements from ADS-B

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Using navigation data of aircraft to derive wind measurements is a usual practice. The wind is always calculated as difference between the speed of the aircraft relative to the air (airspeed) and to the ground (groundspeed), respectively. In research-aircraft, both airspeed and groundspeed are determined as three-dimensional vectors and, hence, allow to calculate the three-dimensional wind vector. However, if only the horizontal wind is needed, as in the AMDAR (aircraft meteorological data relay) programme, the calculation can be simplified significantly by assuming that the flow is parallel to the aircraft fuselage and vertical accelerations are minimal. This allows to calculate airspeed from the aircrafts heading and true airspeed (measured by the speed indicator) as well as groundspeed from the change of the aircraft position.

With the introduction of Automatic Dependent Surveillance - Broadcast (ADS-B) the same navigation information, i.e. frequent reports of airspeed and heading and position reports every few seconds, is made available in the vicinity of the aircraft by transponder (extended squitter) radio broadcast. Dutch weather Service (Koninklijk Nederlands Meteorologisch Instituut, KNMI) has demonstrated that it is possible to derive high-quality wind measurements by taking the airspeed supplied via ADS-B together with the aircraft position determined by the tracking and ranging radar (TAR-1) at Amsterdam Schiphol (EHAM) airport.

Our approach is to use extremely affordable equipment (≤ 150) to collect ADS-B transmissions in the vicinity of an arbitrary receiver position. From these data, wind speed is calculated without radar information. If an airport used by ADS-B-equipped aircraft is within the range of the receiver, this method allows to generate wind profiles at reasonable quality without any wind profiler, lidar or airline participating in AMDAR. Since ADS-B is targeted at enhancing air traffic control in radar-sparse areas, we hope that this approach will help to fill more “white spots” of worldwide upper air data coverage.