

# Detecting and Measuring Turbulence from Mode S Surveillance Downlink Data

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**Abstract**— Instability in the movement of air masses in the atmosphere can result in turbulence. Most often, turbulence causes discomfort to passengers but it can occasionally affect their safety as well. Turbulence experienced by aircraft can be difficult to predict, especially for clear air turbulence (CAT) which occurs in the absence of any visual clues. Pilots may report turbulence when they fly through turbulent areas; their input contributes to the issuance of weather advisories (SIGMETs) that contain meteorological information concerning the safety of all aircraft. This paper presents a novel method to detect turbulence experienced by aircraft based on Mode S data, emitted by transponders in reply to BDS 6,0 requests (heading and speed reports) sent by Secondary Surveillance Radars. The method is first validated on a few flights labelled manually by the authors flying around Europe. Then, a large-scale reconstitution of turbulent areas over Europe on ten days across different seasons in 2018 is compared with SIGMETs emitted during the same time interval. This method may be an encouraging entry point for Air Navigation Service Providers so as to gain a better awareness of the turbulence situation, by simply requesting this type of information from aircraft flying in their airspace.