Automated in-situ Turbulence reports from Airbus aircraft.

Axel PIROTH, Airbus
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co-authors: Anaïs Mermet
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speaker: Axel PIROTH, Airbus

A study published this year by Paul D. Williams showed that the amount of transatlantic wintertime clear-air turbulence in the atmosphere will increase significantly in all aviation-relevant strength categories as the climate changes. This trend is also foreseen all around the globe. Moreover, other studies demonstrate that the strength of those turbulence will most probably be higher. In parallel, more and more turbulence events are reported by airlines, if not directly by the social networks and the media for the worst of them that lead to cabin mess and even passengers and cabin crew injuries. All of these converging facts emphasize the crucial need to better predict and anticipate turbulence events.

In order to achieve this, the scientific community needs to improve its physical understanding of the generation of small-scale processes.

In such a perspective, the capability to rely on massive “real-time” turbulence data detected by aircraft will be a major opportunity. This is the exact goal of the EDR (Eddy Dissipation Rate) project launched by Airbus.

The purpose of this project is to equip Airbus aircraft with an algorithm which calculates the turbulence around the aircraft.

Among the several options that exist to characterise the turbulence, the EDR has been chosen to be compliant with the ICAO recommendation regarding turbulence detection. This parameter, as independent of the type of aircraft which senses it, can be universally used by any consumer.

It can be used directly on-board the aircraft but also downlinked in real time to the ground for any potential users (airlines, meteorological offices/provider, airports etc...)

It enables all along the aircraft route to both determine precisely the areas where a turbulence is occurring but also the area where there are not.
The algorithm has been defined, developed, implemented and tested on board the aircraft. Besides evaluation sessions with pilots on aircraft simulator enabled to determine severity thresholds associated to EDR values. This severity thresholds definition will be matured through further Airbus experimentation in real-event situation. It will concur to converge towards an agreed and recognized “translation” of EDR numerical values in operationally understandable thresholds.

The concept which we are currently demonstrating is relying on the fact that, having a significant number of aircraft equipped with the EDR algorithm detection will enable at least two major improvements:

- the exchange of information between aircraft in order to improve pilots awareness on turbulence occurrence around their position and versus their planned trajectory. This will help them to determine the areas to avoid and those which are safe and bring benefits to the airline in term of safety, fuel consumption, passenger comfort and branding.
- the gathering of such data will be key to improve long and short term forecast of turbulence in order to have a continuous representation of turbulence phenomena and better anticipate and optimise airplanes trajectories taking into account avoidance of turbulence areas.

We have already equipped about 40 airplanes with EDR algorithm since almost a year and developing associated tools to demonstrate the efficiency of this approach. Moreover this data allow us to build some statistical representations of turbulence occurrence over Europe as displayed in the figure below.

We are also sharing this big amount data with some National Met offices to try to evaluate how far they will contribute to the improvement of their activities (forecasting, nowcasting, model initialisation and validation...) This partnership with National MET service providers is a fundamental part of this project and has to be extended as far as to achieve concrete results in this prediction field.

Current activities tend to deploy the initiative to other partner airlines so that to improve the turbulence gridding all over Europe and then in the rest of the world.

The Automated in-situ Turbulence observed data is the key element that will aim to globally contribute to a better turbulence phenomenon understanding, crowd-sharing and nowcasting/forecasting. It will ensure a deeper knowledge of the turbulence events which will be profitable for all the users.