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First results of the CONTUR-1 LIDAR measurement campaign focused on detecting wake turbulences

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In this study we present some results obtained in CONTUR - New technologies to COMbat the effects to clear air TURbulences project which aimes to develop emerging technologies to counteract effects induced by the turbulent flows. The project was designed as a two stage approach to counteract the effects induced by the turbulent flow. The first component is aimed at studying clear-air turbulence (CAT) , while the second focuses on designing new technologies to reduce vibrations.
In severe cases CAT can potentially be hazardous to the health and safety of air travellers. Higher frequencies of such phenomena are expected as a result of climate change and the ever increasing number of commercial flights.
The first testing campaign to detect CAT events took place between 10 and 14 September 2018. The objective of the campaign was to conduct tests to assess the performance of CAT detection using existing LIDAR systems at INOE 2000 (National Institute for Research and Development in Optoelectronics), Bucharest and UBB (Babeș-Bolyai University), Cluj-Napoca, Romania.
The CONTUR1 campaign was focused on the detection of turbulent phenomena caused by the passage of large - scale airplanes - wake turbulence. This type of turbulence can be marked in space and time by continuous air traffic monitoring over the site.
To obtain the LIDAR profiles, measurements were divided into data sets with 3 integration times: high (1 minute), average (30 seconds) and small (15 seconds), corresponding with the temporal scale of this type of turbulence.
Two multi-wavelength Raman LIDAR systems capable of measuring molecular depolarization at 532 nm were used, one at UBB and one at INOE. The measurements were accompanied by continuous flight path monitoring to mark incidence events above the measuring location. For this, an area of interest was defined, which included several degrees of incidence with flights in transit over stations (200, 500, 1000, 2000 m).
Profiles obtained during the campaign did not highlighted patterns that may be associated with turbulence events. Out of a total of 86 flights, only 6 cases where within the 500 m radius. The most suitable integration time for obtaining the LIDAR profiles coincided with the lowest possible statistical error as this was the main indicator for determining the quality of the signal. Thus integration times of 15 seconds and lower should be used in the next campaigns. LIDAR profiles indicated a useful signal up to 5 km for daytime (UBB) and 8 km for night-time (INOE). Based on these early findings the next campaign aims to conduct night-time measurements at low integration times, 15 seconds and lower, focusing on altitudes upwards of 6 km for a greater chance of turbulence detection.