A FEW APPLICATIONS OF AIRBORNE LIDAR FOR SPACE SCIENCE

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ABSTRACT

Since 2009, the Facility for Airborne Atmospheric Measurements BAe-146 atmospheric research aircraft (FAAM, www.faam.ac.uk) is equipped with a cloud/aerosol lidar. Having a lidar on an airborne platform has the unique advantage of being able to take it to different observation scenes around the world, based on scientific requirements. Moreover, a fully instrumented platform such as the BAe-146 permits complementing the lidar observations with several other on-board sensors, both remote sensing and in situ. In this talk, we shall describe a few of the applications of the airborne lidar.

1. VOLCANIC ASH APPLICATIONS

During the eruption of Eyjafjallajokull in 2010, a detailed dataset of volcanic ash concentrations has been compiled during six research flights over the United Kingdom and surrounding seas [1]. This dataset has been successfully used for the improvement of dispersion models (see e.g. [2] and [3]) and for the validation of satellite products based on IASI and SEVIRI (see e.g. [4] and [5]). Fig. 1 illustrates an example of a direct comparison of volcanic ash column loadings derived by SEVIRI and the airborne lidar.

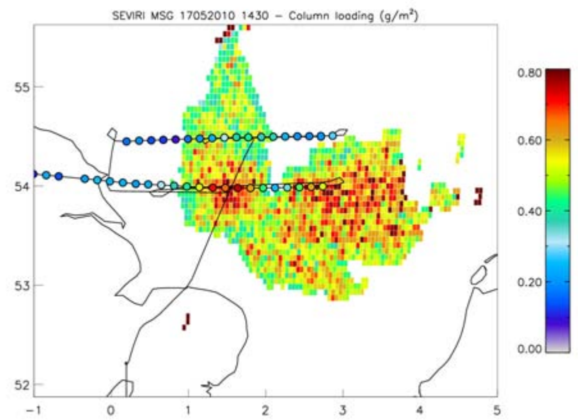

Figure 1. Volcanic ash column loading over the North Sea, determined from Meteosat products for 17/5/2010 at 14:30. Overlaid is the flight track of the FAAM aircraft, and the coloured circles represent the column loadings determined with the aircraft lidar.

2. COMPARISON WITH CALIPSO

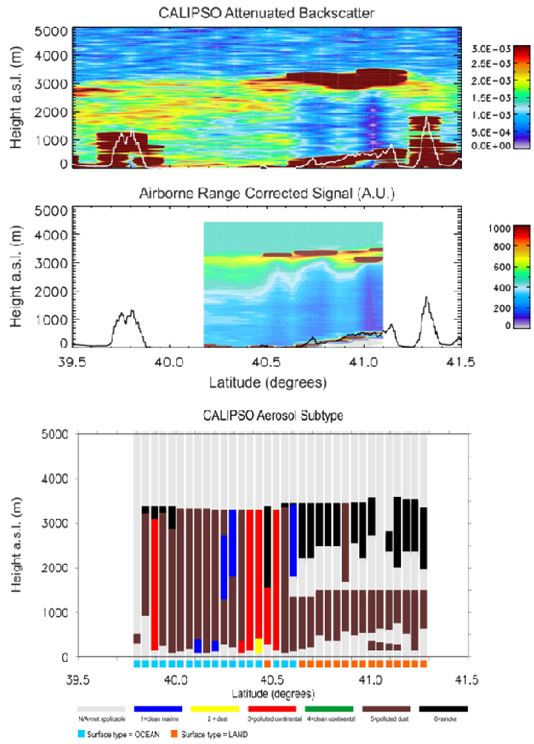

Figure 2. Top: CALIPSO Attenuated backscatter over Thessaloniki on 9 September 2011. Middle: Aircraft lidar range corrected signal. Bottom: CALIPSO aerosol subtype.

Two underpasses of the CALIPSO satellite have been performed, for the evaluation of its products in terms of aerosol subtype and extinction coefficient. The first one was carried out over the city of Thessaloniki on 9 September 2011 during the ACEMED campaign [6]; and the second flight (20 September 2012) took place in the Amazon forest in the biomass burning season (SAMBBA campaign). Difficulties with the CALIPSO automated retrievals have been highlighted, in terms of cloud filtering and aerosol subtyping (see Fig. 2), but vertical profiles averaged over a large horizontal distance have shown a good agreement. Deriving CALIPSO extinction profiles from Level 1 data (attenuated backscatter) has been found to be sometimes a valid alternative to using Level 2 data directly (automatically processed extinction coefficient).

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3. CLOUD COVER OVER THE SAHARA

Several research flights have taken place over the Sahara in 2011 and 2012 within the Fennec campaign, in an environment where elevated optically thick dust layers are frequently capped by small clouds [7]. Two on-board remote sensing instruments have been used to set up an automated cloud-detection algorithm, thus distinguishing clouds from dust: the lidar and the Heimann radiometer. This has permitted mapping the clouds accurately for 25 research flights (see Fig. 3). Planned work is to use this information to validate the representation of cloud fields over the Saharan region in Meteosat products and model predictions.

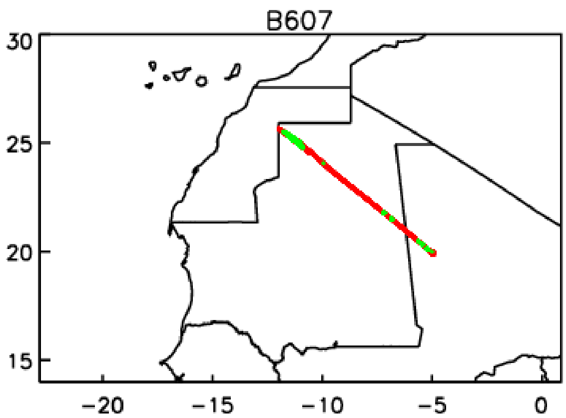

Figure 3. Cloud cover under the aircraft track determined for 22 June 2011 using the lidar and the Heimann radiometer. Green: cloudy; red: cloud-free.

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