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Forecasting of radiation fog with a new decision support system based on automatic LIDAR-ceilometer measurements

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Radiation fog is the most frequent cause of surface visibility below 1 km, and is one of the most common and persistent weather hazards encountered in aviation and to nearly all forms of surface transport. Forecasting radiation fog can be difficult, a number of approaches have been used to integrate the satellite data, numerical modeling and standard surface observations. These approaches lack generally the vertical and temporal resolution, representation of boundary layer and microphysical processes. They typically do not represent accurately the activation processes of fog droplets that depend on the chemical and physical properties of the aerosols.

The automatic LIDAR-ceilometer (ALC) primarily designed for cloud base height detection has greatly improved over the last years and now offers the opportunity to analyse in near real-time the backscatter signal in the boundary layer that potentially contains major information to predict radiation fog formation or not. During the preliminary stage of fog formation, the backscatter profile may be influenced by atmospheric humidity due to the presence in the atmosphere of hygroscopic aerosols that see their size increase with their moisture content inducing an increase of the backscatter magnitude.

In the framework of TOPROF (COST-ACTION, http://www.toprof.imaa.cnr.it/) activities, collaboration was initiated between the Royal Meteorological Institute of Belgium (RMI) and the Site Instrumental de Recherche par Télédéction Atmosphérique (SIRTA, IPSL) to develop a forward stepwise screening algorithm (PARAFOG) to help prediction of radiation fog formation. PARAFOG is a new decision support system for radiation fog forecasting based on analysis of the attenuated backscatter measured by ALCs, found at most airports, which provides information about the aerosol-particle hygroscopic growth process (Haeffelin et al., 2016). The monitoring of this hygroscopic growth process could provide useful warning to forecasters, in support of their fog forecast, minutes to hours prior to formation of radiation fog.

In this presentation, we will describe the methodology used in PARAFOG to derive pre-fog formation alerts and we will show a selection of several radiation fog events observed on two different sites to illustrate the efficiency of PARAFOG to detect radiation fog events.

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