TOWARD AN OBSERVATION OF VOLCANIC ASH: WHICH KIND OF OBSERVATION CAN BE MADE BY DIFFERENT INSTRUMENTS

Florence Besson [1]*, Jean-Luc Lampin [1]*

[1]Météo-France,Upper Air Observation Department,42 Av Coriolis 31057 Toulouse Cedex, France,
**Email: florence.besson@meteo.fr, jean-luc.lampin@meteo.fr*

ABSTRACT

In the first part, this presentation describes how an intercomparison was conducted between several lidars and ceilometers, the processing algorithms used, the difficulties encountered and the method used to design an optimum volcanic ash detection network.

In the second part, we describe the work progress of a feasibility study concerning a WMO intercomparison for volcanic ash detection that is beginning with experts and colleagues from many others countries.

1. INTRODUCTION

The 2010 eruptions of the Eyjafjallajökull (Icelandic volcano) resulted in one of the greatest air traffic disruption in Western Europe with 107,000 flights cancellations during an 8-day period, accounting for 48% of total air traffic and roughly 10 million passengers. The estimated cost of this European controlled airspace shutdown is about € 1.3 billion according to the International Air Transport Association (IATA).

London Volcanic Ash Advisory Center (VAAC) was responsible for providing information about the ash plume to the relevant civil aviation authorities in the form of Volcanic Ash Advisories (VAA). On this basis, the authorities made decisions about when and where airspace should be closed due to the safety issues.

It was difficult for the VAAC to provide accurate information about the size and concentration of the volcanic particles. As a result, Toulouse VAAC asked Météo-France to find solutions to detect volcanic ashes from the ground to a 12km altitude and to assess their concentration.

2. METHODOLOGY

During summer 2012, Météo-France conducted an intercomparison campaign between several lidars and ceilometers with in-situ measurements (balloon-borne particle counters and aircraft sensor) in order to assess their ability to detect Saharan dust for lack of volcanic ash. The observations produced by the instruments are obtained thanks to several algorithms: STRAT from SIRTA and BASIC from the LOA (both French laboratories). It turns out that it was difficult to compare the data one among other for several reasons: there is no aerosol measurement reference, instruments have different wavelengths, they can be dual-polarized. Results show the aerosols lidar technology may be a good mean to meet the VAAC requirements. Moreover, having the desire to built an efficient network in terms of number and location of sites over metropolitan France, Météo-France has run a model of pollutant dispersion, named MOCAGE, in retro-plume mode with different configurations in order to define the network which provides the best coverage.

3. RESULTS

Important differences appeared between ceilometers and lidars concerning Saharan dust observations. The ceilometers were not able to see the aerosols layer because of the noise while it was clearly visible with lidar.

The structure of the plume was well described by the lidars and was coherent with the forecast of the pollutant dispersion model.

It's hard to compare instruments with each other because of their very different technology (wavelength, laser energy, detection mode…).

We also observed that double polarization is interesting by giving information about sphericity of the particle and that the Raman N2 channel is promising, but we didn't have our own algorithm able to deal with N2 Raman channel.

4. CONCLUSIONS

Lidars have shown their great potential for detecting sub-visible atmospheric particles and providing accurately their location in altitude with an accuracy of around 10-100 meters. Lidar technology has been improved and commercial systems are now available. Such instruments can be the best candidate for detecting from the ground, particles coming from volcanic eruptions, pollution, biomass burning, mineral sources, … or can be used for dynamic information such as height of the boundary layer. For operational uses existing lidar systems need to be evaluated with international standards. This is the reason why a WMO intercomparaison would be appreciated but many issues remain and solving them is the aim of the feasibility study that is beginning.