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INTERCOMPARISONS

CEILOMETER AND AUTOMATIC LIDARS INTERCOMPARISON CAMPAIGN

(Submitted by Werner Thomas)

Summary and purpose of document

This document provides a proposal for the CIMO Management Group to consider organizing a CIMO intercomparison of ceilometers and automatic lidars.

ACTION PROPOSED

The Meeting is invited to consider this proposal, assess its relevance and timeliness and to decide on required follow-up actions, if appropriate.

Ceilometer and Automatic Lidars Intercomparison Campaign
Proposal to CIMO Management Board

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The numbers of ceilometers in use at National Meteorological and Hydrological Services (NMHSs) and at aviation control entities has increased during past years. Ceilometers were primarily used for detecting cloud layers in the atmosphere and for determining the cloud base height. But it has recently become clear that such ceilometers in principle can also provide profiles of aerosol volume backscattering coefficients in the boundary layer and identify elevated layers, as was shown during the presence of volcanic ash clouds over large parts of Europe in years 2010 (Eyjafjallajökull) and 2011 (Grimsvoetn). A recent global survey carried out for WMO revealed a number of different ceilometer and automatic lidar types in use (in the RA VI), ranging from relatively old Impulsphysik LD40 instruments to new instruments such as the Jenoptik CHM15K, the Vaisala CL51, and the Leosphere RMAN-510. These are further complemented by more powerful Lidar systems of different layout, laser power and field of application (clouds, aerosols, atmospheric water vapour, ozone) of e.g. multi-wavelength Raman and polarization lidars of the EARLINET consortium. Some of these lidars reached maturity for operational use.

First steps towards data harmonization and data exchange were already carried out under EG-CLIMET (EU cost action ES0702). More recently, EUMETNET has received a proposal (E-PROFILE) for the establishment of operational lidar and ceilometer networks for its next programme phase 2013-2017. Virtually at the same time a follow-on COST action of EG-CLIMET, called TOPROF (Towards Operational ground based PROFiling with ceilometers and microwave radiometers for improving weather forecasts), has been submitted for decision in November 2012 and funding from 2013 onwards. The EU FP7 infrastructure project ACTRIS supports the current activities by its scientific expertise (EARLINET) and by providing access to research facilities in Europe suited for hosting instrument inter-comparison campaigns through its transnational access activity.

Due to the different layout of instruments and differing sensitivity of sensors for the backscattered radiation by cloud and aerosol layers in the atmosphere, the results of retrieved synoptic quantities such as the cloud base height or the cloud coverage vary from instrument type to instrument type. Several publications of recent years discussed and compared the performance of different instrument models. Furthermore, an initial intercomparison campaign of a limited number of instruments organized and implemented by Meteo-France confirmed large performance differences. Standardization and classification of instruments and retrieved products is therefore of prime importance, in order to provide consolidated and accepted data products to users. CIMO is invited to take note and to initialize a discussion about a ceilometer and automatic lidar intercomparison campaign under the aegis of WMO.

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The main goal of this intercomparison campaign is the definition of minimum specifications for cloud and aerosol recognition and a quantitative analysis of the cloud base height and aerosol properties under the same observation conditions. Measurements shall take place for at least 2 months under operational conditions and shall comprise the range of natural atmospheric variability that is expected, e.g. measurements during fog events, during clear sky conditions, and in the presence of clouds and/or aerosols. The focus shall be on instrument performance, reliability and long-term stability of instruments, the error budget of retrieved quantities and the reproducibility of results. The following technical aspects shall be covered and must be considered by the campaign planning:

- Absolute calibration of ceilometer and automatic lidar backscatter and depolarization
- Analysis of the optical overlap functions
- Involvement of multi-wavelength Raman lidar systems with depolarization and differing sensitivity for near-field and remote observations as reference
- Involvement of in-situ measurements of aerosol size distribution at the ground, and in the boundary layer (e.g. under tethered balloon).
- Involvement of extinction measurements at the ground (scattering and absorption) to provide a boundary condition to the ceilometer profiles.
- Involvement of a scanning sun photometer to provide co-located spectral-AOD and column size distribution measurements.
- Involvement of both standard (older) and more advanced (newer) ceilometers
- Involvement of ceilometers and automatic lidars operated at different wavelengths, e.g. 355 nm, 532 nm, 905 nm, 1064 nm
- Fixed time period and place with reasonable infrastructure and a reasonably high possibility for fog, low and high-altitude clouds, both boundary-layer aerosols and lofted aerosol layers of various origins (biomass burning, dust, ash, continental)
- Parallel human eye (or camera-based) observations for cloud coverage (24/7)

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