

**Report of the EUFAR FP7
Expert Working Group meeting 06**

Aerosol

**“How well can the single scattering albedo be
estimated from aircraft measurements?”**

State of the art and required developments”

October, 25th 2010 - Toulouse, France

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2. Date, Time, Location details

Date : 25/10/2010

Location : Météo France/CNRM, Toulouse during ICARE-2010 conference

3. Report

Report of the major outcome of the workshop

Written by: Paola Formenti¹
Supported by the workshop participants

¹ Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), UMR CNRS Univ. Paris12/7
61 avenue du Général de Gaulle, 94010 Créteil, France (formenti@lisa.u-pec.fr)

Within the framework of EUFAR, the Aerosol Working Group has proposed to organize a workshop on the topic of " How well can the single scattering albedo be estimated from aircraft measurements? State of the art and required developments". The workshop, sponsored by EUFAR, was held at the Météo France Campus in Toulouse on 25th October 2010.

This workshop addressed a topic of major interest across the European and the international research communities. Owing to sampling artefacts and misrepresentation of the aerosol physico-chemical properties, the determination of the particle single scattering albedo represents a major unknown in estimating the aerosol perturbation of the earth-atmosphere radiative budget. Yet, local absorption by aerosol layers plays a major role in altering the thermodynamic structure of the atmosphere, therefore uncertainties need to be addressed and reduced.

The major objective of the workshop was to summarize the state of the art in the area of aerosol absorption measurements using aircraft as measurement platforms. In particular, we sought to evaluate the uncertainties and possible systematic biases in the different approaches currently used of direct and indirect methods (measurements of attenuation, measurements of aerosol composition, remote sensing retrievals). New approaches were compared and discussed.

The time table of the workshop is attached in an Appendix at the end of this report. It was attended by seven people (France 1, Germany 3, UK 3).

After a review-type introductory talk on the state of the art of the observation (in situ and remote sensing) as well as modelling of the single scattering albedo, talks of length varying between 30 and 60 minutes were given and followed by lively discussion.

A set of recommendations was outlined as follows:

- Airborne inter-comparison exercise with special focus on absorption should be designed.
- Extinction method (cavity ring down) should be pursued. Measurements of extinction by phase shift cavity ring down should be coupled to scattering and absorption measurements. These should be performed from one inlet, in dry conditions.
- Multi-spectral absorption measurements should be promoted (e.g., three-wavelength PSAP). Measurements in the UV, for example at 355 nm corresponding to the MODIS deep blue channel, should be added also, as well on scattering measurements as well. This would be useful for future satellite calibration/validation activities. Measurements around 550 nm should be improved.
- Measurements of the size-segregated chemical composition are important as indirect way to determine the SSA. The Aerosol Mass Spectrometer provides this quantity for submicron volatile aerosols, whereas for the non-volatile fraction (sub and supermicron) instrumental improvements are required.

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- Coordination of airborne and ground-based measurements should be pursued rather than with satellites (which are more problematic).
 - Optical closure studies on biomass burning should be pursued to test the closure methodology without major problems related to large non-spherical particles.

Finally it was agreed to head for a joint publication of the workshop findings in a peer-review journal to be defined. A first draft shall be circulated amongst the participants by the end of 2011.

APPENDIX

Workshop Agenda

Action 1:

Welcome registration, Coffee/Tea Break

0930-0940: Jean Louis Brenguier (MétéoFrance, Toulouse): Welcome.

0940-0950: Paola Formenti (LISA, Paris): Objectives of the workshop, logistics.

Introduction (chair: P. Formenti, LISA)

0950-1030: **Needs and challenges in estimating single scattering albedo** (A. Petzold, DLR)

What precision is needed to estimate radiative impact? What in terms of spectral dependence, size dependence, RH dependence (depends on aerosol type)? What are the experimental challenges (inlets, particle losses, spectral dependence, RH-dependence)

1030-1100: Coffee/Tea Break

Session 2: Direct measurements (chair: A. Petzold, DLR)

1100-1130: Scattering: description of the instrumentation, their implementation on the EU fleet, dependence on humidity, calibration standards, data treatment, recommendation (P. Formenti, LISA)

Instrumentation concerned: Integrated scattering (TSI nephelometer, Ecotech nephelometer); Angular scattering (TSI neph, polar nephelometer)

1130-1210: Extinction: description of the instrumentation, their implementation on the EU fleet, dependence on humidity, calibration standards, data treatment, recommendation (A. Petzold, DLR)

Instrumentation concerned: Extinction (Sun photometry, Cavity ring-down)

1210-1250: Absorption: description of the instrumentation, their implementation on the EU fleet, dependence on humidity, calibration standards, data treatment, recommendation (G. McMeeking, Univ. Manchester)

Instrumentation concerned: Aethalometer, MAAP, PSAP, SP2, Photoacoustic spectroscopy

1300-1430: Lunch

Session 3: Indirect measurements (chair: P. Formenti, LISA)

Description of instrumentation/techniques, their implementation on the EU fleet, discussion of case studies, calibration standards, usefulness with regards to direct measurements, data treatment, recommendation

1430-1500: Chemical composition, size distribution and mixing state (W. Morgan, Univ of

Manchester)

1500-1530: Inversion of airborne and ground-based radiative fluxes/radiances (J. Haywood, UK MetOffice)

1530-1600: Coffee/Tea Break

1530-1600: AERONET/lidar retrievals (V. Amiridis, NOA, and D. Müller, IfT)

1530-1600: Satellite retrievals (A. Petzold for T Holzer-Popp, DLR)

Session 4. Summary, recommendations and future plans (chair: M. Wendisch, Univ. Leipzig)

1630-1730: Summary of discussions from chairs:

(1) Inherent problems in calculating SSA using these approaches to define what best practise should be: a review of instruments followed by a review of methods

(2) New challenges and developments in the determination of single scattering albedo: a way forward

New instrumentation to be implemented (Ground-based or satellite)?

Homogeneous data protocols? Calibration standards?

Validation - Dedicated field campaign in the EUFAR framework?

Participants

1. Paola Formenti (LISA/CNRS, EU) [paola.formenti@lisa.univ-paris12.fr]
2. Andreas Petzold (DLR, EU) [andreas.petzold@dlr.de]
3. Gavin McMeeking (UNIMAN, EU) [gavin.mcmeeking@manchester.ac.uk]
4. Jim Haywood (EU) [jim.haywood@metoffice.gov.uk]
5. William Morgan (UNIMAN, EU) [william.morgan@postgrad.manchester.ac.uk]
6. Detlef Müller (EU) [detlef.mueller@tropos.de] by vision-conference
7. Manfred Wendisch (EU) [m.wendisch@uni-leipzig.de]