GMES ATMOSPHERE Thematic Project CREATE:
CONSTRUCTION, USE AND DELIVERY OF A EUROPEAN AEROSOL DATABASE

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Introduction

Atmospheric aerosols (tropospheric and stratospheric) are of great importance because of their role in global climate change, air quality and long-range transport of pollutants, their impacts on human health, visibility, continental and maritime ecosystems, the stratospheric ozone layer, thus requiring dedicated monitoring of their concentrations and properties at the European and global scales. Unlike atmospheric gases, aerosols cannot be characterised by a single parameter, and in addition monitoring of atmospheric aerosols is particularly challenging because of their inherent great spatial and temporal variability. There is a major lack of knowledge on aerosols and their variability [*IPCC 3rd Assessment Report*, 2001]. CREATE (and its sister Project DAEDALUS) in the GMES Thematic Project Atmosphere have been established to address issues relating to measurement, modelling and sampling of atmospheric aerosols. In addition, the goals of CREATE (and of DAEDALUS) are to advise on the optimum use of aerosol in-situ, ground based and satellite remote sensing data to meet users needs, to deliver data and information to users and to develop the methodologies necessary for delivery of operational aerosol products.

1. Objectives

- Create a quality European aerosol database
- Deliver a uniform data format
- Validate satellite instruments through ground truth data
- Provide European modelled maps of aerosol fields
- Harmonise aerosol sampling procedures
- Provide training to aerosol/data personnel
- Formulate scientific strategies for future directions
- Deliver quality assured data to end users

2. Results

(a) A major achievement of CREATE has been the creation of a European aerosol database which is housed in NILU (Norway):
http://www.nilu.no/projects/ccc/create
Aerosol data is now being archived in standard format at the NILU EMEP site. The data is linked to GAW-WDCA (World Data Centre for Aerosols) operated through the European Commission Institute for Environment and Sustainability, JRC (Contact: Julian Wilson) at Ispra, Italy.

(b) Another significant achievement has been the establishment of an agreement between EMEP and WMO GAW (Global Atmosphere Watch of the World Meteorological Organisatiion) for archiving of aerosol data and formation of joint supersites. Aerosol data is now being submitted with an agreed standard data exchange format (NASA AMES -1001).

(c) An example of a satellite retrieved property, that of aerosol optical depth (AOD) from the ATSR-2 radiometer on the ERS-2 satellite for cloud-free scenes over Europe is seen in Figure 1, [Robles-Gonzalez et al, 2000]. The AOD results agree with co-located ground based sun-photometer data within 0.1.

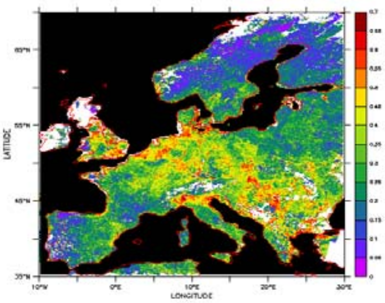

Figure 1. Mean aerosol optical depth at 0.555µm over Europe in August 1997 derived from ATSR-2 satellite data.

Further retrieval of aerosol optical depth data over land is underway for selected periods for the year 2000 under the CREATE Project.

The use of satellite data to calculate $PM_{2.5}$ ground based data is potentially a very useful aerosol product, which can then be compared with ground truth data.

References

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Robles-Gonzalez, C., Veefkind, J.P., de Leeuw, G. 2000. Mean aerosol optical depth over Europe in August 1997 derived from ATSR-2 data, Geophys. Res. Lett., 27, 955-958.

WMO Global Atmosphere Watch (GAW) 2004. Aerosol Measurement Procedures, Guidelines and Recommendations, Report No. 153, TD No. 1178, pp. 72.

3. Further Results

(d) Using multicomponent aerosol and chemistry transport models (LMDzT-INCA) developed by the LSCE group, three dimensional data of aerosol concentration for a range of aerosol constituents have been successfully modelled and mapped over Europe. Comparison of modelled results with ground truth aerosol data are shown in the case of (i) black carbon mass concentration at the free troposphere site of the Jungfraujoch (Figure 2) and (ii) aerosol extinction coefficient at the background marine site at Mace Head (Figure 3) and (iii) Lidar aerosol extinction data at Hamburg (Figure 4).

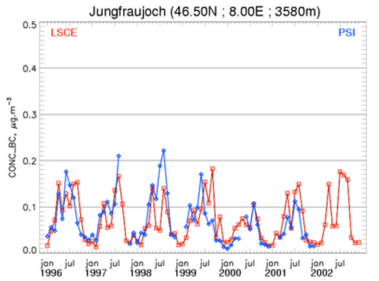

Figure 2. Comparison of modelled results (red) of black carbon mass concentration and measured data (blue) at the Jungfraujoch GAW site.

(e) Harmonised sampling and measurement procedures for a large range of aerosol parameters have been finalised and will be published as a WMO Report (2004).

(f) CREATE through the GAW Aerosol, has been instrumental in organising courses at Schneefernerhaus/Zugspitze on aerosols, aerosol sampling techniques and data handling under the direction (Ali Wiedensohler) of the GAW World Calibration Centre for Physical Aerosol Properties at Leipzig in 2002. Further courses are planned in the coming year at Hyytiälä, Finland and at NILU, Norway.

(g) An intercalibration workshop for aerosol light scattering instruments has taken place in November 2003, at the World Calibration Centre for Physical Aerosol Properties at Leipzig.

(h) It is recommended by CREATE and following on from the EMEP-WMO 1999 Workshop on fine aerosol particulates, that so called 'supersites' be set up. These supersites will contain well equipped and an extensive range of aerosol (and gaseous) instrumentation. This process will be aided with input from modelled aerosol fields as well as from satellite data.

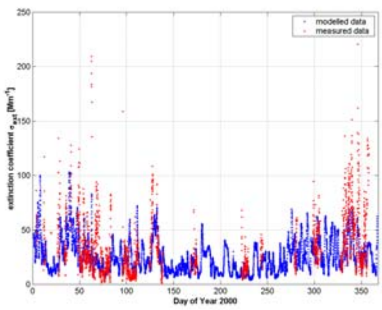

Figure 3. Comparison of averaged measured results (red) of aerosol extinction coefficient and modelled data (blue) at the Mace Head GAW site for the year 2000.
Annual average of measured extinction coefficient = 32.1 Mm^{-1}
Annual average of modelled extinction coefficient = 25.0 Mm^{-1}

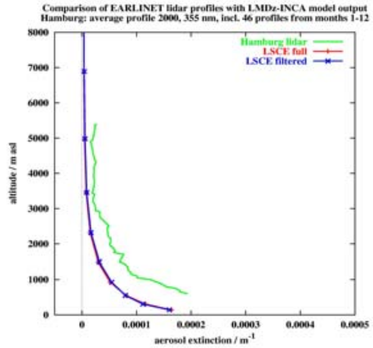

Figure 4. Annual (for year 2000) average profile (green) of Lidar aerosol extinction (m^{-1}) at Hamburg compared to modelled predictions (blue).

4. Lessons learned and Deficiencies/Gaps

- Long term sampling of aerosols is lacking and is needed to determine trends
- There is lack of coverage in the vertical (from LIDAR, balloon, aircraft and satellite platforms) for both the troposphere and stratosphere
- Lack of new fast response aerosol techniques and instrumentation to determine aerosol chemical composition and aerosol optical properties
- Insufficient ground based networks representative of major aerosol types and regions for model intercomparisons and ground truth satellite validation
- In-situ Observing Systems lack dedicated funding support and rely mostly on 'ad hoc' funding
- Access to European satellite products have proven to be slow
- Lack of accurate emission inventories of aerosols and their precursors which are needed for model inputs
- Interaction between existing observing stations needs strengthening

5. Recommendations

- Need for longer term sustainable observational sites with dedicated funding
- Requirement of harmonised in situ networks for air
- 'Supersites' are required to provide leading edge monitoring capabilities
- Integration is required between ground based observation networks with satellite data and with modelled products
- Validation of satellite derived products is required using in-situ ground truth and vertical profile / columnar data
- Need to set up a QA/QC centre(s) in order to ensure quality data for data users
- Future funding programmes should include provision for support of training of station operators and data providers.
- Archiving of data with a uniform data exchange standard, and support for submission to Database Centres should be of prime importance in future Programme Proposal calls
- Need for Supersites with advanced instrumentation (for aerosols and gases) to add to usual measurements made at other network monitoring sites
- Enhancement of existing observing networks as well as development of new in-situ observing systems are needed
- Need for improved access of data, and transferability of data products to user groups.

Funded under the EU 5FP Programme Energy, Environment and Sustainable Development : EESD-ENV-2002-GMES

Acknowledgements to WMO Global Atmosphere Watch (GAW) AEROSOL through its Scientific Advisory Group for Aerosol, for valuable input to the Aerosol Measurement Procedures Report and for support of Aerosol Training and Calibration workshops.

Availability of facilities through the Environmental Change Institute (ECI) at the National University of Ireland, Galway are also acknowledged.

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