WP6- NA6: WP "Integration, outreach, and sustainability"
Deliverable D6.3:

Report on Higher level data product/ Secondary datasets

Long-term trends of aerosol properties

Version 1.0, May 2014
Version 2.0 May 2015

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INTRODUCTION

"Higher level products" or secondary datasets have been proposed during the AeroCom/ACTRIS workshop in Hamburg, October 2014, as a way to bridge the quality controlled raw data and the synthesis of these for advanced use: **ACTRIS Secondary Datasets** are derived from primary ACTRIS data by e.g. averaging, filtering of events, interpolation of data etc. ACTRIS secondary data sets and project data tools can also include codes, algorithms and software used to generate ACTRIS primary or secondary data. Whereas primary datasets, consisting e.g. of a time series of a parameter at a given station, are regularly updated mainly due to extension of the time series into a new year. Secondary datasets are normally not updated, except if a revision is suggested and this is then clearly indicated by a revision number and associated information. Secondary datasets are usually the result of targeted analysis, special studies or are processed for evaluation of model experiments. ACTRIS secondary data sets are stored in dedicated catalog in the ACTRIS Data Centre to provide long term access for all users.

An important secondary data set, being worked upon in task 6.5, is dealing with trends of aerosol parameters typical for ACTRIS quality data. The synthesis, which is expected to be available through the secondary data set, requires a mature quality of the primary data. The necessary discussion with the data providers takes time and has led to delays in finalizing the deliverable through publication of the data themselves. Such delays are esteemed here not critical because the data and analysis itself has been either published or already communicated to end-users such as the scientific community via the EBAS/ACTRIS database, IPCC, AeroCom, MACC and EMEP (see in particular Hartmann et al., 2013, Schulz et al., 2013, MACC 2014). A review of recent published work on European regional aerosol trends, involving ACTRIS data, has been prepared and presented at different occasions, including the AeroCom workshop, and the EMEP-TFMM meeting (Lund Myhre 2013, Schulz et al. 2014) feeding into the recent IPCC report and its chapter on atmospheric composition. Note that the data products presented here from ACTRIS are available to be analysed in conjunction with other trend data sets, which inform about aerosol trends in the last decade, but which are not purely based on ACTRIS data: a) aerosol major ion composition (Torseth er al. EMEP status report 1/2013), b) aerosol optical depth (Mortier 2013,), c) TFMM trend assessment report under preparation (https://wiki.met.no/emep/emep-experts/tfmmtrendpublis).

Long-term trends of aerosol properties data products

The following ACTRIS secondary data sets have been compiled: aerosol optical properties (Collaud Coen et al. 2013) and aerosol number concentration (Asmi et al. 2013). Abstracts of the two papers, which describe the preparation and the content of the data sets are found in the annex. The publication of the two datasets themselves has been achieved via the ACTRIS data portal (http://actris.nilu.no/Content/Resources/Products/).

Datasets used for the decadal trend analysis of aerosol optical properties

The dataset can be found at the following web address:
ftp://ebas-secondary-data.nilu.no/pub/ebas-secondary-data/Coen_et_al_2013/
The datasets and the related methods to prepare the data and to perform the trend analysis are fully described by Collaud Coen et al, 2013. The data are given as daily medians as used in the paper. The missing values are given as NaN, even if 999.9 and 9999.9 are sometimes remaining in some few data sets.
Abbreviation for the stations are similar to the ones of the paper. The non-used data such as for example black carbon for other wavelengths are not reported.

Acronymes used in the datasets:
AE: Aethalometer
PSAP: Particle Soot Absorption Photometer
Neph: Nephelometer
YYYY: year
MM: month
DD: day
hh: hour
mm: minute
ss: seconds
SC: scattering coefficient [Mm-1] (b, g and r standing for blue (450 nm), green (550 nm) and red (700 nm)
BSC: Backscattering coefficient [Mm-1]
T: temperature [°K]
P: pressure [HPa]
U: relative humidity [%]
BC: black carbon. For the unit of the BC, please report to the paper since this is not homogeneous for all stations
Nephelometer correction: Depending on the datasets, the STP (standard temperature and Pressure) correction and/or the truncation correction were applied. Complete informations for each station are given in the paper.

The data policy has been set to:
"This dataset is available free of charge for non-commercial and scientific use. By using this dataset as a whole or in parts, you as data user agree to quote the pertaining publication:
Any further questions can be addressed to: martine.collaudcoen@meteoswiss.ch

Datasets used for the decadal trend analysis of aerosol number concentrations

The dataset can be found at the following web address:

ftp://ebas-secondary-data.nilu.no/pub/ebas-secondary-data/Asmi_et_al_2013/

The datasets and the related methods to prepare the data and to perform the trend analysis are fully described by Asmi et al, 2013.

The data policy has been set to:

"This dataset is available free of charge for non-commercial and scientific use. By using this dataset as a whole or in parts, you as data user agree to quote the pertaining publication:

Any further questions can be addressed to: martine.collaudcoen@meteoswiss.ch

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Annex

Atmos. Chem. Phys., 13, 869–894, 2013
www.atmos-chem-phys.net/13/869/2013/
doi:10.5194/acp-13-869-2013

Atmospheric Chemistry and Physics

Aerosol decadal trends – Part 1: In-situ optical measurements at GAW and IMPROVE stations

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Received: 25 July 2012 – Published in Atmos. Chem. Phys. Discuss.: 20 August 2012
Revised: 4 December 2012 – Accepted: 4 December 2012 – Published: 22 January 2013

Abstract. Currently many ground-based atmospheric stations include in-situ measurements of aerosol physical and optical properties, resulting in more than 20 long-term (> 10 yr) aerosol measurement sites in the Northern Hemisphere and Antarctica. Most of these sites are located at remote locations and monitor the aerosol particle number concentration, wavelength-dependent light scattering, backscattering, and absorption coefficients. The existence of these multi-year datasets enables the analysis of long-term trends of these aerosol parameters, and of the derived light scattering Ångström exponent and backscatter fraction. Since the aerosol variables are not normally distributed, three different methods (the seasonal Mann-Kendall test associated with the Sen's slope, the generalized least squares fit associated with an autoregressive bootstrap algorithm for confidence intervals, and the least-mean square fit applied to logarithms of the data) were applied to detect the long-term trends and their magnitudes. To allow a comparison among measurement sites, trends on the most recent 10 and 15 yr periods were calculated. No significant trends were found for the three continental European sites. Statistically significant trends were found for the two European marine sites but the signs of the trends varied with aerosol property and location. Statistically significant decreasing trends for both scattering and absorption coefficients (mean slope of $-2.0\,\%\,yr^{-1}$) were found for most North American stations, although positive trends were found for a few desert and high-altitude sites. The difference in the timing of emission reduction policy for the Europe and US continents is a likely explanation for the decreasing trends in aerosol optical parameters found for most American

Published by Copernicus Publications on behalf of the European Geosciences Union.

Atmos. Chem. Phys., 13, 895–916, 2013
www.atmos-chem-phys.net/13/895/2013/
doi:10.5194/acp-13-895-2013

Atmospheric Chemistry and Physics

Aerosol decadal trends – Part 2: In-situ aerosol particle number concentrations at GAW and ACTRIS stations

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Received: 25 July 2012 – Published in Atmos. Chem. Phys. Discuss.: 20 August 2012
Revised: 7 December 2012 – Accepted: 2 January 2013 – Published: 22 January 2013

Abstract. We have analysed the trends of total aerosol particle number concentrations (N) measured at long-term measurement stations involved either in the Global Atmosphere Watch (GAW) and/or EU infrastructure project ACTRIS. The sites are located in Europe, North America, Antarctica, and on Pacific Ocean islands. The majority of the sites showed clear decreasing trends both in the full-length time series, and in the intra-site comparison period of 2001–2010, especially during the winter months. Several potential driving processes for the observed trends were studied, and even though there are some similarities between N trends and air temperature changes, the most likely cause of many northern hemisphere trends was found to be decreases in the anthropogenic emissions of primary particles, SO_2 or some co-emitted species. We could not find a consistent agreement between the trends of N and particle optical properties in the few stations with long time series of all of these properties. The trends of N and the proxies for cloud condensation nuclei (CCN) were generally consistent in the few European stations where the measurements were available. This work provides a useful comparison analysis for modelling studies of trends in aerosol number concentrations.

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