Surface data from the GAW World Data Centre for Aerosols and IMPROVE

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What is GAW?

- *The Global Atmosphere Watch (GAW) was founded in 1989 by WMO, thereby consolidating the Global Ozone Observing System (GO3OS) and the Background Air Pollution Monitoring Network (BAPMon) into a single network.*

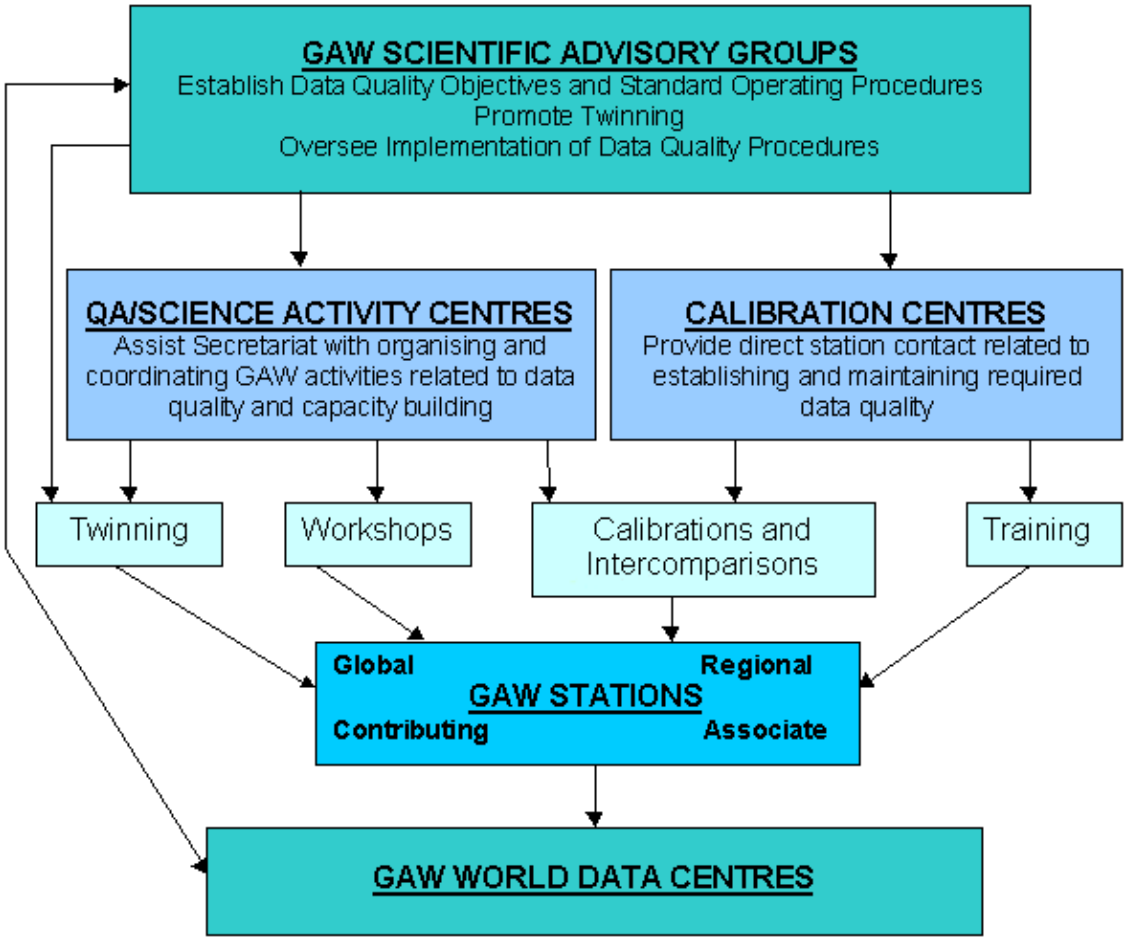
- *The objectives of GAW are:*
  - *to provide reliable long-term observations of the chemical composition of the atmosphere and related parameters in order to improve our understanding of atmospheric chemistry,*
  - *and to organize assessments in support of formulating environmental policy.*

The GAW Aerosol programme

The SAG Aerosol recommends that the GAW aerosol programme include

- *for regional stations any one, or more of the following:*
  - optical depth
  - mass (preferably in two size fractions)
  - major chemical components in two size fractions
  - light scattering coefficient
- *for global stations as many as possible of the following:*
  - optical depth
  - mass in two size fractions
  - major chemical components in two size fractions
  - light scattering & hemispheric backscattering coefficients at various wavelengths
  - light absorption coefficient
  - aerosol number concentration
  - cloud condensation nuclei number concentration at 0.5% supersaturation
  - diffuse, global and direct solar radiation
- *intermittently*:
  - aerosol size distribution
  - detailed size fractionated chemical composition
  - dependence of aerosol properties on relative humidity
  - CCN spectra at various supersaturations
  - LIDAR measurements and other altitude profiles of aerosol properties.

Structure of the GAW Monitoring Component (courtesy WMO AREP)



SAG Aerosol, chairman: Dr. Urs Baltensperger (PSI, CH)

(WCC) for Physical Aerosol Instrumentation: Dr. Ali Wiedensohler (IfT, DE)

GAWTEC IV: 7-14.10.2002 Schneefernhaus, Zugspitze

WDC Aerosols (IES JRC, IT) http://ies.jrc.cec.eu.int/wdca/

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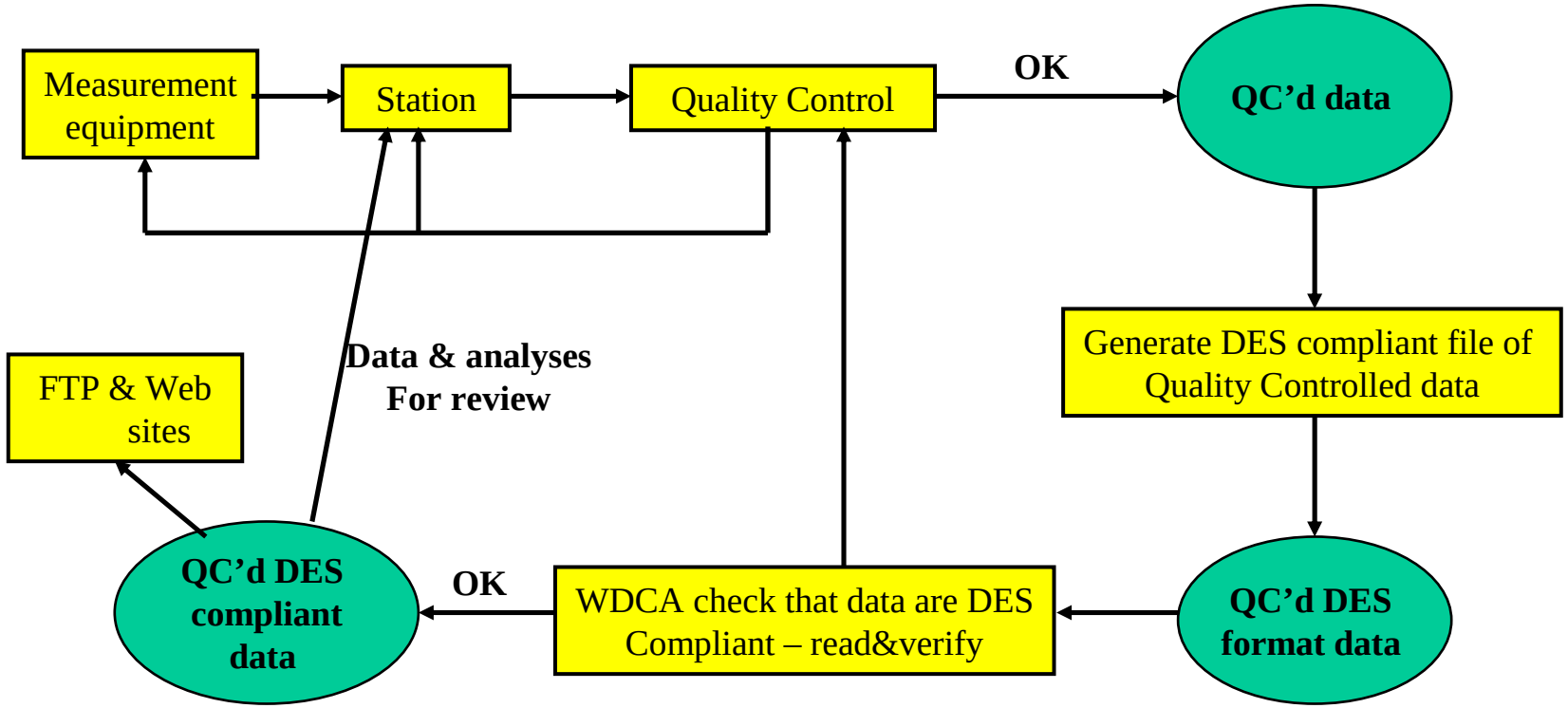
Data Flow to and from WDCA



Data Submission and Retrieval from WDCA

Data Submission

Data and Metadata Format:

NARSTO data exchange standard (DES) extended CSV.

NARSTO DES includes all the file metadata. Additional files provide more detailed information.

Submission:

Data are sent by ftp or email

Quality Analysis at WDCA:

NARSTO quality analysis system – checks conformity with the DES and internal integrity of the data.

QA summary added to each file archived, only posted to ftp site when no errors/warnings.

Data Retrieval

Procedure:

Data available online from WDCA server. Data also supplied by email

Catalogue:

Static catalogue on old WDCA server

Archive:

Both NARSTO and non-NARSTO archives accessible via ftp.

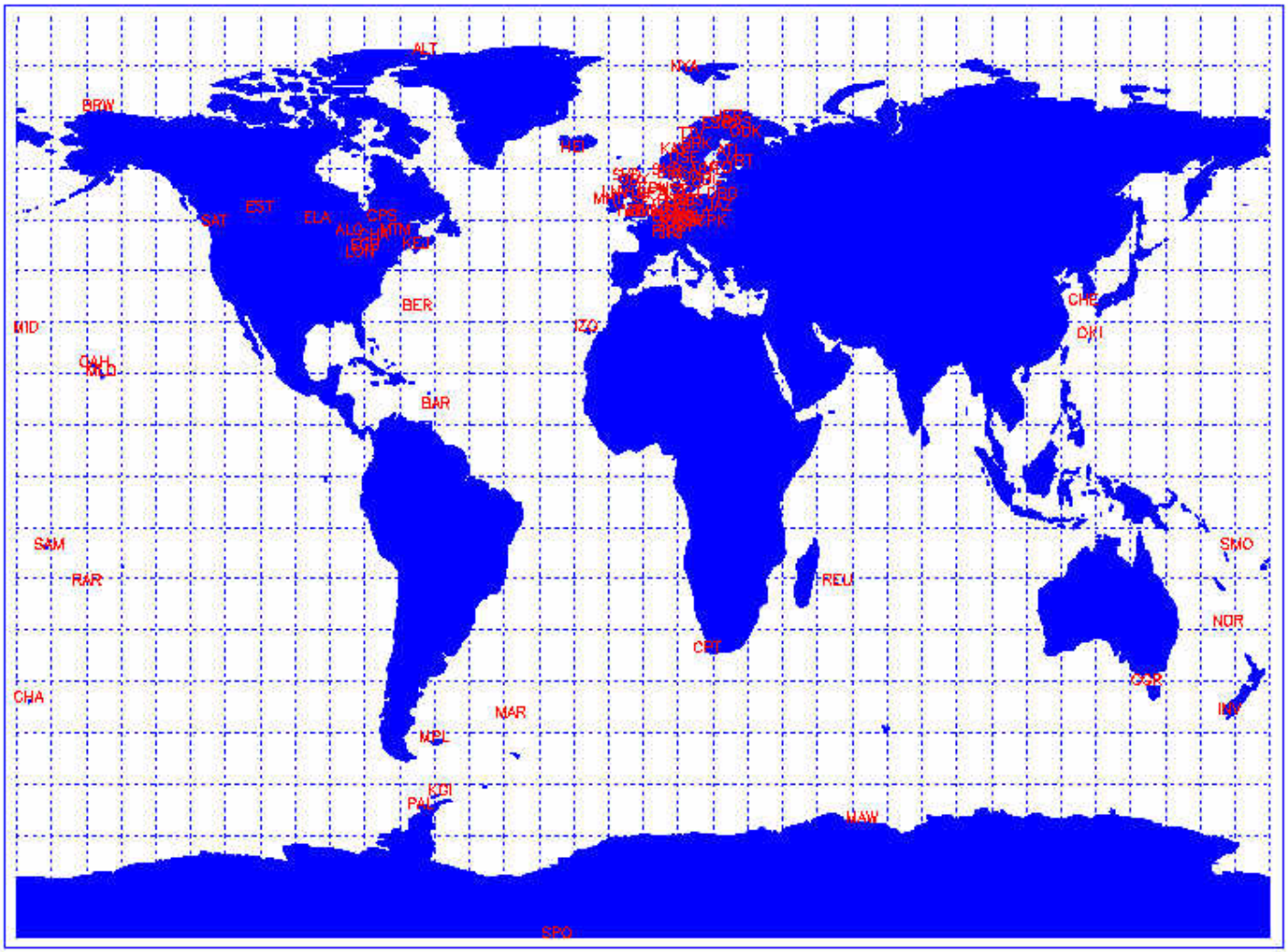
Data:

Data in NARSTO DES format.

Products:

Limited site by site analyses – time histories etc, are available from the new site.

WDCA contributing stations: 01.03.2003



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GAW aerosol parameters for use in AEROCOM

- **optical depth –**

  GAW PFR (Chris Werhli), Aeronet (Stefan Kinne)

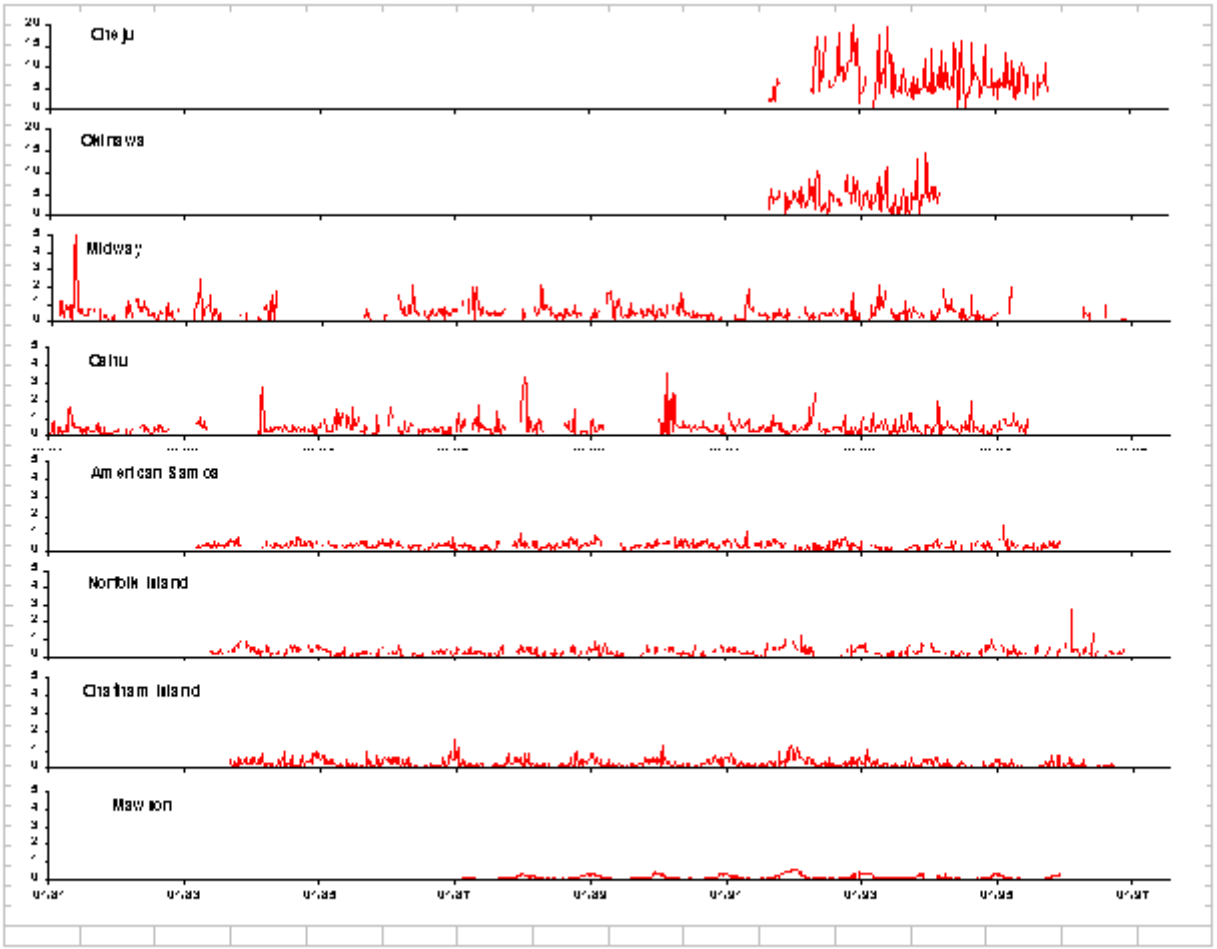
- **major chemical components in two size fractions**

  U. Miami, CaPMON, EMEP, IMPROVE (COSAM, IPCC),

  European Aerosol Climatology (Putaud et al.)

- **light scattering coefficient**
- **light absorption coefficient**
- **aerosol number concentration**

Aerosol Chemistry: NSS sulfate in the Pacific.



Non-sea salt sulfate (µg.m^{-3}) time series for pacific transect and S. Ocean sites in COSAM. data courtesy of Dr. D Savoie, U. Miami

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European Aerosol Phenomenology Report
J-P Putaud et al.

A European Aerosol Phenomenology

physical and chemical characteristics of particulate matter
at kerbside, urban, rural and background sites in Europe.

Jean-P. Putaud[1], Rita Van Dingenen[1], Urs Baltensperger[2], Erika Brüggemann[3], Aurélie Charron[4], M.-Cristina Facchini[5], Stefano Decesari[5], Sandro Fuzzi[5], Robert Gehrig[6], Hans-C. Hansson[7], Roy M. Harrison[4], Alan M. Jones[4], Paolo Laj[8], Gundi Lorbeer[9], Willy Maenhaut[10], Nikolaos Mihalopoulos[11], Konrad Müller[3], Finn Palmgren[12], Xavier Querol[13], Sergio Rodriguez[13], Jürgen Schneider[9], Gerald Spindler[3], Harry ten Brink[14], Peter Tunved[7], Kjetil Tørseth[15], Ernest Weingartner[2], Alfred Wiedensohler[3], Peter Wåhlin[12], Frank Raes[1]

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[4] *University of Birmingham, Division of Environmental health and Risk Management, Birmingham, UK*
[5] *Istituto di Scienze dell'Atmosfera e dell'Oceano, Consiglio Nazionale delle Ricerche, Bologna, Italy*
[6] *Swiss Federal Laboratories for Materials Testing and Research, Dübendorf, Switzerland*
[7] *Institute of Applied Environmental Research, University of Stockholm, Stockholm, Sweden*
[8] *Laboratoire de Météorologie Physique, Université Blaise Pascal, Aubière, France*
[9] *Umweltbundesamt, Wien, Austria*
[10] *Ghent University, Institute for Nuclear Sciences, Department of Analytical Chemistry, Gent, Belgium*
[11] *Environmental Chemical Processes Laboratory, University of Crete, Heraklion, Greece*
[12] *National Environmental Research Institute, Roskilde, Denmark*
[13] *Instituto de Ciencias de la Tierra, Consejo Superior de Investigaciones Científicas (CSIC), Barcelona, Spain*
[14] *Netherlands Energy Research Foundation (ECN), Petten, The Netherlands*
[15] *Norwegian Institute for Air Research (NILU), Kjeller, Norway*

EUR 20411 EN
2002

Compilation of:

- PM2.5 and PM10 masses and chemical composition
- Aerosol size distributions
- Size segregated aerosol chemical composition.

At kerbside, urban and rural and background sites in europe

http://ies.jrc.cec.eu.int/Download/cc

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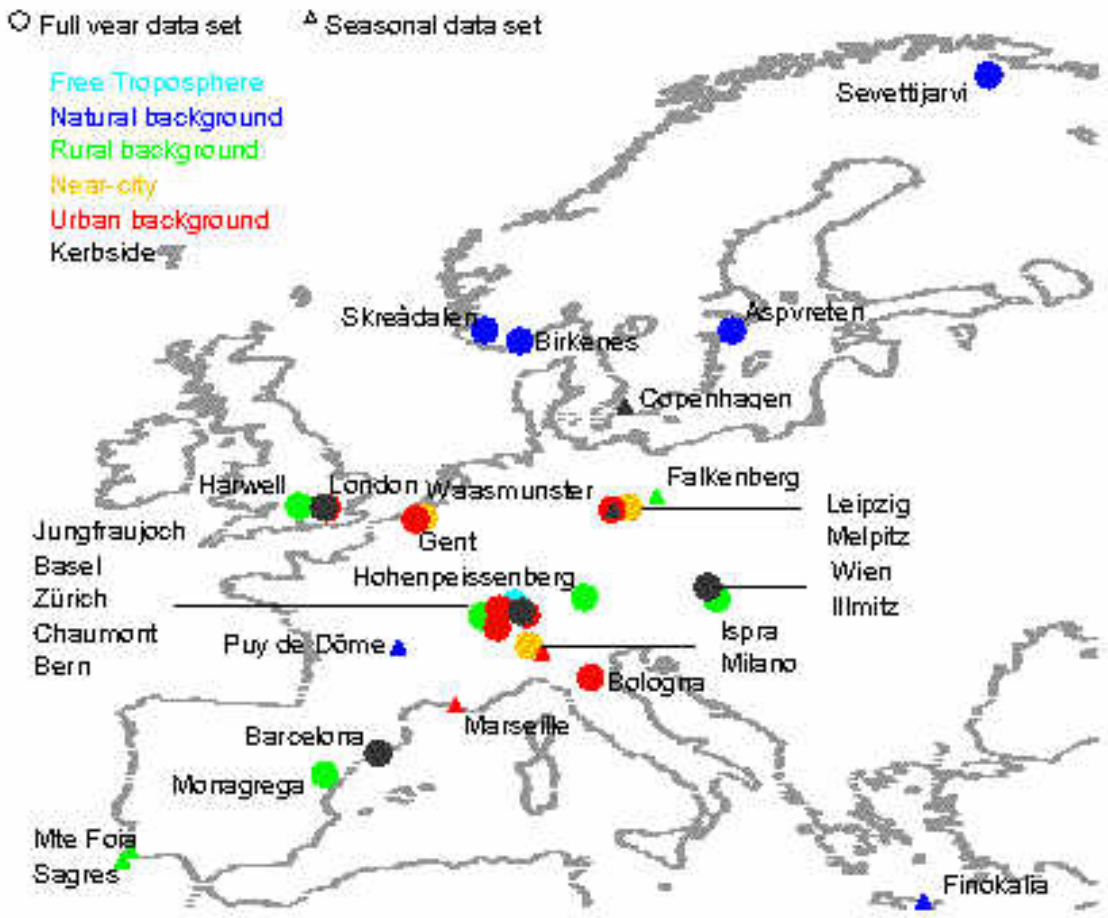
European Aerosol Phenomenology Report



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Sites with co-incident AOD, light-scattering, light absorption, chemical composition for 2000

Region	Station	AOD	Chemistry	Light Scat.	Light Abs.	Lidar
Arctic	Ny Alesund	✔	✔	✔	✔	✔
Arctic	Point Barrow	✔	?	✔	✔	
Europe	Mace Head	✔	?	✔	✔	
Europe	Hohenpeissenberg	✔	✔	✔	✔	
Europe	Ispra	✔	✔		✔	
Europe	Melpitz	?	✔	✔	✔	
N. America	Bratts Lake	2001	✔			
N.America	Bondville	?	?	✔	✔	
N.America	Wyoming	?	?	✔	✔	profiles
S. America	Alta Floresta	✔	✔	?	✔	
S. America	Balbina	✔	✔	?	✔	
Asia	Kwanju/Kosan	✔	✔	✔	✔	
S. Oceans	Cape Grim	✔	✔	?	✔	
Antarctic	S. Pole	✔	?	✔	✔	
Antarctic	Neumayer	?		✔	✔	
F. Trop	Jungfraujoch	✔	✔	✔	✔	
F. Trop	Mount Waliguan	✔	✔	?	✔	
F. Trop	Mauna Loa	✔	✔	✔	✔	✔

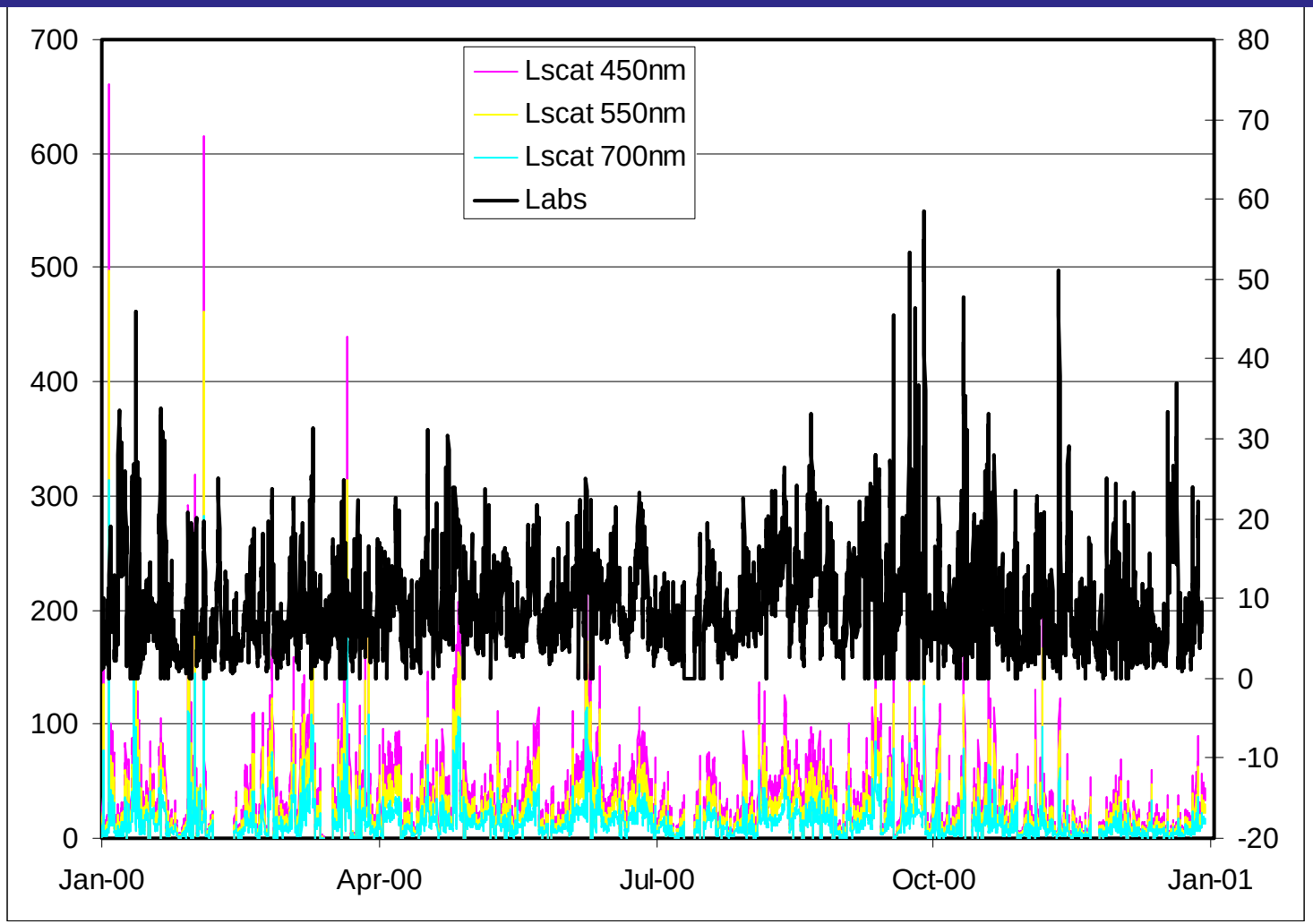
Also Ace-Asia (Kwanju), TRACE-P. Note NO African Sites!

Local ‘closure’ studies

1. Where chemistry/composition compare with the modelled aerosol compsition/loading.
2. Where scattering and absorption, compare with modelled extinction and SSA, and also with that calculated from chemistry/composition data.
3. Where AOD, compare surface extinction with column AOD.
4. Chemistry/composition data 24hr, AOD hourly, but typically morning and or afternoon. Can therefore use the high resolution scattering & absorption to determine if there are strong diurnal cycles that may bias the comparisons.

Light Scattering & Absorption: hourly means Hohenpeissenberg

47.800 N, 11.017 E, 985.0 m asl



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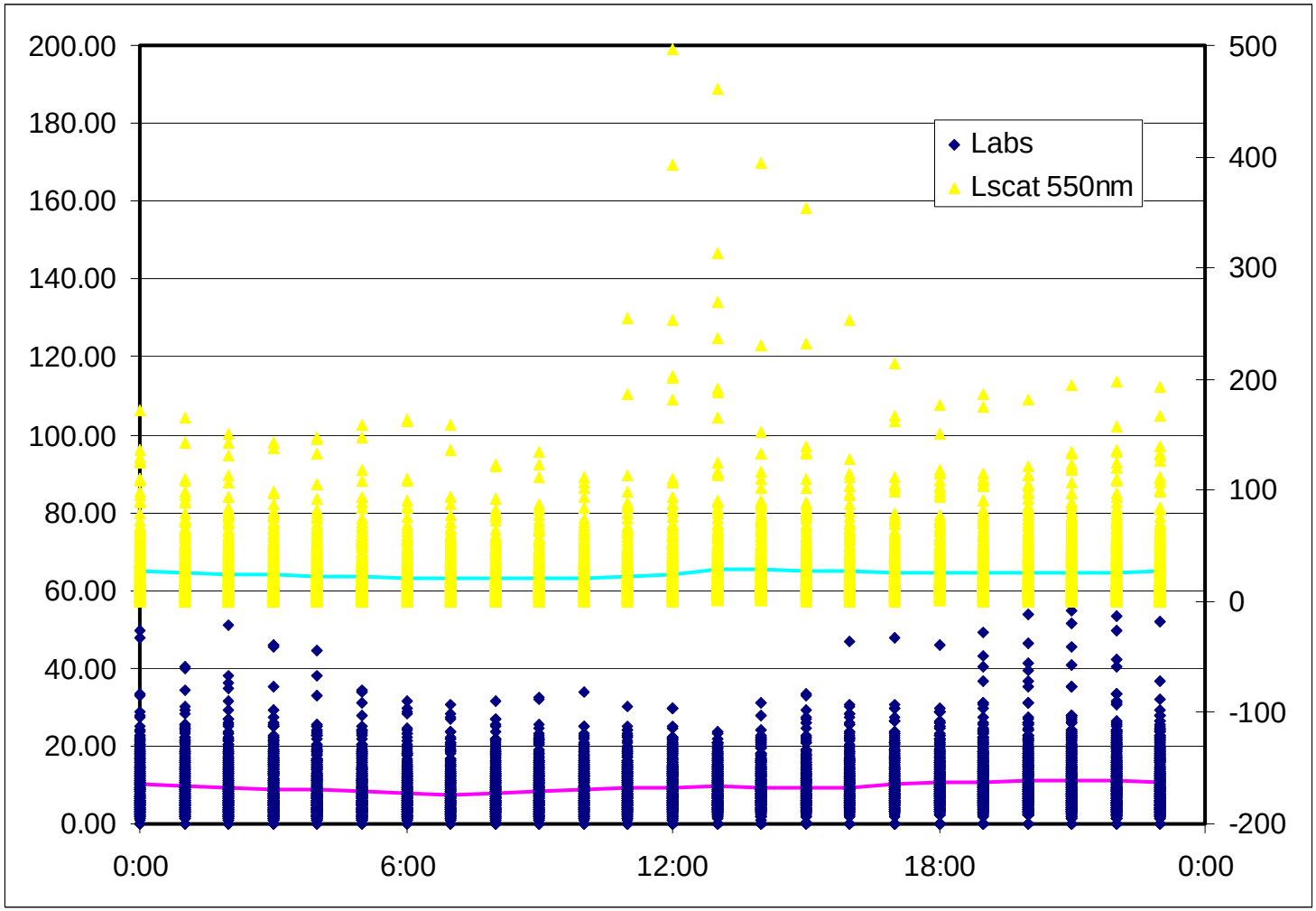
Light Scattering & Absorption: diurnal cycle Hohenpeissenberg

47.800 N, 11.017 E, 985.0 m asl



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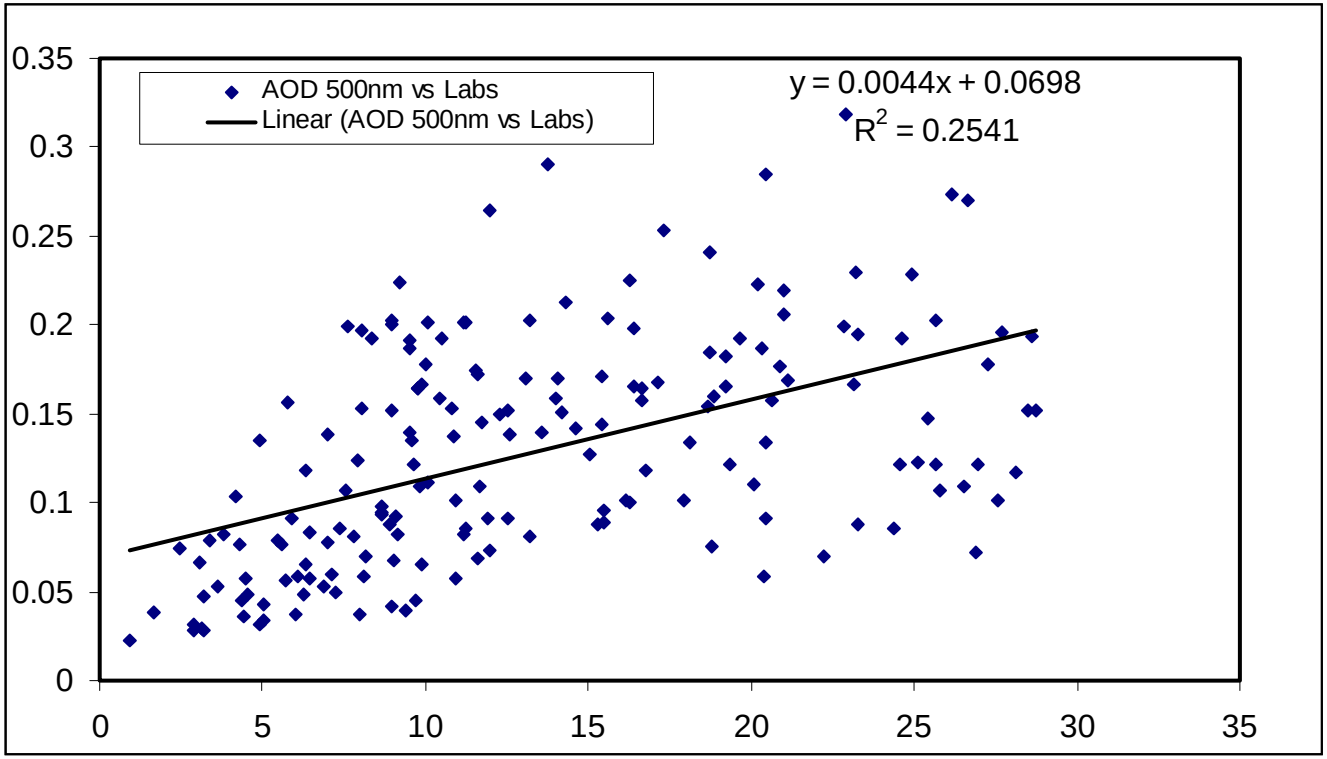
Light Absorption vs AOD 500nm, Hohenpeissenberg 1999.



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IMPROVE Monitoring Program

The Interagency Monitoring of Protected Visual Environments

•Established in 1985 to aid the creation of Federal and State implementation plans for the protection of visibility in Class I areas - 1977 CAA amendments

•A cooperative measurement effort governed by representatives from Federal and regional-state organizations

•Objectives:

–Establish current visibility and aerosol conditions in federal class I areas

–Identify chemical species and emission sources responsible for existing man-made visibility impairment in FCIA

–Document long-term trends for assessing progress towards the national visibility goal to FCIA

–With the enactment of the Regional Haze Rule, to provide regional haze monitoring representing all visibility-protected FCIA

•Key participant in visibility-related research:

IMPROVE Monitoring

- Monitoring Began in March 1988
- **Aerosol** – particle sampling/analysis for six major species & trace constituents to aid in source attribution (24 hour samples twice weekly; every 3rd day starting in 2000)
- **Optical** – extinction by **transmissometer** &/or scattering by **nephelometer** (hourly) plus absorption on particle filters (24-hour)
- **Scene** – color **photography** to document scenic appearance (typically 3 photos/day)
  - photographic spectrums of a range of visibility conditions are generated from 5 years of photos

IMPROVE Aerosol Samplers

- Four independent sampling modules
- Prior to 2000, two 24 hour samples were collected twice a week, after 2000, samples collected every three days.

Module	Filter	Size	Variable	Analysis
A	Teflon	PM2.5	mass	gravimetric
			Na-Mn	Proton Induced X-Ray Emission (PIXE)
			Fe-Pb	X-ray Fluorescence (XRF)
			total H	Proton Elastic Scattering
			optical absorption	Hybrid Integrating Plate/Sphere (HIPS)
B	Nylon	PM2.5	sulfate, nitrate	Ion Chromatography
C	Quartz	PM2.5	OC, EC in 8 fractions	Thermal Optical Reflectance
D	Teflon	PM10	mass	Gravimetric

- Began with 20 sites in 1988, today 163 monitoring sites are in operation
- 116 monitoring sites collected some data in 2000

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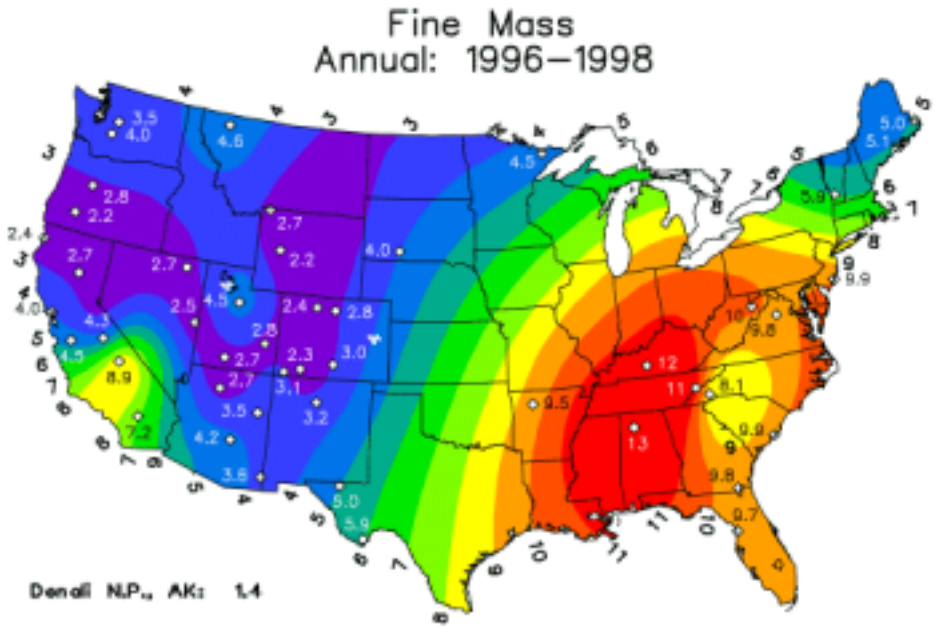
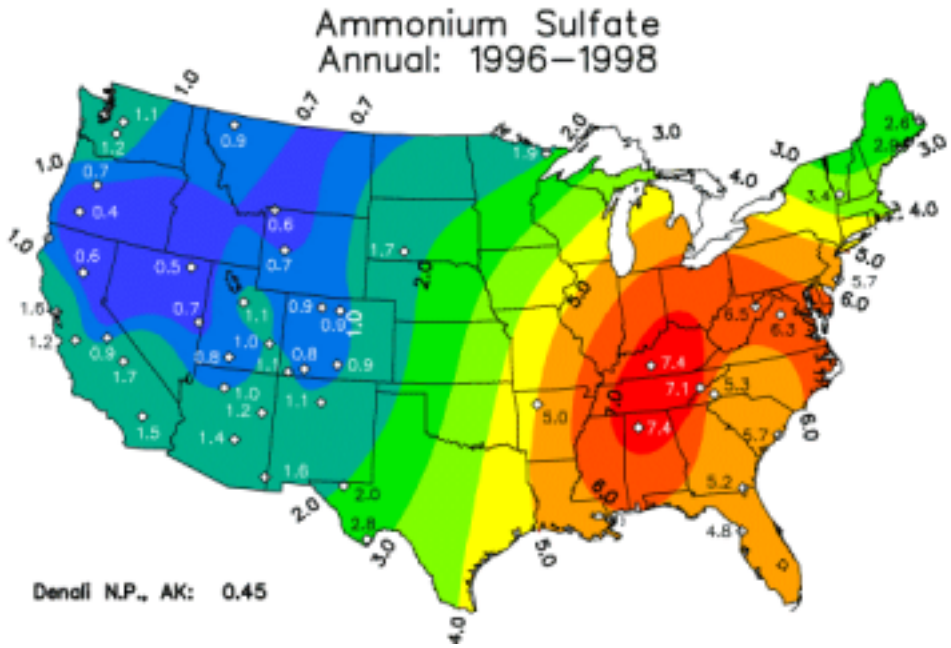
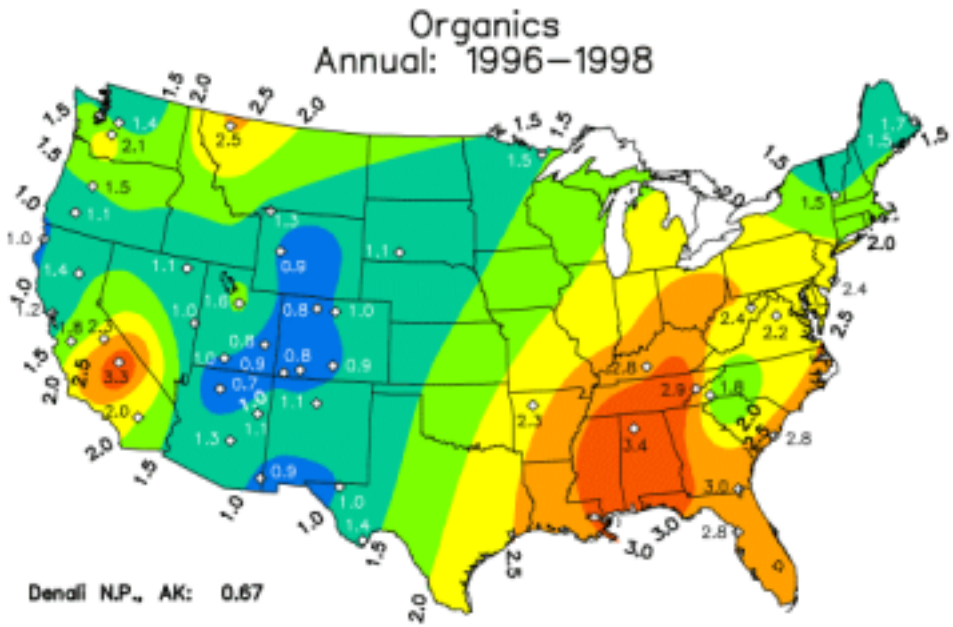
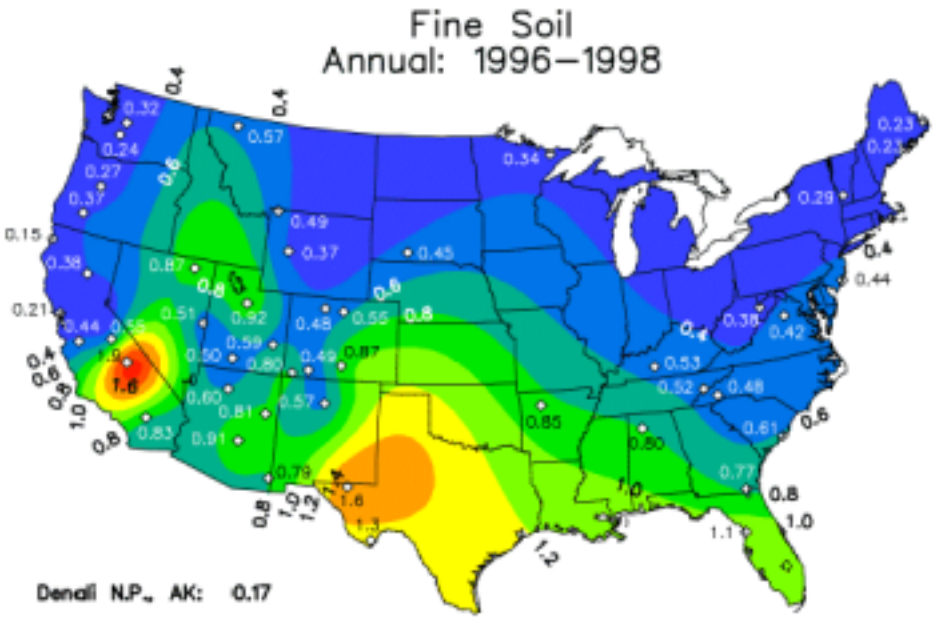
Aerosol Spatial Patterns 1996-1998







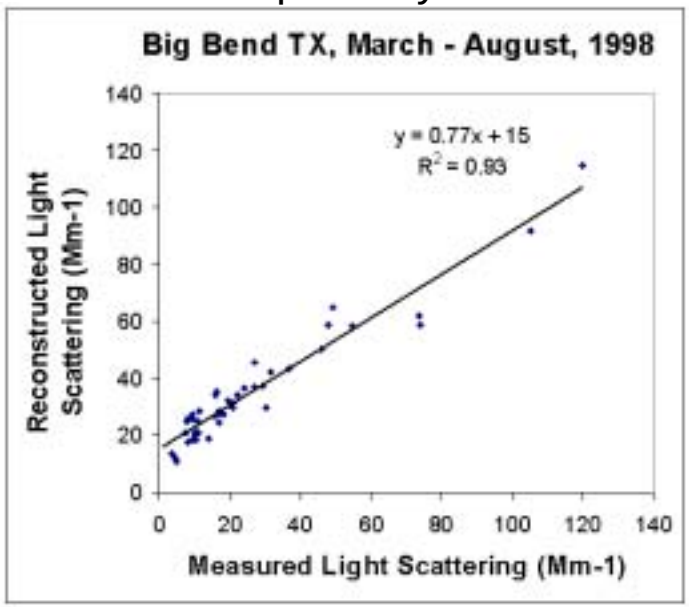


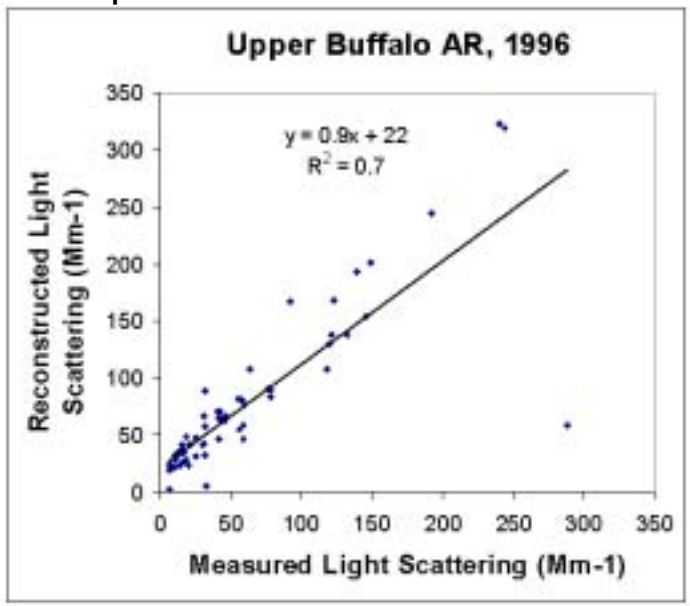
IMPROVE aerosol data are used to estimate haze (b_{ext}) in class I areas (rural United States)

Reconstructed light extinction equation:

$$Light\,Extinction(b_{ext}) = 3f(RH)[Amm.\,sulfate] + 3f(RH)[Amm.\,nitrate] + 4[Organic] + 10[Light\,Abs.\,Carbon] + 1[Soil] + 10$$

The aerosol types are calculated from the speciated aerosol data, e.g. Amm Sulfate = 4.125 * Sulfur. The leading coefficient are extinction efficiencies [m^2/g] and the f(RH) factor accounts for water uptake by the sulfate and nitrate species.





The IMPROVE reconstructed b_{ext} contains a number of assumptions, however, overall it seems to work

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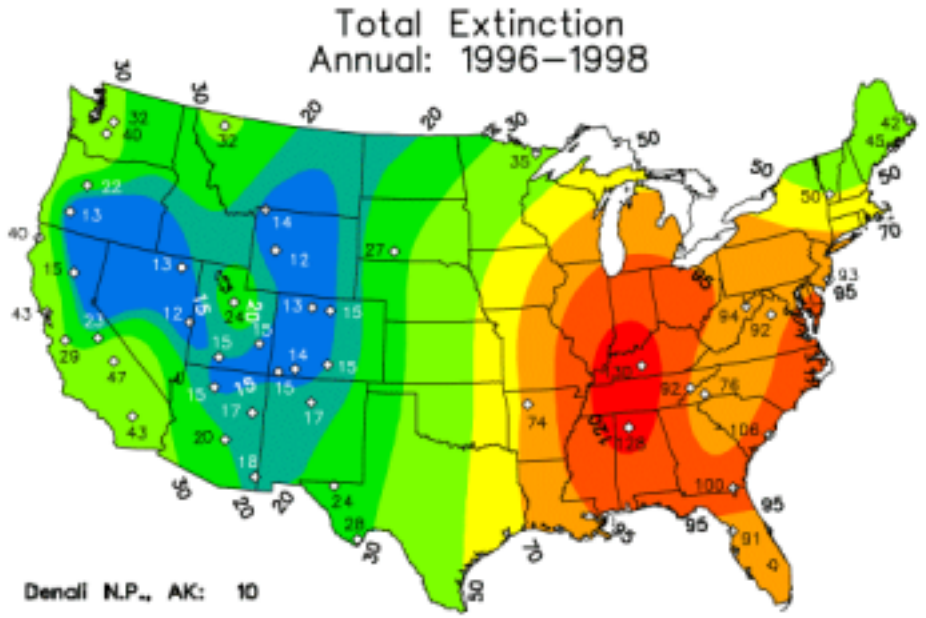
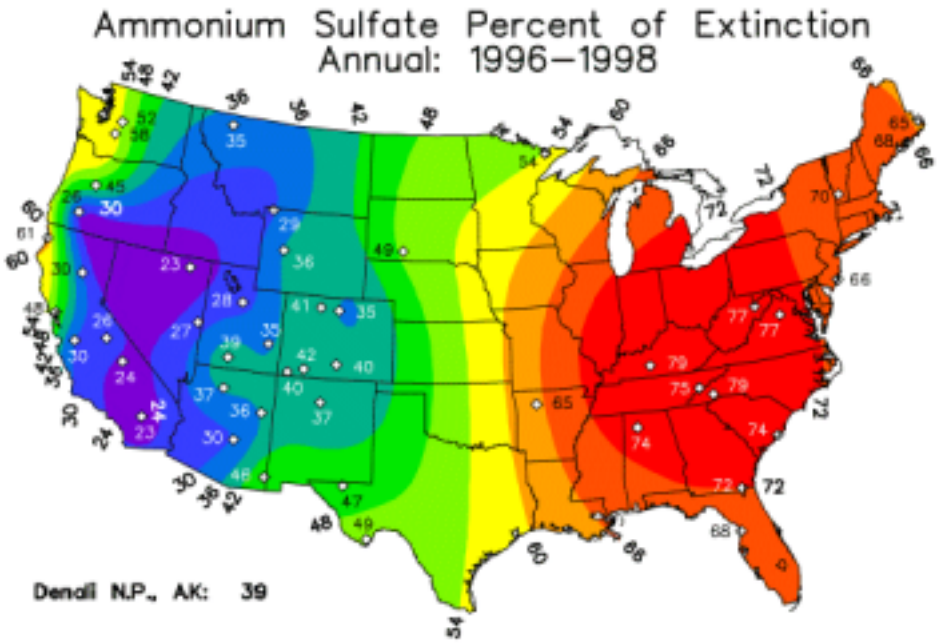
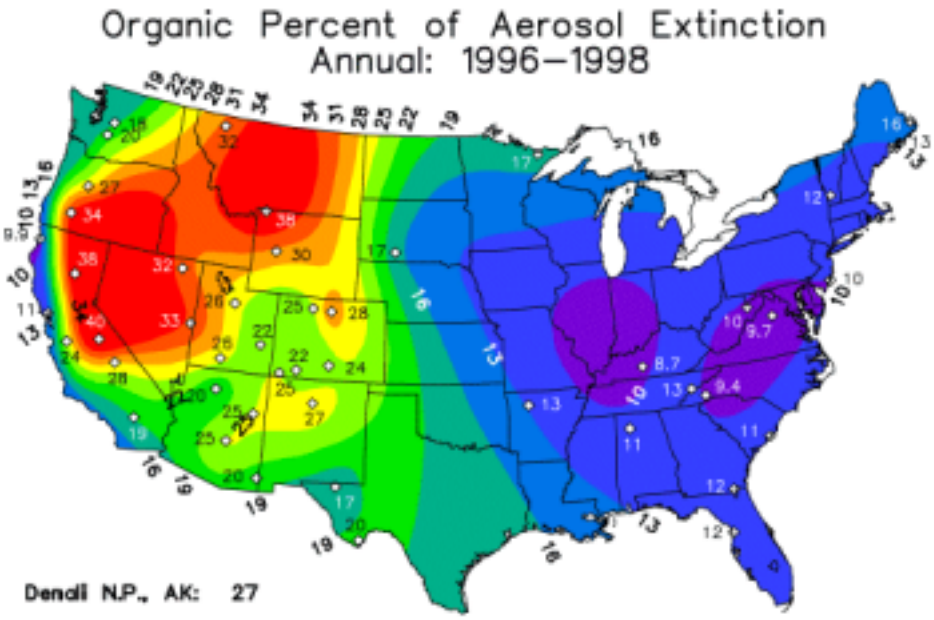
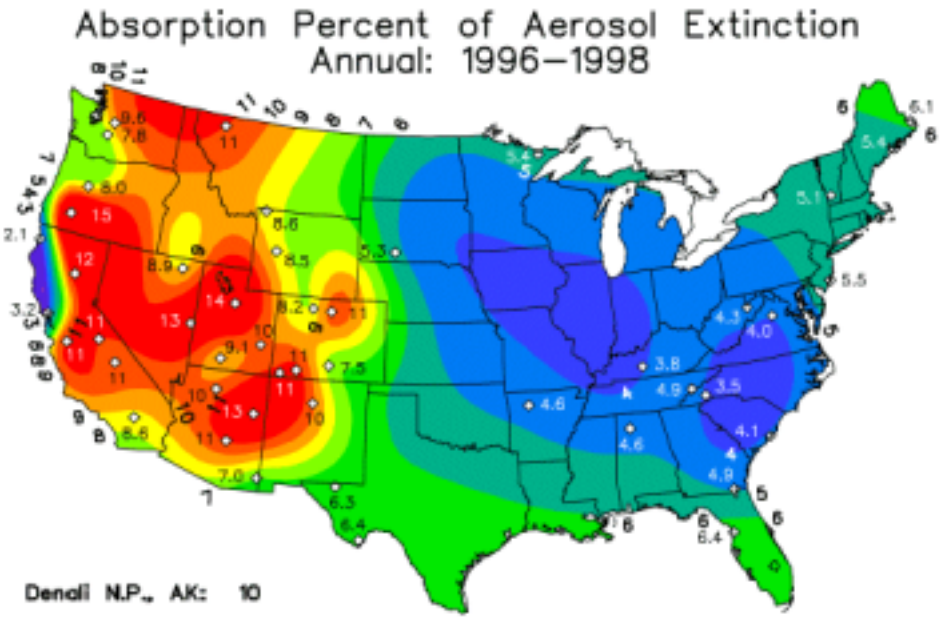
Reconstructed B_{ext} Spatial Patterns 1996-98



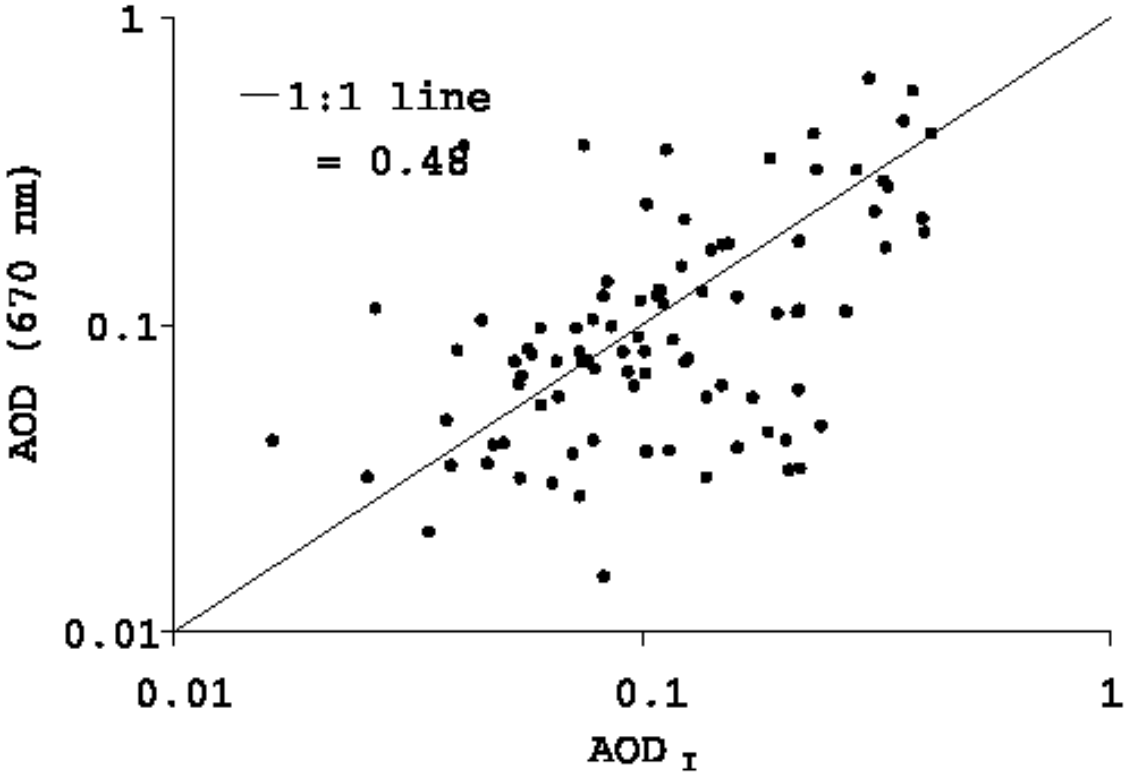






IMPROVE Derived AOD Compared to Measured Values from 1995–1997 (Corbin *et al.*, 2002)

- AOD 670 nm – measured optical depth from the Aerosol Robotic Network (AERONET) instrument at Goddard Space Flight Center
- AOD_I - IMPROVE derived AOD at Washington, D.C. calculated by multiplying the reconstructed b_{ext} by the boundary layer dept at for the years 1995–1997.



- The data were screened for clouds.
- The correlation of the ranks is 0.55

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