active networks of ground aot data-sets

aot

(aerosol optical depth or thickness)

workshop

at Davos, CH March 8-10, 2004

GAW and Switzerland

Swiss contributions to GAW:

- **GAW (strategic plan - WMO)**
- **WCC (EMPA: O3, CO, CH4)**
- **support of Kenya-station**
- **DACH *(Austria, Germany, Switzerland)***
  - **Sonnenblick, Jungfraujoch, Hohenpeissenberg, Zugspitze**
- **WORCC (opt. depth at DAVOS)**
  - **homogeneity of AOT**
  - **test/develop new instruments**
  - **implementations at GAW sites (money for long-term?)**

IGACO (- GAW)

- aerosol inhomogeneity
- satellite cannot do everything (aerosol in dark ?)

- **IGACO** ***is a consortium of 13 international organizations and late additions from the hydro- and carbon- cycle***

  (AREP/GAW, WWW, WMO satellite office, WCRP)

- **Goals**
  - **to establish a global integrated atmospheric system**
    - **start with a short-list, measurement requirements, current state of global observations, proposed structure and recommendation for implementation**
  - **until 2014 implementation, beyond 2014 operational**

[H2O, CO,CO2, NO2, BrO, ClO, HCl, CFCs, aerosol opt.depth]

connect different data networks from different agencies!

GAW aerosol

- **Gwasis** http://empa.ch/gaw/gawsis/
  - 22 global stations, more than 300+ regional stations
    - WDCA (Wilson, JRC) – "a 3 button job"
  - long-term (climate) aspect / harmonization needed
- **primary aerosol parameters**
  - multi-wavelength optical depth
  - mass in two size fractions
  - chem. components in two size fractions
  - light absorption and scattering coefficients
  - cloud condensation nuclei

more GAW: http://www.wmo.ch/web/arep/gaw/gaw-home.htm

USA - AERONET

- Aeronet (US) / Aerocan (CAN) / Photon (FR)
- 2002: now 100 sites with data at 50% rate
- sun-data: aot, Angstrom-para., precipitable water
- sky-data: … + size-distribution, refractive indices
- improved web-interface *(with stats and choices)*
  - http://aeronet.gsfc.nasa.gov
- project … BAMGOMAS
  - now: AERONET, MODIS, MPLNET, GOCART
  - then: more components to be added

USA - BSRN

- surface radiation network (data center at ETH Zuerich)
  - to acquire the highest possible quality (for climate)
    - direct/diffuse // downward infrared // upwelling radiance // surface meteorology // upper air meteorolgy // aot // PAR // UV
  - applications
    - satellite (statistics good … but point by point with errors!)
- 8 sites with aot data
  - multi-spectral (412,862,368 [500,778,675,610] nm)
  - automated 1 minute sampling
- recording
  - date, time, pressure, sun zenith angle, clear-sky flag
  - direct and diffuse transmission as function of wavel.

Japan - SKYNET

- many Asian sites + Lille, Belsk, Rome, GSFC
  - standard: sky-radiometer, up-looking radiometer
  - at times extras: pyrano-/phyrheliometer, pyrgeometer, sky-view camera, lidar, microwave radiometer, …
- differences to AERONET
  - instrument (‘PEDE’ [‘PRF’] not CIMEL)
  - calibration on site *(no central calibration)*
    - site scan and improved Langley
  - SKYRAD.pack (iterative optimization procedure)
    - less stable ss-albedo data than in AERONET (Dubovik)
- initial data
  - low single scattering albedo (as low as 0.8)

Switzerland - WORCC

- **Measurements**
  - optical depth, Angstrom (368, 415, 500, 862 nm)
  - 1 min data → monthly transfer to ISPRA
- **Sites of sun-photometers** (no sky-scanning mode!)
  - Bratts Lake, Ny Alsund, Izana, Mace Head, Davos, Summit, Jungfraujoch, Mauna Loa, Hohenpeissenberg, Ryori, *Tamamrassel (Sahara), Cape Point, Bukit Tobang)*
- **Cloud filters**
  - Harrison/Michalsky, triplet-scheme, opt. depth >3 flagged
- **Calibration**
  - high altitude
  - compare to co-located instrumentation

France - PHOTONS

- 25 sites (part of AERONET)
  - own calibration for 35 CIMEL (many with polarization)
    - outside: MIDI PYRENEE (2900m altitude)
    - inside: Lille (lab)
- web-site http:/www-loa.univ-lille.fr/photons
  - daily aerosol data available
- applications
  - polarization allows non-spherical analysis
  - with lidar example at Belsk (separate levels)
- next
    - new African sites for West-African Monsoon experiment

Australian network

- data: 412,330,610,778,862nm; minute data
- instruments
  - SPOA1: Cape Grim (85-) Alice Springs (96-) Melbourne
  - SPOA2: Darwin Alice, Springs
  - added radiation instrumentation at many sites
- calibration
  - in-situ (Langley, period statistics, ASR(spectrometer))
  - off site (instrument rotation)

Canada - AEROCAN

- 10 sites (part of AERONET), 6>50°N
  - future calibration site: Bratts Lake
  - interesting new site: Resolute (Northern Canada)
  - 15 year of data: Sherbrooke
- fine / coarse mode information
  - from 1st and 2nd derivative of Angstrom parameter
- a note on water vapor retrievals
  - spectral shift of sensor can have a big impact
- next
  - star-retrievals (diff. intensity: self calibration)

USA - SURFRAD

- sites: mainly US, 21 around DOE Cart Sites
  - MFRSR: 415, 500, 615, 673, 870, 940nm
  - 15sec measurement, averaged over 2 minutes
  - web-sites: http://srrb.noaa.gov, http://doe.arm.gov
- interesting results
  - in recent years… Angstrom parameter has decreased
- USDA is not Surffrad
  - interested in UV … by they have the MFRSR as well
- co-location
  - Bondville (CIMEL)

Russia - SIBRAD

- 5 CIMEL sites (part of AERONET)
- 3 SP6 sites
  - SP6 UV sensors: 308,322,340,370,410 nm
  - SP6 VIS sensors: 440,500,670,870,940,1050nm
  - SP6 n-IR sensors: 1.26,1.55,2.06,… um
- calibration
  - Langley and comparisons with CIMEL instruments

DWD - Germany

- 5 sites
  - Zingst (Baltic Sea), Lindenberg(86-), Posdam(84-03), Hohenpeissenberg, Zugspitze
  - same ‘German’ instruments to WMO specs at all sites
- results
  - highest cloud-cover in Europe at highest aot (mid 80s)
  - comparison to MODIS, depend on site reg. represent.
- … and interestingly (again!)
  - Angstrom parameter has decreased in recent years

Japan - JMA

- 3 (sunphotometer) sites (at Ryori since 1988)
  - EKO-MS-100: 368,550,675,778,862nm
- 1 lidar (at Ryori since 2002)
  - scattering, depolarization-ratio, extinction: 532nm
- 14 pyrheliometer sites

Brazil – LBA

- many CIMELs *…since 1994!* (part of AERONET)
- biomass burning season in South America
  - high AOT, even mass accumulation mode dominates
  - ss-albedo largest at the beginning of the burn season
  - aerosol leads to suppression of clouds (“warming”)
  - radiative forcing
    - -10W/m2 (ToA) // 28W/m2 (atm) // -38 W/m2 (surface)
  - effect impact on far away cities (e.g. Sao Paulo)

China – ‘Aeronet’-clone

- ca. 20 sites (standard CIMEL with polarization)
  - for sand and dust forcasting
  - for future climate effect studies
  - own processing – not part of AERONET !
- additional measurements
  - soil moisture, visibility

Netherlands - KNMI

- 2 sites (Cabauw, Surinam)
  - Cabauw
    - SPUV 368,501,675,871,940nm
    - 1 min (aot, Angstrom) – Michalsky cloud screen
  - Surinam
    - 366,494,670,815,1033nm
    - 1 min (aot, Angstrom) - Michalsky cloud screen
- 2 Aeronet (CIMEL) sites
  - Cabauw
  - Den Haag
    - also to study land-sea differences

Italy – polar aots

- high latitudes
  - sensitive to aerosol, sign of climate impact uncertain
  - many different instruments – difficult intercalibration
  - harsh environment
  - 412nm/675nm Angstrom / aot type-classification
- new
  - spectral solid state photometers
    - 234-702nm
    - 665-1103nm
- Interesting result
  - at Ny Alsund: largest aots have increased since 99 !

Russia – polar aots

- ca. 15 stations
  - increase in springtime aot 50s to 90s
- no new data since the 1990

Spain – dust aots

- Izana (part of GAW)
  - sea-level
  - high altitude (>2000m)
- additional sites on the mainland

USA - CMDL

- aot measurements … historically by radiation
- 7 sites
  - sunphotometer PMOD1 (until 2001) – PFR (since 2001)
- items to remember
  - direct bean methods has merit over hemispheric data
  - be cautious with automated cloud-screen algorithms
  - In situ calibrations better than instruments rotations
  - commercial instruments should agree within 0.01 aot
  - handheld instruments are not suitable for networks
- interesting
  - Mauna Loa background T has decreased .937 to .934
    - signs of increased (uplifted) Asian pollution

Europe – lidar activities (Earlinet)

- boundary layer height statistics
  - winter: 1000m, summer: 1500m (with large scatter) …
    … at Hamburg, Germany
- altitude information
  - need complementary info from back-trajectories
- extinction profiles
  - NO: backscatter
  - YES: Raman, HSRL (difficult), angle-scan (if homog.)
- data
  - many… but inhomogeneous in time and space

USA – lidar activities

- **MPL-Net**
  - 2 US operational sites, many temp.sites, plan for more
  - eyesafe lidar data + AERONET lidar ratio ⇨extinction
- **REALMs**
  - 7 operating sites mapping Eastern US, plan for 4 more
  - common processing envisoned (like Earlinet)
- **GLAS** *(web-site: glo.gsfc.nasa.gov)*
  - limited laser life, ice sheet height, aerosol secondary
  - small ice-crystal are problem in aerosol retrievals
- **CALISPO**
  - part of the A-train: 3ch. lidar, IR radiometer, camera
  - aerosol layer top/base, aot>0.1, cirrus, ice-water phase

Japan - lidar

- JMA
  - Ryori (Japan)
- Skynet
  - 5 sites

in-situ

- longterm (light aircraft – over instrumented site)
  - surface data relevant to properties aloft?
    - ss-albedo often higher at higher altitudes
    - general agreement between in-situ and CIMEL (MFRSR+bias)
- case studies (heavy well instrumented aircraft)
  - aerosol altitude (in cloudy scene) matters! (off Namibia)
  - reasonal comparisons to AERONET size-distributions
    - based on PCASP long flight leg data
    - non-spherical size and ss-albedo issues
  - new: FAMM aircraft (BEA 146 … but less duration than C-130)