WMO Rolling Review of Requirements for Aerosols

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WMO Aerosol Objectives

- **GAW:** Improve climate and air quality assessments and predictions through measurements and analysis of aerosols
- **RRR:** develop a consensus view on the design and implementation of composite aerosol observing systems

GAW Strategic Plan

- Develop a three-dimensional global atmospheric chemistry measurement network
- Develop coherent data processing chains
- Implement near-real-time delivery of a few measured parameters
- Assimilate data into models
  - http://www.wmo.int/pages/prog/arep/gaw/documents/gaw172-26sept07.pdf
- Implement the Integrated Global Atmospheric Chemistry Observations (IGACO) Strategy
  - ftp://ftp.wmo.int/Documents/PublicWeb/arep/gaw/gaw159.pdf

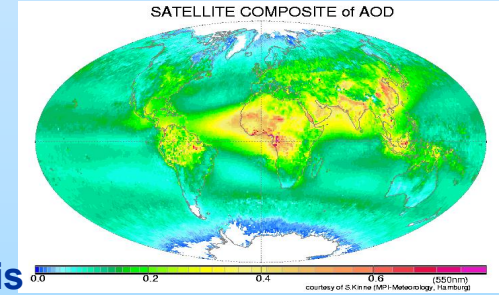
IGACO-Aerosols

Global Products

GAW Calibration
&
Quality Assurance

(GAWNET PFRs)

World Integrated
Data Network:
e.g. WDC-Aerosols
Sat. Centres (WDC-RSAT)
AERONET, etc



Reanalysis

WMO Real-Time Data Distribution:
WMO Information System (WIS)

Satellite:
MODIS, CALYPSO, GEOs

Aircraft: MOZAIC/IAGOS

Surface-based:
Remote sensing
In situ: PM & optical
In situ: Chemistry

Assimilation of
Real-Time Data
By
Forecast Models
(e.g. GEMS;
WMO SDS-WAS)

Data Uses/Applications
1. Public Air Quality Warnings
2. Public SDS Warnings
3. Public Aerosol Bulletins
4. Surface and air transport
5. Scientific Assessments (IPCC, Ozone, etc)
6. Improved Weather Forecasts

Leaders: WMO/GAW & Satellite Orgs & ENV Orgs

ftp://ftp.wmo.int/Documents/PublicWeb/arep/gaw/gaw159.pdf

GAW Aerosol Variables - Continuous

- **Column and profile**
  - Multi-wavelength aerosol optical depth (AOD)
  - Vertical distribution of aerosol backscattering and extinction
- **Chemical (in two size fractions)**
  - Mass and major chemical components
- **Optical coefficients at various wavelengths**
  - Light scattering and hemispheric backscattering
  - Light absorption
- **Physical**
  - Number size distribution and total concentration
  - Cloud condensation nuclei number concentration at various super-saturations

GAW Aerosol Variables - Intermittent

- Detailed, size-fractionated, chemical composition
- Dependence on relative humidity

GCOS Essential Climate Variables

- **GCOS Essential Climate Variable currently only specifies "Aerosol Properties"**
- **SAG-Aerosol recommends to elaborate this vague specification by adding another footnote to the GCOS ECV table**
  - http://www.wmo.int/pages/prog/gcos/index.php?name=EssentialClimateVariables#_ftn1
- **The PRELIMINARY text of this footnote is:**
  - *"Including, but not restricted to, aerosol optical depth, light scattering and absorption coefficients, and vertical distributions of aerosol backscattering and extinction."*

Four Steps of Rolling Review

i. a review of users' requirements for observations, within an area of application covered by WMO programmes;

ii. a review of the observing capabilities of existing and planned observing systems;

iii. a "Critical Review" of the extent to which the capabilities (ii) meet the requirements (i); and

iv. a "Statement of Guidance" based on (iii)

http://www.wmo.int/pages/prog/sat/documents/RRRprocess.pdf

Current Status of RRR for Aerosols

- **User Requirements**
  - http://www.wmo.int/pages/prog/sat/Requirements/Observational-requirements_web.xls
- **Review of Capabilities**
  - 2004 IGACO Report (ftp://ftp.wmo.int/Documents/PublicWeb/arep/gaw/gaw159.pdf)
- **Critical Review of Requirements vs. Capabilities**
  - ? (IGACO Report)
- **Statement of Guidance**
  - http://www.wmo.int/pages/prog/sat/SOG/SoG-Atm-chemistry.doc (c.f. IGACO Report), from 2004

Aerosol variables in WMO UR database

Variable	Originator of Requirement
Aerosol optical depth	GCOS; SOG-AC; CMUG; CCI; MACC
Aerosol profile	CHEM; NWC-VSRF; NWP; WCRP
Aerosol absorption optical depth	GCOS; SOG-AC; CMUG; CCI
Aerosol extinction coefficient	GCOS; SOG-AC
Aerosol mass concentration	SOG-AC
Aerosol size	GOOS
Aerosol Ångström coefficient	CCI
Aerosol depolarisation ratio	CMUG
Aerosol dust fraction of AOD	CCI
Aerosol fine mode fraction of AOD	CCI

- CCI & MACC: http://www.esa-aerosol-cci.org/?q=webfm_send/135
- CMUG: http://dialspace.dial.pipex.com/prod/dialspace/town/estate/gtp89/cmug/CMUG_D1.2_URD_v1.32.pdf

RRR Process Needs Help!

- **Update User Requirements**
  - A specification of requirements from ICAP would be very helpful
  - Requirements should be independent of observation method
- **Update Review of Observing Systems**
  - Space agencies for satellites
  - GAW for sub-orbital measurements
- **Conduct Critical Review**
- **Prepare New Statement of Guidance**
  - Anticipate a two-year process to complete the entire process

Improvements to User Requirements

- **Harmonize requirement categories**
  - Variables and wavelengths
    - e.g., “aerosol profiles” is not a variable
  - Vertical layers and geographic regions
  - Nomenclature for accuracy, precision, stability, etc.
  - Iterate definitions among interested users’ groups
- **Expand requirements to meet user needs**

Improvements to User Requirements

- **Harmonize requirement categories**
- **Change requirements to meet user needs**
  - Include sub-orbital and satellite observations
  - Allow multiple requirements for different uses, e.g.,
    - Assimilation vs. verification;
    - Accuracy and resolution as function of geographic scope
    - Accuracy as a function of temporal resolution (monthly vs. yearly vs. decadal)
  - Require specification of error models

Discussion Questions

- **What are the aerosol "Essential Climate Variables"?**
  - Include chemical composition, size distribution, CCN number concentration?
- **What other "essential" variables should be specified for other application areas?**
- **Is the ICAP group interested in contributing Requirements to the RRR process?**
  - If so, who will take the lead?
  - How well do the CMUG, CCI, and MACC requirements meet ICAP's needs?