COMMUNITY WORKSHOP ON AIR QUALITY REMOTE SENSING FROM SPACE: DEFINING AN OPTIMUM OBSERVING STRATEGY

February 21 - 23, 2006

Center Green CG1 Auditorium, National Center for Atmospheric Research, Boulder, Colorado, USA

Session 1: Current and Future Requirements for Air Quality Satellite Observations.
Co-chairs: *Phil DeCola and Mitch Goldberg*

ORAL PRESENTATIONS

Anthes, University Corp. for Atmospheric Res., USA

Earth Science and Applications from Space: Initial results of decadal study and a progress report

R. Anthes, Co-Chair NRC Decadal Survey
University Corporation for Atmospheric Research, Boulder, CO, USA

In response to requests from NASA, NOAA and the USGS, the National Research Council is carrying out a decadal study of Earth science and applications from space. My talk summarizes the major findings and recommendations from an interim report Earth Science and Applications from Space: Urgent Needs and Opportunities to Serve the Nation, which was issued in April 2005. I also summarize recent activities of the Executive Committee and the seven thematically organized panels and directions of the final report, which will be issued in late 2006. Information on the decadal study may be found at http://qp.nas.edu/decadalsurvey.

DeCola, NASA Headquarters, USA

The NASA Perspective

Philip L. DeCola
Science Mission Directorate, NASA Headquarters, Washington, DC, USA

Goldberg, NOAA/NESDIS, USA

Current and Future Air Quality Applications of NOAA Operational Satellite Data

Mitch Goldberg and Shobha Kondragunta
NOAA/NESDIS

The use of remotely sensed trace gas and aerosol data for surface air quality monitoring and forecasting has evolved tremendously in the last decade. NOAA/NESDIS has been active in developing near real time satellite products for air quality applications from its geostationary and polar-orbiting satellites for users such as the Environmental Protection Agency (EPA) and the NOAA/National Weather Service (NWS). Satellite derived aerosol optical depths, ozone, and PM2.5 emissions in near real time are currently being

used by the NWS in air quality forecast verification and in air quality modeling to improve forecasts. Plans are underway to expand the operational product development to trace gases such as NO2, H2CO, SO2, CO, and absorption/scattering optical depths with the launch of Initial Joint Polar Satellite System (IJPS) GOME-2 and IASI instruments in 2006. The launch of NPP, NPOESS, and GOES-R sensors in the next decade will strengthen and expand this early progres. We will present examples of air quality applications of current operational satellite data and discuss potential applications with future satellite sensors. Despite the progress that will come in the next decade with these next generation hyperspectral sensors, the ability to observe boundary layer pollution will remain a challenge. The call for this workshop is timely and appropriate as there is a critical need to develop satellite sensors that can observe tropospheric pollutants at high spatial, temporal, and vertical resolutions. NOAA is looking forward to partnering with NASA, ESA, and academia to overcome these challenges.

Langen, ESA-ESTEC, Netherlands

A Study on Operational Atmospheric Chemistry Monitoring Missions

J. Langen
ESA-ESTEC, Noordwijk, The Netherlands

A study commissioned by the European Space Agency has recently elaborated requirements for future atmospheric chemistry missions serving operational applications. The study team was led by the Dutch Meteorological Institute and included many research institutions and representatives of potential user communities.

The study identified three major environmental issues associated with atmospheric composition: stratospheric ozone / surface UV, air quality, and climate. Applications for each issue include protocol monitoring / treaty verification, near-real time services such as weather and air quality predictions, and environmental assessments.

For each application a complete set of geophysical observation requirements was established. The assessment of already existing and planned missions revealed that for the target time frame 2010-2020 the operational space data on atmospheric composition would only cover Montreal protocol monitoring. Main observational gaps identified were:

- high temporal/spatial resolution space-based measurements of tropospheric (PBL) composition for application to air quality;
- high vertical resolution measurements in the UT/LS region for ozone and climate applications;
- climate gases (CO2, CH4 and CO) and aerosol monitoring with sensitivity to the PBL.

Investigated mission concepts included

- a regional geostationary mission for European air pollution (to be complemented by a polar low Earth orbit component);
- a constellation of satellites in inclined low Earth orbit for global air pollution and climate;

- a satellite on polar low Earth orbit for air pollution and climate complementing NPOESS and Metop diurnal coverage;
- a limb-sounding mission for climate-chemistry interactions and ozone in the UTLS.

Lyon, US Environmental Protection Agency, USA

EPA Requirements for AQ Monitoring and Regulation

John Lyon
US Environmental Protection Agency, USA

Mathur, NOAA/ US Environmental Protection Agency, USA

On the use of Remote Sensing Air Quality Information in Regional Scale Air Pollution Modeling: Current Use and Future Observation Requirements

S.T. Rao, (Rohit Mathur)
NOAA/Atmospheric Sciences Modeling Division, EPA/Atmospheric Modeling Division, 109 T.W. Alexander Drive, Room E-240D, U.S. Environmental Protection Agency (MD - E243-02), Research Triangle Park, NC 27711

Emerging regional scale atmospheric simulation models must address the increasing complexity arising from new model applications that treat multi-pollutant interactions. Sophisticated air quality modeling systems are needed to develop effective abatement strategies that focus on simultaneously controlling multiple criteria pollutants as well as use in providing short term “chemical weather” forecasts. In recent years the applications of such models is continuously being extended to address atmospheric pollution phenomenon from local to hemispheric spatial scales over time scales ranging from episodic to annual. The need to represent interactions between physical and chemical atmospheric processes occurring at these disparate spatial and temporal scales requires the use of observation data beyond traditional in-situ networks so that the model simulations can be reasonably constrained. Remote sensing data can provide a valuable source of information which can be used both for verification of model results as well as in improving the predictive capability of these models by providing improved estimates of model parameters and through chemical data assimilation. This talk will review several preliminary applications of remote sensing data in regional air quality modeling using the Community Multiscale Air Quality Model (CMAQ) and include: (1) use of data for verification of spatial and temporal trends in columnar pollutant loading, (2) representation of effects of long-range transport originating outside the limited area model domain, (3) improvements in parameter specification for land-surface and dry deposition models such as, high resolution spatial and temporal representations of vegetation and land-use, (4) improvements in representation of cloud effects on surface energy exchange and photolysis rates, and (5) constraining model emissions inputs and verifying trends in emissions. The results from these early applications will be discussed in context of (1) uncertainties in the model and in the remote sensing data and (2) needs for defining a future optimum observing strategy.

Scheffe, US Environmental Protection Agency, USA

Optimizing observational systems for enhanced air quality characterization: Linking Agencies, Disciplines, Media and Global Communities.

Richard Scheffe (1), Steve Young (2), Steve Fine (3), Rudolph Husar (4), Fred Dimmick (5)

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EPA's National Ambient Air Monitoring Strategy (NAAMS) intends to shift a regulatory oriented observation framework toward a more scientifically driven system, emphasizing multiple pollutant and continuous observations in the routine networks operated by States, local agencies and Tribes. Despite these intended improvements, emerging interest in the following areas are driving new expectations of observational networks, including:

- comprehensive air quality characterizations to service air program managers and atmospheric and health scientist communities,

- linking environmental parameters across environmental media recognizing the bi-directional influences media impart on each other,
- incorporating long distance pollutant transport and vertical atmospheric chemistry characterizations to improve assessments over a range (hemispherical to local) of spatial scales,
- harnessing the potential characterization power offered through integrating existing land based networks and remote sensing platforms with advances in data assimilation techniques advances air quality modeling and computational efficiency.

Paralleling a number of exciting technological developments is an increasing commitment to partnerships across organizational entities and missions brought about by a confluence of decreasing discretionary spending and a demand to demonstrate accountability through relevancy of research programs and measurable health and environmental benefits. Strategies for observation networks have been developed by EPA (NAAMS, 2004; http://www.epa.gov/ttn/amtic/monstratdoc.html) and through the Integrated Global Observing Strategy (IGOS) Atmospheric Chemistry Observations Theme (IGACO, http://www.igospartners.org/Atmosphere.htm) which focus on land based and remote satellite observations, respectively. A number of partnerships have been formed that are intended to integrate land and satellite based observations with air quality modeling output to provide greater spatial and temporal detail and accuracy relative to that produced through one component. Examples include the EPA-NOAA-CDC Public Health Air Surveillance and Evaluation (PHASE) project and the Global Earth Observation System of Systems (GEOSS) which together includes virtually all Federal agencies that produce and utilize environmental measurements. Demonstrations of air pollution related applications, including forecasting, utilizing various satellite based observation platforms provide a technology driver complementing underlying these partnerships. Recognizing the interdependence of nations activities on air pollutant transport across continental and hemispherical scales, international partnerships, such as the Long-Range Transboundary Air Pollutants (LRTAP) Task Force on Hemispheric Air Pollution, have emerged that rely on integrated observation platforms as a key assessment component.

The current NAAMS will yield benefits based more on its ability to engage with other observational platforms and organizations, rather than any specific changes in air pollutant measurements. A future air monitoring strategy is poised to take advantage of the framework established by the NAAMS in combination with a genuine collaboration across organizations and disciplines. Key ingredients that coalesce the enormous leveraging opportunities constitute the basis of the next generation monitoring strategy:

1. Information Technology (IT) infrastructure support, guidance and maintenance that enables transparent access and distribution of various information sources allowing for integration of disparate data sets, a precursor to interpretive data analysis.
2. Additions of key "gap" observations that bridge different observation platforms,
3. Development and acceptance of data fusion and assimilation techniques that optimize the value of complementary data sets and air quality modeling results, and
4. Periodic assessments of network efficiency that value the integration and leveraging elements within a particular network operation.

POSTER PRESENTATIONS

van Oss, Royal Netherlands Met. Inst., Netherlands

The GMES Service Element project PROMOTE

R.F. van Oss, PROMOTE project Team
KNMI (Royal Netherlands Meteorological Institute)

In recognition of the mature state of the use of satellite data to better understand some aspects of the atmosphere, the European Space Agency (ESA) supports the PROMOTE project as a part of its Global Monitoring for Environment and Security (GMES) Service Element (GSE) programme. The 20-month project, begun in April 2004, focuses on the operational delivery of services and products related to Stratospheric Ozone and Surface Ultraviolet Radiation, and to the demonstration and start of delivery of services related to Air Quality. All three of these service lines address past, present, and forecasts of various variables and constituents using information derived from satellite data, ground-based measurements, and models. These services are being presented to and evaluated by a set of 14 Core Users who represent a variety of regional, national and international organisations. A two-phase structure in the project will assist in ensuring that the evaluation of these Core Users helps to improve the service that will be available at the end of the project. In addition to providing Core Users today with products and services, a key aspect of PROMOTE is to plan follow-on activities, with a timeframe of up to 10 years, which are based on definitions of future services required by users. In this vein, the initiation of a Greenhouse Gas assessment service has begun through a dialog between PROMOTE research partners and a set of Core Users to help shape a functioning service in the coming years. PROMOTE will likely continue in an implementation phase in the period 2006 – 2008.

This presentation will provide an overview of the project and provide highlights of User feedback received to date. More information on the overall project can be found at the project website at http://www.gse-promote.org/