

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

February 21 - 23, 2006

National Center for Atmospheric Research Boulder, Colorado, USA



Workshop Motivations & Objectives

David P. Edwards NCAR



Satellite Observations of the Troposphere

- There have been significant advances over the last few years in our ability to probe the troposphere and even the boundary layer from space
- This has been made possible with the launch of instruments specifically designed to measure tropospheric composition, and for other instruments that measure total column quantities, the development of sophisticated algorithms that allow separation of the tropospheric component
- We have begun to examine some important questions:
 - What are the major pollution sources?
 - How do natural and anthropogenic processes interact in determining pollutant production?
 - How do intense local pollution sources affect the environment?
 - Where do the pollutants go?
 - What is the subsequent impact on regional and global scale atmospheric pollutant loadings?
 - How is this changing over time?



Terra: MODIS, MISR, MOPITT, CERES, ASTER

Smoke over Eastern Canada/USA

MODIS fires and smoke



Charles Ichoku, NASA GSFC

0.00

1.00

1.40

1.60

1.80

2.00

NCAR M **MOPITT CO Column** 20 Ċ July 1-8 2002 -70 -80 65 -75

2.40

2.20

2.80

3.20

1018 mol/cm2

What do we mean by Air Quality?

This is a clearly defined term in some communities and is loosely used in others... The local composition of air with respect to quantities of certain gaseous and particulate pollutants that may be detrimental to human, animal, or plant well-being

... together with an examination of the biogenic and anthropogenic processes that lead to pollution production and the mechanisms that govern subsequent chemical transformation and transport vertically and horizontally through the atmosphere

There is considerable international interest in the potential use of satellite observations in Air Quality applications from several communities involved in:

- Understanding the basic science of atmospheric composition and transport processes
- o Forecasting chemical weather
- **o** Regulation of environmental pollutants
- **o** Determining the impact and relation to land-use and agriculture



How may space-based observations help?

AQ a cross-scale issue requiring an Integrated Observing Strategy...

- No single measurement technique can meet all the requirements because of the different spatial and temporal scales involved
- A successful observing strategy will use satellite observations in conjunction with in-situ methods, sondes, ground-based remote sensing techniques and aircraft measurements
- Satellite observations provide long-term, large-area coverage and the context for localized observations and the connection to regional and global scales
- Earth system models designed for global, regional and local scales help integrate these diverse measurements with the aim of providing a unified understanding

A challenge for future space-borne missions will be to improve coverage at fine spatial and temporal scales while maintaining the largerscale perspective



Workshop Motivations...

- A community workshop is an opportunity to bring together the different constituencies interested in AQ and to hear the requirements of the data-users and ideas of the measurement-makers.
- Based on our experience using the current satellite remote sensing data for AQ studies, we have an appreciation of their capabilities and limitations. A frank discussion of these "lessons-learned" is important for the definition of future missions.
- Provide an opportunity to review modeling capability including data assimilation techniques, especially at the regional scale.
- The recent NRC Decadal Survey process resulted in ~10 whitepapers concentrating on AQ applications; this testifies to the cross-cutting interest in this issue from "pure-science" studies through operational requirements to societal impacts.
- The workshop will hopefully provide a forum in which future mission ideas can be considered in the context of the needs of potential data-users. Also needed is a mechanism by which we will quantitatively evaluate different observing strategies.



... and Objectives

- **1.** To provide an overview of current and future operational requirements for air quality satellite observations;
- 2. To review the current space-based capabilities for measuring tropospheric trace gases and aerosols and to assess the benefits and limitations for air quality applications;
- **3.** To further the development of techniques for combining space-based measurements with models, particularly at the regional scale, for estimating sources and sinks, and separating the contributions of local production and transported pollution;
- 4. To examine the horizontal, vertical, and temporal measurement resolutions required to capture the variation of the important atmospheric constituents and processes determining air quality;
- 5. To explore future mission concepts and detail the parameters of an optimum observation system for air quality studies from space.
- 6. Workshop Report: Submit to NASA Atmospheric Composition, Decadal Survey....

Ultimately, for the community to establish its own set of key measurements and set priorities



Workshop Agenda

Tuesday, 21 February

AM Session 1: Current & Future Requirements for Air Quality Satellite Observations PM Session 2: Current Observational Capabilities, Limitations and Lessons Learned Wednesday, 23 February

AM Session 3: Modeling PM Session 4: Future Mission Concepts and Observing Strategies Session 5: Posters & Reception

General Discussion time after each Session

Thursday, 24 February

AM Session 6: Next Steps Panel Discussion: Defining an Optimum Observing Strategy Moderated Discussion: How well do future mission concepts address future needs?

- Speakers: Please see Louisa Emmons to upload your presentation prior to your session
- Please keep to time!
- Posters are on display throughout workshop, boards organized by Session





Workshop Organization

Organizing Committee

David Edwards, NCAR, Boulder CO Philip DeCola, NASA Headquarters, Washington DC Jack Fishman, NASA/LaRC, Hampton VA Daniel Jacob, Harvard University, Cambridge MA Pawan Bhartia, NASA/GSFC, Greenbelt MD David Diner, JPL, Pasadena CA John Burrows, University of Bremen, Bremen, Germany Mitch Goldberg, NOAA/NESDIS, Silver Spring, MD

Acknowledgements

The organizers would like to acknowledge the financial support of NSF, NASA, and NCAR ASP for providing support to 18 early career scientists and new faculty to allow them to attend this workshop



Logistics



- Bathrooms: Across the lobby
- Lunch: This building in the NCAR cafeteria
- Dinner: On your own
- Reception: Wednesday evening 4:30 -7:00 pm during the Poster Session
- Buses: Between the Broker Inn and NCAR CG1 each day before and after the meeting
- Internet: NCAR wireless network or Library (across the lobby, 2 floor)
- Administrative Help: Ask Marilena Stone at the desk or David Edwards
- Local information: On the desk outside



Tuesday AM

NCAR

08:00	Registration
08:30 - 08:40	Tim Killeen, NCAR Director: Welcome
08:40 - 09:00	David Edwards, NCAR: Workshop Motivation & Objectives

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

09:00 - 09:15	Rick Anthes, UCAR: Earth Science and Applications from Space: Initial results of decadal study and a
	progress report
09:15 - 09:30	Phil DeCola, NASA HQ: The NASA perspective
09:30 - 09:45	Mitch Goldberg, NOAA/NESDIS: Current and Future Air Quality Applications of NOAA Operational Satellite Data
09:45 - 10:00	Joerg Langen, ESA-ESTEC: A Study on Operational Atmospheric Chemistry Monitoring Missions
10:00 - 10:30	Coffee Break
10:30 - 10:45	John Lyon, US EPA: EPA Requirements for AQ Monitoring and Regulation
10:45 - 11:00	Rohit Mathur, NOAA/US EPA: On the Use of Remote Sensing Air Quality Information in Regional Scale
	Air Pollution Modeling: Current Use and Future Observation Requirements
11:00 - 11:15	Richard Scheffe, US EPA: Optimizing Observational
	Systems for Enhanced Air Quality Characterization:
	Linking Agencies, Disciplines, Media and Global Communities.
11:15 - 12:00	Open Discussion on Session 1
12:00 - 13:00	Lunch

Session 2:

Current Observational Capabilities, Limitations and Lessons Learned Co-chairs: P. K. Bhartia and Dave Diner

Tuesday PM

13:00 - 13:15	P. K. Bhartia, NASA GSFC: Studies of Tropospheric Ozone and Aerosols by Backscatter Ultraviolet Remote
	Sensing
13:15 - 13:30	Kelly Chance, Harvard Smithsonian: Satellite Measurements of Global Tropospheric Pollution: Toward
	Development of Geostationary Capability
13:30 - 13:45	Jim Drummond, U. Toronto: Carbon Monoxide Measurements from Space: Past, Present and Future
13:45 - 14:00	Ilse Aben, SRON: Quantitative Analysis of SCIAMACHY CO Measurements: Retrieval, Calibration and
	Error Analysis
14:00 - 14:15	Kevin Bowman, JPL: Observing Signatures of Air Pollution from Space: Prospects and Challenges for Nadir
	Thermal Infrared Spectrometers
14:15 - 14:30	Chris Barnet, NOAA/NESDIS: Trace Gas Products from High Resolution Infrared Instruments
14:30 - 15:00	Coffee Break
15:00 - 15:15	Paul Palmer, U. Leeds: Using Satellite Observations of Atmospheric Composition to Study Links Between
	European Air Quality and Global Climate: Current and Future Research
15:15 - 15:30	Rainer Volkamer, U. California-San Diego: What Can We Learn by Remote Sensing Glyoxal (CHOCHO)
	from Space?
15:30 - 15:45	Rosemary Munro, EUMETSAT: Atmospheric Composition Measurements from the EUMETSAT Polar
	System (EPS) and plans for Post-EPS
15:45 - 16:00	Ralph Kahn, JPL: Measuring Aerosol Pollution from Space: Capabilities, Limitations, and Next Steps
16:00 - 16:15	Dave Winker, NASA LaRC: Contributions to Air Quality Monitoring from the CALIPSO lidar
16:15 - 16:30	Chris Paciorek, Harvard School of Public Health: Using Satellite Observations to Estimate Long-term Human
	Exposure to Particulate Matter: Characteristics of Remote Sensing Data Useful for Environmental
	Epidemiology
16:30 - 17:00	Open Discussion on Session 2
17:00	Adjourn
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Wednesday AM

Session 3: Modeling Chair: Daniel Jacob

08:30 - 08:45	Guy Brasseur, NCAR: Chemical Weather Prediction and the Potential Impact of Satellite Data
08:45 - 09:00	Steven Pawson, NASA GMAO: Assimilation of Chemical Data from NASA's EOS Instruments:
	Experiences from the GMAO
09:00 - 09:15	Daniel Jacob, Harvard University: Global Air Quality Models: Value of Satellite Data
09:15 - 09:30	Randall Martin, Dalhousie University: Estimation of Emission Sources Using Satellite Data
09:30 - 0945	Colette Heald, U. California-Berkeley: Transpacific Transport of CO and Aerosols as Observed from Space
09:45 – 10:00	Daewon Byun, U. Houston: Utilization of Satellite Measurements at Various Stages of Atmospheric Modeling to Improve Air Quality Simulations
10:00 - 10:30	Coffee Break
10:30 - 10:45	Mian Chin, NASA GSFC: Using Global Aerosol Models and Satellite Data for Air Quality Studies: Challenges and Data Needs
10:45 – 11:00	Jun Wang, U. Alabama-Huntsville: Mesoscale Modeling of Dust and Smoke Transport: How Geostationary Satellite Can Help?
11:00 - 11:15	Maarten Krol, Wageningen University: Model Analysis of High Aerosol Loads Over Northern India as Observed by MISR
11:15 – 11:30	Klaus Schafer, Forschungszentrum Karlsruhe: Satellite-Aided Computational Assessment of Air Ouality and Associated Health Effects
11:30 - 12:00	Open Discussion on Session 3
12:00 - 13:00	Lunch



Wednesday PM

Session 4: Future Mission Concepts and Observing Strategies Co-chairs: John Burrows, Jack Fishman & Phil DeCola

13:00 - 13:15	John Burrows, U. Bremen: Atmospheric Pollution Measurements from Space: The GeoSCIA
	(Geostationary Scanning Imaging Absorption spectroMeter for Atmospheric ChartographY) and
	GeoTROPE (Geostationary Tropospheric Explorer)
13:15 - 13:30	Annmarie Eldering, JPL: Air Quality Investigation Constellation
13:30 - 13:45	Jay Herman, NASA GSFC: Advantages of Earth-Sun Observations from Lagrange 1
13:45 - 14:00	Joe Waters, JPL: Composition of the Atmosphere from Mid-Earth Orbit (CAMEO) Observations for
	Air Quality Studies
14:00 - 14:15	Henk Eskes, KNMI: A Mission for TRopospheric Composition and Air Quality
14:15 – 14:45	Coffee Break
14:45 - 15:00	Jack Fishman, NASA LaRC: Challenges of Characterizing and Forecasting the Outbreak of Pollution
	Episodes: Defining Requirements for Spaceborne Air Quality Observations
15:00 - 15:15	William Brune, Pennsylvania State University: Measurement Requirements for Geostationary
	Observations of Pollutants with the NASA GSFC GeoChem Instrument
15:15 - 15:30	Dave Diner, JPL: The Aerosol Global Interactions Satellite (AEGIS) Concept: Science Objectives,
	Mission Design Considerations, and Applications to Air Quality
15:30 - 15:45	Rich Ferrare, NASA LaRC: Future Spaceborne Aerosol and Ozone Lidars for Air Quality
	Applications
15:45 - 16:00	Michiel van Weele, KNMI: Definition of Operational Atmospheric Chemistry Monitoring Missions:
	Final Results of the ESA CAPACITY Study (2003-2005)
16:00 - 16:15	Stephen Tjemkes, EUMETSAT: The METEOSAT Third Generation UVS Mission
Session 5: Posters	
16:30 - 19:00	Posters & Reception



Thursday AM

Session 6: Next Steps

08:30 - 10:00	Panel Discussion:
	Defining an Optimum Observing Strategy:
	What are the requirements on species observed, spatial resolution and coverage,
	temporal resolution and repeat times, probing the boundary layer, etc.?
	Moderator: Daniel Jacob, Harvard University
	Panel: Cathy Clerbaux, CNRS
	David Edwards, NCAR
	Claire Granier, CNRS
	Shobha Kondragunta, NOAA/NESDIS
	Jim Szykman, NASA/LaRC
10:00 - 10:30	Coffee Break
10:30 - 12:00	Moderated Discussion:
	How well do future mission concepts address future needs?
12:00 - 12:30	Next Steps
12:30	Adjourn



