

size structure versus time in the largely anthropogenic transition and heavy metals, which when combined with trajectory analysis should clarify the sources of the highly absorbing fine aerosols so characteristic of the orient. The aerosol data will be evaluated for optical impacts and compared to co-located optical instrumentation.

DELTA - Detection and Evaluation of Long-range Transport of Aerosols

### A32D-11 1630h

#### Mixing States of East Asian Aerosols During the Spring 2001 ACE-Asia Intensive

James R Anderson<sup>1</sup> (480-965-7139; janderson@asu.edu)

Hua Xin<sup>1</sup> (huaxin@asu.edu)

<sup>1</sup>Environmental Fluid Dynamics Program, Arizona State University, Tempe, AZ 85287-6106, United States

Aerosols originating in China and Korea and transported to the East during the Spring 2001 dust season have been analyzed using manual and automated scanning electron microscopy to determine compositions, sizes, shapes and states of mixing. Samples discussed were collected from the NCAR C-130 aircraft, the NOAA R/V Ronald H. Brown and two ground sites on Cheju Island. Depending upon distance of transport, altitude and air mass history, the aerosols are varying mixtures of mineral dust, marine particles, and primary and secondary anthropogenic particles. Degree of reaction or aggregation of mineral dust and marine particles with secondary sulfate and nitrate are highly variable. Although these samples all have many different individual particle types present, and are therefore strongly externally mixed, the range of internal mixing states exhibited between particles of different origins is extreme.

Mixtures of mineral dust and anthropogenic combustion products (both from coal and biomass) sampled at low altitude tend to exhibit a high degree of internal mixing. Many higher altitude samples (2500 m and higher) have lower proportions of anthropogenic particles and show less internal mixing between the two categories. A common feature in the lower altitude samples is the internal mixture of mineral particles and elemental carbon in the form of soot, thus significantly altering the optical properties of the mineral dust.

### A32D-12 1645h

#### Measurements of Aerosol Optical Properties From South Korea During ACE-Asia

Anne Jefferson<sup>1,2</sup> (303-497-6493; anne.jefferson@noaa.gov)

Patrick J. Sheridan<sup>1</sup> (303-497-6672; psheridan@cmdl.noaa.gov)

John A. Ogren<sup>1</sup> (303-497-6210; john.a.ogren@noaa.gov)

<sup>1</sup>Climate Monitoring and Diagnostics Lab National Oceanic and Atmospheric Association, 325 Broadway, Boulder, CO 80305-3328, United States

<sup>2</sup>Cooperative Institute for Research in Environmental Sciences, University of Colorado, Campus Box 216, Boulder, CO 80309-0216, United States

Measurements of the aerosol scattering coefficient as a function of wavelength, aerosol size, and relative humidity were taken along with those of the aerosol absorption coefficient at a ground based site on Cheju Island, South Korea. The aerosol scattering coefficient was highly variable during the campaign ranging between 20 and 250 Mm<sup>-1</sup>. Spring in Korea is known as the dust season when southeasterly winds bring dust to the region from the Gobi Desert. Two such events were apparent in April. On these days over 60% of the aerosol scattering was in the super micron size mode as indicated by the low values of F<sub>bsp</sub>, the ratio of the sub micron aerosol to sub 10 micron aerosol scattering coefficients. The aerosol single scattering albedo, the fraction of aerosol scattering to that of the total extinction, during the dust events declined slightly to 0.93 for super micron aerosol and as low as 0.63 for sub micron aerosol. Most of the aerosol absorption during the campaign was in the sub micron mode aerosol. The aerosol hygroscopic growth, a measure of the increase in scattering due to aerosol water uptake, was relatively high during the dust events ranging from 1.5 to 2.5. The low single scattering albedo and high hygroscopic growth factor indicate the aerosol at the site was composed of not only dust but also likely had absorbing elemental and organic carbon and hygroscopic species such as sulfate, oxidized organics and sea salt.

URL: <http://www.cmdl.noaa.gov/aero>

### A32E MC: 123 Wednesday 1520h

#### Chemical and Dynamical Data Assimilation I

*Presiding:* W Lahoz, University of Reading; R Swinbank, Met Office

### A32E-01 1520h

#### Featured Presentation: Recent Developments in the Theory of Data Assimilation

Olivier Talagrand (talagran@ravel.ens.fr)

Ecole Normale Supérieure, Laboratoire de Météorologie Dynamique, Paris, France

There is no abstract available for this presentation.

### A32E-02 1540h INVITED

#### Constituent Data Assimilation: Challenges and Limitations

Richard B Rood<sup>1</sup> (301-614-6155;

rrood@dao.gsfc.nasa.gov); Ivanka Stajner<sup>1</sup>

(301-614-6177; istajner@dao.gsfc.nasa.gov);

Nathan Winslow<sup>1</sup> (301-614-6207;

nwinslow@dao.gsfc.nasa.gov); Anne R Douglass<sup>1</sup>

(301-614-6028;

douglass@persephone.gsfc.nasa.gov); Steven

Pawson<sup>1</sup> (301-614-6159;

spawson@dao.gsfc.nasa.gov); Susan Strahan<sup>1</sup>

(301-614-5995; sstrahan@dao.gsfc.nasa.gov)

<sup>1</sup>NASA/Goddard, Laboratory for Atmospheres, Greenbelt, MD 20771, United States

The assimilation of observations of atmospheric constituents naturally divides into two major pieces. The first is the assimilation of trace gases whose variability is related to atmospheric motions. The second is the assimilation of trace gases which are sharply influenced by chemical exchange between different constituents. In order to advance beyond the initial successes of explorative investigation of assimilation techniques, tremendous challenges must be met to improve the geophysical integrity of assimilated data products.

A subject of special interest is ozone near the tropopause. At the tropopause the information from both the observations and the model simulation becomes most uncertain. However a number of important geophysical parameters, e.g. stratosphere-troposphere exchange and tropospheric ozone, require the assimilation to have high accuracy at the tropopause. This talk will review the current status of the quality of assimilated data products near the tropopause, what must be done to improve the assimilation near the tropopause, and the intrinsic limitations that will require additional sources of information in order for the field to advance.

### A32E-03 1600h INVITED

#### 4D Variational Chemical Data Assimilation of CRISTA I and MLS stratospheric observations

Dominic Fonteyn (32-2-3730382;

D.Fonteyn@oma.be)

BIRA-IASB, Ringlaan 3, Brussel B-1180, Belgium

Although global data assimilation has been run operationally by NWP centres for more than two decades, global data assimilation of chemical species with a model taking into account all relevant chemical interactions has started the last five years. The main objective of chemical data assimilation is the production of a model consistent picture of the chemical composition distribution based on the synoptic observations of some chemical species. Since our assimilation system is based on an Eulerian 4D-Var scheme, the 3D chemical transport model and its adjoint will be discussed. The results of two case studies will be shown and used to illustrate the characteristics of the assimilation results. The assimilation of the CRISTA I observations (O<sub>3</sub>, HNO<sub>3</sub>, ClONO<sub>2</sub>, N<sub>2</sub>O<sub>5</sub>, N<sub>2</sub>O, CH<sub>4</sub>, CFC-11 (November 5-11, 1994) highlights the fundamentals of the 4D-Var method. The second case study, the assimilation of MLS O<sub>3</sub>, HNO<sub>3</sub> and ClO for the period December, 1995 until March, 1996 represents a longer period during which Polar Stratospheric Clouds and subsequently ClO activation was present. During this period a non-standard chemical regime was active. These results will be used to present the statistics of the assimilation. Furthermore, since the Polar Stratospheric Cloud particles are interactively calculated in the model, the chlorine activation and resulting ozone loss will be discussed.

### A32E-04 1620h INVITED

#### Assimilation of GOME ozone data in chemistry-transport model

Hennie Kelder<sup>1</sup> (+31-30-2206472; kelder@knmi.nl)

Ghada El Serafy<sup>1</sup> (elserafy@knmi.nl)

Henk Eskes<sup>1</sup> (eskes@knmi.nl)

Ronald van der A<sup>1</sup> (avander@knmi.nl)

Pieter Valks<sup>1</sup> (valks@knmi.nl)

<sup>1</sup>KNMI, P.O.Box 201, De Bilt 3730 AE, Netherlands

In this presentation we will give an overview of GOME ozone data assimilation activities at the KNMI. Topics to be discussed are:

The assimilation software TM3-DAM provides operational global ozone maps and five-day ozone (and UV) forecasts, based on GOME total ozone measurements. The chemistry-transport model used is driven by the new 60 layer ECMWF model analyses and forecasts, with a well resolved stratosphere and a top level in the mesosphere. Parameterised chemistry schemes have been included for stratospheric gas phase and heterogeneous chemistry.

Ozone profiles derived from the GOME nadir observations are assimilated using a fast simplified Kalman filter approach. The data assimilation software provides near real time assimilated ozone fields. The assimilation approach and validation results will be presented.

GOA is a Fifth Framework EU project that has started in 2001 and is co-ordinated by the KNMI. The aims of GOA are: a) To generate and distribute a five year data set of assimilated fields of ozone and NO<sub>2</sub> based on GOME observations. b) To compare this data set to independent observations obtained during measurement campaigns and from monitoring networks. c) To confront this data set with output from global chemistry-transport models (CTM's) to improve their modelling capability.

### A32E-05 1640h INVITED

#### MOPITT CO MEASUREMENTS: ASSIMILATION AND INVERSE MODELING

Boris Khattatov<sup>1</sup> (boris@ucar.edu); Jean-Francois

Lamarque<sup>1</sup> (lamar@ucar.edu); Gabrielle Petron<sup>1</sup>

(gap@ucar.edu); Valery Yudin<sup>1</sup>

(vyudin@ucar.edu); John Gille<sup>1</sup> (gille@ucar.edu);

David Edwards<sup>1</sup> (edwards@ucar.edu); Lawrence

Lyjak<sup>1</sup> (vl@ucar.edu); Daniel Ziskin<sup>1</sup>

(ziskin@ucar.edu); Gene Francis<sup>1</sup>

(gfrancis@ucar.edu); Merritt Deeter<sup>1</sup>

(mnd@ucar.edu); Guy Brasseur<sup>3</sup>

(brasseur@mpi.ge); Jim Drummond<sup>2</sup>

(jim@atmosp.physics.utoronto.ca); Phil Rasch<sup>1</sup>,

Louisa Emmons<sup>1</sup>; Doug Kinnison<sup>1</sup>; Stacy

Waters<sup>1</sup>; Claire Granier<sup>1</sup>; Didier Hauglustaine<sup>1</sup>

<sup>1</sup>NCAR, PO Box 3000, Boulder, CO 80305, United States

<sup>2</sup>University of Toronto, 60 St. George Street, Toronto M5S 1A7, Canada

<sup>3</sup>Max Planck Research Institute, Bundesstr. 55, Hamburg, Germany

The MOPITT (Measurements Of Pollution In The Troposphere) instrument on board the NASA Terra satellite has been taking measurements of tropospheric carbon monoxide since March of 2000. MOPITT along-track observations are irregular in both time and space and they contain gaps while it is highly desirable to have data presented on a uniform, space (latitude, longitude, and height) and time grid. In addition, MOPITT averaging kernels are fairly wide, meaning that an observation is actually a weighted mean taken over a portion of the true, unknown CO profile.

Data assimilation allows one to overcome some of these limitations and to map MOPITT measurements onto regular time-space grid. In addition, it opens possibilities for expanding our understanding of atmospheric chemistry and dynamics via systematic comparisons of model and observations. In this talk we present results of assimilation of MOPITT measurements of carbon monoxide in the global chemistry transport model MOZART 2.

MOPITT measurements provide a unique opportunity to better understand surface sources and sinks of carbon monoxide. Such task, however, is made difficult due to chemical interactions of carbon monoxide with OH and other atmospheric chemicals. These interactions make the relationship between local concentrations of CO and its surface emissions non-linear. We review challenges arising in inverse modeling of emissions of chemically active gases and present some results of our work on inversion of surface sources of CO from MOPITT data.