

A24A CC: 520 F Tuesday 1530h

Stratospheric Composition and Dynamics II

Presiding: E C Weatherhead,

Cooperative Institute for Research in Environmental Sciences (CIRES); J de Grandpre, McGill University

A24A-01 1530h

Mission Simulation and Error Analysis for the Stratospheric Wind Interferometer For Transport Studies (SWIFT)

Peyma Rahnama¹ (rahnama@stpl.cress.yorku.ca); Ian C. McDade¹ (mcdade@yorku.ca); Yves J. Rochon²; Gordon G. Shepherd¹; William A. Gault¹; Alan Scott³¹York University, 4700 Keele St., Toronto, ON. M3J 1P3, Canada²Environment Canada, 4905 Dufferin St., Toronto, ON. M3H 5T4, Canada³EMS Technologies Canada Ltd., 1725 Woodward Dr., Ottawa, ON. K2C 0P9, Canada

The Stratospheric Wind Interferometer For Transport studies (SWIFT) is a Canadian satellite instrument designed to measure stratospheric winds and ozone densities. The measurement technique is known as Doppler Michelson Imaging Interferometry. This paper describes a mission simulation for SWIFT which includes the instrument simulation, simulation of the measurement along the orbit and performing the data processing accordingly. The mission simulation is carried out to assess instrument performance and test the SWIFT data reduction algorithms. The mission simulation also includes error analysis. One of the aspects of the error analysis is to evaluate the impact of the instrument characteristics on wind error. The error analysis can be used to assess different instrument configurations and measurement scenarios and can serve to suggest optimum ways for processing the data. The simulations and error analysis are repeated for various design options in order to quantify the expected SWIFT wind errors.

A24A-02 1545h

Retrieval of atmospheric ozone and nitrogen dioxide vertical distribution from SAGE III limb scattering measurement

Didier F Rault¹ (7578644388; d.f.rault@larc.nasa.gov)David E Flittner¹ (7578642966; d.e.Flittner@larc.nasa.gov)Robert Loughman² (7577275137)¹NASA Langley Research Center, 1 Langley Blvd, Hampton, Va 23681, United States²Hampton University, Hampton Blvd, Hamton, Va 23666, United States

SAGE III has been making a series of Earth limb radiance measurements over the past year. The paper will present an analysis and a discussion of the data. Since SAGE III was not designed to operate in this mode, instrument issues such as stray light and altitude registration, need special attention, and methods to deal with these issues will be first described. The methodology used to retrieve gas density profile will be explained. Two algorithms are used, the first one being based on Flittner's triplet method, and the second one relying on spectral fitting. Sample of retrieved ozone and nitrogen dioxide vertical profiles will be presented and discussed. Comparison of the retrieved profiles with measurements from other methods will be shown for validation: ozone sonde, lidar, other space borne instruments. The results will show the potential of SAGE III to operate in limb scattering mode and provide accurate determination of atmospheric ozone and nitrogen dioxide vertical distribution.

A24A-03 1600h

Formation of large NAT particles and denitrification in polar stratosphere: Possible role of cosmic rays and effect of solar activity

Fangqun Yu (yfq@asrc.cestm.albany.edu)

Atmospheric Sciences Research Center, University at Albany, 251 Fuller Road, Albany, NY 12203, United States

Polar stratospheric clouds (PSCs) are crucial to the ozone depletion because of their well-recognized role both in activating chlorine (through heterogeneous reactions on the surface of PSC particles) and denitrifying the lower stratosphere (through gravitational settling of large HNO₃-containing PSC particles). The formation of large nitric acid trihydrate (NAT) particles (i.e., type 1a PSC particles) has important implications for denitrification and ozone depletion. Existing theories can't explain the recent observations of large NAT particles over wide Arctic regions at temperature above ice frost point. Climate models predict that the increased concentrations of greenhouse gases and depletion of the ozone layer may lead to lower stratospheric temperatures and more widespread PSC formation and denitrification in the Northern Hemisphere. Modeling simulations show that widespread denitrification could enhance future Arctic ozone loss. To evaluate properly the consequences of future lower stratospheric temperatures on the arctic ozone layer, details about the formation of large NAT particles must be known. Our analyses reveal that high-energy cosmic rays may induce the freezing of supercooled HNO₃-H₂O-H₂SO₄ droplets when they penetrate these thermodynamically unstable droplets. The cosmic ray-induced freezing (CRIF) is consistent with the observed highly selective formation of NAT particles. We suggest that the physics behind the CRIF mechanism is the reorientation of polar solution molecules into the crystalline configuration in the strong electrical fields of moving secondary ions generated by passing cosmic rays. Our simulations indicate that strong solar proton events (SPEs) may significantly enhance the formation of large NAT particles and denitrification. The CRIF mechanism can explain the high correlations between the thin nitrate-rich layers in polar ice cores and major SPEs. The observed enhancement in aerosol backscattering ratio at PSC layers shortly after an SPE and the significant precipitation velocity of the enhanced PSC layers also provide strong support for the CRIF mechanism.

URL: <http://www.albany.edu/~yfq>

A24A-04 1615h

Comparisons of the MANTRA Balloon Campaign Measurements of the Stratospheric Constituents with the Canadian Middle Atmospheric Model.

Stella M. L. Melo¹ (416 971 2363; stella@atmosph.physics.utoronto.ca); C. McLandress¹(charles@mam.atmosph.physics.utoronto.ca); C. Nowlan¹ (cnowlan@atmosph.physics.utoronto.ca); E. Farahani¹(elham@atmosph.physics.utoronto.ca); T. Shepherd¹ (tgs@atmosph.physics.utoronto.ca); K. Strong¹ (strong@atmosph.physics.utoronto.ca); H. Wu¹ (hjwu@atmosph.physics.utoronto.ca); C. T. McElroy² (Tom.McElroy@ec.gc.ca); C. McLinden² (chris.mclinden@ec.gc.ca); J. Davies²(jonathan.davies@ec.gc.ca); F. Goutail³(florence.goutail@aerov.jussieu.fr); P. Fogal⁴(pfogal@du.edu); R. Blatherwick⁴

(pfogal@du.edu)

¹University of Toronto, Department of Physics, 60 St. George Street, Toronto, ON M5S 1A7, Canada²Meteorological Service of Canada, 4905 Dufferin Street, Toronto, ON M3H 5T4, Canada³Service d'Aeronomie du CNES, Bp3 F91371, Verrières-le-Buisson, France⁴University of Denver, Department of Physics 2112 E. Wesley Ave., Denver, CO 80208, United States

MANTRA (Middle Atmosphere Nitrogen TRend Assessment) is a series of high-altitude balloon campaigns conducted in late summer over Saskatchewan to measure stratospheric trace gases from a float altitude of about 35 km. Previous flights have occurred in late August or early September of 1998, 2000 and 2002. By launching in late summer, dynamical variability is minimized and the changing chemical balance of the stratosphere can be studied, with an emphasis on the nitrogen partitioning. In this talk these MANTRA measurements are compared with the Canadian Middle Atmosphere Model (CMAM), a fully interactive chemistry climate model. Such comparison of model with measurements has many benefits: it helps to validate the model under conditions where the stratosphere is largely under photochemical and radiative control, but at the same time aids in the interpretation of the measurements. In particular, the model can help assess the representativeness of the measurements and the possible impact of dynamical variability. For example, we show that the model appears to simulate a realistic 5-day wave which has an impact on the chemical fields.

A24A-05 1630h

An Algorithm for Extracting Zonal Mean and Migrating Tidal Fields in the Middle Atmosphere From Satellite Measurements: Applications to TIMED/SABER Measured Temperature and Tidal Modeling

Xun Zhu¹ (443-778-8764; xun.zhu@jhuapl.edu);Jeng-Hwa Yee¹ (443-778-6206);Sam.Yee@jhuapl.edu); Elsayed R. Talaat¹; M. G. Mlynecak²; L. L. Gordley⁴; C. J. Mertens²; J. M. Russell³¹Johns Hopkins University, JHU/APL 11100 Johns Hopkins Road, Laurel, MD 20723, United States²NASA Langley Research Center, 21 Langley Blvd., Hampton, VA 23681/0001, United States³Hampton University, 23 Tyler Street, Hampton, VA 23668, United States⁴G & A Technical Software, Inc., 11864 Canon Blvd., Suite 101, Newport News, VA 23606, United States

For a data series with grids that do not uniformly cover a whole wave cycle the traditional least squares-fitting method will lead to aliasing between the wave component and mean field. In this paper a set of regularity conditions is formally defined and used to select available grids for deriving the zonal mean and tidal components from unevenly sampled or incomplete measurements to reduce aliasing. Zonal mean and migrating tidal fields are derived from SABER temperature measurements. The measured fields are binned into a 4 degrees of latitude by 20 minutes in local time grids. The derived zonal mean temperature and wind are merged with CIRA-86 model atmosphere and can be used as input fields for tidal models. Using the zonal mean temperature and wind fields derived from the SABER measurements as input fields, we examine the effect of zonal mean fields on the amplitude variabilities of migrating tides in the upper stratosphere and the mesosphere. The model derived migrating tides are compared with those derived directly from the SABER measurements during the same periods. The model and measurement comparison shows a significant effect of the zonal mean wind on the amplitude of migrating diurnal tides.

A24B CC: 520 D Tuesday 1530h

Constraining the Global Mass Distribution of Mineral Dust Aerosol II (joint with B, GC)

Presiding: R L Miller, NASA Goddard Institute for Space Studies; C S Zender, University of California, Irvine

A24B-01 1530h INVITED

The Anthropogenic Contribution to Dust Aerosols

Ina Tegen (itegen@bgc-jena.mpg.de)

Max Planck Institute for Biogeochemistry, P.O. Box 100164, Jena 07701, Germany

The magnitude and distribution of atmospheric soil dust is strongly controlled by dust emissions, which depend on the extent and type of terrestrial vegetation and land use, as well as on soil properties and meteorological variables. The percentage of soil dust emissions from anthropogenically disturbed soils, which could change with changing population pressure, is not well constrained. For example, it is unclear if the increase in dust storm frequencies in China over the recent years was influenced by changes in land use. While previous estimates used a comparison of satellite retrievals with results of global dust cycle models to obtain a rough estimate of anthropogenic soil dust, which was estimated to contribute as much as 50% to the global aerosol load, we recently used a global dataset of dust storm frequency observations to obtain the revised estimate of a less than 10% contribution of agricultural soils to global dust emissions. Future dust emission changes were simulated with a global offline dust model which includes dust emissions from natural and cultivated source areas to estimate future changes in dust emissions for IPCC scenarios with increased greenhouse gas concentrations, using meteorological fields extracted from future scenario results of the ECHAM4 and HADCM3 models, and taking into account expected changes in vegetation and land use to compute dust emissions. We find that expected future changes in meteorological parameters and changes in natural vegetation cover as consequence of increased greenhouse gases have a stronger influence on dust emissions than changes in cultivation. The estimates of future changes in dust emissions are strongly