by Hurricane Juliette that propagates poleward along the Mexican coast, into and out of the Gulf of California before continuing its poleward journey along the west coast of the Baja California Peninsula. High correlations exist between modeled and observed sea level along its path.

URL: http://hycom.rsmas.miami.edu/

A52F-06 1730h

1/32° Global Ocean Modeling and Prediction

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The resources of a three-year Department of Defense (DoD) High Performance Computing (HPC) Challenge project was crucial in the development a data-assimilative 1/32° global ocean nowcast/forecast system, which included the associated basic research and exploratory development. This system is scheduled for transition to the Naval Oceanographic Office (NAVO) in the first quarter of FY04. This 1/32° global system will be an upgrade to the existing 1/16° NRL Layered Ocean Model (NLOM) nowcast/forecast system which is operational at NAVO. A critical issue in forecast system design is determining the resolution required. Ocean models require finer resolution and more computer time than atmospheric models in part because the space scales for variability due to flow instabilities (oceanic mesoscale eddies vs. atmospheric highs and lows) are about 20-30 times smaller than found in the atmosphere. We need to resolve the oceanic eddy space scale very well because (1) upper ocean - topographic coupling via flow instabilities has a major impact on the pathways of many upper ocean currents (including mean pathways) and very fine resolution of the flow instabilities is required to get sufficient coupling, (2) very fine resolution is required to obtain (a) inertial jets and sharp oceanic fronts which span major ocean basins as observed and (b) the associated nonlinear recirculation gyres which affect the shape of large-scale ocean gyres, (3) it is necessary to resolve small islands and narrow passages which affect current pathways and current transports in many regions, (4) in data assimilative mode we do not want the ocean model to "fight" the data because the natural behavior of the ocean model is inconsistent with the observations, and (5) a very high horizontal resolution model is needed to help get an accurate mean sea surface height field to add to the deviations obtained from satellite altimetry (observations alone do not provide sufficient resolution to do this). The need for 1/32° resolution (∼3.5 km at mid-latitudes) has been demonstrated through extensive research, including essential contributions from earlier DoD HPC Challenge projects as well as non-challenge HPC usage. These projects also helped establish 1/16° (∼7 km at mid latitudes) as the minimum resolution needed for a fully eddy-resolving global ocean prediction system. Major improvement in model simulation skill was obtained with an increase to 1/32° resolution, but only modest additional improvement with a further increase to 1/64° resolution. Hence, our target resolution globally is 1/32°. The ocean model, after 30 years of climatological spinup, was run interannually spanning the period 1979-present. In addition to re-equilibration, the climatological simulation was used to fix problems that arose, optimize model parameters, assess the impact of the resolution increase on model realism and dynamics and to perform climatological model-data comparisons. These results were used to generate statistics and a model sea surface height (SSH) mean for data assimilative experiments. The model assimilates SSH from 3 satellite altimeters (ERS-2, GFO and JASON-1) and sea surface temperature from satellite IR imagery. Assimilation of satellite altimeter data is critical in allowing the model to map individual current meanders and eddies. Forecast experiments were then initialized from the data assimilative experiments. Results from this 1/32° system were then compared with observed data to assess model realism and the value added of the resolution increase from 1/16° to 1/32°.

A52F-07 1745h

Simulation of a Landfalling Hurricane Over the Gulf of Mexico Region Using Weather Research and Forecasting Model

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The Gulf costal states region is prone to the highest national frequency to severe weather accompanied by huge economic loss. The region lacks adequate study with regard to significant coastal processes - "weather dynamics". Understanding modeling and predicting the coastal processes and dynamics is important in improving weather forecasting. A mesoscale modeling investigation of tropical cyclonehurricane forecast over the Gulf of Mexico has been undertaken pertaining to NOAA's interest to assess and predict environmental changes, protect life and property and provide decision makers with reliable scientific information. In the present study the Weather Research and Forecasting *WRF* model is run on a high performance computing environment using non-conventional datasets. Data from the PennStateNCAR MM5 v.3 model is fed into the WRF v.1.3 model as initial and lateral boundary conditions to simulate the surface features of a case oriented 2003 landfalling hurricane. Simulation parameters include seal level pressures, surface fluxes, sea surface temperature, wind direction and magnitude, and precipitation. The results will be compared with aircraft observations taken by the National Hurricane Center. This model output is then incorporated into a decision support matrix. The results of the model simulations will be presented and discussed.

A52G MCC: 3016 Friday 1600h

Contributions to Middle Atmosphere Science by Solar Occultation Instrumentation V *(joint with SA)*

Presiding: **L W Thomason,** NASA Langley Research Center**; P L DeCola,** NASA Headquarters**; R Bevilacqua,** Naval Research Laboratory

A52G-01 1600h

Changes in stratospheric water vapor derived from HALOE, 1991-2003

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Interannual changes in stratospheric water vapor are examined using Halogen Occultation Experiment (HALOE) satellite measurements over 1991-2003. Anomalies in water vapor with an approximate 2-year periodicity originate near the tropical tropopause, and propagate vertically and latitudinally with the mean stratospheric transport circulation (in an analogous manner to the seasonal tape recorder). Unusually low water vapor anomalies are observed in the lower stratosphere for 2001-2002. The water vapor changes in HALOE data are well correlated with temperature anomalies near the tropical tropopause. Comparisons of the HALOE data with balloon measurements of lower stratospheric water vapor at Boulder, Colorado (40N) show some agreement for interannual changes during 1992-2002, but decadal increases observed in the balloon measurements for this period are not observed in HALOE data.

URL: http://acd.ucar.edu/~randel/H2O_changes.html

A52G-02 1615h

The Long-Term Change in Stratospheric Water Vapor Isotopes

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More than 20 years of observations from high altitude aircraft of high-resolution infrared absorption have been analyzed, using non-linear least squares spectral fitting, to retrieve stratospheric column amounts of $H_2{}^{16}O$, $H_2{}^{17}O$, $H_2{}^{18}O$ and HDO. Total vertical column amounts above 12 km are retrieved. However, analysis of the information content of the solar viewing geometry shows that most of the contribution to the column comes from altitudes below 25 km. So the measured column amounts may be considered as lower stratospheric amounts. The lower stratosphere is a difficult region to observe, especially for H_2O. It is above the in situ sampling range for most aircraft. The strong absorption by H_2O makes the lower stratosphere difficult to measure remotely by both surface and satellite techniques. Observations by our remote sounding spectrometer, from a platform at the base of the stratosphere, are optimum for determining lower stratospheric water vapor amounts. The advantage of having deployed the same instrument over such a long measurement period and the uniform analysis of all the data make this data set extremely useful for long-term trend analyses. Water vapor plays an important role in chemical and radiative processes in the lower stratosphere and upper troposphere. We expect lower stratospheric water to have a latitudinal and a seasonal variation, as well as a long-term trend. However, the dominant component of the water variation is found to be a linear long-term trend. Monthly averaged column amounts of $H_2{}^{16}O$, $H_2{}^{17}O$, $H_2{}^{18}O$ and HDO for the period from 1978 to 2000 are presented to show the latitudinal distribution of these isotopes in both hemispheres. Results show an increase at mid-latitudes of approximately 3 % / year in all isotopes. Annual trends diverge at low latitudes for the four isotopes with the increase in HDO being much depressed.

A52G-03 1630h

Comparison of POAM III Water Vapor Measurements With a Microphysical Model During the SH Winter

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The Integrated Microphysics and Aerosol Chemistry on Trajectories (IMPACT) model is used to examine processes leading to dehydration in the Southern Polar stratosphere. Air parcels are advected along 3-D trajectories to establish a temperature history throughout the winter season. The temperature history is used by the model to simulate the processes of nucleation, freezing, and uptake of gases onto the aerosol surface. The values of several parameters are varied in order to establish their effects on dehydration and polar stratospheric cloud formation. Model results are compared to water vapor and extinction measurements obtained by the Polar Ozone and Aerosol Measurement (POAM) III instrument. The amount of dehydration at the end of the season is sensitive to minimum temperatures encountered along the trajectories, and therefore to any biases in the temperature minima in the UKMO [or other] assimilation model inputs. Preliminary results show that the model dehydration agrees well with the POAM measurements when ice particle formation is dominated by heterogeneous nucleation.

A52G-04 1645h

Cloud Structure Over Tropical Pacific During 1985–1999: Preliminary Analysis

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SAGE II observations from 1985 to 1999 during the month December–April are used to infer cloud vertical structure over tropical Pacific with the focus on two specific regions of climate sensitivity, namely, the Pacific warm pool (WP; 5°S-10°N, 100°E-170°E) and the Eastern Pacific (EP; 7.5°S-7.5°N, 200°E-280°E). Cloud distributions over these two geographic regions are closely linked through large scale circulation systems, particularly the Walker circulation. SAGE II cloud data have been used to study tropical cloud characteristics associated with the strong 1997/1998 El Niño. It was shown that, with respect to normal years, both opaque cloud (OC) and subvisual cloud (SVC) are enhanced over the EP and weakened over the WP as consistent with outgoing radiation observations from satellite instruments. The objectives of the present study are to explore the long-term behavior of the cloud structure over the WP and EP, and to study the relationship of cloud properties between these two areas. The preliminary results from the present analysis indicate that the opaque cloud occurrence over the WP declined during 1986/87, 1989/90, 1994/95, and 1997/98, with opposite changes over the EP, except in 1994/95. These interannual opaque cloud variations appear to be the manifestation of large scale circulation changes in the Tropics in response to El Niño events. In the case of subvisual cloud, the interannual variation over the EP closely resembles that of the opaque cloud in the same area. Over the WP, such a resemblance is much less evident, except from 1996 to 1999.

A52G-05 1700h

Multi-year Characterization of PSCs Using Solar Occultation Satellite Observations

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POAM solar occultation observations from1994 to present are studied for the purpose of determining Type I PSC formation characteristics and winter-long evolution. This information is critical to an improved understanding and predictive capability of stratospheric ozone depletion. Solar occultation satellite observations of these clouds yields more continuous and widespread information than can be obtained from aircraft, balloon, or ground-based observations. This multi-winter PSC study is augmented by the use of our Type Ia/Ib discrimination scheme. Recent studies of PSC formation made with POAM observations and simulations during the 1999-2000 Arctic winter have shown characteristics that shed light on the formation mechanisms responsible for Type Ia solid phase PSCs. This study examines PSC observations from many years on a common basis to see if the characteristics observed during the 1999-2000 Arctic winter are observed in other years and if other characteristics can be identified. The results show that Type Ia PSCs form at the beginning of the winter, within several days of the first drop in temperature below NAT frost point, and peak early in the winter. Type Ia PSCs typically outnumber Ib PSCs over the winter, especially at the beginning of the winter. Type Ia and Ib PSC observations continue throughout the winter. Micro-physical models of PSC formation must match these observed characteristics. Differences in PSC characteristics between the first two Arctic winters (1994-1995 and 1995-1996) and later winters also suggest the influence of volcanic perturbations on PSC formation. Type Ia and Ib PSC characteristics observed by POAM III and SAGE III for the 2002-2003 Arctic winter are compared.

A52G-06 1715h

An Initial Assessment of SAGE III Polar Stratospheric Cloud Observations

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The suite of solar occultation instruments collecting data on polar stratospheric clouds (PSCs) now includes SAGE III, which began routine operations on the Russian Meteor-3M spacecraft in late February 2002. SAGE III sunset data are collected from 65N-80N during local winter; hence, the likelihood of Arctic PSC observations is high. There is a much smaller (but not zero) probability of observing PSCs in the Southern Hemisphere since the latitude range for local (sunrise) data collection during austral winter is only 50S-60S. This talk will present SAGE III PSC observations from the 2002-2003 Arctic winter, and compare them to the relatively few PSCs observed by the instrument in the Southern Hemisphere during 2002 and 2003. A focus of the talk will be the ability to distinguish PSC types by using multiple-wavelength SAGE III extinction data.

A52G-07 1730h

Using SAGE III PSC observations to derive solid particle nucleation rates in the Arctic

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Stratospheric Aerosol and Gas Experiment (SAGE) III aerosol extinction data from the Arctic in December 2002 are used to evaluate and refine a 3-D model of large NAT particles (NAT rocks). The observations and model results are used in a unique iterative procedure to determine the optimum NAT nucleation rate as a function of NAT supersaturation. We use the DLAPSE model (Denitrification by Lagrangian Particle Sedimentation). DLAPSE generates 3-D fields of solid PSCs by simulating the nucleation, growth and sedimentation of several thousand individual NAT particles in the Arctic vortex. These particles evolve by interacting with the nitric acid field in a chemical transport model, causing denitrification. In DLAPSE each model particle stands for a particular number of real particles, and this number can be adjusted to simulate any nucleation mechanism. The unique feature of DLAPSE is that after a model run each particle can be traced back to its point of formation and the effective number of particles adjusted (according to the physical conditions and the chosen nucleation model) to optimise agreement with the SAGE PSC extinctions. The optimum choice of rates can then be used in a second model run and the procedure repeated until optimum agreement between SAGE and model is obtained. In this paper we demonstrate the potential of SAGE III observations to quantify NAT nucleation rates in this way.

A52G-08 1745h

Inferring Denitrification From Twenty Years of Solar Occultation Measurements of Arctic PSCs

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Recently, Fromm et al. [J. Geophys. Res., 108(D12), 4366, doi:10.1029/2002JD002772, 2003] have reanalyzed the Polar Ozone and Aerosol Measurement (POAM II and POAM III) and the NASA Stratospheric Aerosol Measurement (SAM II) satellite PSC databases using a unified detection algorithm and methodology. This has yielded an internally consistent, nearly unbroken PSC climatology extending from 1979 to the present. A technique has been developed by Bevilacqua et al. [J. Geophys. Res., 107(D20), 8281, doi:10.1029/2001JD000477, 2002] to infer irreversible denitrification. This technique stems from the assumption that irreversible denitrification lowers the NAT saturation temperature which in turn lowers the temperature for PSC formation. This results in a decreased PSC frequency at a given temperature as the Arctic vortex season progresses. In this paper we apply this technique to the long-term Arctic PSC database provided by Fromm et al. to yield a proxy climatology of denitrification which extends back for more than 20 years. Results suggest that denitrification is a relatively common occurrence in cold Arctic winters.

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