• *What are the roles of tropospheric ozone and aerosols in climate change?*
• *What are the causes of surface UV-B change?* Proven TOMS and DOAS retrieval algorithms for trace gases will be employed as well as new ones, which will take advantage of experience gained by both European and US scientists. OMI ozone data will be of the same quality as TOMS to insure continuity of ozone trends detected to date. Tropospheric ozone will be retrieved using two algorithms developed for TOMS but tailored for OMI and using ozone profiles from all Aura instruments. Measurement of aerosols characteristics will be enhanced using data from the A-Train. Some of these algorithms are presented in the Aura poster session, while all OMI algorithms are available at http://eospso.gsfc.nasa.gov/. Performance of the OMI instrument and its algorithms relative to Aura's science goals will be discussed. Information on possible co-operation in the OMI validation program will be given.

A12C-04 1450h INVITED

The EOS AURA Tropospheric Emission Spectrometer (TES)

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The Tropospheric Emission Spectrometer (TES) is a high-resolution infrared Fourier Transform spectrometer that operates in both limb and nadir viewing modes for the investigation of the physics and chemistry of the Earth's lower atmosphere. TES is currently being integrated onto the AURA spacecraft in readiness for launch into Sun-synchronous polar orbit early in 2004. The talk will focus on pre-delivery system tests and calibrations as they impact the expected on-orbit performance.

A12C-05 1510h

Validation of Aura Data: Needs and Implementation

Lucien Froidevaux[1] (818-354-8301; Lucien.Froidevaux@jpl.nasa.gov); Anne R Douglass[2] (Anne.R.Douglass@nasa.gov); Mark R Schoeberl[2] (Mark.R.Schoeberl@nasa.gov); Ernest Hilsenrath[2] (Ernest.Hilsenrath@nasa.gov); Douglas E Kinnison[3] (dkin@ucar.edu); Mark Kroon[4] (Mark.Kroon@knmi.nl); Stanley P Sander[1] (Stanley.P.Sander@jpl.nasa.gov)

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Validation of Aura data: needs and implementation L. Froidevaux, A. R. Douglass, M. R. Schoeberl, E. Hilsenrath, D. Kinnison, M. Kroon, and S. P. Sander We describe the needs for validation of the Aura scientific data products expected in 2004 and for several years thereafter, as well as the implementation plan to fullfill these needs. Many profiles of stratospheric and tropospheric composition are expected from the combination of four instruments aboard Aura, along with column abundances, aerosol and cloud information. The Aura validation working group and the Aura Project have been developing programs and collaborations that are expected to lead to a significant number of validation activities after the Aura launch (in early 2004). Spatial and temporal variability in the lower stratosphere and troposphere present challenges to validation of Aura measurements even where cloud contamination effects can be minimized. Data from ground-based networks, balloons, and other satellites will contribute in a major way to Aura data validation. In addition, plans are in place to obtain correlative data for special conditions, such as profiles of O3 and NO2 in polluted areas. Several aircraft campaigns planned for the 2004-2007 time period will provide additional tropospheric and lower stratospheric validation opportunities for Aura; some atmospheric science goals will be addressed by the eventual combination of these data sets. A team of "Aura liaisons" will assist in the dissemination of information about various correlative measurements to be expected in the above timeframe, along with any needed protocols and agreements on data exchange and file formats. A data center is being established at the Goddard Space Flight Center to collect and distribute the various data files to be used in the validation of the Aura data.

A12C-06 1525h

Contribution of AURA-OMI and A-train observations to the understanding of tropospheric aerosol absorption effects on climate

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It is well known that aerosols contribute to the mitigation of the warming effect of the greenhouse gases by scattering back to space a fraction of the incoming solar radiation. Particle absorption, however, alters the radiative properties of the atmosphere by reducing the aerosol cooling effect and warming the atmosphere. Since black carbon containing aerosols are of anthropogenic origin, the quantification of the atmospheric aerosol load over the industrialized areas as well as over the areas affected by biomass burning is necessary to reduce the currently large uncertainties on the climate role of aerosol absorption. The near UV approach of aerosol absorption sensing from space developed and tested using measurements by the Total Ozone Mapping Spectrometer (TOMS), will be applied to observations by the Ozone Monitoring Instrument (OMI), on the AURA platform. OMI will measure the aerosol absorption optical depth by taking advantage of the strong signal resulting from the interaction of aerosol absorption and the large molecular scattering in the near UV spectral region. OMI measurements of aerosol absorption optical depth over ocean and land surfaces, in conjunction with additional aerosol related information derived from other sensors in the A-train (e.g., aerosol vertical distribution from CALIPSO observations and aerosol size and optical depth in the visible and near IR from Aqua-MODIS), will provide valuable information on the spatial and temporal variability of absorbing aerosols. The AURA-OMI observational record of aerosol absorption optical depth over the estimated 6-year lifetime of the mission will constitute the first global long-term data set on aerosol absorption optical depth.

A12D MCC: 3016 Monday 1340h

Tropical Cirrus Anvils: Properties and Processes III *(joint with SA, AE)*

Presiding: **E Jensen,** NASA Ames Research Center**; D E Anderson,** NASA Headquarters

A12D-01 1340h

Evaluation of the Adapative Infrared Iris Hypothesis Using TRMM Satellite Measurements

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Significant controversy surrounds the adaptive infrared iris hypothesis put forth by Lindzen et al. (2001), whereby tropical anvil cirrus detrainment is dependent on the underlying temperature and this dependence acts as an iris to inhibit changes in the surface temperature. This hypothesis implies increased precipitation efficiency in regions of higher sea surface temperatures (SSTs) which reduces cirrus detrainment. Tropical Rainfall Measuring Mission (TRMM) satellite measurements are used to investigate the adaptive infrared iris hypothesis. Pixel-level Visible and Infrared Scanner (VIRS) 10.8 μm brightness temperature data and Precipitation Radar (PR) rainrate data from TRMM are collocated and matched to determine individual convective cloud boundaries. Each cloudy pixel is then matched to the underlying SST. This study examines clouds with a single convective core to determine if a relationship exists between the size of convective clouds and the underlying SSTs. In doing so, we address some of the criticisms of the Lindzen et al. study by eliminating the cloud-weighted SST and limiting ourselves to only clouds identified as convective by the PR. The proposed mechanism for the iris hypothesis is also examined using cloud size and rainfall information. Normalizing cloud size by the amount of rainfall from the cloud provides information on whether or not the cloud size decreases at higher SSTs with increasing rainfall. Preliminary results support the adaptive infrared iris hypothesis and mechanism. It should be noted, however, that the strength of support for the iris is dependent on the brightness temperature threshold chosen for the cloud boundaries. Regressions of cloud size with SST show negative slopes and correlations signifying that cloud size decreases with increasing SST as proposed by Lindzen et al. Normalized cloud size by rainfall regressed against SST also shows a negative slope and correlation, indicating that the amount of rainfall from a cloud does increase as the cloud size decreases at higher SSTs.

A12D-02 1355h

An examination of the spatial relationship between the water minimum and convection in the TTL

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Recently, it has been argued that the region where water vapor is a minimum in the tropical tropopause layer is located downstream of convection. If true, this would suggest that in situ dehydration was playing a role in regulating water vapor near the tropical tropopause. In this presentation, I will use UARS MLS water vapor measurements, as well as various proxies for convection, to argue that the water vapor minimum is closely collocated with convection. I will also provide potential explanations as to why previous analyses have reached a different conclusion.

A12D-03 1410h

Combined Lidar-Radar Measurements of Tropical Cirrus Anvils During the CRYSTAL-FACE Field Campaign

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During the CRYSTAL-FACE field experiment the Cloud Physics Lidar (CPL) and the new Cloud Radar System (CRS) were flown together on the NASA ER-2 aircraft, providing the first high-altitude collocated measurements from lidar and cloud profiling radar. The lidar and radar provide complementary measurements with varying degrees of vertical measurement overlap within cloud layers and permit near-complete vertical coverage through the atmosphere. In this presentation a description of the combined airborne lidar-radar measurements will be given, followed by a comparison of instrument sensitivity. Focus will be on cirrus anvils observed during several days of the CRYSTAL-FACE experiment. Data from July 23, 28, and 29 will be used to show evolution of the temporal and structural features of the cirrus anvils using the full profiling capability permitted with the combined lidar-radar measurements. On these particular days, flight tracks designed specifically to capture evolving cirrus anvils allow an unprecedented view of the cirrus anvil life cycle.

URL: http://cpl.gsfc.nasa.gov

A12D-04 1425h

Results from Emerald-2: Measurements in the Cirrus Outflow from Tropical Convection above Darwin

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The EMERALD-2 campaign was conducted from Darwin Australia in November 2002 to study the cirrus outflow from tropical convection. This involved two aircraft from which in-situ sampling and remote sensing were applied. One aircraft, called the Egrett, flew to heights of 15 km while carrying instruments for measuring cloud particles, humidity, temperature, ozone, turbulence, and far-IR radiative spectra. Another aircraft, the King-Air, flew directly below the Egrett while carrying an upward viewing polarization lidar. The airborne lidar mapped the structure of the outflow cloud while, simultaneously, the Egrett sampled inside the same volume of cloud. Thirteen separate flights were focused on a major convective event (called Hector) that occurs nearly every day during the pre-monsoon period (November) over the Tiwi Islands. Measurements will be presented that show the variation in crystal properties, dynamics, water vapour and ozone within and around the convective outflow in the upper troposphere. Comparisons will be made with the properties of frontal cirrus clouds, as measured in the EMERALD-1 campaign.

A12D-05 1440h

Gravity Waves in ER-2 Observations During CRYSTAL-FACE: Propagation Characteristics and Potential Role in Cirrus Cloud Formation

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Gravity waves are known to affect cloud formation via the temperature perturbations they cause, and these effects can be significant in conditions that are otherwise marginal for cloud formation. Cirrus clouds near the tropopause can form in the cold phases of gravity waves. The ER-2 aircraft observations during the CRYSTAL-FACE campaign provide a unique set for gravity wave analysis. For the first time, data from both the Microwave Temperature Profiler (MTP) and Meteorological Measurement System (MMS) were obtained together from the ER-2 platform, with flight paths near convection. Analyses of MTP and MMS data can be combined to provide the full set of gravity wave parameters needed to model their origin, propagation, and eventual fate. This wave analysis requires long, constant-level flight paths. First a wavelet analysis in horizontal wavenumber is performed along the flight path direction for measurements of temperature and horizontal wind. From this, the strongest wave modes are identified, and the vertical wavenumber estimated from the MTP data for these modes. Linear wave theory is then employed to compute the propagation directions and intrinsic frequencies for these strongest wave modes. The results of this analysis thus provide the full three-dimensional propagation characteristics for the dominant gravity wave modes in the data. We subsequently use these results to examine their role in cirrus cloud formation at lower altitudes, and compare the results to in situ measurements made from the WB-57F aircraft platform.

A12D-06 1455h

Dual-Satellite Retrievals of Tropical Ice Cloud Particle Shapes and IWC During CRYSTAL-FACE: Comparisons With In-situ and Ground Site Observations

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The study consists of (i) evaluating a satellite shape retrieval by comparing its results with in-situ observations within tropical ice clouds (ii) evaluating the impact of the shape retrieval on the satellite IWC estimation and (iii) comparing the satellite IWC with ground-based radar values. The particle shape retrieval uses dual-satellite observations at 650 nm. This method takes advantage of the sensitivity of bi-directional observations in the visible domain to the ice crystal phase function. The phase function is itself mainly a signature of the particle shape in the visible domain, as most of the ice crystals have sizes larger than the wavelength. The method used for retrieving the particle shape has been applied to several cases of observations in the past (Chepfer at al. 2002), but its performance has never been evaluated against in situ observations for tropical ice clouds. The paper will primarily present the comparisons between the shapes as retrieved from satellite and in-situ data. Moreover, the current satellite retrieval of IWC are using particle size retrieval as deduced from infrared wavelengths. Those particle size retrievals require the use of an a-priori assumption of the particle shape that significantly impacts the results. The second part of this study will focus on the potential improvement of the satellite IWC estimation using the ice crystal shape as constrained by the dual-satellite method. Finally, the resulting cloud IWC will be compared to the ones obtained from radar ground based sites.

A12D-07 1510h

Measurements of HNO_3 and NO_y on Cirrus Ice Particles and in Solution Aerosols During CRYSTAL-FACE

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NO_x ($NO + NO_2$) is central to tropospheric O_3 production. The larger family of gases with which NO_x interconverts, NO_y, or total reactive nitrogen, includes HNO_3. One potential mechanism for the removal and/or vertical transport of NO_y is via uptake on ice particles and aerosols. NO_x is unlikely to be subject to such uptake, and HNO_3 is likely the most significant NO_y species subject to uptake. Thus the uptake of HNO_3 has the potential to affect indirectly the O_3 budget of the atmospehre [Lawrence and Crutzen, Tellus, 1998; Meier and Hendricks, JGR, 2002]. To assess the degree of uptake, condensed-phase HNO_3 and NO_y were measured during CRYSTAL-FACE by instruments in adjacent pallets on the WB57. The instruments employed nearly identical inlets for the enhanced (anisokinetic) sampling of condensed-phase species. Each instrument employed a second inlet for the measurement of the gas-phase plus small-particle fraction. Differences in the small-particle sampling by these latter inlets has proven beneficial for the inference of condensed-phase HNO_3 on particles with diameters of order 1 micron. This talk will emphasize the southern survey flight of 9 July 2002, for which we infer the presence of condensed-phase HNO_3 in ternary solutions of H_2O, H_2SO_4, and HNO_3. Ice was found in greater and lesser amounts in the presence of the aerosols, but ice appears to have played little role in the uptake of HNO_3 here, as the aerosols compete very effectively for the HNO_3 in this particular case, due to the relatively large particle volume and the low temperatures. In addition, the condensed-phase NO_y measurements are compared to the condensed-phase HNO_3 measurements described in another presentation at this meeting (Popp et al.) Overall the condensed-phase HNO_3 and NO_y amounts are similar to one another and give no indication that other NO_y species are taken up by cirrus ice particles.

A12D-08 1525h

Comparison of Aerosol Particles Collected From Cloud Bases and Cirrus Anvils

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Deep convection in tropical regions can vertically transport aerosol particles that potentially affect formation of cirrus clouds. In order to better understand the processes occurring in the convective clouds, we studied aerosol particles from cloud bases (altitudes:1-3 km) and cirrus anvils (altitudes: 13-15 km) and compared their morphologies and compositions. Aerosol sampling was performed during the July 2002 CRYSTAL-FACE mission. Particles between 0.07 and 3 μmwere collected directly onto TEM grids. Cloud-base samples consist of ammonium sulfate (50-90 % by number), sea salt (5-35 %), Na- and Ca-sulfates (2-25 %), soil particles (2-15 %), and anthropogenic materials such as soot and flyash (< 3 %). These particles are similar in morphology to those from marine boundary layers (Posfai et al., 1995; Li et al., 2002). In contrast, cirrus samples have different particle types. They contain abundant (35-80 %) tiny round particles (0.05-0.5 μm) that appear to have been solution droplets. The particles are rich in S and O and contain elements such as Na, Mg, Cl, K, Ca, and Fe. Droplets of sulfuric acid (10-25 %) and Zn-rich particles (5-40 %) are also abundant in cirrus samples. Direct links between aerosol particles from cloud bases and cirrus anvils are not evident. Hygroscopic ammonium sulfate and sea salt particles tend to develop into aqueous droplets that rapidly grow and are removed from convecting air mass by precipitation. The remaining particles experience mixing, coagulation, and break-up in the clouds. The round S- and O-rich particles in the cirrus samples presumably formed through such complex processes.