INSIGHTS INTO TROPOSPHERIC CHEMISTRY: NEW RESULTS UTILIZING EOS TES, OMI, AND MOPITT ON THE A-TRAIN

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1. ABSTRACT

The NASA EOS satellites have been providing unique measurements of global tropospheric chemistry. In this talk, we will highlight some of the new insights into the impact of local and regional sources on global atmospheric chemistry including biomass burning, megacities, and biogenic emissions. A number of examples of the interplay of dynamics and chemistry on the global scale that is revealed from global satellite measurements and analysis will be discussed.

The total ozone record is being continued by OMI, and using MLS stratospheric ozone profiles, global tropospheric ozone residuals are being calculated daily. TES measurements directly differentiate the stratospheric and tropospheric ozone, and can even see upper and lower tropospheric ozone differences, such as over the tropical Atlantic, where biomass burning enhances lower tropospheric ozone north of the ITCZ, and ozone enhancements south of the ITCZ are seen in the upper troposphere. A profile retrieval from OMI radiances that separates the stratosphere and troposphere is also being developed. Nitrogen dioxide (NO_2) measurements from OMI are being used to constrain global emissions estimates. These observations have shown the impact of control strategies and the imprint of activity and emissions differences of weekdays and weekends. SO_2 emissions of volcanoes are monitored by OMI, and they are able to indentify point sources, such as copper smelters. OMI data is also being used to derive formaldehyde and glyoxal concentrations, which are used to constrain VOC emissions.

The time series of CO measurements from MOPITT has been used to improve the emission inventory for Africa, and it showed that the interannual variability of the seasonal cycle of burning in northern Africa was reduced, and the burning season lasts longer than in previous emission inventories. In southern Africa, the emissions peak was moved one month later. MOPITT CO observations have also been used to characterize regional pollution. In an analysis of all cities of populations greater than 4 million, it was shown that when high CO concentrations and good thermal contrast is present, CO pollution on the city scale can be identified with MOPITT. Many cities in China were detected, as well as those with pollution trapped by mountains, and those having high thermal contrast. In a different, but related study, pollution over the Indian subcontinent was studied with MOPITT, and it was shown that there are high concentrations of CO over the Indo-Gangetic Basin in the spring, and a build-up of high CO over the eastern states of Bihar and West Bengal in winter.

These satellite measurements are now being used in combination to address question about global tropospheric composition. The zonal variability of ozone in November of 2004 was explored with a variety of remote sensing data, and it was concluded that the surface emissions in Indonesia and Australia were greater than previous estimates by a factor of 2 or more. TES data show large differences in these gases over Indonesia and the eastern Indian Ocean in October–December 2006 relative to 2005. In 2006, O3 was higher by 15–30 ppb (30–75%) while CO was higher by >80 ppb in October and November, and by 25 ppb in December. These differences were caused by high fire emissions from Indonesia in 2006 associated with the lowest rainfall since 1997, reduced convection during the moderate El Nino, and reduced photochemical loss because of lower H2O. These findings are consistent with the impact of El Nino seen in the TOMS/OMI total ozone column record. The impact of boreal fires on tropospheric pollution was explored, and showed that CO is elevated near fires, but ozone may not increase, if there are sufficient aerosols present to depress the photochemical production. OI aerosols measurements have proven valuable in tracking biomass burning plumes. In addition, the long range transport of pollution is being quantified using

integrated satellite measurements, aircraft measurements, and modeling tools. A recent study showed that Asian pollution increases the background ozone of flow into North America, rather than arriving as episodic plumes.