Satellite Observations of Peroxyacetyl Nitrate (PAN) in the Tropical Troposphere: New Insights Into the Seasonal and Inter-annual Variability of the Reactive Nitrogen Budget

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Peroxyacetyl nitrate (PAN) is a thermally unstable reservoir for nitrogen oxides (NO_x) that can be transported over large distances, enabling ozone formation far from the original source. PAN is the primary reservoir of tropospheric reactive nitrogen over much of the globe and plays a key role in determining the global ozone distribution. Sources include biomass burning, lightning and athropogenic combustion. Until now, measurements of PAN in the troposphere have been sparse, particularly in the tropics.

Here we present new global observations of tropospheric PAN from the Tropospheric Emission Spectrometer (TES), a thermal infrared spectrometer flying on the Aura satellite since 2004. TES is primarily sensitive to PAN in the free troposphere and PAN can be retrieved from TES spectra for cases where the free-tropospheric volume mixing ratio is above ~0.2 ppbv.

TES PAN observations over two example years (2005 and 2006) in the tropics confirm model expectations of large-scale enhancements of PAN in the southern Atlantic due to lightning and biogenic emissions. These features are needed to sustain the large-scale ozone enhancements that stretch across the southern hemisphere. In addition, TES observations over central Africa support the hypothesis that convective transport directly over emitting regions plays a critical role in the reactive nitrogen budget in the free troposphere. In contrast to model expectations, we find that the 2006 Indonesian fires did not result in strongly enhanced tropospheric PAN concentrations, despite enormous fire emissions that resulted in extremely large enhancements in concentrations of many other tropospheric trace gases.

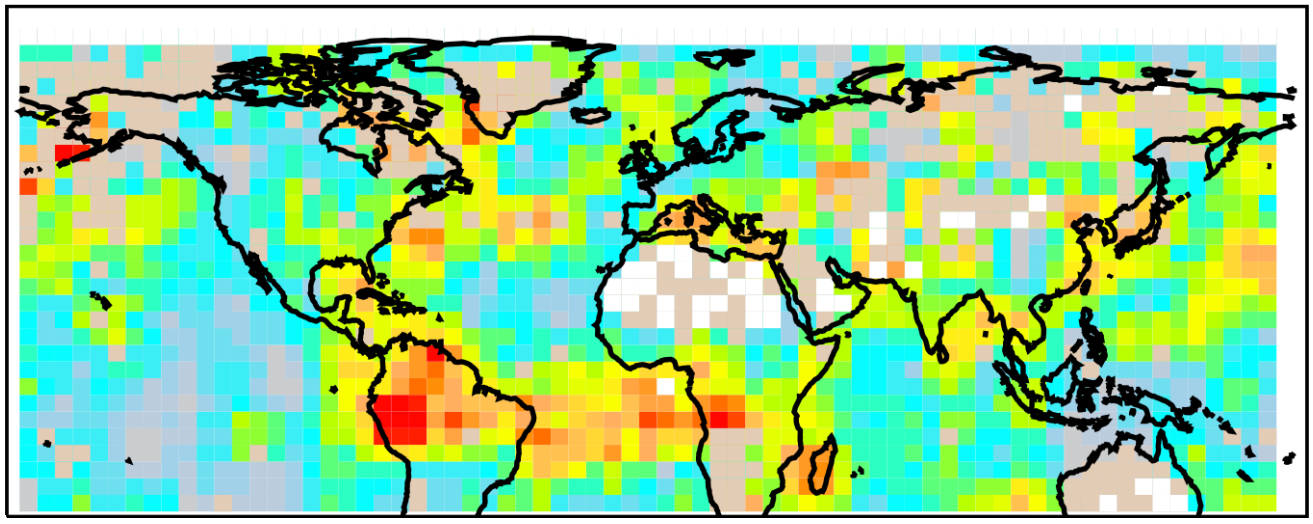

Figure 1. Figure shows the fraction of TES measurements acquired in October 2006 where elevated PAN was detected.