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Signatures of transport into the tropical lower stratosphere. Is there supporting evidence for observations of anomalously high aerosol concentrations in the tropical lower stratosphere?

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Size resolved aerosol concentration profiles in the tropics have been completed on 5 occasions using in situ instruments deployed on balloons. Two profiles were completed from Baru, Brazil, 23ºS in November 1997, one profile from near Darwin, Australia, 13ºS, in November 2005, and two profiles from Niamey, Niger, 13ºN, in July, August 2006. In addition to providing tropical profiles of the size distribution of stratospheric aerosol, these measurements indicate the presence of surprisingly large ($>$ 1.0 um radius) particles several kilometers above the tropical tropopause. Such large particles were observed at all three locations: on one of two flights from Brazil, on the only flight from Australia, and on one of two flights from Niger. In a long series of measurements from the mid latitudes, such particles have never been observed, except following recent volcanic eruptions, and following the Kuwaiti oil fires in 1991. The tropical particle layers are surprisingly local. From Australia they were observed on the descent profile, but not on ascent. In Niger particles were observed on both ascent and descent but there were significant differences. In both cases large particles extended up to 2 km above the tropopause, and were part of a 4-6 km thick layer of aerosol spanning the tropopause; however on ascent the particles extended to 25 km, 8 km above the tropopause. In Brazil, the large particles (2.0 um) appeared at 4 km above the tropopause, and were isolated from any larger aerosol layer. Instrument malfunction during these measurements is ruled out by ascent descent comparisons outside of the disturbed regions, post flight laboratory checks, and independent ob-

servation of the layers by complementary instruments on the gondola. To search for other evidence of the extent and frequency of stratospheric intrusions of tropical tropospheric air, several satellite data records have been analyzed. The 20 year SAGE II 1.0 micrometer extinction measurements were analyzed by dividing the data into latitudinal bands and investigating excursions of two and three standard deviations above the zonal averages for lower stratospheric measurements. This was completed on a seasonal basis for the 20 year record. A small number of excursions were observed over equatorial Africa and Brazil, while relatively more frequent excursions were observed in mid to high latitudes in the winter hemisphere. The SAGE II data are limited by large averaging volumes and sparse equatorial coverage, thus although SAGE II measures aerosol there are better satellites for tropical coverage. To increase the tropical coverage a similar analysis of MLS measurements of CO from the AURA satellite was completed. July 2006 averages of the CO data indicate maximum upwelling of tropospheric air above northern India, as has been reported by others. This is a signature of tropical convection to the east of India. Although this pattern of high CO over northern India is repeated in a daily analysis of the data, there are additional areas of high CO indicating intrusions of tropospheric air into the stratosphere near the time of the Niger measurements in late July 2006.