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Increase of total stratospheric NO2 in the tropics after 2001

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The tropical region is the main entry point of tropospheric chemical species lifted by convection and transported into the stratosphere across the tropopause. It is therefore the most sensitive region to dynamical and chemical changes. Long series of NO_2 columns have become available in the tropics from two SAOZ uv-visible spectrometer stations, in Bauru (Brazil, 22˚S, 49˚W) since 1995 and in Reunion Island (21˚S, 55˚E) in the Indian Ocean since 1993 with which the evolution of the total NO_2 has been investigated. Most significant modulation at both stations is the seasonal cycle but of larger amplitude $\sim$3.2*10^{15}mol./cm^2 in Bauru than $\sim$2.4*10^{15}mol./cm^2 in Reunion because of the contribution tropospheric lightning and biomass burning NOx in continental Brazil, absent over the oceanic Reunion station. As shown by a multi-linear regression analysis, most important geophysical parameters controlling the interannual variability are the Quasi-Biennial Oscillation (QBO) of respectively $\approx$30% in Bauru and 20% in Reunion, followed by the El Niño-Southern Oscillation (ENSO) of 17% and 11 % and the 11 year solar flux cycle of 11% at both stations. After removing the signal from all statistically significant proxies, the long-term evolution shows a total NO_2increase by about $\sim$0.2*10e^{15} mol./cm^2 after 2001 at both stations, exceeding by far the trend expected from the known N_2O concentration increase of 2.5%/decade. The event is confirmed by the GOME - SCIAMACHY NO_2 total column series, but ignored by the SLIMCAT model forced by ECMWF analyses. The partial NO_2 column between 19-50 km derived HALOE and SAGE II above the stations confirms the increase of NO_2 after 2001 and shows that it has occurred in the lower stratosphere. The coincidence of the NO_2 enhancement with the drop of water vapour ($\sim$0.2 ppmv) reported by HALOE in the lower stratosphere and the cooling of $\sim$1K the tropopause, attributed by Randel at al., (2006) to a reinforcement of the Brewer-Dobson circulation, suggests an increase of the NOx concentration after 2001 following that of its N_2O source, either because of a faster B-D circulation or a more intense convective vertical transport.