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Ozone stratospheric and tropospheric trends (1995-2015) at nine ground-based NDACC FTIR stations (79°N to 78°S)

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Long-term measurements of ozone total column and vertical distribution are required to understand the ozone response to different natural and anthropogenic forcings. Such a record might be provided by merging ozone profiles measured since more than 30 years by satellite limb sounders. Reliable data from ground-based stable instruments are vital to validate these extented satellite data sets and to estimate potential drifts resulting from instrumental aging or glitches. They also offer an alternative determination of ozone changes.
Ground-based FTIR (Fourier transform infrared) measurements derived from high-resolution solar absorption spectra provide ozone total columns with a precision of 2 %. In addition, the pressure dependence of fully resolved absorption lines allows retrieving distinct information in four altitude layers: one in the troposphere and three in the stratosphere up to about 45 km, with a precision of 5–6 %. In Vigouroux et al. (ACP, 2015) and the last Scientific Assessment of Ozone Depletion report (WMO, 2014), we have reported the total column and the four altitude layers ozone trends (1995-December 2012) at FTIR stations distributed in both hemispheres and all part of the Network for the Detection of Atmospheric Composition Change (NDACC). We used a stepwise multiple linear regression model including several proxies to reduce the trend uncertainties and explain the ozone varibility (e.g., tropopause pressure, equivalent latitude, Quasi Biennial Oscillation, volume of polar stratospheric clouds, ...). One of the major results of Vigouroux et al. (ACP, 2015) was that some signs of the onset of ozone mid-latitude recovery were observed at the Southern Hemisphere stations, while a few more years seemed to be needed to observe it at the northern mid-latitude station (Jungfraujoch), where a positive upper stratospheric trend was close to significance (+0.9±1.0 %/decade).
The present work uses data up to December 2015 at the following NDACC stations: Ny-Ålesund (79°N), Thule (77°N), Kiruna (68°N), Harestua (60°N), Jungfraujoch (47°N), Izaña (28°N), Wollongong (34°S), Lauder (45°S), and for the first time at Arrival Heights (78°S). Its main objectives are to determine whether the ozone recovery can now be observed at the Jungfraujoch and to confirm the positive ozone trends at the mid-latitude Southern Hemisphere stations. At the polar sites, the high ozone inter-annual variability inhibits the evidence of an ozone recovery, but we will report ozone observed changes and explain the inter-annual variability through appropriate proxies. A last objective of this work using 3 more years of data is to clarify the role of the 11-year solar cycle in ozone variability, which remained unclear in Vigouroux et al. (ACP, 2015), especially for the shortest time-series starting in the early 2000s.