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SI^{2}N assessment of vertical ozone trends: Stability of limb/occultation data records over 1984-2013 against ground-based networks

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Since the first indirect solar occultation measurement of the ozone profile with Echo-1 in 1960, numerous limb/occultation viewing instruments were deployed in space over the past 50 years to measure the vertical distribution of atmospheric ozone. Among them, a few provided data records potentially suitable for documenting the evolution of the ozone layer and for improving our understanding of the interactions between changes in ozone, climate, and solar radiation. Three decades after the start of stratospheric ozone depletion by man-made chemicals, the first weak signs of slow recovery in stratospheric ozone abundance over Northern mid-latitudes were reported in the last WMO Ozone assessment, in 2010. The data collected since then, together with recent improvements of historical data records, may substantiate these initial findings and even provide hints as to how to attribute the recovery of the ozone layer. In preparation of the upcoming WMO assessment in 2014, the ozone research community set up the SPARC/IO$_3$C/IGACO-O$_3$/NDACC Initiative on Past Changes in the Vertical Distribution of Ozone (SI^{2}N), to study and document those long-term changes. To increase the significance of trend studies, ozone records from measurement systems with different instrumental design and retrieval technique were merged. As a prerequisite, the stability of and consistency between these data records played a pivotal role in the SI^{2}N effort and are the subject of this report.

In this SI^{2}N context, we present a comprehensive and systematic quality assessment of the 14 major space-based limb and occultation ozone profile records potentially suitable for ozone trend assessments, from the ground up to the middle stratosphere. All satellite records were analysed within one methodological framework. Correlative ground-based observations from the ozonesonde and lidar networks (NDACC, GAW) act as a reference standard with well-characterized quality. The application of robust statistical methods and various methodological cross-checks furthermore increases the reliability of this assessment. We present estimates of the decadal drift, the bias, and the short-term variability of each satellite record relative to the ground-based network data. The dependence of these parameters on altitude and, whenever possible, on latitude and season, is discussed as well. Particularly important in the data/trend merging approach of SI^{2}N are the conclusions on the consistency between records, and its dependence on the specific coordinate system in which the ozone profile is represented.