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# Break-detection and time series homogenization through joint observations from independent ozone observation systems: a case study for the Mauna Loa ozone records

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Since the detection of the Antarctic ozone hole the scientific community and public has been increasingly concerned about changes in the global ozone layer and related negative health effects through changes in erythemal UV-radiation. A globally distributed and WMO referenced observational ozone network has been established several decades ago allowing a detailed assessment of ozone trends and variability. Although recent results by state-of-the-art chemistry climate models project ozone recovery (or even super-recovery) to (above) 1980-levels, due to decreasing concentrations in ozone depleting substances (ODS), to date no significant onset of such recovery could be inferred from ground-based measurements. The inference of ozone recovery from ground-based measurements is complicate through (1) the relatively short time period with slowly declining ODS concentrations since peak values have been reached in the late 1990s, (2) natural atmospheric variability, and (3) breaks/discontinuities in operational records resulting from changes in instrumental characteristics over time and instrument replacements. Here we focus explicitly on the latter by evaluating a series of comprehensive ozone measurements performed by different observational systems at NOAA's Mauna Loa Observatory and at Hilo, Hawaii. Dobson Umkehr ozone measurements at Mauna Loa Observatory are dating back to the early 1980s. The set of observations available comprises measurements from three observational platforms: (1) Umkehr measurements (starting 1982), (2) recently homogenized sonde measurements (available from 1991), and (3) microwave measurements (starting 1995). Here we assess time series properties, variability, and trends across the joint observational record. We evaluate the co-evolution of ozone at vertical levels (i.e. integrated layers) and of integrated total column amounts to identify potential breaks in the observational records related to changes in the observational setup (i.e. instrument degradation/replacements). To this aim we apply a series of statistical tools including STL-decomposition, time series segmentation and probabilistic analyses. Identified breaks are related to changes in instrumentation and a joint homogenized ozone record for the recent past is presented. Furthermore we investigate the influence of large scale climate modes (e.g. ENSO) on ozone variability in the troposphere and stratosphere.