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On the confidence in SI2N vertical ozone profile trend assessments

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The abundance and distribution of atmospheric ozone has undergone major alterations due to large-scale emissions of man-made ozone-depleting halogens. Clear declines in stratospheric ozone levels have been observed since the late 1970s. Depleted ozone levels have fortunately stabilized since the late 1990s thanks to the ban of ozone-depleting substances by the Montreal Protocol and amendments. Model predictions anticipate increasing ozone levels in the first half of the 21th century. However, current observational results do not always converge: while hints of the onset of recovery are reported by some, others do not conclude to significant evidence. Central to settling this issue is to understand the measurement and trend analysis uncertainties, down to the level of a recovery rate of a few percent per decade. Such stringent requirements pose a real challenge to the community, which needs to consider uncertainties due to, e.g., instrumental degradation, retrieval method, smoothing and sampling, ancillary data, merging technique, trend assessment method etc.

This paper discusses the confidence we can have in recent vertical ozone trend estimates. We start by reviewing the ground-based satellite validation analyses and the satellite-to-satellite intercomparison studies that contribute to the SI2N initiative, with focus on temporal (long-term) and spatial (vertical, geographical) characteristics of the difference between different nadir, limb and occultation sounders and ground-based networks. Since trends based on merged satellite records lead to further complications, we explore a few methods to estimate merging-related uncertainties and propose recommendations on how to minimize them. The paper concludes with perspectives on how to advance towards the required level of knowledge on ozone trend uncertainties, and on how to advance the ongoing debate on whether or not there is sufficient observational evidence for ozone recovery.