Ozone trends at two extreme southern GAW/WMO stations

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In situ ozone (O_3) determinations are scarce in the Southern Hemisphere (SH), but in Ushuaia (U), Argentina, and in Cape Grim (CG), Australia, surface O_3 measurements have been carried out for decades at two GAW-WMO stations (Global Atmospheric Watch - World Meteorological Organization), with well characterized climatology. It can be assumed that these O_3 quantities reckoned on the surface could be representative up to mid-tropospheric levels. At both stations, mainly dependent on southern westerlies/ocean flux of air, destructive O_3 processes have been shown to occur, probably related to both the photochemistry of bromoforms and the lack of O_3 precursors in the marine boundary layer. Nevertheless, preliminary analyses suggest a growing tendency in the O_3 mixing ratios at CG, but an unusual (for the SH) decreasing trend in the detected O_3 at U station. In this context, we performed a detailed analysis on the complete daily data available (missing data 3.9 % for U and 15.5 % for CG) of these two GAW stations. Our primary aim was to achieve better understanding of the possible effects of some natural forcings, such as the solar cycle, ENSO (El Niño-Southern Oscillation) and QBO (Quasi-Biennial Oscillation), in the possible trends of these series. We focused on the reconstruction of monthly data series and the possibility of trends determination. We show that it is possible to reconstruct monthly series of 25-years in length in the case of U and of 36-years in length in the case of CG (Figs. 1, 2). In addition, the estimated minimum number of years to detect trends in these series is between 12.03-18.3 yr for U, and 7.57-11.34 yr for CG (95% confidence interval, respectively). Our estimates confirm a negative trend for U of –0.2 ppbv/decade where the only forcing that could reasonably be considered is the solar cycle. In the case of CG a trend of 0.4 ppbv/decade is determined, being the ENSO effect the only forcing compatible with a best fit criterion. While the case of CG is consistent with a global increase in greenhouse gases, the U long-term decrease seems to be driven by atmospheric processes, as argued in *Adame et al.*, (2021), involving blocking of the westerlies and consequently, atmospheric stagnation. Although the data length used by these authors is short as to derive a robust trend (2010-2018), if these results are considered plausible, our result for U suggests that these blocking effects, related to a high-pressure system in the Pacific ocean, have been increasing their frequency over the last decades.

References

Adame, J. A., Puentedura, O., Gómez, L., Condorí, L., Carbajal, G., Barlasina, M. E., & Yela, M.: Patterns and trends of ozone and carbon monoxide at Ushuaia (Argentina) observatory, *Atmospheric Research*, **255**, 105551, doi:10.1016/j.atmosres.2021.105551, 2021.