

INTAKE HEIGHTS AT CAPE POINT

E.-G. Brunke⁽¹⁾, T. Mkololo⁽¹⁾, C. Labuschagne⁽¹⁾, and H.-E. Scheel⁽²⁾

(1) South African Weather Service, Stellenbosch 7599, South Africa; (ernst.brunke@weathersa.co.za)
(2) Forschungszentrum Karlsruhe, IMK-IFU, 82467 Garmisch-Partenkirchen, Germany



Cape Point GAW station: 34°S, 18°E; 230 m a.s.l.



Ozone Analyser

Analytical technique and data processing

The instruments in use comprise Thermo Electron (Teco) analysers based on a UV detection technique. An O₃ calibrator (TEI 49i-PS) is being used to calibrate the three instruments every four months. Daily zero and sensitivity checks are conducted automatically. Monthly zero-calibration levels are factored into the data processing routine, which yields 30-min. averages, while the SPAN sensitivity values provide information on long-term instrument stability. For the purpose of this study, ozone levels in unpolluted air (30-min. averages) were selected via a filtering technique based on carbon monoxide (CO) background data.

Overview

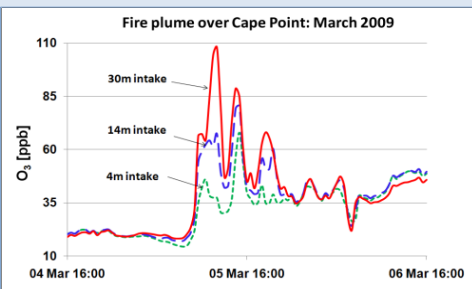
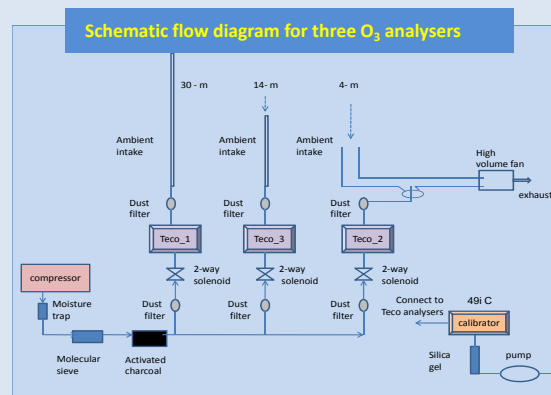
Surface ozone measurements have been made at Cape Point since 1982 from the top of a 30-m air intake mast. In 1996 measurements were also started from a 4 m high air intake and from September 2008 onwards, they were extended to 14-m elevation as well. Seven months of ozone data from 3 air intake levels: 4 m, 14 m and 30 m, respectively, are being compared and discussed here. The data have been analysed for background conditions as well as for air sampled during urban pollution episodes and biomass burning events.



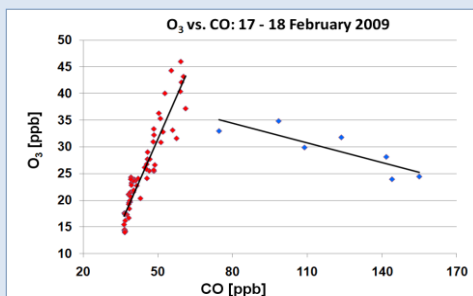
Plume of veld fire (17-02-08) moving over Cape Point (<http://modis.gsfc.nasa.gov>).



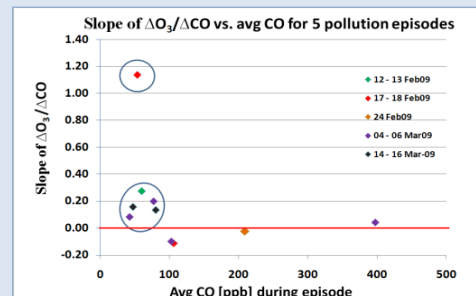
Three ozone air intake systems at Cape Point



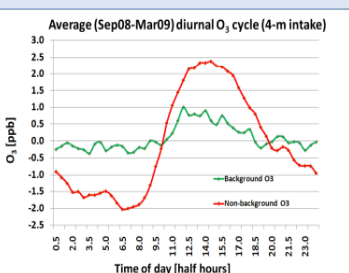
Five pollution episodes were selected from the period February–March 2009 (most of these were associated with biomass burning plumes). The O₃ levels observed at the three intakes, with differences sometimes > 65 ppb, do not reflect a consistent upward or downward gradient. It is speculated that these levels are haphazard and are a function of the individual fire plume.



Ozone shows either positive or negative correlations with the CO mixing ratios. These are indicative of conditions favourable for photochemical O₃ production or O₃ removal in polluted air masses, respectively. In most cases positive correlations and slope values of a linear regression ($\Delta[\text{O}_3]/\Delta[\text{CO}]$) were observed for daylight hours. However, there are cases where such ratios have persisted into the night hours.



The five pollution events are characterized by $\Delta[\text{O}_3]/\Delta[\text{CO}]$ ratios ranging from +1.14 to -0.11. Some episodes such as the one from the 4th – 6th of March encompass the whole range (day and night processes), whilst others (e.g. the 24th of February) indicate neither production nor destruction ($\Delta[\text{O}_3]/\Delta[\text{CO}] \approx 0$).



Average diurnal O₃ cycles (Sep 08 till Mar 09) for the 3 air intakes agree within the experimental error margin of 0.5 ppb. Shown here is O₃ (4-m intake) filtered via background and non-background CO. The former shows smaller diurnal cycling (1.2 ppb peak-to-peak) than the non-background data (4.4 ppb peak-to-peak). The latter is indicative of photochemical O₃ production during the day and possible O₃ loss (NO chemistry) at night.

Summary and Conclusions

- O₃ values from 3 analysers measuring air from 4, 14 and 30 m height, respectively, agreed within the analytical error margin of 0.5 ppb under background conditions.
- During pollution episodes (especially fire plumes) differences of > 60 ppb could be observed between the intakes. These differences are haphazard and do not represent a uniform upward or downward concentration gradient.
- $\Delta[\text{O}_3]/\Delta[\text{CO}]$ slope values during episodes varied between +1.14 and -0.11.
- Diurnal O₃ cycles showed amplitudes of only 1.2 ppb during background, but up to 4.4 ppb for non-background conditions, thus reflecting different air-chemical conditions on local to regional scales.