



## **A re-evaluated Canadian ozonesonde record: measurements of the vertical distribution of ozone over Canada from 1966 to 2013**

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In Canada routine ozone soundings have been carried at Resolute Bay since 1966, making this record the longest in the world. Similar measurements started in the 1970s at three other sites (Edmonton, Goose Bay and Churchill). These four sites switched to ECC sondes in 1980, and the network was subsequently expanded with the addition in 1987 of Alert, of Eureka in 1992 and in 2003 of four southern mid-latitude sites, Kelowna, Bratt's Lake, Egbert and Yarmouth.

The global ozonesonde record is increasingly important for understanding long-term changes in both tropospheric and stratospheric ozone, as both may be affected by changes in long-range quasi-horizontal transport, as well as by vertical exchange. Much effort has therefore gone into homogenization and re-evaluation of some of the longer time series from Europe and other parts of the world. As part of the SPARC/IO<sub>3</sub>C/IGACO-O<sub>3</sub>/NDACC (SI2N) initiative, Canada's important record has also been re-evaluated.

The Brewer-Mast sonde, used in the Canadian network until 1980, is somewhat different in construction from the ECC sonde, and the ECC sonde itself has also undergone minor design changes over the period 1980-2013. In order to produce a more homogeneous dataset, corrections have been made for the estimated effects of these changes.

The effect of the corrections is generally modest, and so should not invalidate past analyses that have used Canadian network data. However, the overall result is entirely positive: the comparison with co-located total ozone spectrometers is improved, in terms of both bias and standard deviation, and trends in the bias have been reduced or eliminated. An uncertainty analysis (including the additional uncertainty from the corrections, where appropriate) has also been conducted, and the altitude-dependent estimated uncertainty is included with each revised profile.

The resulting time series show negative trends in the lower stratosphere of up to 5% per decade for the period 1966-2013. Most of this decline occurred before 1997, and linear trends for the more recent period are generally not significant. The time series also show large variations from year to year. Some of these anomalies can be related to cold winters (in the Arctic stratosphere), or changes in the Brewer-Dobson circulation, which may thereby be influencing trends.

In the troposphere trends for the 48-year period are small, and for the most part not significant. Larger variations are seen for shorter periods, and interannual variability appears connected to that of the stratosphere: modest but statistically significant (95% confidence) correlations are found for the lowest stratospheric layers with all tropospheric layers. This suggests that ozone levels in the troposphere over Canada are partly controlled by stratospheric ozone.