Fine Particles and Ozone in Canada

A Canada-wide Standards Perspective

2003 National Summary

Executive Summary

An Environment Canada Staff Report

in Support of the Canada-wide Standards for Particulate Matter and Ozone

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October, 2005

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This report is available electronically at:
http://www.ccme.ca/assets/pdf/2003_pm_oz_ntnlsmryrpt_e.pdf

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Introduction

The air that we breathe contains many substances, including microscopic particulate matter (PM) and ozone (O_3), the two main components of summer smog. PM and ozone cause a number of health effects, including premature mortality, and they also adversely affect the environment. Recognizing the detrimental effects associated with PM and ozone, in June 2000 the Canadian Council of Ministers of the Environment (CCME) endorsed Canada-wide Standards (CWS) for PM and ozone which include ambient numerical targets to be achieved by 2010.

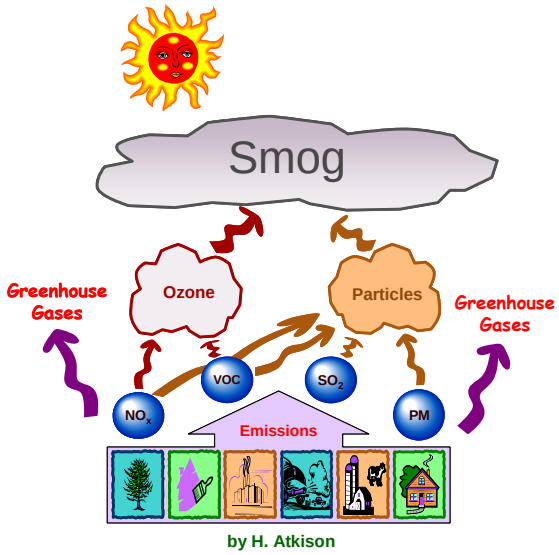
The ambient numerical targets (hereafter referred to as *standards*) are 30$\mu g/m^3$ for the fine size fraction of PM (i.e. $PM_{2.5}$) and 65 ppb for ozone. The levels to use for direct comparison to the standards (i.e. the *form* of the standards) are the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations for $PM_{2.5}$, and the 3-year average of the annual 4th highest of the daily maximum 8-hour average concentrations for ozone. The forms of these standards are referred as the *3-year averages*.

All ambient data are from the NAPS and CAPMoN monitoring networks.

This report includes information on the national anthropogenic emissions of the sources of PM and its precursors (the gases sulphur dioxide (SO_2), oxides of nitrogen (NO_x), ammonia (NH_3) and volatile organic compounds (VOC)), and ozone precursors (NO_x and VOC). Its main objective, however, is to present information on the 2003 ambient monitoring results for $PM_{2.5}$ and ozone based on the CWS numerics, including the 3-year averages for the period 2001-2003. Also included is an indication of how typical the $PM_{2.5}$ and ozone levels were in 2003, and information on trends in ozone levels. Trends in $PM_{2.5}$ levels could not be reported because of insufficient long-term data. The report also includes an Appendix that provides an update on the $PM_{2.5}$ measurement method path forward, additional information on the nature of PM and ozone, information on some of the methods adopted for data analysis, and identification of the considered monitoring stations.

Anthropogenic Emissions

In 2000, 7700 kilotonnes (kt) of the aggregated emissions of SO_2, NO_x, VOC and primary $PM_{2.5}$ were emitted in Canada from anthropogenic sources (excluding open sources). Industry was the largest emitter of the aggregated emissions followed by Transportation and Electricity Production. The Agriculture sector and the Pesticides and Fertilizer Applications sector were the two largest contributors to the national emissions of ammonia. Between 1990 and 2000, national NO_x emissions (excluding open sources) decreased by 6% and VOC emissions decreased by 15%. For both NO_x and VOC, reductions in emissions from On-road vehicles were partially offset by increases from the Upstream Oil and Gas Industry. National SO_2 emissions decreased by 27%, and National emissions of primary PM decreased by 30%.

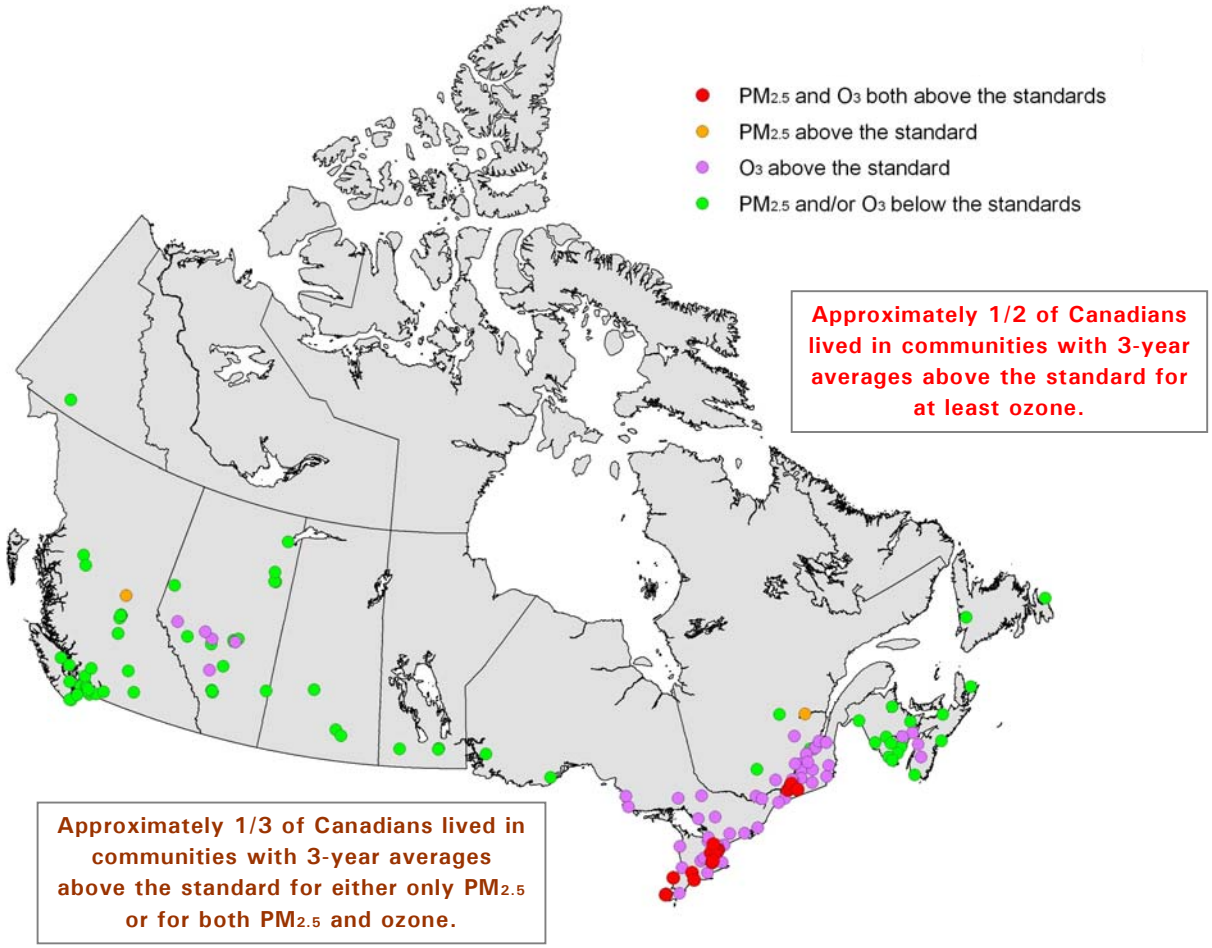


Comparison to the standards

The 3-year averages for 2001-2003 were computed for both $PM_{2.5}$ and ozone on a monitoring station basis for all stations that satisfied the applicable data completeness criterion. Figure 1 below indicates whether these 3-year averages are below or above the standards. Because a number of these stations are within a rural setting, because not all stations in a given community are necessarily CWS reporting stations, and because CWS achievement reporting is on a community basis, the information in the Figure is not to be construed as being formally indicative of the achievement status of the standards for any of the communities in which the monitoring stations are located.

Saskatchewan, Manitoba and Newfoundland where the only three regions with 3-year averages below both standards at all considered stations. In British Columbia, only one station in the interior of the province recorded a 3-year average above the standard for $PM_{2.5}$, and in Alberta and Atlantic Canada only the ozone 3-year average was above the standard at some stations. In Ontario and Québec, most stations recorded an ozone 3-year average above the standard, and many stations (mostly in southern Ontario and Montréal) recorded 3-year averages above both standards.

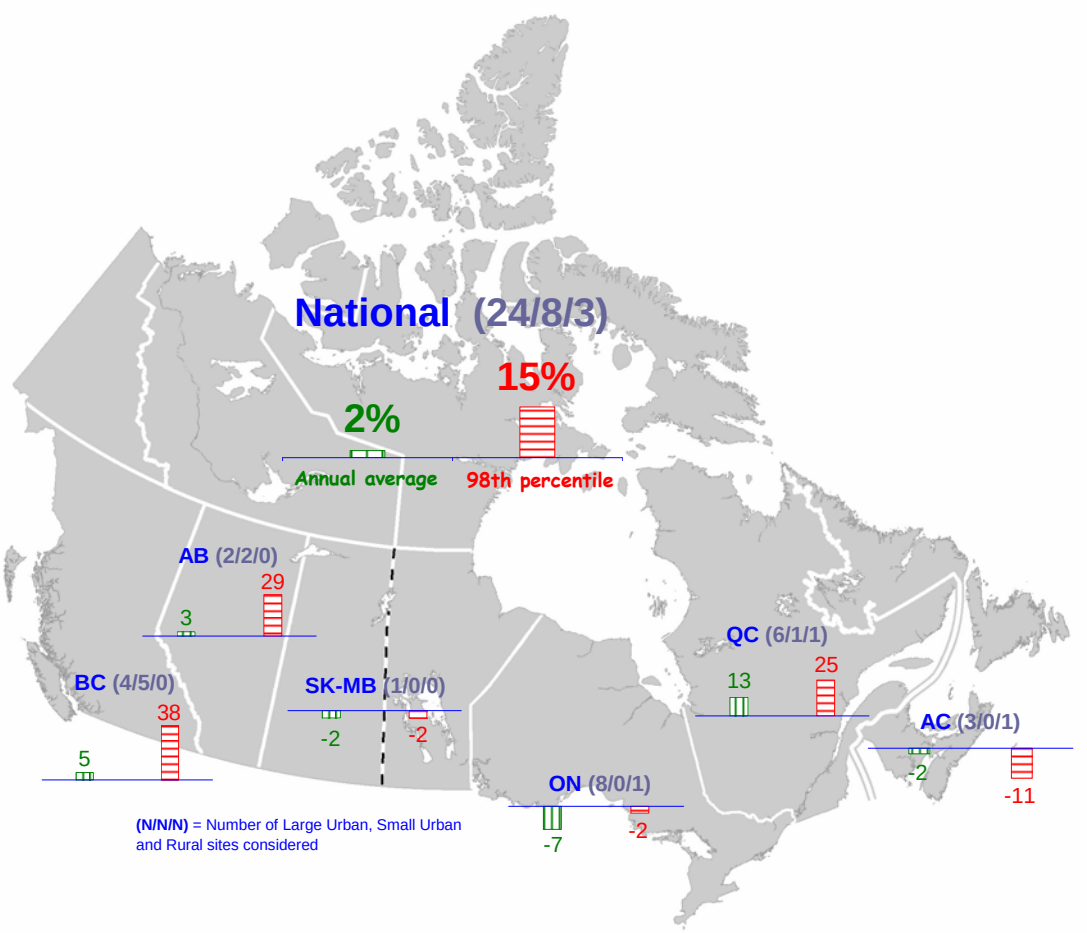
Figure 1: Stations below and above the $PM_{2.5}$ and ozone standards.



2003 Compared to previous years

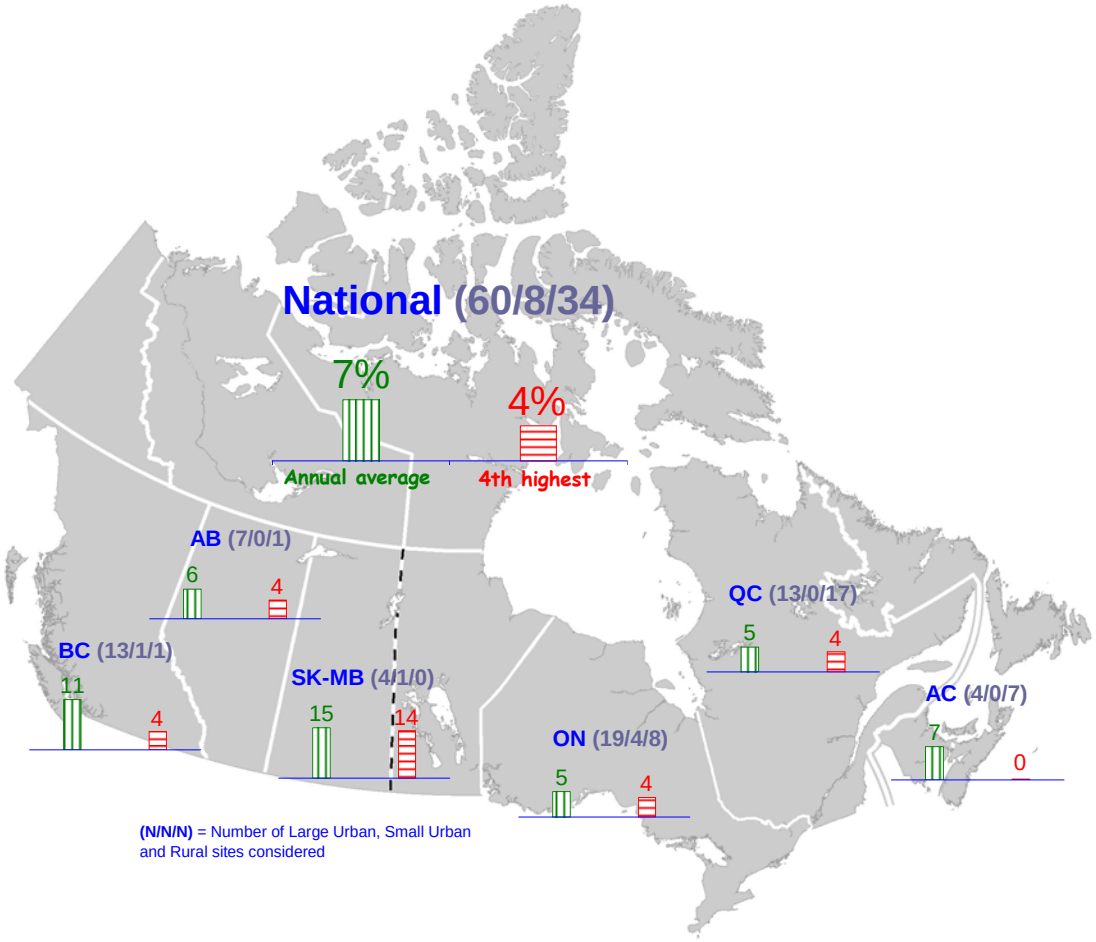
The 2003 regional annual average and 98th percentile of the daily 24-hour average $PM_{2.5}$ concentrations were compared to those over the previous four years (1999-2002) to obtain an indication of how typical the levels were in 2003. Figure 2 below indicates the percentage difference between the levels in 2003 and the average of those over the previous four years. Nationally, 2003 was more or less typical of the previous 4-years with respect to the annual average, and a high year for the 98th percentile. Regionally, 2003 was a slightly low year in Saskatchewan-Manitoba, Ontario and Atlantic Canada, and a high year in Québec. In Alberta and British Columbia, 2003 was a slightly high year with respect to the annual average, but a very high year for the 98th percentile.

Figure 2: Percentage difference between the $PM_{2.5}$ levels in 2003 and the average of those over the previous four years.



For ozone, to obtain an indication of how typical the levels were in 2003, the 2003 regional annual average and regional annual 4th highest of the Dmax 8-hour O_3 were compared to those over the previous ten years (1993-2002). Figure 3 below indicates the percentage difference between the levels in 2003 and the average of those over the previous ten years. The year 2003 was a slightly high year nationally and also regionally in Alberta, Ontario, Québec and Atlantic Canada. In BC, 2003 was a slightly high year for the 4th highest, and a high year for the annual average. In Saskatchewan-Manitoba, 2003 was a high year for both the annual average and annual 4th highest.

Figure 3: Percentage difference between the 2003 ozone levels and the average of those over the previous ten years.

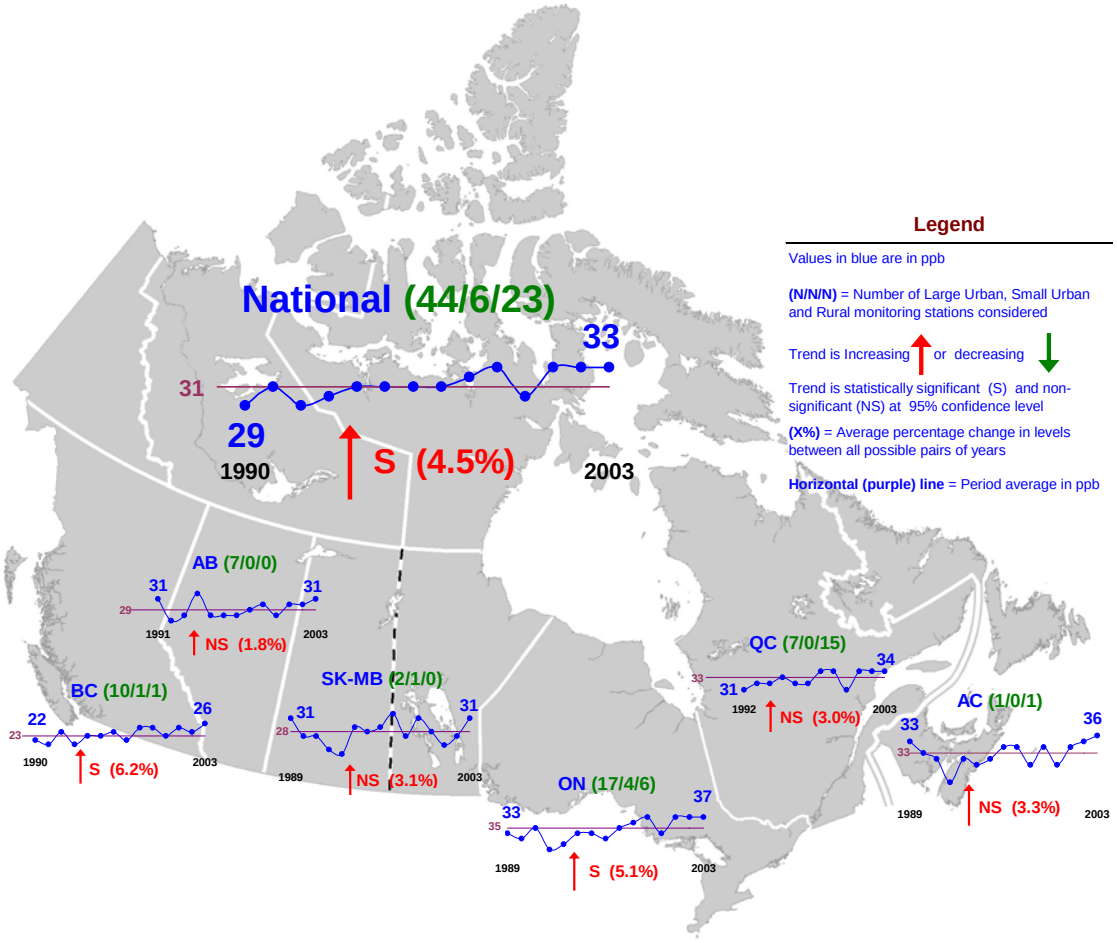


Trends in Ozone Levels

Trends in ozone levels were evaluated for the regional (and national) annual average and the annual 4th highest of the Dmax 8-hour O_3 for (up to) the 15-year period from 1989 to 2003 based only on stations that satisfied stringent data completeness requirements.

The trends in the annual average Dmax 8-hour O_3 are indicated in Figure 4 below. The annual average Dmax 8-hour O_3 increased nationally and also in each of the six regions considered. The trends were statistically significant nationally and in British Columbia and Ontario, and non-significant in the other regions. The largest increases occurred in BC and in Ontario.

Figure 4: Trends in the regional annual average Dmax 8-hour O_3.



Trends in the annual 4th highest Dmax 8-hour O_3 are indicated in Figure 5. Nationally, the annual 4th highest Dmax 8-hour O_3 remained essentially unchanged over the 15 years. Regionally it increased in Québec, Ontario, Saskatchewan-Manitoba and Alberta, and it decreased in Atlantic Canada and BC. None of these trends, however, were statistically significant.

Figure 5: Trends in the regional annual 4th highest Dmax 8-hour O_3.