Okanagan Air Quality Technical Steering Committee (1995)

In August of 1995 the Okanagan Air Quality Technical Steering Committee (O.A.Q.T.S.C.) was formed. It is comprised of the City of Kelowna, Ministry of Environment, North Okanagan Regional District, Ministry of Health, Okanagan University College, Ministry of Forests, Riverside Forest Products, and Environment Canada. The committee was formed with the following objectives:

- To establish a proactive approach to managing air quality within an area defined as the Okanagan Valley Airshed.
- To maintain and enhance air quality from a health, environmental and aesthetic perspective.
- To accomplish the above in accordance with local, regional, provincial and national air quality objectives.
- To provide technical based air quality information to local government and public agencies.
- To increase public awareness of local and regional air quality issues.
- To determine air quality monitoring and related research needs for the Okanagan airshed.
- To develop short term and long term technical recommendations for maintaining and/or improving air quality (O.A.Q.T.S.C., 1997).

The O.A.Q.T.S.C. has made several accomplishments since its establishment in 1995. There has been collaboration between agencies on research and funding to gain a better understanding of the Okanagan Airshed. In addition, the O.A.Q.T.S.C. supplies information to the newly formed Regional Air Quality Committee and also provides information to local media to raise public awareness on air quality issues.

Other Links:

Summer 1998 Air Quality Monitoring Project (Ozone & PM10)

Tropospheric Ozone Regimes in the Semi-Arid Interior of Southern British Columbia (Executive Summary, Conclusions and Recommendations)

Time Lapse Video Study

An Examination of Mesoscale Wind Flows within the Okanagan Airshed

Summer 1998
Air Quality Monitoring Project

Submitted by: Dr. Graham Bruce, OUC and
Ms. Tracy Gow, City of Kelowna

January, 1999

Table of Contents

1. Preamble

Two groups within the Central Okanagan are directly involved in addressing aspects of regional air quality: the City of Kelowna's Okanagan Air Quality Technical Steering Committee (OAQTSC) and the Regional District of the Central Okanagan's Air Quality Committee (RDCO-AQC).

In order to have a more comprehensive overview of regional air quality the OAQTSC identified a need for additional spatial measurements of air quality parameters, particularly ozone and PM_{10} (the main contributors to poor air quality episodes in the region). With this in mind, it was suggested that a request be made to have the Provincial Ministry of Environment Mobile Air Monitoring Station located in the Central Okanagan during the summer of 1999. For optimum use of the mobile monitor, locations should be predetermined to maximize sample time and minimize costs. To accomplish this, it was decided that during the summer of 1998 an air quality-monitoring project be carried out. Specifically, this project would utilize low cost passive samplers to measure ozone and portable monitors to measure PM_{10} at several sites within the Central Okanagan.

This report summarizes the data obtained by the monitoring project. In addition, some provisional analyses of data obtained from the Provincial monitoring stations are also included.

2. Introduction

The air quality in the Central Okanagan, as expressed by the BC Government's Air Quality Index, is for the most part classified as "good" (89% in 1997), however there are periodic episodes of "fair" (11% in 1997) and "poor" (less than 1% in 1997) indices (City of Kelowna, 1998). The two major contributors to these incidences of unsatisfactory air quality are:

(a) particulate matter less than 10 μm (micrometers) in diameter (PM_{10}) and
(b) Ozone gas.

Both pollutants can pose as health hazards; particulate matter can lead to unsightly haze, and ozone, which can reduce crop yields and attack materials (such as plastics), also, has the potential to promote unsightly photochemical smog (Bunce, 1991)

The major air pollutants (ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide, PM_{10}) are continuously monitored by the Provincial Ministry of Environment at Okanagan University College's (OUC) KLO Road campus. In 1997, a $PM_{2.5}$ monitor was added to the system. Hourly and daily average values for the aforementioned pollutants are entered into a Provincial database.

The air quality data collected is used to generate the Air Quality Index (AQI). On comparing data over several years trends in air quality may be identified. The development of a regional air quality model would attempt to correlate these trends with such variables as population growth, combustion activities, traffic patterns, industrial and agricultural practices and meteorological parameters such as temperature, wind speed, sunlight intensity, air stability, etc. The model could then be used to predict future trends in air quality. The development of such a model is a long-term goal of the OAQTSC, and would be of value to local representatives charged with implementing air quality initiatives.

In the short term the OAQTSC identified the need for additional data at locations other than that of the Provincial monitor. The KLO Road site is centrally situated but it is unknown if the data collected is representative of the whole region. It is possible to request the Provincial Ministry of Environment mobile monitoring unit to be used for a regional study. The set-up time, however, would restrict its use to only a few sites during a summer sampling program. In addition, the operating costs of the unit are a factor in the feasibility of a mobile monitor study.

In order to help determine potential locations to situate the mobile monitor for its optimum use, the OAQTSC initiated a low cost study of the spatial variation of ozone and PM_{10} in the Central Okanagan during the summer, 1998. In 1994-95, a similar study was carried out using atmospheric nitrogen dioxide as the target analyte. It was found that the Province's KLO Road monitor consistently registered readings that were low in comparison to other sites. Sites adjacent to the Highway 97 recorded values up to 250% greater than those obtained at KLO Road (Bruce and Gow, 1997). This is not surprising as nitrogen dioxide is produced indirectly from vehicle emissions.

The OAQTSC requested support for the ozone/PM_{10} spatial variation-monitoring program. Grants for the project were received from the RDCO, Okanagan University College, and Deep River Science Academy and, later from CPPI (Canadian Petroleum Products Institute). The City of Kelowna also supported the project through an in-kind donation of staff time.

Sampling and analyses were carried out by OUC students, Deep River Science Academy students as well as by the authors of this report.

3. Project Description

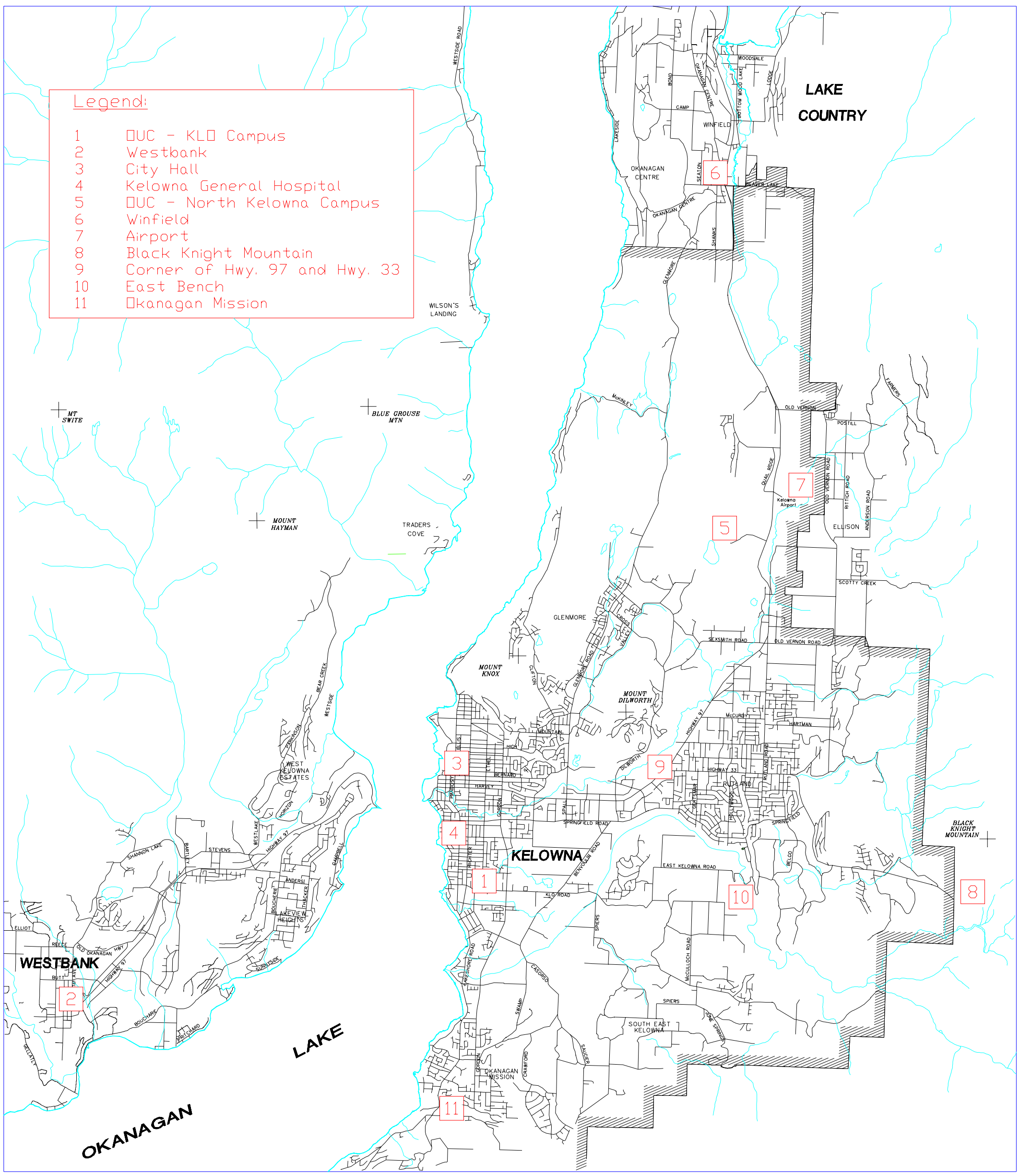
3.1 Ozone Monitoring Project

Monitoring ozone at a number of sites using monitors similar to that at the Provincial Monitoring Station at KLO Road would require a large capital outlay. Inexpensive low-tech passive monitors that gather data averaged over several days have recently been developed for ozone determinations. A comparison of two commercially available passive monitors was carried out in May/June. A sampler produced by

Maxxam Analytics (Edmonton) was established as being superior to a US manufactured device and was selected for use in the project. In addition, it was also more economic to purchase and operate.

Passive ozone monitors were placed at ten representative sites, from Winfield to Westbank (see Figure 1). A control monitor was situated adjacent to the Province's KLO Rd. monitor. The passive monitors contain a chemical that reacts with atmospheric ozone. After the 7-day sampling period, the monitors were returned to the Chemistry Laboratories at OUC where the extent of ozone induced chemical reaction was measured using an ion chromatograph. The data obtained was then converted to a weekly average ozone concentration.

Figure 1: Monitoring Locations



3.2 PM_{10} Monitoring Project

The Provincial Ministry of Environment provided 4 portable MiniVol PM_{10} air sampling monitors for the project. These devices pump air, at a known flow rate, through a filter that traps the particulate matter less than 10 μm in diameter. The change in mass of the filter divided by the volume of air passed through the filter gives a PM_{10} value, in micrograms per cubic meter.

The four filter units were placed at sites in Winfield, Westbank, City Hall and East Kelowna. Sampling was carried out for 24 hours every three days, from May until mid-November. Alternate sampling dates correspond with the National Air Pollution Surveillance Network (NAPS). This is a network of Federal Government high volume air samplers that run at various locations across Canada every 6 days. Data collected during the sampling period will be entered into the NAPS database. Battery problems occurred when the temperatures dropped resulting in poor data capture in October and November. The filters were sent for weighing to the "AIRmetrics" Laboratory in Oregon.

4. Data

4.1 Ozone Data

The data in Table 1 indicates the ozone determinations for two series of sites. The agreement between the passive (KLO) and continuous monitors at KLO Road (Actual) were within about 15% of each other. This variation is typical in comparing the two different technologies.

Table 1 – Weekly Averaged Ozone Concentrations in parts per billion, ppb.

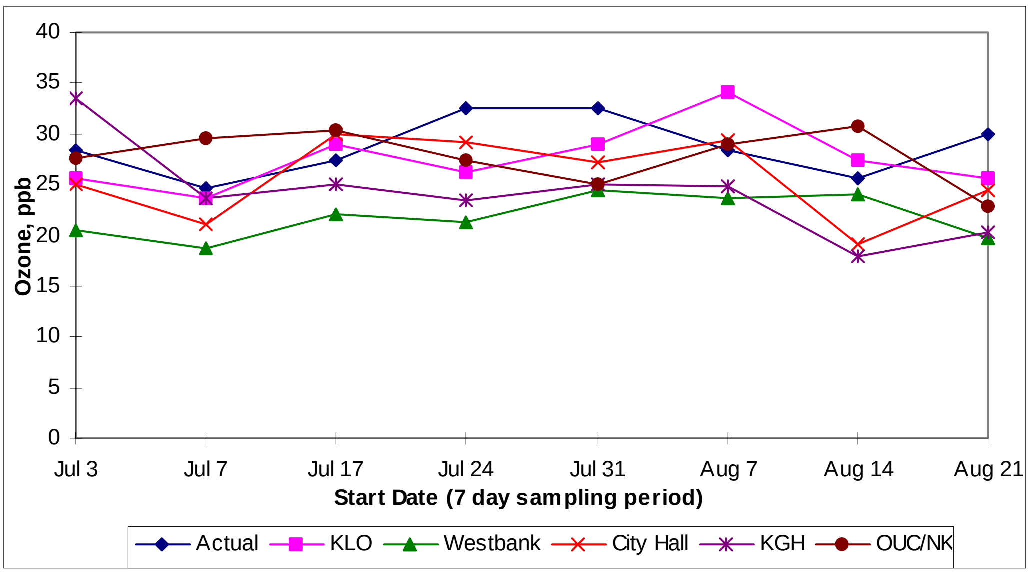
Period	Actual	KLO	Westbank	City Hall	KGH	OUC/NK
July 3-10	28.4	25.6	20.5	25.1	33.5	27.6
July 10-17	24.6	23.6	18.7	21.1	23.6	29.5
July 17-24	27.4	28.9	22	30	25	30.4
July 24-31	32.5	26.3	21.2	29.2	23.4	27.4
Jul 31-Aug 7	32.5	28.9	24.5	27.2	25.1	25
Aug 7-14	28.4	34	23.6	29.3	24.9	28.9
Aug 14-21	25.7	27.3	24.1	19.2	18	30.7
Aug 21-28	30	25.6	19.8	24.4	20.3	22.8
Average	**28.7**	**27.5**	**21.8**	**25.7**	**24.2**	**27.8**

Period	Actual	Winfield	Airport East	Black Knight	Corner Hwy 97/33	East Bench	Okanagan Mission
July 7-14	30.5	18.8	28.6	20.4	25.1	19.8	22.7
July 14-21	22.8	18.3	24	18.3	17.4	20.7	20.4

July 21-28	29.9	18.2	28.9	24.2	24.1	31.3	30.2
Jul 28-Aug 4	32.6	24.3	33.2	28.1	20.8	25	27.3
Aug 4-11	32.1	28.3	32.6	35.6	26.3	29.1	27.6
Aug 11-18	28.3	27	36.4	32.6	30	32.7	31.6
Aug 18-25	26.4	17.9	27.1	24.4	15.6	18.2	16.6
Average	**28.9**	**21.8**	**30.1**	**26.2**	**22.8**	**25.3**	**25.2**

The data from Table 1 is shown graphically in Figure 2. With a few minor exceptions the general shapes of the graphs are similar. The weekly average ozone concentrations throughout the two-month sampling period follow similar trends at all the sites.

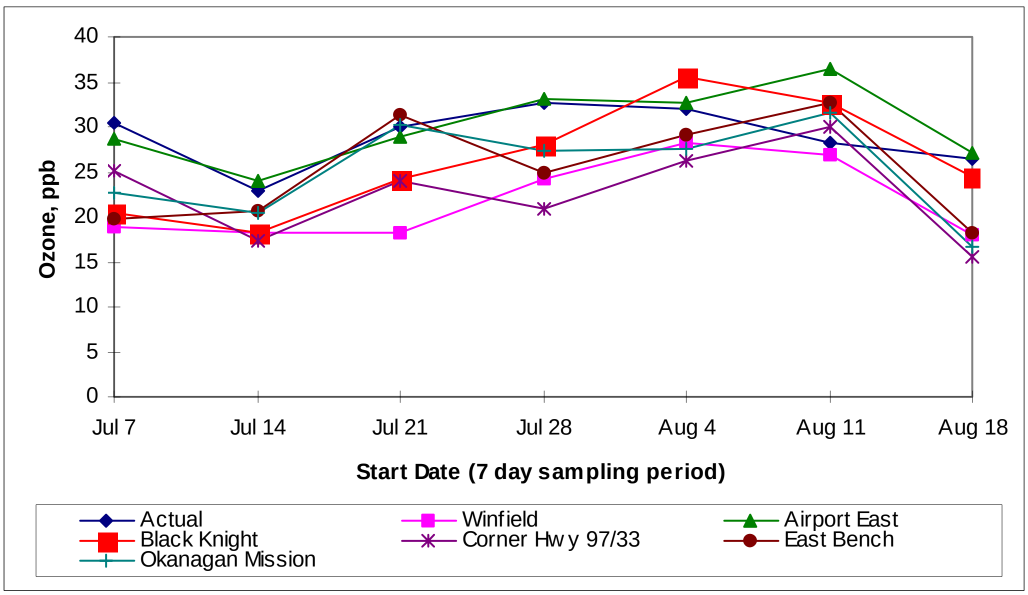
Figure 2: Variation of ozone concentration at each sampling site with time



The average ozone concentration at each site is also indicated in Table 1. The Westbank and Winfield locations have values about 30% lower than the other locations. The corner of Highways 97/33 also has a low value, which may be related to the high nitrogen dioxide concentration, found at this site in a previous study. The other sites have remarkably similar values.

This indicates that ozone is generated and dispersed fairly evenly throughout the City but is lower at the northern and southern extremes of the region. It can be concluded that the data obtained at the Provincial monitor is certainly representative of the City's air quality, unlike the nitrogen dioxide variations found in the 1994/95 study.

Ozone studies in the Fraser Valley show peak ozone concentrations at Abbotsford, down wind from the pollutant gases generated by vehicles in the Vancouver region and carried to Abbotsford by prevailing winds (BC

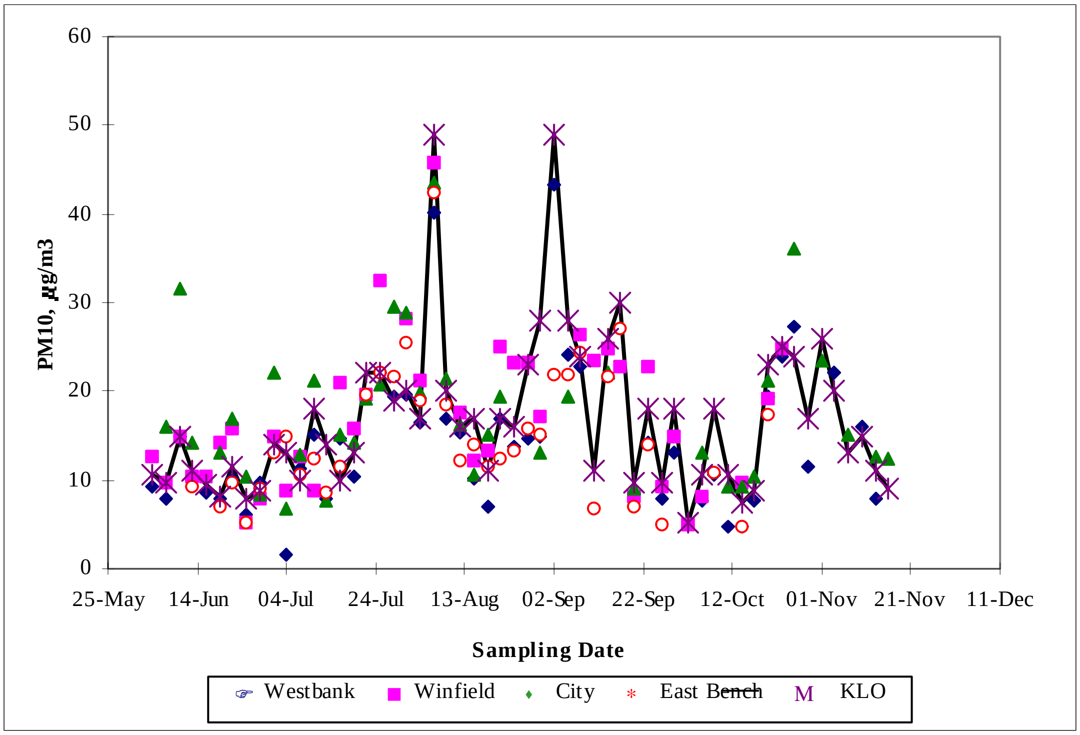


Environment, 1992). Is there a similar ozone plume downwind (east) from the traffic areas in the Central Okanagan? This study did not establish the presence of such a plume, further studies are required to establish this conclusively.

4.2 PM_{10} Data

The data obtained from the 4 monitoring sites as well as the KLO monitor is shown graphically in Figure 3. Outstanding features in the data are the spikes in the graph coincident with the two major forest fires near Salmon Arm and Tulameen. A bulge in October/November may be indicative of the agricultural burning period and/or the onset of the use of domestic wood-burning appliances in response to cooler weather. With a few exceptions the data points on a particular sampling day do not exhibit a large spread.

Figure 3: Variation of PM_{10} Concentration with time at each sample site.
Note that the solid line represents the data from the Provincial KLO Road Monitor.



Average values of PM_{10} obtained at the 5 sites, in $\mu g/m^3$, are:

- Westbank 14.4
- Winfield 17.0
- City Hall 17.5
- East Bench 15.0
- Provincial Monitor 16.9

Similar to the ozone results, variations are not large, of the order of 20% difference between the largest and smallest.

Comparing the data at the 5 sites it is apparent that again the KLO Rd monitor data gives a good estimate of the regional PM_{10} dispersion. This is probably because particles in the coarse fraction of PM_{10} stay in the atmosphere for a few hours to a few days, and the fine fraction of PM_{10} can remain in the air for days to and hence are dispersed fairly evenly throughout the airshed (BC Environment, 1994).

4.3 Other Data

4.3.1. Comparison of Kelowna and Vernon Data

The above data on ozone and PM_{10} indicates a fairly even dispersion of these pollutants in the Central Okanagan. It is unknown whether this generalization can be extended to the whole Okanagan Airshed. There are no permanent air monitors in Vernon or Penticton. However, the Province situated their mobile monitoring unit in Vernon from December 1996 until May 1997. It is difficult to make conclusions on just a few data points but a remarkably strong correlation appears between the PM_{10} and ozone data for the two cities, see Figures 4 and 5. The plotted values are for monthly averages. The equivalent graphs for nitrogen dioxide, Figure 6, show almost no correlation.

Figure 4a: Comparison of PM10 monthly average data between Kelowna and Vernon, 1995-96

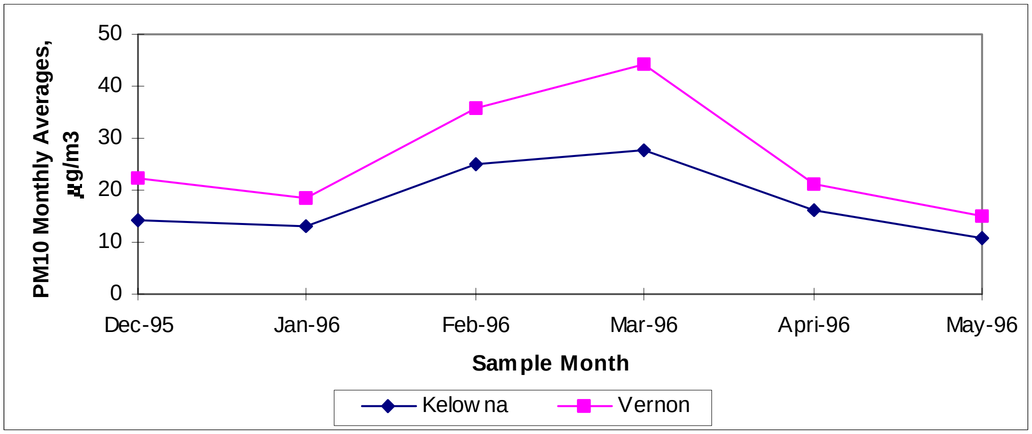

PM10 Monthly Averages, µg/m3
50
40
30
20
10
0
Dec-95
Jan-96
Feb-96
Mar-96
Apri-96
May-96
Sample Month
Kelowna
Vernon

Figure 4b: PM_{10} Correlation between Vernon and Kelowna

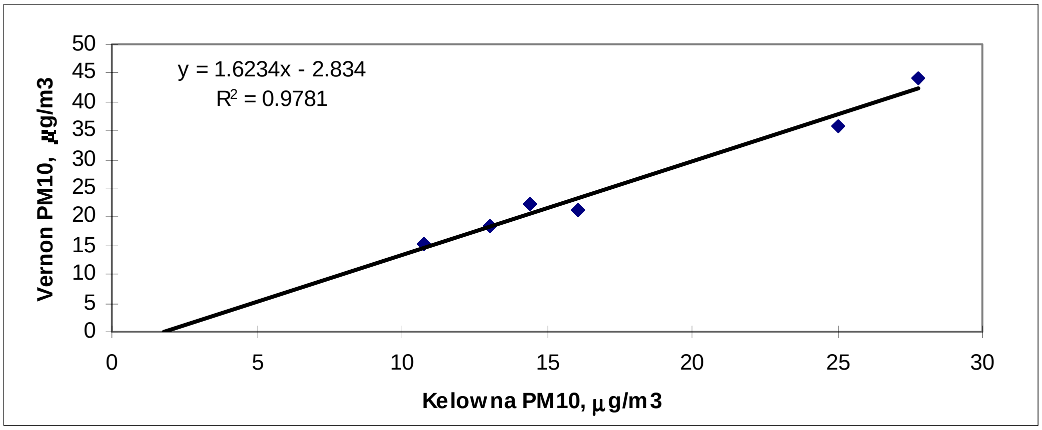


Figure 5a: Comparison of monthly average ozone data between Kelowna and Vernon, 1995-96

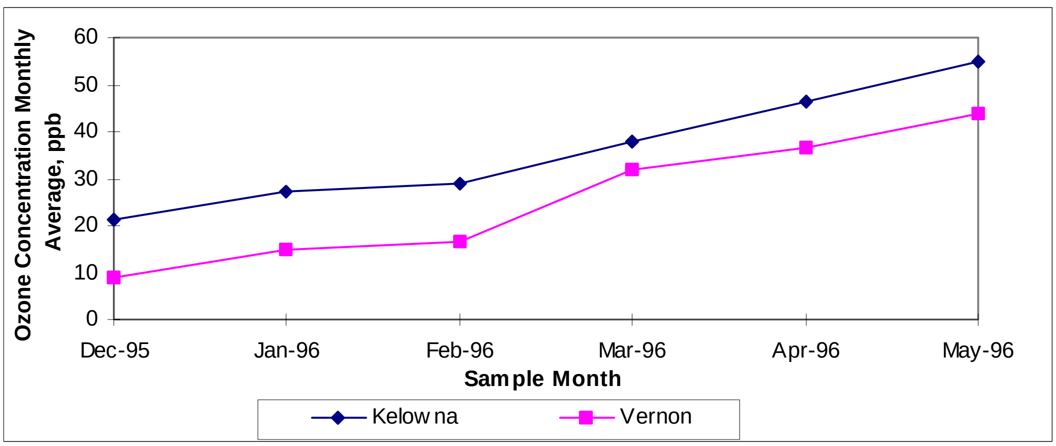


Figure 5b: Ozone Correlation between Vernon and Kelowna

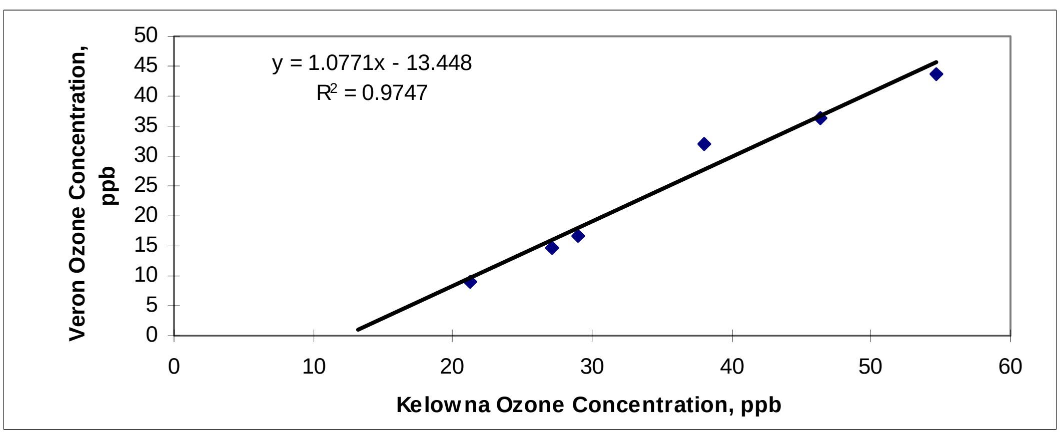


Figure 6a: Comparison of monthly average nitrogen dioxide data between Kelowna and Vernon, 1995-96

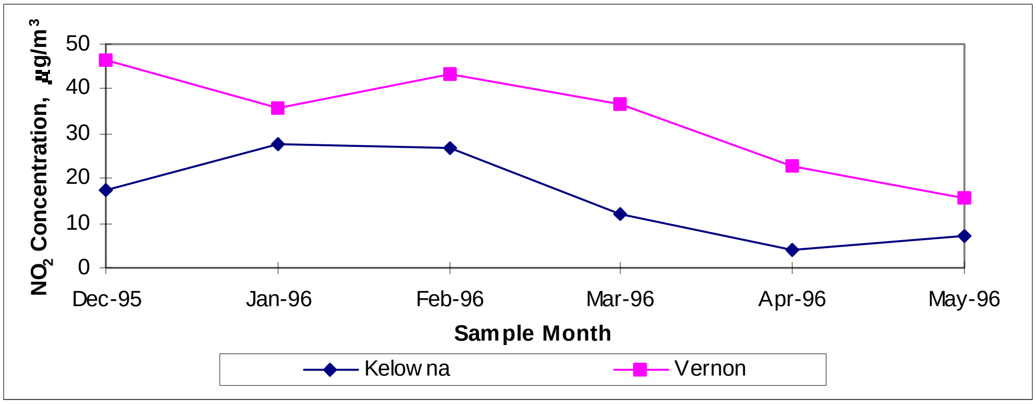
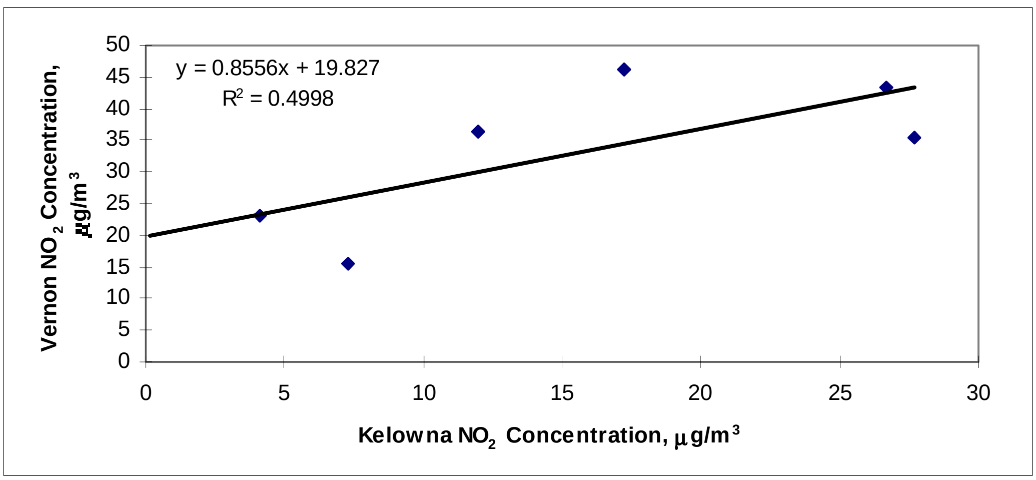


Figure 6b: NO_2 Correlation between Vernon and Kelowna



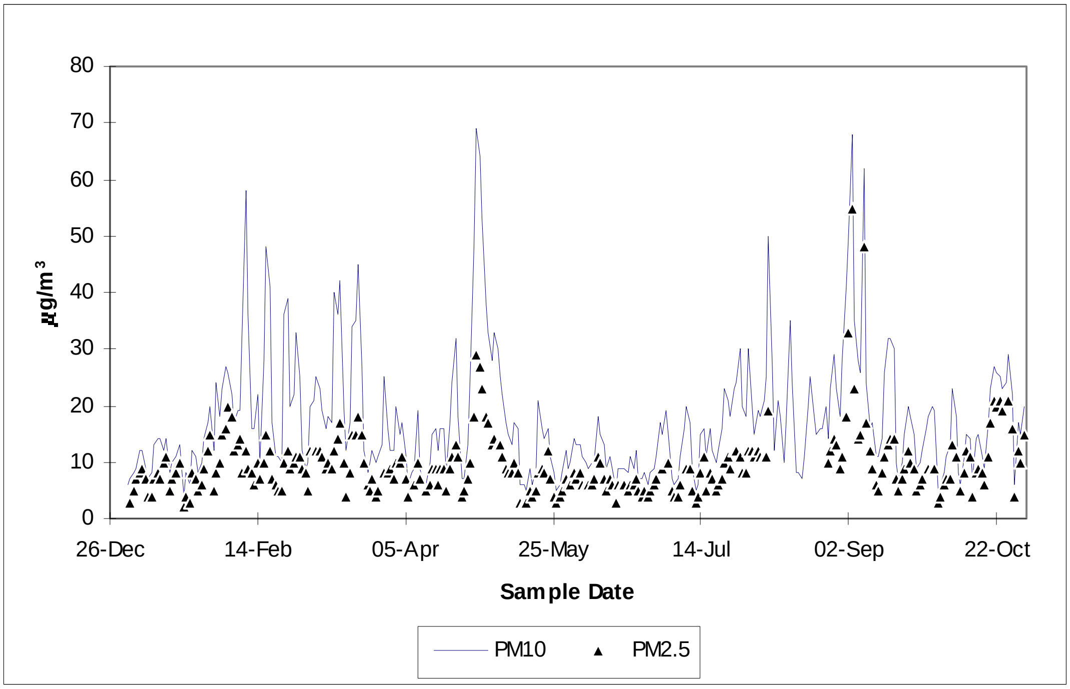
It may be concluded, within the reservations of considering only a few data points, that there is indeed a proportionality between the monthly averaged ozone and PM_{10} values measured in Kelowna and Vernon. PM_{10} is close to 50% higher in Vernon than Kelowna and ozone is about 45% higher in Kelowna than Vernon. It should be noted that the data from a summertime study, the peak ozone production period, may contradict these findings.

4.3.2. Correlation between $PM_{10}/PM_{2.5}$

Although PM_{10} has been measured in Kelowna, $PM_{2.5}$ has only been monitored since 1997. In the US a recommended standard for $PM_{2.5}$ has been established. This is because particles less than 2.5 µm in diameter are liable to be inhaled more deeply into the lung causing breathing difficulties and sometimes permanent damage to lungs (BC Environment, 1994).

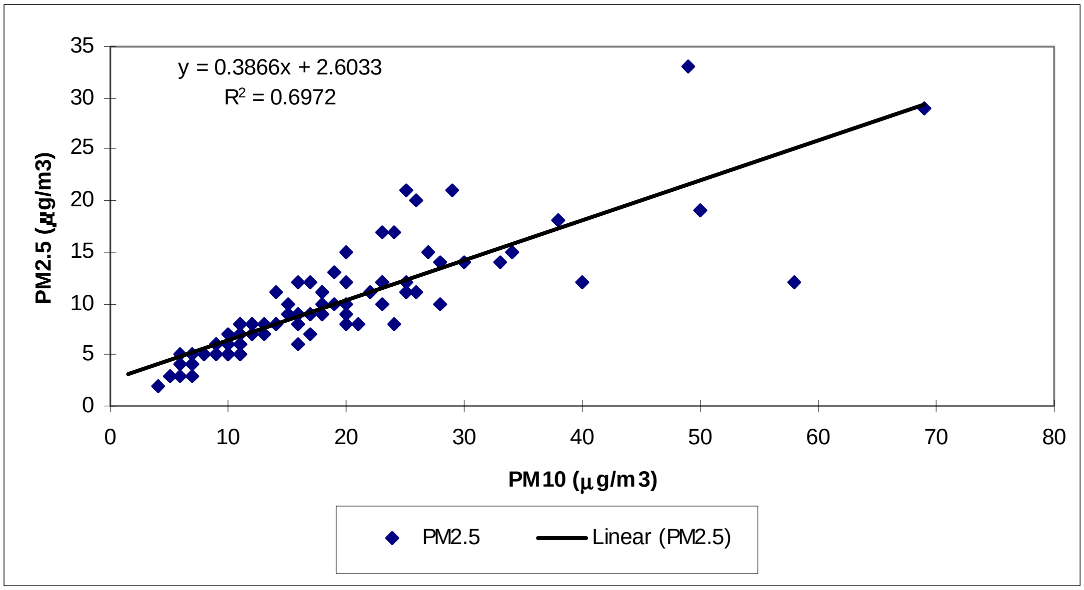
Is there a correlation between PM_{10} and $PM_{2.5}$ as measured in Kelowna? A correlation between the two may indicate a constancy of source. Figure 7a shows the daily average values of PM_{10} and $PM_{2.5}$ for January to November, 1998.

Figure 7a: Comparison of Kelowna PM_{10} and $PM_{2.5}$ Data 1998



When plotted against each other (Figure 7b) the data indicates a good linear relationship at low PM_{10} values becoming much more scattered at higher values. The $PM_{2.5}$ is approximately 60% of that for PM_{10}.

Figure 7b: Correlation between $PM_{10}/PM_{2.5}$



4.3.3. Annual Trends

The Provincial KLO Road monitor has been fully operational for 5 years although ozone data has been collected for 15 years. Can trends in Okanagan Air Quality be detected from this data set?

Monthly averaged values for ozone and PM_{10} are plotted for each year in Figures 8 and 9.

Figure 8: Variation of Kelowna's Average Monthly PM10 Data (1994-1998)

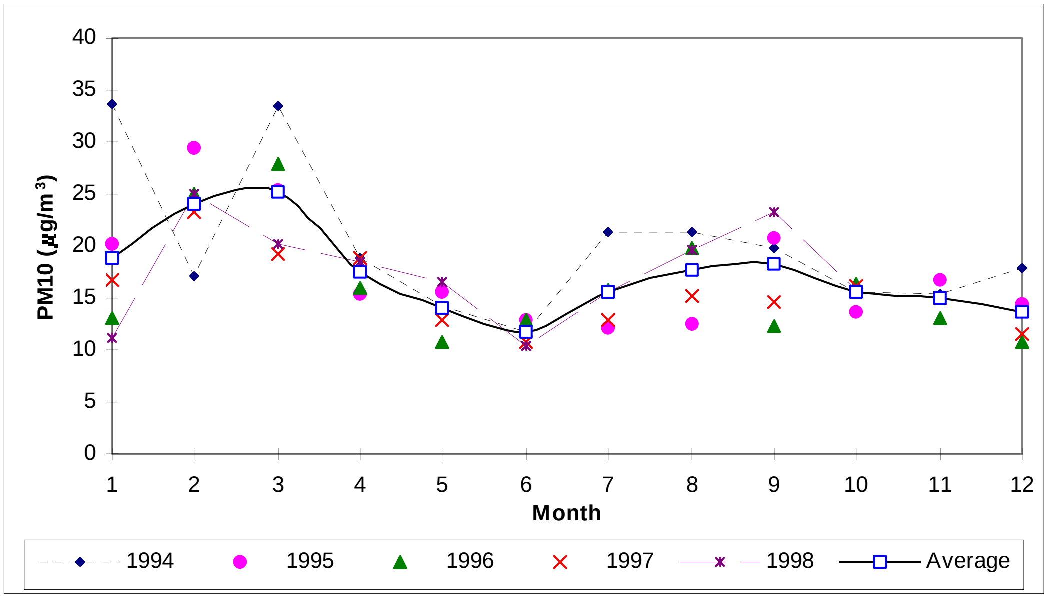
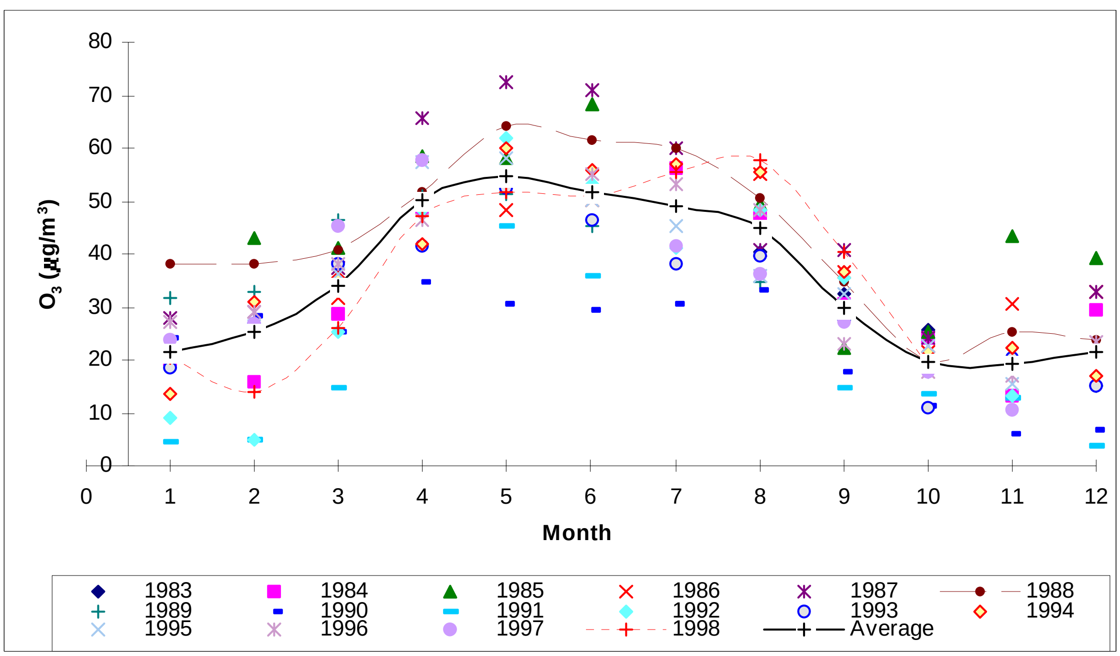


Figure 9: Variation of Kelowna's Average Monthly Ozone Data (1983-1998)



In each case only broad generalizations may be made. Spurious data points need to be investigated more thoroughly.

The 5 years of monthly average PM_{10} data (Figure 8) show no obvious trends to suggest that the air quality is changing.

For ozone there are very large extremes in values varying from 1990 a good year to 1987 a bad year. The graphs show lines drawn to compare 1998 with 1988 and also the overall 15-year monthly average. At a glance it appears that this year, 1998, had below average ozone for the first six months and above average for the next 4 months. The November and December data were not included in the Provincial database at the time of writing this report.

From a cursory examination one cannot conclude that there has been a measurable change in average monthly ozone concentrations over the past 15 years.

5. Conclusions

It should be emphasized that the concentration of ozone, PM_{10}, nitrogen dioxide, etc. are constantly changing and that weekly averaged data will not detect short term fluctuations in these parameters.

- The ozone monitoring indicates that there may be a concentration of ozone in the central "bowl" of the Central Okanagan region. Concentrations of this gas in Winfield, Westbank are at least 30% lower. Comparison of limited data between Vernon and KLO Road showed a similar trend. The KLO Rd continuous monitor gives good representative ozone values for the City and its immediate environs.

- The concentration of PM_{10} appears to be fairly evenly dispersed within the region with differences of 10% between the urban and more rural monitoring sites.

- There is a reasonably strong correlation of monthly averaged ozone and PM_{10} values between Kelowna and Vernon. This is not the case for nitrogen dioxide.

- At concentrations less than 30 $\mu g/m^3$, there is reasonably strong correlation between PM_{10} and $PM_{2.5}$ as measured by the KLO Rd. monitors. This may reflect a constancy in the sources of these particles.

- Preliminary comparisons of ozone data accumulated over the past 15 years and PM_{10} over the past 5 years do not indicate noticeable trends - the air quality has not dramatically changed.

- There appears to be no need to request that the Provincial mobile monitor be used in the Central Okanagan in 1999.

6. Further Studies

The following outlines potential further studies that could be completed for the Central Okanagan to gain further understanding about the air quality in the region.

- **Correlations Between Air Quality Variables.** It is most unfortunate that the position of Air Quality Meteorologist, previously occupied by Peter Reid, has not received funding. This means continuous interpretation of the air quality parameters being measured by the Province's monitor in Kelowna is not being done. There is a need for a comprehensive statistical analysis of this large database to ascertain correlations between variables in order to identify trends in air quality parameters. The data from 15 years of ozone measurements is a prime candidate for multivariate analysis.

- **Valley-Wide Study of Ozone and PM_{10}.** Preliminary studies between Vernon and Kelowna show a strong correlation for ozone and PM_{10} between the two locations, the data, however, is very limited. A 12-month study at several locations from Armstrong to Osoyoos, would help establish a better pollutant profile.

- **Source and Content of PM_{10}.** A survey initiated by the City of Kelowna identified that the public regarded air quality as the environmental issue of greatest concern (Benchmark Research Inc., 1998). The two major contributors to low air quality in the Central Okanagan are PM_{10}, which drives the air quality index about 65% of the time, and ozone, responsible for the remaining 35%. There is a need to identify and quantify the PM_{10} sources and to analyse PM_{10} material for inorganic and organic content.

- Volatile Hydrocarbon Study. **The Okanagan could be prone to incidences of toxic and unsightly photochemical smog. High summertime temperatures, strong sunlight and high concentrations of ozone, nitrogen dioxide and hydrocarbons are the essential ingredients for smog formation. A further study could be to analyze and identify the volatile hydrocarbons in the atmosphere and to determine their sources.**

- **Air Quality and Health Degradation Study**. A major concern of poor air quality is the effect that it may have on those with weak respiratory systems - especially, infants, the elderly and those with identifiable respiratory ailments, such as asthma. There is a need to gather information that may correlate degradation of air quality with degradation of health. A recent Federal Government announcement by the Ministries of Health and Environment indicates that funding is available for such a study. The application deadline for this year is February 26, 1999.

7. Acknowledgments

The 1998 monitoring project was initiated by OAQTSC, chaired by Mark Watt. Funding was gratefully received from RDCO-AQC, Okanagan University College, CPPI (Canadian Petroleum Products Institute), Deep River Science Academy and an in-kind donation from the City of Kelowna.

Credit and thanks are accorded to Mr. Steve Josefowich, Air Quality Technician with BC Ministry of Environment, Lands and Parks who obtained the PM_{10} samplers, arranged for their set-up and servicing, trained our technicians in their operation and also arranged for funding to purchase the air filters and their laboratory processing costs.

Dr. Hongmao Tang of Maxxam Analytical, supplier of the ozone samplers, should also be acknowledged for twice visiting Kelowna to help with method development, data handling and quality control. His enthusiasm is infectious.

Finally, full credit must go to Mr. Mike Wilson and Ms. Teresa Rawsthorne, students from OUC, who were responsible for most of the sampling and laboratory analysis.

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Tropospheric Ozone Regimes in the Semi-Arid Interior of Southern British Columbia

Report by: BC Ministry of Environment, Lands and Parks (November 1997)
Peter D. Reid, M.A., BC Ministry of Environment, Lands and Parks
Christopher Hepworth, University College of the Cariboo

Executive Summary

Traditional ozone summaries (1-hour, 24-hour, and annual mean) reveal very little about the differences between sites with different ozone regimes. For example, using traditional ozone summaries it may be impossible to distinguish large urban areas from areas affected by transport from large urban areas. Medium sized urban areas may be indistinguishable from remote rural sites. These regimes are easily discerned utilizing the concept of diurnal-curve space.

Three scientific papers by Bohm, McCune and Vandetta (1991, 1995a, 1995b) outline a novel approach to classifying ozone regimes utilizing the concept of diurnal-curve space. Unlike traditional summaries this method involves examining both the 24-mean ozone value (y-axis or magnitude) and the shape of the daily curve (x-axis or standard deviation). Bohm, McCune and Vandetta (1991) used a variety of multivariate statistics to discerned 17 characteristic patterns of diurnal ozone exposure at numerous sites in the western United States. The study reported on herein replicates their analysis on ozone data from southern British Columbia.

In this study individual days consisting of 24 hourly ozone values from Kelowna and Kamloops were run through a pattern-matching algorithm to classify each day as one of 17 characteristic diurnal curves. Each curve falls into one of 6 general 'categories', and it is the relative mix of these categories that determine which of 8 larger 'regimes' that site represents. It was determined that overall both Kelowna and Kamloops most closely fit the "Urban-Small" regime. This regime is dominated by urban/small categories (25% to 55%), (Kelowna is 39.5%, Kamloops is 40.0%), but have some urban/large, urban/medium and urban/transport categories (less than 5%). Remote categories occur frequently (30% to 50%), (Kelowna is 48.1%, Kamloops is 41.0%). Ozone maxima occur during summer.

To provide a larger context the analysis was repeated on 2 coastal sites in southeastern British Columbia; Surrey East and Victoria. Surprisingly, Surrey East, Kelowna and Kamloops differed very little. Both fit within the "Urban-Small" regime. The main difference between them is the absence of the urban/large category in Kelowna (Surrey is 0.2%), and a doubling of the urban/transport category in Surrey (Kelowna is 0.3%, Surrey is 0.8%). The difference between the two boils down to the diurnal ozone behavior for approximately 0.7% (1.3

days per year) of the May-October ‘ozone season’. Victoria, on the other hand, fits the “Remote” regime description (74.8% Remote, 24.4% Urban Small).

While Kelowna, Kamloops and Surrey are all classified as ‘ Urban Small’, Surrey has the ozone precursors to produce a far greater number of urban/large curves, but the meteorology is ideal for the formation of excess ozone. The populations of Kelowna and Kamloops is quite small compared to Surrey, but given the current level of growth and expected climate changes these interior cities may be consistently producing urban/medium curves in the not-too-distant future.

By consulting Bohm, McCune and Vandetta (1995a) and (1995b) it was possible to determine which sites in the Western United States which most closely approximate the regimes experienced in Kelowna and Kamloops. These are Marion County, Medford, and Eugene, all in the State of Oregon. Marion County, Eugene and Medford are all located some distance inland along the I-5 corridor. There are some interesting geographic, climatic and demographic similarities between Kamloops/Kelowna and this region. Contacts with land managers responsible for implementing air quality management measures in Oregon may be instructive.

Through this work a great deal has been learned about the ozone exposure regimes in the semi-arid interior of southern British Columbia, and how they compare with other sites in western North America. This analysis and the subsequent findings could form the means and basis for initiating pro-active ozone abatement and control strategies. It is recommended that airshed management planning activities be initiated in the southern interior similar to those completed by the Greater Vancouver Regional District. Initially, a detailed emission inventory must be compiled. Following completion of the inventory modeling of the respective airsheds can commence. There is also a need to intensively study airshed dynamics with respect to precursor availability, ozone production, and transport phenomenon.

Conclusions and Recommendations

Prior to conducting this study the main source of insight into ozone regimes in Kelowna and Kamloops was gained by counting the number times a year the Federal 1-hour Level B guideline was exceeded. No hourly exceedances of the 160-ug/m3 threshold meant no problem with ozone. This guideline was also the main means of comparing from one year to the next, or between widely scattered sites. This simple technique provides a very limited insight into a regions' ozone regime, and does not allow for a proactive approach to managing urban air quality. In contrast, the application of the diurnal-curve space technique has proven to be an extremely insightful exercise. It has provided a new perspective on historic data, and yielded an important insight into the future. Through this study the following can be concluded:

- Ozone regimes in the semi-arid interior of southern British Columbia are very similar to those experienced in the lower Fraser Valley. Kelowna, Kamloops and Surrey all share the same “Urban Small” designation despite some major difference between the interior and coast in terms of climate, geography, population and quantity of ozone precursors.

- Kelowna and Kamloops share a virtually identical ozone exposure regime. They appear to be behaving as expected given their climate, geography, population and quantity of ozone precursors. As these regions grow the ozone exposure regimes can be expected to change accordingly. Interior climate and geography are better suited to ozone production compare to the coastal regions.

- The lower Fraser Valley (Surrey) on the other hand appears to be behaving in a manner inconsistent with the quantity of ozone precursors available. This is due mainly to the prevailing cool, moist climate which prevents the region from producing ozone in line with its potential. The Surrey site only behaves as expected during very warm and stagnant conditions, which occur infrequently.

- Given these findings and present population growth trends it is reasonable to expect that ozone levels in the semi-arid interior of British Columbia will eventually surpass those of the coastal region. Determining exactly when ozone levels of the southern interior surpass those of the lower Fraser Valley requires further research.

- Climate change may exacerbate this situation by increasing the frequency and duration of high amplitude ridges, leading to an increase in the number of days with hot, dry and stagnant conditions. This increase in ozone production potential adds to the pressures wrought by the expected population growth.

Recommendations for future actions fall into two categories: I) emission control measures (actions which reduce ozone precursors), and ii) airshed management planning (actions to develop priorities with future air quality on mind). The emission control measures include:

- A variety of measures to prevent substantial growth on emissions of NOx, CO and VOCs. This will likely take the form of an Air Care program, as is in effect in the lower Fraser Valley. Other means of controlling emissions must also be considered, with the most effective (e.g. dollars spent per ton of emission avoided) being implemented first.

- Development of alternatives to the automobile as the prime means of transportation in interior communities. These measures include: travel demand management, public transit, rideshare programs, tele-commuting, increasing core density and co-locating work, shopping and living spaces to reduce the need to commute.

The airshed management planning activities include:

- Developing a means of considering the air quality consequences of regional development as a whole. Such an exercise is usually called an Air Quality Management Plan or an Airshed Management Plan. The Greater Vancouver Regional Districts' Plan is an excellent model for Interior communities to consider. To be effective these plans must be implemented on a airshed (valley-wide) basis, and this often means traversing existing Municipal and Regional District boundaries.

- The assembly of a very finely detailed emission inventory for each airshed. This is of primary importance as it provides a means of discerning significant from insignificant sources, and of evaluating the proposed emission control strategies. A detailed emission inventory is also required to do any computer modeling of the airshed behavior. Another valuable tool in any airshed planning exercise.

- The initiation of a summertime intensive research project to study the spatial and temporal aspects of several ozone episodes in 1999. Conducted over a single ozone season the multi-agency study would discern the spatial distribution of ozone and precursors (NOx, VOC). With the meteorological resources available transport phenomenon (lake breeze) could also be resolved.

For more information on this report, contact the Ministry of Environment, Lands and Parks, Kamloops Branch phone: (250) 371-6200

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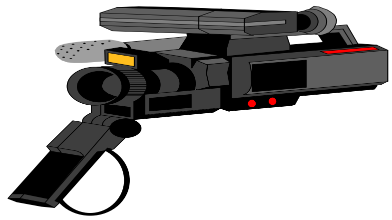
Time Lapse Video Study

Project Description



A time lapse video recorder is set up on the west side of Okanagan Lake overlooking the City of Kelowna. Video footage is recorded 24 hours a day, 7 days a week. Environment Canada Mountain Weather Services Office, the Regional Air Quality Committee and the Okanagan Air Quality Technical Steering Committee are particularly interested in those days that have meteorological conditions that favor bad air pollution episodes. The data is taken and used for education purposes, for scientists to confirm meteorological predictions and to analyze daily pollutant development and transport. CHBC Television News plays portions of the previous week's time lapse film on Friday newscasts. Hopefully, there can be clips of poor air quality episodes to show on this web site in the future.

Funding for this project came from the Canadian Petroleum Products Institute (CPPI) Clean Air Research Fund.

Project Background

Time lapse video study is beneficial because it allows the viewing time of long-term dynamic events to be reduced to a more practical time period. The videos can also be viewed at various speeds, in order to enhance the media. Time lapse video study has been used for many applications and projects, and in other regions, has been used to study the development and transport of pollutants.

In the Central Okanagan, localized airflow and air mass stability, which influence air pollution episodes, is for the most part unknown. However, the weather patterns combined with local topography and population growth, make air pollution a high risk in the Okanagan Valley. More information needs to be obtained to understand the current problem and the potential for future problems.

Completing a time lapse video study for areas in the Central Okanagan would be very beneficial for several groups including the Okanagan Air Quality Technical Steering Committee (O.A.Q.T.S.C.), City of Kelowna, Regional District of Central Okanagan and the BC Lung Association. The data obtained can be used to:

- Confirm meteorological predictions
- Analyze daily pollutant development and transport
- Effectively educate the general Public on air pollution in the Okanagan airshed.

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An Examination of Mesoscale Wind Flows within the Okanagan Airshed

Project Background

The concentration of an air pollutant at any given location is a combination of the volume of the pollutant released into the airshed, and the subsequent transport and dispersion of the pollutant. Our current ability to predict pollutant concentration is rudimentary at this time. Sophisticated tools are available, but expensive to implement and operate. Tools, which are currently employed, consist of surface wind observations from only 5 locations, a twice-daily radiosonde sounding of the atmosphere in the vertical, and a crude forecast of the dispersion expected in the current afternoon. The latter is called the Ventilation Index (VI) and is comprised only of the forecast mixing height in the airshed, and the average winds within the mixed layer. Further improvements to our ability to forecast receptor concentrations of air pollutants will require much more detailed analysis and prognosis, which in turn will depend on the collection of a much more comprehensive set of data - especially meteorological data.

During 1999, the Mountain Weather Services Office will use a mesoscale model and display software to impart a deeper understanding of the low-level winds through the Okanagan Valley. This knowledge is necessary in order to explain the local transport and diffusion of pollutants in the airshed.

Project Description

A temporary meteorological station has been installed at a location on the East Kelowna Bench. Data from that station is used to validate output from a numerical forecast model being implemented by the Mountain Weather Services Office of Environment Canada. Output from this model includes fine-scale wind flow throughout the airshed at 3 hourly intervals. It is expected that detailed study of these localized (Mesoscale) winds will reveal areas within the valley susceptible to elevated pollution levels.

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