Monitor Ozone Concentration at University of New Haven

Yo Ng and Chong Qiu Ph. D

Department of Chemistry and Chemical Engineering,

University of New Haven, 300 Boston Post Road, West Haven, CT 06516

Introduction

High exposure of ground level ozone could trigger or worsen health conditions, including respiratory irritation and asthma. Ground level ozone is created by chemical reactions between nitrogen oxides and volatile organic compound in the presence of sunlight. The most common sources of the reactants that produces ozone include but not limited to industrial facilities, motor vehicle exhaust and chemical solvent.

The objective of this research is to investigate the different factors affecting the indoor and outdoor ground level ozone concentration, and reveal the potential diurnal trend of ozone concentration at the University of New Haven. The Aeroqual series 200 portable ozone monitor was deployed for the detection of ozone. Data were collected periodically at various locations, including the University of New Haven (UNH) campuses, local trails and costal areas. Data collected were processed and compared to identify key factors influencing ambient ozone concentrations.

The results of this study contribute to understanding the factors that affect ground level ozone concentration, including vehicle usage, human activities and UV strength, and serve as a foundation of further studies on ozone concentrations in other seasons.

Approach

A series of preliminary data were collected using an Aeroqual Series 200 portable ozone monitor at various locations to investigate the possible factors contributing to the production of ground level ozone. Periodical measurements were also conducted at the University of New Haven, West Haven campus (Campus) to study the ozone concentration trend throughout the day. For each measurement, the local weather condition was also recorded for the analysis of weather effect. Indoor ozone concentration measurements were collected alongside with outdoor measurements in order to provide comparison under similar weather condition. All data collected were processed and analyzed to study possible trends and factors affecting the ozone concentration. Indoor and outdoor ozone concentration were compared side-by-side to study their relationship.

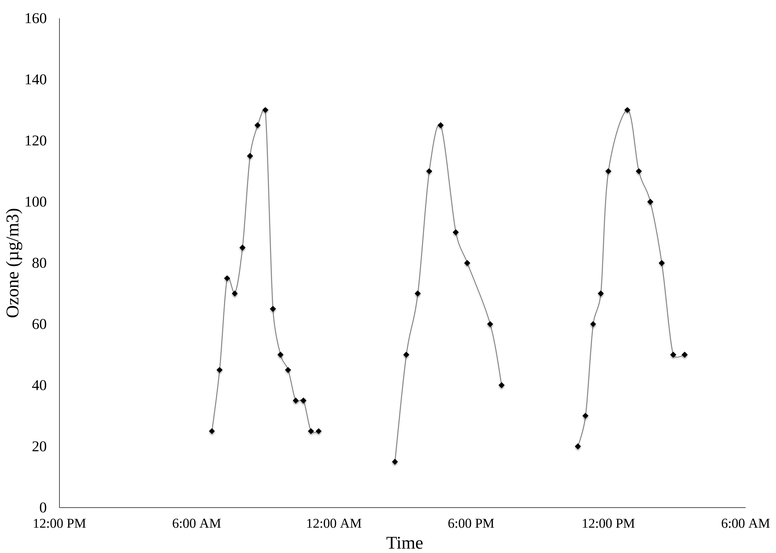

Figure 1: Periodical outdoor measurement on three consecutive days.

Results and Discussion

Table 1: Outdoor and indoor ozone concentration (µg/m^3) at various locations measured within the same hour.

Outdoor Reading	Indoor Reading	Indoor Location
15	BDL	Bartels
40	BDL	Library
50	23	Gehring
50	BDL	Maxcy
50	10	Dodds
80	17.5	Kaplan
90	30	Bartels

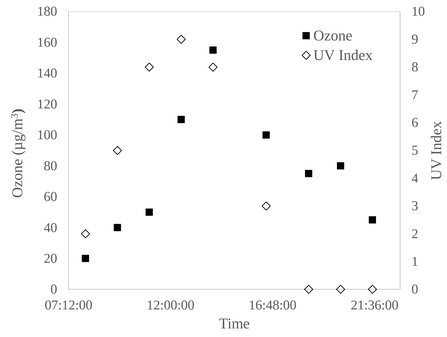

Figure 2: Outdoor ozone concentration (µg/m^3) and its corresponding UV index.

Table 2: Various trail sites reading compared to outdoor campus reading.

Weather	Temperature (ºC)	Humidity	Wind Speed (mph)	UV Index	Pressure (in Hg)	Location	Ozone (µg/m^3)
Partly cloudy	22	51%	NNE 19	4	29.8	Turkey Hill	45
Partly cloudy	28	46%	S 10	4	30	Campus	65
Sunny	14	57%	SE 4	–	29.9	Maltby Lake	62
Sunny	22	61%	S 4	–	29.9	Campus	60

Table 3: Ozone concentration at various campuses.

Weather	Temperature (ºC)	Humidity	Wind Speed (mph)	UV Index	Pressure (in Hg)	Location	Ozone (µg/m^3)
Cloudy	27	85%	S 8	2	29.8	NJIT campus	55
Cloudy	24	84%	SSW 3	2	29.9	Campus	50
Partly cloudy	30	44%	S 3	–	30	Lyme Campus	55
Partly cloudy	29	55%	WSW 8	9	29.9	Campus	85
Partly cloudy	22	51%	NNE 19	4	29.8	Orange Campus	40
Partly cloudy	24	61%	S 15	3	30.1	Campus	90
Sunny	24	61%	SW 6	–	30	Orange Campus	100
Sunny	28	64%	SSW 8	8	30	Campus	50

Table 4: Various coastal reading compared to campus outdoor reading with comparable weather conditions.

Weather	Temperature (ºC)	Humidity	Wind Speed (mph)	UV Index	Pressure (in Hg)	Location	Ozone (µg/m^3)
Cloudy	21	70%	ENE 7	2	30.1	Branford Point	50
Cloudy	21	69%	NNE 7	2	30.1	Branford River Gateway	35
Mostly cloudy	28	63%	W 9	2	29.9	Campus	90
Cloudy	21	69%	NNE 7	5	30.1	Thimble Island, Branford	45
Mostly cloudy	27	69%	SSE 11	6	30	Campus	90

Table 5: Various locations with high vehicle usage compared to campus outdoor reading with comparable weather conditions.

Weather	Temperature (ºC)	Humidity	Wind Speed (mph)	UV Index	Pressure (in Hg)	Location	Ozone (µg/m^3)
Slightly cloudy	18	49%	SW 7	–	29.9	Milford mall	60
Sunny	26	48%	NE 3	5	30.1	Campus	50
Sunny	14	72%	S 5	–	29.9	Shopping Center (Bullhill Lane)	45
Sunny	19	70%	N 3	1	30.1	Campus	15
Slightly cloudy	15	75%	N 9	–	29.9	I-95 Branford Service Plaza	60
Sunny	28	64%	SSW 8	8	30	Campus	50
Sunny	21	62%	SW 7	–	29.9	Route 15 Service Plaza	120
Sunny	21	62%	SW 7	–	29.9	Campus	150
Partly cloudy	24	61%	S 15	3	30.1	ShopRite Parking Lot	90
Partly cloudy	27	51%	S 10	3	30	Campus	50

Conclusions

The result of analyzing the periodical outdoor ozone measurements revealed a diurnal trend, and the peak ozone delay when compared to the peak UV level. The study of indoor ozone concentration alongside with the outdoor ozone concentration revealed a positive correlation. The impact of human activity on the ozone concentration requires additional data collection during the fall and spring semester, when there will be more human activity on campus.

Acknowledgements

The authors acknowledge funding from the University of New Haven Summer Undergraduate Research Fellowship (SURF) program and additional support from the Department of Chemistry and Chemical Engineering and the National Science Foundation (Award # NSF-AGS 1463703).

References

Carslaw, N.; Ashmore, M.; Terry, A. C.; Carslaw, D. C. Crucial role for outdoor chemistry in ultrafine particle formation in modern office buildings. *Environ. Sci. Technol.* **2015**, 49, 11011–11018.

Valuntaite, V.; Girgzdiene, R. Outdoor and indoor ozone level – A potential impact on human health. *Vojnosanit Pregl.* **2015**, 72, 696–701.

Yang, J.; Miller, D. R. Trends and variability of ground-level O3 in Connecticut over the period 1981–1997. *J. Air & Waste Manage. Assoc.* **2002**, 52, 1354–1361.

Filayson-Pitts, B. J.; Pitts, J. N. *Atmospheric chemistry : Fundamentals and experimental techniques.* 1st ed. John Wiley & Sons, **1986**.