Seasonal Variation of Trace Gases at an Urban Location in Delhi of IGP of India

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HIGHLIGHTS

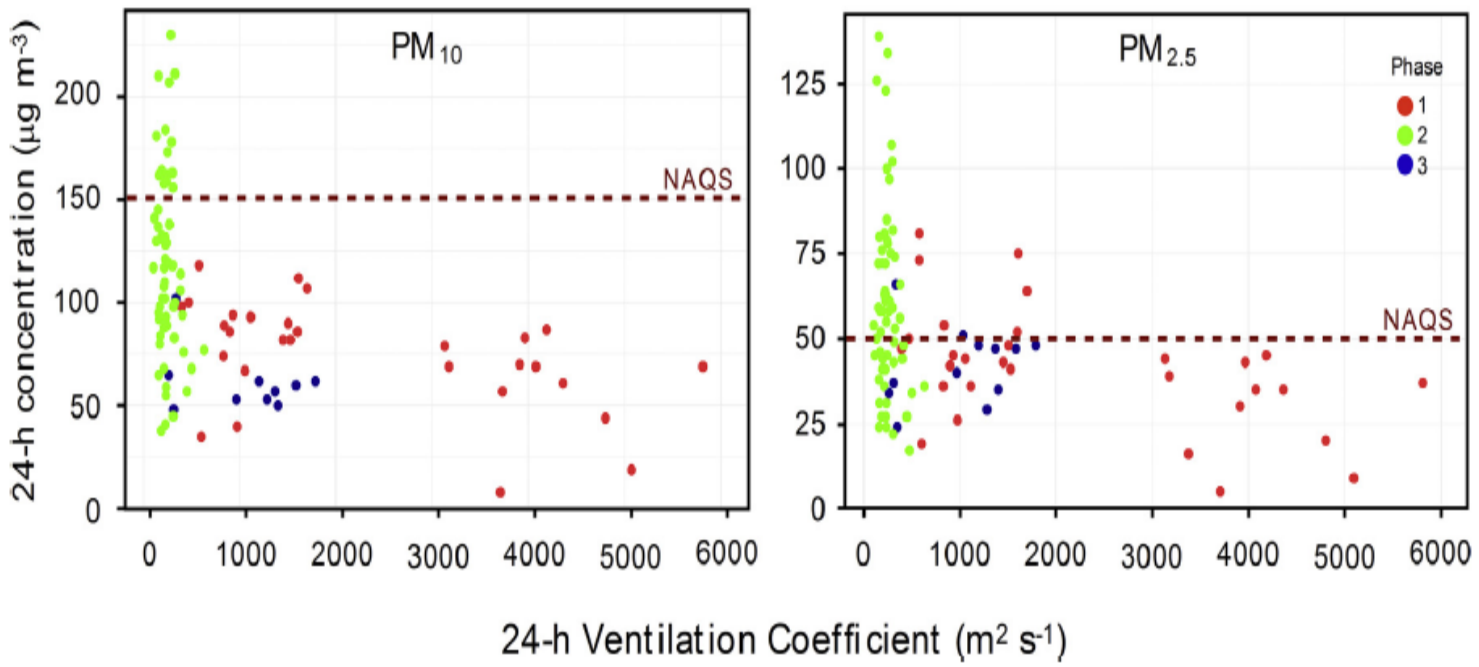
Common Aim:

- Seasonal Variation of Trace Gases at an Urban Location in Delhi, IGP of India.
- Complementary research questions???

❖ Why seasonal variation of Trace Gases?

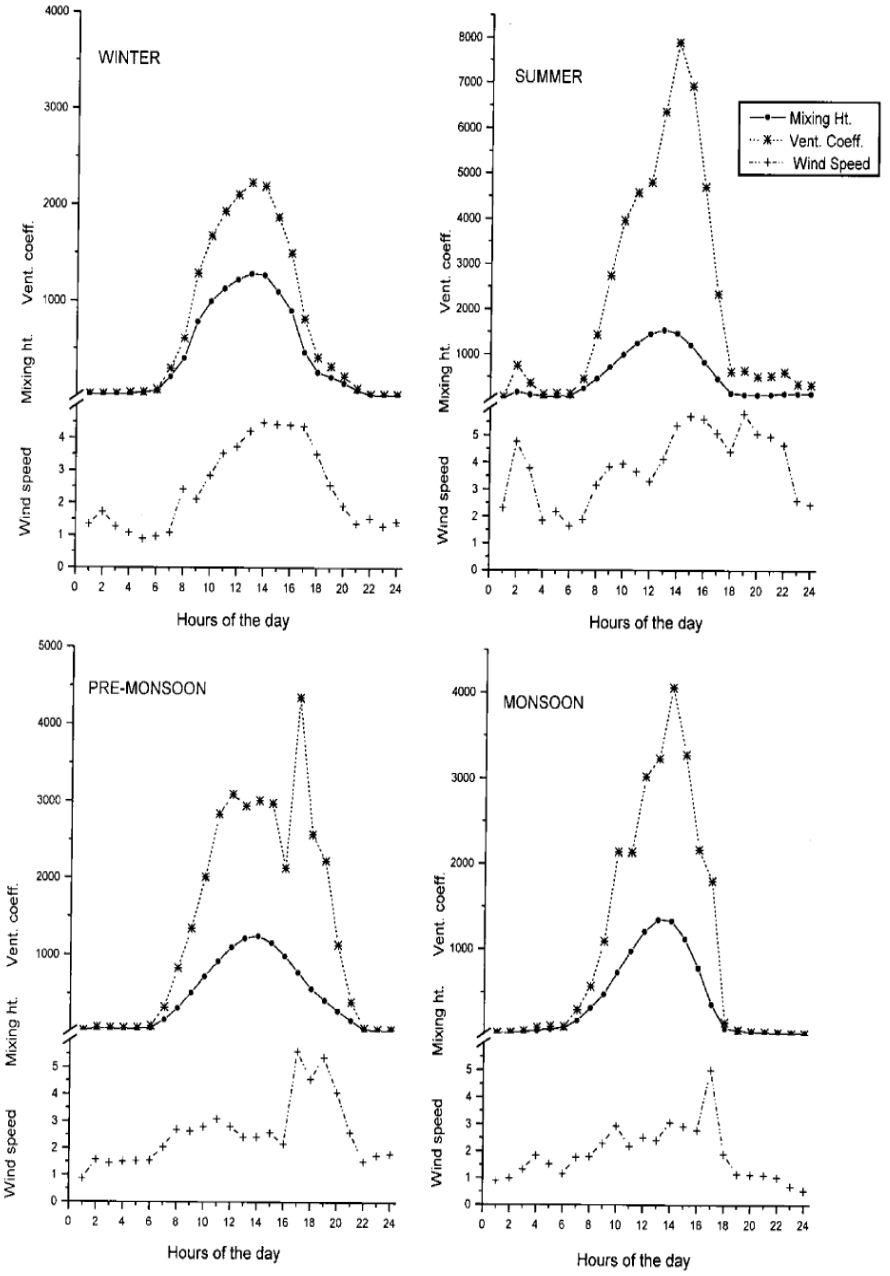
❖ How meteorological parameters affect concentrations of trace gases?

❖ Role of Ventilation Coefficient in pollution dispersion?



Scatterplot of the 24-h averages of the VC and recorded PM_{10} (left) and $PM_{2.5}$ (right) concentrations. Each point represents the daily concentration at individual MACAM/3 sites. The red dashed line shows the NAAQS. The PM2.5 concentration exceeded the NAQS for most days and monitoring sites during Phase 2 . These exceedances are found for the daily mean VCs below 500m^2/s. On the other hand, the PM_{10} concentrations exceeded the NAQS only for the daily mean VCs below 300m^2/s during Phase 2. Source: A Toro et al. 2019, Environmental Pollution 244 (2019) 705-714.

Diurnal variation of wind speed, mixing height and ventilation coefficient for different seasons in 1998 over Manali. The maximum values of ventilation coefficient recorded are 7900m^2/s in summer followed by pre-monsoon and monsoon with 4340 and 4060m^2/s, respectively. Winter records the least value of 2226m^2/s. These values are found to occur during 13.00–17.00 h (IST), which is indicative of better dilution. Source: Manju et al. 2002, Atmospheric Environment, 3461–3471.

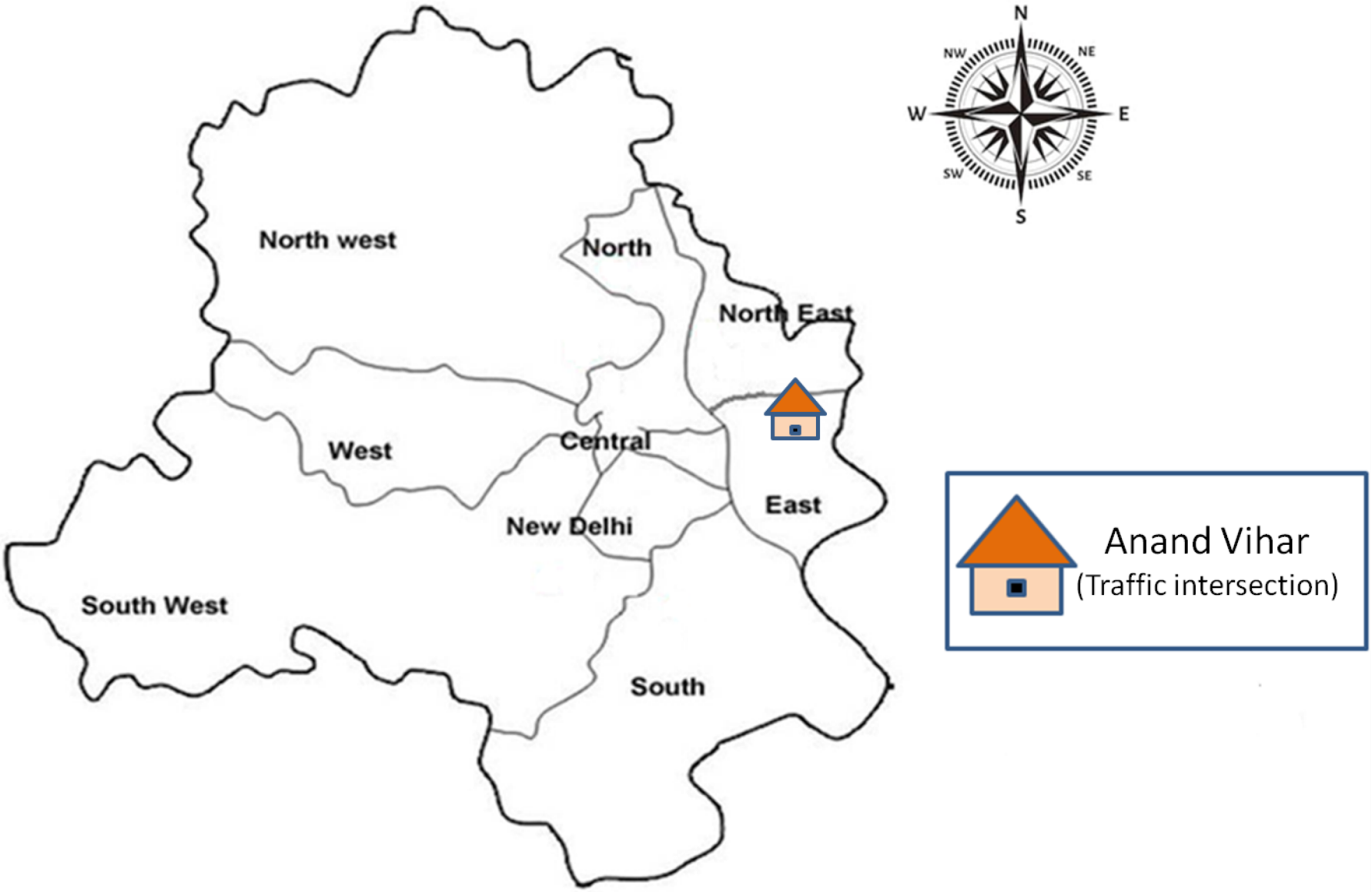


RATIONALE OF STUDY

- Lack of systematic monitoring data of trace gases mostly in Asian countries.
- Less studies have been reported so far on ventilation coefficient in most of the developing Asian countries.
- Long-term continuous measurements of trace gases and meteorological variables are crucial to better understand the characterization of air pollutants at diverse locations.

OBJECTIVES

- Trace Gases and their seasonal trends at an urban location of Delhi, IGP of India from January 2017 – January 2019.
- Average monthly and diurnal variations of trace gases are analyzed in relation with meteorological conditions.
- To estimate the ventilation coefficients in different selected seasons during selected period at an urban location of Delhi, IGP of India.


N
NW
NE
W
E
SW
SE
S
North west
North
North East
West
Central
East
New Delhi
South West
South
Anand Vihar
(Traffic intersection)

Parameters Under Study

A. Selected Pollutants:

NO_x : using NOx analyzer, Thermofischer

O_3 : using O_3 analyzer, Environment S.A.

CO : CO analyzer, Thermofischer

SO_2 : SO2 analyzer, Thermofischer

Secondary data procured from CPCB, New Delhi.

B. Meteorological Parameters: Temp, Relative Humidity, rainfall, Solar Radiation, Wind Speed and Wind Direction

Secondary data procured from IMD.

Selection of Study Period

Selected Seasons: Pre monsoon/summer: March – May, Monsoon: June-August; Post monsoon: September – November and Winter: December - February

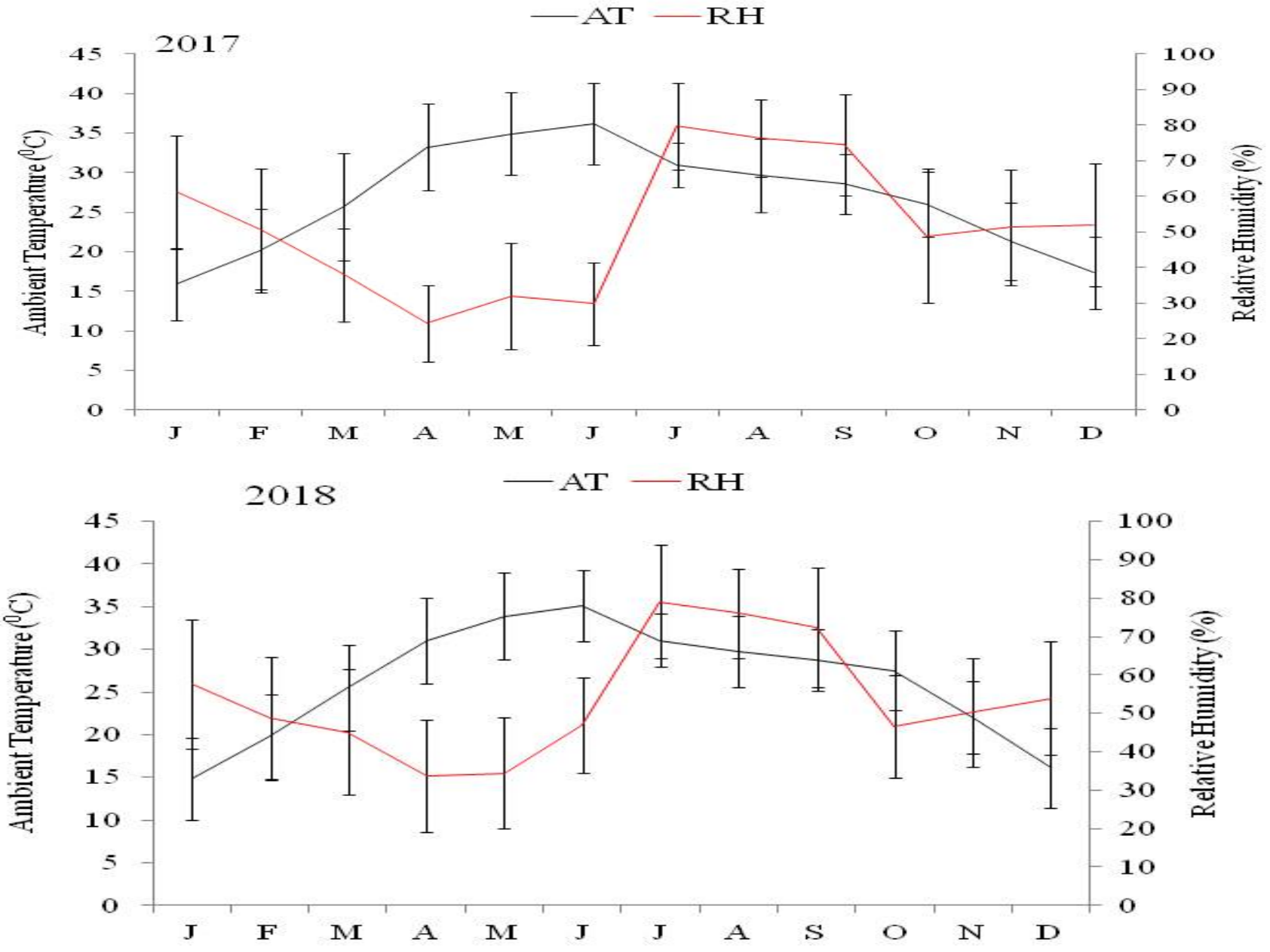
Data Matrix: 1 site x 4 seasons x 4 parameters

Statistical Analysis

- **Pearson's Correlation**

Software Package Used: SPSS (19.0 version)

Monthly mean variation of meteorological parameters in 2017-18 and 2018-19



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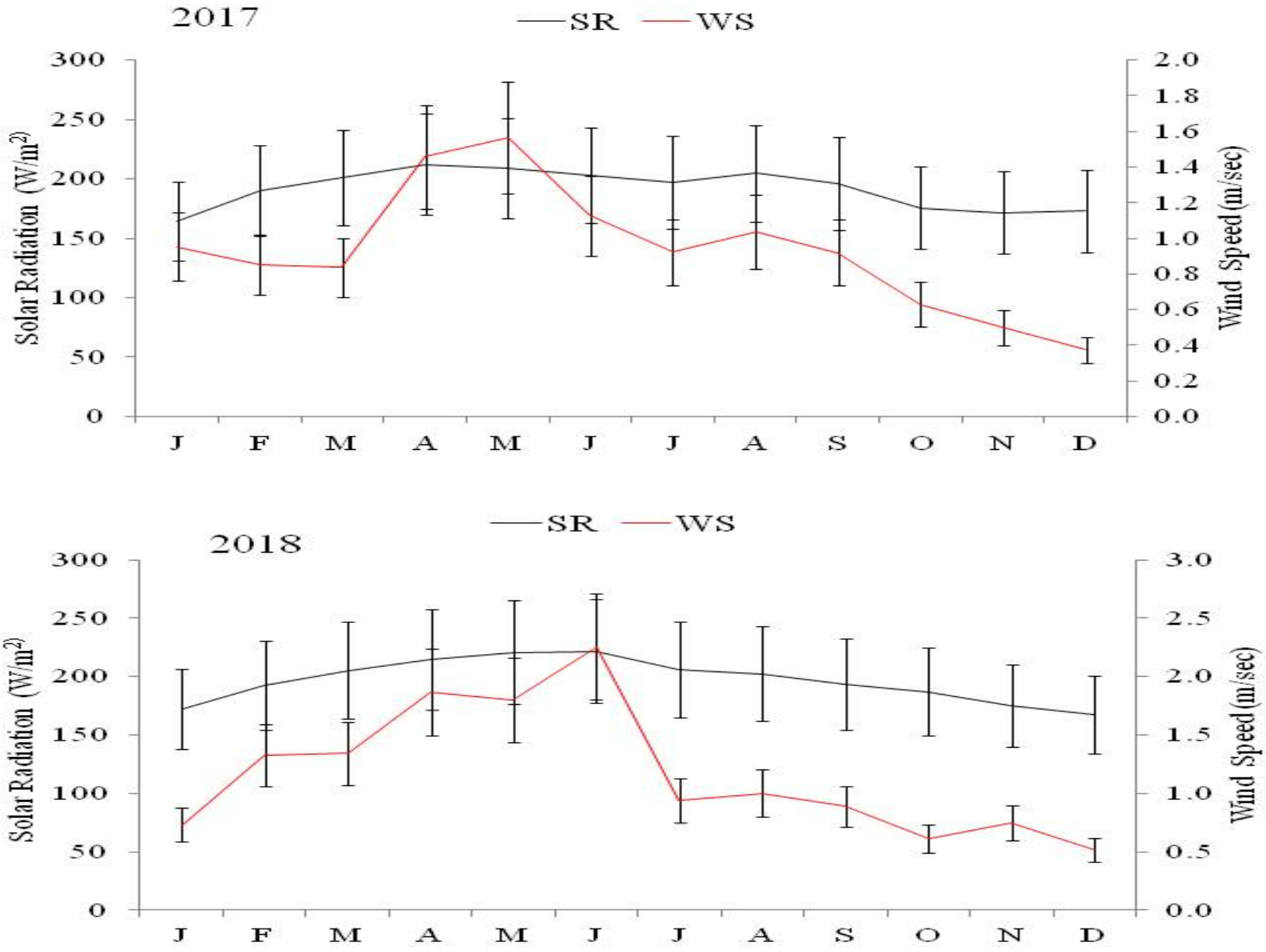

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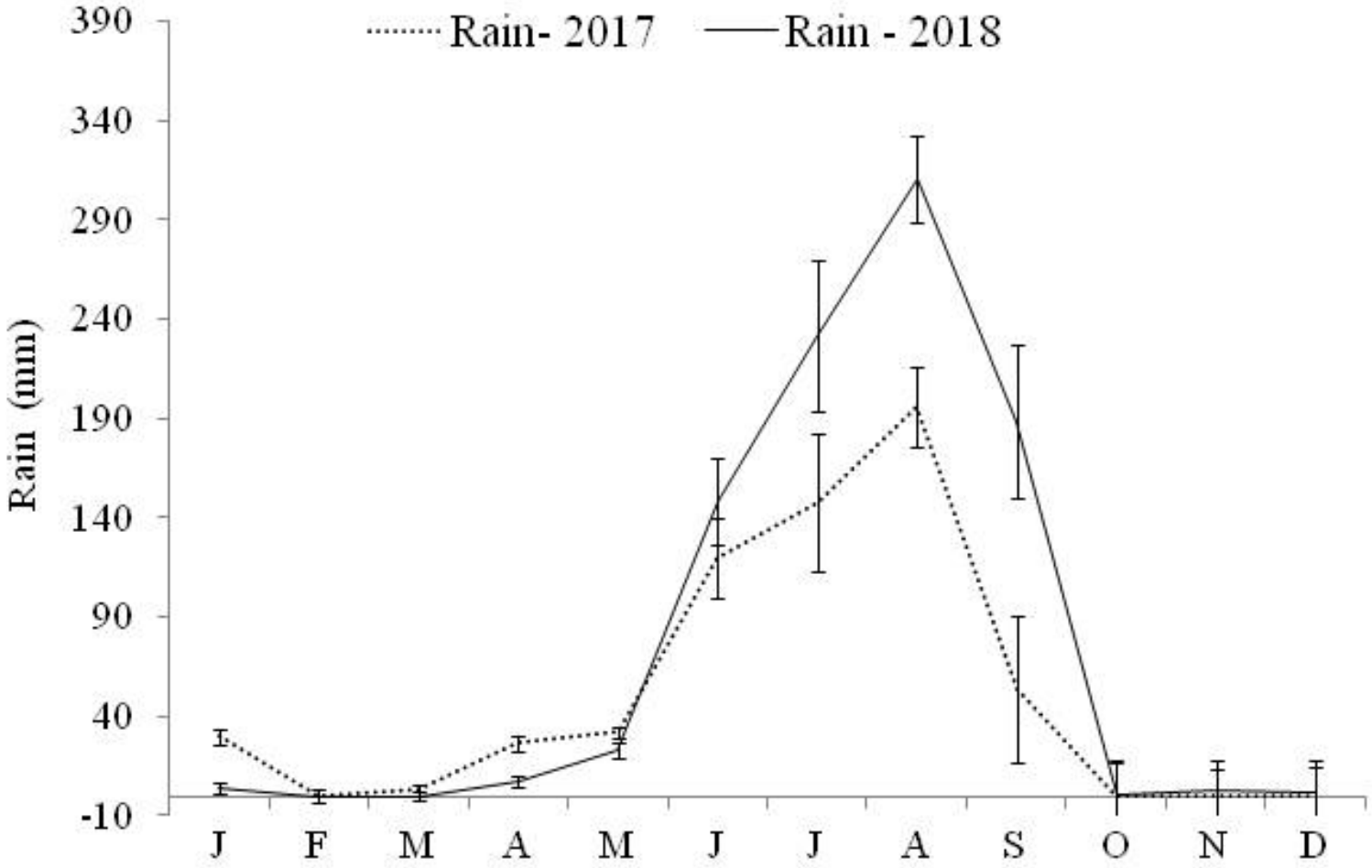
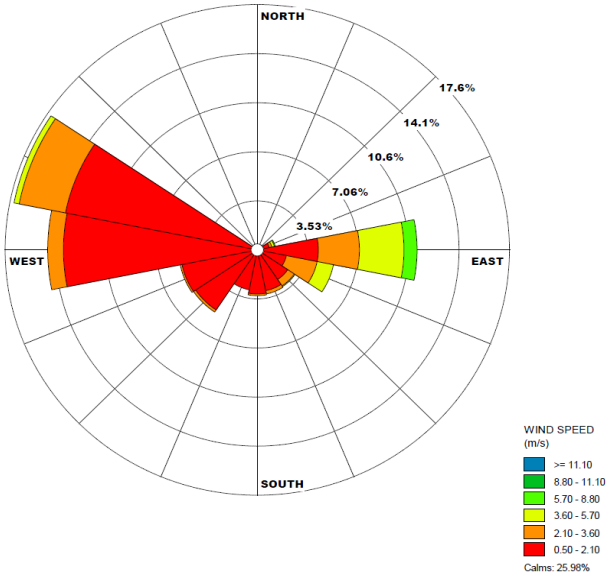
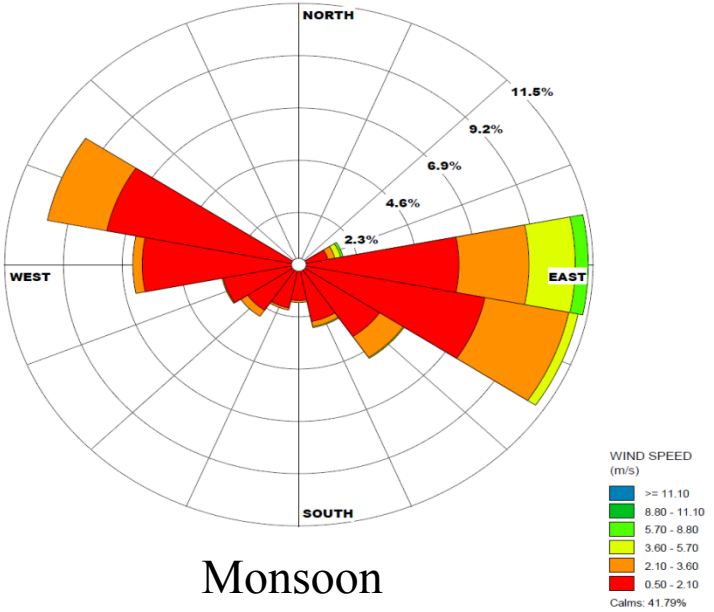


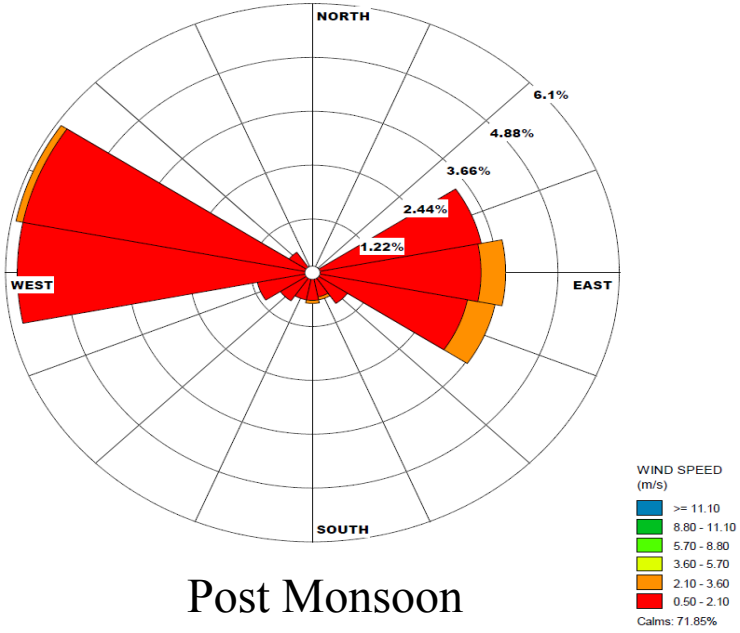
Windrose Plots for 2017-18



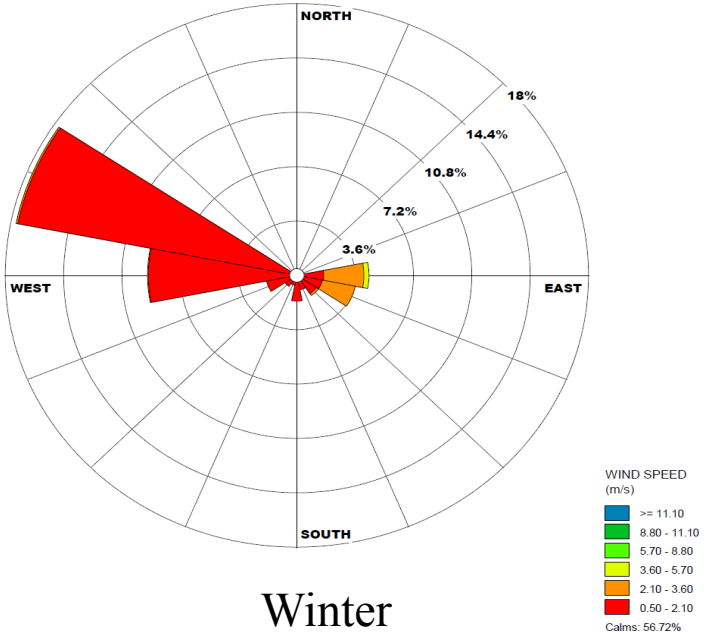
Pre Monsoon/Summer



Monsoon

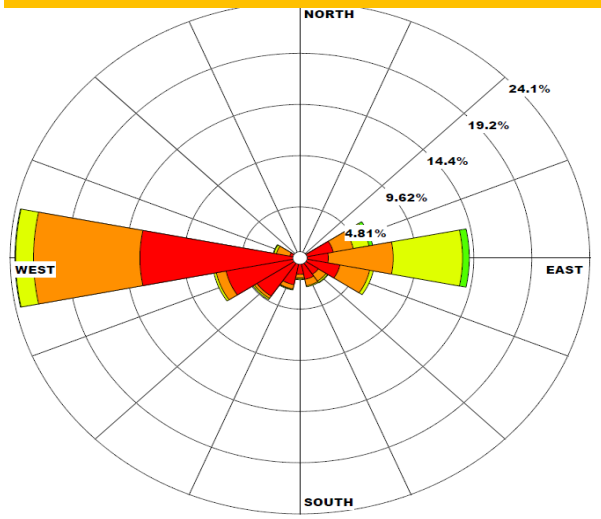


Post Monsoon

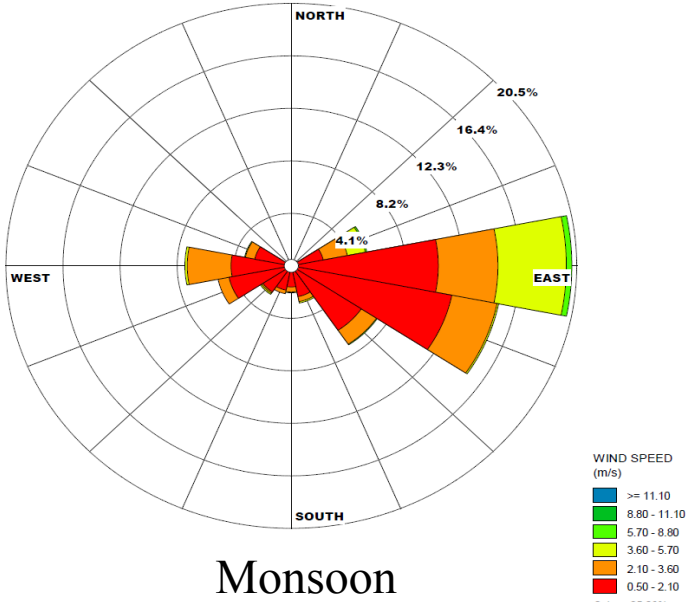


Winter

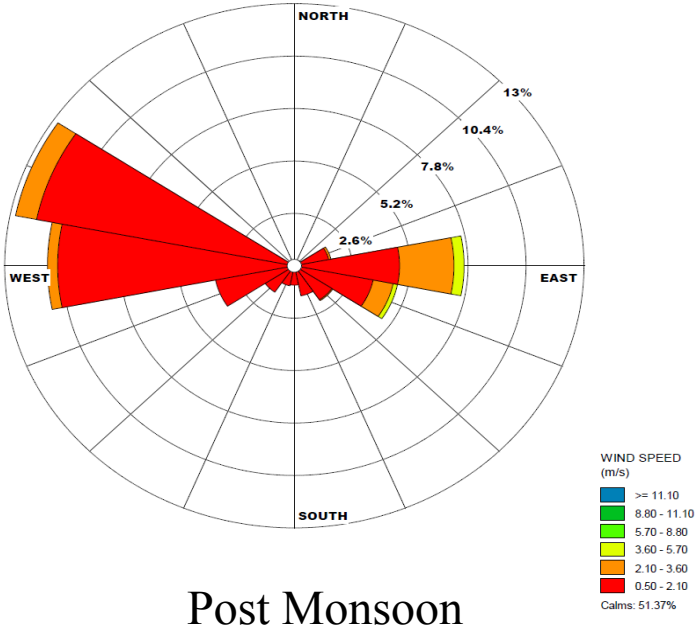
Windrose Plots for 2018-19



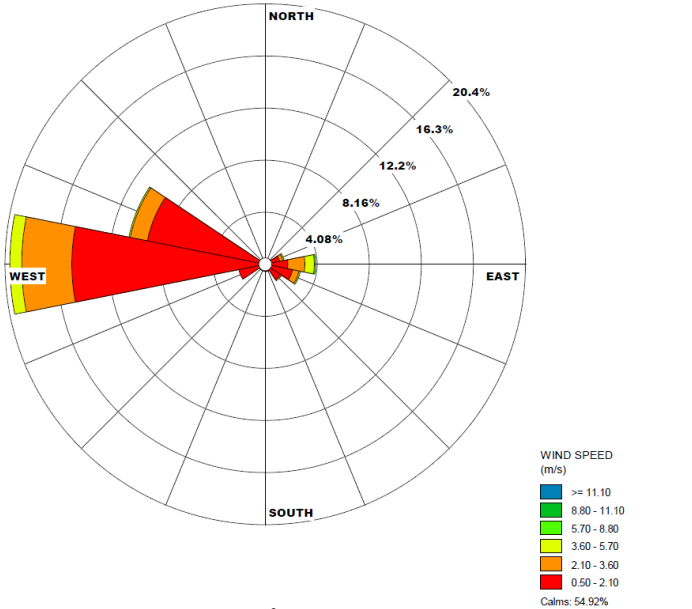
Pre Monsoon/Summer



Monsoon

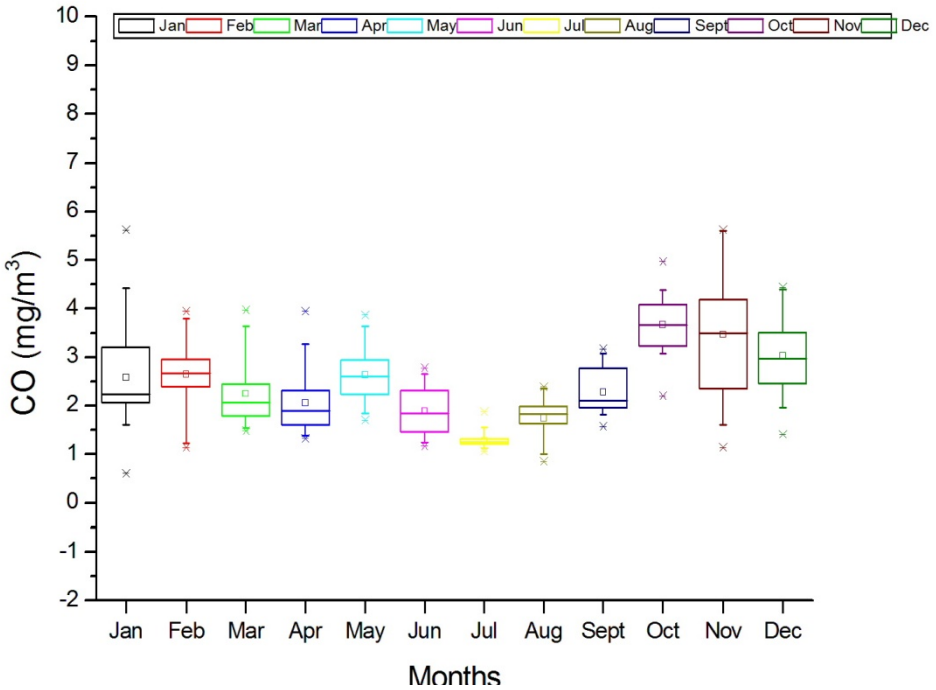


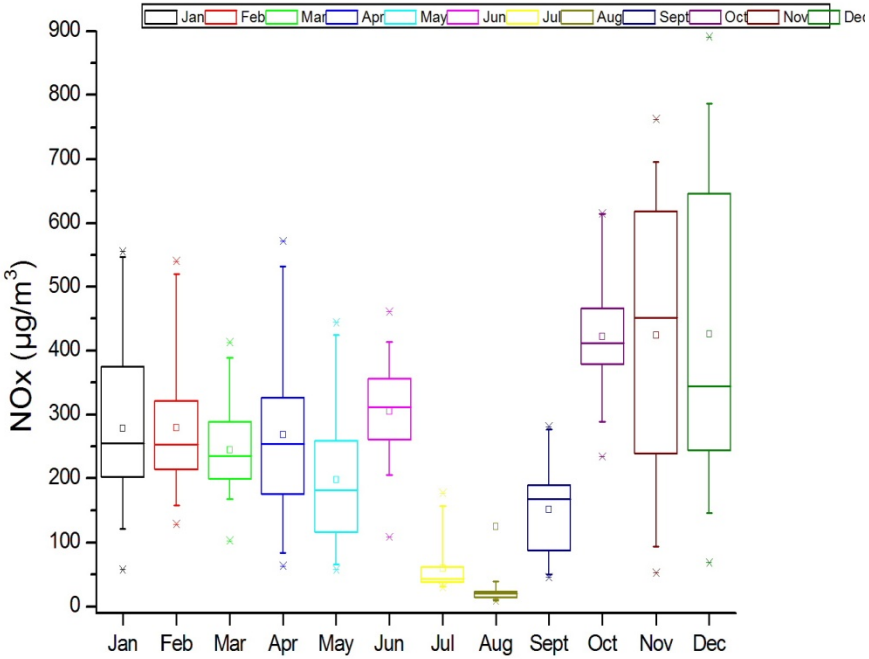
Post Monsoon

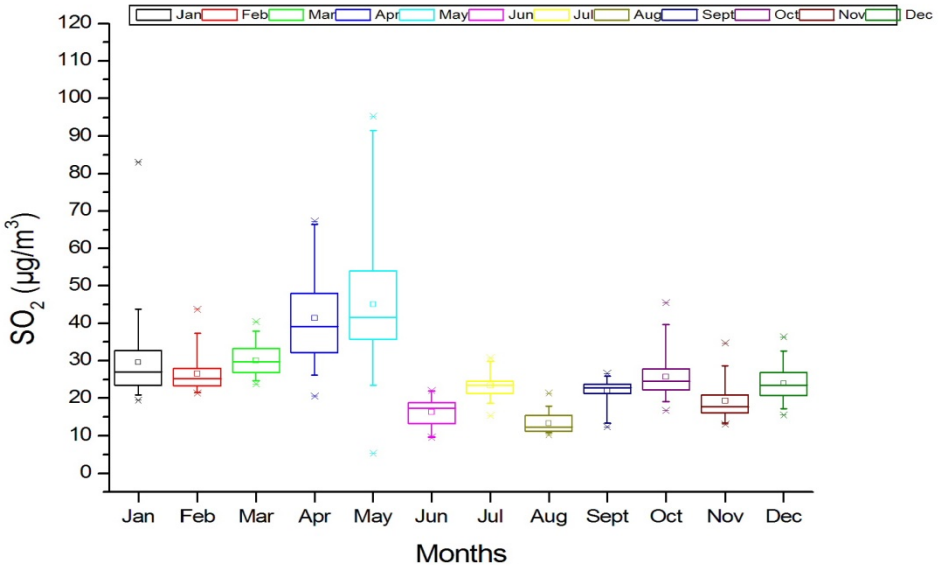


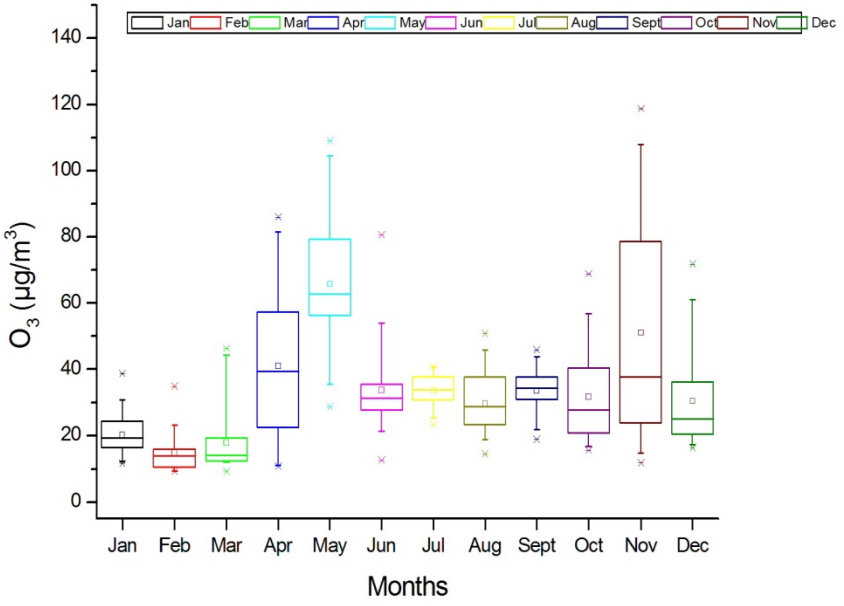
Winter

Statistical Analysis of Trace Gases at Selected site of Delhi for 2017-2018

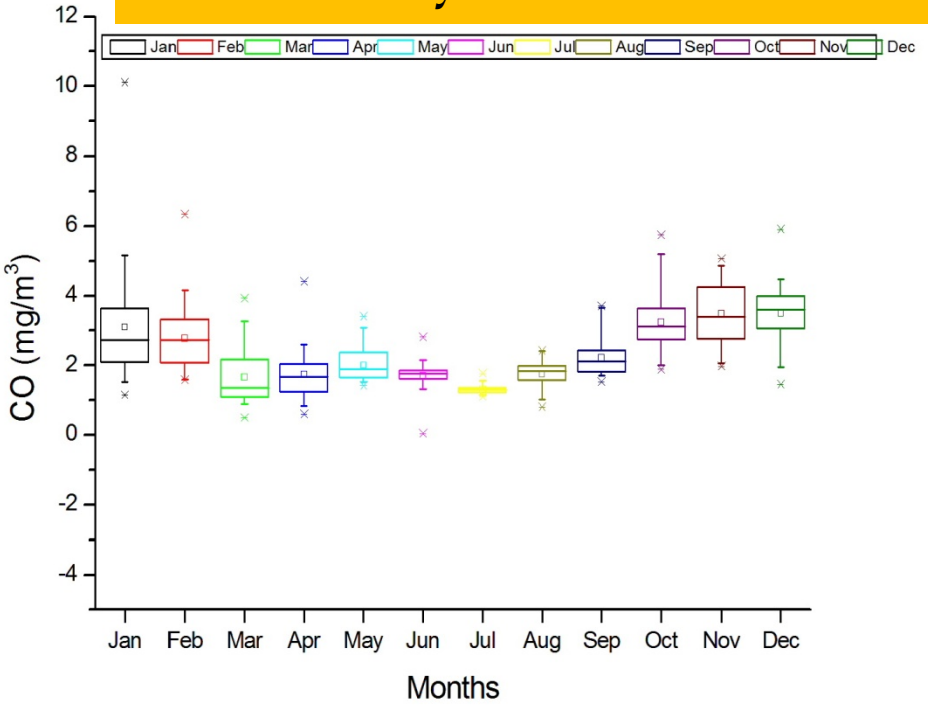


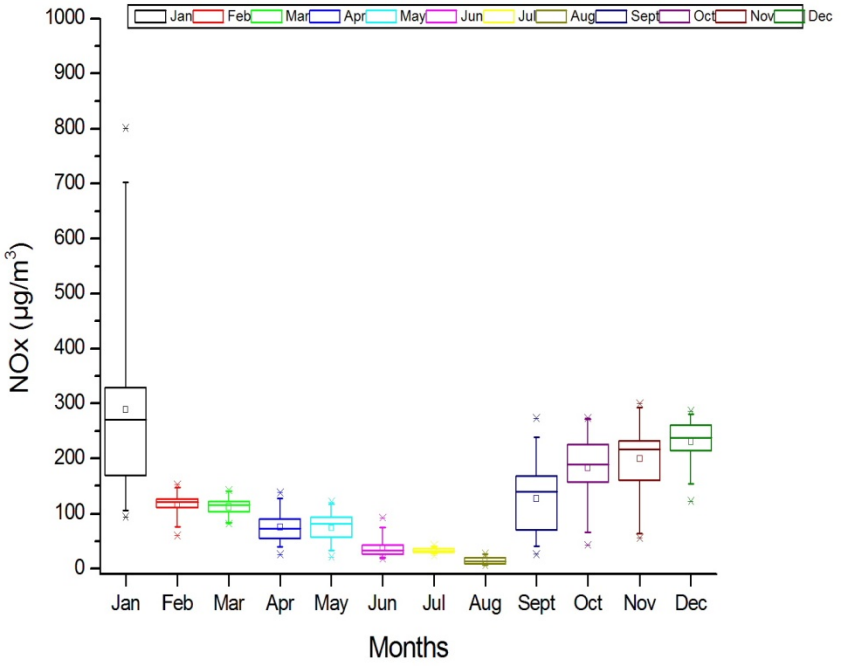


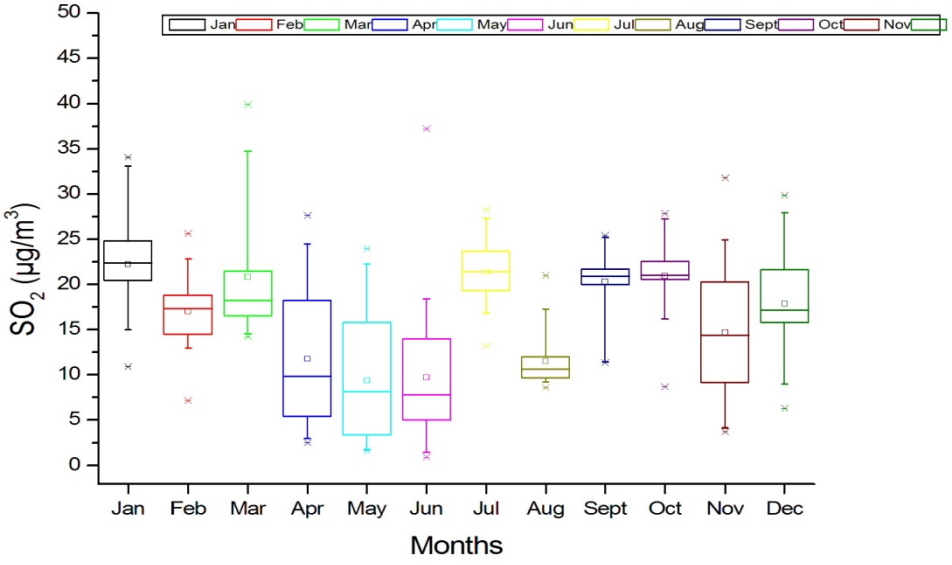


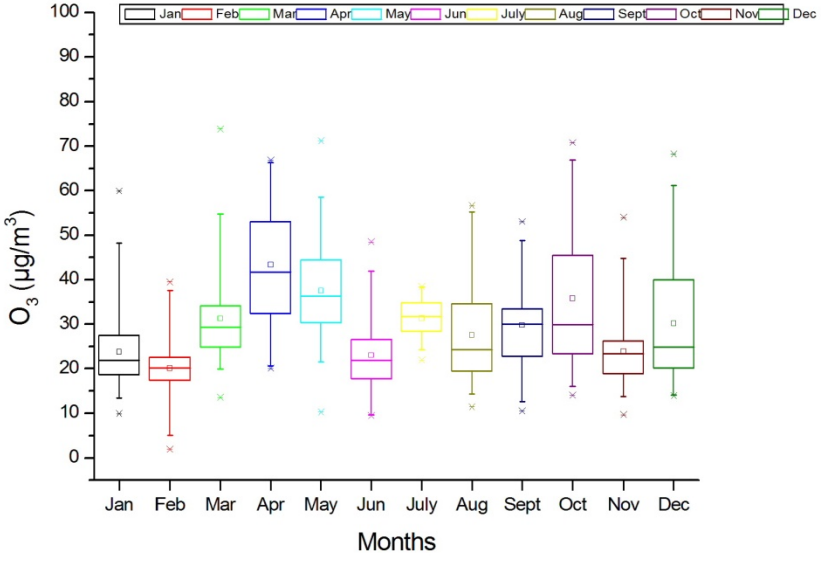


Statistical Analysis of Trace Gases at Selected site of Delhi for 2018-19

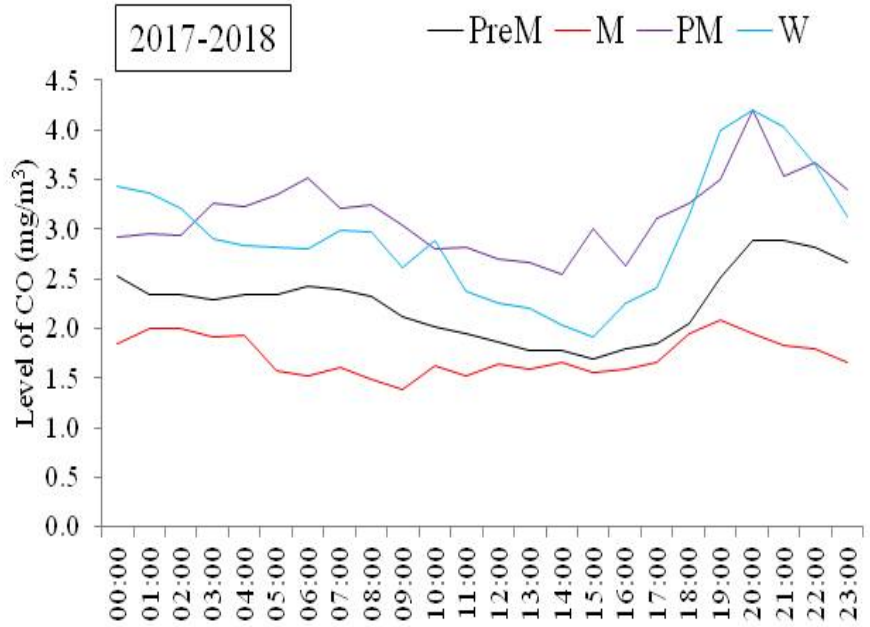


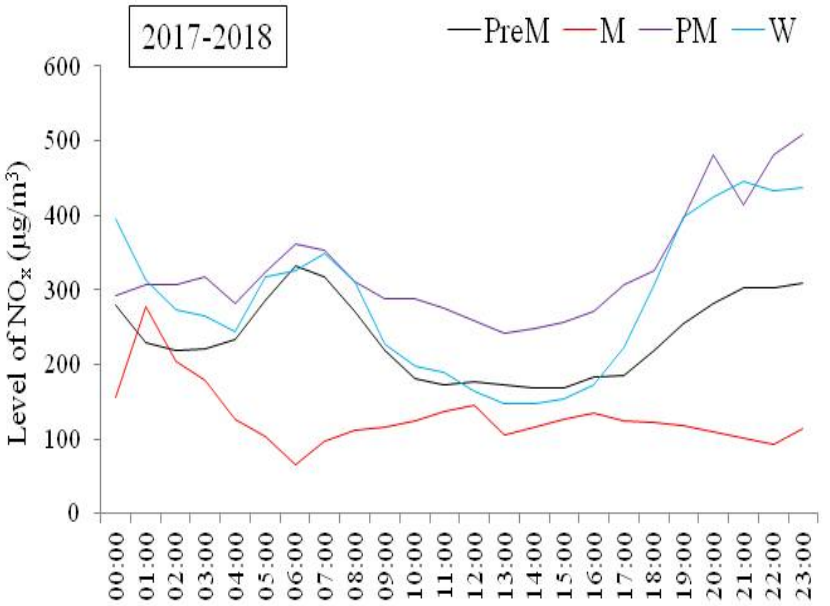


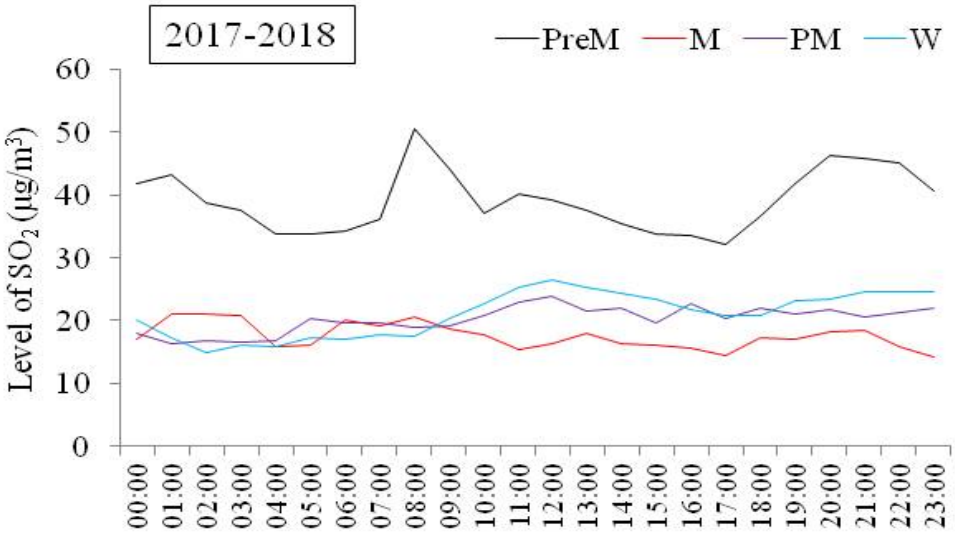


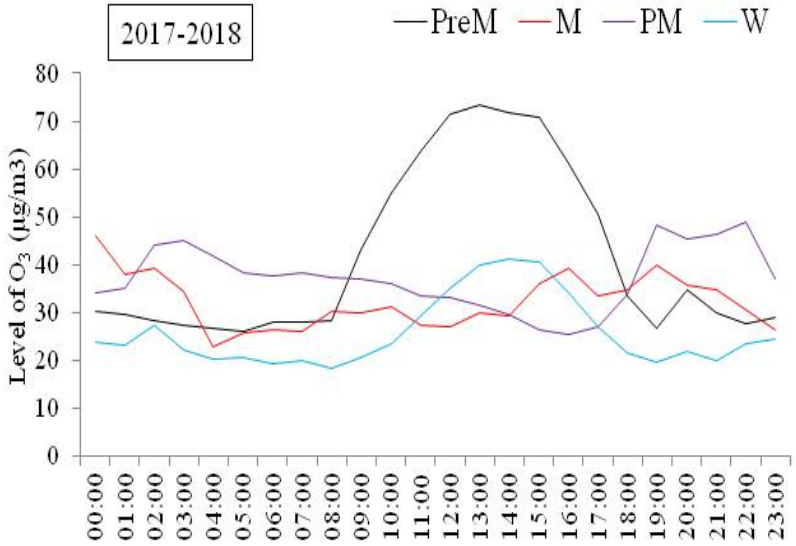


Seasonal mean diurnal variation of trace gases at selected site, Delhi in 2017-18

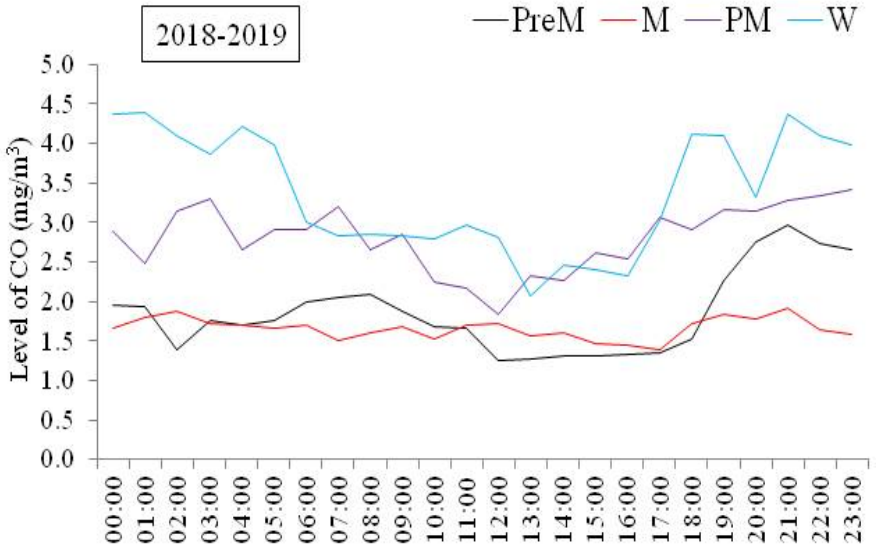


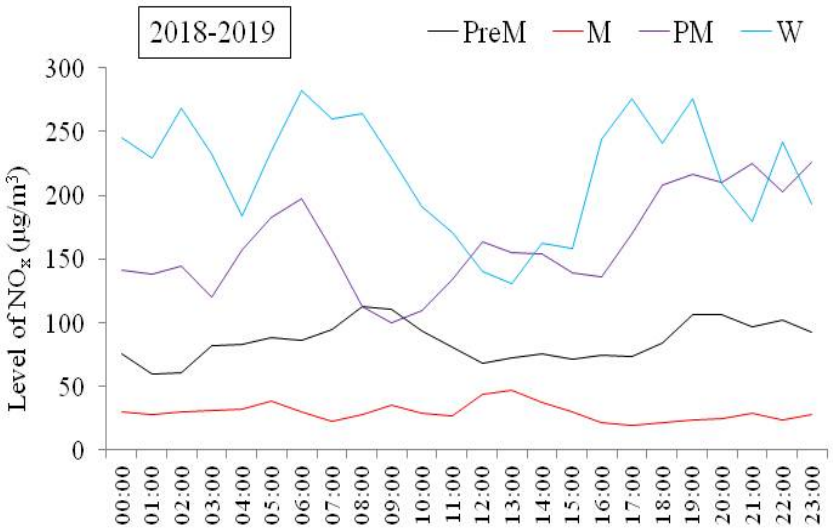


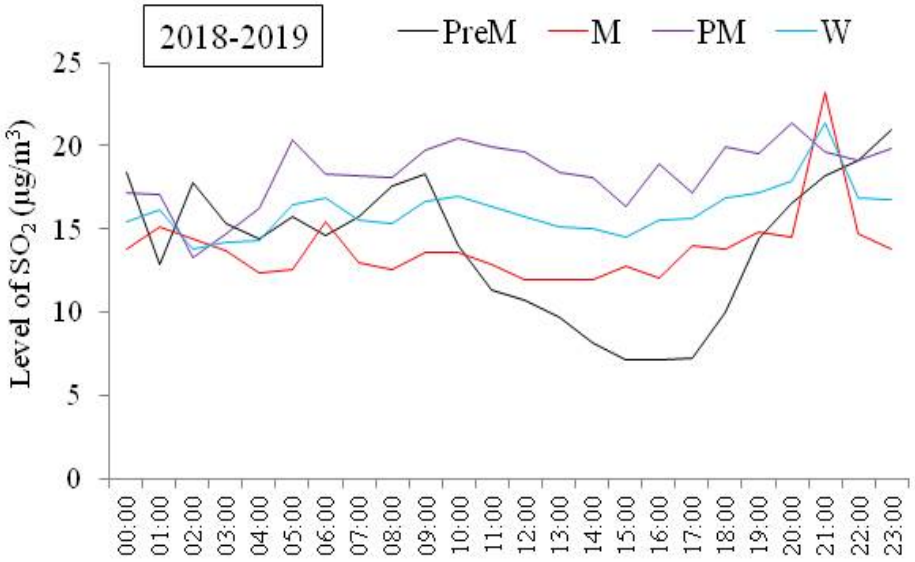


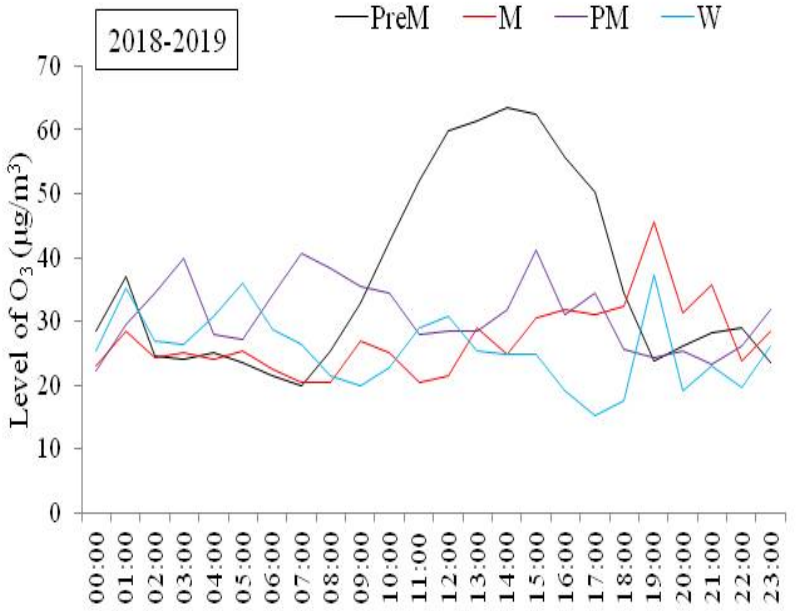


Seasonal mean diurnal variation of trace gases at selected site, Delhi in 2018-19









Correlation Coefficients for Selected Trace Gases

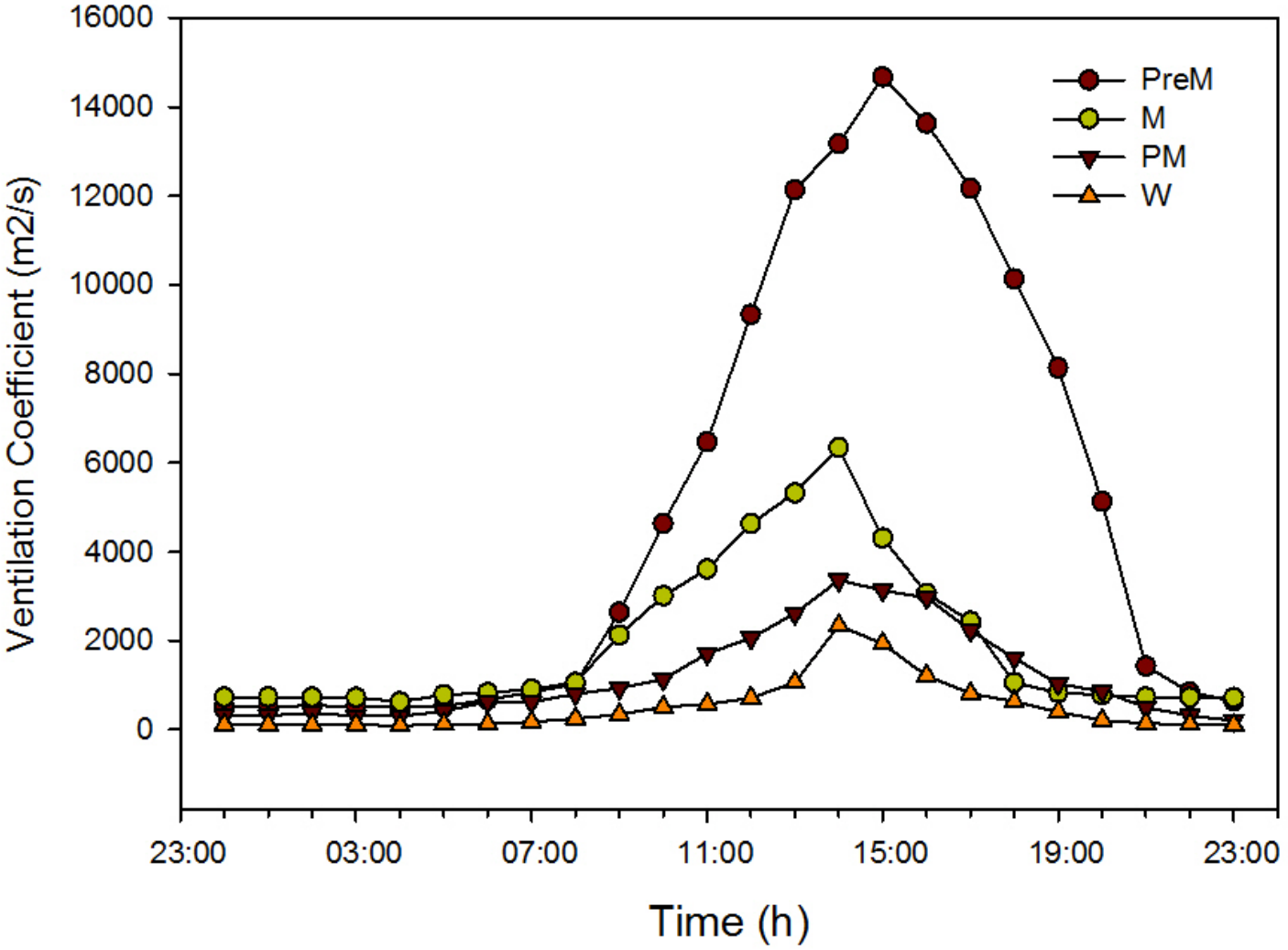
Correlations

		O3	Temp	RH	CO	NOx	SO2
O_3	Pearson Correlation	1	.247**	-.172**	-.015	.080*	.279**
	Sig. (2-tailed)		.000	.000	.681	.030	.000
	N	730	730	730	729	730	730
Temp	Pearson Correlation	.247**	1	-.615**	-.126**	-.079*	.167**
	Sig. (2-tailed)	.000		.000	.001	.032	.000
	N	730	730	730	729	730	730
RH	Pearson Correlation	-.172**	-.615**	1	.173**	.062	-.110**
	Sig. (2-tailed)	.000	.000		.000	.096	.003
	N	730	730	730	729	730	730
CO	Pearson Correlation	-.015	-.126**	.173**	1	.394**	.011
	Sig. (2-tailed)	.681	.001	.000		.000	.759
	N	729	729	729	729	729	729
NOx	Pearson Correlation	.080*	-.079*	.062	.394**	1	.326**
	Sig. (2-tailed)	.030	.032	.096	.000		.000
	N	730	730	730	729	730	730
SO_2	Pearson Correlation	.279**	.167**	-.110**	.011	.326**	1
	Sig. (2-tailed)	.000	.000	.003	.759	.000	
	N	730	730	730	729	730	730

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Seasonally Averaged Diurnal Variation of Ventilation Coefficient of Entire Study Period (2017-2019)



CONCLUSION

- The mean concentrations of NOx and CO were found to be highest during winter and lowest in monsoon in both the years 2017-18 and 2018-19. While O_3 showed highest in pre monsoon and lowest in monsoon season in both the years. Interestingly, SO_2 showed different trend as highest in pre monsoon during 2017-18 and in 2018-19, highest in post monsoon and one of the winter month.
- O_3 consistently found the similar result in both the years as highest during afternoon hours and then declining towards the night time.
- The average diurnal patterns at traffic intersection site showed high peaks of NO_x, CO during morning and evening traffic hours irrespective of seasons which are clearly due to lower boundary layer concept. In contrast, O_3 depicted a reverse pattern with highest concentrations during afternoon hours and lowest in morning hours.
- The major sources of trace gases namely SO_2, NO_x and CO were attributed by high vehicular density, idling of vehicles, biomass burning, transboundary movements of air masses from nearby crop residue burning, domestic activities like cooking etc. and low mixing height and lower boundary layer in winter, whereas in summer was clearly due to the enhanced chemical production of O_3 and in monsoon, the concentrations was found to be lowest due to efficient wet scavenging by precipitation.
- On the basis of correlation analysis, O_3 was found to be linearly positively correlated with temperature and negatively correlated with relative humidity.
- The ventilation coefficient was found to be highest in the pre-monsoon season and lowest during winter. Low ventilation coefficient during winter indicated the high pollution potential occurs at this site.

ACKNOWLEDGEMENT

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- Authors also pay sincere thanks to Central Pollution Control Board, Delhi for providing secondary data of trace gases and Indian Meteorological Department, Delhi for providing meteorological data.


THANKS
FOR THE
ATTENTION