Tropospheric ozone concentrations in the Sao Paulo Metropolitan Area: seasonal variability or land use characteristics?

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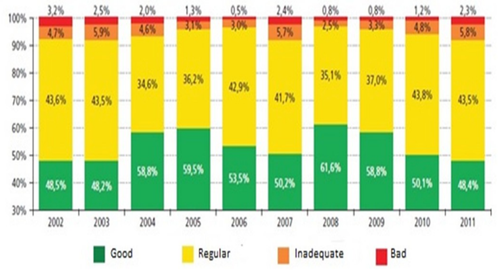
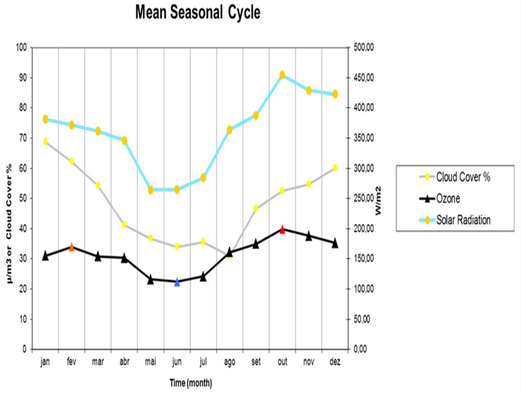
Characteristics of ozone pollution in the São Paulo Metropolitan Area:

*No decreasing tendency observed in the last decade:



*Seasonal cycle with a maximum in Spring and minimum in Winter, associated to solar radiation availability and predominance of stable atmospheric conditions.



DATA & METHODOLOGY:

•Hourly ozone pollution data from the State Environmental Agency (CETESB), 1996-2001.

•4 monitoring points, each representative of different land use types within the city – vehicular, commercial, residential and urban background.

•Monthly averages were calculated and one month was chosen to be representative of each season: January (summer), April (Autumn), July (Winter) and October (Spring). They were compared in percentage.

*Atmospheric influence: same monitoring point, different seasons of the year – seasonal variability.

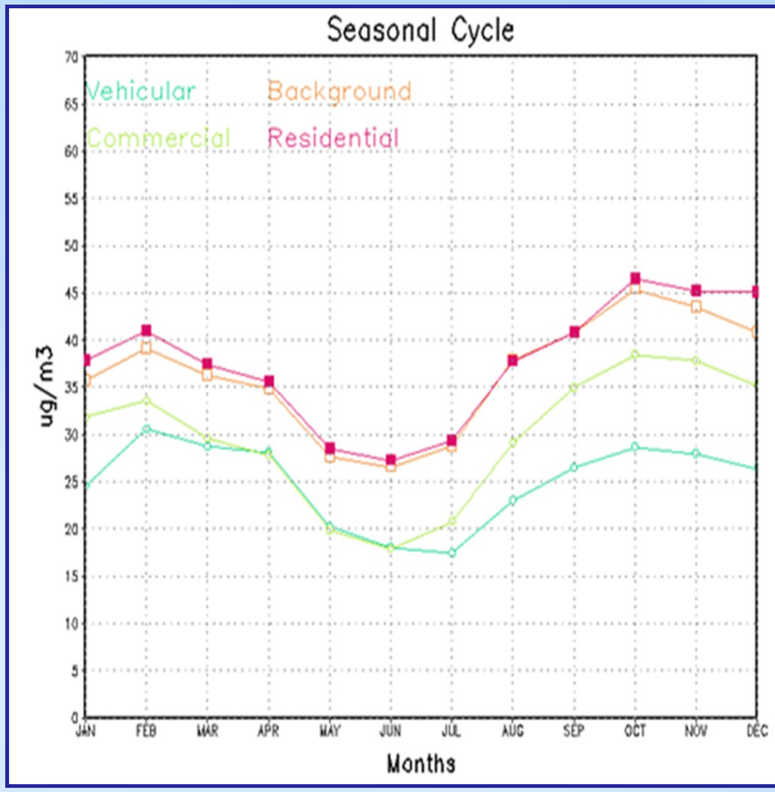
*Land use influence: same season of the year, different monitoring points – atmospheric chemistry.

Aerial photographs of each station location. Does different land use types affect the spatial distribution of tropospheric ozone concentrations in the intra-urban scale?

Station		Vehicular (Terminal Pedro II)	Commercial (Mooca)	Urban background (Ibirapuera Park)	Residential (São Caetano)	Difference between residential and vehicular* station in %
Concentration in µg/m³	*Summer*	24.58	31.92	35.81	37.85	**35%**
	Autumn	28.14	27.85	34.94	35.60	**22%**
	Winter	17.48	20.82	28.81	29.43	**41%**
	Spring	28.74	38.52	45.47	46.52	**39%**
Difference between winter and spring in the same station in %		*40%*	*46%*	*37%*	*37%*	***266%*** **

*Except for the autumn month, when the commercial station average was slightly lower than the vehicular one.

**Total difference between absolute minimum (winter in the vehicular station) and absolute maximum (spring in the residential station) average concentrations.



RESULTS

*Vehicular Station: lowest tropospheric ozone concentrations.

Probably related to excessive amount of NOx and VOCs, directly emitted by intense heavy and light-duty vehicle traffic at about 10m.

*Commercial station: relatively low to average concentrations.

More distant from the emission points than the vehicular station (about 50 m) , but also under the influence of many important avenues with intense vehicle traffic. Mixed land use: commercial, leisure, industrial.

*Urban background station: very high concentrations.

No direct emission in the vicinity of the station, situated in a city park. Ozone probably accumulates due to the availability of precursors coming from the avenues at about 400 m distance.

*Residential Station: highest concentrations.

In an area with lesser vehicle traffic and distant from the main avenues (150m), but with some urban activity. Very similar behaviour to the urban background station.

DISCUSSION

*Both seasonal variability and land use characteristics influence tropospheric ozone concentrations in the area of study.

*Seasonal Variability :

max in Spring & min in Winter

…in all monitoring stations, no matter the land use type (up to 46% in the Commercial station).

*Land Use:

max. in Residential/Background & min. in Vehicular

…in all months, no matter the season of the year (up to 41% in Winter).

***Residential** and **Urban Background** stations: lesser vehicle traffic density, similar tropospheric ozone concentration high values and well-defined seasonal cycles.

***Vehicular** station: close to intense vehicular traffic and high road density, lowest concentrations and a less-defined seasonal cycle.

***Commercial** station, mixed land use, medium concentrations: highest seasonal variability.

*The highest monthly concentration averages (Spring) in the **Vehicular** station are comparable to the lowest concentration averages (Winter) in the **Background** and **Residential** stations, showing that land use control over tropospheric ozone concentrations, through emission of NOx and VOCs, influenced by the distance to the monitoring point and road and traffic density, is of a comparable magnitude to the control exerted by the seasonal atmospheric variability, through availability of solar radiation and cloud cover through the year.

FUTURE STUDIES

The Weather Forecast and Research (WRF) atmospheric model will be used for future simulations. By replacing the land use index in urban areas for grassland of forest, we will be able to simulate the construction of a park or square inside the city, surrounded by avenues. It is expected that tropospheric ozone concentrations will rise inside the modified area in this scenario.

•Partial results of a PhD research project started in 08/2012, under supervision of professor Maria Elisa Siqueira Silva. We thank FAPESP for the financial support. Process No: 2012/12216-5