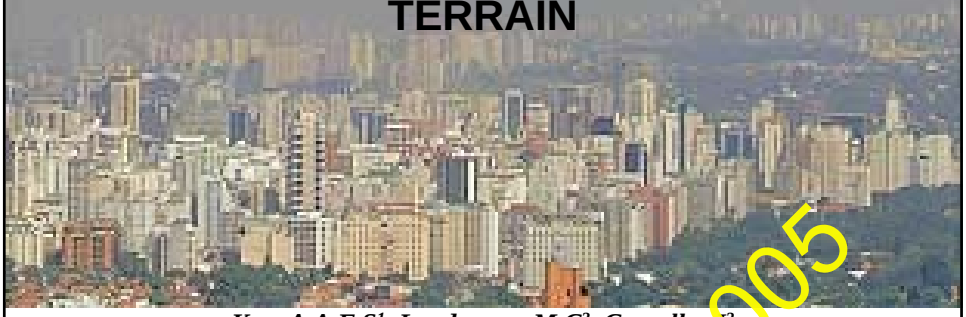
INVESTIGATION OF CO DISPERSION FROM SÃO PAULO METROPOLIS BY MEANS OF A MODELLING SYSTEM FOR COMPLEX TERRAIN



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RMS MODEL SYSTEM (RAMS-MIRS-SPRAY)

RAMS

Fields of - WIND, TEMPERATURE, T.K.E., K (3 D)
TOPOGRAPHY, SURFACE FLUXES (2 D)

MIRS

Fields of - WIND, K, SKEWNESS/KURTOSIS, T_L (3 D)
TOPOGRAPHY, PBL height (2 D)

SPRAY

Fields of - PARTICLE POSITIONS
CONCENTRATION FIELDS

Parameterisation for RAMS

Grid-1 resolution: 18 km (23.550S;46.500W); Grid-2 resolution: 4.5 km (23.388S;46.677W)
Meteorological data for initialization are provided by CPTEC, at 00, 06, 12, 18 GMT.
Topography from U.S. Geological Survey (resolution of 30 s).
Land use and roughness from satellite information classified by Freitas (2003).
and the others parameterizations needed to run the model are from RAMS inner files.

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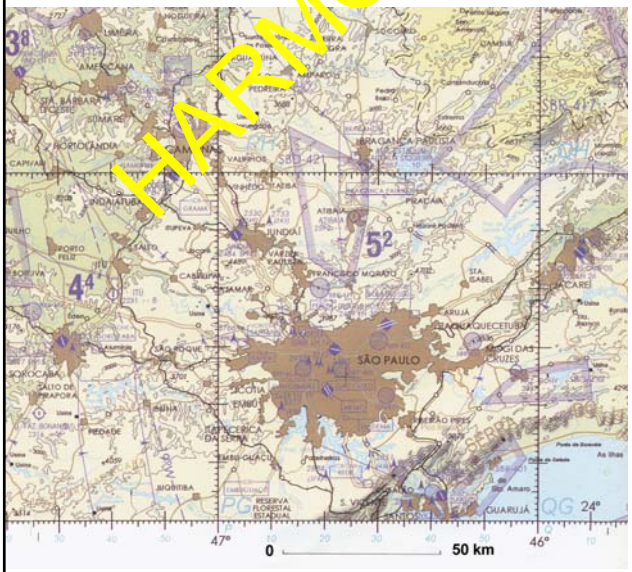
Map of the Grid-2 (area where the CO simulations are performed)



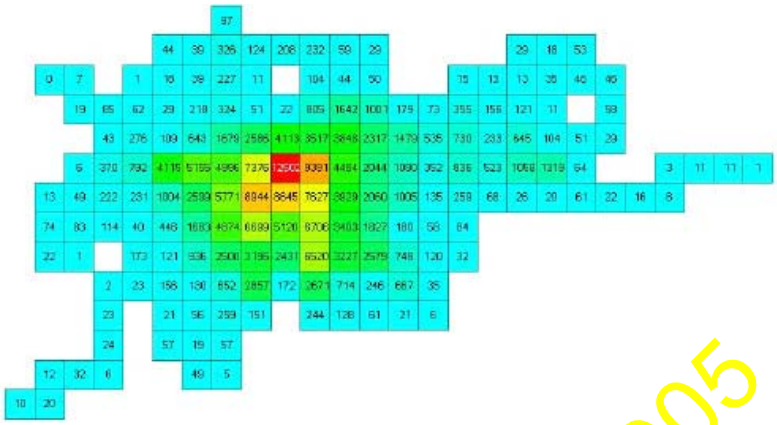
São Paulo Metropolis
8,051 km^2
19 x 10^6 inhabitants

Campinas Metropolis
3,673 km^2
2.6 x 10^6 inhabitants

Baixada Santista Metropolis
2,273 km^2
1.6 x 10^6 inhabitants

Total population in this area:
~ 24 x 10^6 inhabitants

The RMSP CO source (kg/h) - 169 squares with 5x5 km^2



Defined by:

1) Density and velocity of vehicles in the streets
2) Average emission factor of the vehicles (models, fuel, age)
3) Evaluated: 1.69x10^6 t/year

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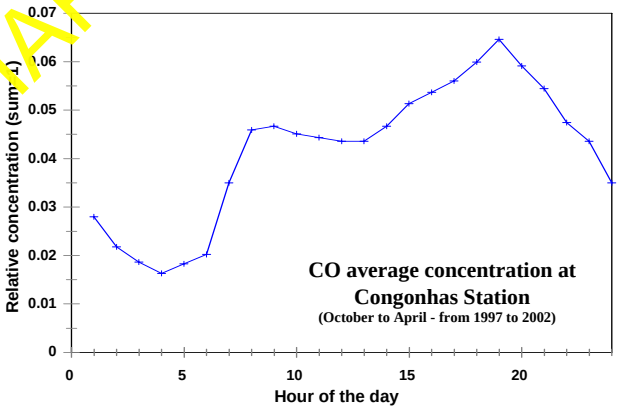
Daily cycle for the CO source



Results: comparisons and discussion

(days: October 11, 12 and 13/2000)

For the meteorological parameter simulated by RAMS

- 6 ground meteorological stations

For the CO concentrations simulated by SPRAY

- 4 environment control stations at the RMSP

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Comparison between the measured and simulated surface wind

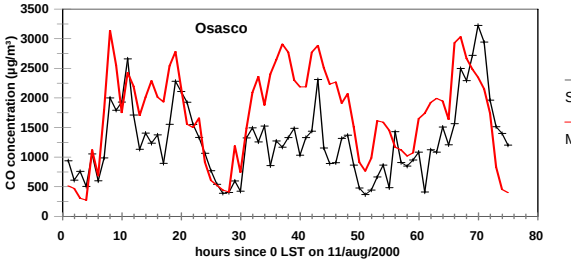
Station	Local	(lat,lon)	RMSVE	MD		FB	
			(U and V)	speed	direction	speed	direction
sibi	RMSP	(-23.553;-46.629)	1.68	-0.57	-2.3	-0.33	-0.01
spii	RMSP	(-23.544;-46.660)	1.75	-0.05	-19.1	-0.03	-0.12
sscs	RMSP	(-23.617;-46.556)	1.85	-0.23	-4.8	-0.13	0.08
siag	RMSP	(-23.649;-46.625)	2.62	-0.88	-39.4	-0.47	-0.26
ssor	Sorocaba	(-23.502;-47.479)	1.48	-0.49	2.3	-0.21	0.01
spau	Paulinia	(-22.772;-47.154)	2.25	-0.07	17.1	0.18	0.11

RMSVE (root-mean-square vector error)
RMSE (root-mean-square error)
FB (relative mean bias)
MD (mean difference)

The agreement was similar or better than those obtained on other works (Pielke and Pearce, 1994; Cox et al. 1998; Freitas, 2003).
Discrepancies are greater than the average for temperature and we also expected better results for humidity.

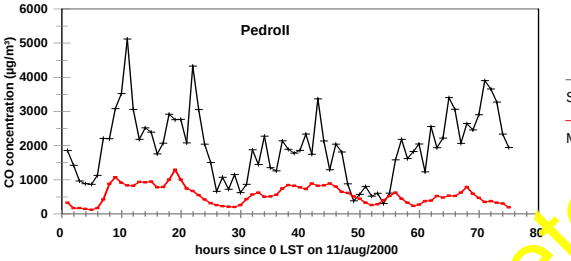
Problems could be atributed to the high variability in the land use and the need of a better definition of the urban centres - heat and humidity

Comparisons of the simulated and measured CO concentrations



Fitting:
Adj = b.Mes

Correlation
N=75
b=0.70
R=0.62
P<0.0001



Correlation
N=75
b=3.2
R=0.46
P<0.0001

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Heterogeneity in the area of some stations

(centre at Station Ibirapuera)

Transported CO – maxima and averages

City	Transported (µg/m³)	
	Maximum	Average
Jundiaí	1200	152
Campinas	390	43
Paulínia	220	37
Americana	410	42

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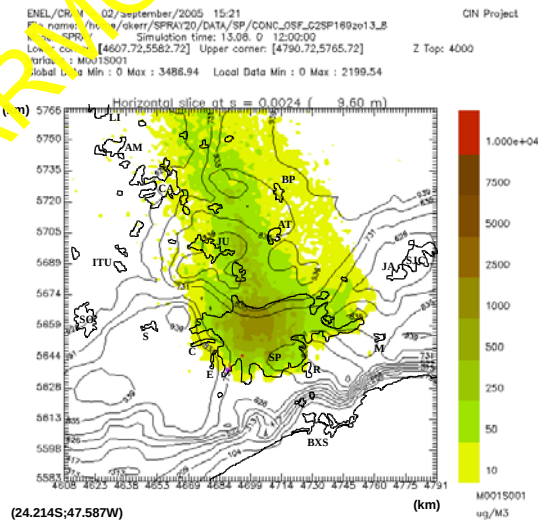
From October/13 at 12GMT to October /14 at 5GMT



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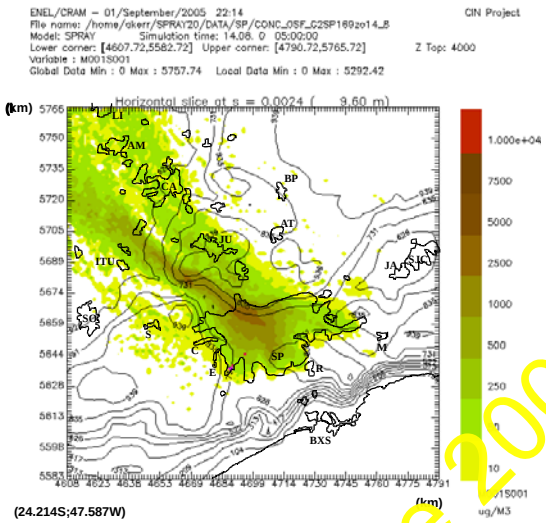

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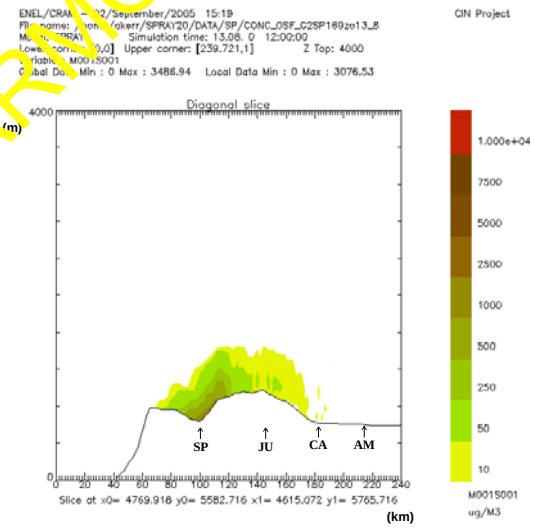

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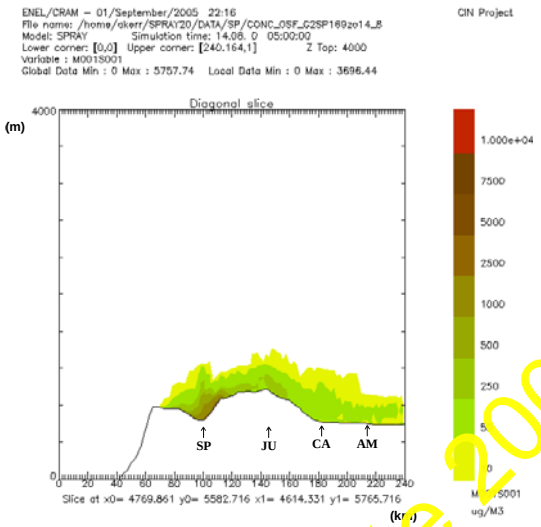

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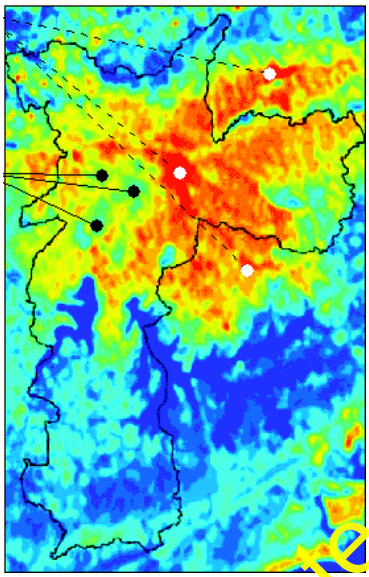
Conclusions

Meteorological parameters fields and CO concentrations fields showed a fair agreement with the available measurements at ground level and enabled a discussion about the CO transport to other cities around the RMSP.

To improve simulations we will try:

1) increase the grid resolution to account the land use heterogeneity;
2) incorporate some specific parameterisations for São Paulo, as the not accounted anthropogenic contribution to the island of heat we have at São Paulo and the fast time variation of the land use on crop areas;
3) improve the CO source definition and incorporate the CO emissions of the other urban centres on evaluation.



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