A discussion on the paper “Measurements of CO_2 fluxes from the Mexico City urban landscape” by Velasco

Reporter: Gao Yunqiu

u Outline

- Background
- Methods
- Results
- Conclusions
- Inspiration

u Background

- Mexico City is a good example of subtropical megacity in a less developed country.
- An eddy covariance (EC) flux system was deployed on a tall urban tower within a densely populated section of the city to obtain direct measurements of CO_2 emissions.
- The results are analyzed in terms of the magnitude of the CO_2 fluxes in relation to the source footprint as a function of wind direction and in relation to vehicular activity.

Yale

u Methods

- Measurement site and study period

Mexico City is located at 2240m above sea level; the city experiences mild weather, temperatures of over 20℃, and intense solar radiation all year.

CO_2 fluxes were measured for 23 days during the warm dry season in April 2003 (April 7–29).

The EC flux system was deployed at the CENICA super site.

Instrumentation

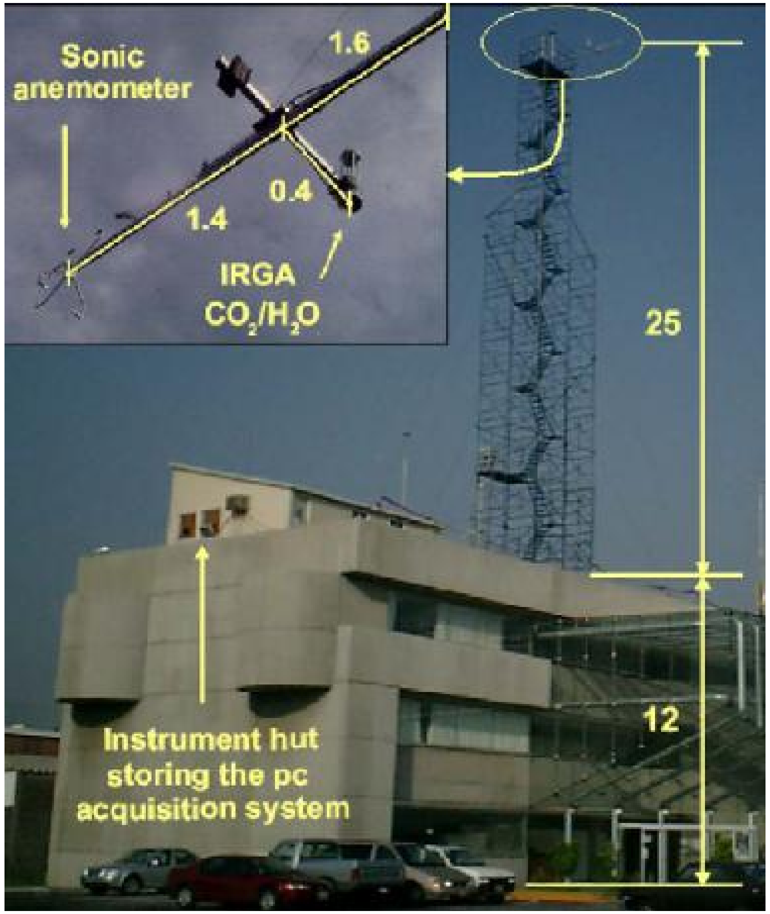

Fig 1. Schematic diagram of the instrumented flux tower. The azimuth orientation of the sonic is 161 from north. Dimensions are in meters.

Postprocessing for eddy covariance flux calculations

$$F_c = \overline{w'c'_c} = \frac{1}{N}\sum_{i=1}^{N} w'(t_i)c'(t_i)$$

w' the instantaneous deviation of the vertical wind velocity

c'_c the instantaneous deviation of the trace gas concentration

Spectral and cospectral analysis

The quality of flux measurements is difficult to assess, because there are various sources of errors.

Aubinet et al.(2000) suggest an empirical approach to determine whether the fluxes meet certain plausibility criteria.

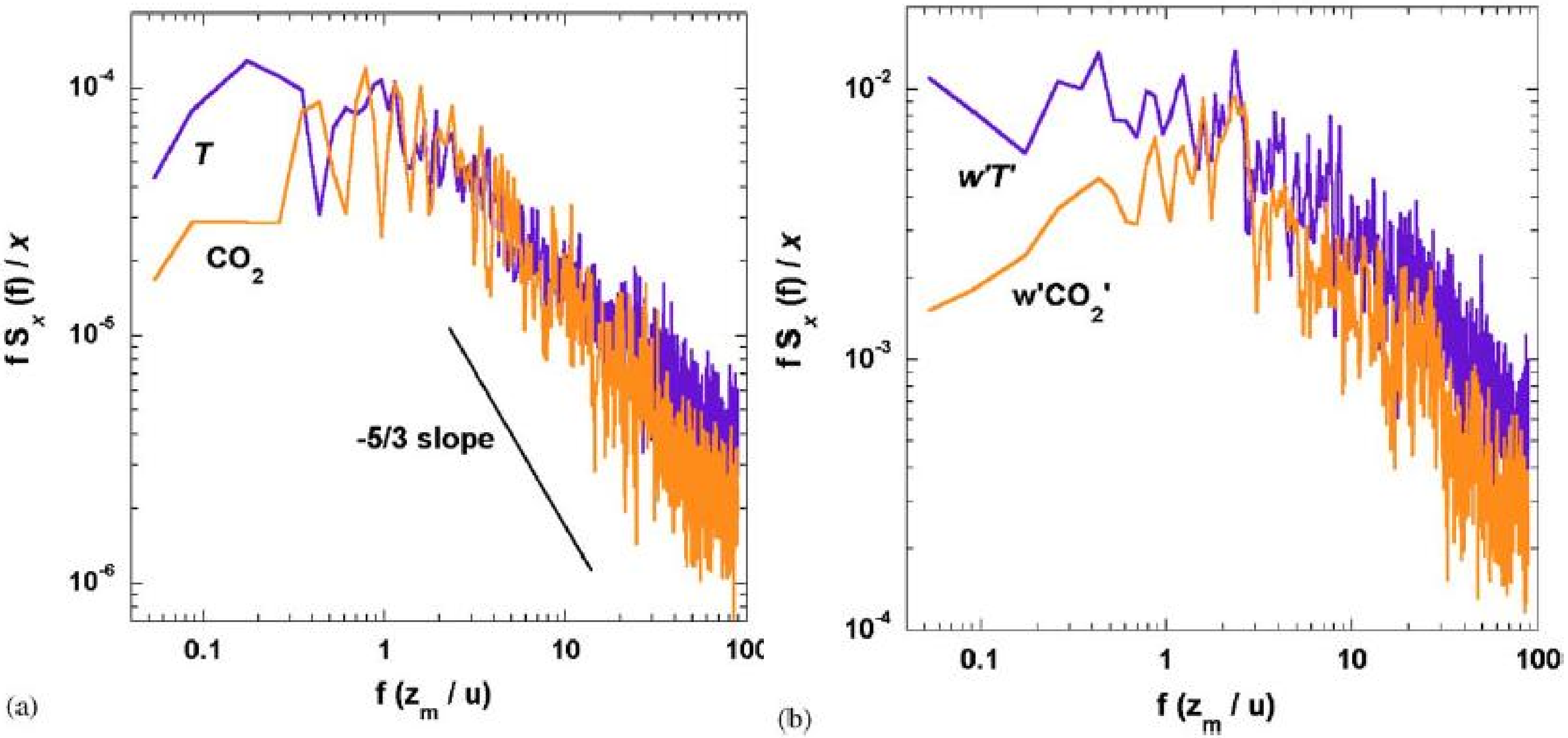

Fig 2. (a) Power density spectra for CO_2 concentration and ambient temperature, normalized for comparison. (b) Cospectra of vertical velocity with ambient temperature and CO_2 concentration, normalized for comparison.

Stationarity test

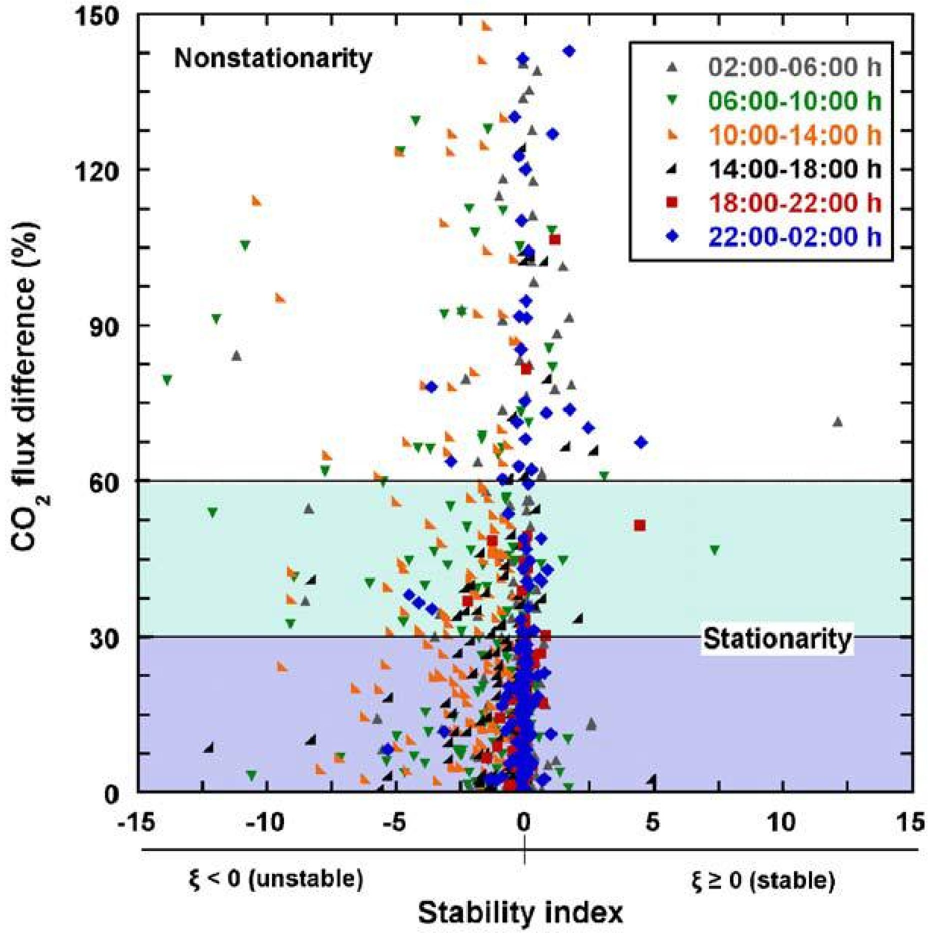

Fig 3. Stationarity test for CO_2 flux. In 56% of the periods, the flux difference was less than 30%, which indicates periods that meet and exceed the stationarity criteria. In 18% of the periods, the flux difference was between 30% and 60%, which means that these periods have an acceptable quality.

Yale

- Footprint analysis

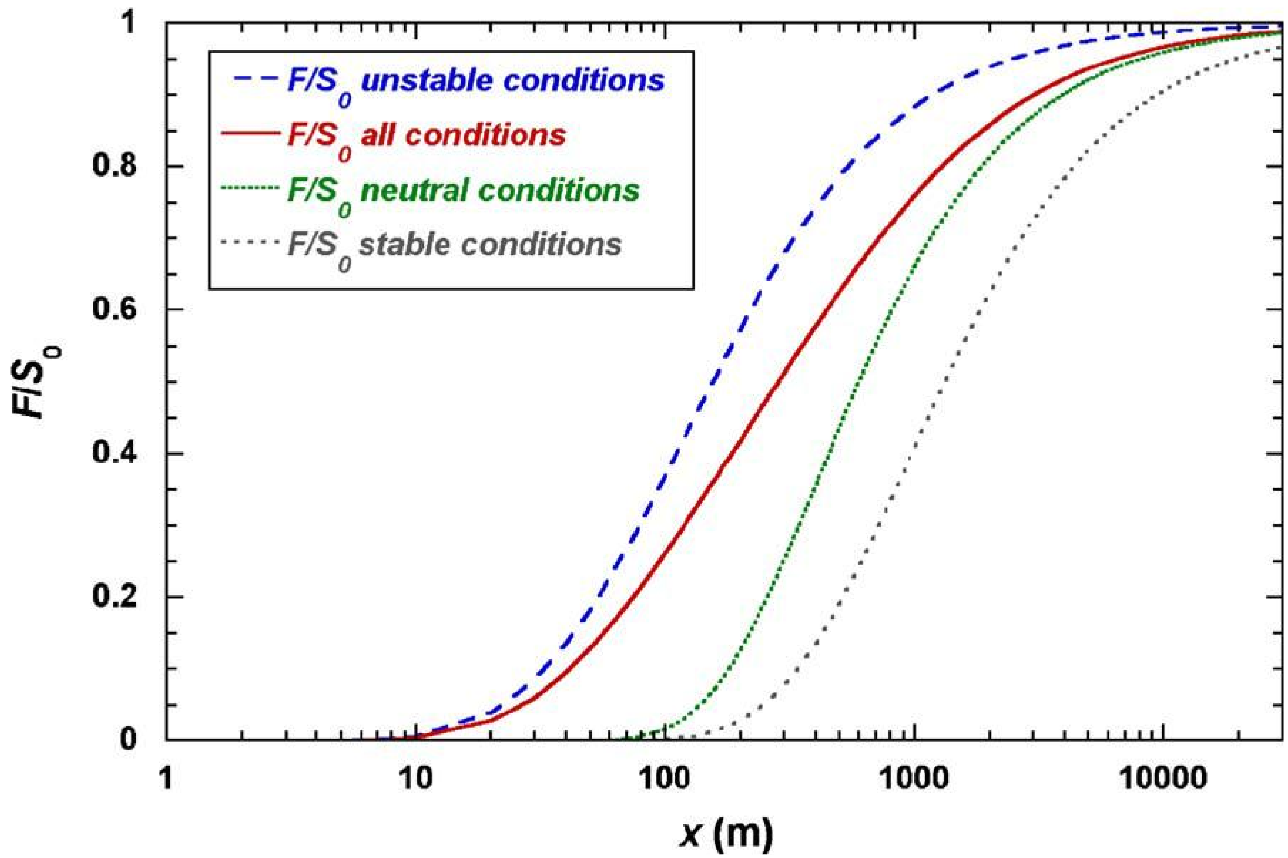

Fig 4. Fraction of the flux measured (F/S_0) versus the upwind distance or effective fetch (x).

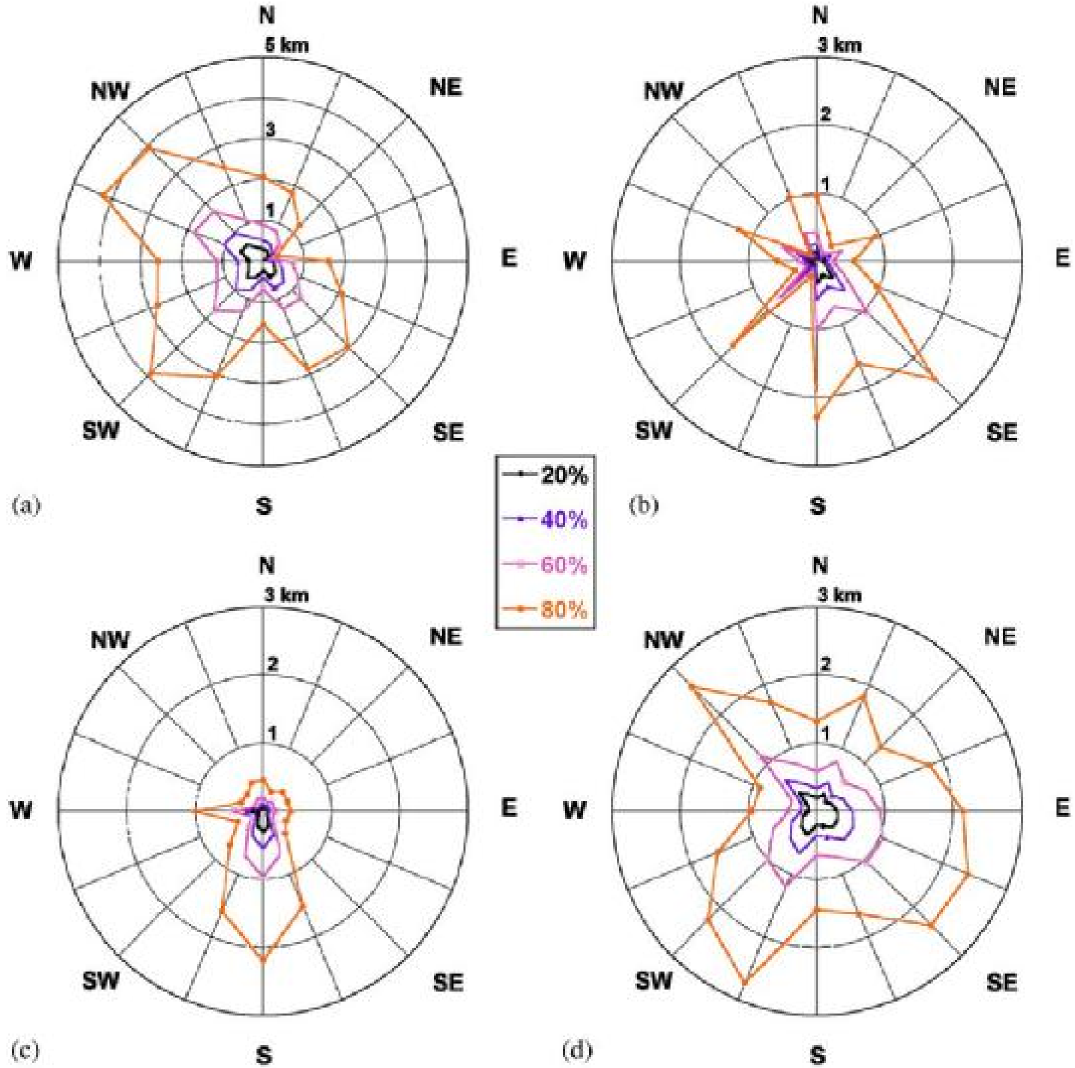

Fig 5. Different fractions of the measured flux (F/S_0) during the entire campaign as function of the wind direction for different intervals of time, (a) from 0:00 to 3:00 h, (b) from 6:00 to 9:00 h, (c) from 12:00 to 15:00 and (d) from 18:00 to 21:00 h.

Yale

u Results

- Concentrations

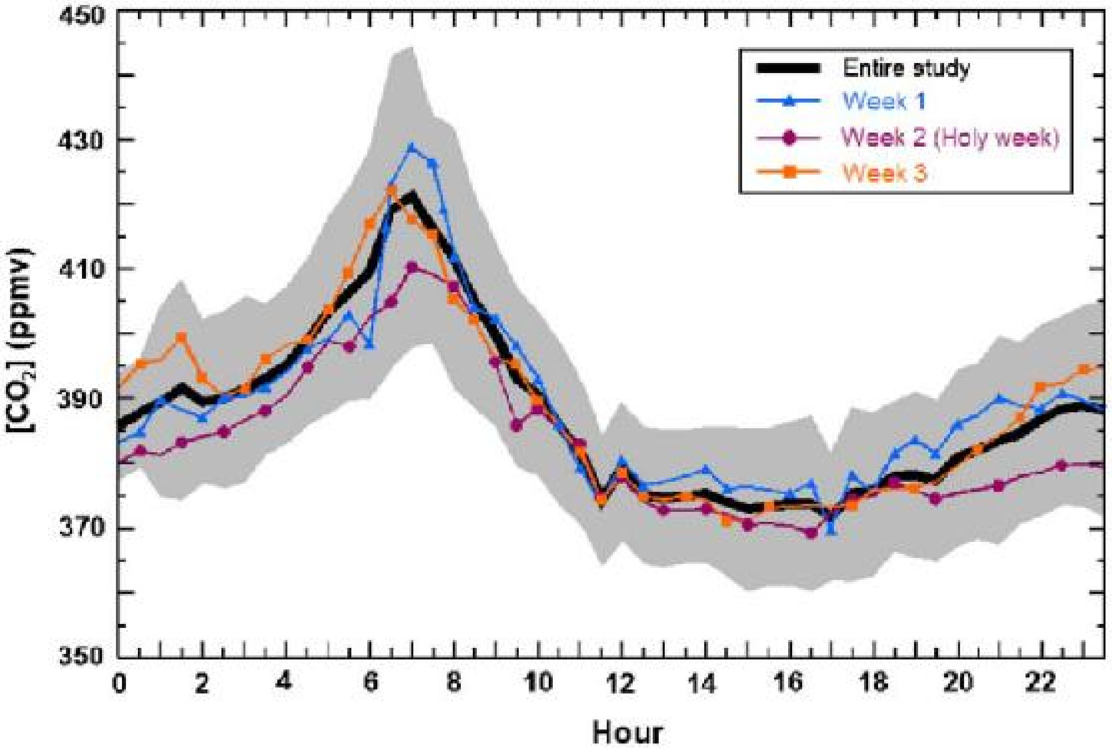

Fig 6. Average diurnal pattern of CO_2 concentrations for the entire study and for separate weeks. The gray shadow represents ±1 standard deviation from the total average.

Yale

Fluxes

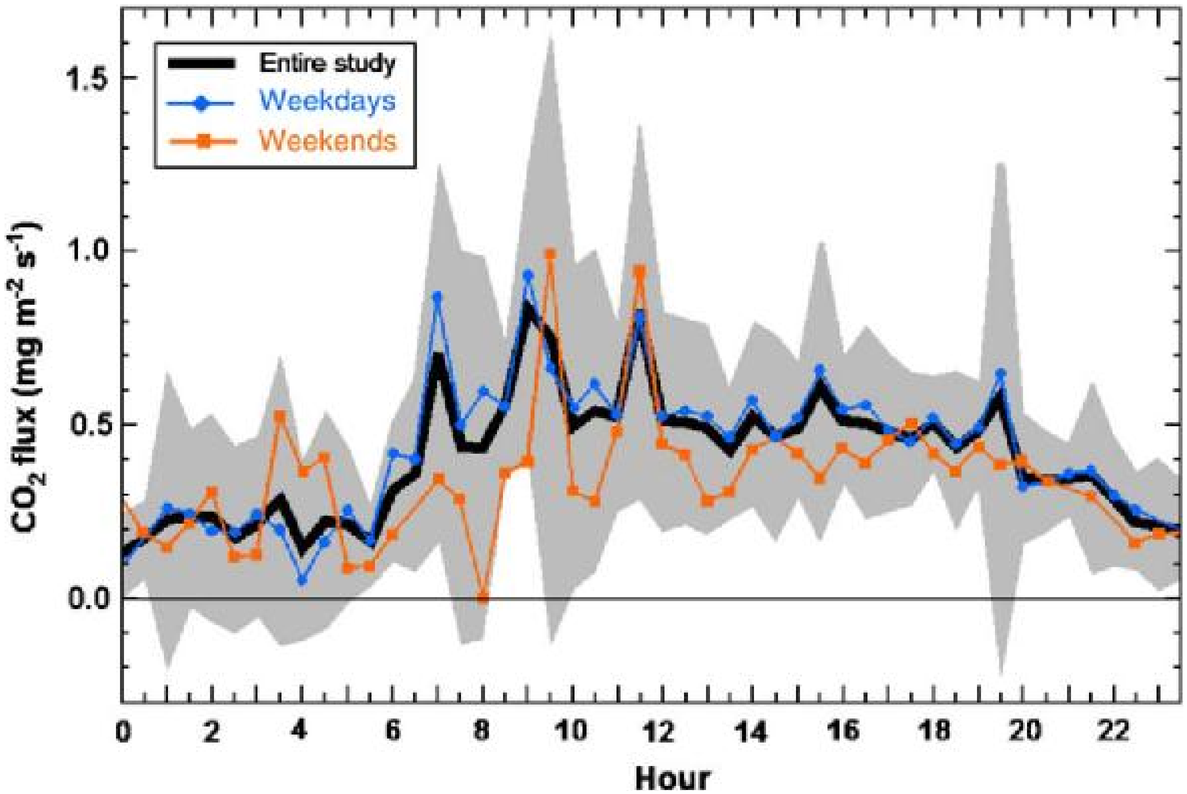

Fig 7. Average diurnal pattern of CO_2 fluxes for the entire study and for weekdays and weekends. The gray shadow represents ±1 standard deviation from the total average.

- Fluxes as a function of the upwind direction and the vehicular activity

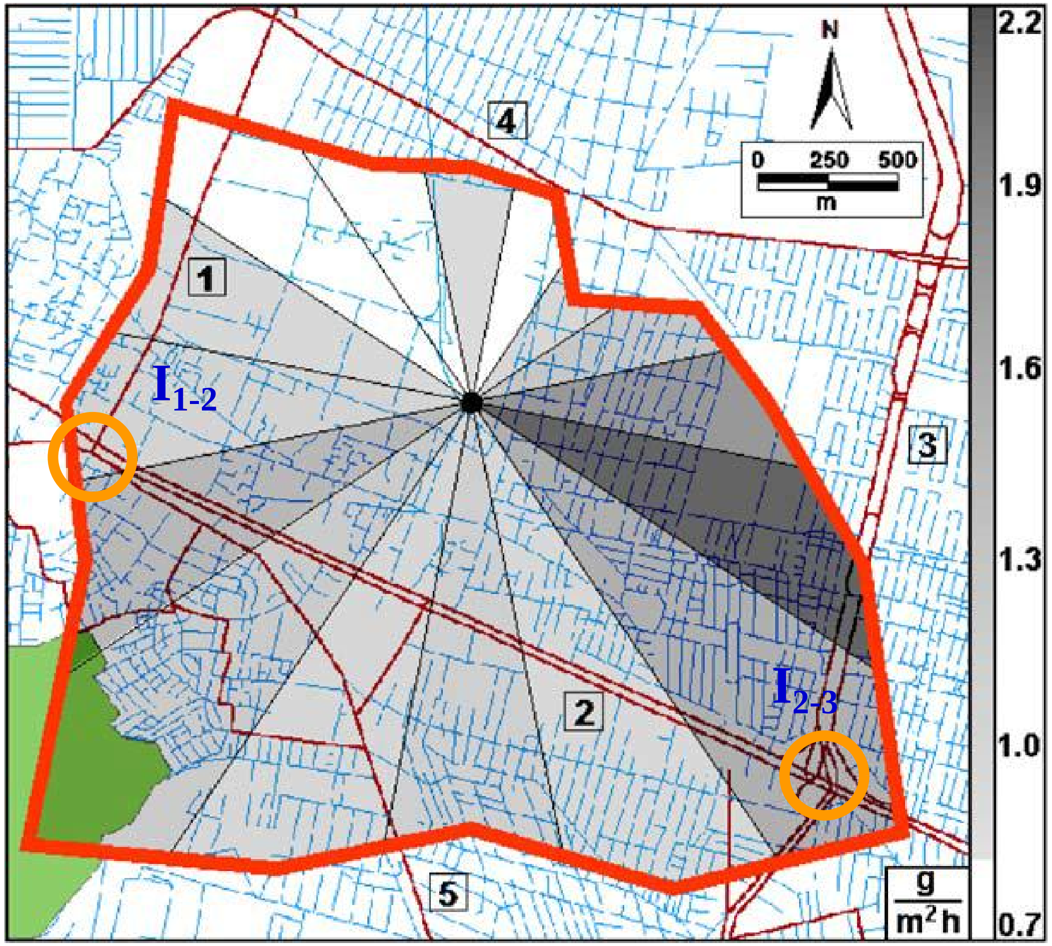

Fig 8. CO_2 flux distribution as a function of the upwind direction during the entire study.

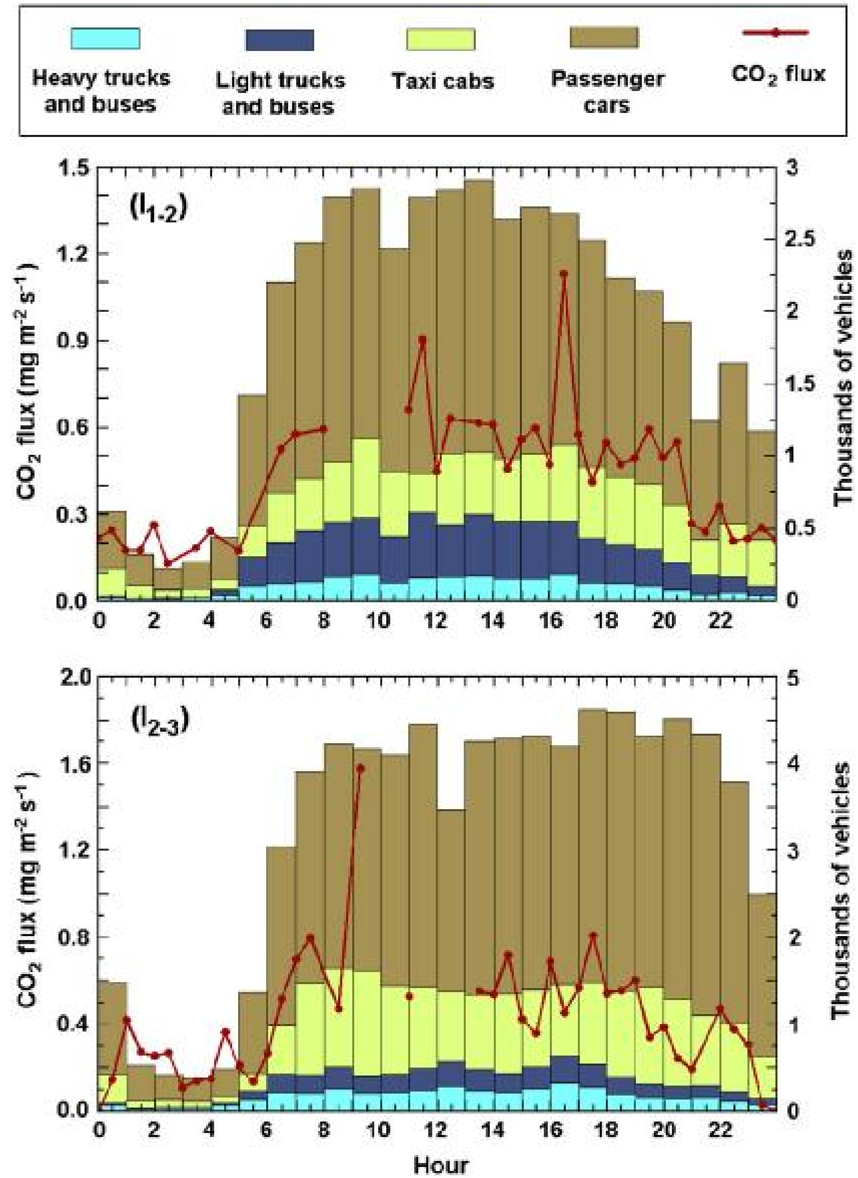

Fig 9. Diurnal profiles of CO_2 fluxes superimposed over plots of traffic counts for two intersections within the footprint.

Yale

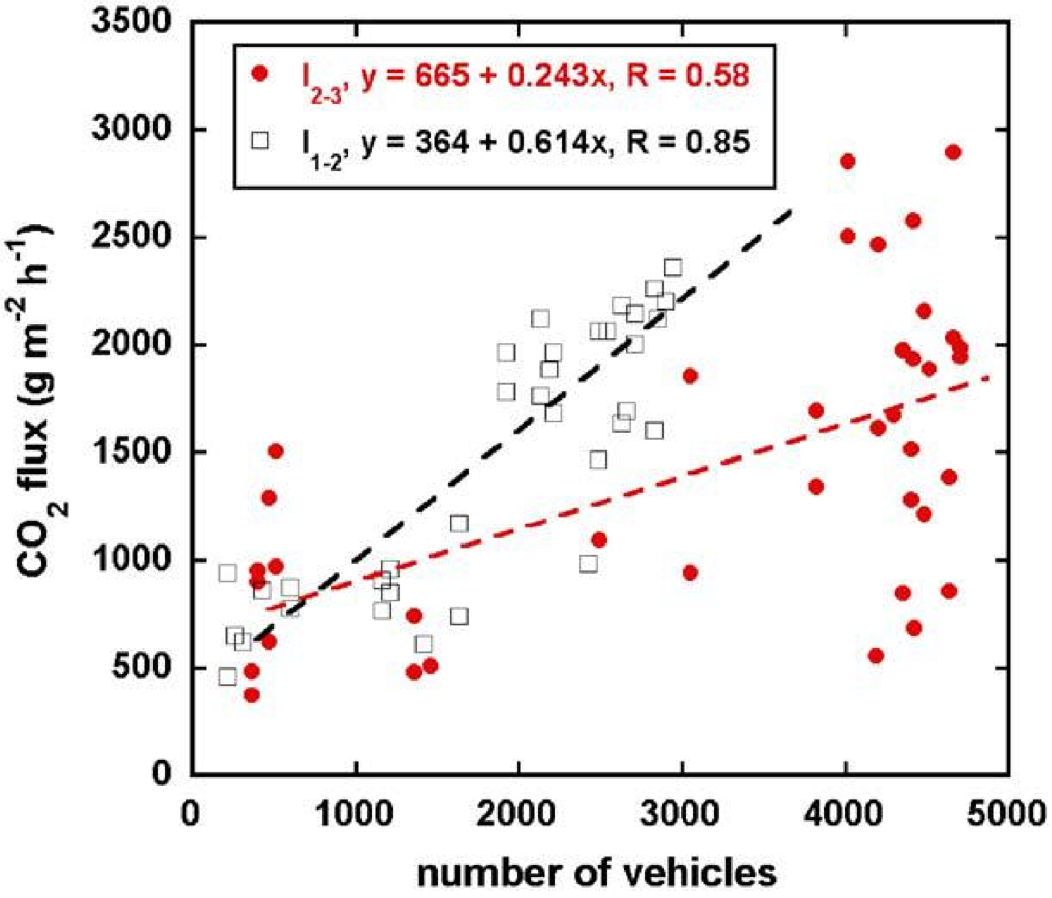

Fig 10. Correlation between CO_2 fluxes and vehicular traffic for two intersections, $I_{1–2}$ and $I_{2–3}$. Fluxes correspond to the 45° upwind sectors where both intersections are located, respectively.

- Evaluation of random and systematic errors in the measured daily mean CO_2 flux

We applied the approach proposed by Moncrieff et al. (1996) to evaluate the random and systematic errors on the mean daily flux.

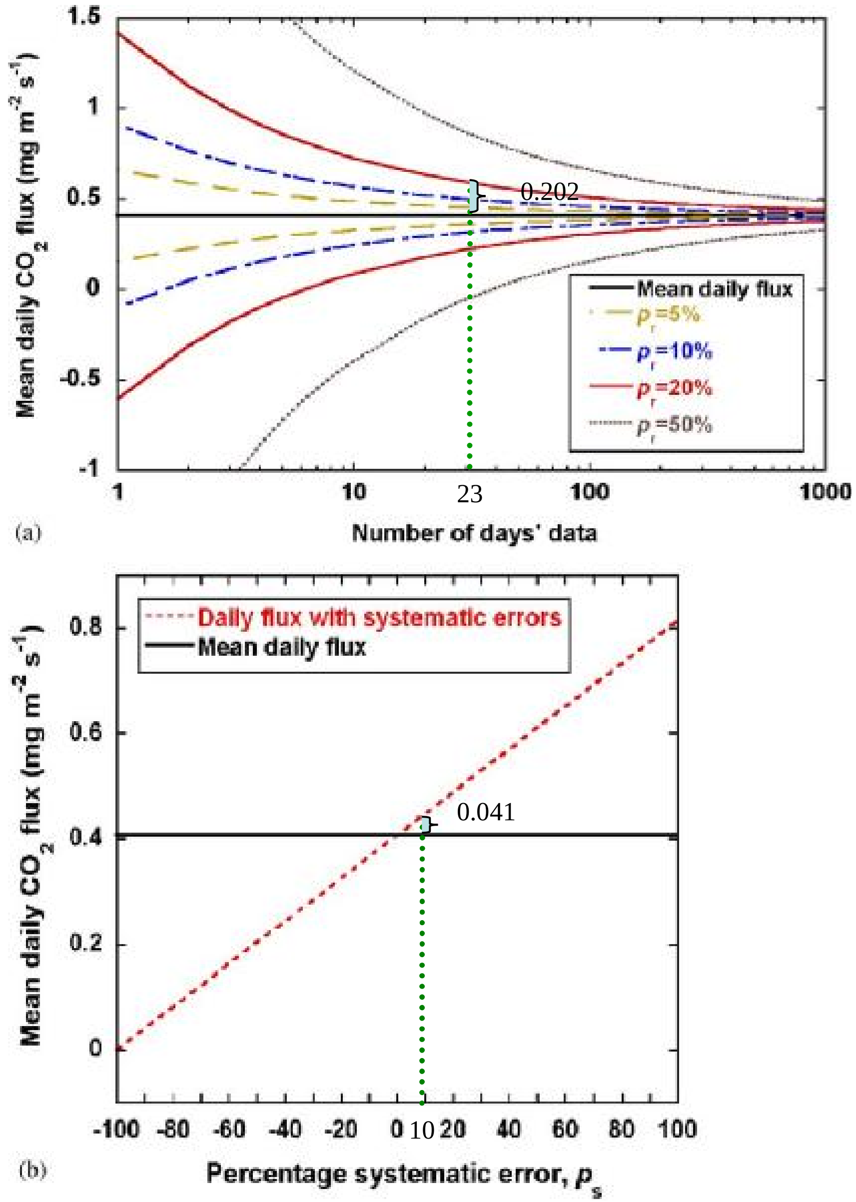

Fig 11. Effects of random and systematic errors for the mean daily CO_2 flux.

Yale

Conclusions

The CO_2 measurements show clear diurnal patterns for both concentrations and fluxes, which are strongly correlated to vehicular traffic during the day.

It is important to evaluate available emission estimates with direct measurements. In the future, long-term measurements similar to those described in this paper would be a valuable contribution to quantification of CO_2 emissions from megacities.

u Inspiration

- Research objectives
- Research ideas

CO_2 —site selection→ Iztapalapa —Instrumentation→ EC —data processing→

Result —Analyze Angle→ { Concentrations / Fluxes } → Go on work

Yale

	Mexico City	**Nanjing**
Geographical location	98°57′~ 99°22′W 19°36′~ 19°03′N	118°22″~ 119°14″E 31°14″~ 32°37″N
Sea level	2240m	8.9m
Climate	Subtropical monsoon climate	Subtropical monsoon climate
Temperature	Over 20℃, intense solar radiation all year.	15.4°C, four distinctive seasons
City size	The second largest city in the world(1,964,375 km^2)	Second-tier city in China (6600 km^2)
Population	The high density population 18,000,000	The high density population 8,100,000

Thank You