

CO₂ fluxes modelling over urban areas

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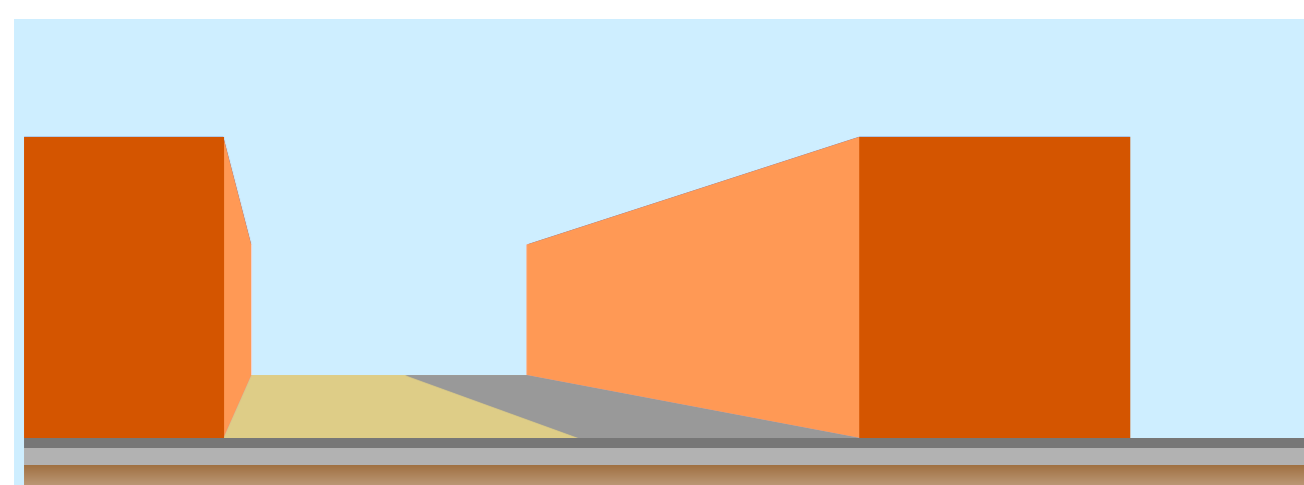
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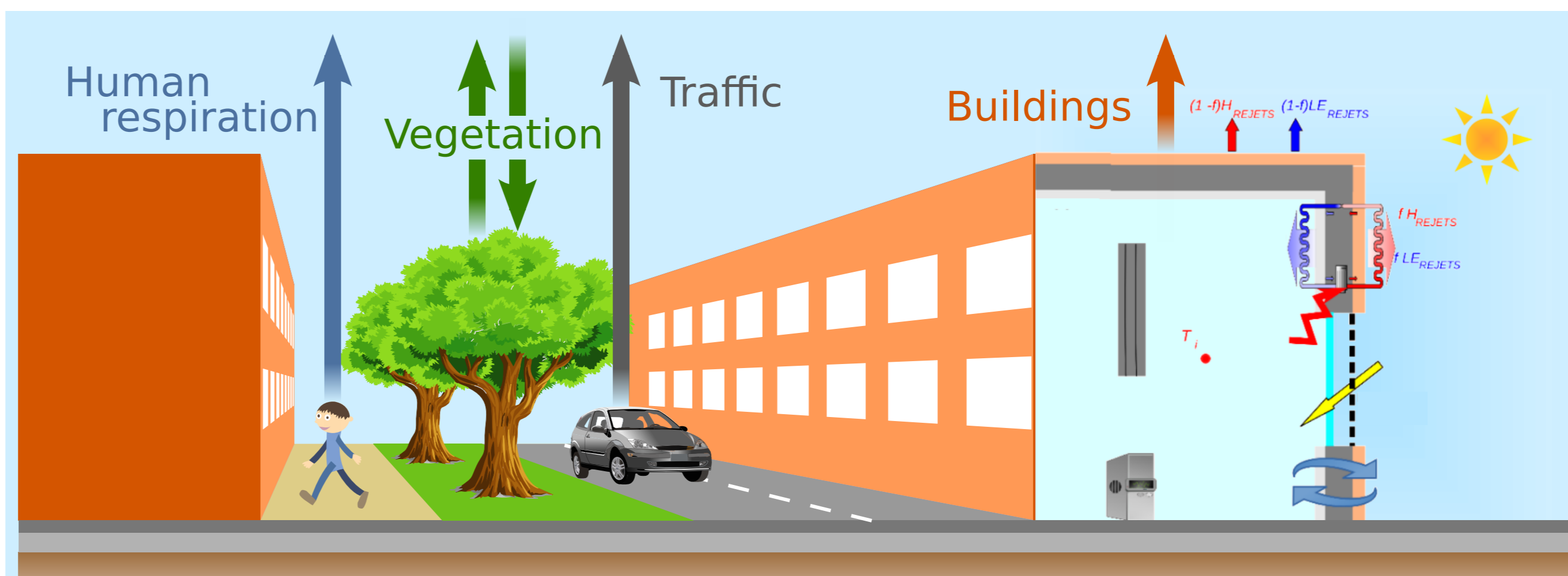


TEB MODEL [2]



- Each urbanized grid cell is represented by a **urban canyon** with the average characteristics of the cell.
- An **energy budget** is done for each elementary surface (roof, road, 2 walls).

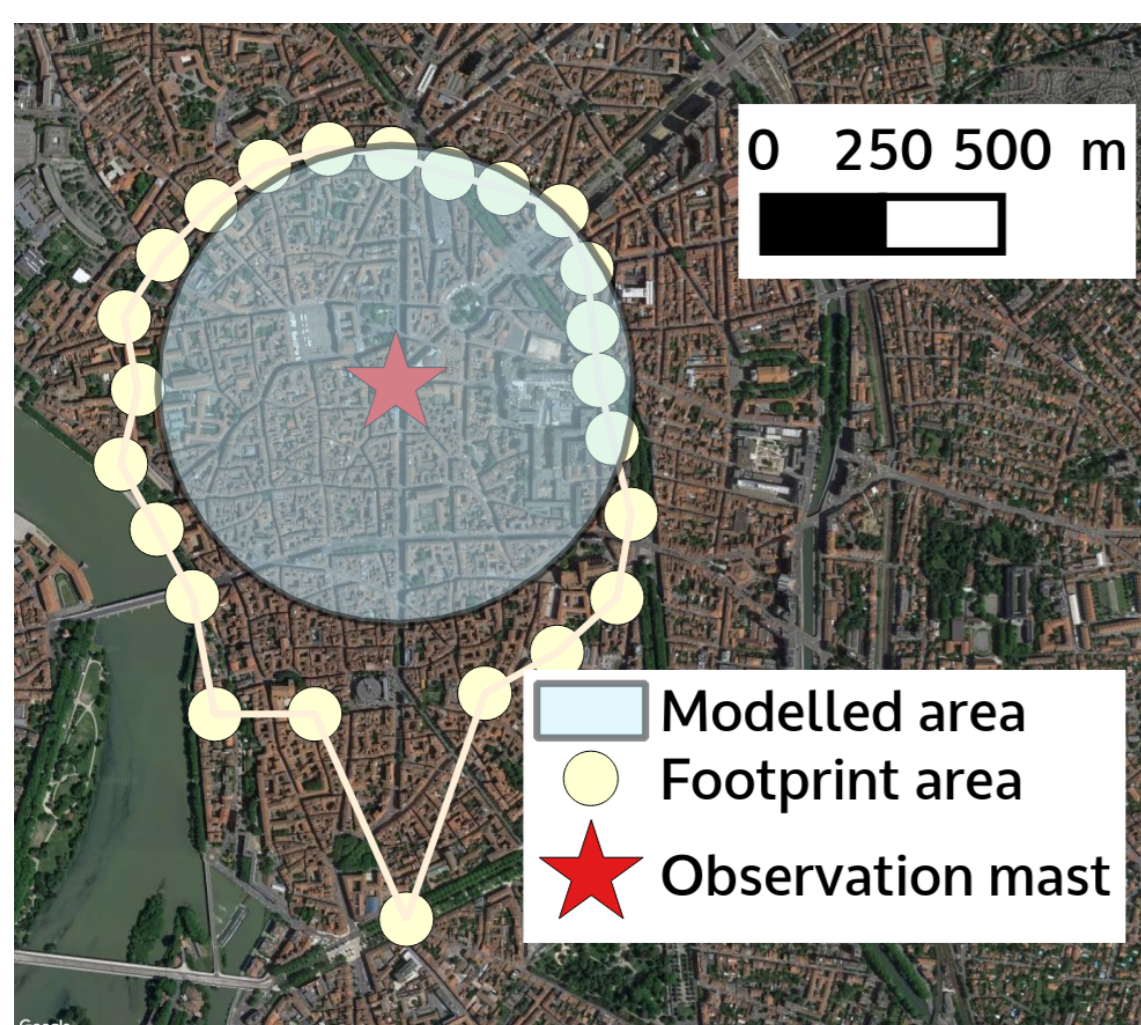
TEB CO₂



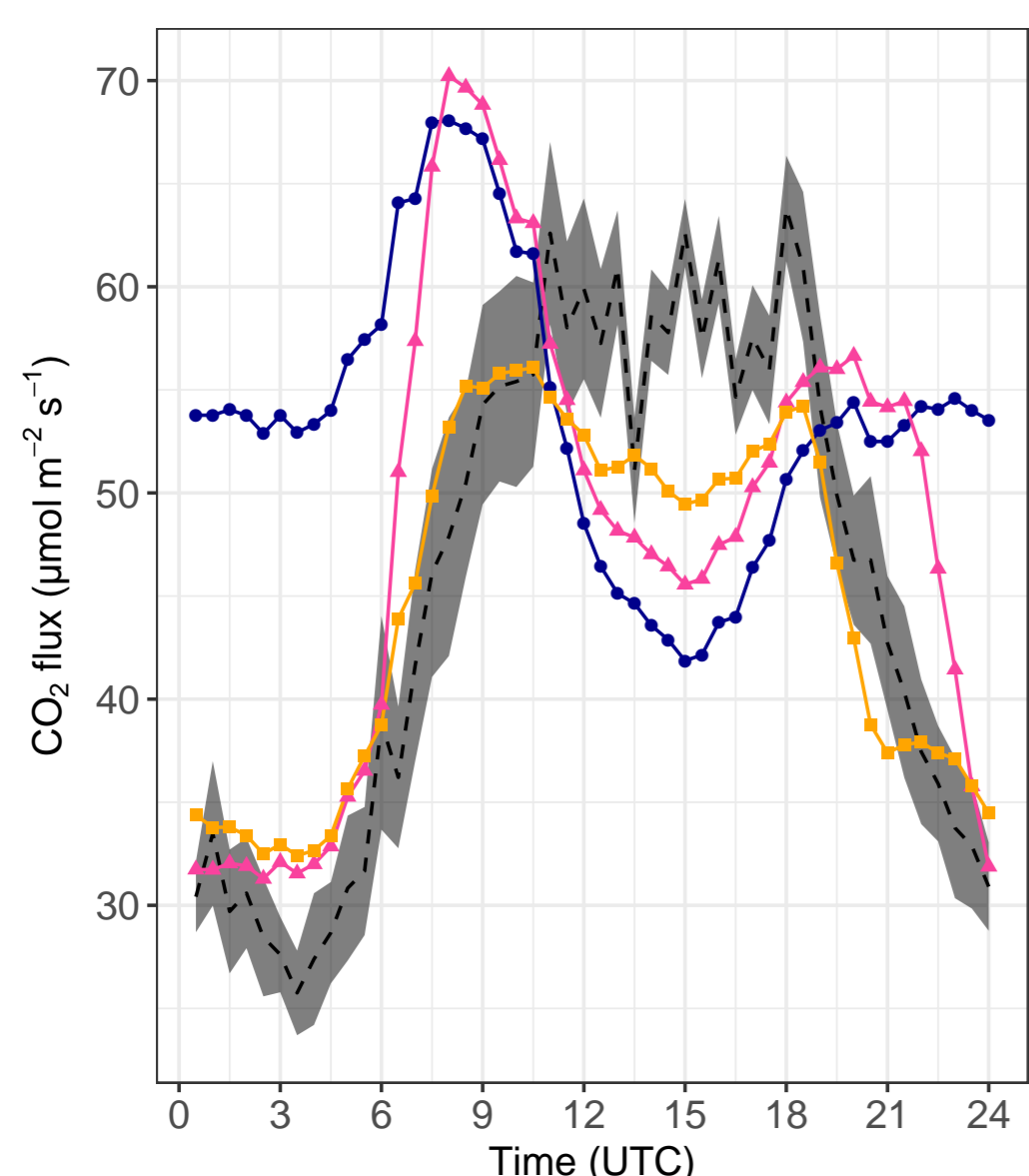
- **Non weather dependant** contributors are **parametrized**:
 - **Traffic**: mean CO₂ fluxes rejected by traffic is modulate depending on month, day of the week and hour;
 - **Human respiration**: population density is multiply by the mean amount of CO₂ rejected by one person.
- **Weather dependant** contributors are **explicitly modelled**:
 - **Vegetation**: photosynthesis and respiration are calculated by the SVAT model ISBA;
 - **Buildings**: buildings energy consumption calculated by BEM [1] are multiplied by emission factors depending on the source of energy used (electricity, gas, fuel, wood).
- **TEB CO₂ explicitly described interactions between local climate and CO₂ fluxes.**

CO₂ FLUXES OBS

- CAPITOUL campaign (Mar 2004 - Feb 2005) [3]
- Toulouse city center



SENSITIVITY TO HUMAN BEHAVIOURS



Average daily cycle of CO₂ fluxes for DJF. Observations are in dashed line and model in plain line.

- Assuming a **constant indoor temperature** (19°C) does not allow to reproduce the CO₂ daily cycle (●).
- **Lower the temperature during night** by 2°C improve results (▲).
- Considering a **more detail description of human behaviour** with several usage (residential, commercial, offices...) allows to get a smoother cycle, **closer to observations** (■). Indoor temperature is set depending on usage, time slot and probability of occupation.

FUTURE WORK

- Validation of fluxes due to vegetation, with a more vegetated case study.
- Study of impacts of adaptation strategies of cities on CO₂ fluxes.

BIBLIOGRAPHY

- [1] B. Bueno et al. "Development and evaluation of a building energy model integrated in the TEB scheme". In: *Geoscientific Model Development* 5.2 (Mar. 2012), pp. 433–448. ISSN: 1991-9603.
- [2] V. Masson. "A Physically-Based Scheme For The Urban Energy Budget In Atmospheric Models". In: *Boundary-Layer Meteorology* 94.3 (2000).
- [3] V. Masson et al. "The Canopy and Aerosol Particles Interactions in TOulouse Urban Layer (CAPITOU) experiment". en. In: *Meteorology and Atmospheric Physics* 102.3-4 (Dec. 2008), pp. 135–157.