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Short-term energy and carbon balance calculation and footprint-based land cover classification at an urban site

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ITINERIS
ICOS Integrated Carbon Observation System

Sharing is encouraged

Main challenges

1. Impacts of **urbanization** and **human activities**
2. Urban energy balance **alteration**
3. Increase of **energy and water uses**

Objectives

1. Analysis of the **urban energy balance**
2. **CO_2 flux variation** assessements
3. Study of **fluxes fractions and distribution**

Materials & Methods

Data window of **four months** (Feb 6 to Jun 4 2024)

Eddy covariance technique

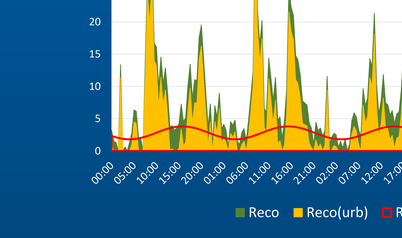
1. Urban **ICOS-associated station** in Sassari (Sardinia, Italy)
2. Data processing with **EddyPro®** (by LI-COR®)

Flux Footprint calculation

1. Fluxes characterization with **Tovi®** (by LI-COR®)
2. Land cover classes of urban emissions with **Flux Footprint Prediction** (Cost action Optmise ES1309 of EU Horizon 2020)

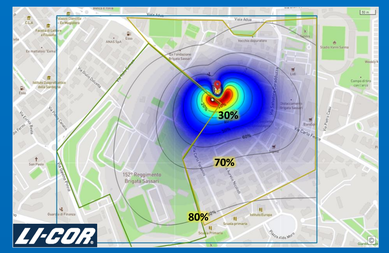
Results of data analysis

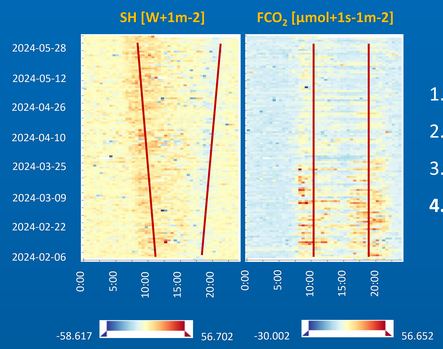
Corrected regression model (Mauder et al., 2013)



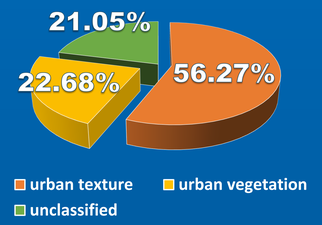
1. State of **balance closure** (R^2 = 0.68)
2. Balance **residuals** fitted with net radiation
   - anthropogenic emissions
   - storage heat
   - ET from vegetation

Footprint calculation (Kljun et al., 2015)



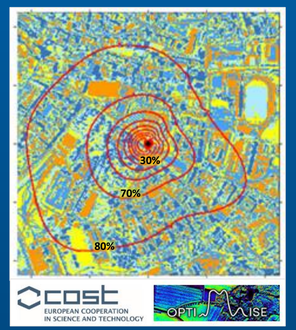


1. Late evening **storage heat (SH) release**
2. Night-time **warming effect**
3. Daily **traffic-affected** CO_2 profile
4. **Vegetation uptake** on late-season CO_2 profile



Ecosystem respiration levels of CO_2 (10-day window)

- 99.85% of **anthropogenic emissions Reco(urb)**; cov = 46.643
- 0.15% of **biogenic emissions Reco(bio)**; cov = 1.201



K-means **classification of surface fluxes** → complex **urban vegetated site** with a uniform distribution of fluxes

Conclusion

1. Balance **non-closure** due to surface heat, **anthropogenic and biogenic** inputs
2. **Night-time warming effect** on air temperature
3. CO_2 accumulation dropped by **vegetation uptake**

Take-home message

An **accurate evaluation** of human emissions, vegetation processes and surface heat capacity and their composite action is needed for **effective urban climate actions**.

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References

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Mauder M, Cuntz M, Drüe C, Graf A, Rebmann C, Schmid HP, Schmidt M, Steinbrecher R. 2013. A strategy for quality and uncertainty assessment of long-term eddy-covariance measurements. Agricultural and Forest Meteorology. 169:122–135. doi:10.1016/j.agrformet.2012.09.006.

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