Observation and comparison of C-fluxes of cities and peri-urban forests

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Summary

- The measurement sites:
  - Roma and Firenze, urban
  - Castelporziano and Lecceto, peri-urban forest
- The measurement techniques/protocols
- Results from two years of urban flux measurements
- Validation of urban flux measurements
- Seasonal and annual comparison of urban Vs peri-urban forest fluxes
- The role of biospheric sinks offsetting urban sources
Measurement sites:

- Roma and Firenze (urban)
- Castelporziano and Lecceto (forests)
Measurement sites: Roma

Site characteristics:
Height over road plan: 36 m
Building average height: 20 m
Measurements since 2004
Measurement sites: Castelporziano

Site characteristics:
Instrument height: 15 m
Canopy height: 10 m
Dominant species: Quercus ilex
Biome: Evergreen Broadleaf
Measurements since 1996
Measurement sites: Firenze

*Osservatorio Ximeniano*

1.6 km

**Site characteristics:**
- Height over road plan: 25 m
- Building average height: 15 m
- Measurements since 2005
Measurement sites: Lecceto

Site characteristics:
Instrument height: 14 m
Canopy height: 10 m
Dominant species: Quercus ilex
Measurements since 2005
The flux measurement technique: "Eddy Covariance"

The eddy covariance technique is used to measure carbon, water, momentum and energy fluxes at half-hourly intervals.

- CO₂ Flux
- Sensible heat Flux (H)
- Latent heat Flux (\(\lambda e\))
- Momentum Flux (u*)
Urban flux measurements in Roma: some results

intra-day half-hourly fluxes - 4 periods 2005 ROMA

intra-week daily fluxes - 4 periods 2005 ROMA

Roma: 2004 and 2005 monthly fluxes
Urban flux measurements in Firenze: validation of eddy covariance fluxes

• Measured eddy covariance fluxes (FLUX_EDDY)

• Traffic counters data → estimated flux using cars emission factors (FLUX_CARS)

• Methane consumption data → estimated flux (for all central city area) (FLUX_HEAT)

\[ \text{FLUX_EDDY} \quad \text{Vs} \quad \text{FLUX_CARS} + \text{FLUX_HEAT} \]
On average,

To offset 1 m² of urban emission in Roma we need:

1.7 m² of peri-urban forest area in June

31 m² of peri-urban forest area in January
Seasonal comparison of urban Vs peri-urban forest fluxes: FIRENZE

On average,

To offset 1 m² of urban emission in Firenze we need:

5.7 m² of peri-urban forest area in June

112 m² of peri-urban forest area in January
Annual comparison of urban Vs peri-urban forests: ROMA and FIRENZE

Total yearly fluxes:
ROME_URBAN: 4400 gC m\(^{-2}\)
CATELP_FOREST: -658 gC m\(^{-2}\)
FLORENCE_URBAN: 9380 gC m\(^{-2}\)
LECCETO_FOREST: -380 gC m\(^{-2}\)
ROMA

Total yearly fluxes:
ROME_URBAN: 4400 gC m$^{-2}$
CATELP_FOREST: -658 gC m$^{-2}$

500 ha forest = 74 ha city area
FIRENZE

Total yearly fluxes:
FLORENCE_URBAN 9380 gC m$^{-2}$
LECCETO_FOREST  - 380 gC m$^{-2}$

1200 ha forest = 49 ha city area
CONCLUSIONS

- Eddy covariance technique can be applied in urban environments.
- Eddy covariance data have been validated vs estimated emissions as derived from road traffic and methane consumptions data.
- Flux measurements both in cities and peri urban forests provide a tool to monitor urban C offset made by forests at the regional scale, appliable in a wide range of conditions worldwide.
Proposal for EU COST-Action

**Carbon Fluxes in Urban Areas**
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