GHG EMISSIONS ESTIMATION OVER A MEDITERRANEAN CITY THROUGH **DIRECT MEASUREMENTS AND INVENTORY APPROACH**

Serena Marras^{1,2}, Costantino Sirca^{1,2}, Veronica Bellucco¹, Laura Sanna³, Roberto Ferrara³, Pierpaolo Duce³, Donatella Spano^{1,2}

1. DIPNET-Department of Science for Nature and Environmental Resources, University of Sassari, Italy, serenam@uniss.it;

2. CMCC, Euro-Mediterranean Centre on Climate Change, Sassari, Italy;

3. CNR-IBIMET, Consiglio Nazionale delle Ricerche, Sassari, Italy



Population: 127,625 (2014) **Pop. density:** 237 people/km² **Municipality Area:** 546 km² **Urbanized area:** 2.24 km² (4%) **Arable and horticulture crops lands: (56%)** Altitude: 225 m asl **Mean annual temperature:** 16.2 °C (30-yr) **Annual precipitation:** 567 mm (30-yr)



Mean Maximum Minimum Total

Sassari is the second town in Sardinia, a large island located in the center of the Mediterranean Basin (Fig. 1).

As part of a Regional Project, a research activity has been carried out with the general aim to quantify urban fluxes and identify the main GHG emissions sources. A **combined methodology** is used for this purpose.

1. DIRECT CO, MEASUREMENTS

An Eddy Covariance tower was set up, in April 2015, in the Sassari city center to directly measure CO₂, water, and energy fluxes. Gill-HS sonic anemometer and Li-7200 Enclosed gas analyser were used for this purpose. Meteorological and radiometric stations were also installed (Fig. 2).



CO₂ flux ranged from -12 to 63 μ mol m⁻² s⁻¹ with an average value of 4.2 μ mol m⁻² s⁻¹ (Fig. 4a). Emission peaks are clearly related to the rush hours during the working days (Fig. 4b).

Air temperature measurements revealed that temperature was above 25 °C for 14 days (i.e. for about half of the measurements period).



Fig. 1. Sassari location in the North of Sardinia island (Italy).



Fig. 3. Wind-rose for the city of Sassari, Italy. Mistral (NW) and Libeccio (W-SW) are the main prevailing winds.

Table 1. Measured values of air temperature (Tair), precipitation (Pcp), wind speed (WS), and relative humidity (RH).

Fig. 2. Eddy Covariance tower on the roof of the Policy building in the city center.

2. GHG INVENTORY

Fig. 4. Half-hourly CO₂ flux measurements (a) and mean diurnal cycle for both working days and weekend or holiday periods (b).

Tair (°C)	19.2	33	9.9	-
Pcp (mm)	-	5	-	14.2
WS (km h ⁻¹)	8.3	25.9	-	-
RH (%)	57.6	98.9	7.9	-

A spatial and temporal high resolution GHG emissions inventory for the urban area of Sassari is currently under construction, in line with European and international standard protocols, to establish a baseline for tracking emission trends.





The first result of the Inventory approach was the classification of the urban emissions, catalogued by GHG, productive activity and emissive source (baseline year 2010) (Table 2).

Table 2. Inventory categories of GHG emissions in the town of Sassari, Italy.

Stationary Units	Mobile Units	Waste
Residential building	On-Road transportation	Solid waste disposal
Building types (year, heating, etc.)	Private cars	Landfilled municipal solid waste (MSW)
Commercial Facilities	Pubblic cars	Special wastes
Store Centers	Light trucks	Biological treatment of waste
Shops	Heavy trucks	Composting
Institutional Facilities	Motorcycles	Wastewater treatment and discharge
Hospital	Mopeds	Anaerobic digestion
Municipal buildins	Motorhomes	Aerobically treatment
County buildings	ATP Bus	IPPU
Regional buildings	ARST Bus	Industrial Processes and Product Uses
Public Light	Railways	Calcrete uses
Bank buildings	Trains and Metro	Consumption of cement, lime and soda ash
Energy generation (undirect	Aviation	Chemical production
emissions)	Helicopters	Consumption of petroleum products
Grid-supplied electricity	Off-Road	Limestone uses
Energy Use in Industrial Activities	Go-kart	Lubrificants uses
Bakery	Brush-cutters	Bitume, road oil and other petroleum diluents
Smiths	Tractors	Solvents (kerosene and other aromatics)
	Construction equipments	Paraffin waxes
	Landscape equipments	Nitrous oxide











LEGGE REGIONALE 7 AGOSTO 2007, N.7: **"PROMOZIONE DELLA RICERCA** SCIENTIFICA E DELL'INNOVAZIONE **TECNOLOGICA IN SARDEGNA"**



REFERENCES

- C40 Cities Climate Leadership Group, ICLEI Local Governments for Sustainability, 2012 - Global protocol for community-scale greenhouse gas emissions (GPC) Pilot Version 1.0 – May 2012: pp 14. - Gurney et al – Quantification of fossil fuel CO_2 emissions on the building/street scale for a large U.S. City. Environment Science & Technology, 46: 12194-12202

A.D. MDLXXII