LIFE15 ENV/IT/000392

life VITISOM

"Monitoraggio delle emissioni diffuse di gas serra a fronte di diverse gestioni del suolo vitato: primi risultati del progetto Vitisom" Ilaria Minardi (West Systems)

WEST Systems

ENVIRONMENTAL MONITORING

Analysis and characterisation of soil, air and water (MAC)
Landfill monitoring
Air quality monitoring
Monitoring and characterisation of contaminated sites

ENVIRONMENTAL ENGINEERING

Water and environmental services
Water risk control
Environmental protection
Modelling and management of environmental data
Projects for the treatment and reuse of wastewater
Planning of urban sanitation services

INSTRUMENTATION

Environmental radioactivity
Airborne radioactivity
Continuous monitoring stations for gas fluxes from the soil
Geochemical environmental stations
Measurement of diffuse emissions: portable flux meters

RESEARCH & INNOVATION

ENVIRONMENTAL MONITORING
ANALYSIS AND CHARACTERISATION OF SOIL, AIR AND WATER (MAC)

- MONITORING OF EMISSIONS FROM LANDFILLS FOR MSW, SPECIAL, HAZARDOUS AND NON-HAZARDOUS WASTE
- MONITORING AND CHARACTERISATION OF SPECIFIC AREAS
- MONITORING AND CHEMICAL AND ISOTOPIC CHARACTERISATION OF AIR QUALITY
- CHARACTERISATION OF CONTAMINATED SITES, DECOMISSIONING OF PLANTS AND RISK ANALYSIS
- ENVIRONMENTAL RADIOACTIVITY
- RADIOMETRY AND RADIATION PROTECTION
- CHARACTERISATION OF ODOUR EMISSIONS WITH DYNAMIC OLFACTOMETRY AND CHEMICAL SPECIATION
- APPLIED ECOLOGY AND ENVIRONMENTAL MONITORING
- MANAGEMENT OF INDUSTRIAL WASTE

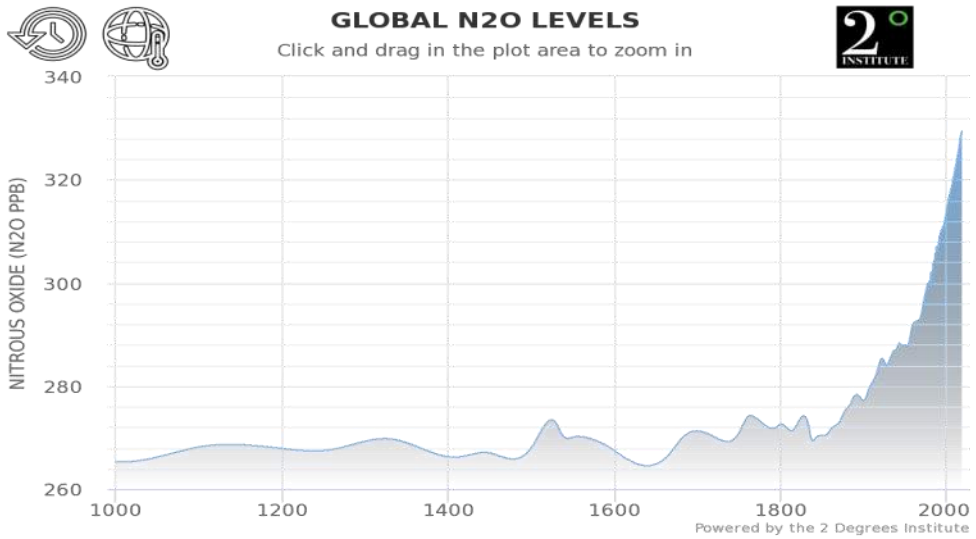
VITISOM PROJECT:

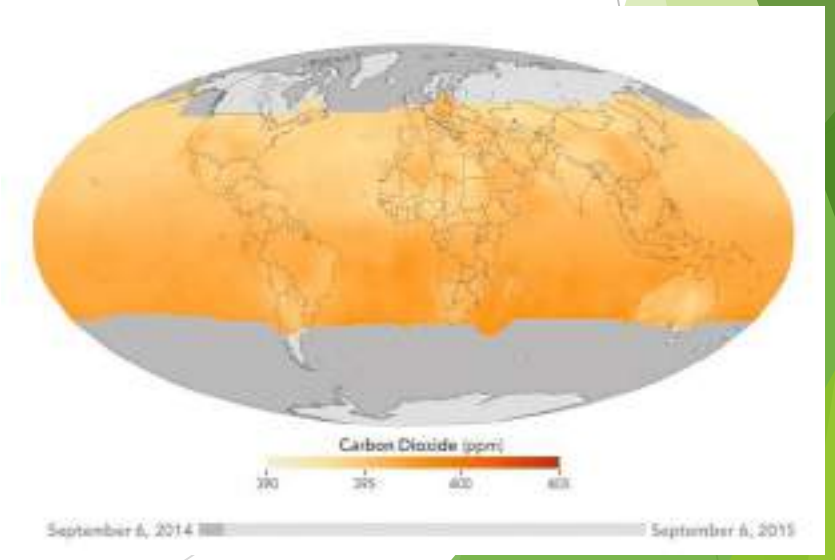
Azione B2: Testing of prototypes on viticultural sector
Definition of monitoring protocol and Field Blank monitoring activity

Azione C1: Impact assessment of the project
Spatial and temporal monitoring of GHG fluxes from soil

Main Green House Gases (GHGs)

Common Name		Atmospheric Concentration (NOAA 2016)	GWP (100Year) (IPCC AR4)
Carbon Dioxide	CO_2	399.5 ppm	1
Methane	CH_4	1.834 ppm	25
Nitrous Oxide	N_2O	0.328 ppm	298





Why is it important to measure GHG soil flux in agriculture

- To better understand the biogeochemical processes that are sources of these emissions;
- To identify the most affecting factors among environmental conditions and cultural practices on GHG emissions;
- To calibrate the models for the simulation of GHG emissions;
- To identify the best management practices for GHG emission mitigation;

Monitoring of spatial variation of GHG emissions:"tracked off-road vehicle with electric

Detector N_2O

Cavity Ring Down Spectroscopy (LGR)
Ldl = 2* 10-6 moli/(m2day)

Detector CO

Cavity Ring Down Spectroscopy (LGR)
Ldl = 2* 10-6 moli/(m2day)

Detector CH_4

TDLAS Tunable Diode Laser Absorption Spectroscopy
Ldl = 5*10-4 moli(m2day)

Detector CO_2

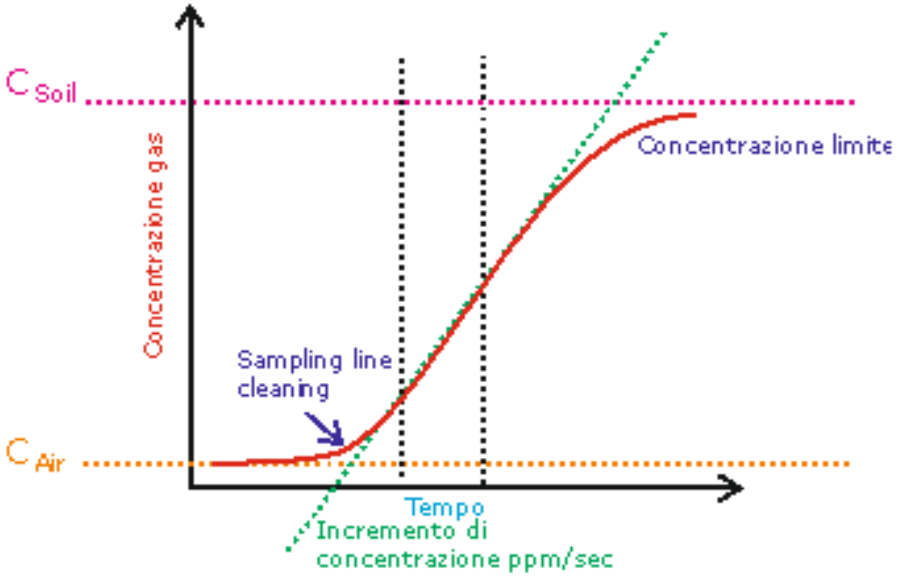
Absorption spetroscopy
Ldl = 2 * 10-3 moli (m2day)

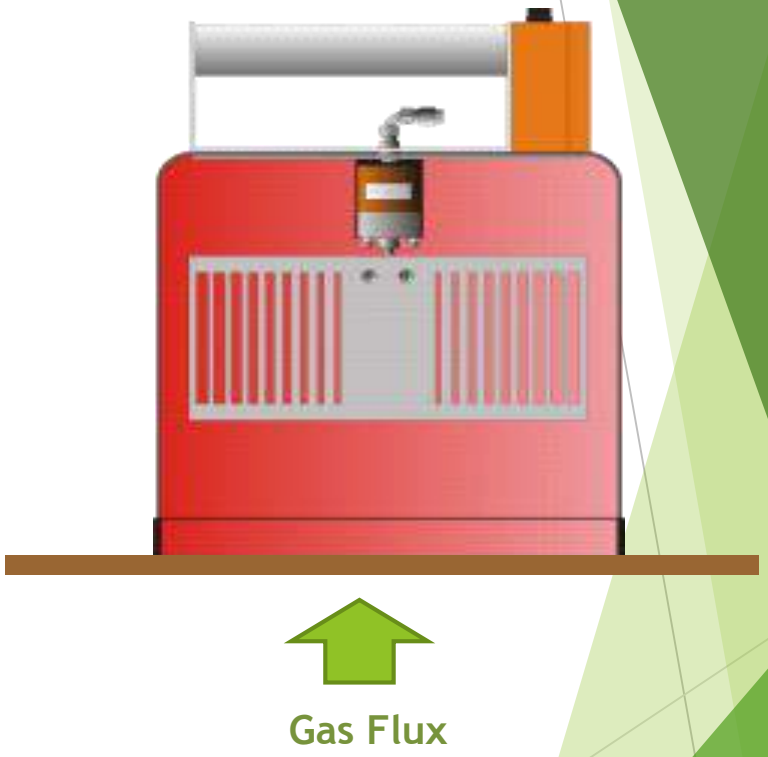
Soil Box

Accumulation Chamber Method

The **chamber methods** based intruments measure **the flux** at the **soil-atmosphere interface.**

The **chamber footprint area** can vary in the range from 0.01 up to 0.5 square meter, where the **height** can vary from few centimeters up to 1 meter.



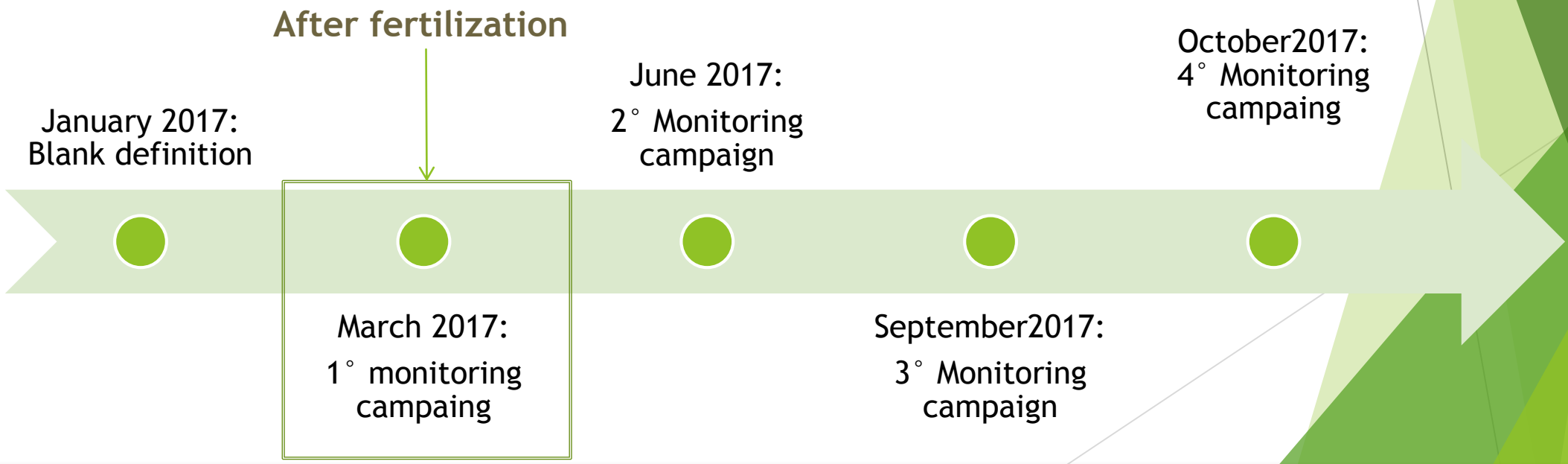


GHG emissions: VITIOM Spatial Monitoring

GHG emissions monitoring started in January 2017.

The monitoring has been developed using the IPNOA Prototype, an instruments which permits to measure N_2O, CH_4 and CO_2 fluxes from soil, moving through one sampling site to another.

From January to October has been realized **21 monitoring campaigns** in 5 Viticultural Enterprise: Conte degli Azzoni, Castelvecchi, Bonomi, Berlucchi and Bosco del Merlo.



Monitoring Activity: January-October 2017

Castelvecchi

- 1°survey: January 2017
  Duration: 2 days
  Number of Samples: 65
- 2°survey: MArch 2017
  Duration: 2 days
  Number of Samples: 128
- 3° Survey: July 2017 Duration: 3 days
  Number of Samples: 128

Bonomi

- 1°survey: January 2017
  Duration: 3 days
  Number of Samples: 80
- 2°survey: March 2017
  Duration: 3 days
  Number of Samples: 116
- 3° Survey: June 2017 Duration: 3 days
  Number of Samples: 120
- 4° Survey: September 2017
  Duration: 3 days
  Number of Samples: 119
- 5° Survey: October 2017
  Duration: 3 days
  Number of Samples: 119

Berlucchi

- 1°survey: January 2017
  Duration: 2 days
  Number of Samples: 102
- 2°survey: March 2017
  Duration: 2 days
  Number of Samples: 128
- 3° Survey: June 2017
  Duration: 3 days
  Number of Samples: 128
- 4° Survey: September 2017
  Duration: 3 days
  Number of Samples: 127

Conte degli Azzoni

- 1°survey: March 2017
  Duration: 3 days
  Number of Samples: 128
- 2°survey: June 2017
  Duration: 3 days
  Number of Samples: 128
- 3° Survey: October 2017 Duration: 3 days
  Number of Samples: 129

Bosco del Merlo

- 1°survey: January 2017
  Duration: 2 days
  Number of Samples: 91
- 2°survey: March 2017
  Duration: 2 days
  Number of Samples: 118
- 3°survey: April 2017
  Duration: 3 days
  Number of Samples: 156
- 4° Survey: June 2017 Duration: 3 days
  Number of Samples: 156
- 4° Survey: Octorber 2017
  Duration: 3 days
  Number of Samples: 156

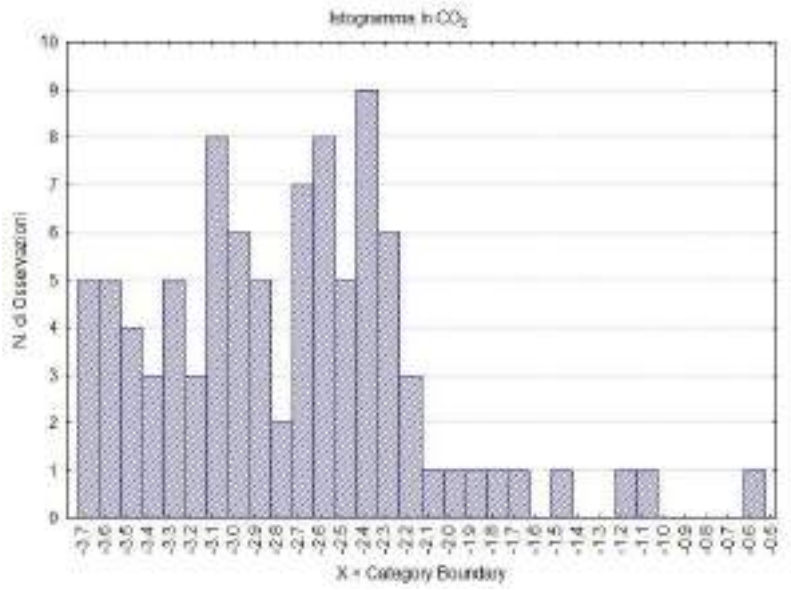
Field Monitoring Activities

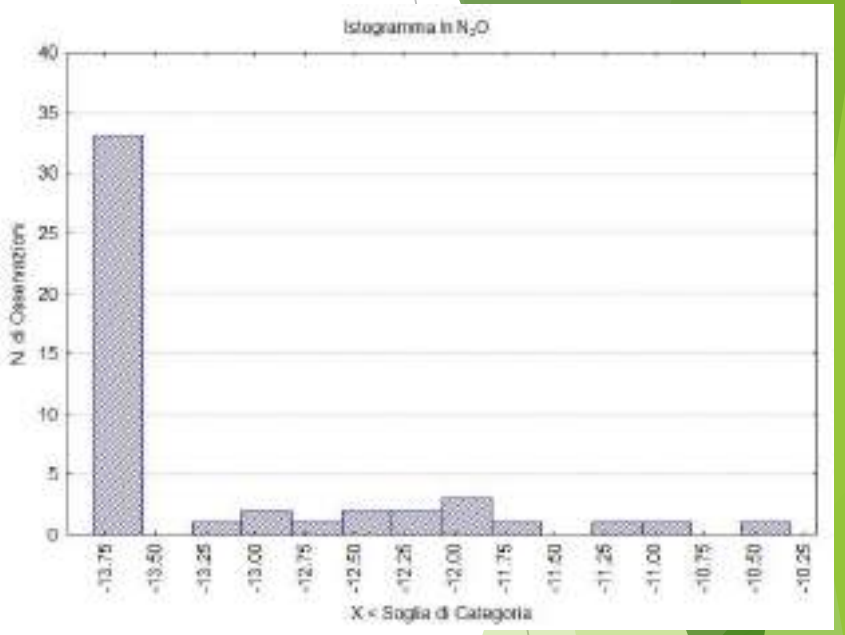
January 2017: Blank Definition

Statistical Data Analysis

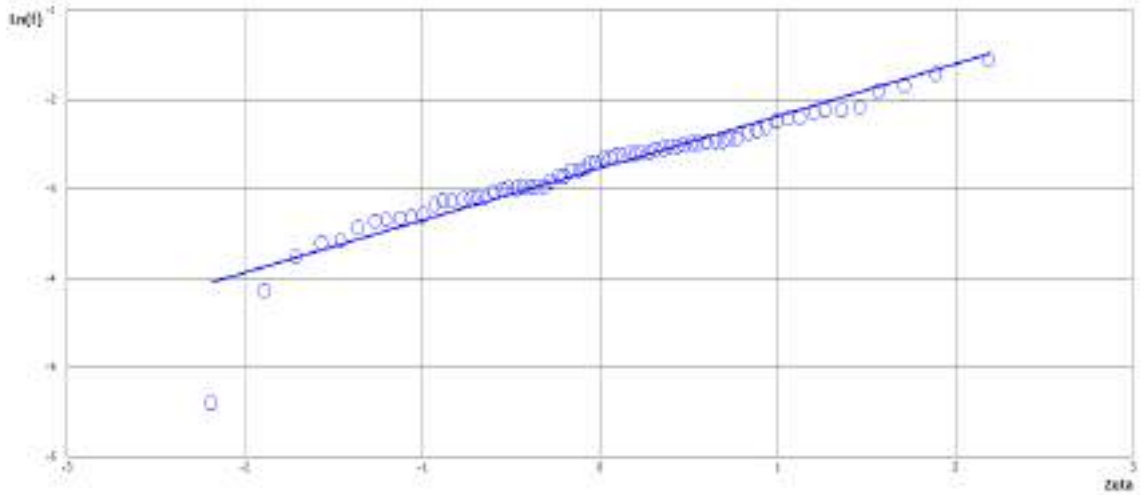
CO_2 mol/m^2 giorno	Conteggio	Conteggio Cumulato	Percentuale	% Cumulata
0.000<=x<0.025	1	1	1.08	1.08
0.025<=x<0.050	34	35	36.56	37.63
0.050<=x<0.075	21	56	22.58	60.22
0.075<=x<0.100	20	76	21.51	81.72
0.100<=x<0.125	8	84	8.60	90.32
0.125<=x<0.150	2	86	2.15	92.47
0.150<=x<0.175	2	88	2.15	94.62
0.175<=x<0.200	1	89	1.08	95.70
0.200<=x<0.225	0	89	0.00	95.70
0.225<=x<0.250	1	90	1.08	96.77
0.250<=x<0.275	0	90	0.00	96.77
0.275<=x<0.300	0	90	0.00	96.77
0.300<=x<0.325	1	91	1.08	97.85
0.325<=x<0.350	1	92	1.08	98.92
0.350<=x<0.375	0	92	0.00	98.92
0.375<=x<0.400	0	92	0.00	98.92
0.400<=x<0.425	0	92	0.00	98.92
0.425<=x<0.450	0	92	0.00	98.92
0.450<=x<0.475	0	92	0.00	98.92
0.475<=x<0.500	0	92	0.00	98.92
0.500<=x<0.525	0	92	0.00	98.92
0.525<=x<0.550	0	92	0.00	98.92
0.550<=x<0.575	1	93	1.08	100.00
0.575<=x<0.600	0	93	0.00	100.00

N_2O mol/m^2 giorno	Conteggio	Conteggio Cumulato	Percentuale	% Cumulata
0.000<=x<0.329E-5	37	37	77.08	77.08
0.329E-5<=x<0.659E-5	6	43	12.50	89.58
0.659E-5<=x<0.988E-5	2	45	4.17	93.75
0.988E-5<=x<0.131E-4	0	45	0.00	93.75
0.131E-4<=x<0.164E-4	1	46	2.08	95.83
0.164E-4<=x<0.197E-4	1	47	2.08	97.92
0.197E-4<=x<0.230E-4	0	47	0.00	97.92
0.230E-4<=x<0.263E-4	0	47	0.00	97.92
0.263E-4<=x<0.296E-4	0	47	0.00	97.92
0.296E-4<=x<0.329E-4	0	47	0.00	97.92
0.329E-4<=x<0.362E-4	1	48	2.08	100.00





Total Emission Extimation though Sinclair partitioning method



	Misure	Media	Varianza	Sichel-V	Flusso (mol/giorno)	Limiti al 95% di confidenza (mol/giorno)	
LnFlusso CO_2							
I	68	-2.76	0.343	1.19	2620	2320	3050
				Tot CO_2	***2620***	***2320***	***3050***
LnFlusso N_2O							
I	24	-13.7	0.114	1.06	0.042	0.037	0.049
				Tot N_2O	***0.042***	***0.037***	***0.049***
				Flusso totale	***2620.04***	***2320.04***	***3050.05***

January 2017: Results

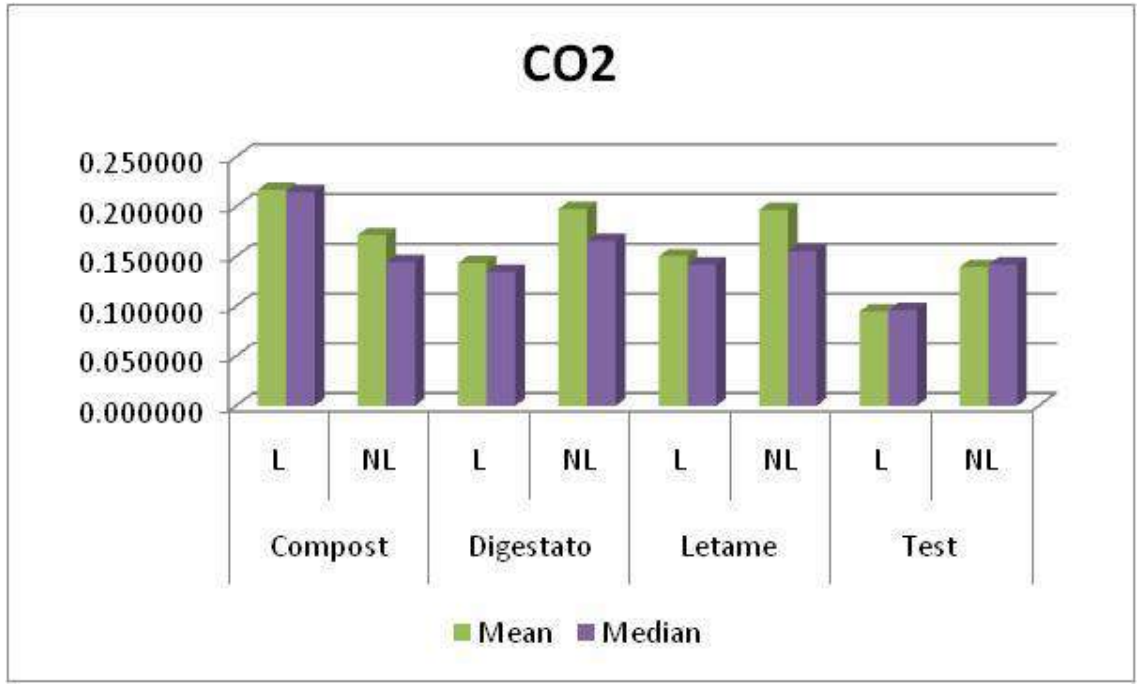
Azienda	Area m^2	N. punti CO_2	N. punti N_2O	Flussi di CO_2 in moli/m^2giorno	Flussi di N_2O in moli/m^2giorno
Conti degli Azzoni	**18000**	78	48	**0.04**	**$3*10^{-6}$**
Castello Bonomi	**8000**	80	47	**0.04**	**$1.2*10^{-6}$**
Berlucchi	**10000**	101	40	**Da rivedere area**	
Bosco del Merlo	**10000**	90	37	**0.66**	**$9*10^{-6}$**
Castelvecchi	**35000**	68	24	**0.07**	**$1.2*10^{-6}$**

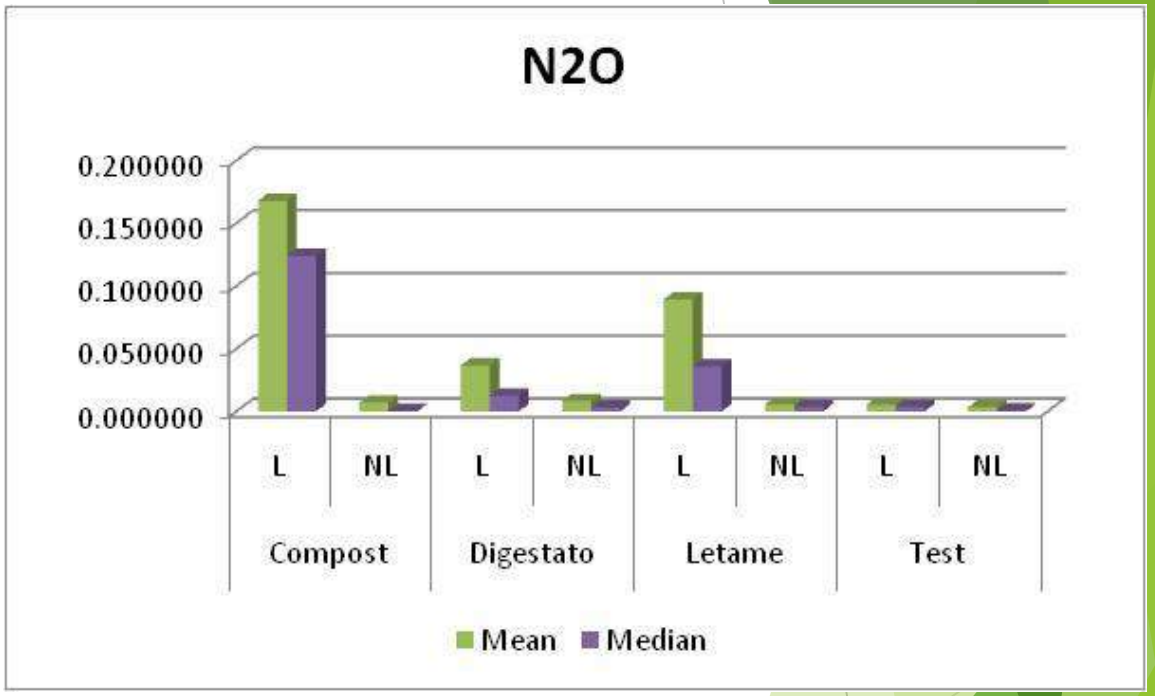
GHG Spatial Monitoring Sites: March 2017

Azienda	*Collocazione*	*Area Monitorata [m²]*	*N° punti CO_2*	*N° punti N_2O*
Conti degli Azzoni	Montefano (MC)	15000	128	128
Castello Bonomi	Coccaglio (BS)	2600	115	115
Berlucchi	Corte Franca (BS)	3200	128	128
Bosco del Merlo	Annone Veneto (VE)	24000	156	156
Castelvecchi	Radda in Chianti (SI)	6700	128	128

Bonomi: marzo 2017

Bonomi: CO_2 and N_2O emissions in mol/m² day

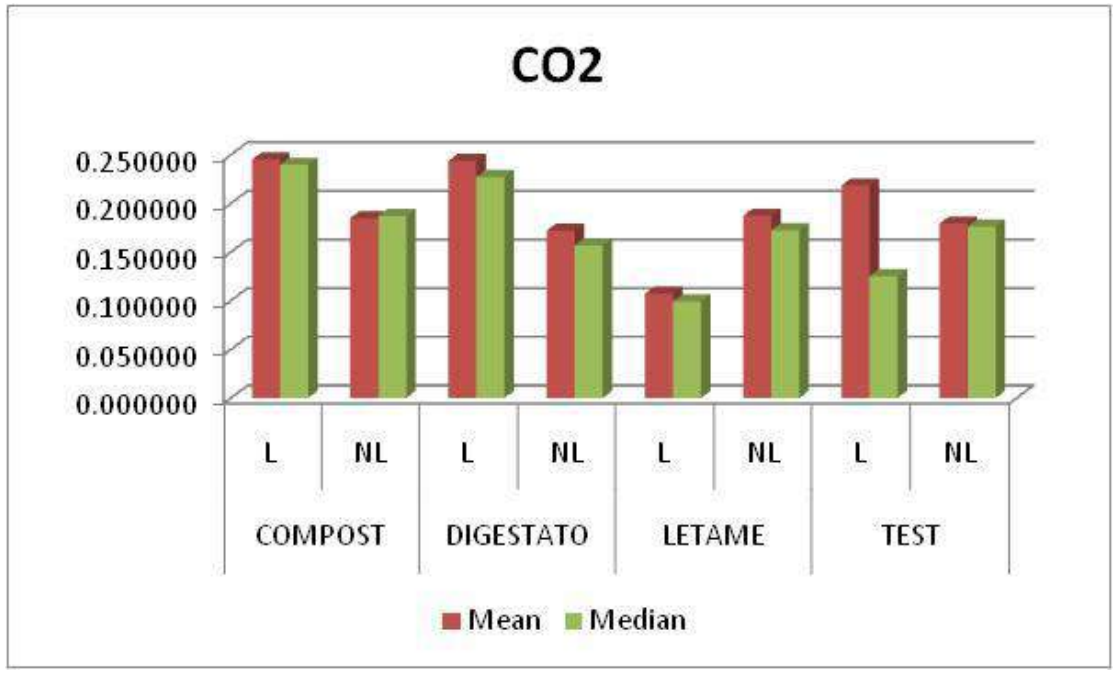


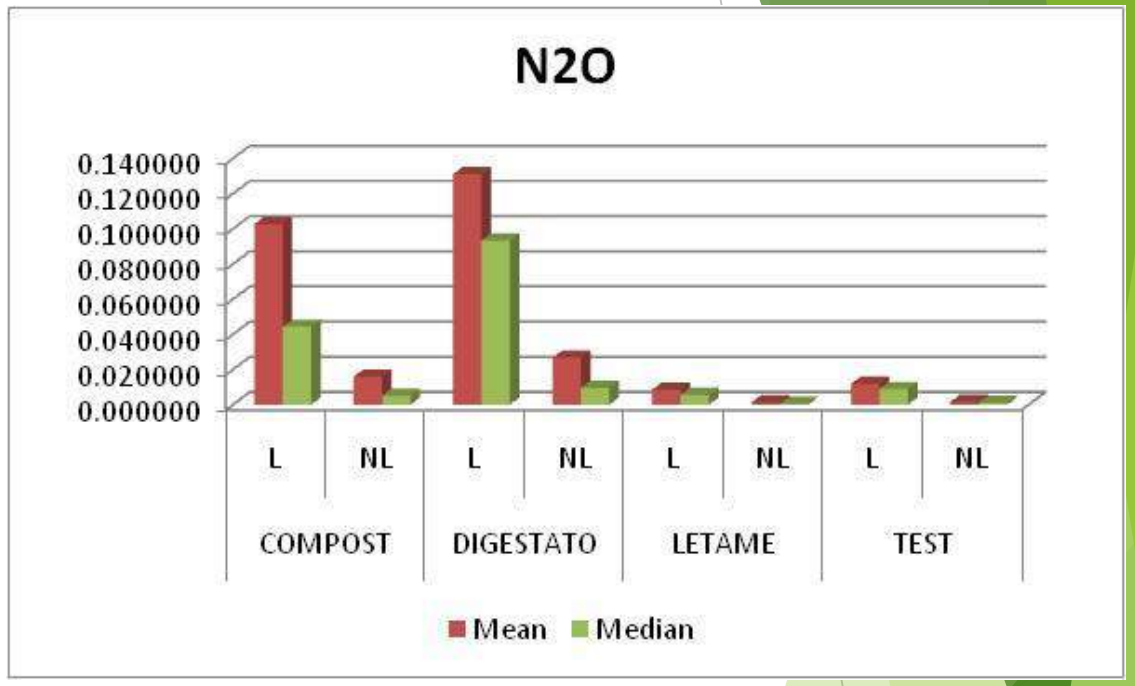


		N. validi	Media	Mediana	Minimo	Massimo	Varianza	Dev.Std.	Coef. Curtosi
mol/mq giorno	CH_4	115	0.00025	0.00025	0.00025	0.00025	2.67E-38	1.63E-19	-2.03571429
mol/mq giorno	CO_2	**115**	**0.159666**	**0.1429**	**0.001**	**0.5126**	**0.007085**	**0.08417**	**4.32585723**
mmol/mq giorno	N_2O	**115**	**0.026159**	**0.003669**	**0.0005**	**0.4293**	**0.004085**	**0.063912**	**17.67947587**
mol/mq giorno	CO	115	-0.00013	-0.00011	-0.00035	9.58E-05	5.02E-09	7.08E-05	1.229235274

Berlucchi: marzo 2017

Berlucchi: CO_2 and N_2O emissions in mol/m² day and total flux in Nm³/hr

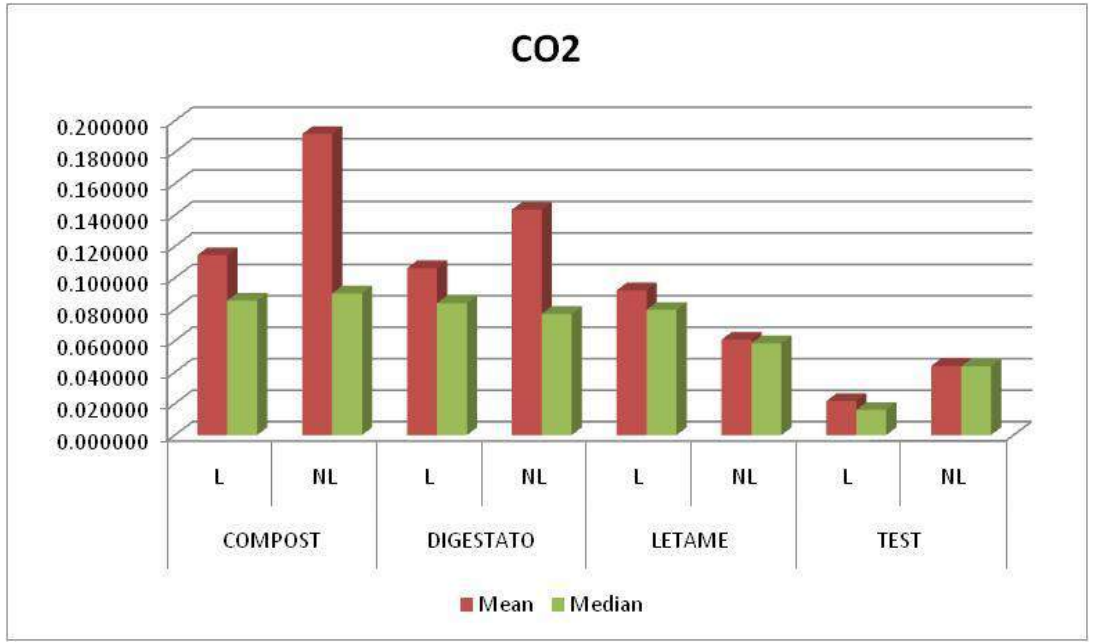


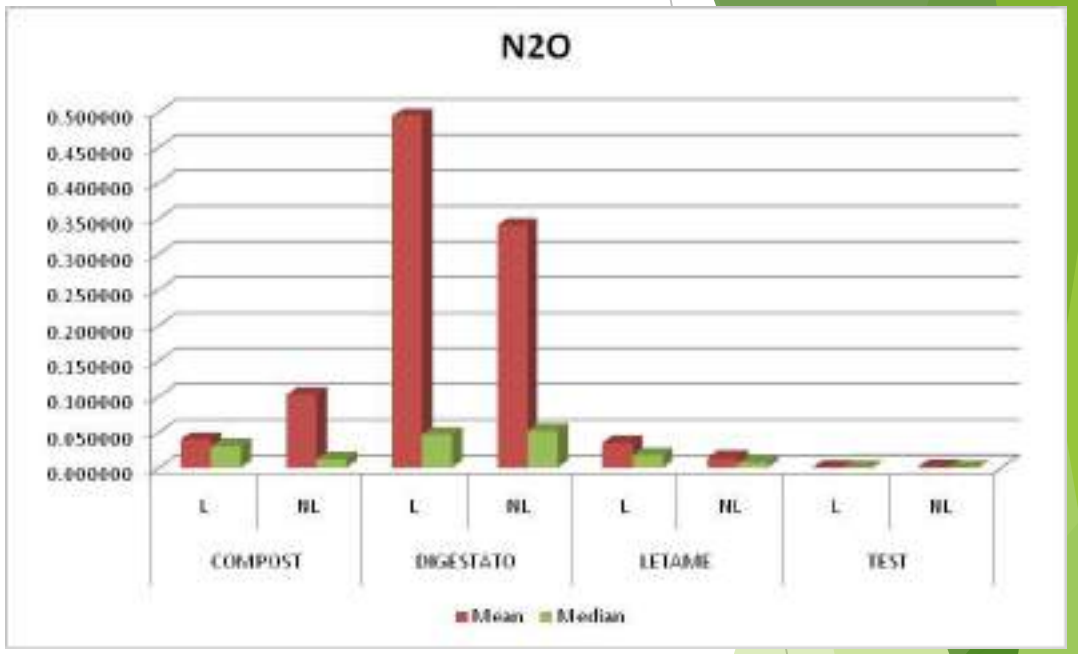


mmol/mq giorno	N. validi	Media	Mediana	Minimo	Massimo	Varianza	Dev.Std.	Coef. Curtosi
CH_4	128	32.5	32.5	1	64	343.937	18.54554	-1.20046
CO_2	128	0.192207	0.17215	580000	580145	2358.584	48.56525	-1.78726
N_2O	128	0.037488	0.007029	5053718	5053823	887.6929	29.79417	-1.37561
CO	128	0.00025	0.00025	0.00025	0.00025	2.67E-38	1.63E-19	-2.032

Conte degli Azzoni: marzo 2017

Conte degli Azzoni: CO_2 and N_2O emissions in mol/m² day



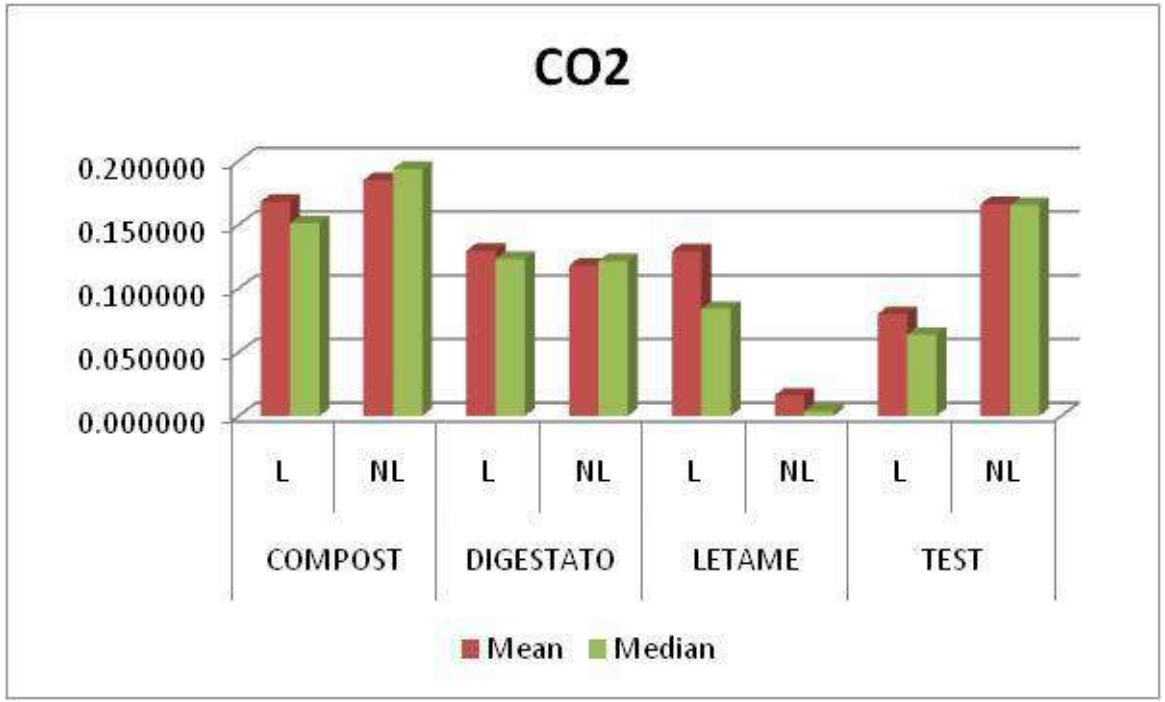


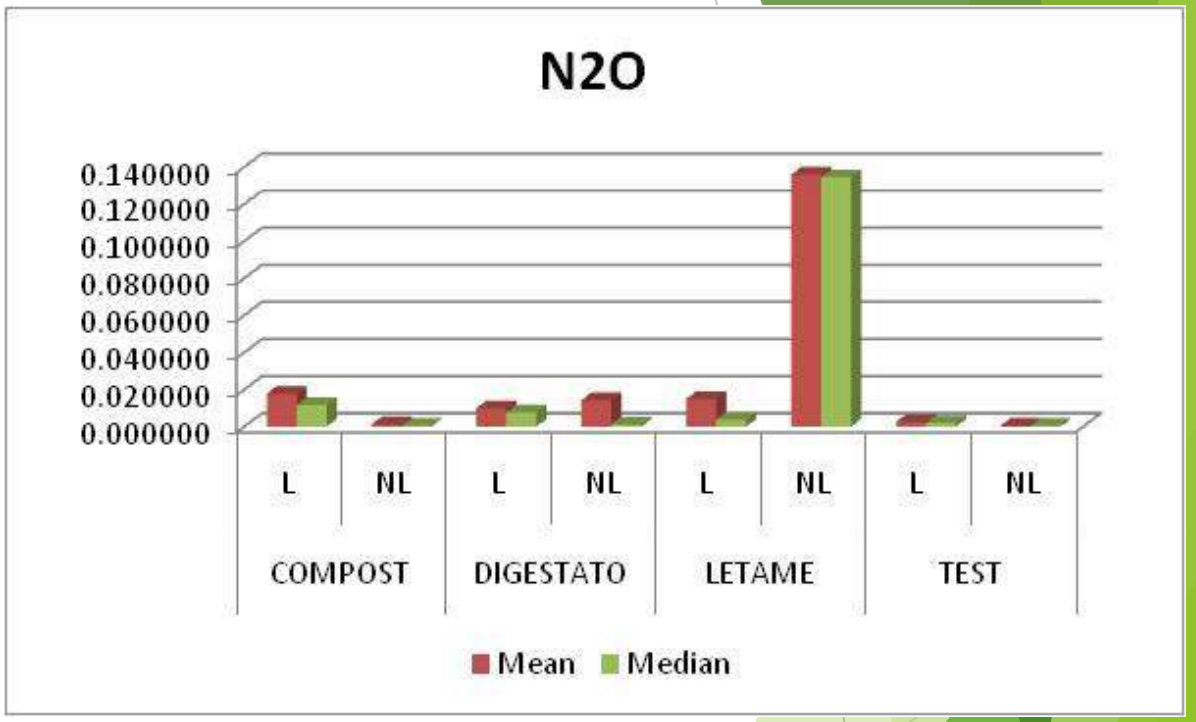
CO_2	Trattamento	Valid N	Mean	Median	Minimum	Maximum
COMPOST	L	16	0.114462	0.085605	0.021150	0.296800
	NL	16	0.191583	0.090115	0.001000	0.495600
DIGESTATO	L	16	0.106206	0.083910	0.021810	0.236000
	NL	16	0.143341	0.077125	0.042810	0.291000
LETAME	L	16	0.092086	0.079665	0.029240	0.167200
	NL	16	0.060659	0.058360	0.027010	0.099470
TEST	L	16	0.021637	0.016020	0.001000	0.094960
	NL	16	0.044038	0.043765	0.004210	0.084680

N_2O	Trattamento	Valid N	Mean	Median	Minimum	Maximum
COMPOST	L	16	0.040051	0.030790	0.000500	0.158100
	NL	16	0.102961	0.012448	0.000500	0.363200
DIGESTATO	L	16	0.494156	0.046940	0.000500	1.907000
	NL	16	0.340367	0.052025	0.000500	1.181000
LETAME	L	16	0.034881	0.017735	0.000500	0.111400
	NL	16	0.014147	0.006862	0.000500	0.071970
TEST	L	16	0.000928	0.000500	0.000500	0.002241
	NL	16	0.001880	0.000500	0.000500	0.007312

Castelvecchi: marzo 2017

Castelvecchi: CO_2 and N_2O emissions in mol/m² day

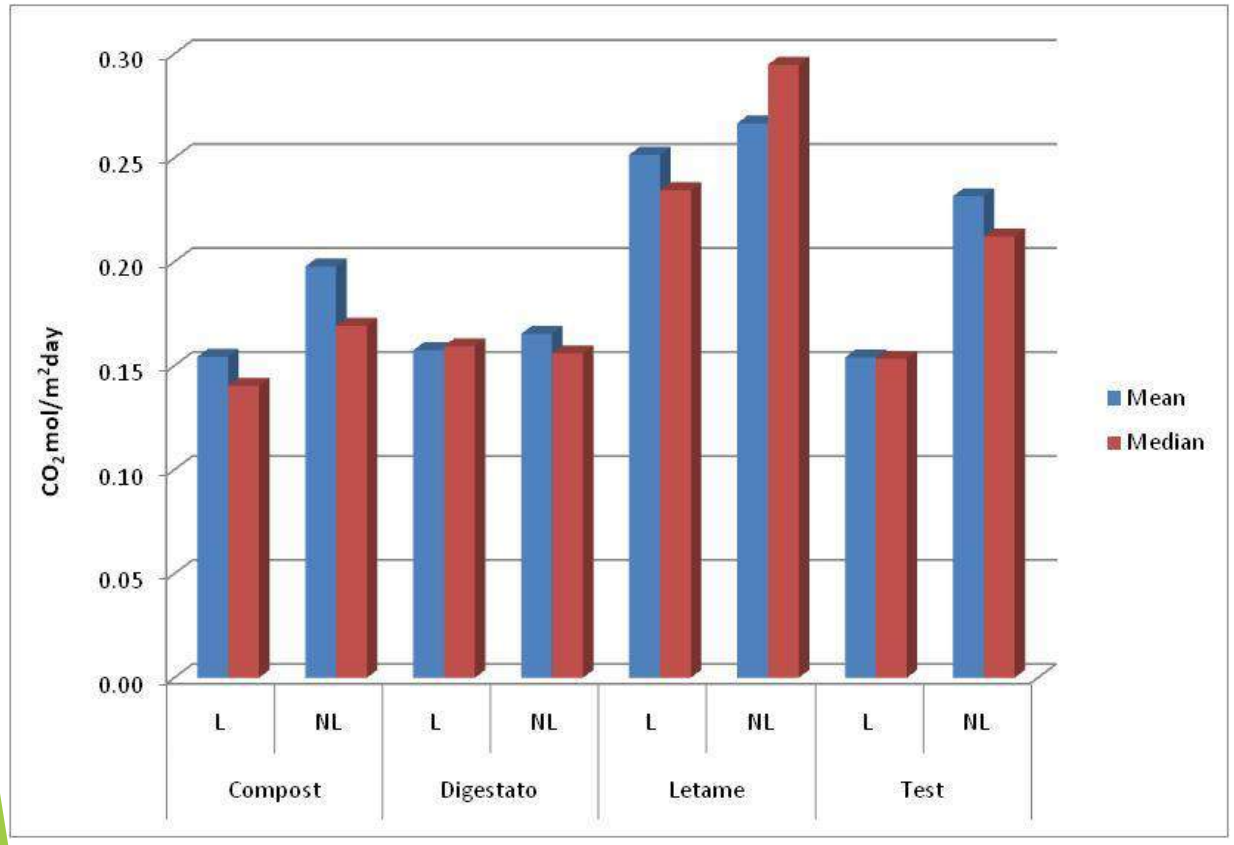


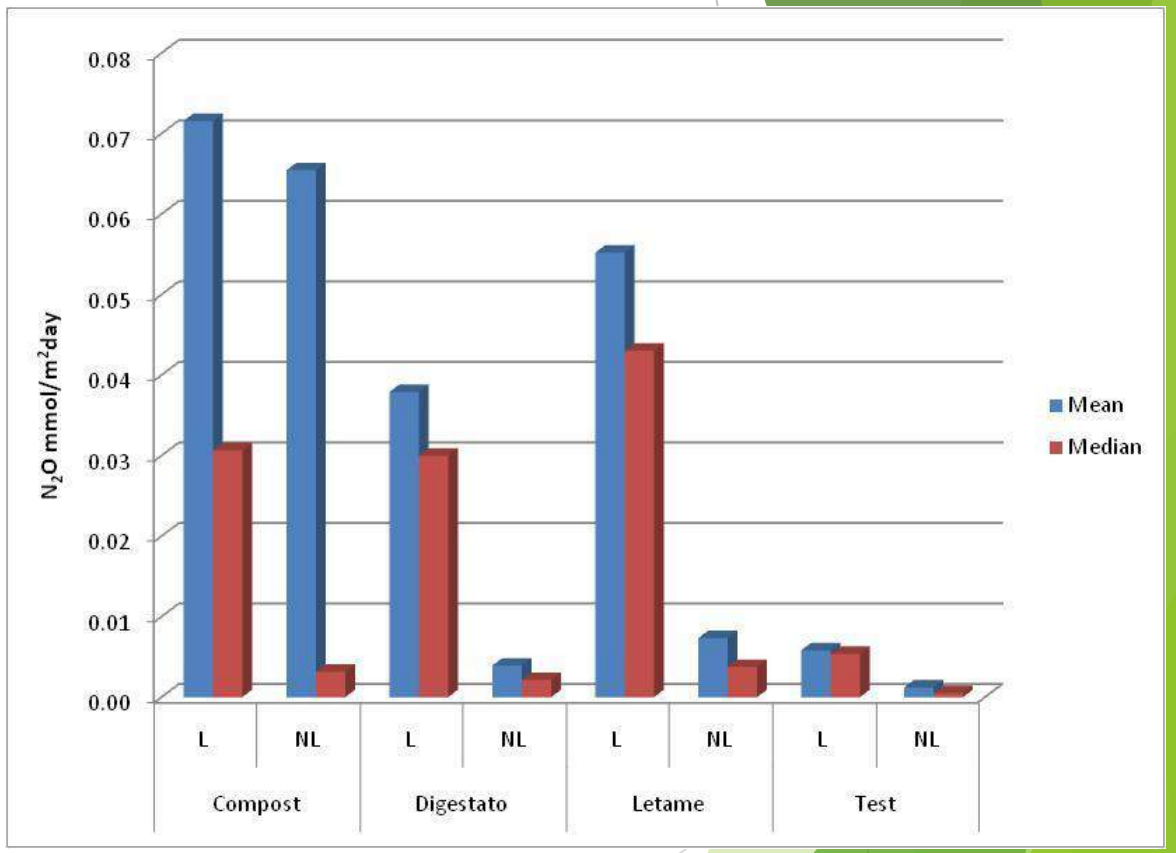


		N. validi	Media	Mediana	Minimo	Massimo	Varianza	Dev.Std.	Coef. Curtosi
mol/mq giorno	CH_4	128	0.00025	0.00025	0.00025	0.00025	2.67E-38	1.63E-19	-2.032
mol/mq giorno	CO_2	128	0.139048	0.1234	0.0179	0.8203	0.008179	0.090436	24.30837
mmol/mq giorno	N_2O	128	0.0097	0.002737	0.0005	0.1607	0.000468	0.021641	27.78671
mol/mq giorno	CO	128	3.52E-05	0.000018	-0.00031	0.000386	5.73E-09	7.57E-05	6.972609

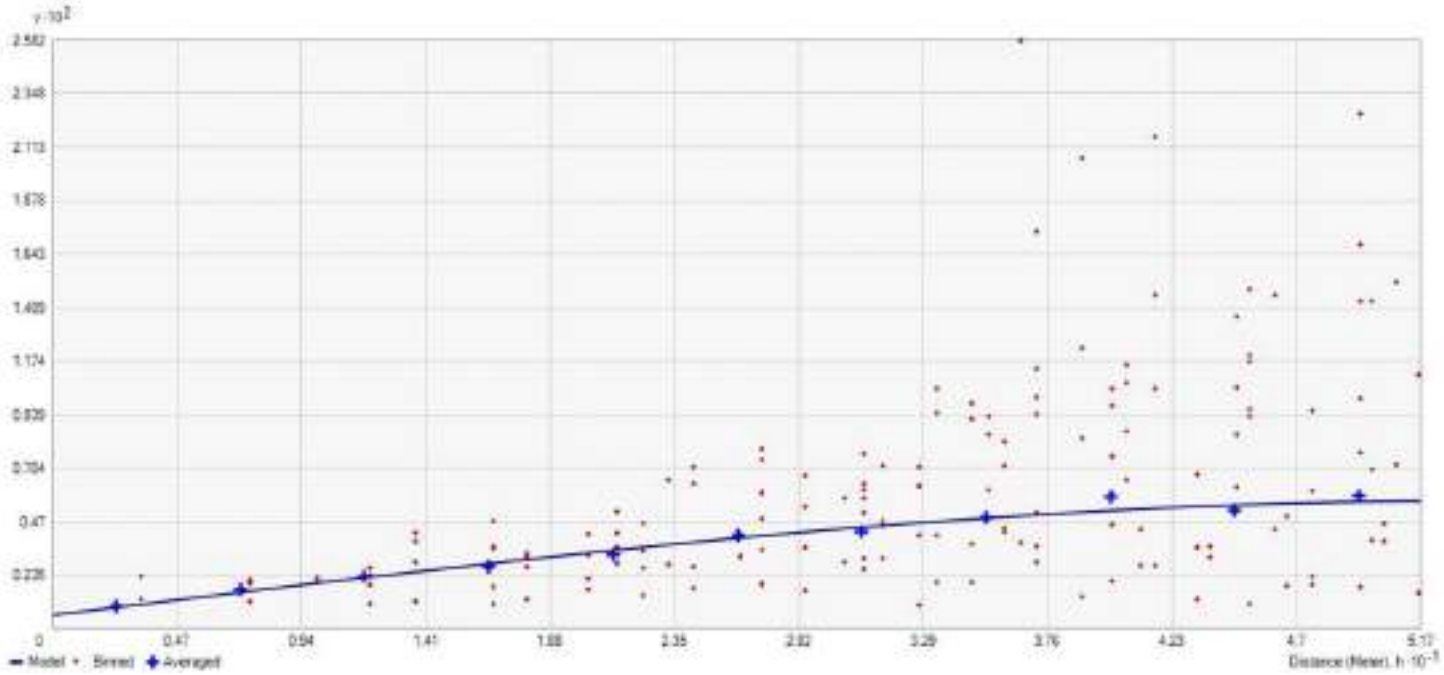
Bosco del Merlo: marzo 2017

Bosco del Merlo: CO_2 and N_2O emissions in mol/m² day





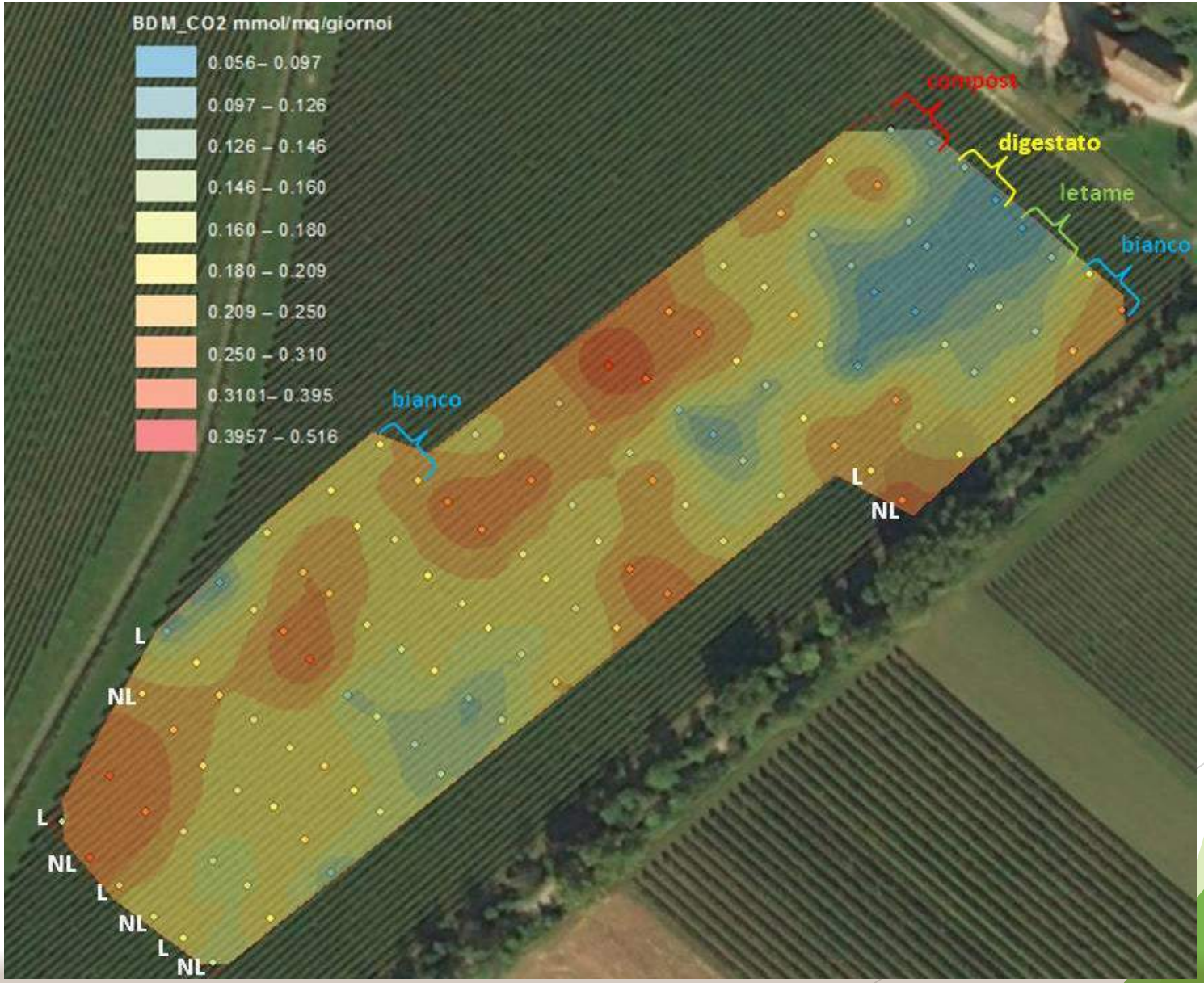
Variogram analysis and Kriging



Variogramma sperimentale:
Lag Size: 4.7
N. Lag: 11

Modello
Sferico: Range 53 e Partial Sill 0.005
Nugget: 0.0006

CO_2 Estimation map in moli/$m_2$day



...what we can do within the VITISOM Project

- Spatial monitoring has been integrated with continuos monitoring throught two fixed station located in Lison and Berlucchi. This we'll provide important information on correlation between diurnal and nocturnal fluxes.

- The large number of data will permit to relate emission from soil with soil treatment in particular with the different fertilizer.

- Seasonal variation will be highligthed from both spatial and continuosly monitoring.

- The comparison between Eddy Covariance and Accumulutation Chamber method could provide important information for the CO2 Carbonfootprint

Thanks for the attention

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