



LIFE-18 PRE IT 003 - The VEG-GAP project has received funding from the LIFE Programme of the European Union



# Impatto della vegetazione urbana sulla qualità dell'aria ed il microclima urbano: Risultati del Progetto Life VEG-GAP



Sandro Finardi (ARIANET) and Mihaela Mircea (ENEA)  
In rappresentanza del Consorzio VEG-GAP

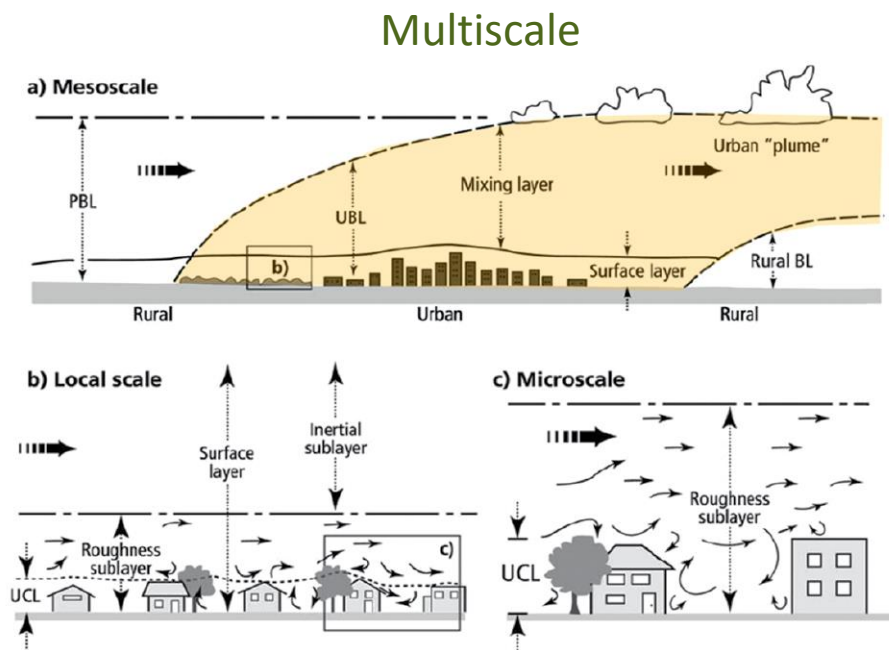
<https://www.lifeveggap.eu>



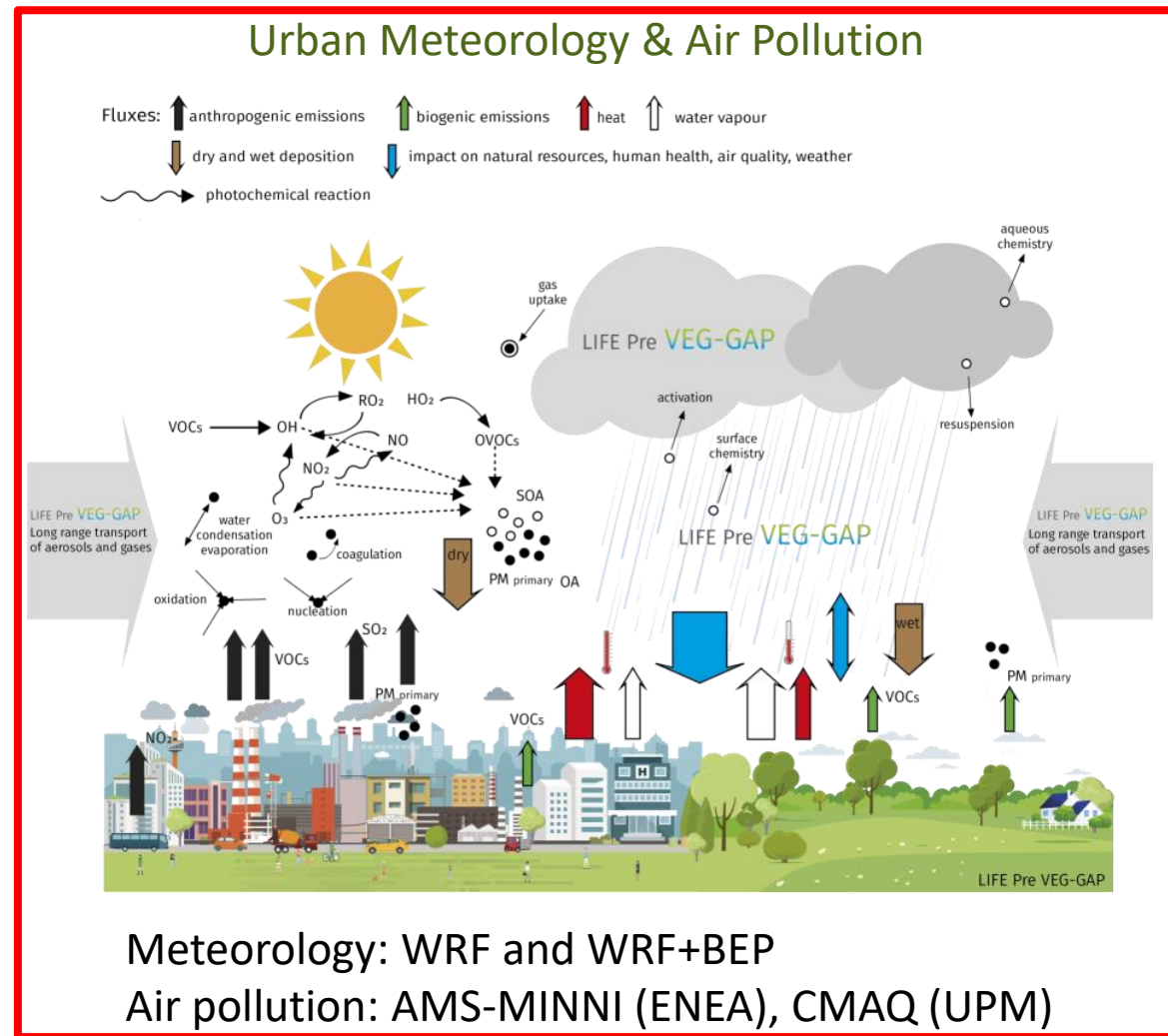
UNIVERSIDAD POLITÉCNICA DE MADRID



# L'approccio di VEG-GAP: analisi dei processi fisici e chimici atmosferici a scala urbana



(Oke, 2006)

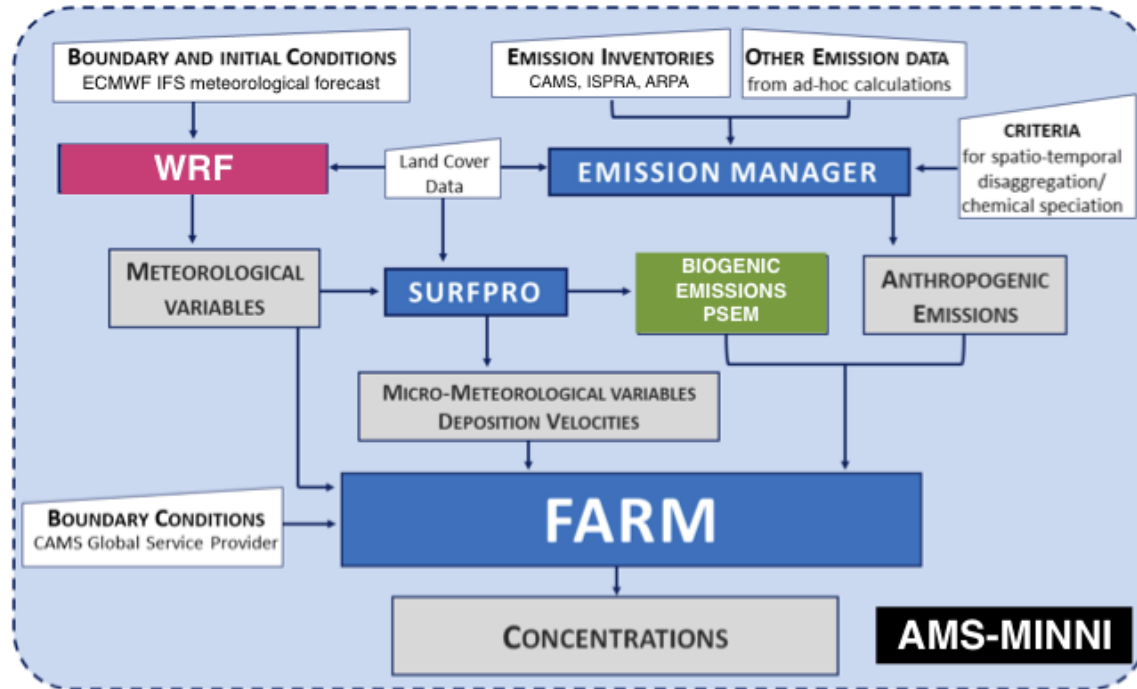




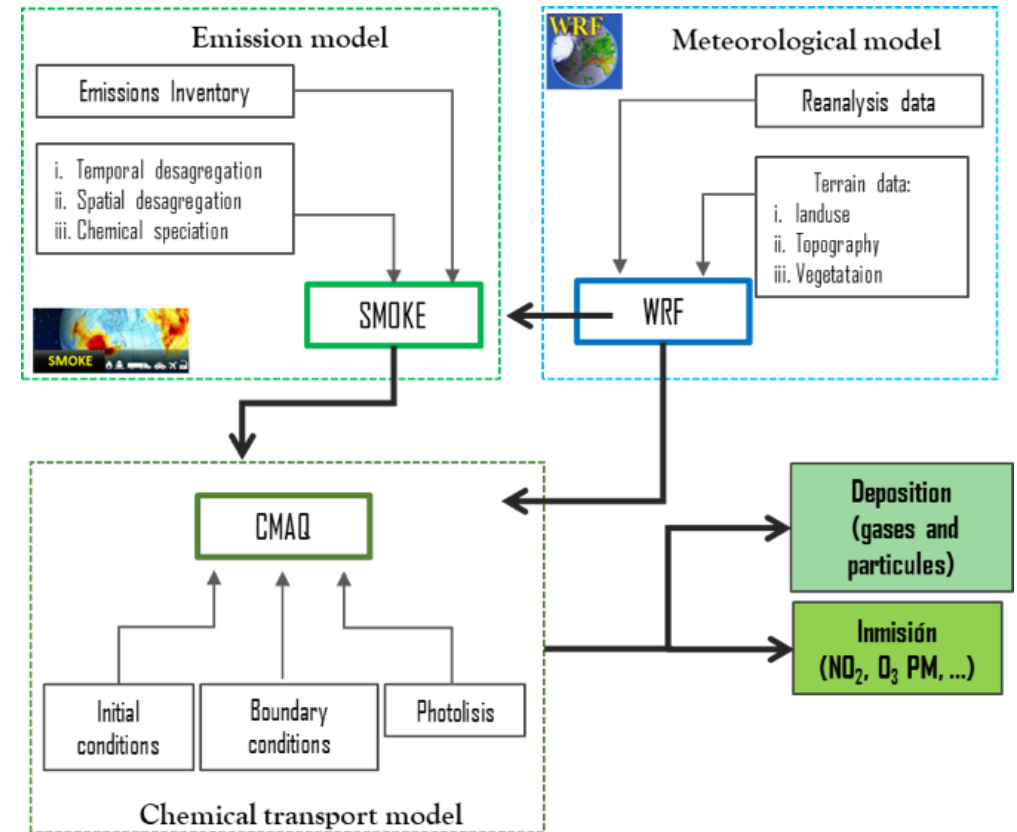
# Sistemi modellistici utilizzati in VEG-GAP

impatto della vegetazione su microclima e qualità dell'aria

ITALIA: AMS-MINNI (ENEA)



SPAGNA: WRF-CMAQ

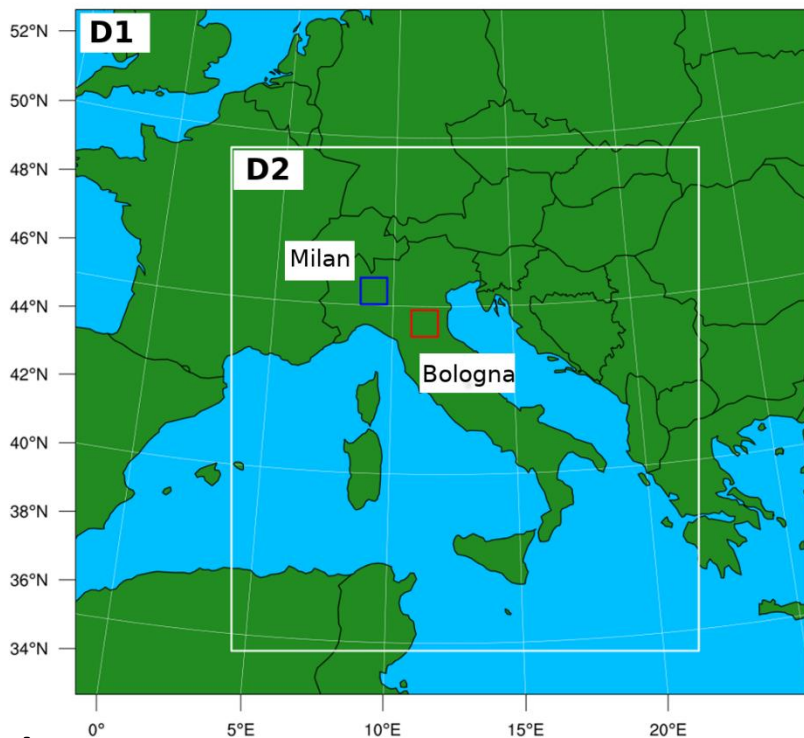




## Sistemi modellistici usati da ENEA (Italia) e UPM (Spagna)

domini e dati di input

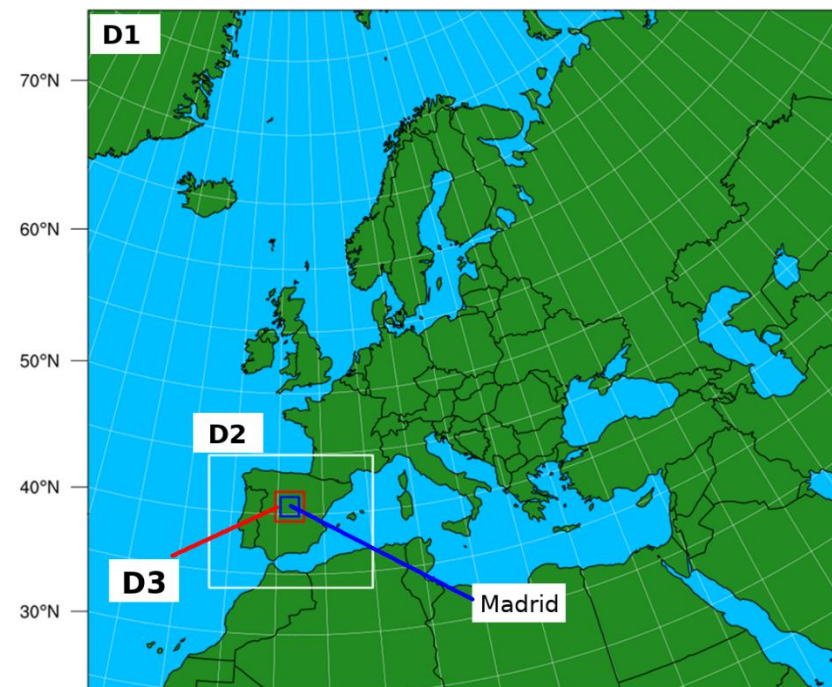
ITALIA: AMS-MINNI (ENEA)



### Input data

Europe: anthropogenic emissions CAMS-REGAP\_v2.2.1 for 2015 provided by TNO

SPAGNA: WRF-CMAQ





# Descrizione sistemi modellistici atmosferici di ENEA e UPM

## Schemi di calcolo e parametrizzazioni

METEOROLOGY		
	ENEA AMS-MINNI	UPM WRF-CMAQ AMS
<b>Model</b>	WRF v3.9.1.1	WRFv4.1.2
PROCESSES		
<b>Microphysics</b>	WSM6	WSM6
<b>Cumulus Parametrization</b>	Off	Off
<b>PBL Scheme</b>	Mellor Yamada Jancic	Bougeault-Lacarrère PBL (BOULAC)
<b>Surface layer</b>	Monin-Obukhov	Monin-Obukhov (Janjic Eta)
<b>Urban Physics</b>	BEP	BEP
<b>Land Surface</b>	Noah	Noah LSM
<b>Sf_surface_physics</b>	Sf_surface_physics=2 (Noah Land Surface Model (Unified ARW/NMM version in Version 3)	Sf_surface_physics=2 (Noah Land Surface Model (Unified ARW/NMM version in Version 3)
<b>Longwave Radiation</b>	4 (RRTMG)	GFDL (Fels and Schwarzkopf)
<b>Shortwave Radiation</b>	4 (RRMTMG)	MM5 Dudhia (Dudhia)
<b>Landuse database</b>	Corine Land Cover 2006 (22 classes)	Corine Land Cover 2012 (mapped to USGS 22 classes)
<b>Vertical layers</b>	40 Layers	39 Layers
<b>Vertical extent</b>	19800m	17600m

CHEMISTRY		
Model	FARMv4.14	CMAQv5.3
PROCESSES		
<b>Gas phase chemistry</b>	SAPRC99 (Carter,2000)	CB6 (Emery, 2015)
<b>SIA module</b>	ISORROPIA v1.7 (Fountoukis and Nenes, 2007)	ISORROPIA II (Fountoukis, C and A. Nenes, 2007)
<b>SOA module</b>	SORGAM module (Shell et al. 2001)	SOA (Pye,H. et al., 2017; Murphy,B. et al., 2017)
<b>Aerosol module</b>	AERO3 (Binkowski and Roselle, 2003)	AERO6 (3 modes) (Appel et al., 2013)
<b>Cloud chemistry</b>	Simplified S(IV) to S(VI) formation (Seinfeld and Pandis, 1998)	acm_ae6 (Fahey, K.M., 2017)
<b>Wet deposition</b>	In-cloud and sub-cloud scavenging coefficients (EMEP, 2003)	Jesse Bash, Sarwar et al. (2015)
<b>Dry deposition</b>	Resistance model based on Wesely (1989)	Model based on Pleim and Ran (2011)
<b>Boundary conditions</b>	One-way from regional scale	One-way from regional scale
<b>Vertical layers</b>	16 terrain following	39 fixed terrain following
<b>Vertical extent</b>	6264m	17600m
<b>First layer</b>	10m	7.7m
<b>Horizontal resolution</b>	1 km	1 km
EMISSION PROCESSING		
<b>Software</b>	EMMAv6.0	SMOKEv3.6.5
<b>Emission inventory</b>	Regional	
<b>Biogenic model</b>	PSEM (Silibello et al., 2017)	PSEM (Silibello et al., 2017)
<b>Soil-NO</b>	MEGAN v2.04 (Guenther et al., 2006)	
<b>Saharan Dust</b>	no	no
<b>Sea Salt</b>	Zhang et al. (2005)	Gantt, B. et al (2015)
<b>Windblown dust</b>	Vautard et al. (2005)	no



- Simulazione annuale (anno riferimento 2015) con outputs orari per:
  - a. NOVEG: No URBAN Vegetation
  - b. VEG: present URBAN vegetation
  - c. SCENARIO: additional (scenario) URBAN vegetation

I risultati sono valutati in termini di **campi di differenza**:

VEG - NOVEG impatto della vegetazione attuale su meteorologia (e inquinanti)

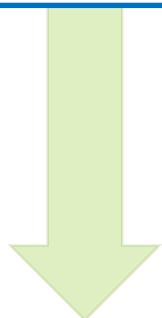
SCENARIO - VEG impatto della vegetazione di scenario su meteorologia (e inquinanti)



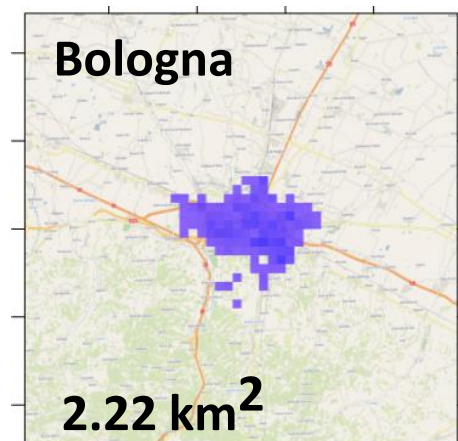
## Mappatura della vegetazione urbana

### Scenario base e futuro della vegetazione

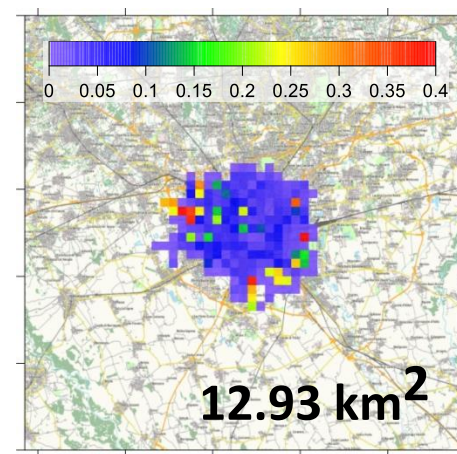
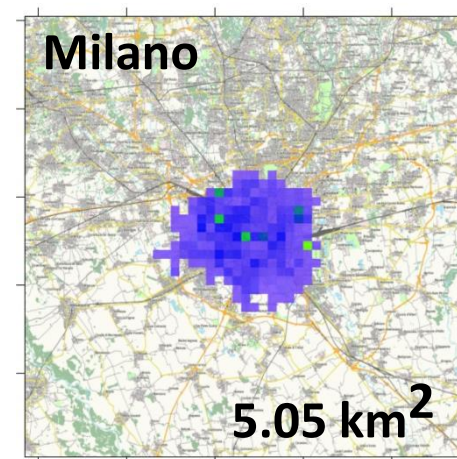
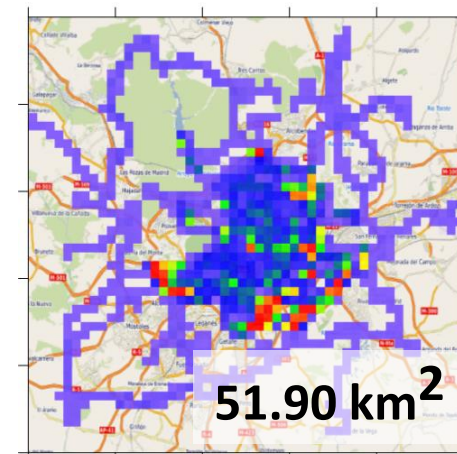
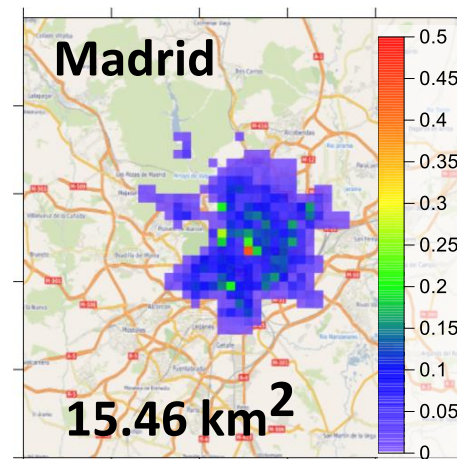
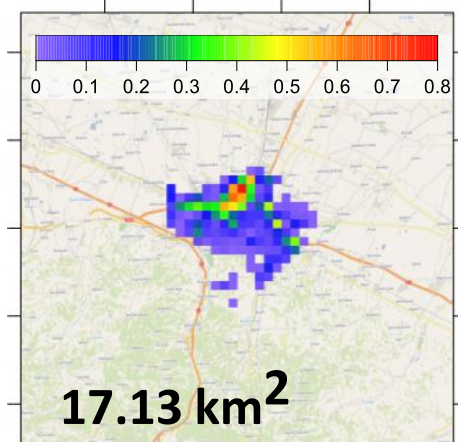
Scenario base  
(inventario municipale)

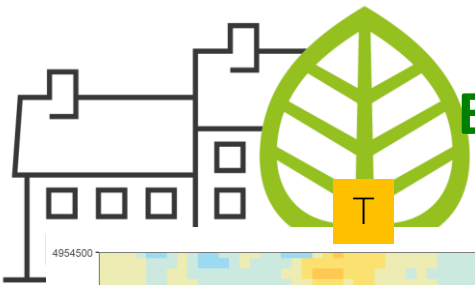


Scenario futuro

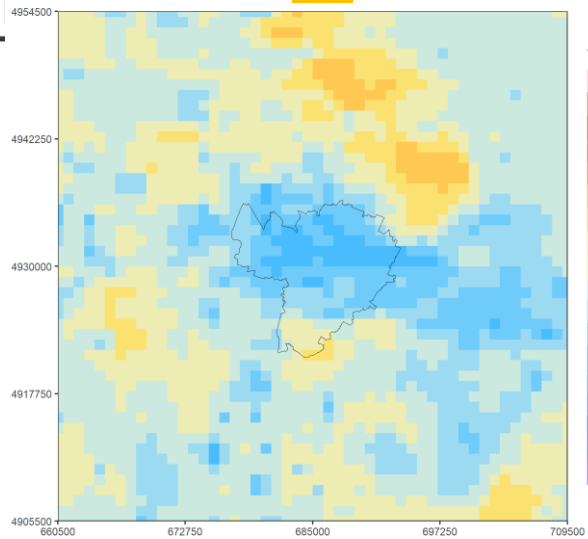


Reference + Scenario

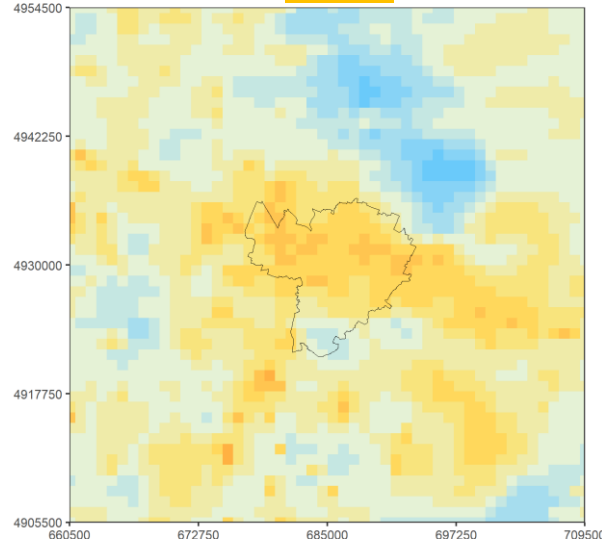




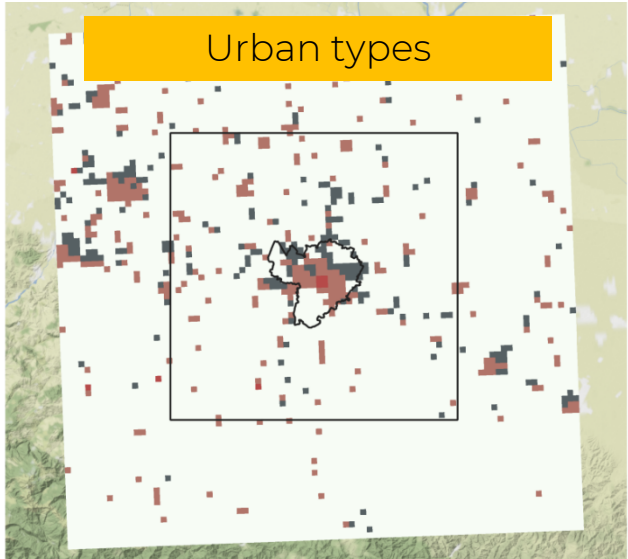
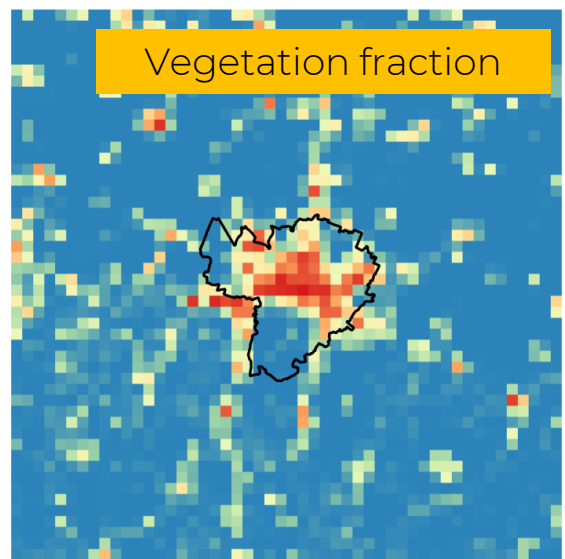
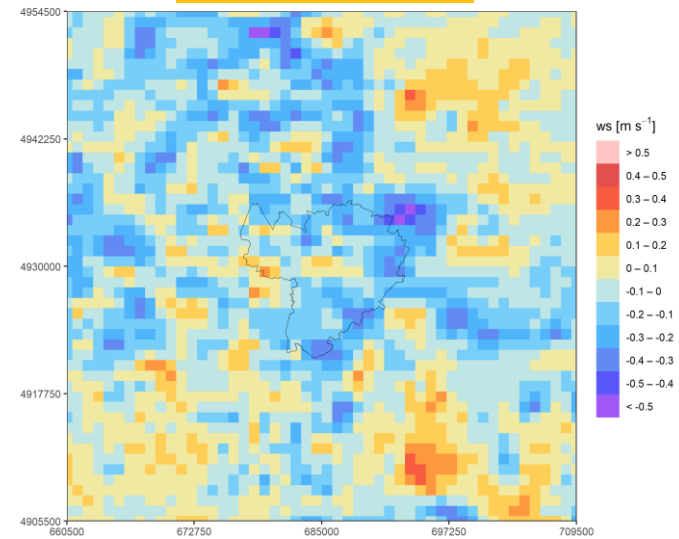
# Effetti della Vegetazione sui parametri meteorologici – media giornaliera



RH



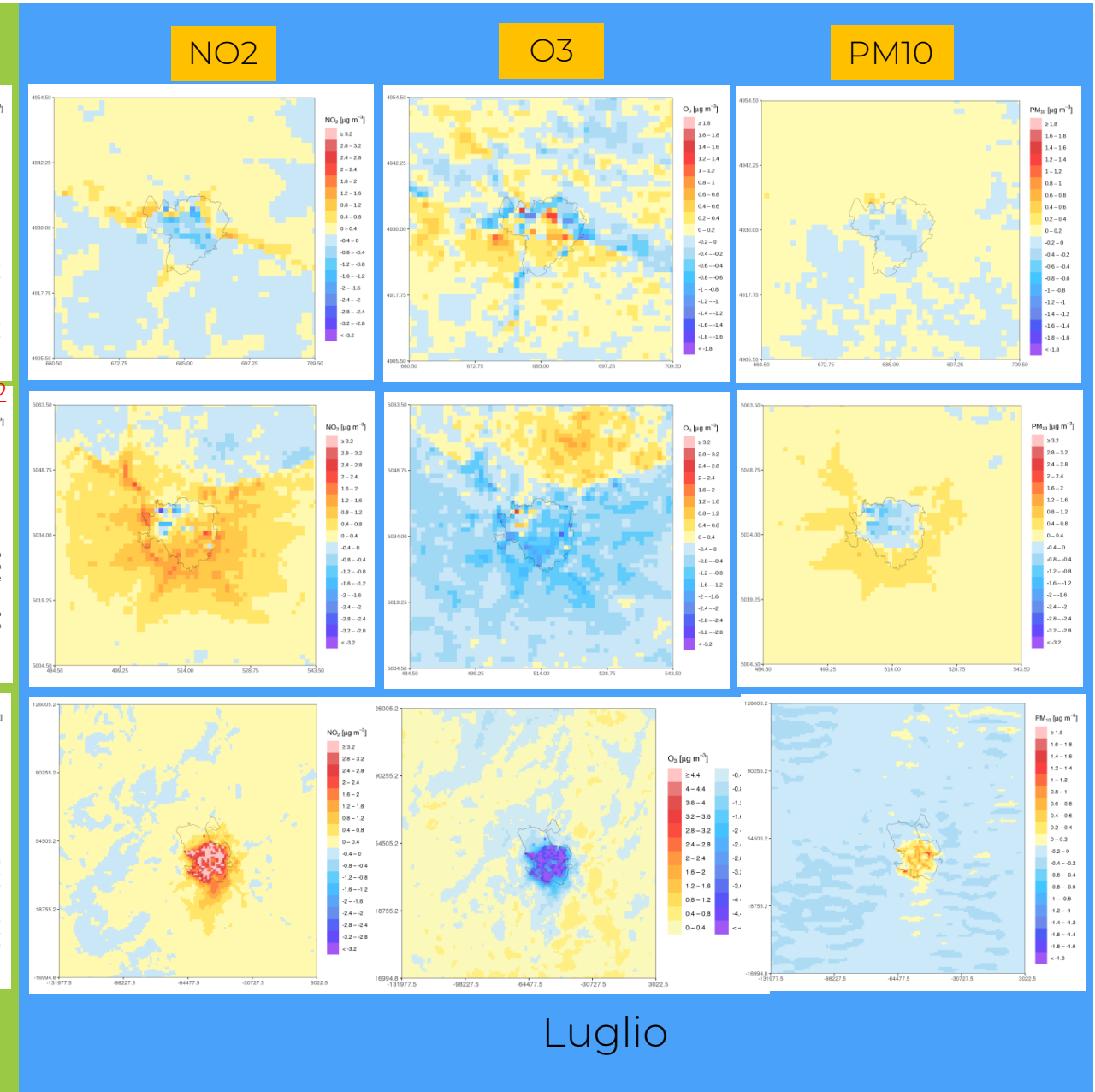
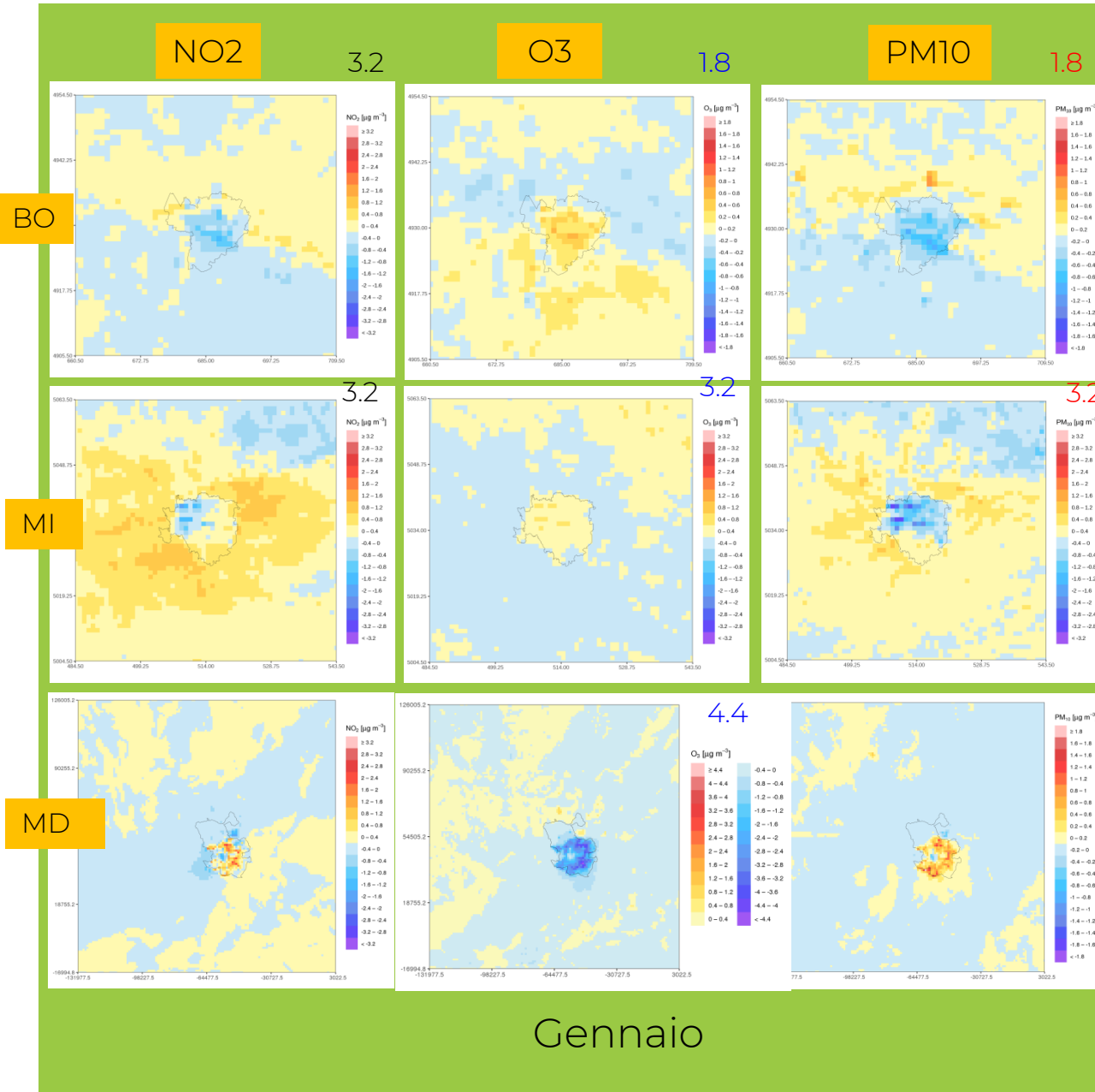
Wind Speed



Bologna  
13 Luglio 2015



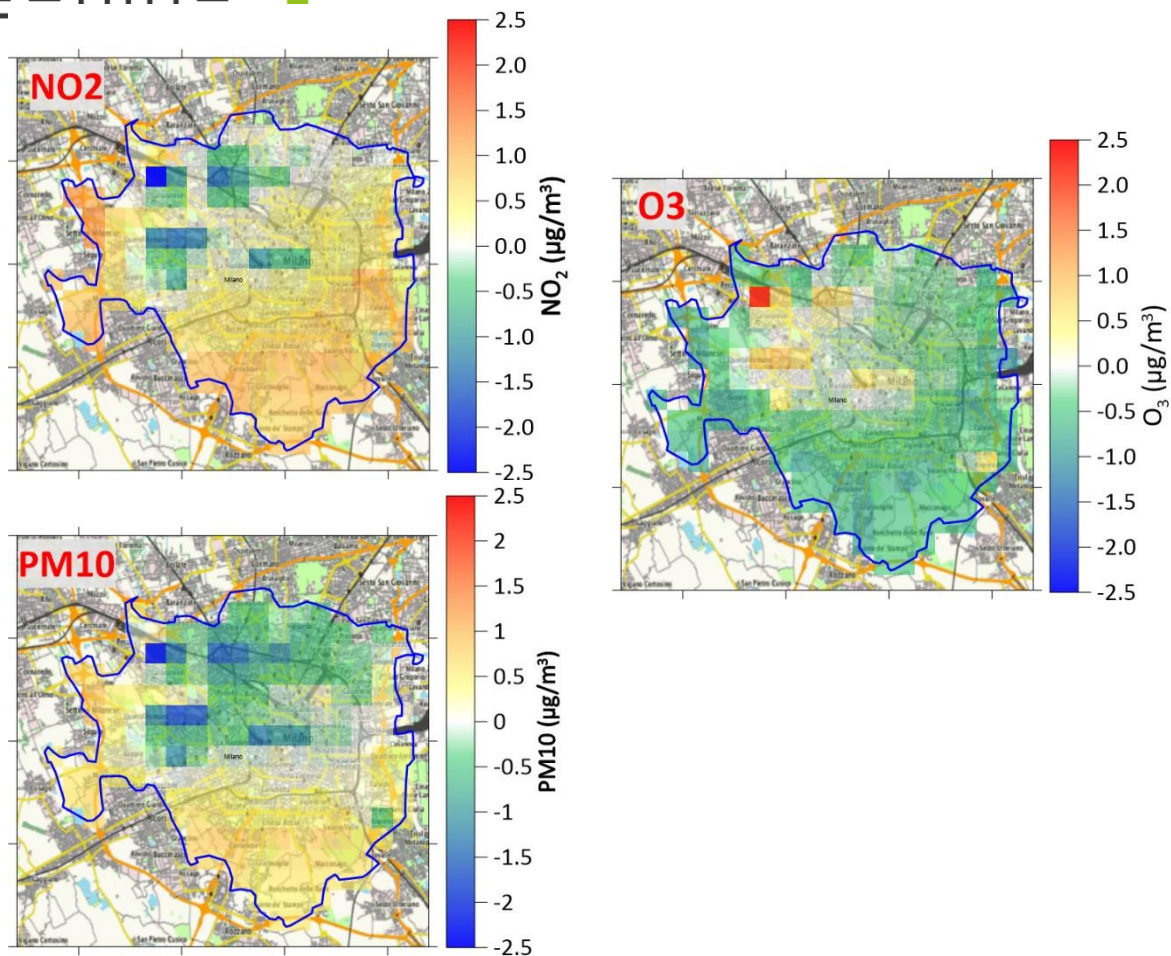
# Effetti della vegetazione sulle concentrazioni



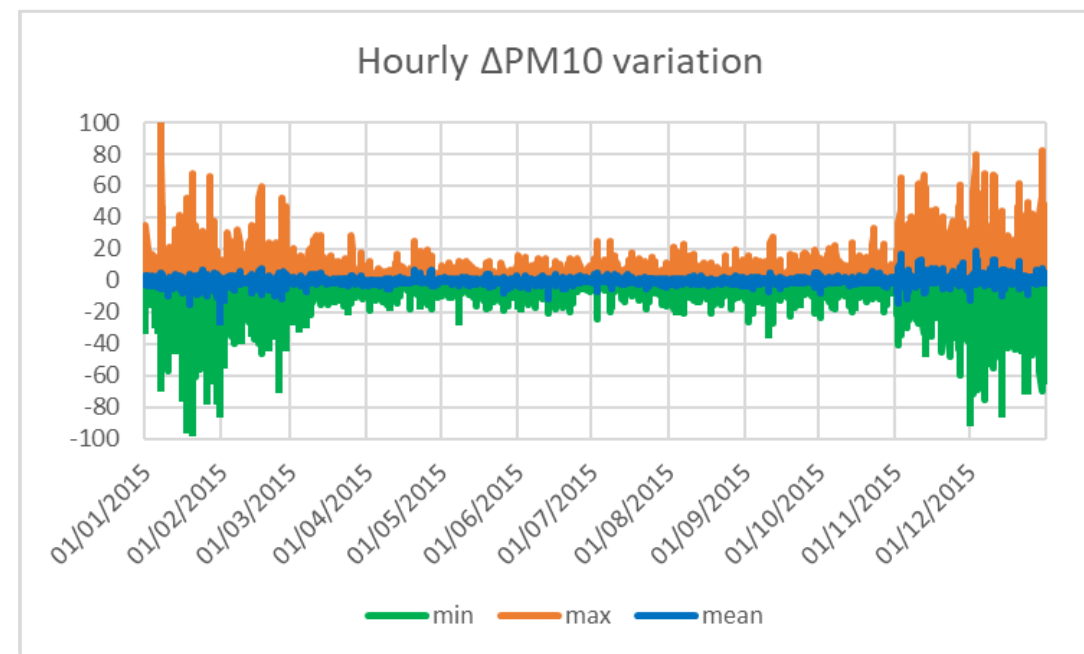


# Impatto sulla qualità dell'aria della vegetazione attuale

## Impatto medio annuale a scala urbana sulle concentrazioni di inquinanti



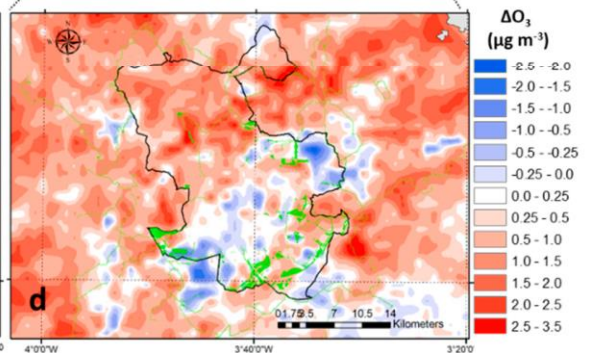
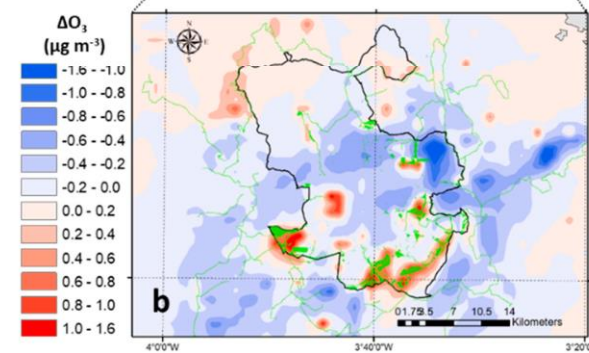
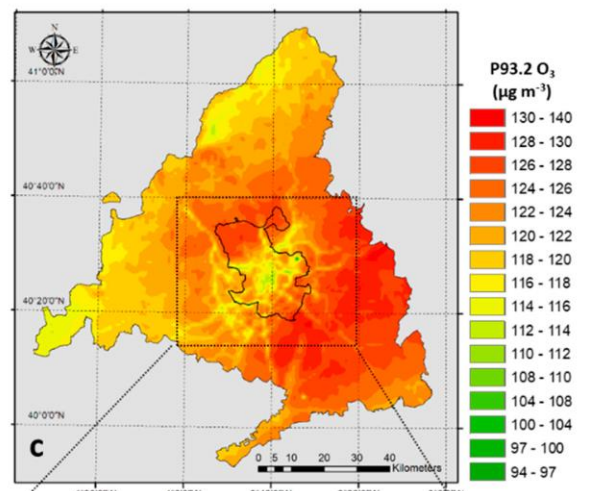
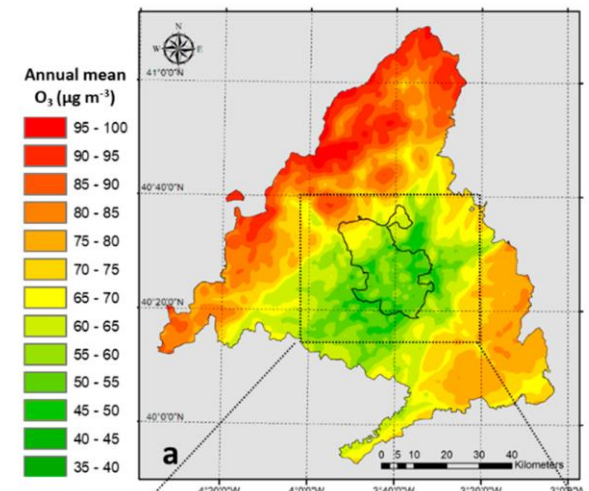
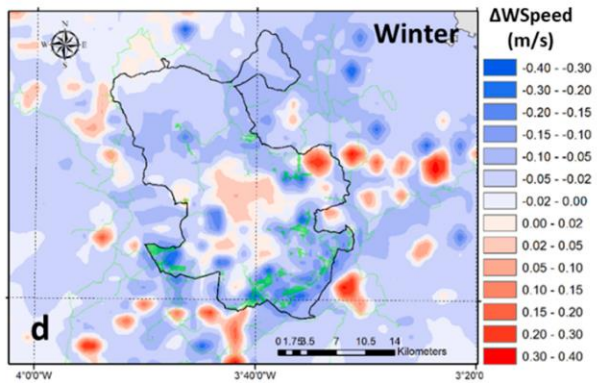
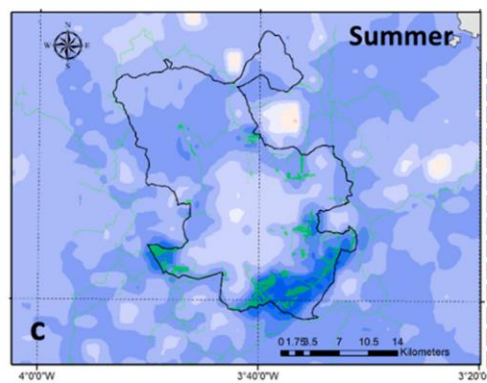
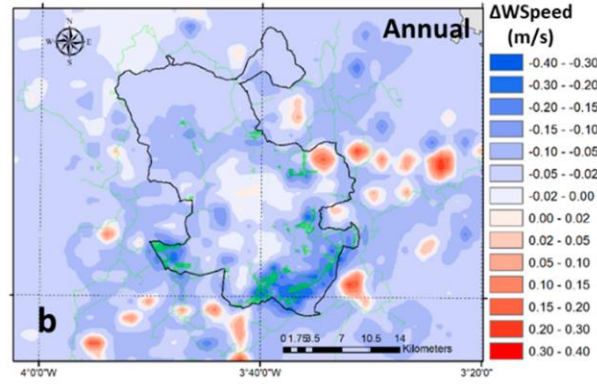
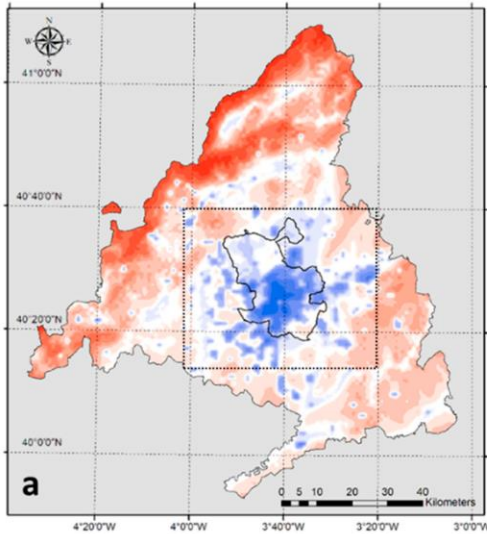
Elevata variabilità locale  
(dipendente dal punto griglia)  
delle concentrazioni di inquinanti





# Impatto dello scenario di riforestazione urbana

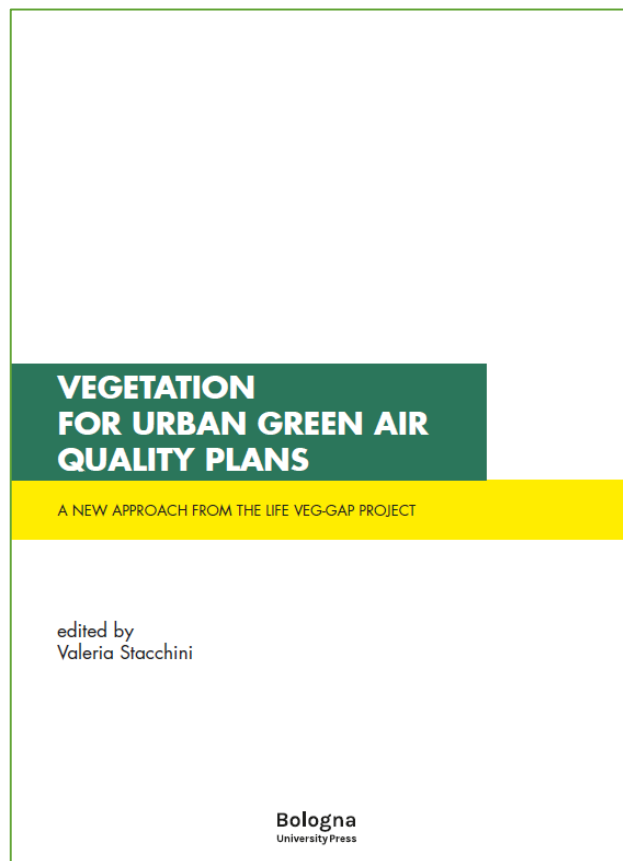
## Madrid





## Progetto VEG-GAP: prodotti

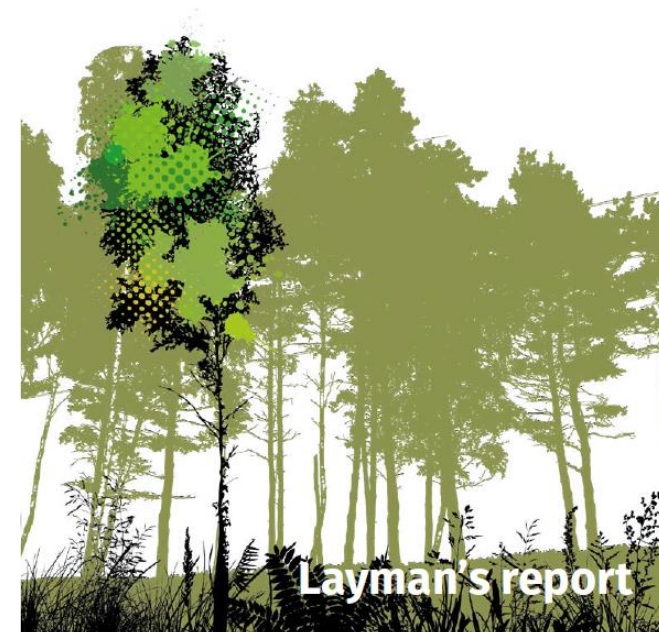
### Documentazione disponibile: VEG-GAP book & Layman report



#### CONTENTS

<b>INTRODUCTION</b> <i>Valeria Stacchini</i>	7
<b>1. The challenges addressed</b> <i>Valeria Stacchini</i>	13
<b>2. Vegetation mapping and biogenic emissions</b> <i>Sandro Finardi, Nicola Pepe, Camillo Silibello</i>	25
<b>3. Integration of vegetation inventories with data from satellites</b> <i>Ilaria Zappitelli, Alessandro Alivernini, Silvano Fares</i>	41
<b>4. Impacts of vegetation on meteorology and air quality</b> <i>Mihaela Mircea, Ettore Petralia</i>	57
<b>5. Impacts of vegetation on health and ecosystem risks</b> <i>Rafael Borge, David de la Paz, Juan Manuel de Andrés Almeida, Adolfo Narros</i>	67
<b>6. Engaging relevant actors and co-design to gain lasting results</b> <i>Valeria Stacchini, Elisa Pighi, Marino Cavallo</i>	77
<b>7. The three pilot cities: Introduction</b>	93
7.1. Reforestation and nature-based solutions in Bologna metropole <i>Marino Cavallo, Elisa Pighi, Valeria Stacchini</i>	95
7.2. Madrid is going green: programme and policies to boost the presence of vegetation and better air quality <i>Luis Tejero Encinas</i>	114
7.3. Green plans and projects of Milan Municipality <i>Marta Alessandra Mauri, Piero Pelizzaro, Elisa Torricelli, Marina Trentin</i>	129
<b>8. The VEG-GAP information platform</b> <i>Stefania Pasetti, Simone Mantovani</i>	141
<b>References</b>	153
<b>List of figures and tables</b>	169
<b>Authors</b>	175

**Veg  
Gap**  
Vegetation for  
Urban Green Air  
Quality Plans










forests



Article

### Assessment of Air Quality and Meteorological Changes Induced by Future Vegetation in Madrid

David de la Paz <sup>1</sup>, Juan Manuel de Andrés <sup>1</sup>, Adolfo Narros <sup>1</sup>, Camillo Silibello <sup>2</sup>, Sandro Finardi <sup>2</sup>, Silvano Fares <sup>3,4</sup>, Luis Tejero <sup>5</sup>, Rafael Borge <sup>1,\*</sup> and Mihaela Mircea <sup>6</sup>

Ciccioli, P., Silibello, C., Finardi, S., Pepe, N., Ciccioli, P., Rapparini, F., Neri, F., Fares, S., Brillì, F., Mircea, M., Magliulo, E., Baraldi, R. (2022): **The potential impact of biogenic volatile organic compounds (BVOCs) from terrestrial vegetation on a Mediterranean area using two different emission models**

Submitted to Agricultural and Forest Meteorology



**Replicabilità sel progetto: Guidelines (project deliverables)**

**Linee guida VEG-GAP:**

- ❖ **Guidelines on mapping vegetation characteristics in urban areas**
- ❖ **Guidelines on estimating BVOC emissions**
- ❖ **Guidelines on relating vegetation ecosystem urban heat island and air pollution for supporting AQPs of municipalities.**
- ❖ **Guidelines and support tool for estimating impact of urban ecosystems/vegetation on health and ecosystem risks due to their effect on air pollution in partner municipalities in support to AQPs**



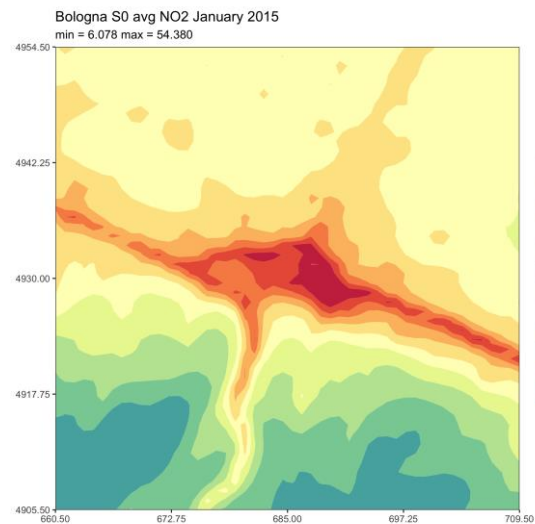
## Progetto VEG-GAP: prodotti

### AirVeg – a R package for validation and further data analysis

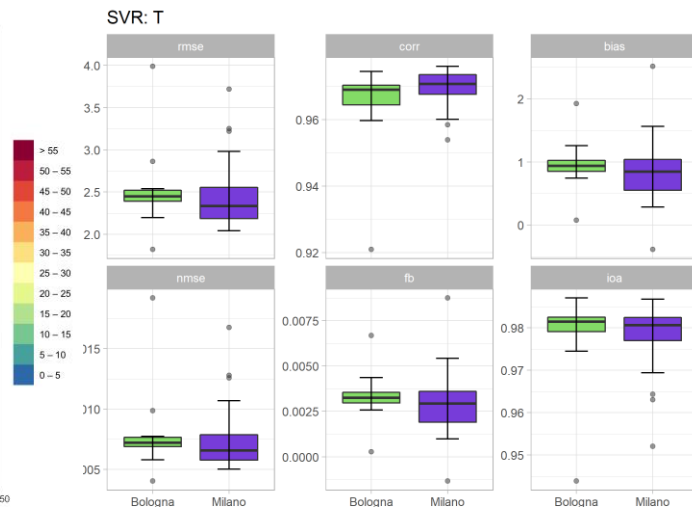
During the project a R toolset has been developed to import, pre-process and post-process air quality and meteorological data, with main focus on data validation: it includes functions to import NetCDF binary files and read measurement datasets, utilities to aggregate data and check validity, tools to compute statistical scores and produce graphical outputs. AirVeg is Open Source, distributed under the GNU General Public License and currently maintained by Simularia ([www.simularia.it](http://www.simularia.it)) – a collection of ready-to-use scripts are also shared by users/developers on CRESCO (final data repository).

<https://gitlab.com/simularia/veg-gap/airveg>

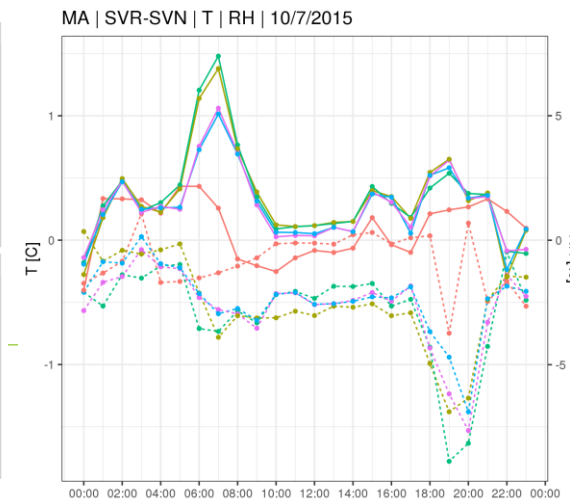
#### Contour plots



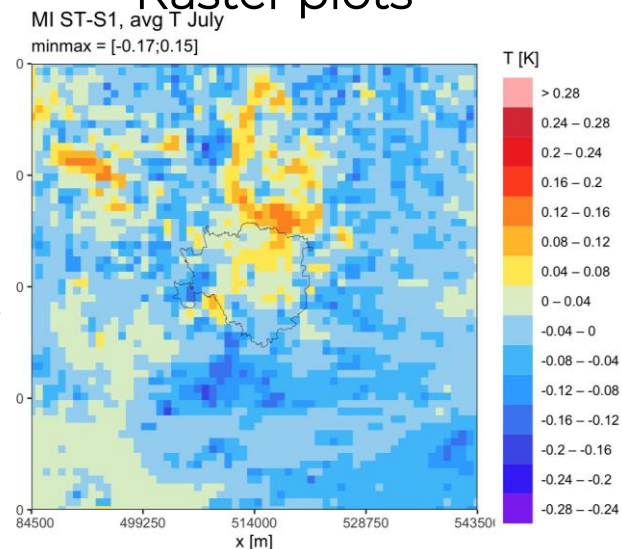
#### Statistical scores



#### Time series



#### Raster plots





# I dati VEG-GAP sulla Piattaforma Informatica (PI) BASIC e ADVANCED

**BASIC per tutti e ADVANCED per esperti interessati ad analizzare, confrontare e scaricare i layer informativi, etc**

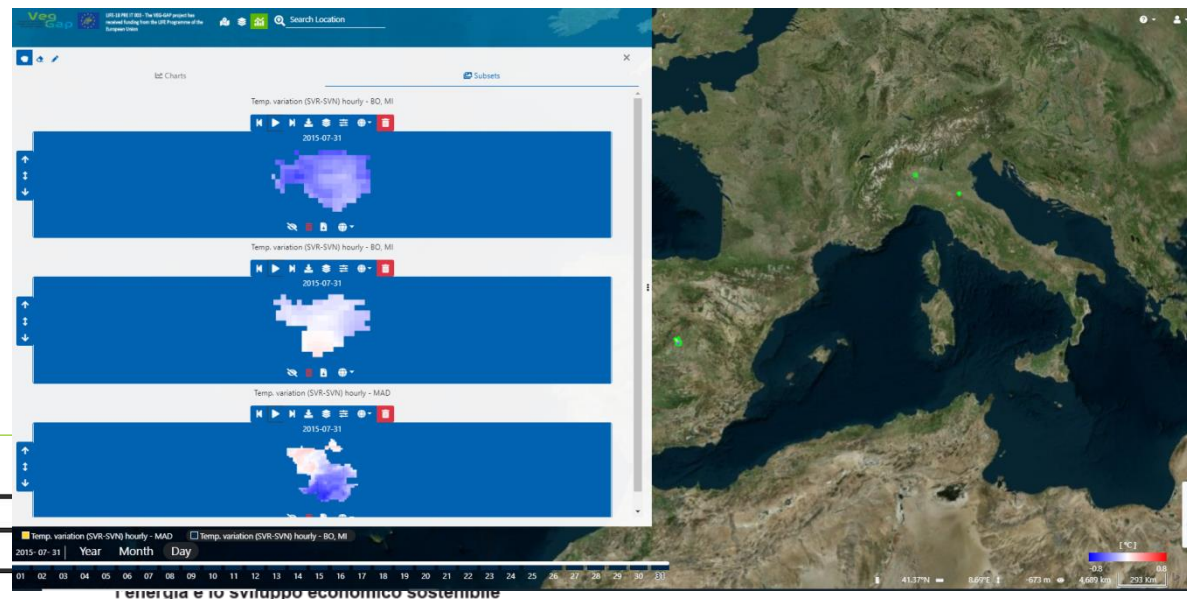
## Informazioni sulla piattaforma:

- ❖ -vegetazione
- e dati da simulazioni con vegetazione attuale e scenari di vegetazione:
- temperatura
- concentrazioni in aria di inquinanti: NO<sub>2</sub>, O<sub>3</sub> e PM10
- deposizioni "secche" di inquinanti: NO<sub>2</sub>, O<sub>3</sub> e PM10
- emissioni biogenici di composti organici volatili (BCOV)
- altri parametri su ADVANCED (umidità relativa, velocità del vento, precipitazioni, etc.)

**BASIC**



**ADVANCED**



**PI è flessibile ed estendibile:**

- -ad altre città
- -ad altre variabili
- -ad altre analisi
- .....



# Grazie!



**Riduzione delle emissioni e NBS devono essere strumenti integrati per il miglioramento della qualità dell'aria urbana!**

Scoprite la nostra piattaforma informativa su :

<https://www.lifeveggap.eu/>

<https://veggapplatform.enea.it>



Italian National Agency for New Technologies,  
Energy and Sustainable Economic Development

[info@lifeveggap.eu](mailto:info@lifeveggap.eu)

[mihaela.mircea@enea.it](mailto:mihaela.mircea@enea.it)

