

# A web based Geospatial Decision Support System to quantify the impact of soil sealing on soil functions

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[www.landsupport.eu](http://www.landsupport.eu)

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We know that the environment and the landscapes planning and management are today crucial points in the Agenda for Land Policies...



- European-Decision-n.-529/2013—LULUCF
- 7th-Environmental-Action-Plan
- 2030-Agenda-for-SDG-(N.-2,-3,-15)
- National-strategy-for-Adaptation-to-Climate-Change
- Common-Agricultural-Policy-Development-plans-(2014-2020; 2021-2027)
- WFD-Directive-2000/60/EC—
- Groundwater-Directive-2006/118/EC-
- Nitrate-Directive-91/676/EEC-
- Forestry-Strategy-COM(2013)-659-final-
- COM(2006)-231-final--Thematic-Strategy-for-Soil-Protection
- Pesticide-Directive-2009/128/EC
- Roadmap-to-a-resource-efficient-Europe-COM(2011)-571-final;
- Directive-2001/42/EC

## The needs

Sustainable land management

Increase income in rural areas

Double the agricultural productivity by 2030

Protecting the environment

Sustainable Intensification

Climate change resilience

Climate-smart agriculture

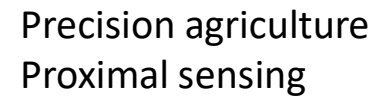
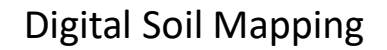
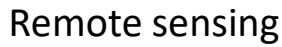


Combining and balancing crop productivity and environmental protection



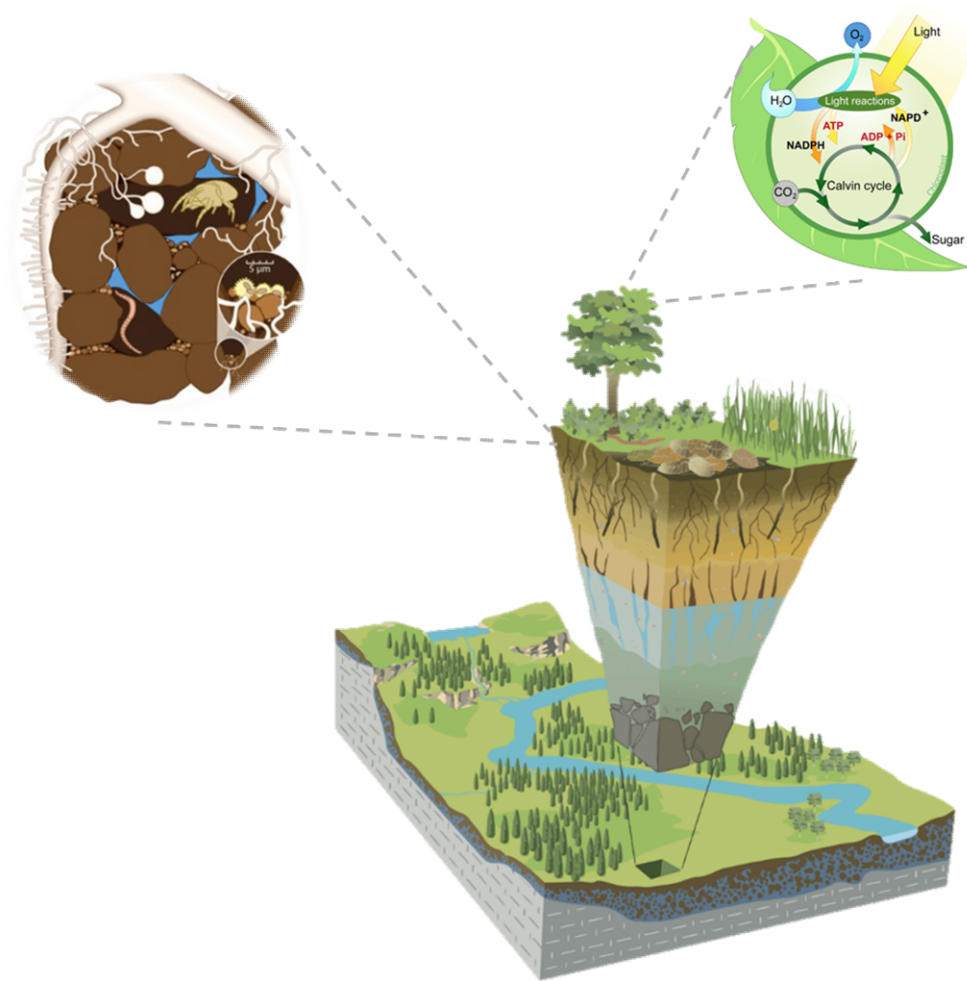
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The scientific community has made big steps forward to meet this needs...from micro to macro scale



These issues are very complex...

because they concern dynamic processes  
variable both in time and space



.. to deal with are needed  
multidisciplinary and transdisciplinary  
approaches!



Our Answer:

The Horizon 2020 LANDSUPPORT project:  
**Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment**

*The project in numbers..*

19 partners

10 Countries

3.5 years

Budget 7M€

60 peoples



Start: May 2018

*I am here to tell you about the work done  
by more than 60 people with very  
different expertise*

**PROJECT PARTNERS**

**ITALY**

CRISP – University of Naples  
ARIESPACE  
ISPRA  
Regione Campania  
Consiglio Nazionale delle Ricerche - CNR  
Università degli Studi di Milano

**SPAIN**

Barcelona Supercomputing Center - BSC

**AUSTRIA**

Umweltbundesamt GmbH (EAA)  
BOKU

**MALAYSIA**

Crops for the Future Research Centre - CFF

**LEBANON**

ICARDA

**HUNGARY**

iASK  
Zala County Government  
University of Pannonia

**GERMANY**

Rasdaman GmbH

**BELGIUM**

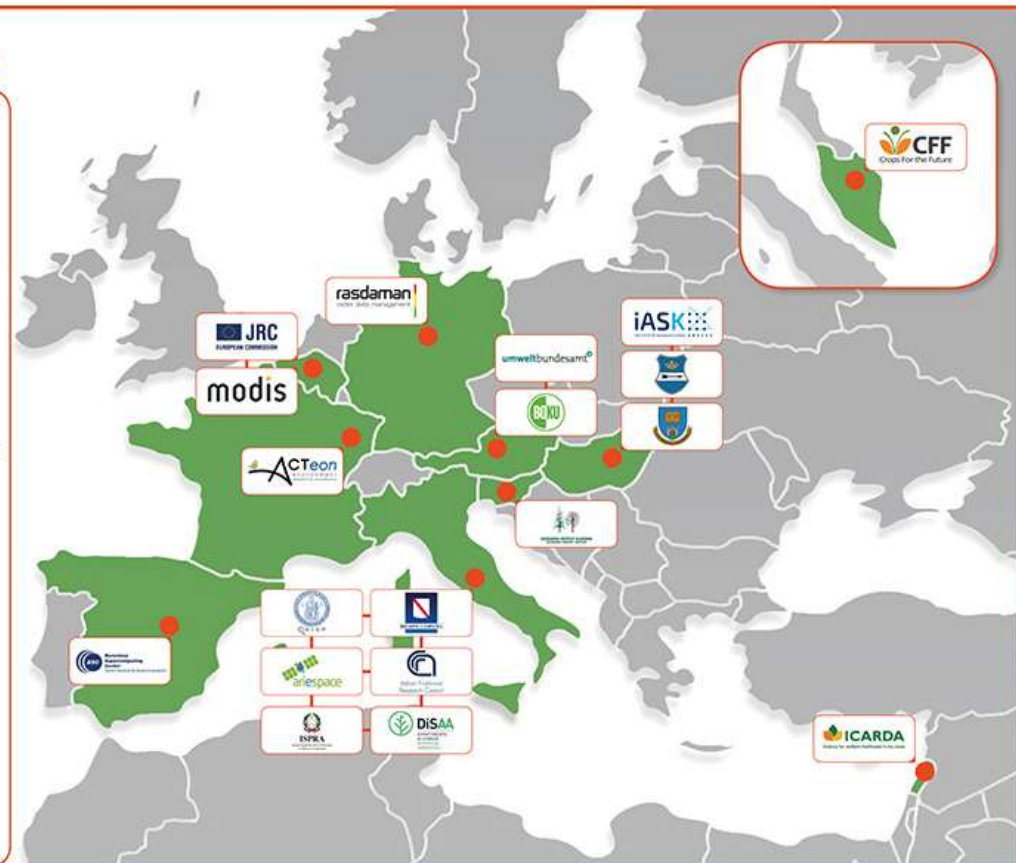
Joint Research Centre - EC - JRC  
Modis

**FRANCE**

ACTeon

**SLOVENIA**

Slovenian Forestry Institute - SFI



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# Landsupport is a Geospatial Cyber Infrastructure:

- ✓ *Open access system*
- ✓ *Web based*
- ✓ *100 operational tools to achieve technical and land policy-oriented specific objectives*
- ✓ *From the European level to the national and regional/ local scale –in Italy, Hungary and Austria – with two additional pilot sites in Tunisia and Malaysia*



Those are the groups of main issues the platform will address through specific tools designed to meet user requirements...

...each of one characterized by both classic GIS approaches and modelling.

**From simple and empirical to very complex dynamic models**



Operational tools (under development with stakeholders)

**Public Authorities**



**Agriculture & Forestry**



**Environmental protection**



**Land take & Spatial planning**



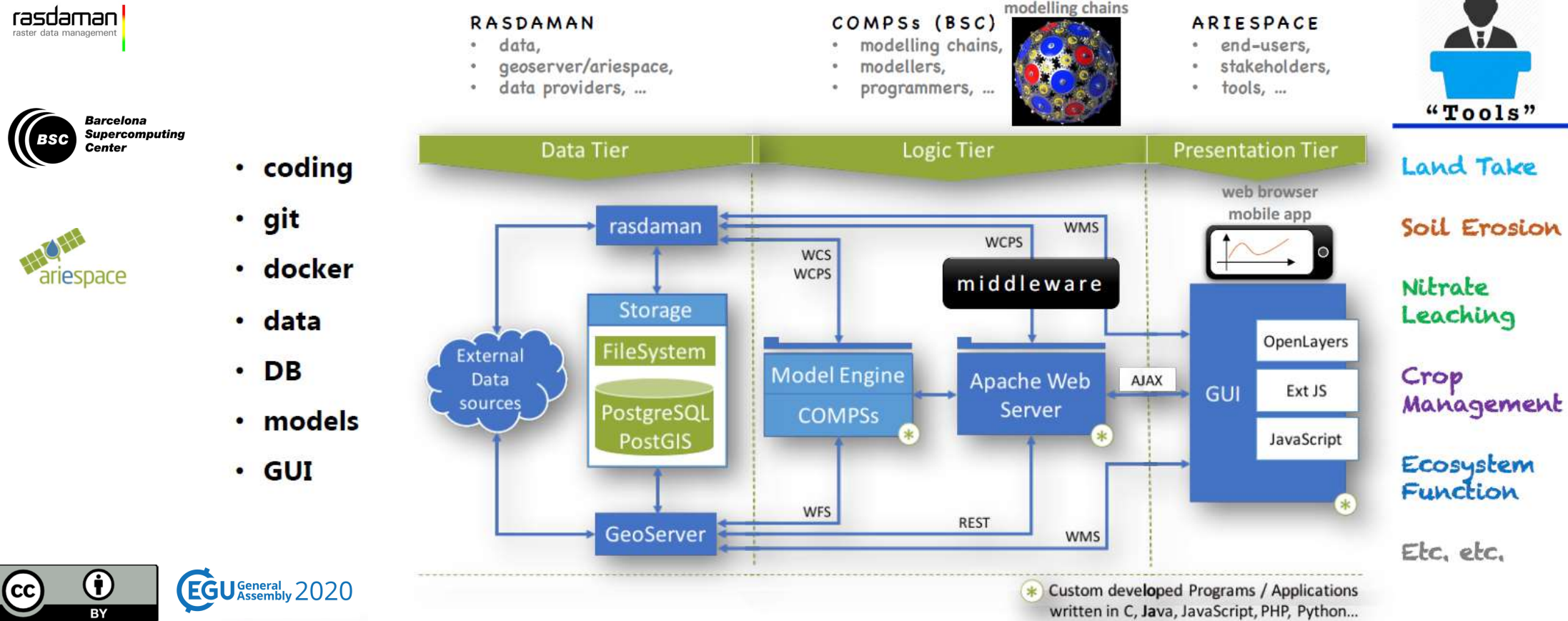
**Biodiversity & Ecotourism**





We have a three tier structure: data, logic and presentation tier. **Data tier** is the place where all the data coming from several databases of project partners are stored; **Logic tier** is the place where the models run by picking the data input from data tier, e.g. a soil-plant-atmosphere model needs as input data *soil information* (chemical and physical properties), *plant data* (leaf area index, roots depths, root density, ET rates), *climate data* (rain, temperatures, solar radiation,...); **Presentation tier** is the GUI (Graphical User Interface) the place where the users query the system by applying the tools.

stakeholders

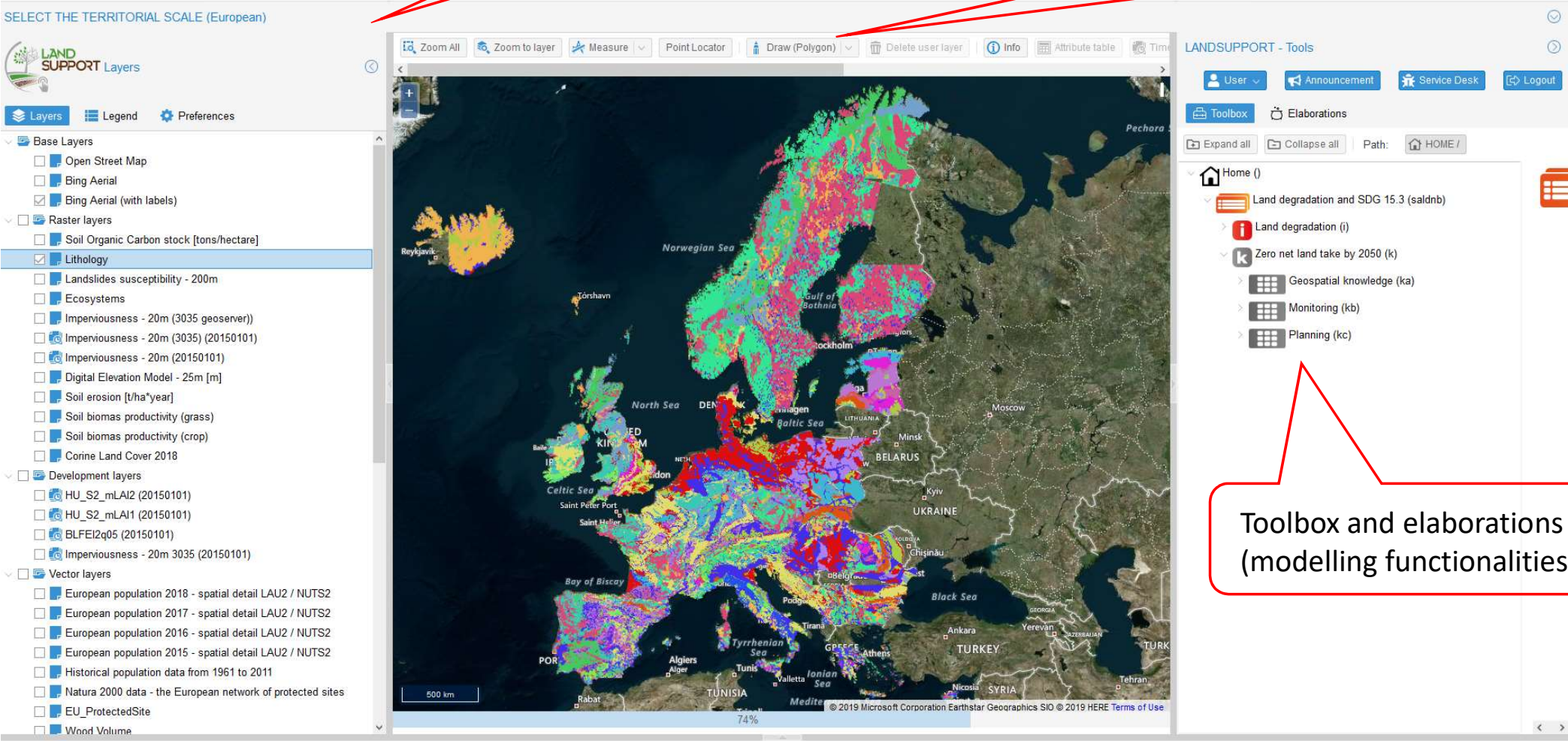




# GUI – Graphical User Interface

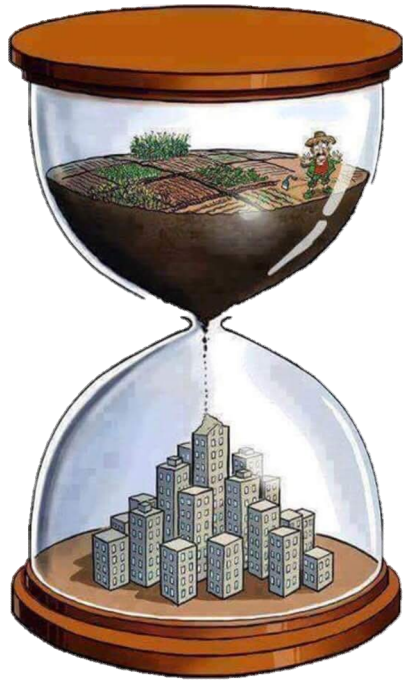
GIS functionalities

Draw your ROI  
The user is enabled to draw his Region Of Interest and apply the Landsupport tools within this area



Toolbox and elaborations  
(modelling functionalities)

Maps visualization



# Some examples

## Issue: Soil Sealing

# Land Take monitoring (EU spatial extension)

Red pixels represent new urbanization = losses of soil surfaces occurred over time (time window defined by the user). Green pixels = gains of surfaces (de-sealing)

Model requester

\* Land take monitoring (5)

ROI (Polygon):

Select ROI

or Administrative Limits \*:

Bologna NUTS level=3

Start Date:

2006-01-01

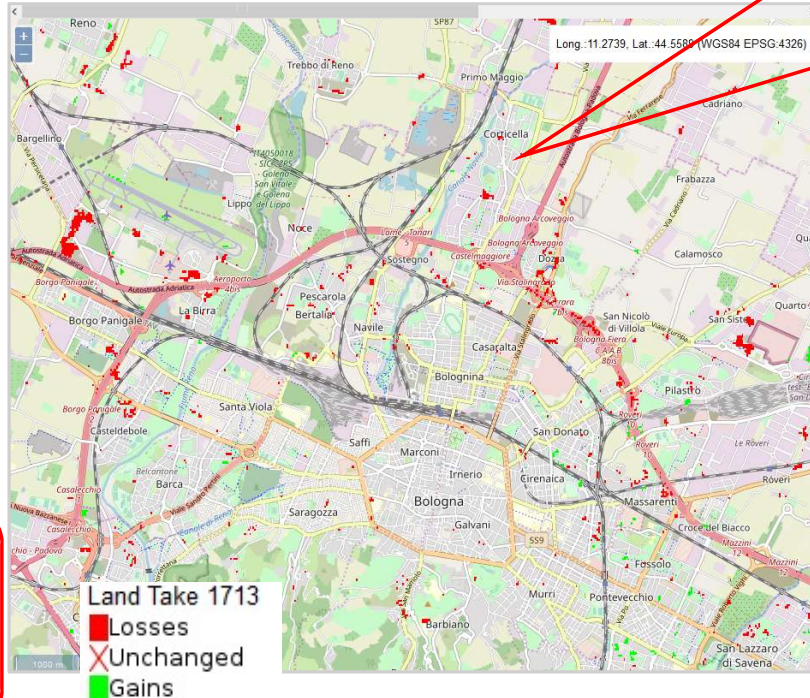
End Date:

2015-01-01

Or:

NUTS level

Evaluate Close



LAND SUPPORT

LAND TAKE TOOL

Land Take monitoring (i)

Region of Interest

Name : Administrative Limit, Bologna, NUTS level 3

Extention [ha] : 370868.44

Centroid location : 44.43068 N 11.34756 E

Parameters

Start date : 2006/01/01

End date : 2015/01/01

Results

CHANGE IN LAND TAKE (between the above two dates) (ii):

	Area	UoM
Loss or rural area (*)	583.05	hectares
Gain of rural area (*)	72.38	hectares

LOSS IN SOIL PRODUCTIVITY (hectares) (iii)

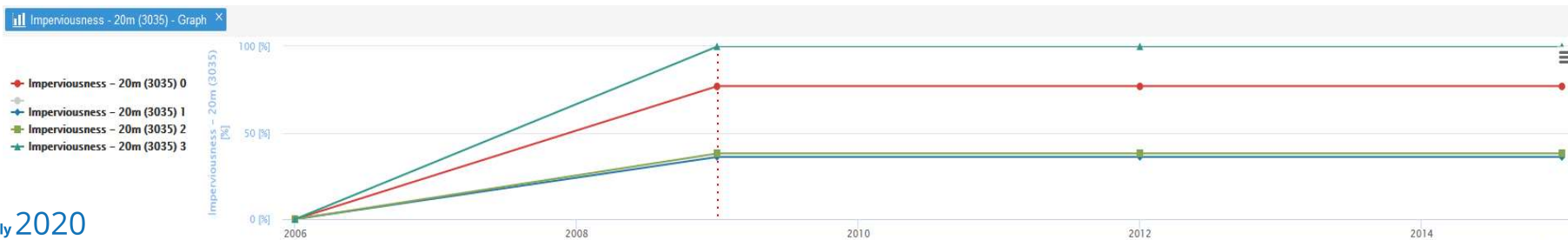
	Classes									
	increasing soil productivity from 1 to 10									
	1	2	3	4	5	6	7	8	9	10
Crop	0	0	0	0	2.33	314.63	69.3	13.88	0	0
Forest	0	0	0	2.7	1.35	23.78	1.35	11.33	0	0
Grass	0	0	0	0	0.68	0.9	3.68	0	0	0

3 The Land take monitoring tool compiles on the fly a technical report showing data about the selected ROI, statistics on loss and gain of rural areas, statistics about potential loss of soil productivity

1 The user can draw a ROI or select an Administrative limits to run elaboration (on the fly) about Land Take monitoring over time.

2 By clicking on the map the user can get a pixel based graph depicting the soil sealing occurrence (and % of cover) over time.

Base data → Copernicus HRL – 20m res (2006 – 2009 – 2012 – 2015)



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# Simulate New Urban Development (EU spatial extension)



Simulate the impact of new urban development (i)

## Region of interest

Name : User ROI, new urban 3  
 Extention [ha] : 339.02  
 Centroid location : 40.87086 N 14.39976 E

## Parameters (ii)

Percentage of planned soil sealing: [%] 100  
 Scale factor: '100 / 100 \* 3390210.2527811 / 10000.0 / ca' 0.033902102527811

## Results (iii)

### Potential loss in ecosystem services (MAES approach):

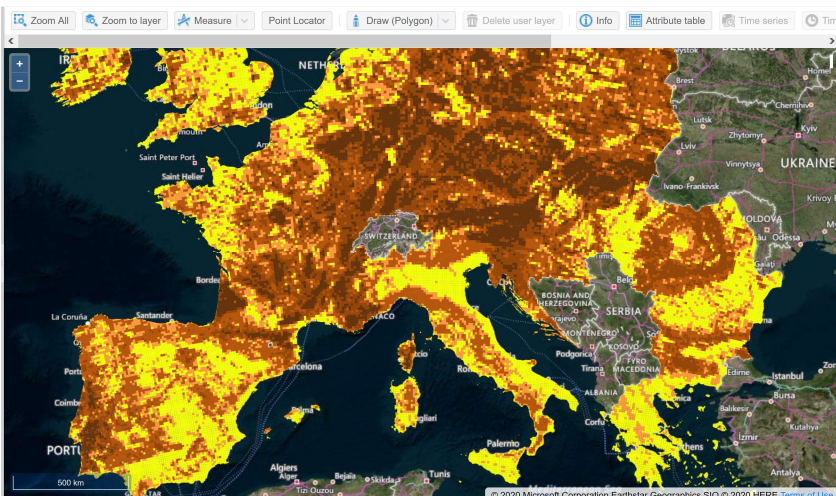
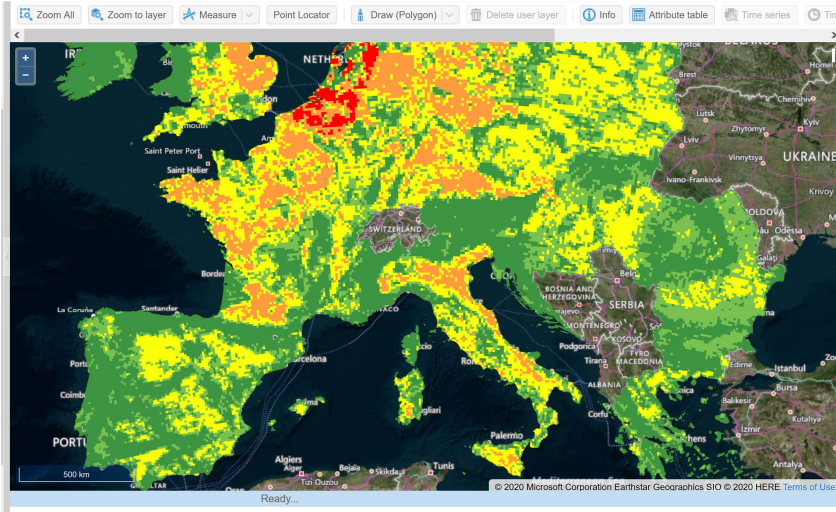
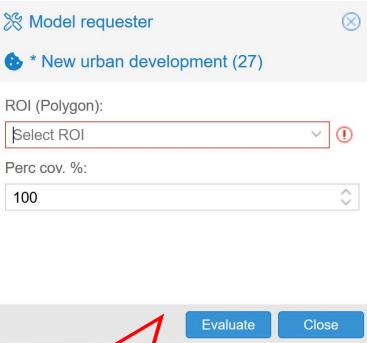
Food crops	902.99	ton/year
Fodder crops	1201.48	ton/year
Energy crops	296.28	ton/year
Textile crops	0.01	ton/year
Organic crops area	15.877	ha
Grazing livestock	0	heads
Timber removal	58.282	m3/year
Wood volume	10761.338	m3
Water abstraction for industrial use	0	m3
Water abstraction for agricultural use	0	m3
Water abstraction for public use	828409.741	m3
Forest with protective functions area	59.398	ha

### Potential loss in soil organic carbon (tons)

Loss of organic carbon	1.17	ton
------------------------	------	-----

3

The New Urban Development tool compiles on the fly a technical report showing data about the selected ROI and statistics about losses in Ecosystem services and soil functions



MAES: Mapping and Assessment of Ecosystems and their Services



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1 The user can draw a ROI and select the % of simulated sealing within that ROI.

2 The tool works by clipping several MAES map layers in correspondence of the selected ROI and calculating spatial statistics.



# Rural Fragmentation (EU spatial extension)

Model requester

\* Fragmentation (22)

ROI (Polygon):  
Select ROI

or Administrative Limits \*:  
Select Administrative Limits

Fragmentation radius [m]:  
200

Date:  
2015-01-01

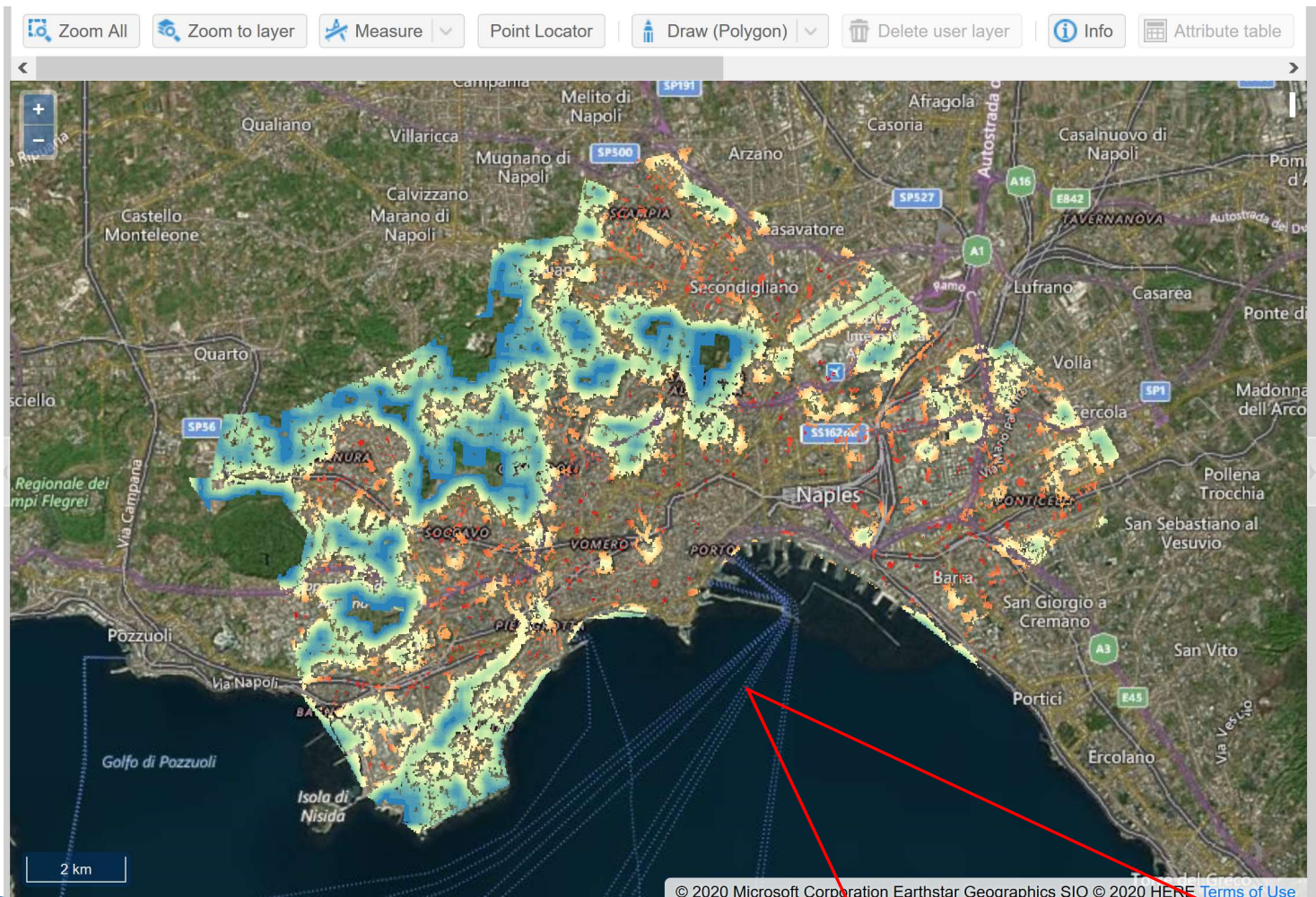
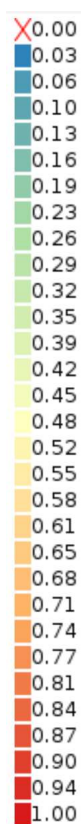
Or:  
☐ Timeseries

Type:  
☒ Rural ☐ Urban

Evaluate Close

\* NUTS level

1 The user can draw a ROI or select an Administrative limit, select a radius for the elaboration and a reference period



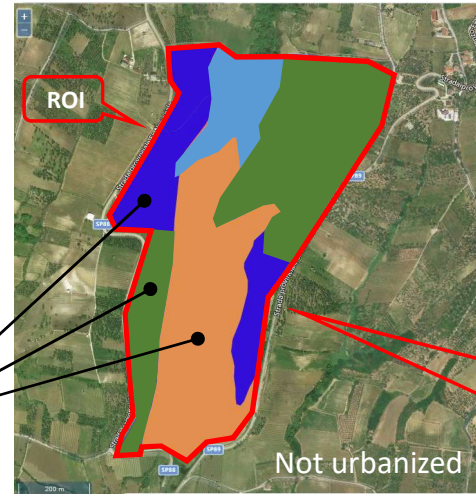
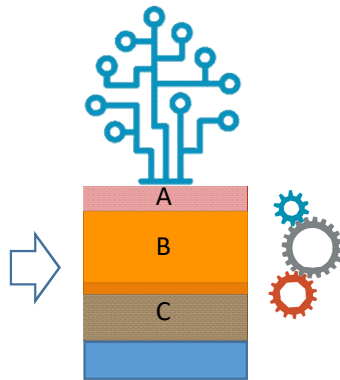
2 The Rural Fragmentation tool calculates on the fly a fragmentation rates of rural areas by using a kernel (defined by the radius chosen by the user) and counting the pixels classified as "urbanized". Each pixel is classified according to an index ranging from 0 to 1; 0 = 0% of urbanized pixel within the kernel; 1 = 100% of urbanized pixels within the kernel

# Future development (local extension)

Reality



Simulation



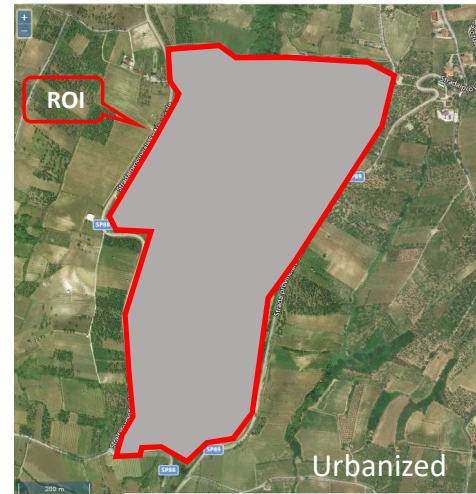
Output: loss of biomass productivity

Results

Soil	Class USDA	Area [ha]	Area %	Yield q.li/ha*year
Consociazione dei suoli Padulo dell'Oro	Vitrantic Calciust...	8.70	17.29	39.50
Consociazione dei suoli Candro	Typic Calciustepts	5.63	11.19	35.50
Consociazione dei suoli Pennine	Typic Calciustolls	2.09	4.16	34.80
Consociazione dei suoli Pennine	Typic Calciustolls	7.34	14.58	34.80
Associazione dei suoli La Cerasa, To...	Typic Haplustolls ...	18.22	36.19	26.70
Consociazione dei suoli Padulo dell'Oro	Vitrantic Calciust...	8.36	16.60	39.50

Soil units potentially subjected to new urbanization

The user will get at local scale estimate of Ecosystem services loss due to new simulated urbanization within the selected ROI.



The implementation of SPA dynamic modelling (Soil – Plant – Atmosphere modelling) will enable Landsupport to estimate on the fly, with a physically based approach, the potential loss (due to new urbanization) of several Soil Ecosystem services, e.g. biomass productivity, water holding capacity, filtering capacity, etc.



The tool described represents an evolution of a previous S-DSS tool named Soil sealing and landscape planning, still operational and described in a scientific publication (<https://doi.org/10.1002/ldr.2802>)

LAND DEGRADATION & DEVELOPMENT

*Land Degrad. Develop.* (2017)

Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/ldr.2802

## SOIL SEALING: QUANTIFYING IMPACTS ON SOIL FUNCTIONS BY A GEOSPATIAL DECISION SUPPORT SYSTEM

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### Soil Monitor: an advanced and freely accesible platform to challenge soil sealing in Italy

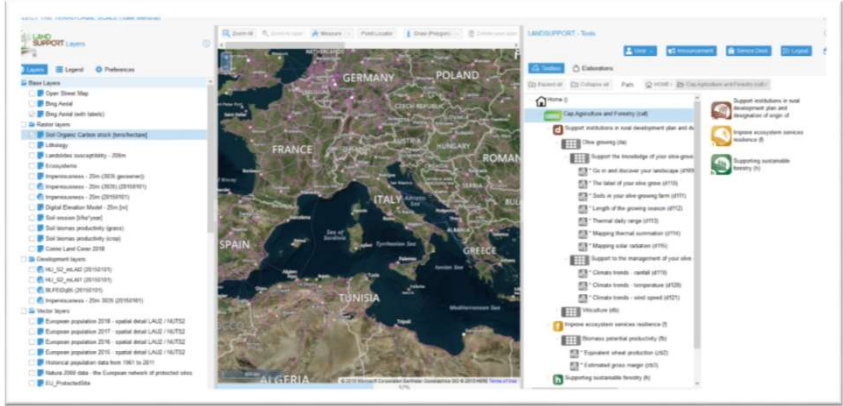
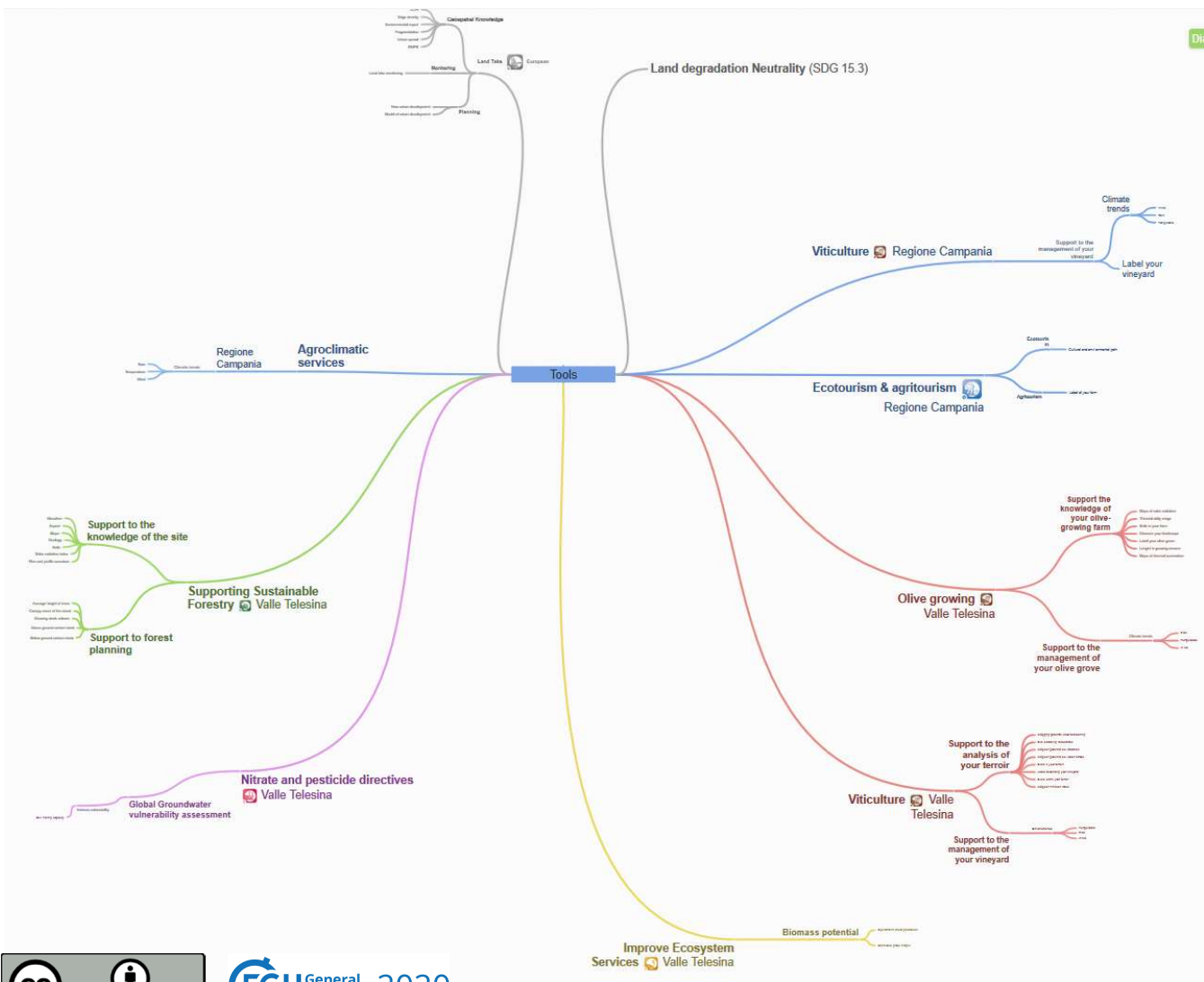
Giuliano Langella (1,6), Angelo Basile (1,6), Simone Gianneccchini (2), Francesco Domenico Moccia (3,6), Michele Munafò (4), Fabio Terribile (5,6)

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At the EGU2017 was presented  
a first prototype of a soil sealing DSS tool



# Landsupport is continuously evolving...



[www.landsupport.eu](http://www.landsupport.eu)

...at the end of the project more than 100 tools will be implemented.  
Try yourself to visit the web page



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Thanks for reading!

