Sistema Nazionale per la Protezione dell'Ambiente

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Il monitoraggio del territorio e del consumo di suolo

Michele Munafò
ISPRA

michele.munafo@isprambiente.it
@mic_mun

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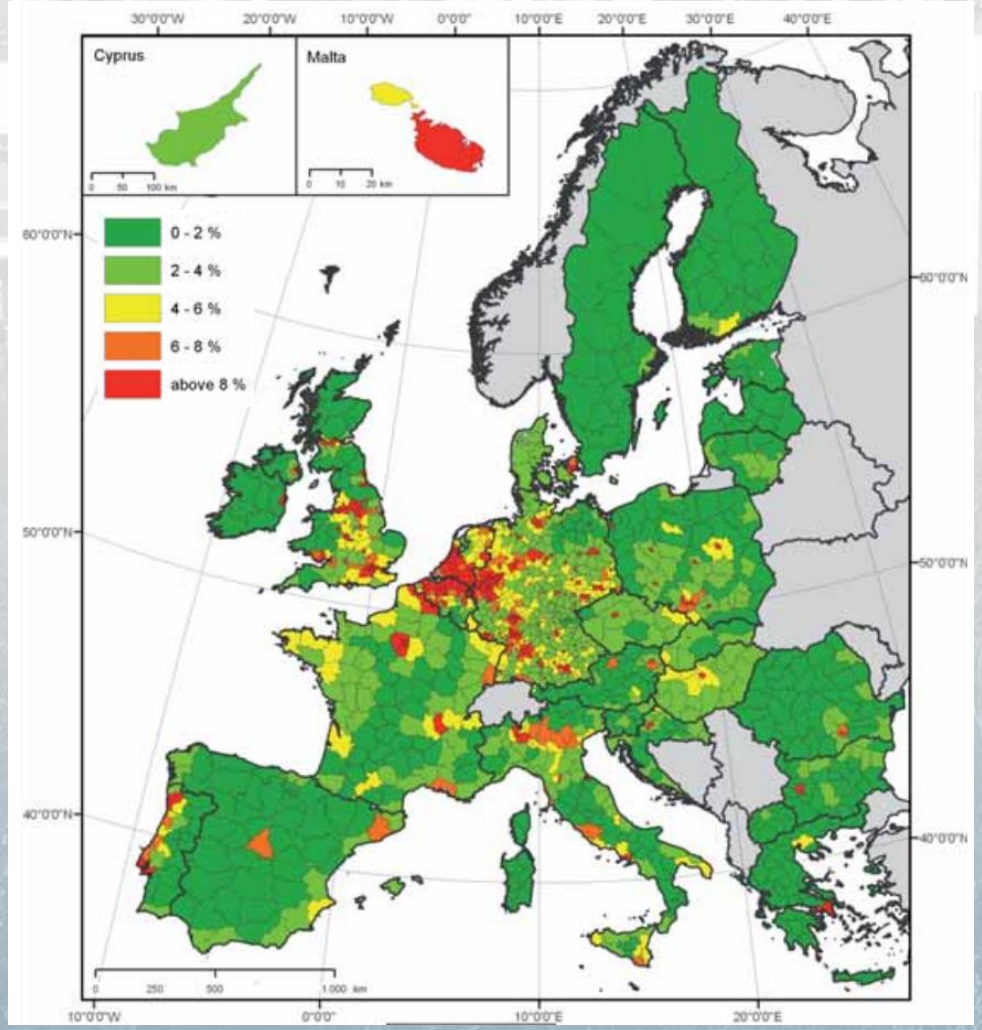
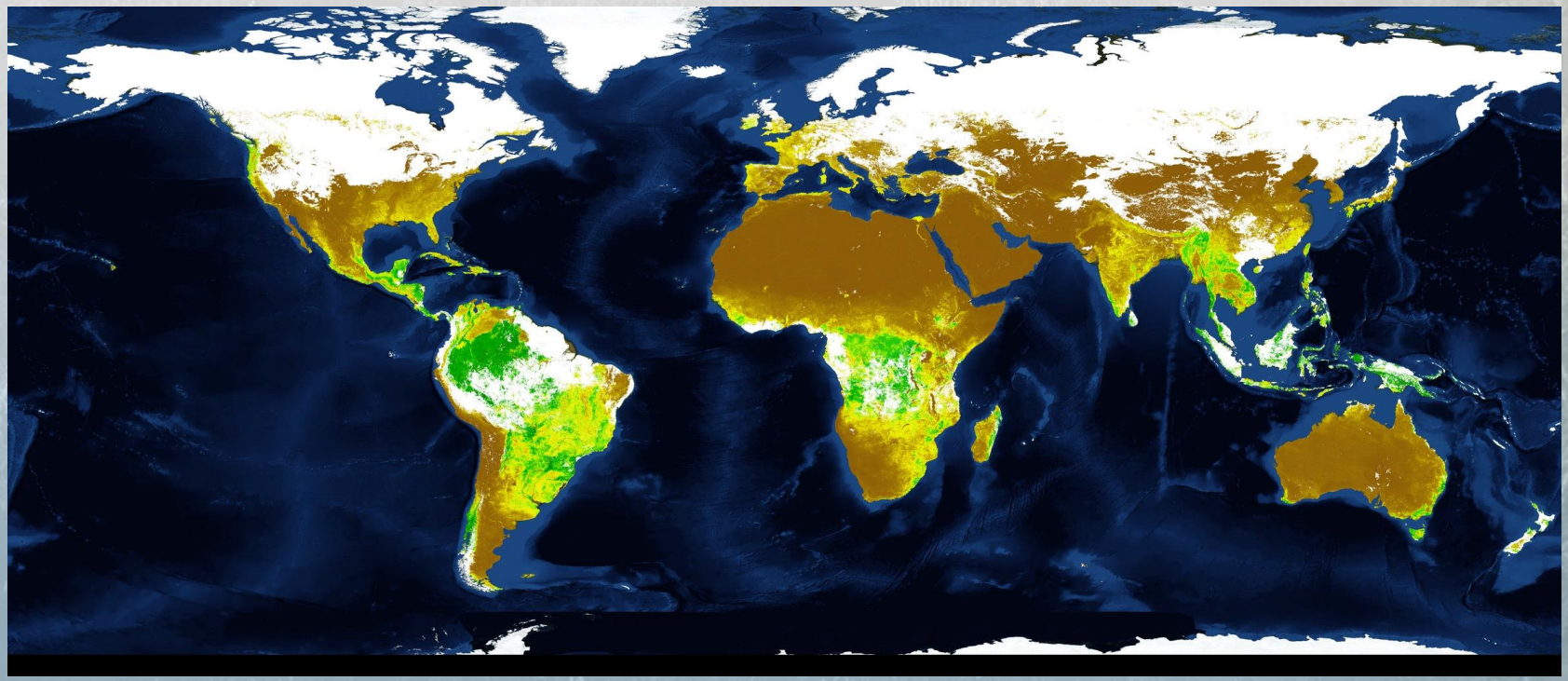


On the basis of data published by the European Environment Agency in the context of Corine Land Cover for the years 1990, 2000 and 2006, estimated that detected land take between 1990 and 2000 was around **1 000 km² per year in the EU** – an area larger than the city of Berlin – **or 275 hectares per day**, and settlement areas increased by nearly 6 %. From 2000 to 2006, the rate of land take decreased slightly to 920 km² per year (252 hectares per day), while the total settlement area increased by a further 3%.

European Commission


GLOBALLY, UP TO 50 000 SQUARE KILOMETRES OF SOIL, AN AREA AROUND THE SIZE OF
COSTA RICA,
IS LOST EVERY YEAR
11 HA OF SOILS
ARE SEALED UNDER EXPANDING CITIES EVERY HOUR IN EUROPE
100 miles
100 km



The Sustainable Development Goals

We must take action today to help ensure the health and well-being of future generations. As an outcome of the Rio+20 Conference, the **Sustainable Development Goals** are part of ***The Future We Want*** Resolution, which is in pursuit of achieving tremendous goals by 2030 to promote sustainable development.

These 17 goals set out to end poverty, protect the planet, and ensure prosperity for all. This requires participation from everyone, including governments, the private sector, civil society, and even people like you.

From Millennium Development Goals to the Sustainable Development Goals

At the turn of the century, the United Nations established 8 goals in an effort to tackle some of the world's most pressing challenges. The Millennium Development Goals were an ambitious project aimed at alleviating poverty by 2015. Building on the success of the MDGs, the UN created 17 Sustainable Development Goals that came into effect in January 2016.

While the MDGs were focused on developing countries, the SDGs are universal. These Sustainable Development Goals cover three

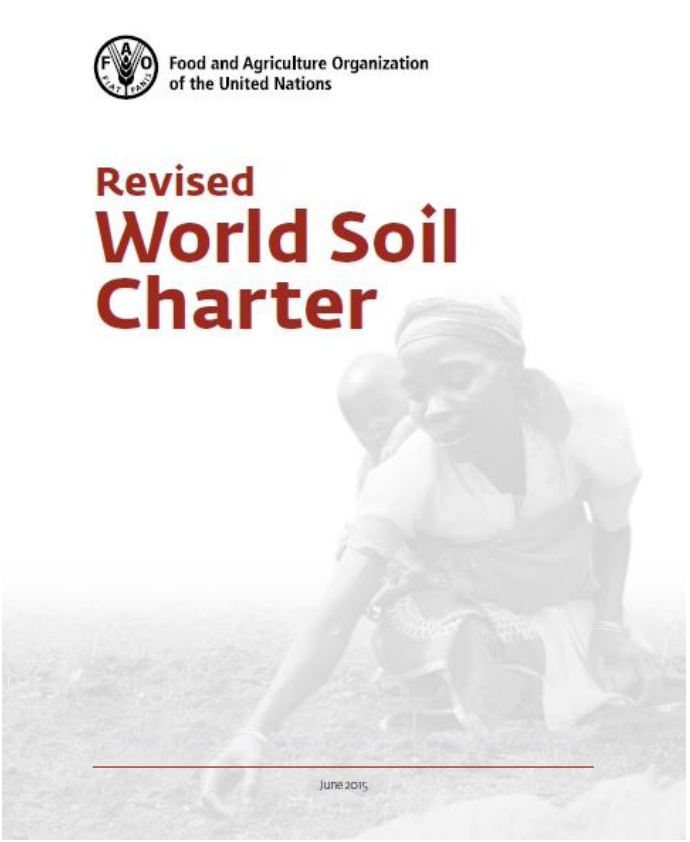
The list includes **230** indicators

SUSTAINABLE DEVELOPMENT GOALS

11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

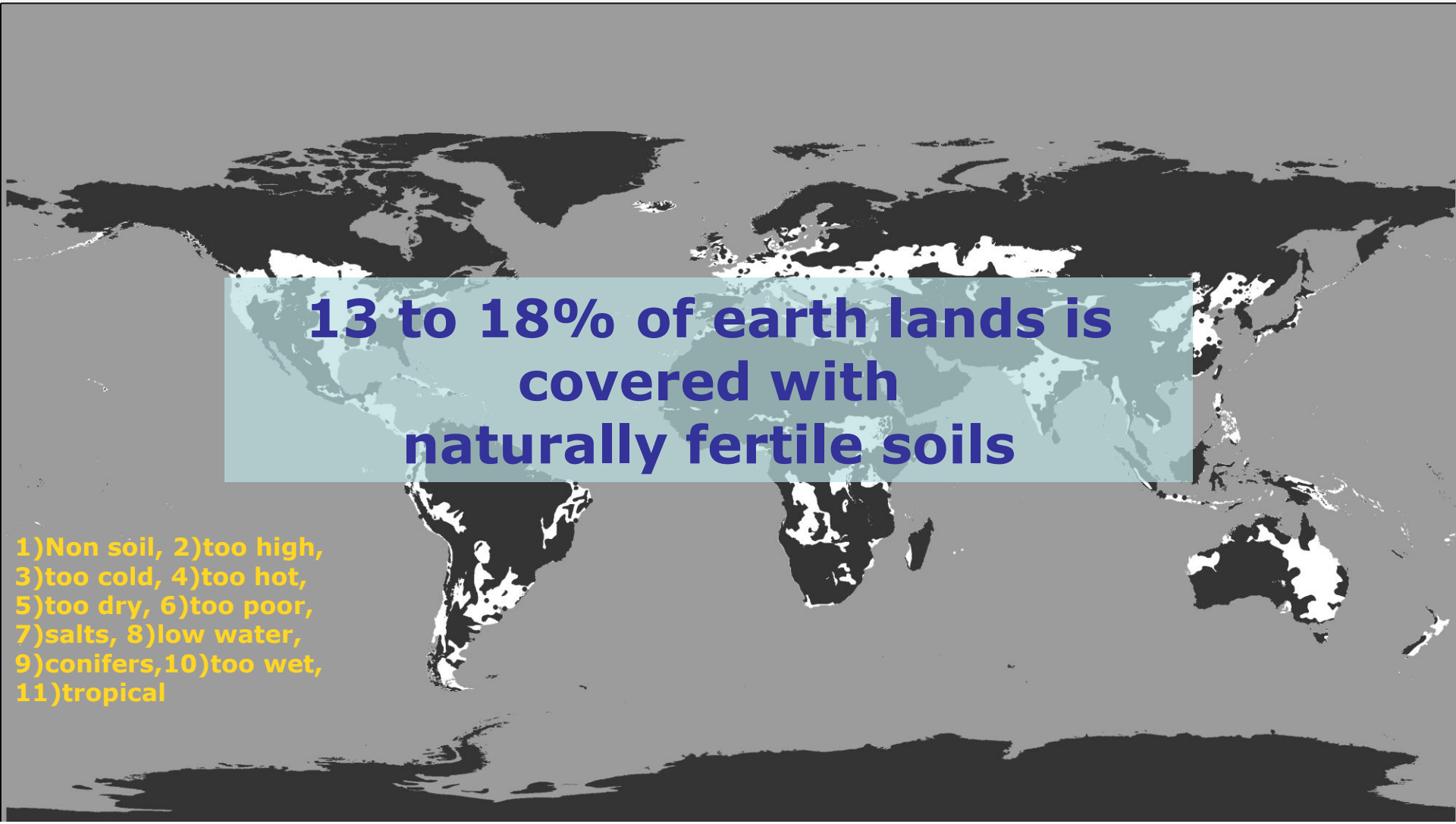


Voluntary Guidelines
for Sustainable Soil
Management

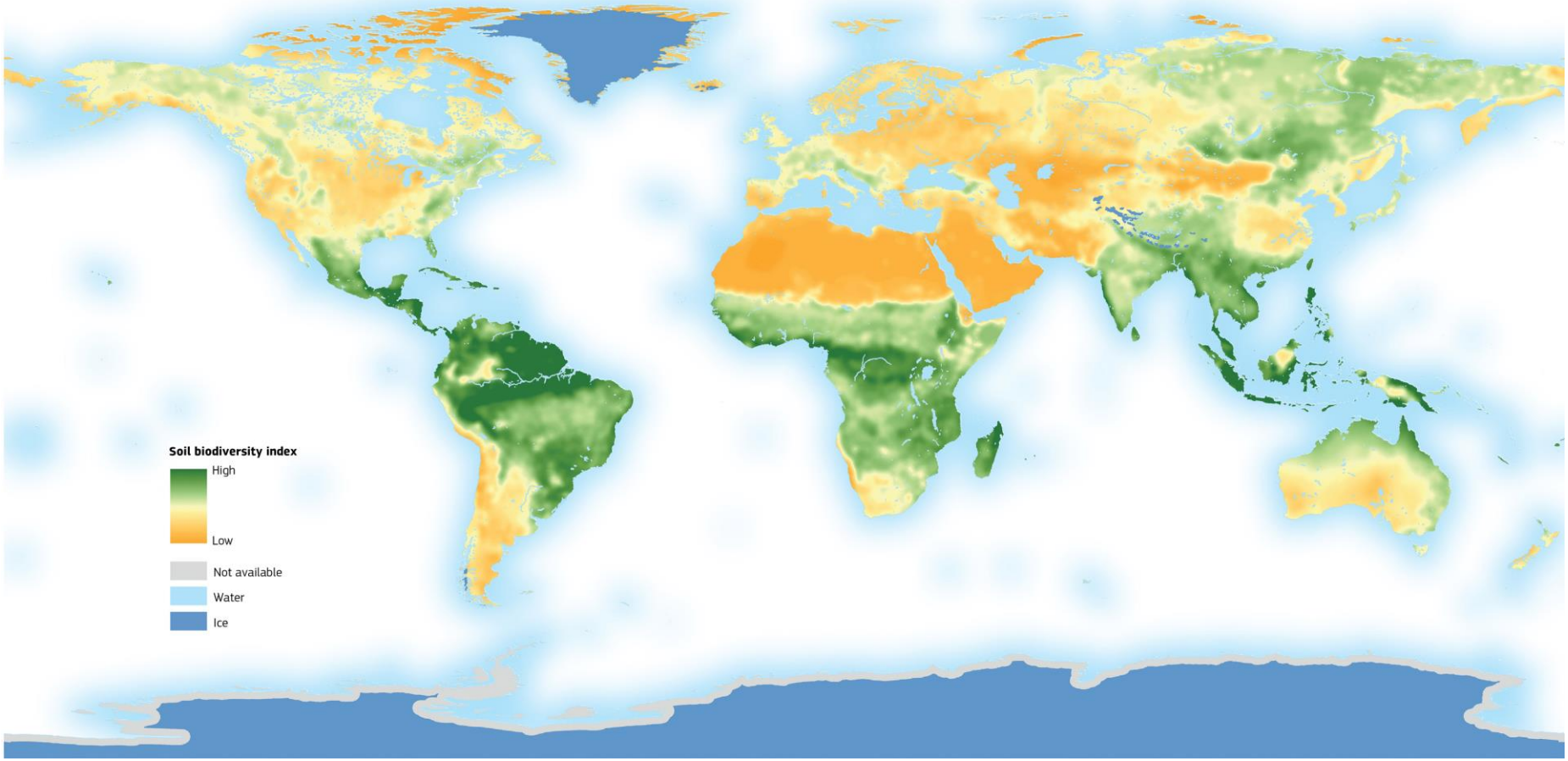
One planet for 9 billion people

How much good soil we have ?

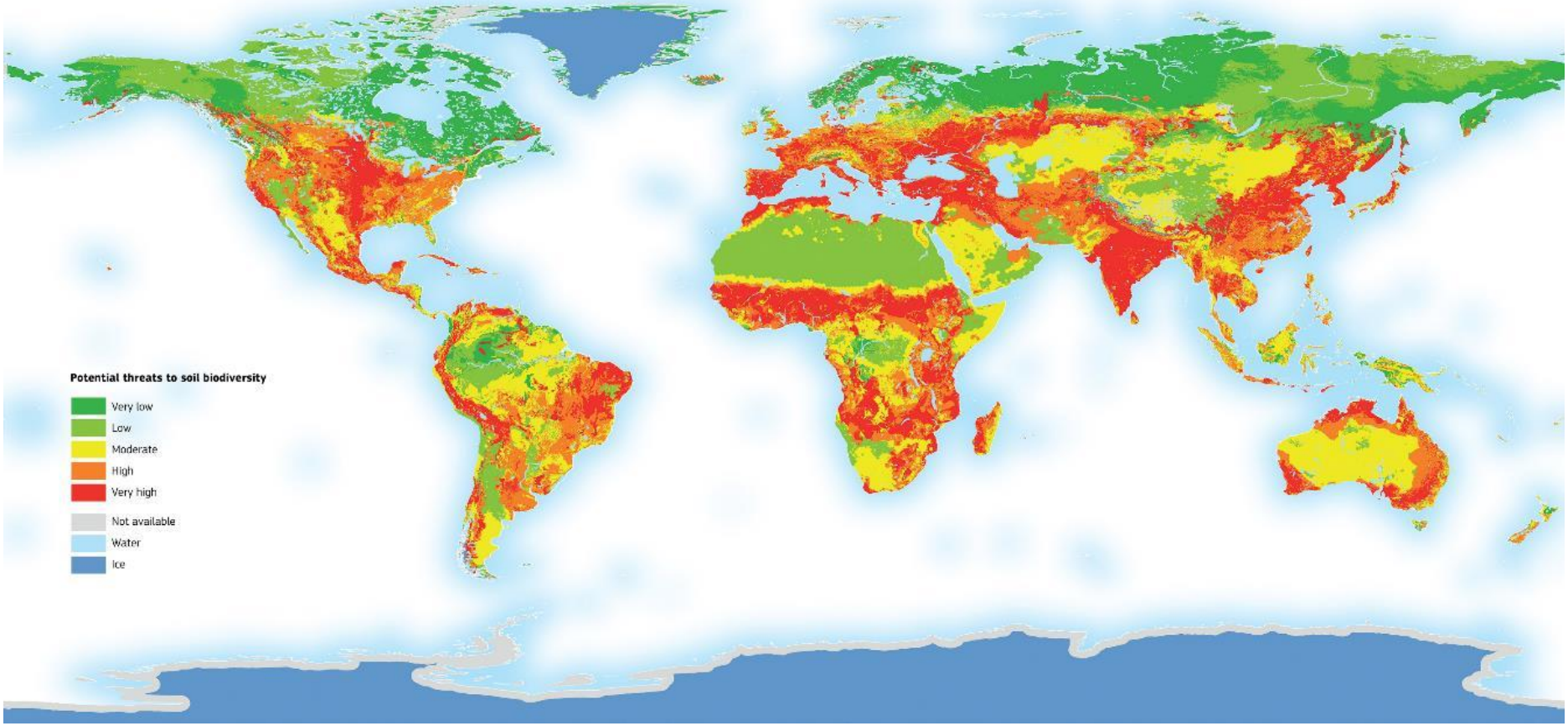
European Commission



Map of global distribution of soil biodiversity

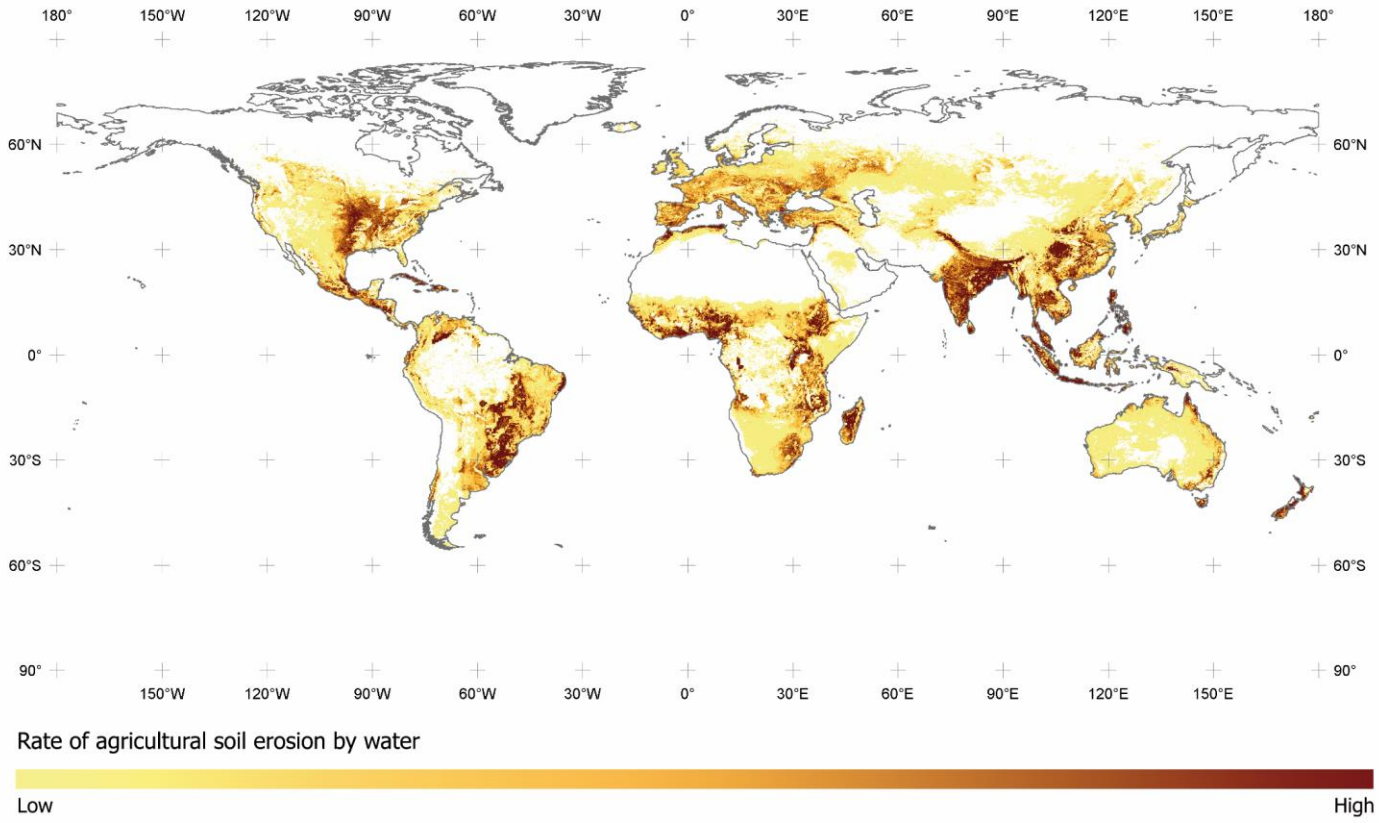


Map of potential threats to soil biodiversity



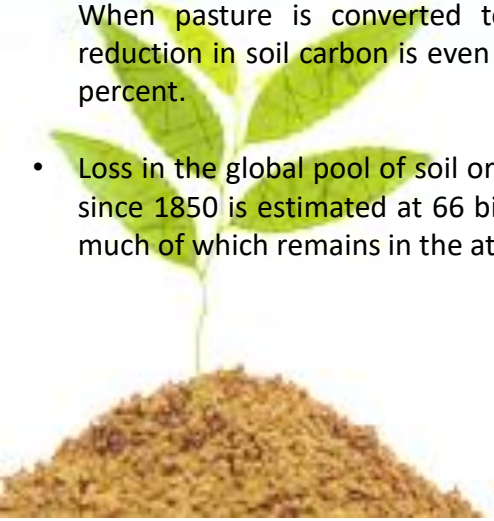
Erosion

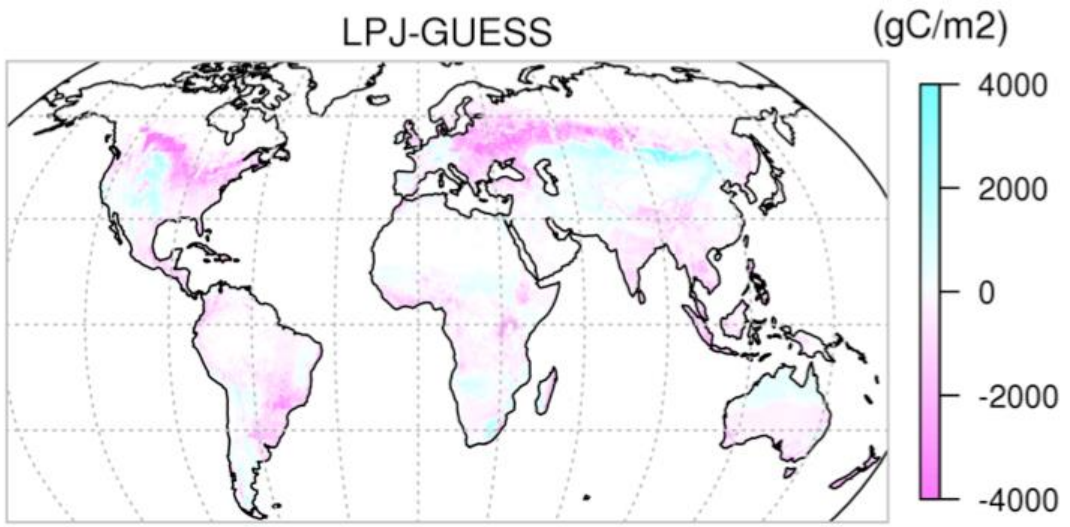
- Erosion is ranked as the most important threat to the soil in Africa, Asia, Latin America and the Caribbean, North America, and the Near East and North Africa.
- Annual crop losses due to erosion have been estimated at 0.3% of crop yields. If erosion continues at this rate, a total reduction of over 10 percent could take place by the year 2050.
- Erosion on croplands and intensively grazed land is 100 to 1,000 times the natural background rate.
- The annual cost of fertilizer to replace nutrients lost to erosion is US$110-US$200 billion.



Soil Organic Carbon (SOC) loss

- Soils contain nearly three times as much carbon as is stored in all terrestrial plants
- The primary driver of loss in soil organic carbon is land use change.
- When land is converted from native forest to crops, soil carbon decreases by 42 percent. When pasture is converted to crops the reduction in soil carbon is even greater – 59 percent.
- Loss in the global pool of soil organic carbon since 1850 is estimated at 66 billion tonnes, much of which remains in the atmosphere.



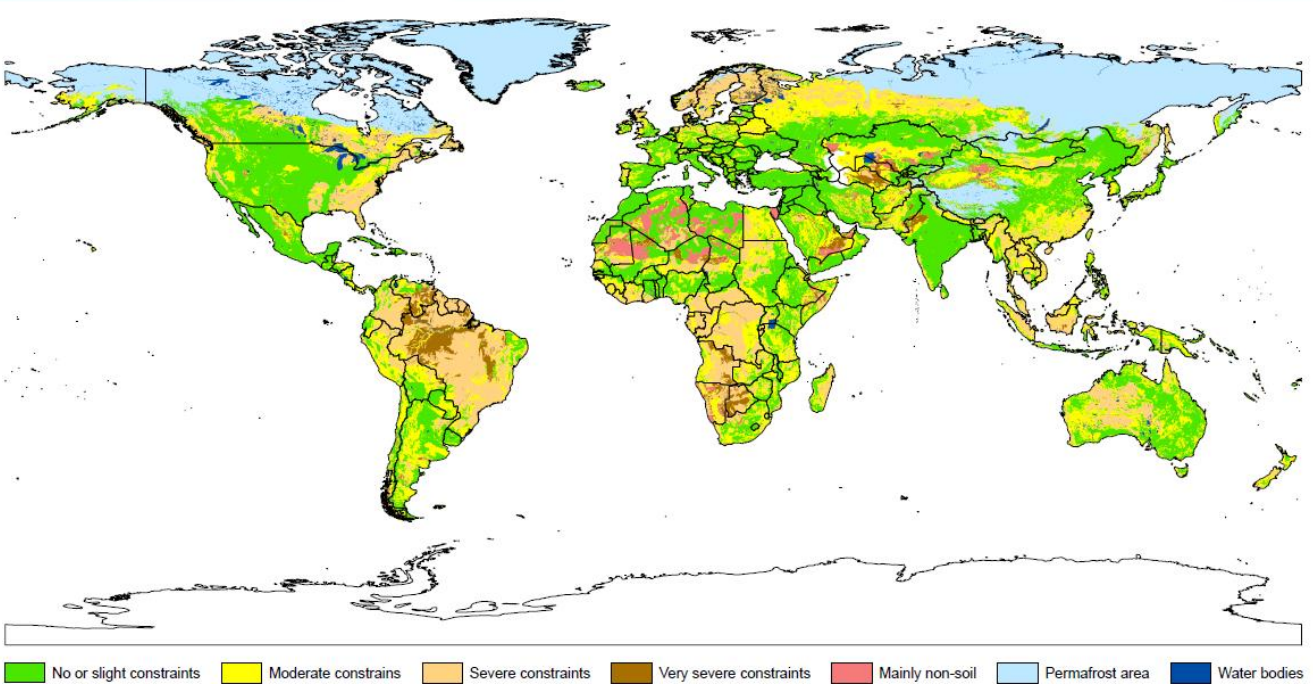


Map of change in soil carbon due to land use change and land management from 1860 to 2010 from three vegetation models.

Pink indicates loss of soil carbon, blue indicates carbon gain.

Nutrient imbalance

- The greatest obstacle to improving food production and soil function in many degraded landscapes is the lack of nutrients, especially nitrogen and phosphorus, and organic inputs.
- In Africa, all but three countries mine more nutrients from the soil every year than are returned through use of fertilizer, crop residues, manure, and other organic matter.
- In other areas, oversupply of nutrients contaminates soil and water resources and contributes to greenhouse gas emissions.
- In 2010, nitrogen oxide emissions from agricultural soils caused by the addition of synthetic fertilizers were the equivalent of 683 million tonnes of CO^2.



Nutrient availability in soils

Soil salinization

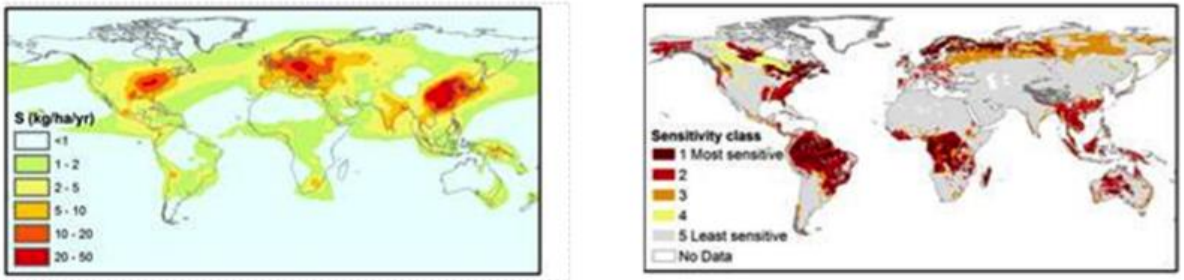
- An estimated 760,000 km^2 of land worldwide are affected by human-induced salinity – an area larger than all the arable land in Brazil.
- Ill-designed, large-scale irrigation projects are the main cause of human-made salinization.
- Increasing soil salinity takes an estimated 3,000 to 15,000 km^2 of irrigated cropland out of production every year and decreases the production potential of much more land.

Soil contamination

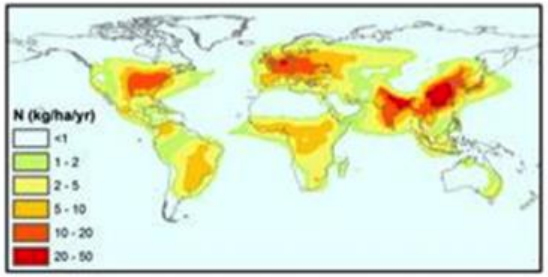
- Soil contamination damages food security, both because toxic levels of contaminants reduce crop yields and because crops that are produced can be unsafe to consume.
- Nearly a fifth of the farmland in China (19.4%) is contaminated with heavy metals.
- Over 130 million people worldwide routinely consume well-water with arsenic concentrations that exceed WHO recommendations
- More than 2.5 million potentially contaminated sites have been identified in Europe, of which 340,000 are expected to be contaminated.

a) Atmospheric sulphur deposition (2001)

b) Soil sensitivity to acidification



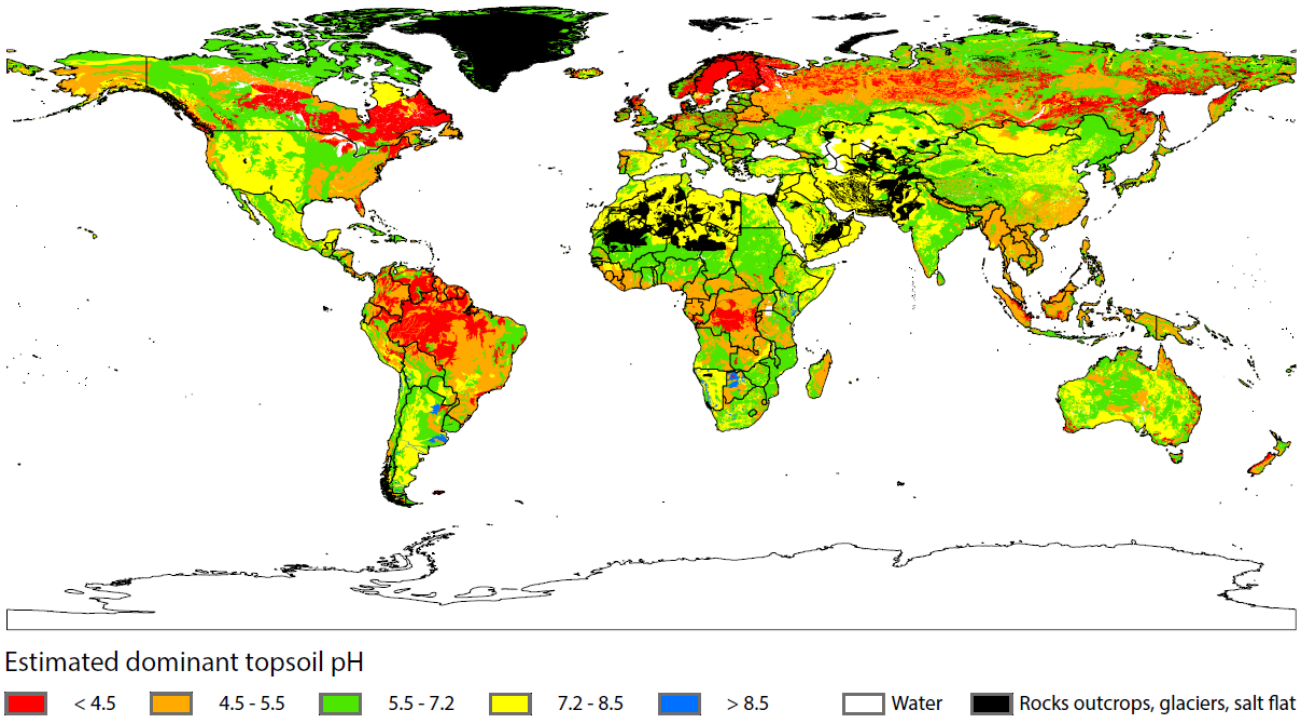
c) Atmospheric nitrogen deposition (2001)



Global distribution of (a) atmospheric S deposition, (b) soil sensitivity to acidification and (c) atmospheric N deposition.

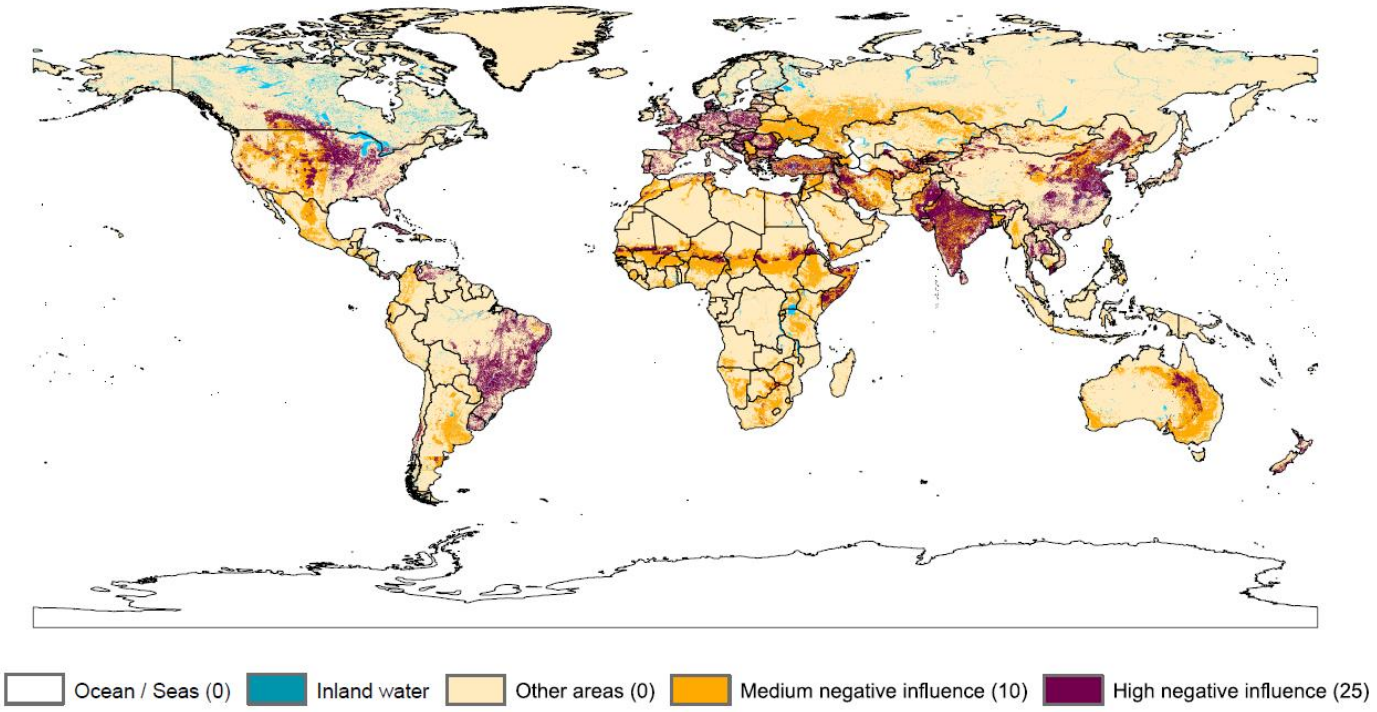
Soil acidification

- Around 30 percent of the topsoil and 75 percent of subsoil on the world's ice-free land is affected by acidity.
- The most acidic topsoils in the world are located in areas of South America that have experienced deforestation and intensive agriculture.
- The main causes of human-induced acidification are acid deposition (commonly called acid rain) and massive application of ammonium-based fertilizers.
- Use of high-nitrogen fertilizers and high rates of product removal increase soil acidity in intensive agricultural areas.



Soil compaction

- Soil compaction has degraded up to 330,000 km^2 in Europe.
- Worldwide compaction has degraded an estimated 680,000 km^2 of soil, or around 4% of the total land area.
- Soil compaction can reduce crop yields by as much as 60 percent.
- Cattle trampling and insufficient cover of top soil by natural vegetation or crops account for compaction of 280,000 km^2 in Africa and Asia.
- The damage caused by soil compaction is long-lasting or even permanent. A one-time compaction event can lead to reduced crop yields up to 12 years later.



Soil compaction risk derived from intensity of tractor use in crop land and from livestock density in grasslands.

Soil sealing

- Land take and soil sealing are regarded as the greatest threat to soil functions in Europe and Eurasia.
- Over 70% of the land take in the European Union between 1990 and 2000, and over half of the take between 2000 and 2006 consumed agricultural land.
- In 2000, urban areas covered 657,000 km^2, equivalent to almost 4% of the arable land on the planet.
- Between 1990 and 2006, the total extent of urban area worldwide increased by 58,000 km^2.

European Commission

EN

Guidelines on best practice to limit, mitigate or compensate soil sealing

Environment

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Ce lo dice l'Europa…

- L'obiettivo dell'azzeramento del consumo di suolo è stato definito a livello europeo già con la **Strategia tematica per la protezione del suolo** del 2006, che ha sottolineato la necessità di porre in essere buone pratiche per ridurre gli effetti negativi del consumo di suolo e, in particolare, della sua forma più evidente e irreversibile: l'impermeabilizzazione (*soil sealing*).
- Questo obiettivo generale è stato ulteriormente richiamato nel 2011, con la **Tabella di marcia verso un'Europa efficiente nell'impiego delle risorse**, nella quale si propone il traguardo di un incremento dell'occupazione **netta** di terreno pari a zero da raggiungere, in Europa, entro il 2050.
- L'obiettivo è stato rafforzato nel 2014 dal Parlamento Europeo con l'approvazione del **Settimo Programma di Azione Ambientale**.
- La Commissione ha ritenuto utile anche indicare le priorità di azione e le modalità per raggiungere tale obiettivo e, nel 2012, ha pubblicato le **linee guida per limitare, mitigare e compensare l'impermeabilizzazione del suolo**.

1. Commissione Europea (2006) Strategia tematica per la protezione del suolo, COM(2006) 231 (http://ec.europa.eu/environment/soil/three_en.htm)
2. Commissione Europea (2011) Tabella di marcia verso un'Europa efficiente nell'impiego delle risorse, COM(2011) 571 (http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm)
3. Council and European Parliament (2013) Decision of the European Parliament and of the Council on a General Union Environment Action Programme to 2020 "Living Well, within the Limits of our Planet" (http://ec.europa.eu/environment/newprg/index.htm)
4. Commissione Europea (2012) Guidelines on best practice to limit, mitigate or compensate soil sealing SWD (2012) 101 (http://ec.europa.eu/environment/soil/pdf/guidelines/IT%20-%20Sealing%20Guidelines.pdf)

Una giornata per il SUOLO #SoilDay 2016

Consumo di suolo (*una* definizione)

Variazione da una copertura non artificiale a una copertura artificiale del suolo

- Per *copertura del suolo (Land Cover)* si intende la copertura biofisica della superficie terrestre, comprese le superfici artificiali, le zone agricole, i boschi e le foreste, le aree seminaturali, le zone umide, i corpi idrici, come definita dalla direttiva 2007/2/CE.
- L'*impermeabilizzazione del suolo*, ovvero la copertura permanente di parte del terreno e del relativo suolo con materiali artificiali (quali asfalto o calcestruzzo) per la costruzione, ad esempio, di edifici e strade, costituisce la forma più evidente e più diffusa di copertura artificiale. Solo una parte dell'area di insediamento è davvero impermeabilizzata, poiché giardini, parchi urbani e altri spazi verdi non devono essere considerati (Commissione Europea, 2013). Altre forme di copertura artificiale del suolo vanno dalla perdita totale della "risorsa suolo" attraverso l'asportazione per escavazione (comprese le attività estrattive a cielo aperto), alla perdita parziale, più o meno rimediabile, della funzionalità della risorsa a causa di fenomeni quali la compattazione.
- L'*uso del suolo (Land Use)* è, invece, un riflesso delle interazioni tra l'uomo e la copertura del suolo e costituisce quindi una descrizione di come il suolo venga impiegato in attività antropiche. La direttiva 2007/2/CE lo definisce come una classificazione del territorio in base alla dimensione funzionale o alla destinazione socioeconomica presenti e programmate per il futuro (ad esempio: residenziale, industriale, commerciale, agricolo, silvicolo, ricreativo). Un cambio di uso del suolo (e ancora meno un cambio di destinazione d'uso del suolo previsto da uno strumento urbanistico) potrebbe non avere alcun effetto sullo stato reale del suolo, che potrebbe mantenere intatte le sue funzioni e le sue capacità di fornire servizi ecosistemici.

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LAND COVER
LAND USE
LAND TAKE
SOIL CONSUMPTION
SOIL SEALING

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DIRETTIVA INSPIRE (2007/2/EC) LAND USE_LAND COVER

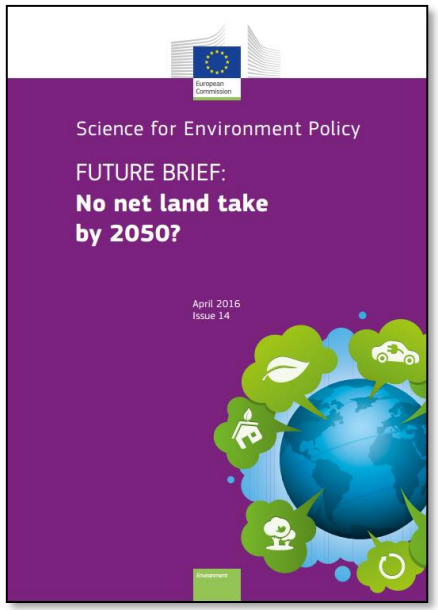
LAND USE

Territory characterized according to its *current* and *future planned* functional dimension or socio–economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational).

ELU: Existing land use (Current Land Use)
PLU: Planned land use (Future Planned Land Use)

LAND COVER

Physical and biological cover of the earth's surface including artificial (semi-)natural areas, wetlands, water bodies



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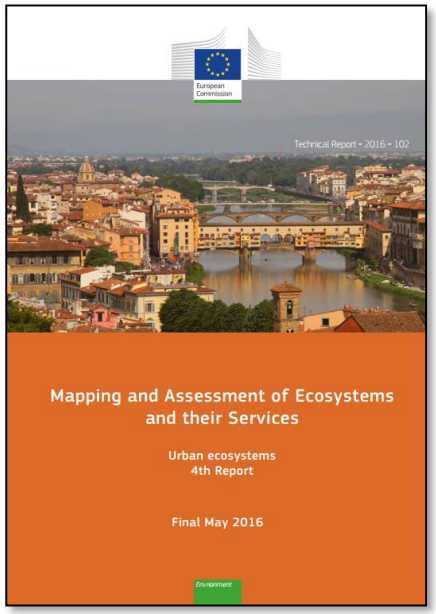
- *"What does 'no net land take' mean? Sealing agricultural land and open spaces should be avoided as far as possible and the focus should be on building on land that has already been sealed"* (Commissione Europea, 2016)
- *"Land take includes the development of scattered settlements in rural areas and the conversion of land within an urban area (densification)"* (Commissione Europea, 2012)
- *"The aim is to raise awareness about the value of land as a resource for crucial ecosystem services"* (Commissione Europea, 2016)



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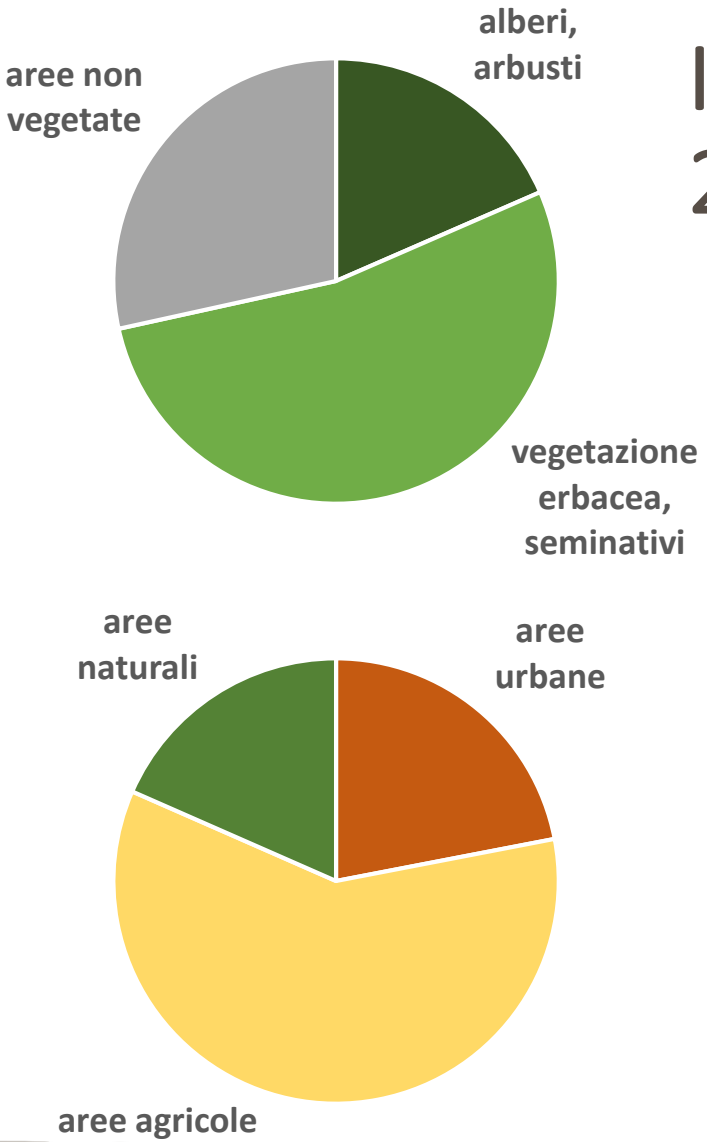
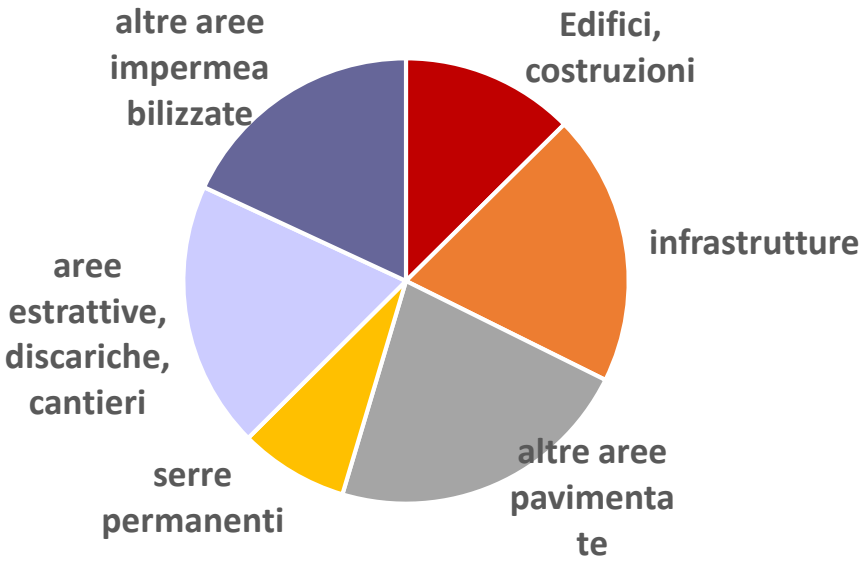
Il consumo di suolo tra il 2008 e il 2013 in Italia





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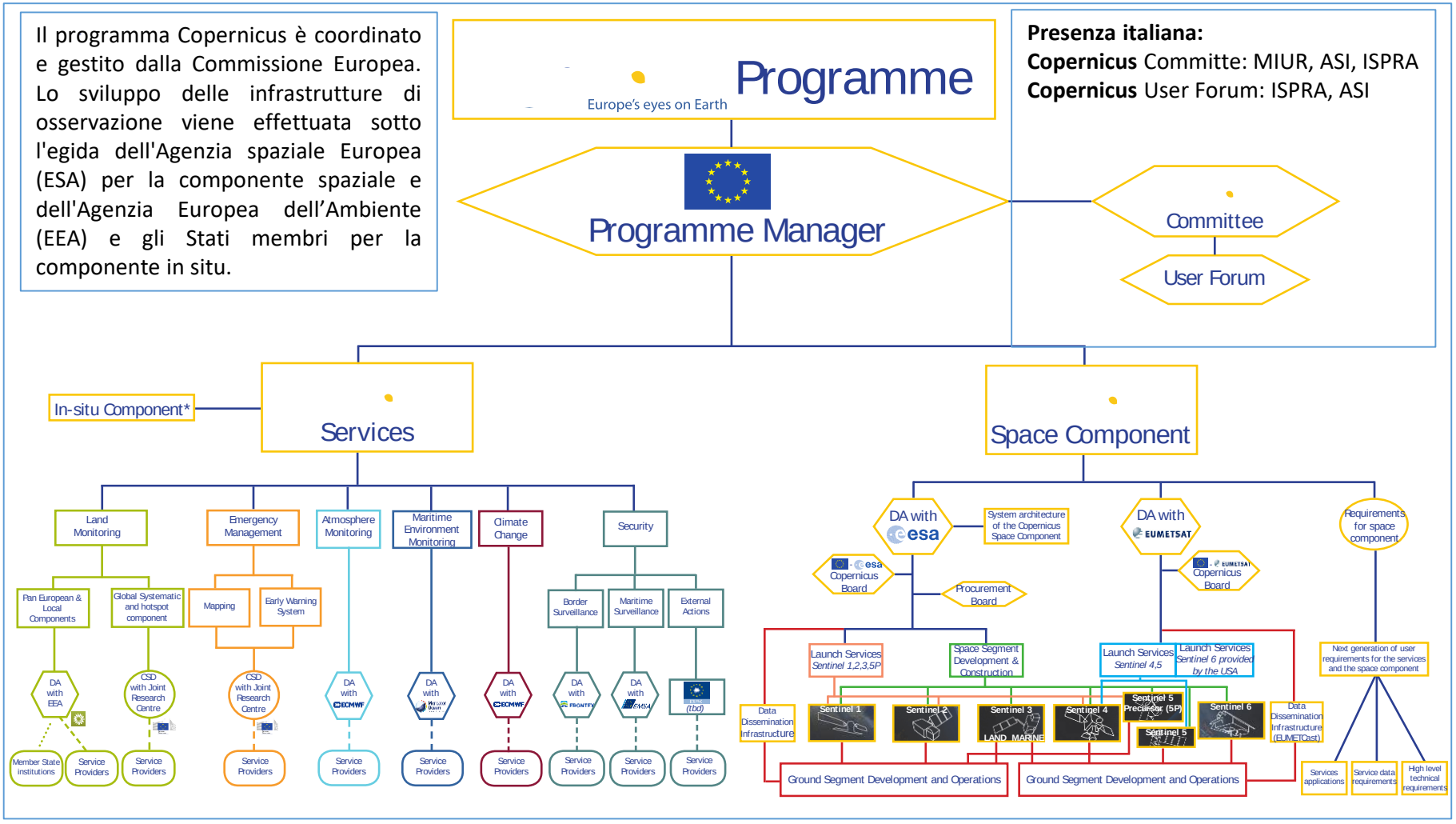
Monitoraggio del territorio in Europa

- Copernicus (Land Monitoring)
- Lucas (Land Use and Coverage Area frame Survey)

European Environment Agency

eurostat

Il programma Copernicus è coordinato e gestito dalla Commissione Europea. Lo sviluppo delle infrastrutture di osservazione viene effettuata sotto l'egida dell'Agenzia spaziale Europea (ESA) per la componente spaziale e dell'Agenzia Europea dell'Ambiente (EEA) e gli Stati membri per la componente in situ.



Presenza italiana:
Copernicus Committe: MIUR, ASI, ISPRA
Copernicus User Forum: ISPRA, ASI

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Evolution of GMES/Copernicus Land Products and Services

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Global Monitoring for Environment and Security → geoland2 → GMES.info Because we need to know → Copernicus The European Earth Observation Programme

GMES "FAST TRACK" Services	Core Mapping Services: Euroland	GIO Land Components	Copernicus Land Monitoring Services
• Land cover and land use mapping at European scale; • More detailed land cover and land use mapping of urban and Natura2000 zones; • Delivery of a pan-European digital elevation model.	• Continental component; • Local component (information on specific areas of interest).	• Global component; • Pan-European land cover, land cover change and land cover characteristics; • Local component (information on specific areas of interest); • In-situ data.	• Global component; • Pan-European land cover, land cover change and land cover characteristics; • Local component (information on specific areas of interest); • In-situ data.
Products: • Degree of soil sealing, 2006	Products: • Corine Land Cover 2006 • Degree of soil sealing, 2009 • HRLs on demonstration sites • Urban Atlas on demonstration sites	Products: • Bio-geophysical products (NDVI, LAI, etc.) • Urban Atlas for 305 Large Urban Zones	Products: • The Digital Elevation Model over Europe • Sentinel 1 images In production: • Corine Land Cover 2012 • HRLs 2012 • Sentinels images

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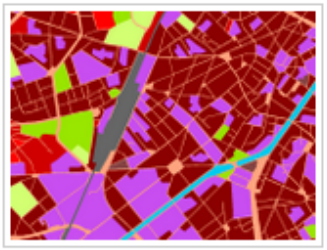
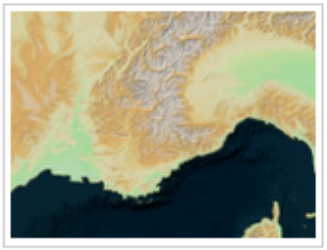
Copernicus Land Monitoring Services

Copernicus

Copernicus - The European Earth Observation Programme

Print



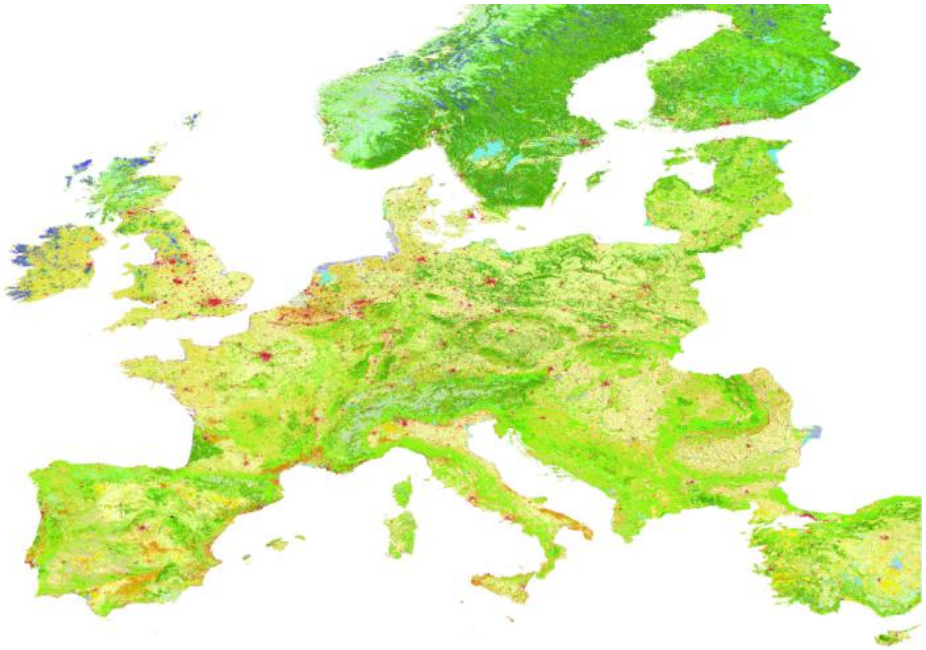



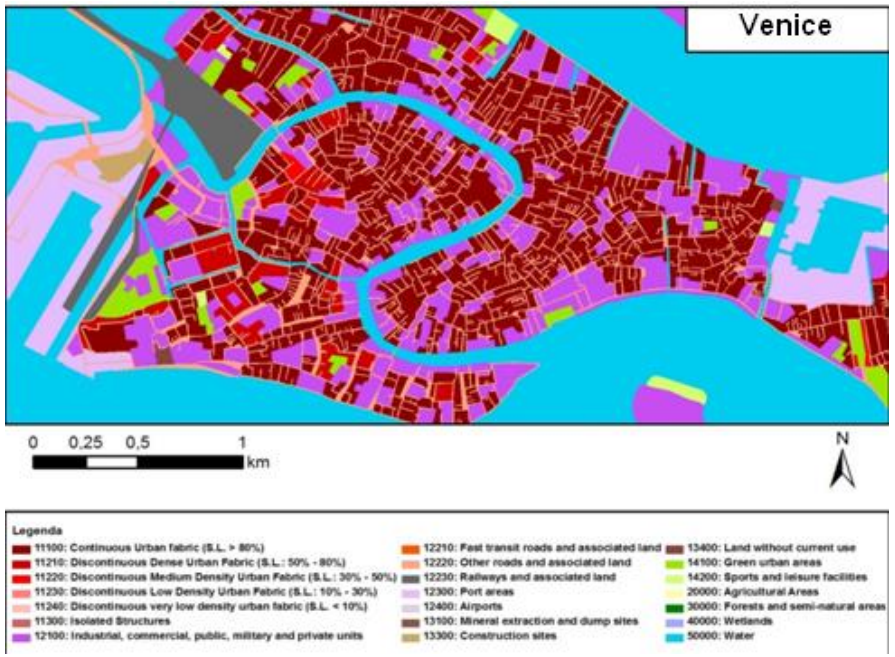
Copernicus is a European system for monitoring the Earth. Data is collected by different sources, including Earth observation satellites and in-situ sensors. The data is processed and provides reliable and up-to-date information about six thematic areas: land, marine, atmosphere, climate change, emergency management and security. The *land* theme is divided into four main components:

1. Global. The Global Land Service provides a series of bio-geophysical products on the status and evolution of the land surface at global scale at mid and low spatial resolution. The products are used to monitor the vegetation, the water cycle and the energy budget.
2. Pan-European. The pan-European component provides information about the land cover and land use (LC/LU), land cover and land use changes and land cover characteristics. The latter includes information about imperviousness, forests, natural grasslands, wetlands, and permanent water bodies.
3. Local. The local component focuses on different *hotspots*, i.e. areas that are prone to specific environmental challenges and problems. This includes detailed LC/LU information for the larger EU cities (Urban Atlas), riparian zones along European river networks and NATURA 2000 sites. It will also include maps of coastal areas.
4. In-situ. All of the Copernicus services need access to in-situ data in order to ensure an efficient and effective use of Copernicus space-borne data. Next to data provided by participating countries, Earth observation from space also yields pan-European reference datasets, such as a Digital Elevation Model.

CORINE Land Cover e Urban Atlas

- CORINE Land Cover: 38 Paesi Europei (risoluzione 25 ha)
- Urban Atlas: Larger Urban Zones (risoluzione 0,25 ha)





High Resolution Layers

- Degree of Imperviousness (2006, 2009, 2012)
- Tree Cover Density and Forest Type (2012)
- Permanent grassland (2012)
- Wetlands (2012)
- Permanent Water bodies (2012)

Il monitoraggio del territorio e del consumo di suolo

Sistema Nazionale per la Protezione dell'Ambiente

L. 132/2016

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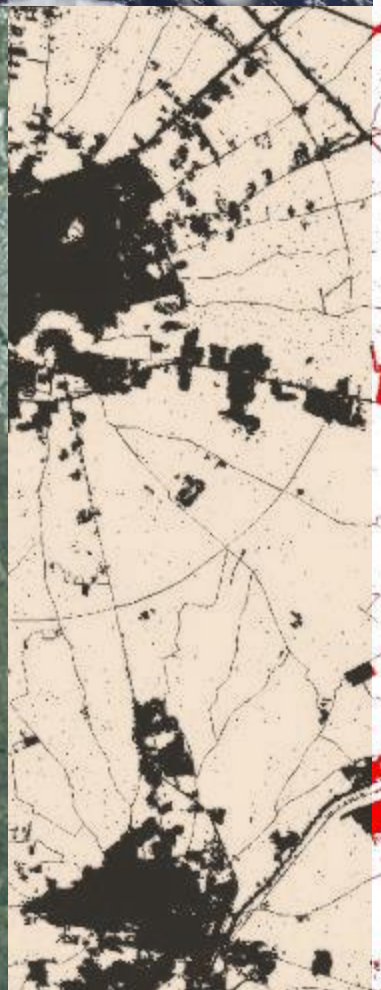
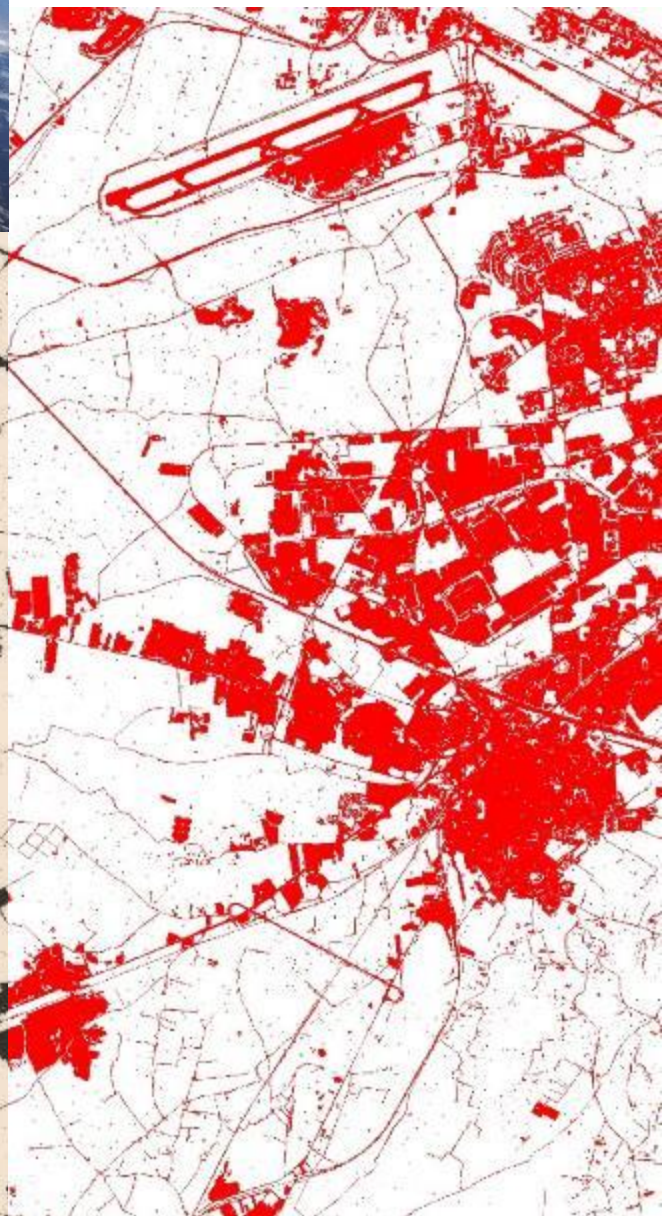


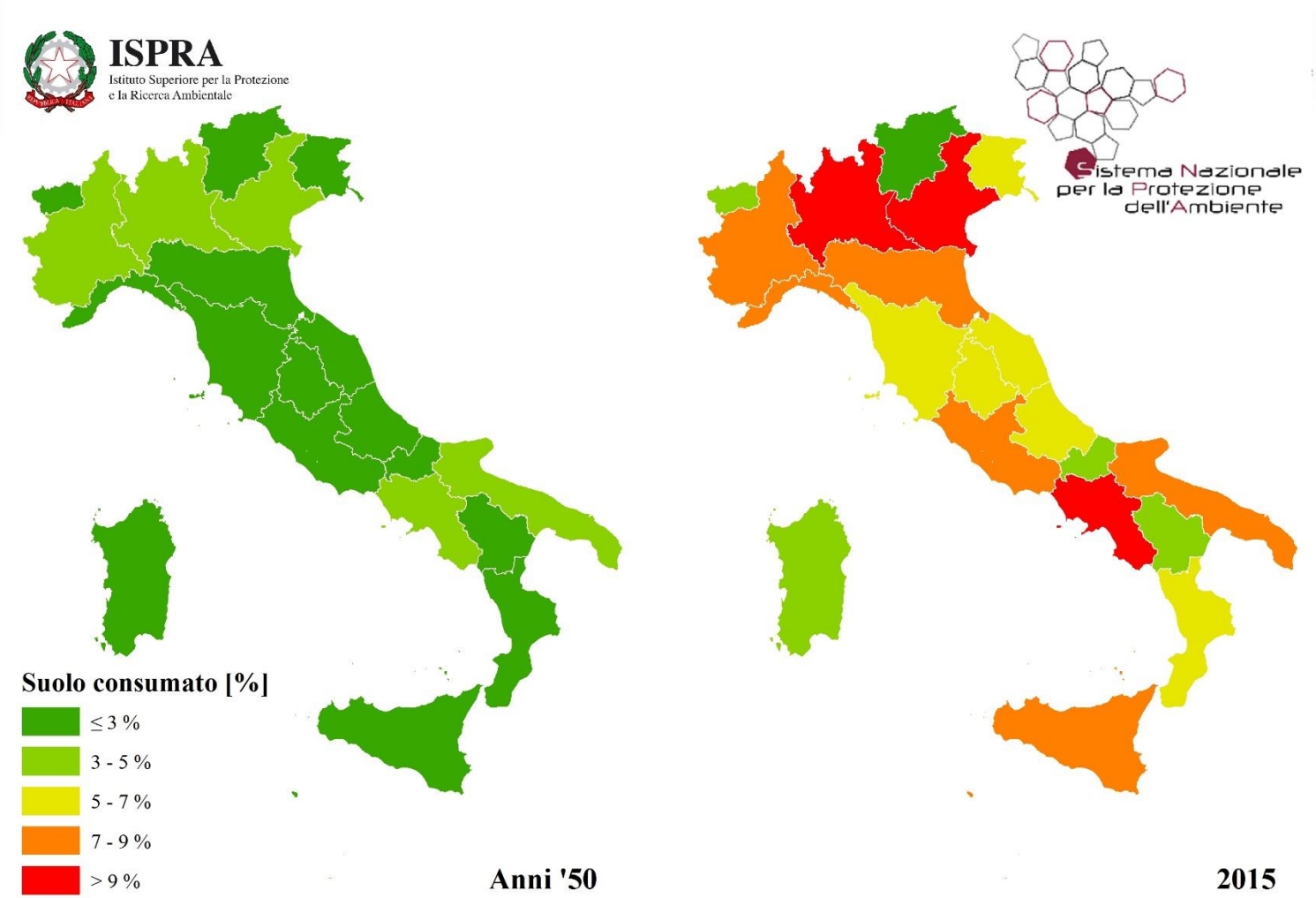


Copernicus EU map

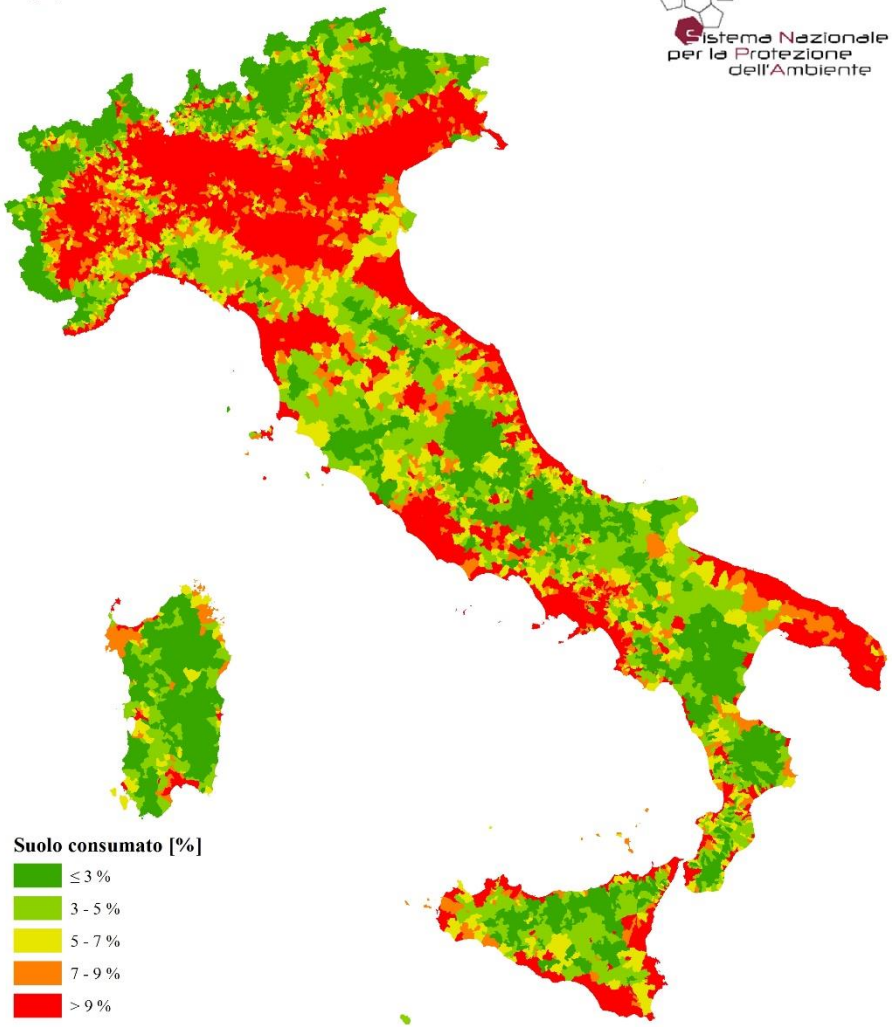
National map (ISPRA)

Copernicus

Il consumo in Italia



- 21.100 km^2 (2015)
- 7% (era il 2,7% negli anni ‘50)

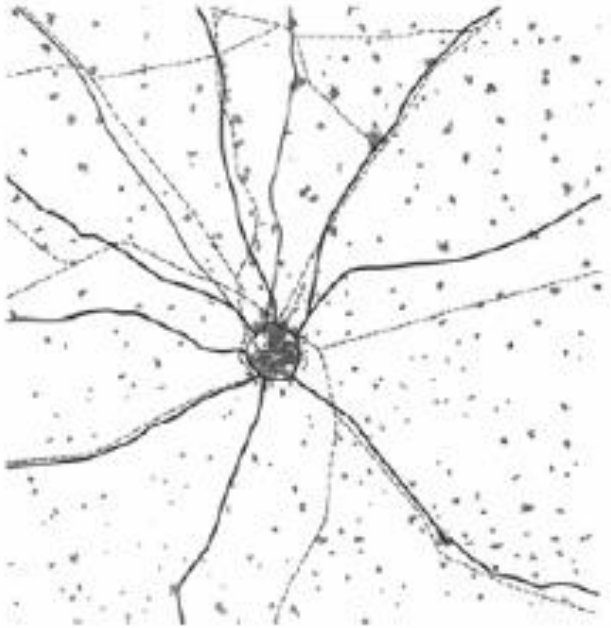


Dove?

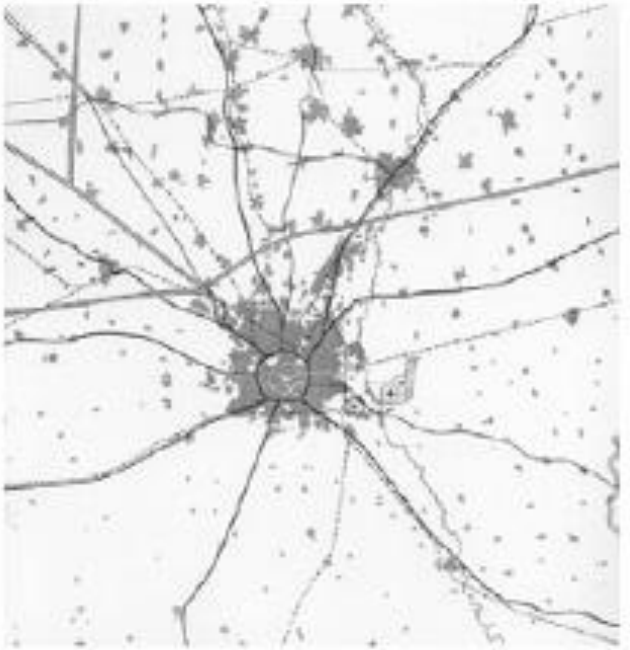
- 5.000 km^2 nelle città metropolitane (2015)
  - 700 km^2 a Roma
  - 400 km^2 a Napoli
- Il 60% avviene in aree agricole
- Lungo le coste
  - 21,9% entro i 300 m (quasi il 50% in Liguria)
  - 19,3% entro 1 km

(Eurostat, 2015)

- 3% in aree a pericolosità da frana molto elevata o elevata
- 10,5% in aree a pericolosità idraulica (quasi il 30% in Liguria)
- 7,2% in aree a pericolosità sismica alta
- 7,2% nella fascia a distanza di 150 metri dai corsi d'acqua

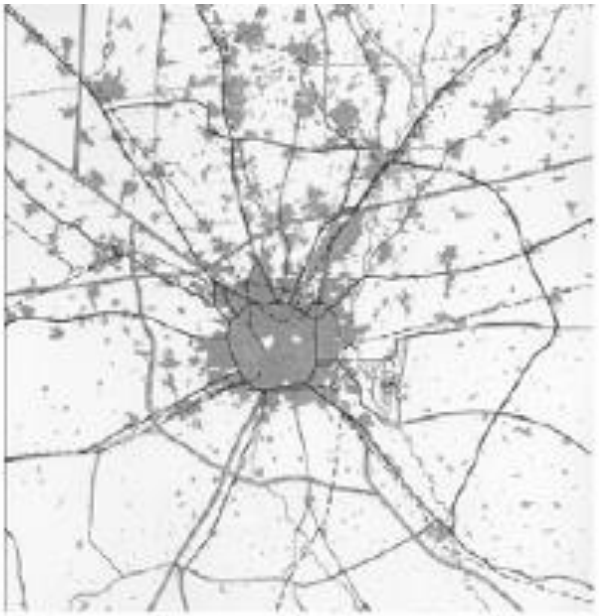


Il territorio urbanizzato al 1888 (fonte: IGM)

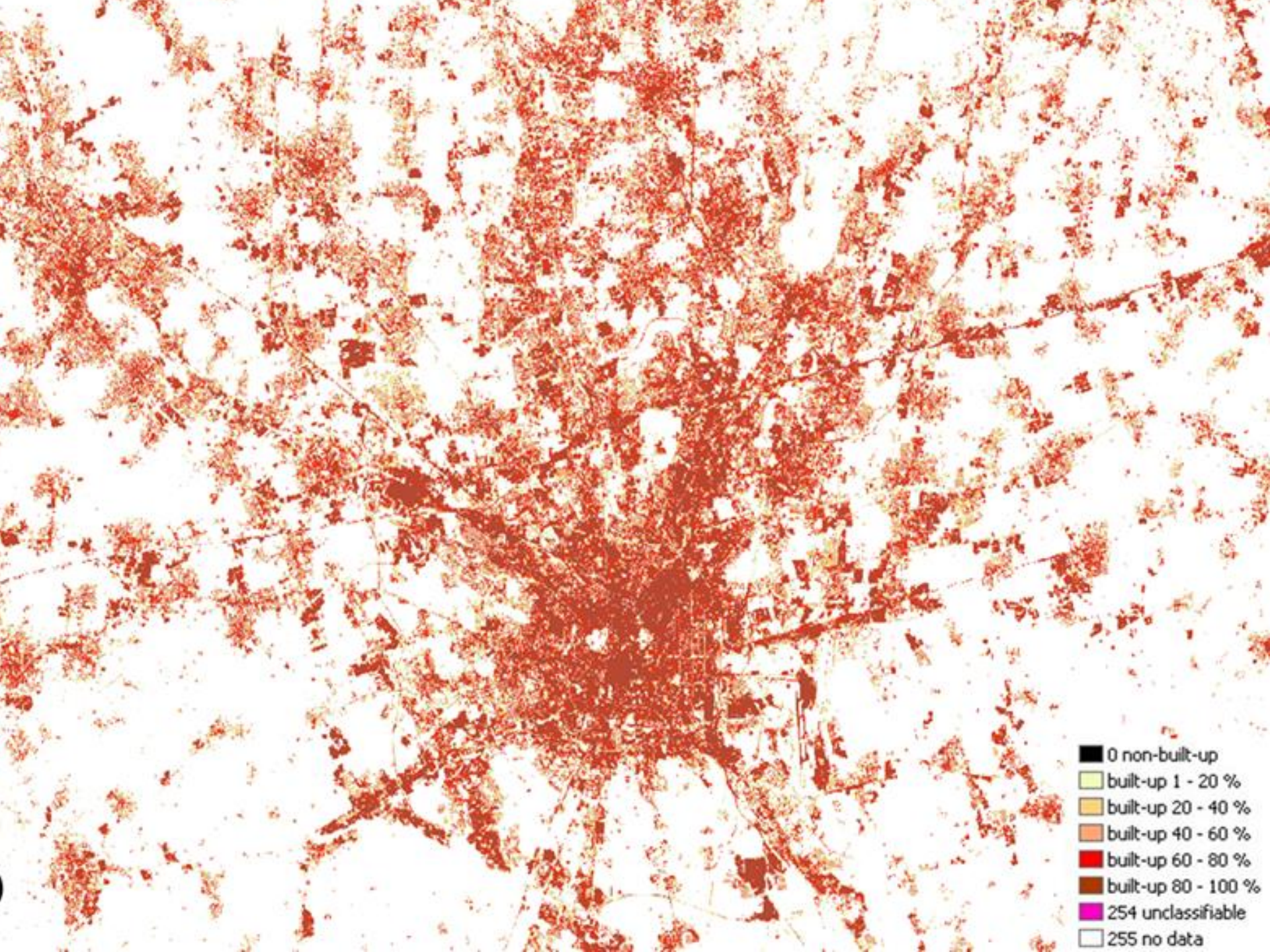


Il territorio urbanizzato al 1936 (fonte: IGM)

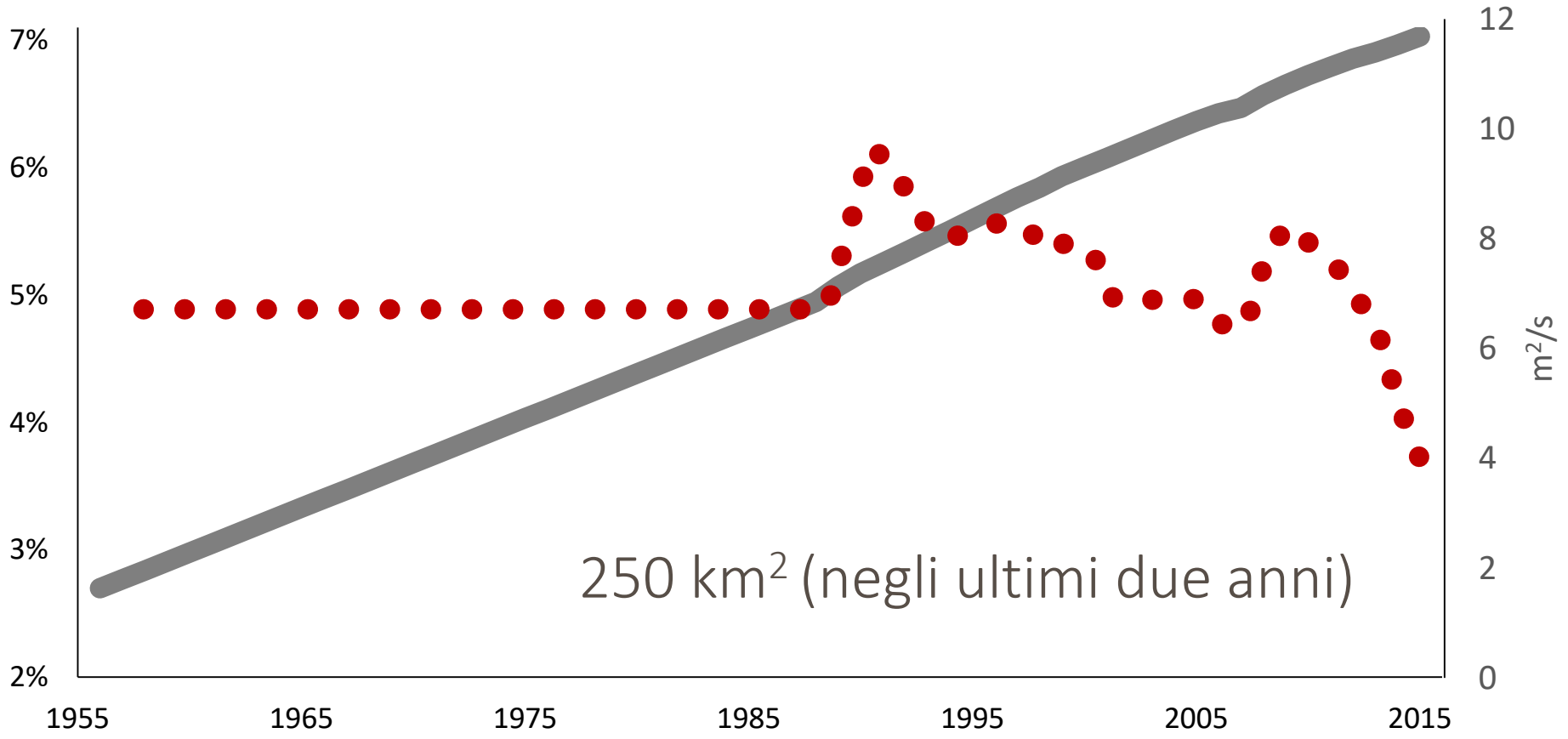
Il territorio urbanizzato (Milano)



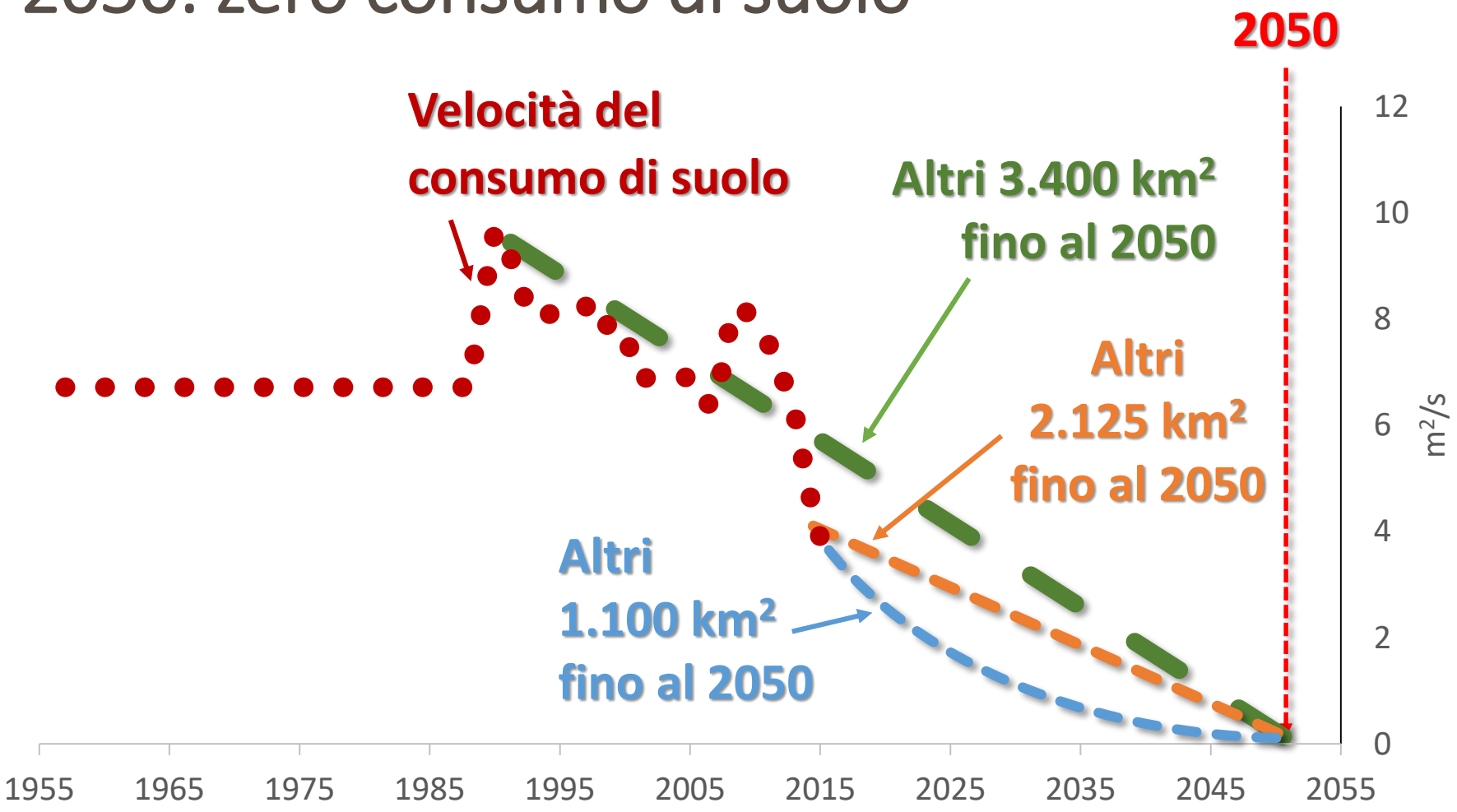
Il territorio urbanizzato al 1963 (fonte: IGM)

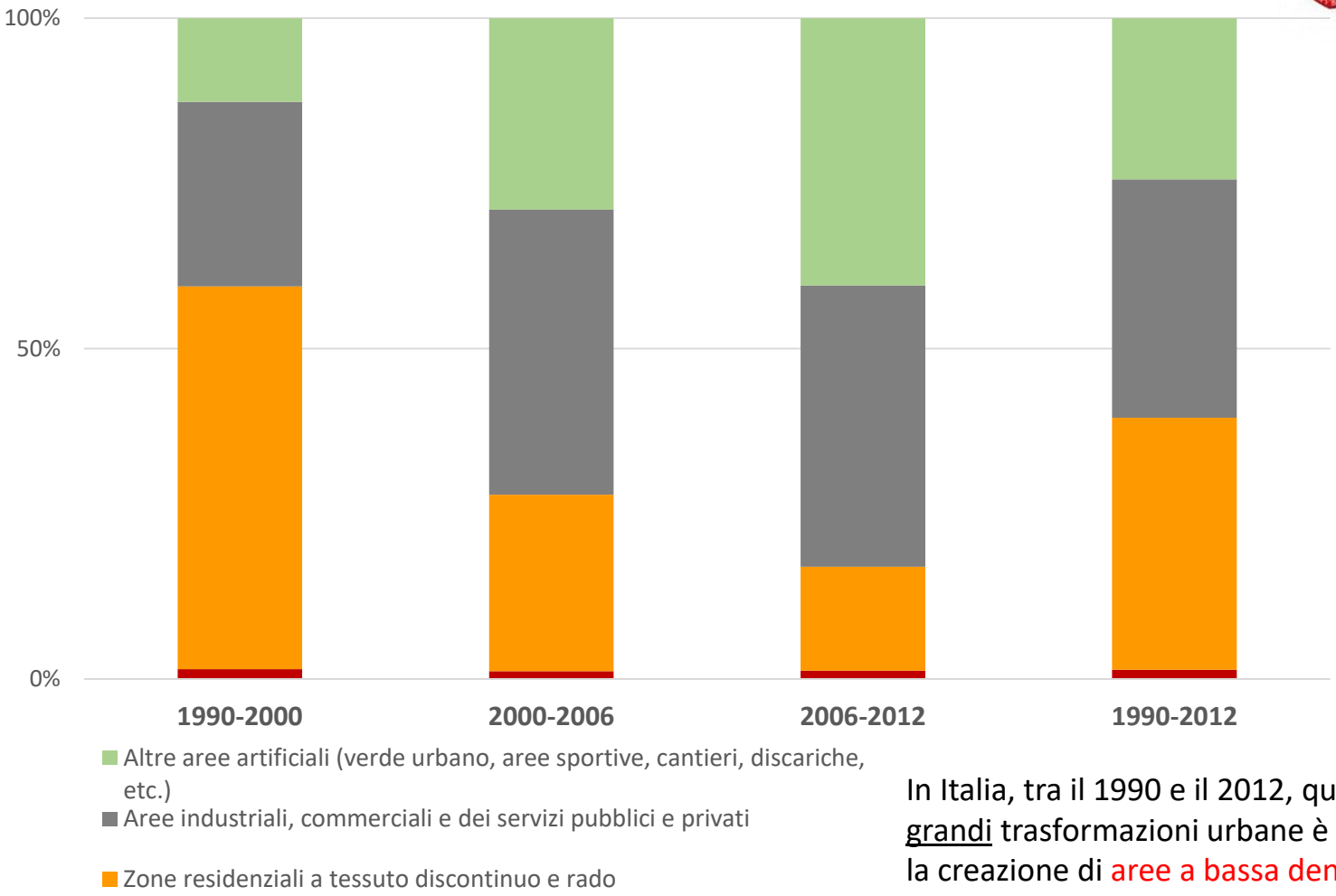

0 non-built-up
built-up 1 - 20 %
built-up 20 - 40 %
built-up 40 - 60 %
built-up 60 - 80 %
built-up 80 - 100 %
254 unclassifiable
255 no data

La velocità del consumo



2050: zero consumo di suolo





In Italia, tra il 1990 e il 2012, quasi il 40% delle grandi trasformazioni urbane è avvenuto attraverso la creazione di aree a bassa densità, mentre più di un terzo è avvenuto con la realizzazione di nuovi poli commerciali, industriali e terziari.

Le aree compatte ad alta densità rappresentano meno dell'1% delle nuove aree urbane.

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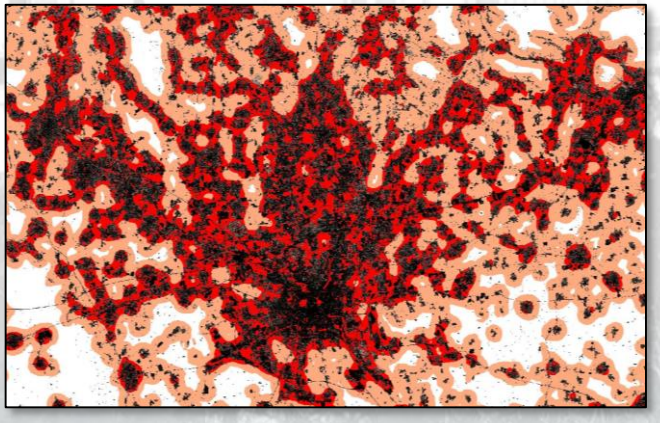
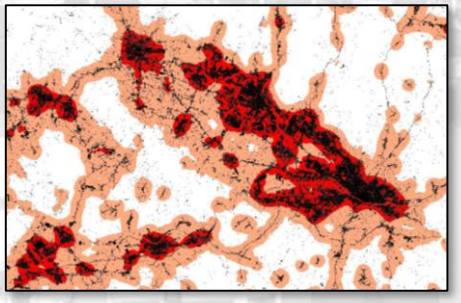
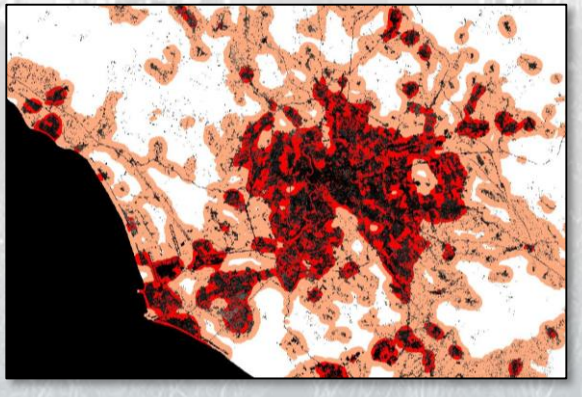
Milano

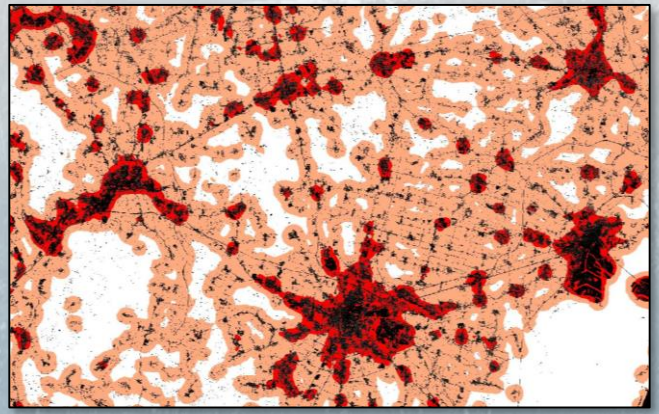


Firenze



Roma





Padova

Legenda

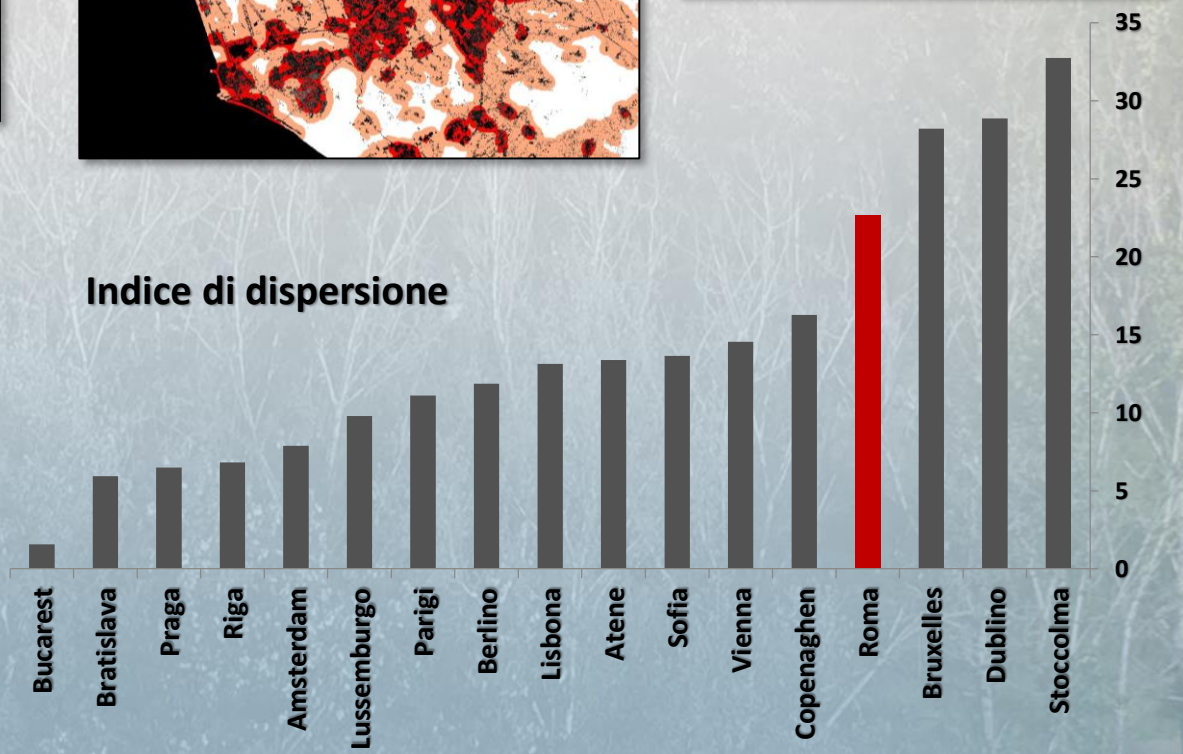
- aree ad alta densità (rosso);
- aree a bassa densità (rosa);
- aree in prevalenza naturali o seminaturali (bianco).

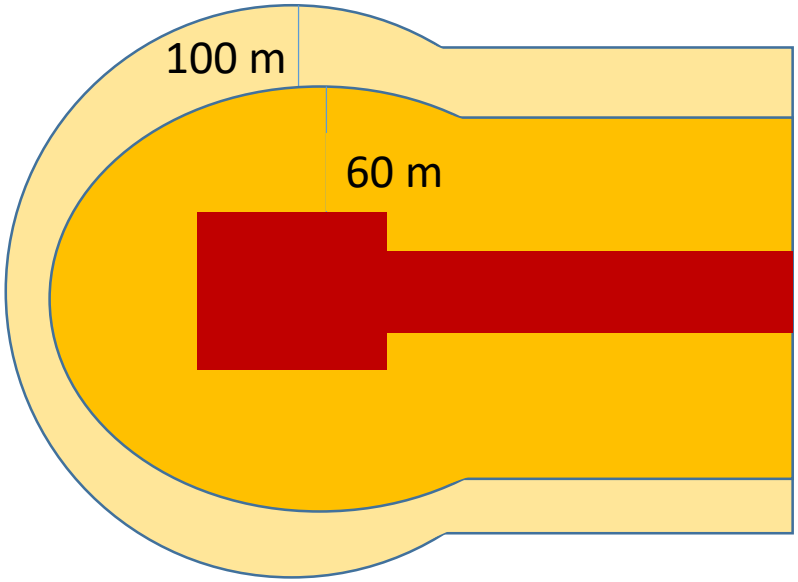
* * *

Indice di dispersione (ESPON, 2011):

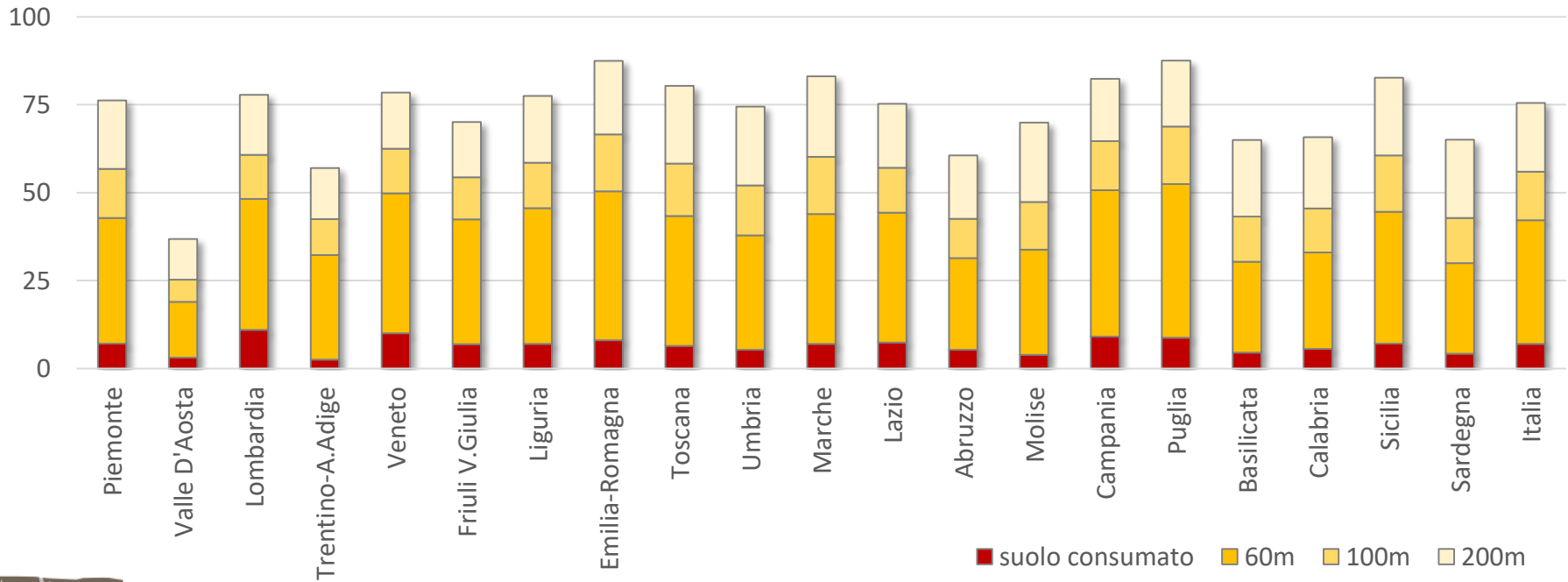
Calcolato come rapporto tra la superficie complessiva delle aree a bassa densità e la superficie sommatoria delle aree edificate a bassa e ad alta densità ricadenti all'interno dei limiti comunali.

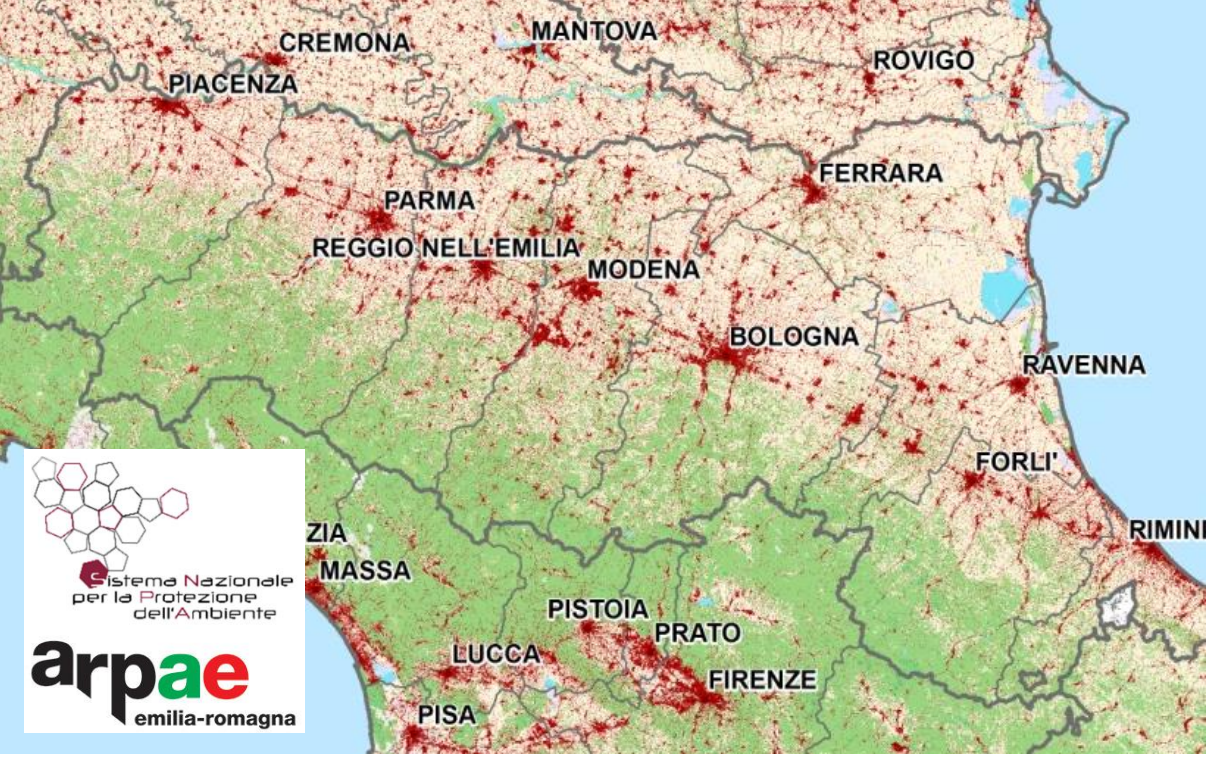
Indice di dispersione





Impatto del consumo di suolo





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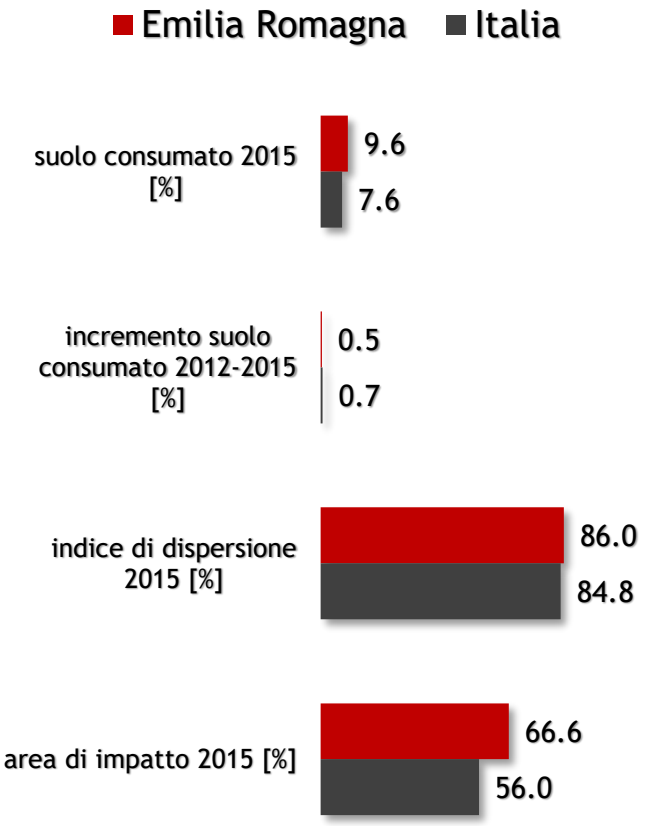
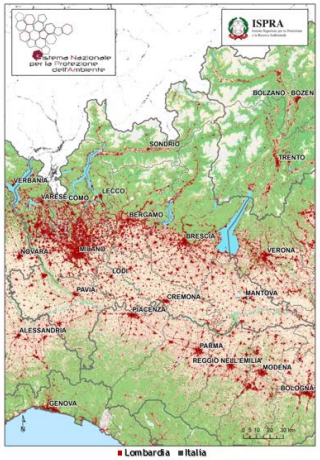
Sistema Nazionale per la Protezione dell'Ambiente
arpae emilia-romagna

Provincia	% 2015	km² 2015	Incremento % 2012-2015
Rimini	**12,9**	112	0,3
Reggio nell'Emilia	**12,1**	277	0,2
Modena	**11,5**	310	0,6
Ravenna	**10,2**	189	0,9
Parma	**9,3**	321	0,3
Piacenza	**9,0**	234	0,3
Bologna	**9,0**	332	0,7
Forlì-Cesena	**7,6**	182	0,5
Ferrara	**7,5**	198	0,7



Una giornata per il SUOLO #SoilDay 2016



Lombardia

Comuni con una % di consumo di suolo maggiore

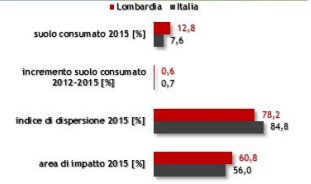
Comune	% 2015	km² 2015	Incremento % 2012-2015
Lissone	**71,3**	7	0,0
Sesto San Giovanni	**66,7**	8	0,0
Cusano Milanino	**64,6**	2	0,0

Comuni con una superficie di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Milano	57,2	**104**	0,7
Brescia	44,5	**40**	0,4
Cremona	28,7	**20**	0,2

Comuni con un incremento % di consumo di suolo maggiore

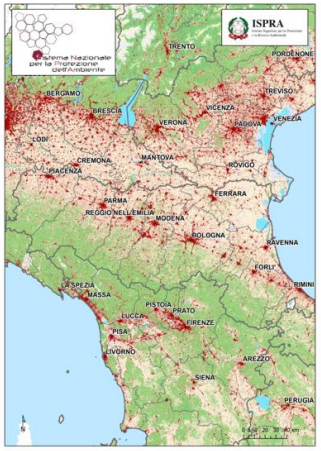
Comune	% 2015	km² 2015	Incremento % 2012-2015
Vizzolo Predabissi	27,8	2	**35,1**
Gambarana	4,3	1	**24,6**
Merlino	13,3	1	**18,9**



La Lombardia si conferma, per caratteristiche territoriali e densità di popolazione, produttiva e infrastrutturale, la regione italiana con la percentuale più alta di suolo consumato. L'incremento relativo di consumo di suolo nel periodo considerato risulta comunque leggermente inferiore alla media nazionale [1]. Le province lombarde con le percentuali di consumo di suolo maggiore risultano essere quelle maggiormente popolate e con la maggiore densità di insediamenti

Provincia	% 2015	km² 2015	Incremento % 2012-2015
Monza e della Brianza	**40,7**	165	0,5
Milano	**31,7**	500	1,2
Varese	**22,0**	264	0,3
Como	**13,0**	167	0,8
Bergamo	**12,7**	348	0,6
Lecco	**12,7**	103	0,2
Lodi	**12,6**	99	1,3
Brescia	**11,4**	547	0,5
Mantova	**11,2**	263	0,3
Cremona	**11,2**	199	0,6
Pavia	**10,2**	303	0,4
Sondrio	**3,2**	103	0,4

[1] In questa valutazione va considerato che il periodo di riferimento "2012-2015" può variare da regione a regione: per la Lombardia è leggermente più lungo rispetto alla media, poiché la cartografia "2012" è in diverse zone basata su immagini satellitari del 2011.



Emilia Romagna

Comuni con una % di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Cattolica	**60,0**	4	0,0
Riccione	**49,3**	9	0,0
Gambettola	**36,2**	3	0,6

Comuni con una superficie di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Ravenna	10,5	**69**	1,0
Parma	23,4	**61**	0,5
Ferrara	13,2	**53**	0,4

Comuni con un incremento % di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Voghiera	7,6	3	**2,7**
San Felice sul Panaro	13,0	7	**2,4**
Mirandola	9,7	13	**2,3**

Provincia	% 2015	km² 2015	Incremento % 2012-2015
	12,9	112	0,3
nell'Emilia	**12,1**	277	0,2
	11,5	310	0,6
	10,2	189	0,9
	9,3	321	0,3
za	**9,0**	234	0,3
	9,0	332	0,7
esena	**7,6**	182	0,5
	7,5	198	0,7

Toscana

Comuni con una % di consumo di suolo maggiore

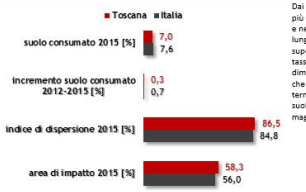
Comune	% 2015	km² 2015	Incremento % 2012-2015
Forte dei Marmi	**47,3**	4	0,1
Viareggio	**41,7**	14	0,0
Firenze	**41,7**	43	0,2

Comuni con una superficie di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Firenze	41,7	**43**	0,2
Arezzo	9,3	**36**	0,1
Prato	33,2	**32**	0,3

Comuni con un incremento % di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Civitella Paganico	3,2	6	**5,8**
Monticiano	3,4	4	**5,2**
Barberino di Mugello	6,3	8	**2,6**



Provincia	% 2015	km² 2015	Incremento % 2012-2015
Prato	**15,0**	55	0,3
Pistoia	**11,5**	111	0,2
Livorno	**10,7**	130	0,3
Lucca	**10,0**	177	0,1
Firenze	**8,2**	290	0,4
Massa Carrara	**8,0**	92	0,0
Pisa	**7,6**	187	0,2
Arezzo	**6,1**	197	0,4
Siena	**5,1**	197	0,3
Grosseto	**4,0**	182	0,5

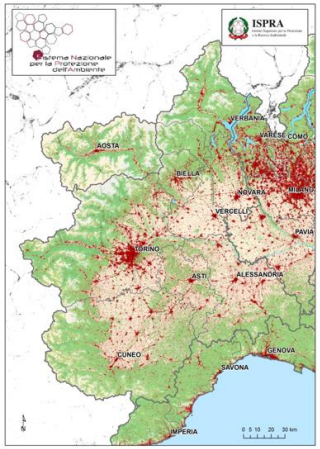
Dai dati presentati in questo rapporto risulta evidente che le aree con i valori più elevati di suolo consumato si concentrano nel bacino Firenze-Prato-Pistoia e nella fascia costiera tra il confine con la Liguria e la città di Livorno, oltre che lungo le direttrici principali dello sviluppo urbano e infrastrutturale (Valdarno superiore e inferiore, Valdinievole, Lucchesia, Valdelsa, etc). Le province con i tassi maggiori di consumo di suolo risultano, anche a causa delle ridotte dimensioni, quelle di Prato e Pistoia, mentre la città metropolitana di Firenze – che dal 2015 è subentrata alla provincia – fa registrare il valore più grande in termini assoluti. Analogamente, tutti i comuni con le percentuali maggiori di suolo consumato si trovano nella Versilia e nel bacino fiorentino anche se le maggiori superfici consumate si registrano nei comuni capoluogo di provincia.

Barberino di Mugello (FI)

2011

2014

Fonte: Carta nazionale del consumo di suolo ISPRA-ARPA-APPA, 2016



Piemonte

Comuni con una % di consumo di suolo maggiore

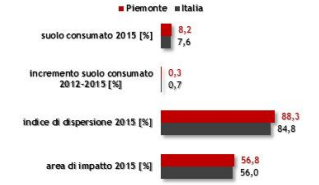
Comune	% 2015	km² 2015	Incremento % 2012-2015
Torino	**63,0**	82	0,1
Beinasco	**58,5**	4	0,2
Grugliasco	**54,4**	7	0,1

Comuni con una superficie di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Torino	63,0	**82**	0,1
Alessandria	16,6	**34**	0,3
Asti	16,8	**25**	0,2

Comuni con un incremento % di consumo di suolo maggiore

Comune	% 2015	km² 2015	Incremento % 2012-2015
Torrazza Piemonte	19,7	2	**10,5**
Voltaggio	2,6	1	**6,4**
Villanova Biellese	5,4	0,4	**5,2**



Provincia	% 2015	km² 2015	Incremento % 2012-2015
Novara	**13,2**	177	0,4
Biella	**10,2**	93	0,2
Torino	**9,9**	674	0,4
Asti	**9,9**	149	0,2
Alessandria	**8,5**	304	0,3
Cuneo	**6,6**	454	0,2
Vercelli	**6,4**	133	0,4
Verbania-Cusio-Ossola	**3,8**	86	0,1

Voltaggio (AL)

2011

2015

Fonte: Carta nazionale del consumo di suolo ISPRA-ARPA-APPA, 2016

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Land Monitoring

USE CASE 1: WHAT HAS BEEN DONE

- Input data:
  - More than 200 Rapid Eye images at 5m resolution (from ESA DWH)
  - Reference year 2012
  - Preprocessing: Ortho-rectification/ Calibration / Cloud masking
- Production workflow based on HRL Imperviousness 2012
  - Semi-automatic built-up detection
  - Integration of HRL Imperviousness (20m) into the training process of the automatic classifier
  - Customization of the nomenclature towards a better integration into ISPRA land take estimation process (to be combined with the existent stratified sampling monitoring network)
    - e.g. railways network, landfills and mines are included
  - Integration of OSM database, topographic DB

Copernicus Europe's eyes on Earth

European Commission

Land Monitoring

USE CASE 1 IN ITALY: THE RESULTS

The first national map of land take at Very High Resolution in Italy

- Reference year: 2012
- Resolution: 5m
- Coverage: national
- Content: binary imperviousness map
- Features included:
  - Built-up (residential, industrial, etc.), Parking areas, Roads, Railways, Mines, Landfills
- Link: www.consumosuolo.isprambiente.it

Copernicus Europe's eyes on Earth
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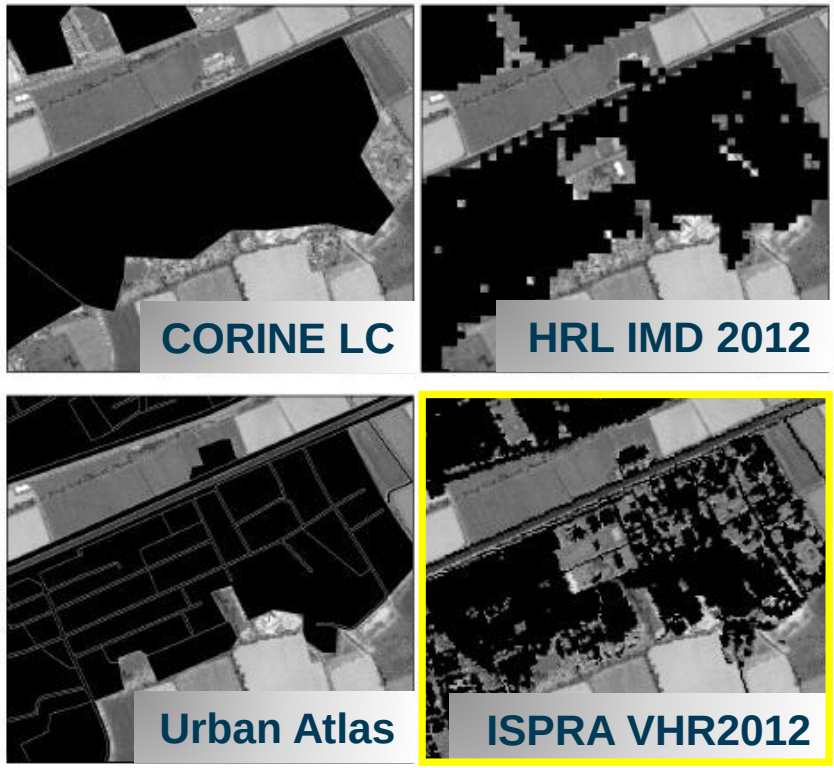
USE CASE 1 IN ITALY: SOME EXAMPLES

Example Urban area 1 (Background: aerial photo)



Source: ISPRA (2015), “Il consumo di suolo in Italia”, Rapporti 218/2015, ISPRA, Roma

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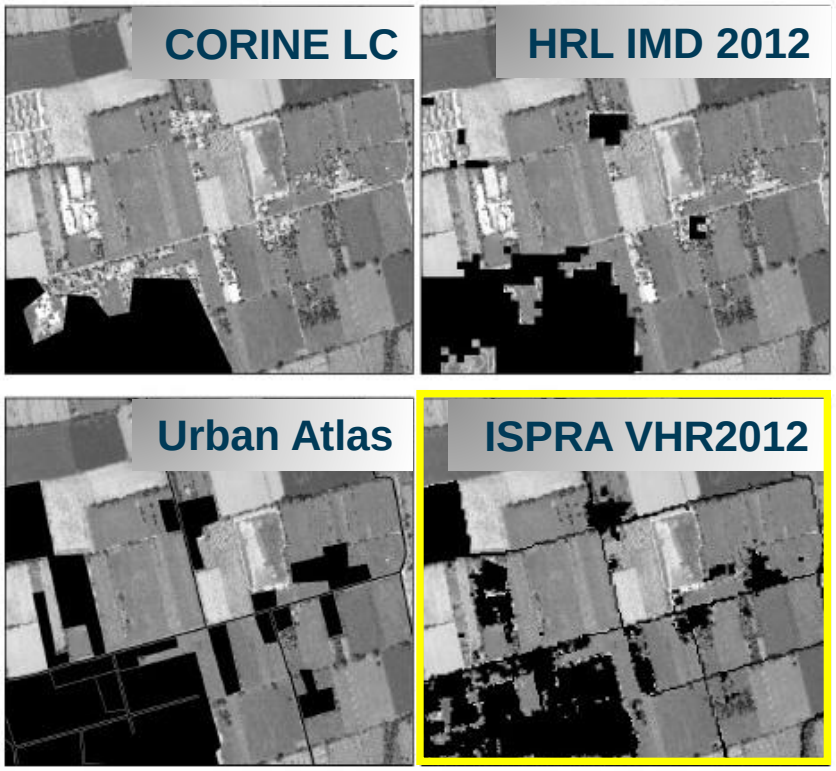
USE CASE 1 IN ITALY: SOME EXAMPLES

Example Urban area 2 (Background: aerial photo)



Source: ISPRA (2015), "Il consumo di suolo in Italia", Rapporti 218/2015, ISPRA, Roma

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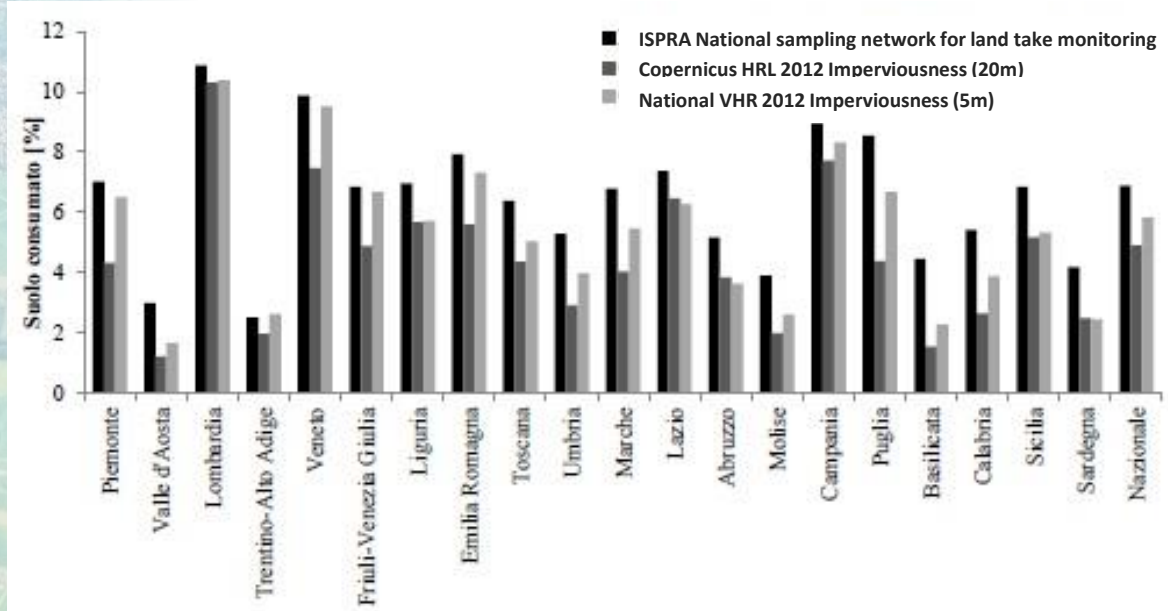
Land Monitoring

USE CASE 1 IN ITALY: THE RESULTS

VHR 2012 land take estimation is close to the values derived from the sampling network monitoring strategy



Land take distribution per region, with estimation derived from three different sources: ISPRA National sampling network, Copernicus HRL Imperviousness 2012 (20m) and National VHR 2012 Imperviousness (5m).
Source: ISPRA (2015), "Il consumo di suolo in Italia", Rapporti 218/2015, ISPRA, Roma

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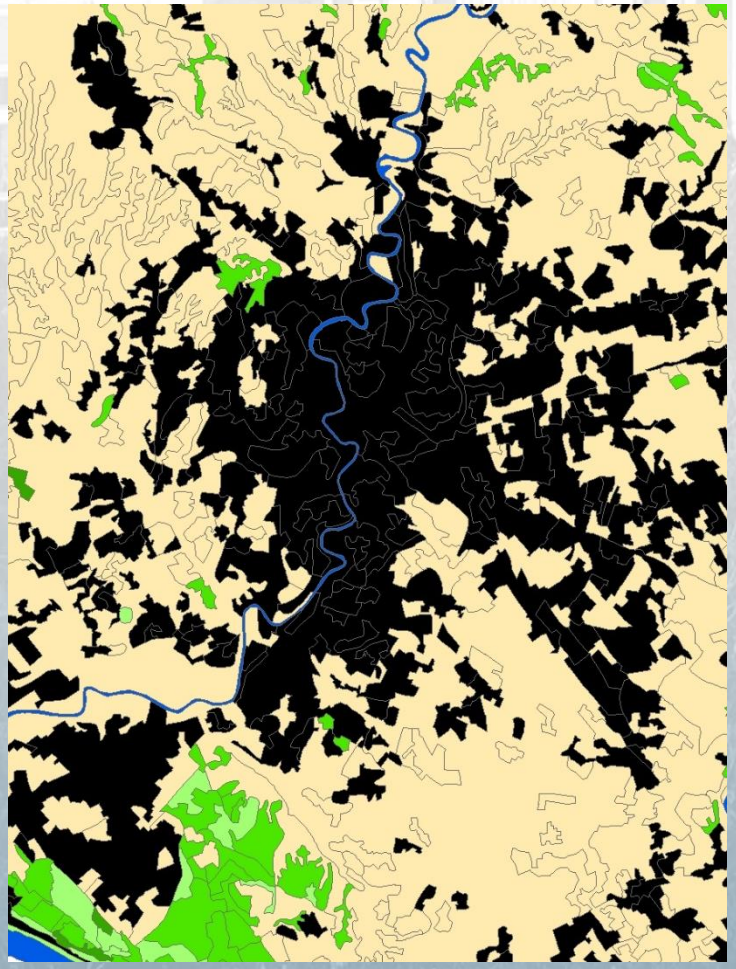
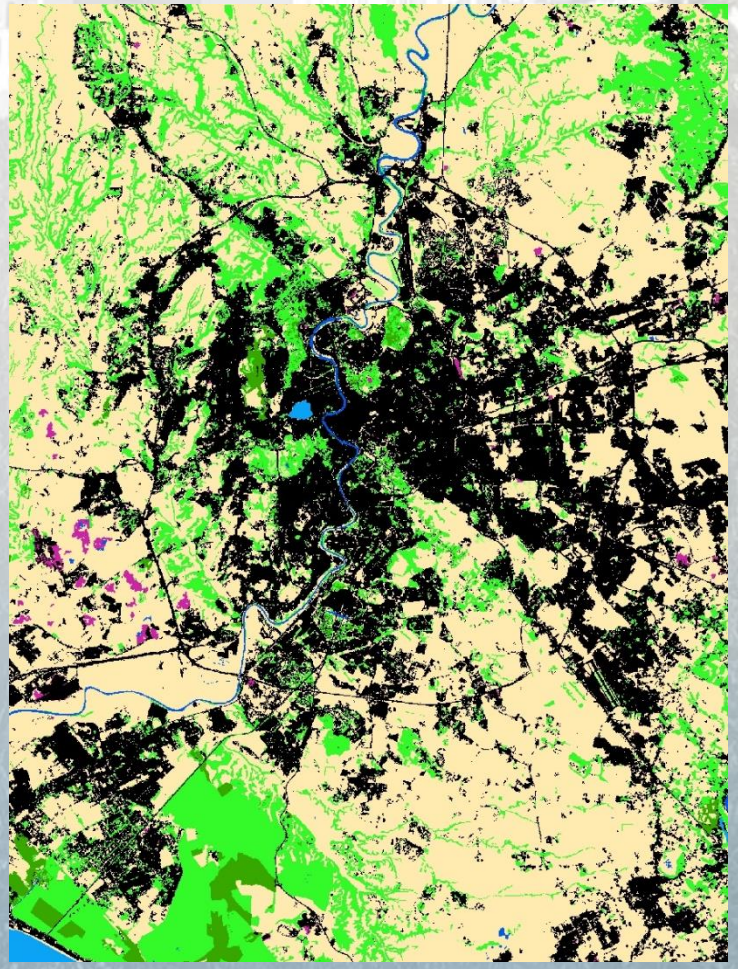
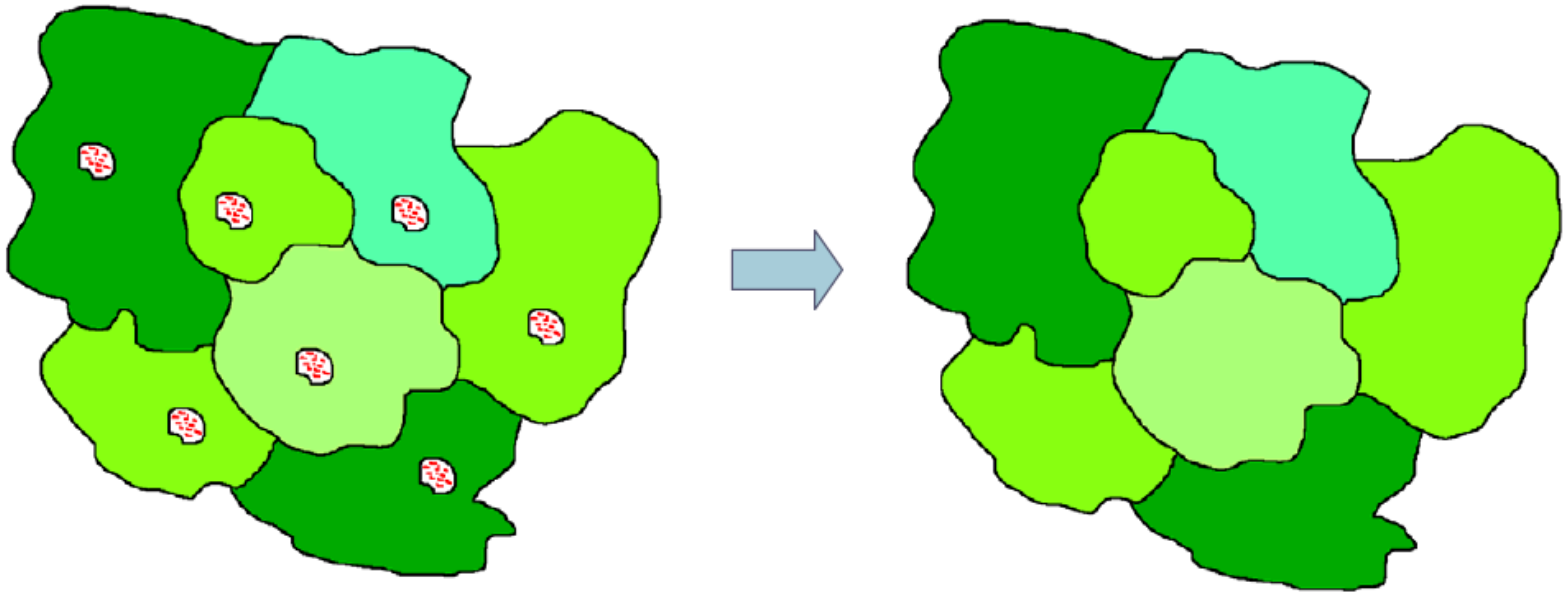
CORINE Land Cover



High Resolution Layers



Statistical Inconsistencies between high resolution and low resolution databases



High resolution (national) classification database:

10 % of region is 1.1.1. "Continuous urban fabric"

But all polygons (< 25 Ha: LR MMU)

Low resolution (European) classification database:

0 % of region is 1.1.1. "Continuous urban fabric)

Because Polygons have been assigned to dominant classes

- If these changes do not "cross" the "**definition rule**" threshold.

*E.g.: If the **building density** of a polygon has **increased from 11% to 79 %** this polygon is labeled as Corine's 1.1.2. "Discontinuous urban fabric", in both databases, and so*

no change is registered.

and/or:

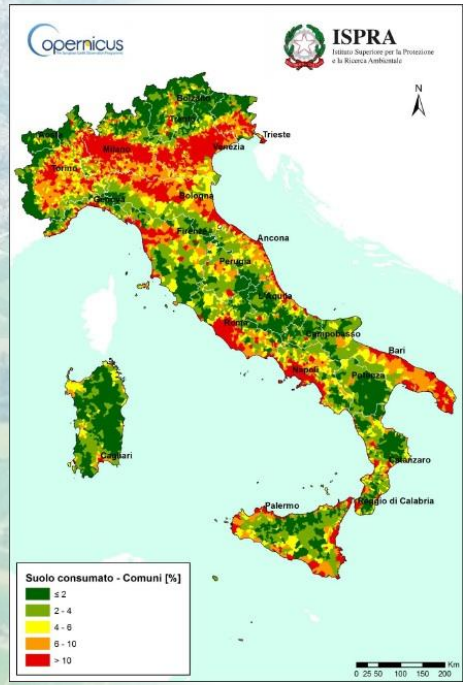
- These changes are "hidden" in polygons assigned to **dominant classes** or to **mixed classes**.

Change not registered !!

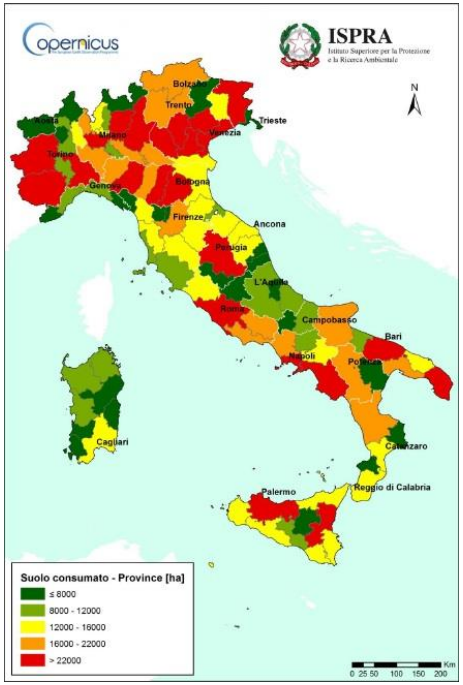
Land Monitoring

USE CASE 1: LAND TAKE REPORTING 2012

VHR 2012 layer has been used as input for the estimation of a series of landscape indicators (e.g. land take, urban sprawl, edge density)



2012 Land take (%) by city



2012 Land take (ha) by province

Source: ISPRA (2015), "Il consumo di suolo in Italia", Rapporti 218/2015, ISPRA, Roma

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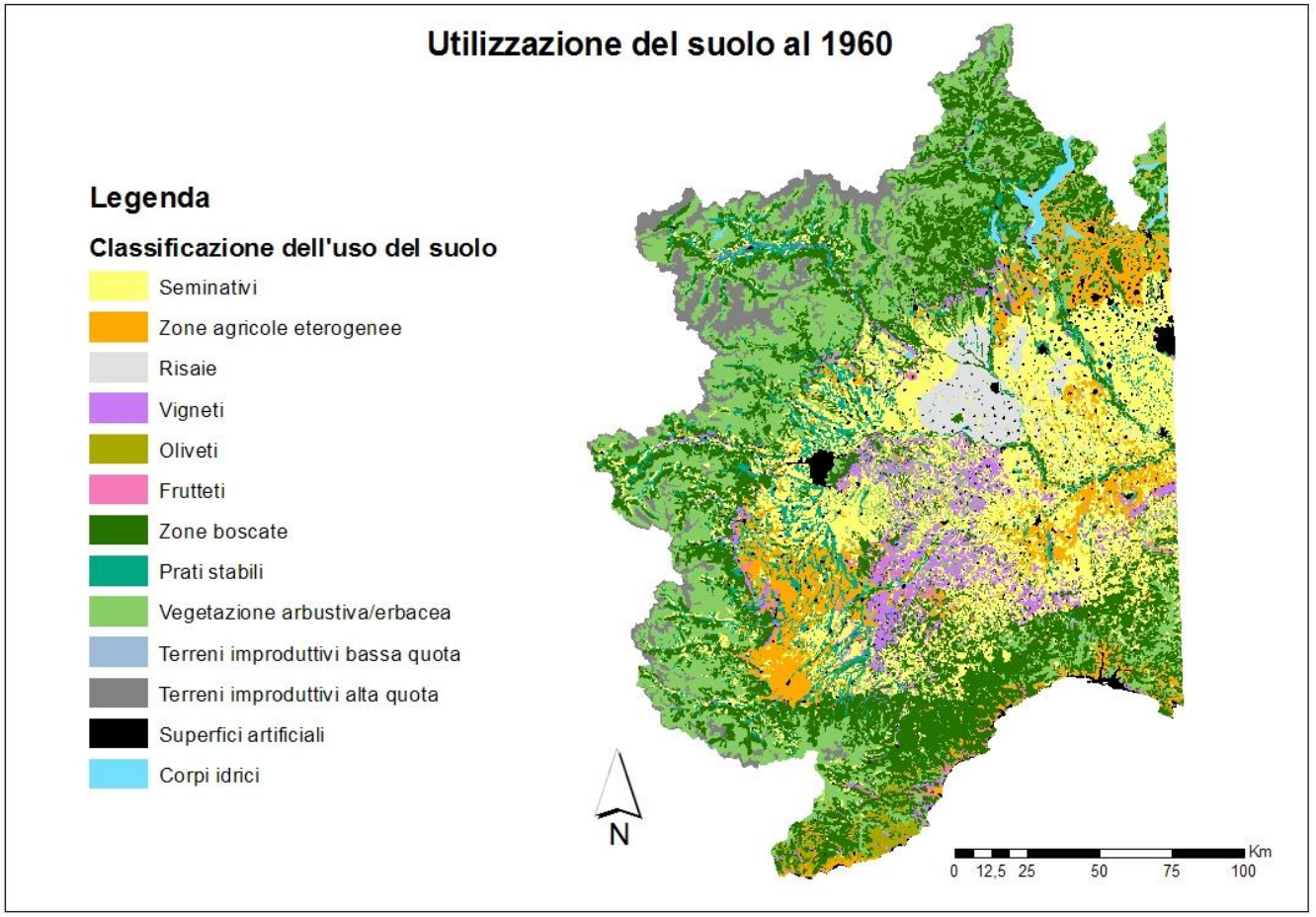
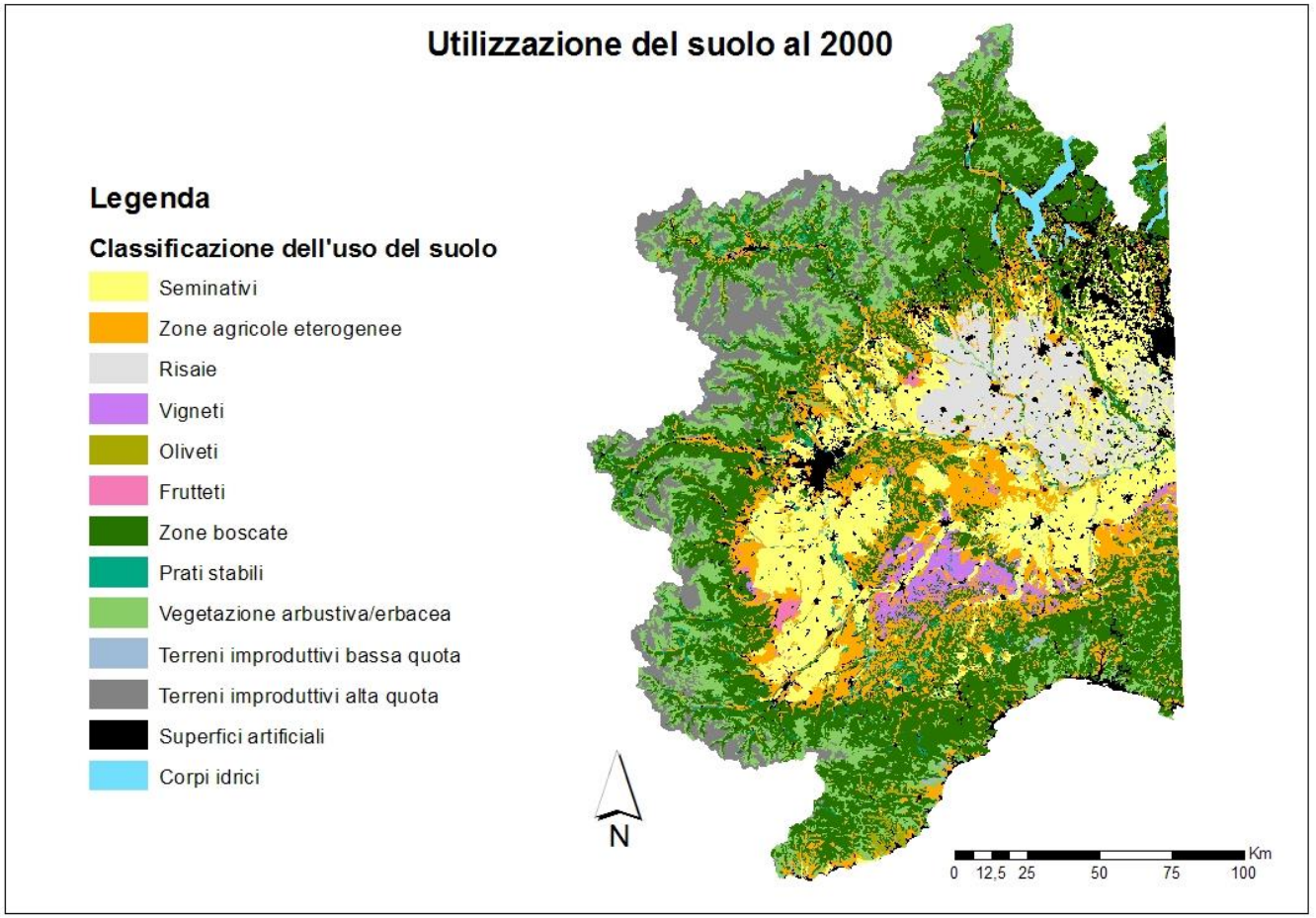


Classi	1	2	3	4	5	6	7	8	9	10	11	12	13
Area totale in km²	7.751	3.200	1.011	1.978	346	115	9.499	2.074	8.351	29	1.939	854	419
% sull'area totale	20,63	8,52	2,69	5,27	0,92	0,31	25,29	5,52	22,23	0,08	5,16	2,27	1,11



Classi	1	2	3	4	5	6	7	8	9	10	11	12	13
Area totale in km²	5.619	5.261	2.333	716	135	142	12.122	603	4.708	174	3.037	2.320	396
% sull'area totale	14,96	14	6,21	1,91	0,36	0,38	32,27	1,61	12,53	0,46	8,08	6,18	1,05

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USE CASE 2: VHR LAYER UPDATING 2015

- Update 2015
  - Need to preserve high spatial and thematic accuracy obtained with the former 2012 VHR mapping exercise
  - Need to ensure harmonized and regular approach in the land take estimation and monitoring over the national territory

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USE CASE 2: WHAT HAS BEEN DONE

- Input data:
  - More than 100 Sentinel-2A images at 10m resolution (2015-2016)
  - Reference year 2015
  - Preprocessing: calibration, cloud masking, working units organization
- Production workflow based on change detection:
  - Image change detection
  - Resampling of VHR 2012 layer (5m) to 10m
  - VHR 2012 layer as reference for training phase and correction of false changes
  - Same nomenclature adopted for VHR 2012 layer
  - VHR 2012 map updating and improving (commission/omission correction)

USE CASE 2 IN ITALY: THE RESULTS

Land Monitoring

VHR 2015

Source: ISPRA (2016), (Detail on Sicily region) "Consumo di suolo, dinamiche territoriali e servizi ecosistemici", Rapporti 248/2016, ISPRA, Roma

- Reference year: 2015
- Resolution: 10m
- Coverage: Italy
- Content:
  - Binary 2015 VHR map
  - Change layer 2012-2015
  - Binary 2012 corrected VHR map
- Features included:
  - Built-up (residential, industrial, etc.), Parking areas, Roads, Railways, Mines, Landfills, permanent greenhouses
- Link: www.consumosuolo.isprambiente.it

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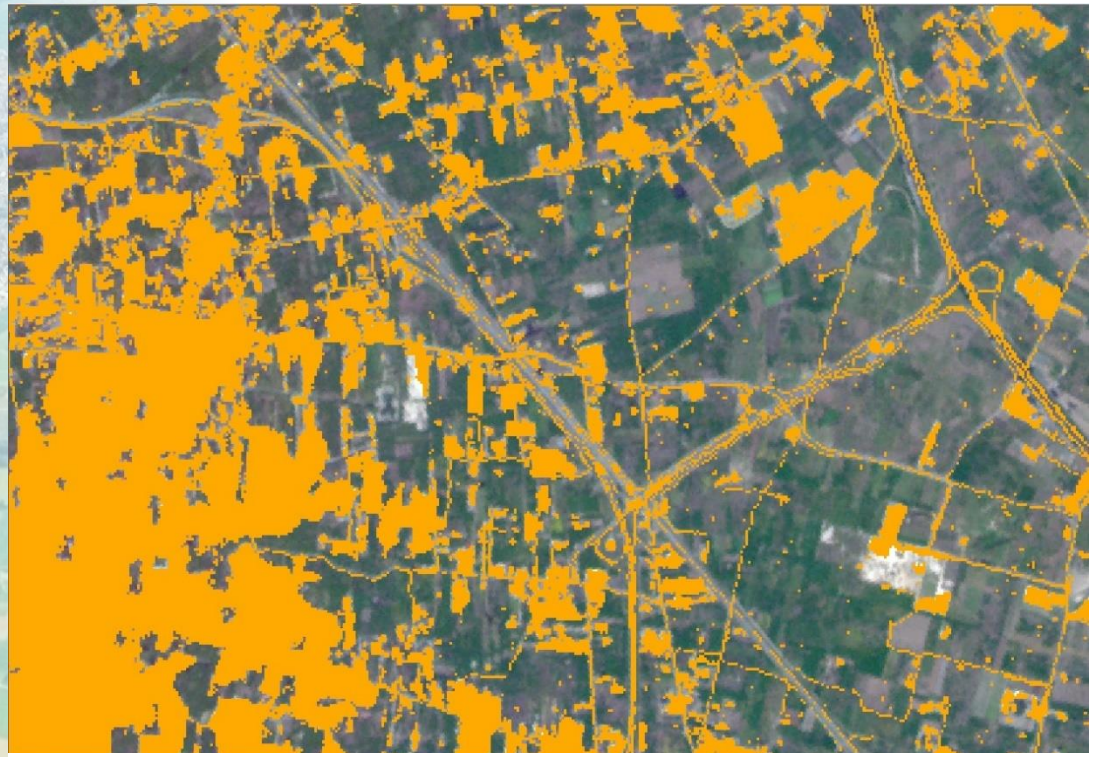
USE CASE 2 IN ITALY: SOME EXAMPLES

map VHR 2012 (based on RapidEye 2011-2012)



VHR 2012_V1 (original)

Background image: RapidEye image natural color (12 April 2011)
Example area around Naples (South Italy)

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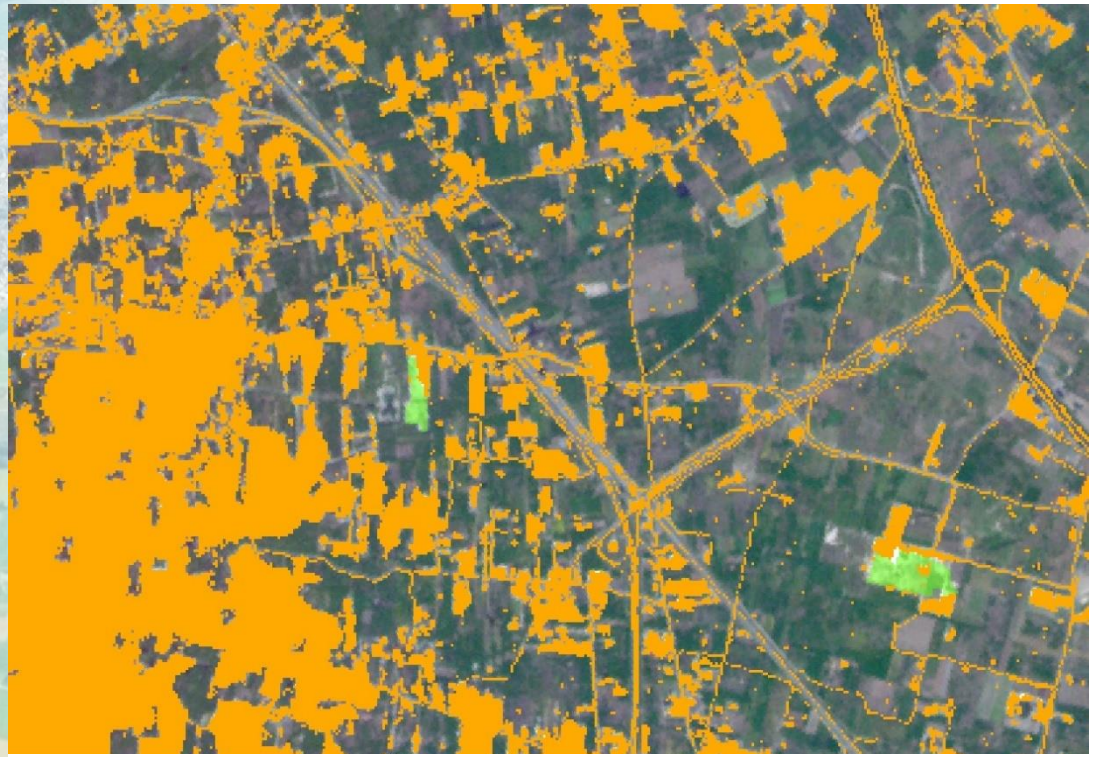
USE CASE 2 IN ITALY: SOME EXAMPLES

map VHR 2012 (based on RapidEye 2011-2012)



Background image: RapidEye image natural color (12 April 2011)
Example area around Naples (South Italy)

VHR 2012_V1 (original)

Omission errors

(discovered as false changes, during the imperviousness map updating process)

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USE CASE 2 IN ITALY: SOME EXAMPLES

map VHR 2012 (based on RapidEye 2011-2012)

VHR 2012_V2 (corrected)

Background image: RapidEye image natural color (12 April 2011)
Example area around Naples (South Italy)

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USE CASE 2 IN ITALY: SOME EXAMPLES

changes VHR 2012-2015

Background image: Sentinel-2A natural color (22 June 2015)
Example area around Naples (South Italy)

- VHR 2012_V2 (corrected)
- New 2015 map
  (real changes detected during the map updating process)

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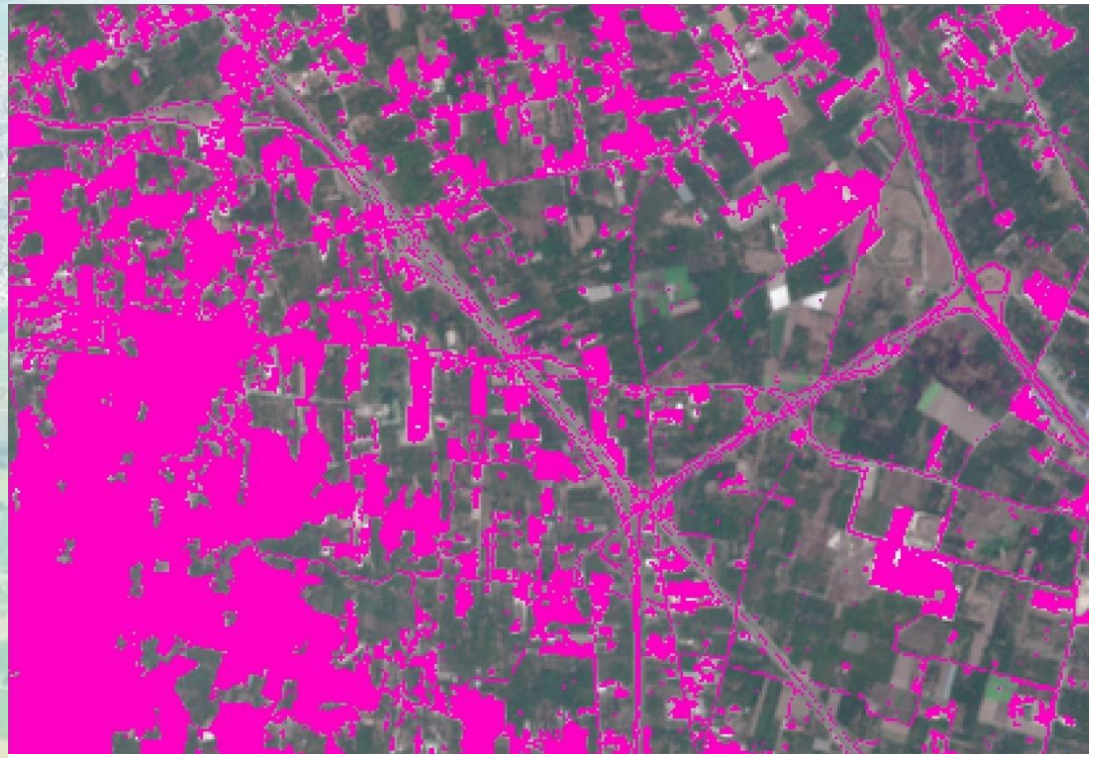
USE CASE 2 IN ITALY: SOME EXAMPLES

map VHR 2015 (based on Sentinel-2A 2015-2016)



VHR 2015

Background image: Sentinel-2A natural color (22 June 2015)
Example area around Naples (South Italy)

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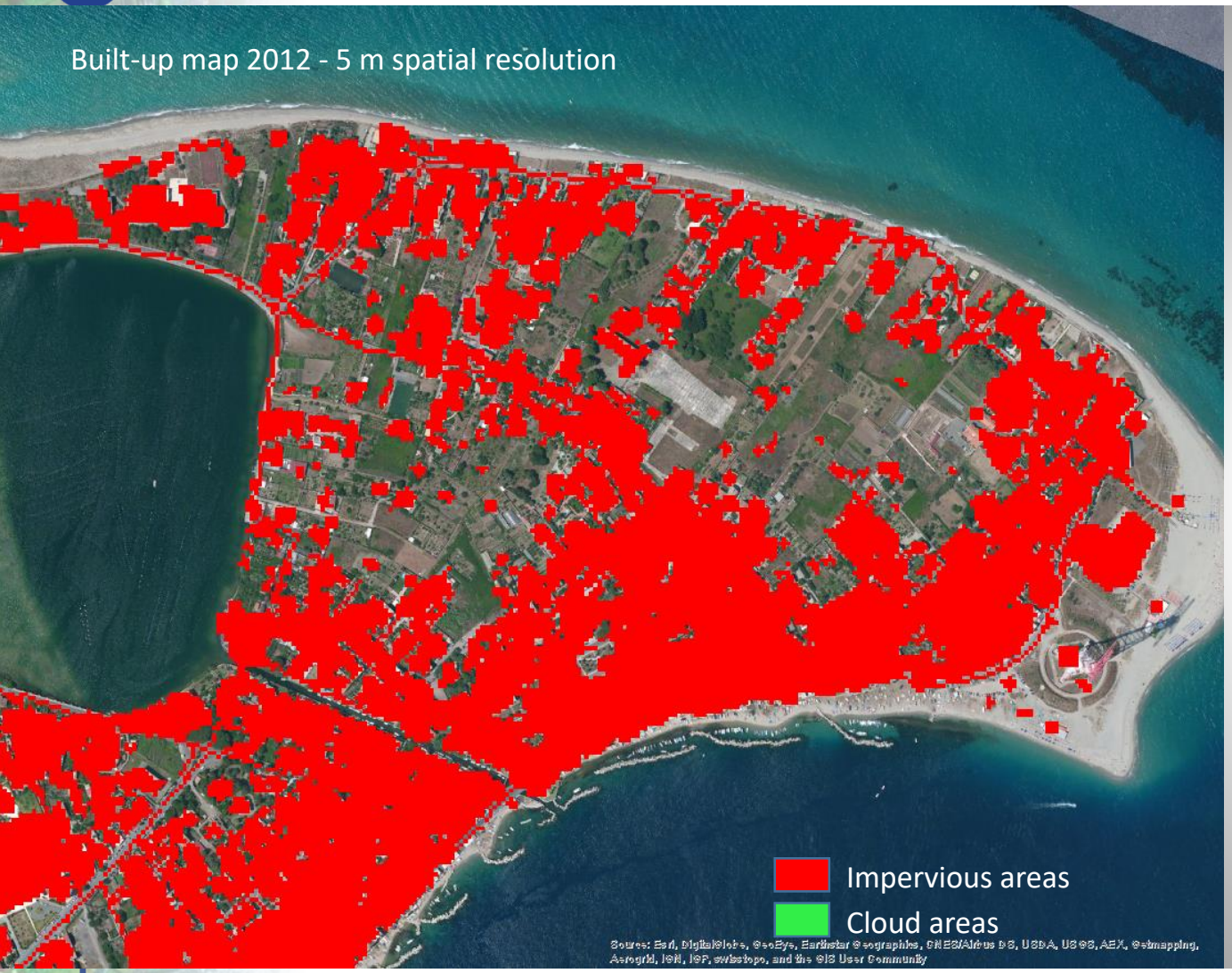
Built-up map 2012 - 5 m spatial resolution



- Sicily map
- Coastal buffer (300 m)
- Resampled 10 m

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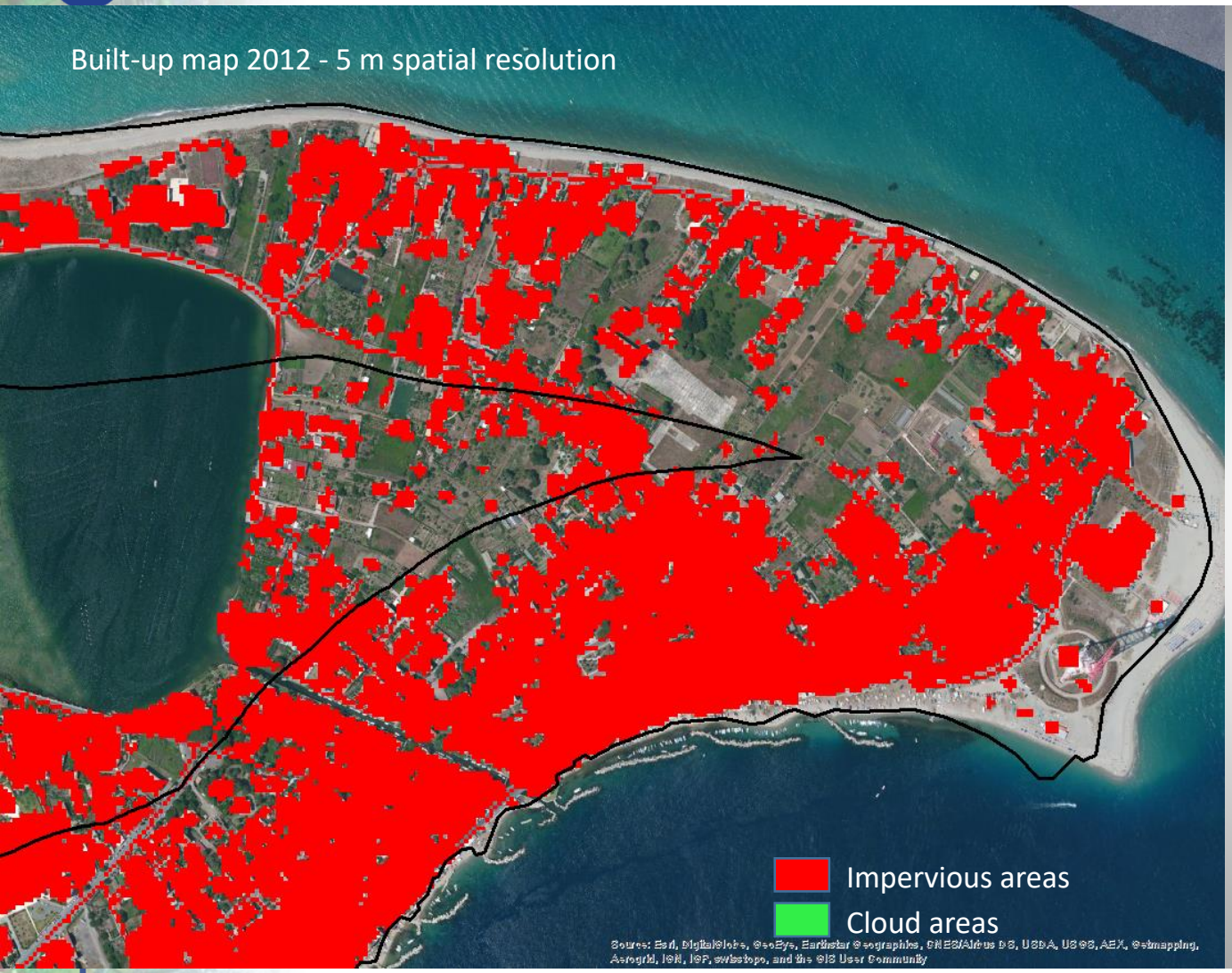
Built-up map 2012 - 5 m spatial resolution



- Sicily map
- Coastal buffer (300 m)
- Resampled 10 m

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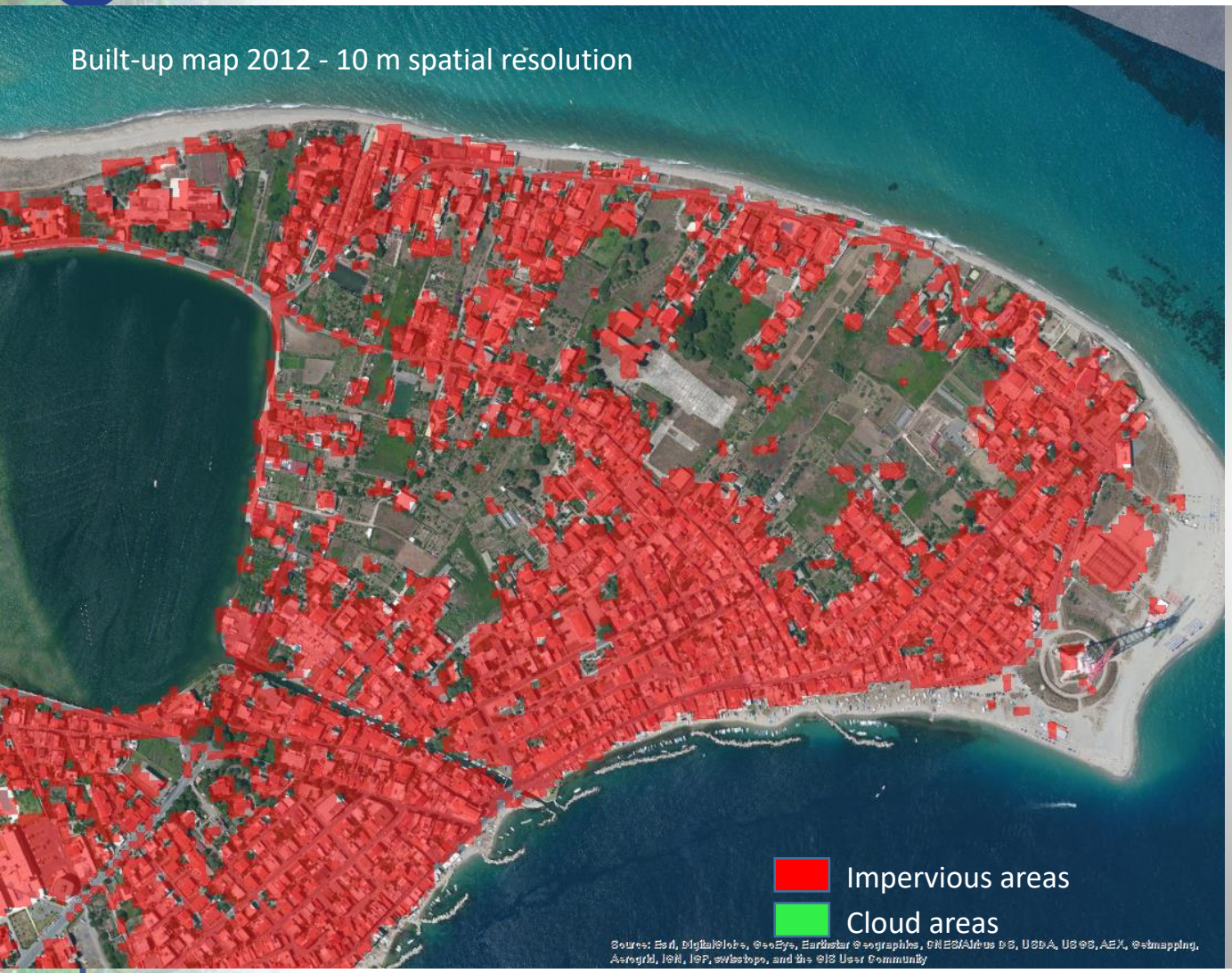
Built-up map 2012 - 10 m spatial resolution



- Sicily map
- Coastal buffer (300 m)
- Built-up map 2015

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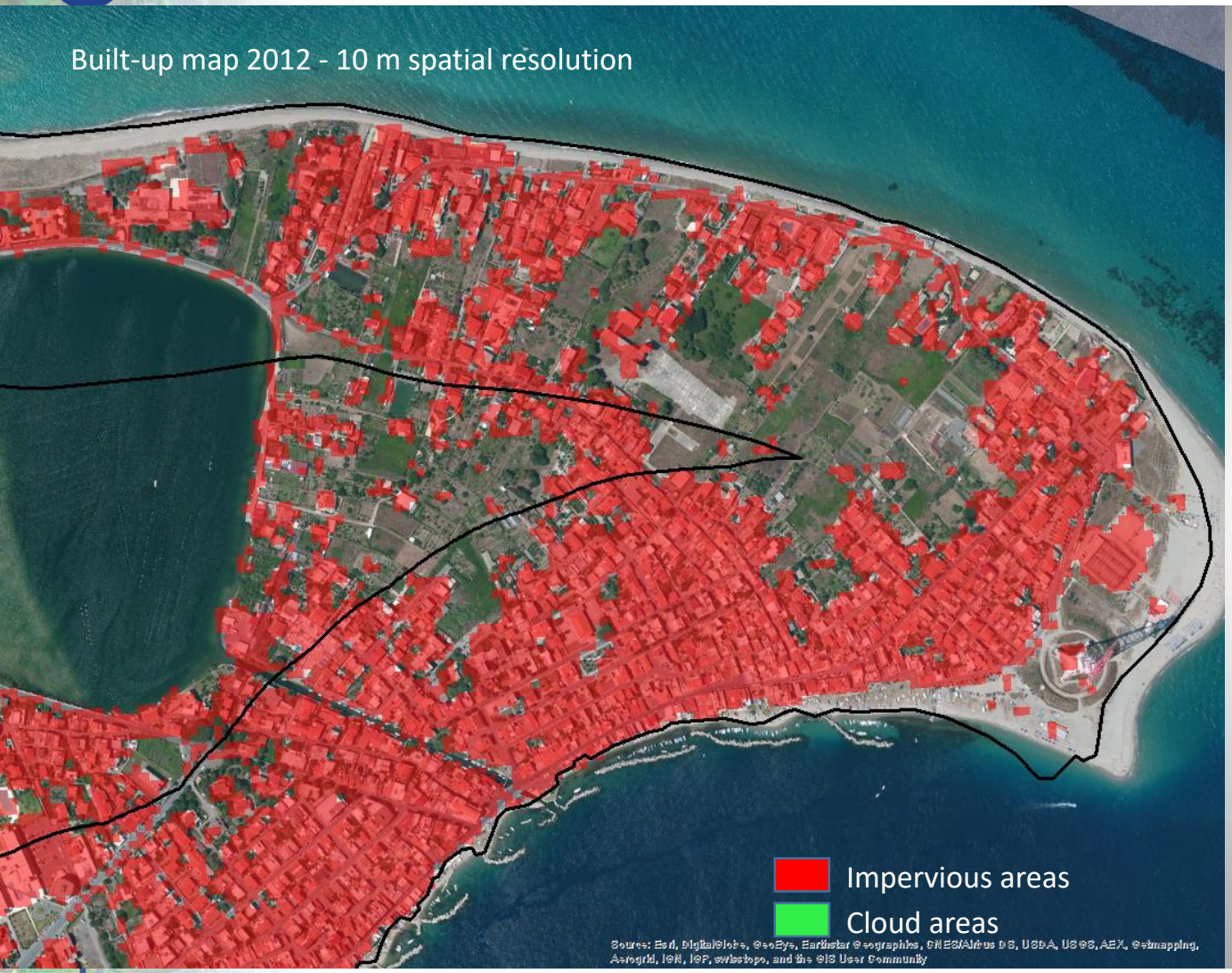
Built-up map 2012 - 10 m spatial resolution



- Sicily map
- Coastal buffer (300 m)
- Built-up map 2015

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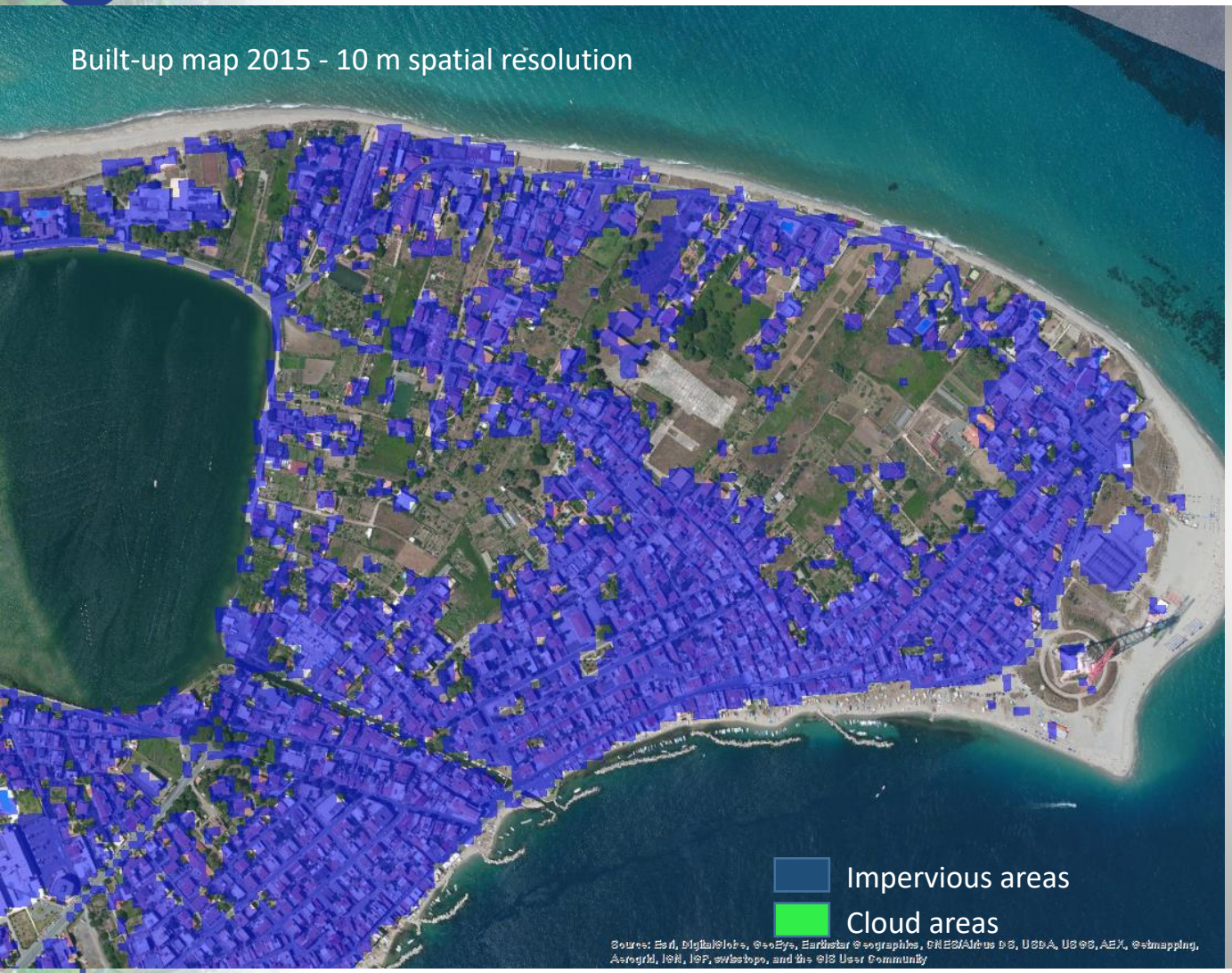
Built-up map 2015 - 10 m spatial resolution



- Sicily map
- Coastal buffer (300 m)
- Built-up map 2012
- Change map

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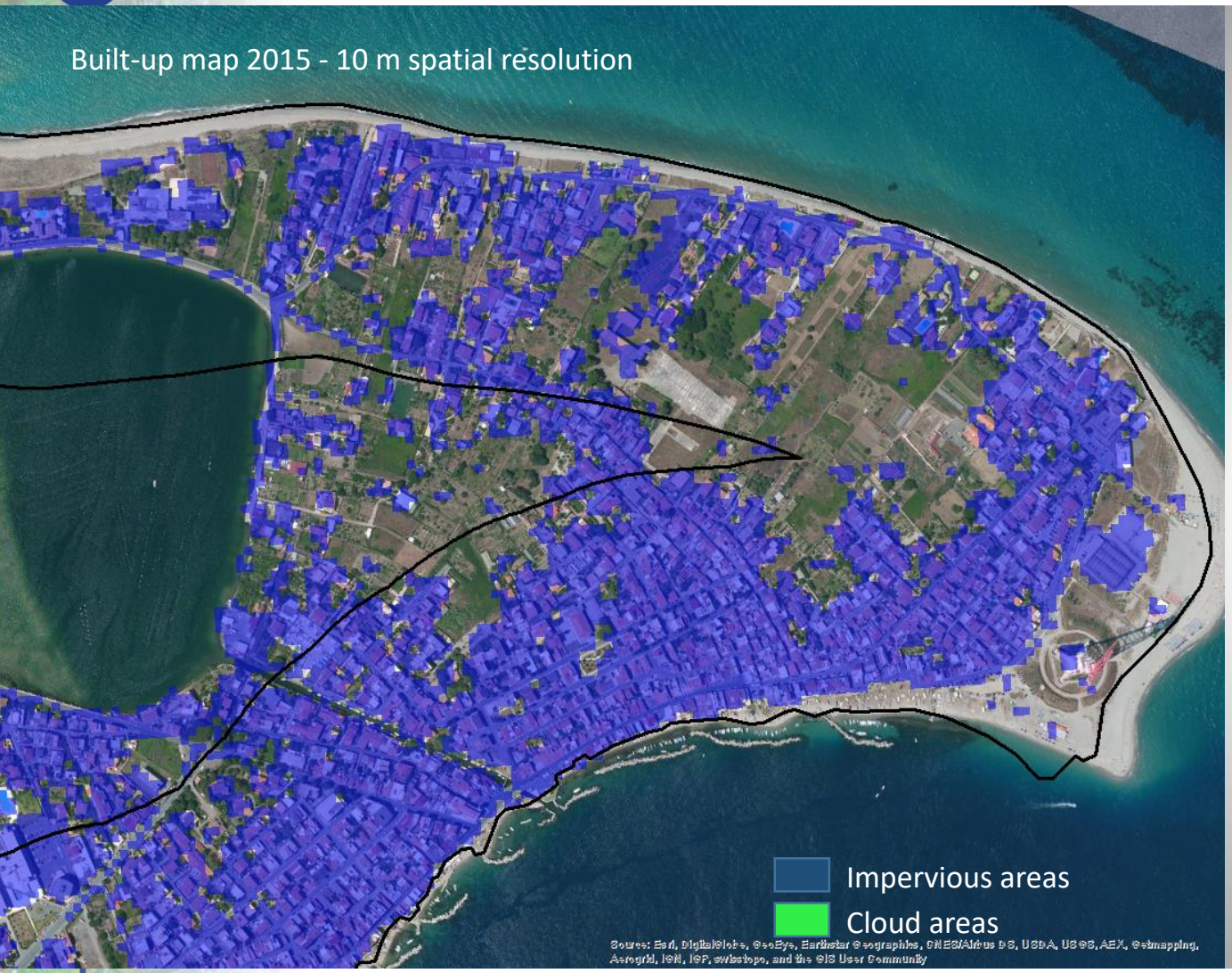
Built-up map 2015 - 10 m spatial resolution



- Sicily map
- Coastal buffer (300 m)
- Built-up map 2012
- Change map

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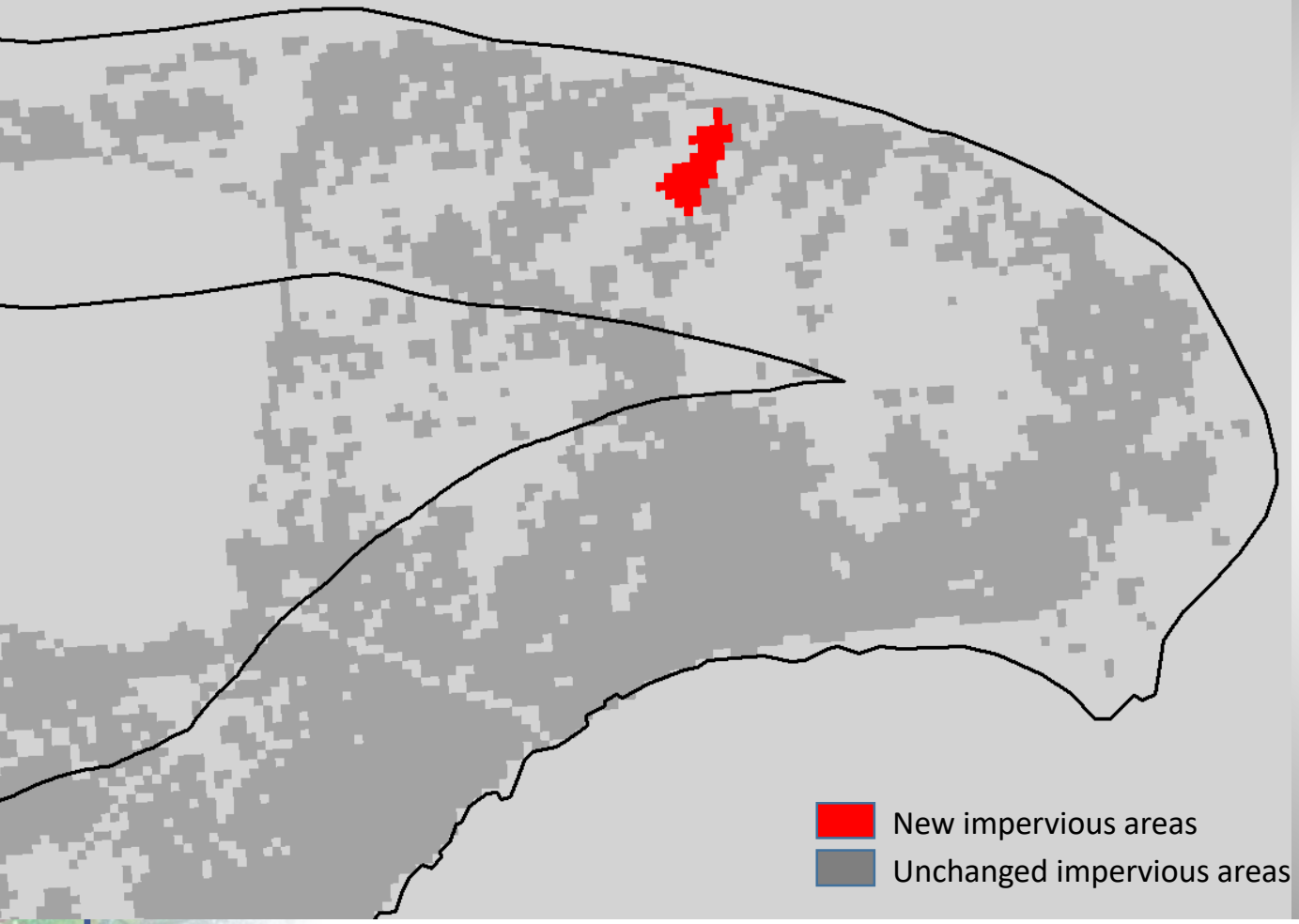
Change map 2012-2015 - 10 m spatial resolution



- **Sicily map**
- **Built-up map 2012**
- **Built-up map 2015**
- **Sentinel-2 image**

Sentinel 2 - 10 m spatial resolution

- Sicily map
- Built-up map 2012
- Built-up map 2015
- Sentinel 2 + maps
- Basemap + maps
- Change image

Quit

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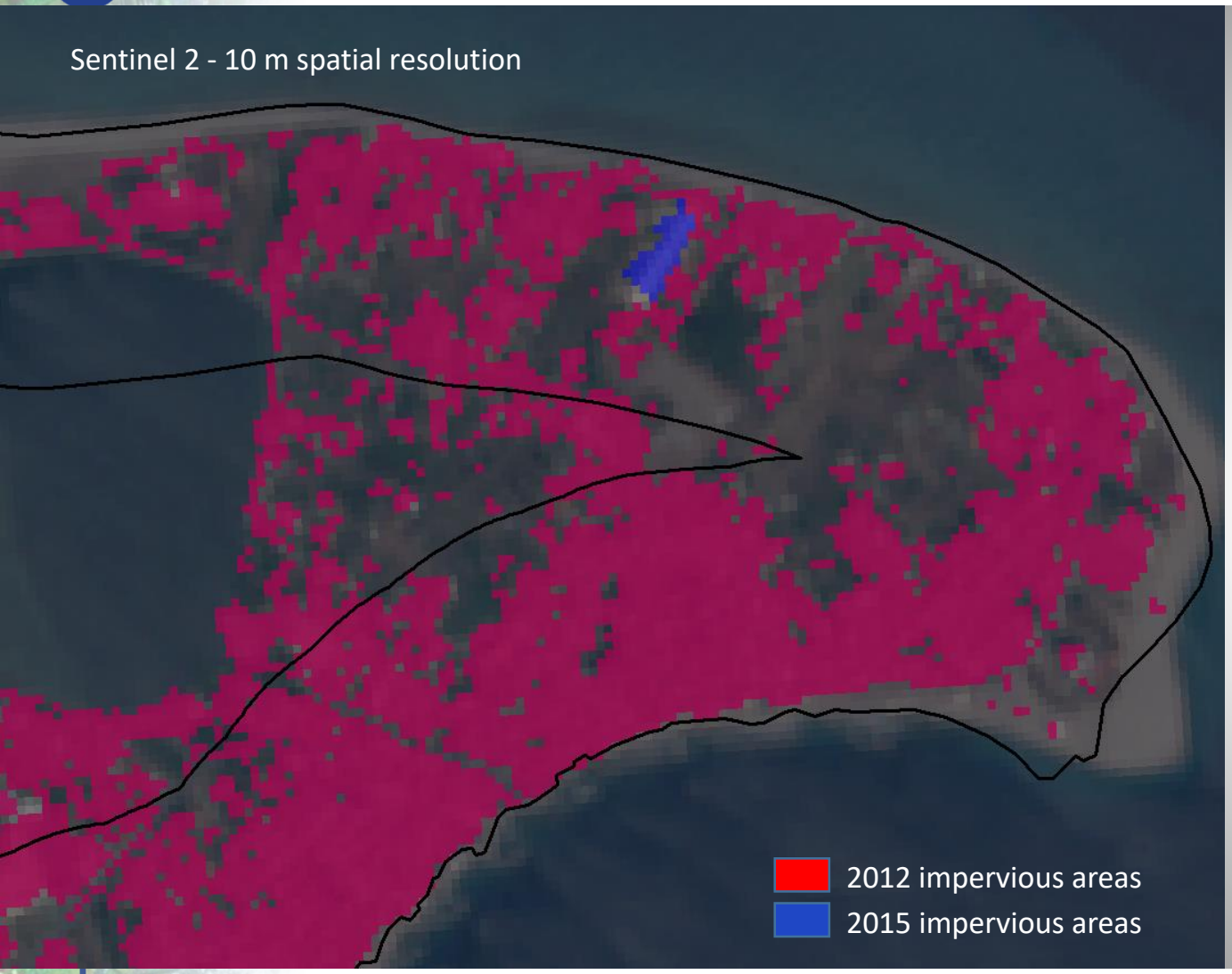
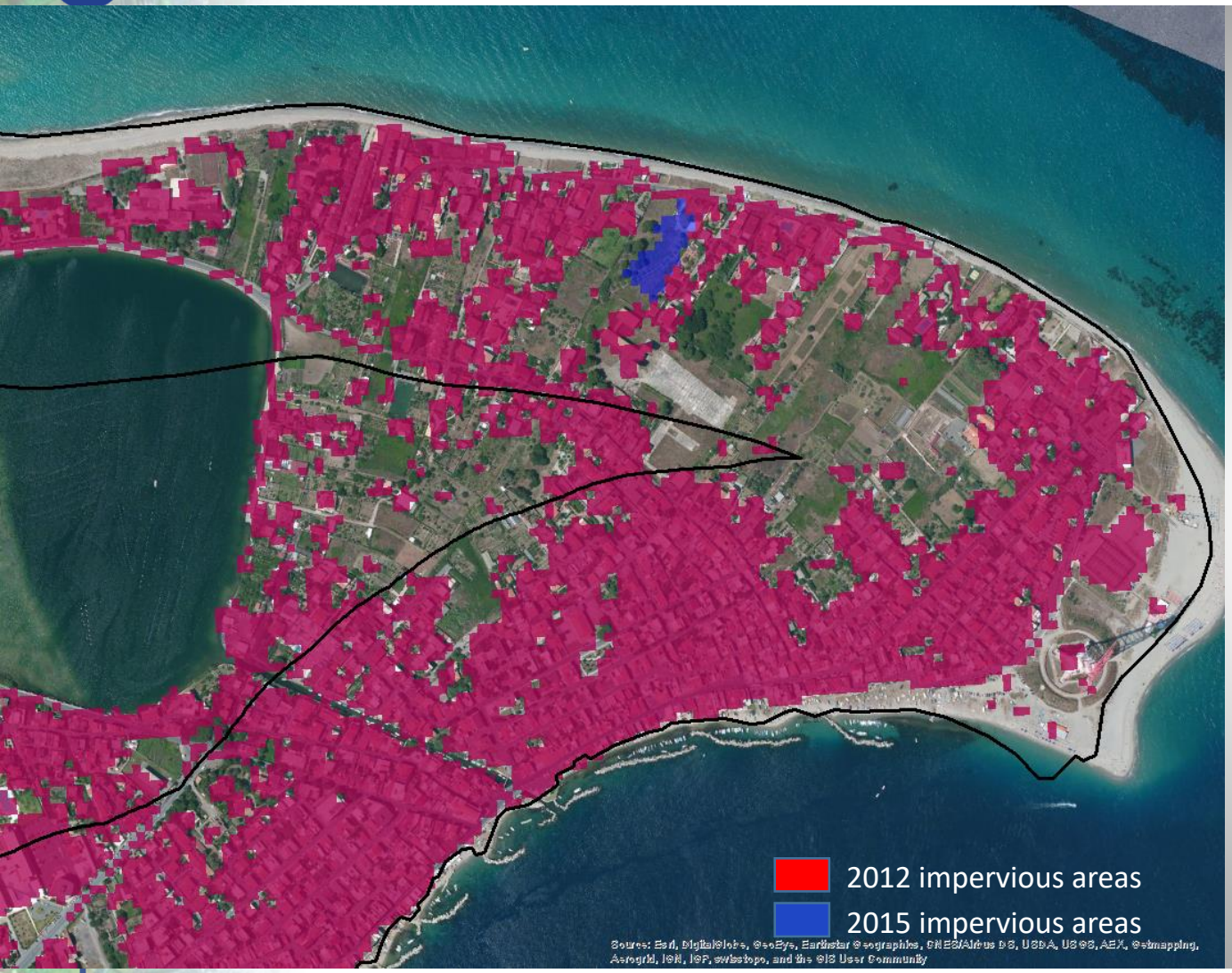
Sentinel 2 - 10 m spatial resolution



- Sicily map
- Built-up map 2012
- Built-up map 2015
- Sentinel 2
- Basemap + maps
- Change image

Quit



- Sicily map
- Built-up map 2012
- Built-up map 2015
- Sentinel 2
- Sentinel 2 + maps
- Change image

Quit

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USE CASE 2: LAND TAKE REPORTING 2015

- The national VHR layer is a valuable basis for the direct computation of landscape INDICATORS, fundamental to the process of evaluation and environmental monitoring of urban and regional plans.

- A set of landscape indicators has been identified as feasible to be calculated using the VHR map as main input (together with auxiliary data such as administration boundaries, natural areas, etc.)

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USE CASE 2: EXAMPLES OF INDICATORS

List of some indicators derived from VHR imperviousness layer

Indicator	Description	Expression
Land take	Ratio between the imperviousness surface and the territory surface under analysis	CSU = (Su / Str) x 100 Su: the imperviousness surface Str: surface under analysis
Urban dispersion	Ratio between the sum of sparse/discontinuos imperviousness area and the total imperviousness surface	Dsp = [(Sud + Sur) / Su] x 100 Sud: discontinuos imperviousness area Sur: sparse imperviousness area Su: total imperviousness surface
Edge Density (ED)	Ratio between the perimeter of the imperviousness polygons and the total surface under analysis	ED = (SP / Str) x 10,000 SP: Sum of the perimeter of the imperviousness polygons Str: Total surface under analysis
Ecological impact	Ration between the surface impacted by the occurrence of imperviousness and the total area under analysis.	EI = (bufferArea / Str) x 100 bufferArea: measure of the buffered impervousness area (100m) Str: surface under analysis

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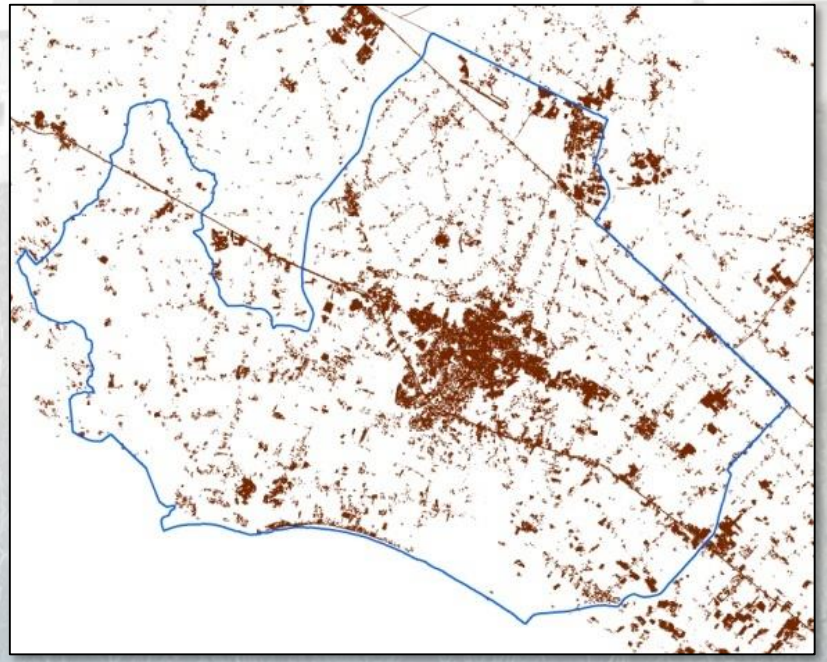
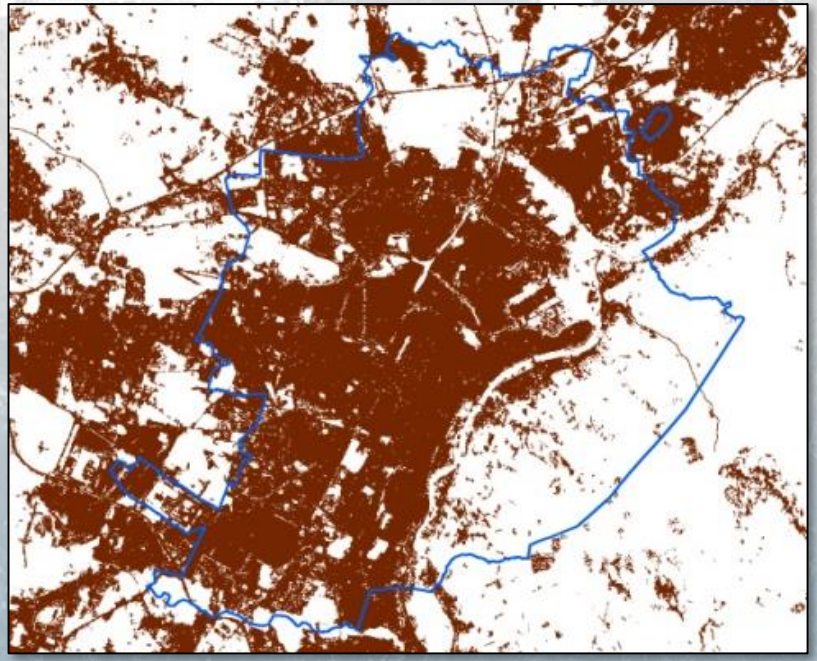
Comune di Latina



4 abitanti per ettaro
288 metri quadrati di suolo consumato pro capite

Comune di Torino



67 abitanti per ettaro
86 metri quadrati di suolo consumato pro capite

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Urban Sprawl Assessment

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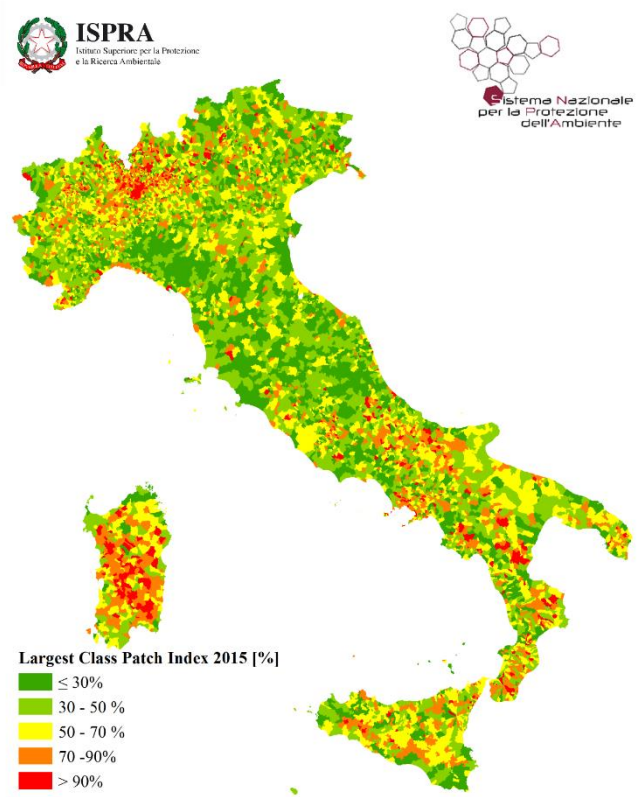
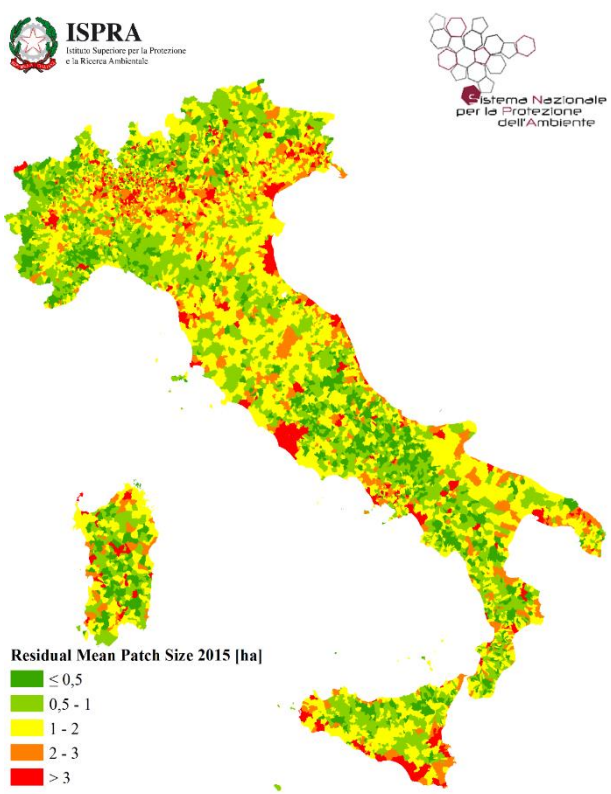
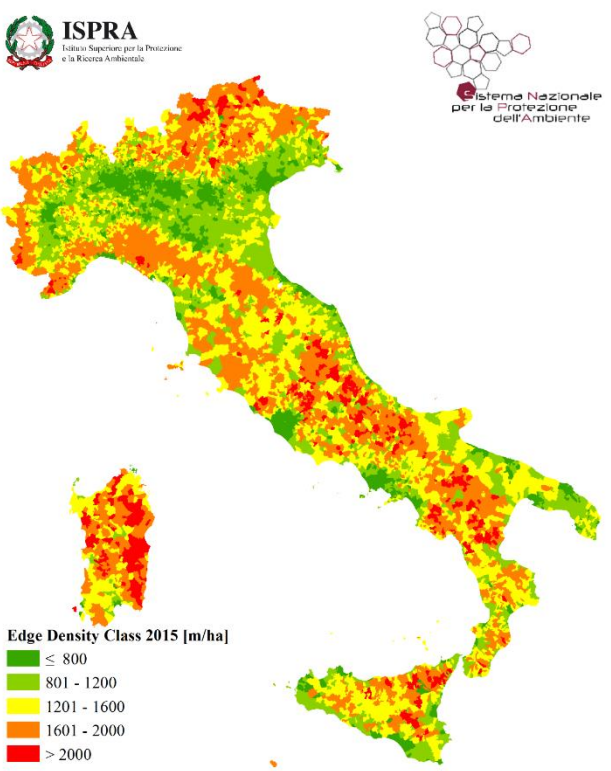


Valori di LCPI (Largest Class Patch Index) per comune (2015). È un indicatore della compattezza della città. Il valore è più elevato per aree urbane monocentriche con un centro urbano di dimensioni elevate e/o compatte. Valori inferiori si riscontrano in aree con un maggiore grado di diffusione urbana.



Valori di RMPS (Residual Mean Patch Size) per comune (2015). È un indicatore della diffusione del tessuto urbano periferico, essendo calcolato come il valore medio della dimensione delle aree urbanizzate escludendo il poligono urbano più esteso. Per una corretta lettura dei dati è utile confrontare i valori con una misura di densità per valutare la consistenza sul territorio di aree più o meno disperse



Valori di ED (Edge Density) per comune (2015). Tale indicatore aumenta con la maggiore frammentazione dei margini urbani e con la dispersione insediativa. Passando da aree urbane con forma compatta a poligoni con confini più frastagliati l'ED assume valori sempre maggiori, mentre invece per confini regolari l'ED assume valori più bassi.

Indicatore	Descrizione e significato
LCPI (Largest Class Patch Index)	Ampiezza percentuale del poligono di area costruita di dimensioni maggiori. È un indicatore di compattezza.
RMPS (Residual Mean Patch Size)	Ampiezza media dei poligoni residui, escluso quello maggiore. Fornisce la dimensione della diffusione delle città attorno al nucleo centrale.
ED (Edge Density)	Rapporto tra la somma totale dei perimetri dei poligoni delle aree costruite e la loro superficie. Descrive la frammentazione del paesaggio in termini di densità dei margini del costruito.

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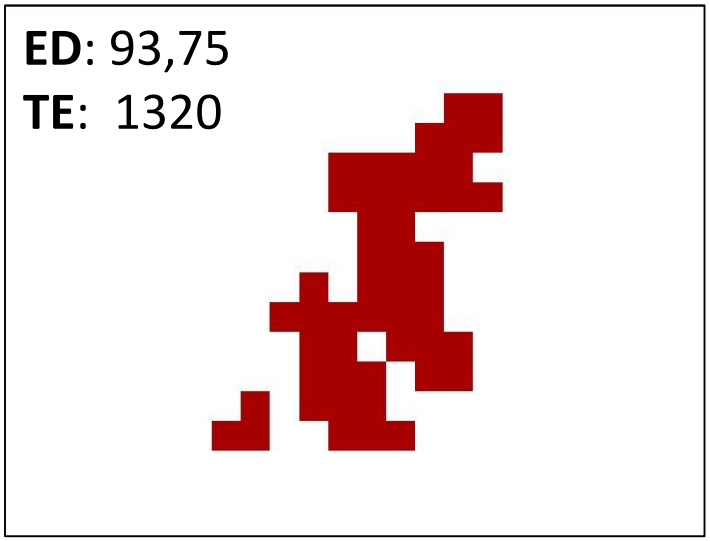
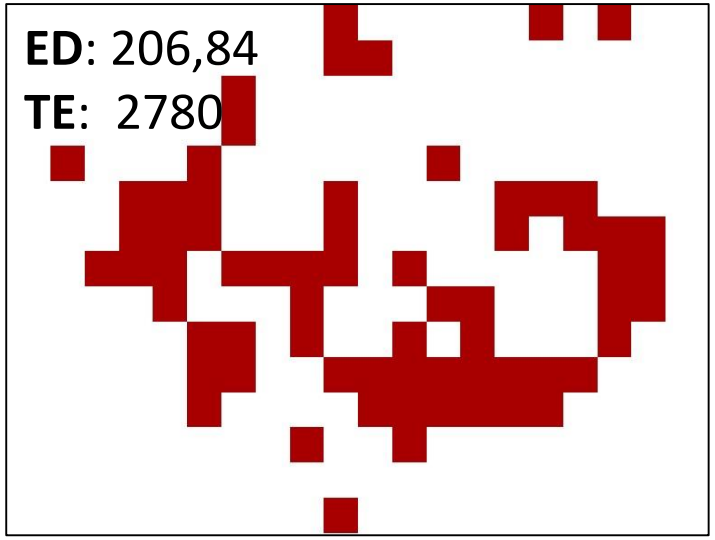
Soil Consumption

- Indicators of the Scenario [5]
  - Use Case 2. *Analysis of the Degree of Imperviousness for the calculation of landscape metrics at the municipal level*.
    - **ED [m/ha].**

      It equals the sum of the lengths (m) of all edge segments involving the corresponding patch type, divided by the total landscape area (sqm), multiplied by 10.000 (to convert to hectares).In other words it is the ratio between the total sum of the perimeters of the areas of the polygons constructed and municipal surface investigated. The indicator facilitates comparisons among landscapes of varying size and lends itself to be an effective measure of the shape and complexity of the different urban areas. In particular, the ED assumes increasing values, with the same surface area, in passing from urban areas with compact form in situations with limits more jagged. This indicator is expressed in meters per hectare and its range is ED>=0, without limit.

Soil Consumption





An example of ED (source: Deliverable B.14)

Soil Consumption

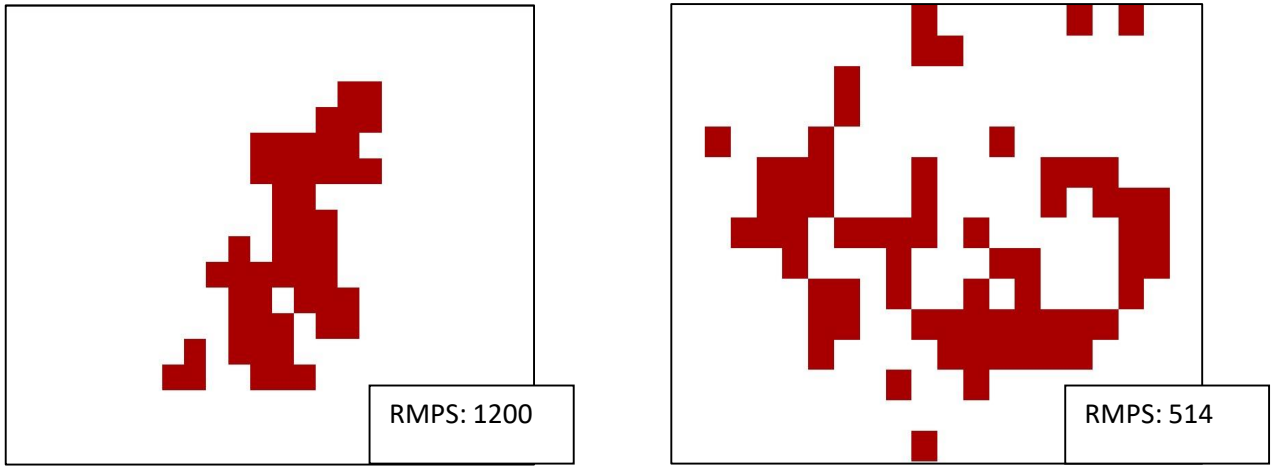
- Indicators of the Scenario [6]
  - Use Case 2. *Analysis of the Degree of Imperviousness for the calculation of landscape metrics at the municipal level*.
    - **MPA [ha].**

      It is based on the number of patches and provides the average size of the patch related to the class of urbanized surface. It is an indirect measure of habitat fragmentation, in fact progressive reduction in the size of habitat fragments is a key component of habitat fragmentation (MCGARIGAL). Thus, it can definitely be related to an increase in the number of patches. Although the MPS derives from the number of patches (NP), it does not refer to any direct information on the number of patches. MPS = 10 ha may refer to one or 100 patch. This indicator is expressed in hectares and its range is MPS>=0.

Soil Consumption

- Indicators of the Scenario [4]
  - Use Case 2. *Analysis of the Degree of Imperviousness for the calculation of landscape metrics at the municipal level*.
    - **RMPS –Residual Mean Patch Size [ha].**

      It represents the average size of the polygons excluding the largest polygon and refers to the residual obtained by subtracting to the total built area, the area of the polygon greater. It is expressed in hectares.



An example of RMPS (source: Deliverable B.14)

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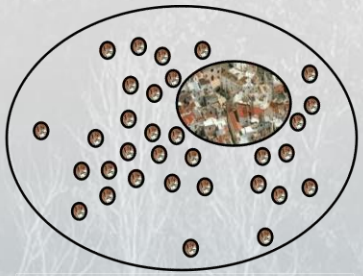
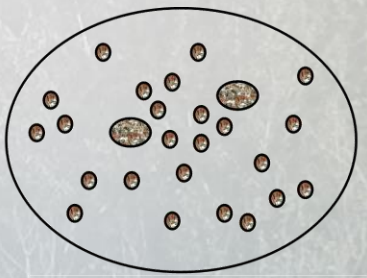
Monocentrica satura

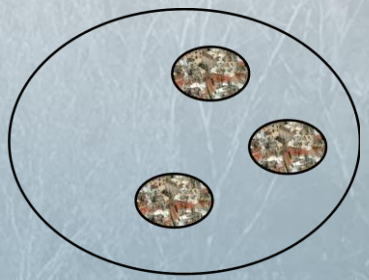
Monocentrica



Monocentrica dispersa



Diffusa



Policentrica

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Land take is going to affect irreversibly on:

- Availability of natural resources and related ecosystem functions;
- Hydrogeological stability;
- Landscape structure;
- General life quality.

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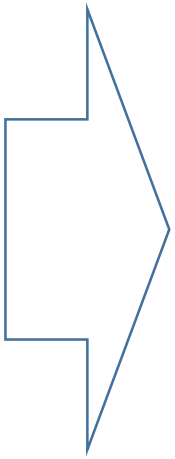
Uso del suolo --> Copertura del suolo --> Servizi ecosistemici

LIFE SAM4CP
SOIL ADMINISTRATION MODEL FOR COMMUNITY PROFIT

Una giornata per il SUOLO #SoilDay 2016

Servizi ecosistemici

- «Le condizioni e i processi attraversi i quali gli ecosistemi naturali e le specie che li compongono sostengono e permettono la vita umana» (Daily, 1997)
- «Benefici multipli forniti dagli ecosistemi al genere umano» (MEA, 2005)
- «Le condizioni e i processi degli ecosistemi che generano o aiutano a generare benefici per l'umanità» (Guerry et al., 2015)

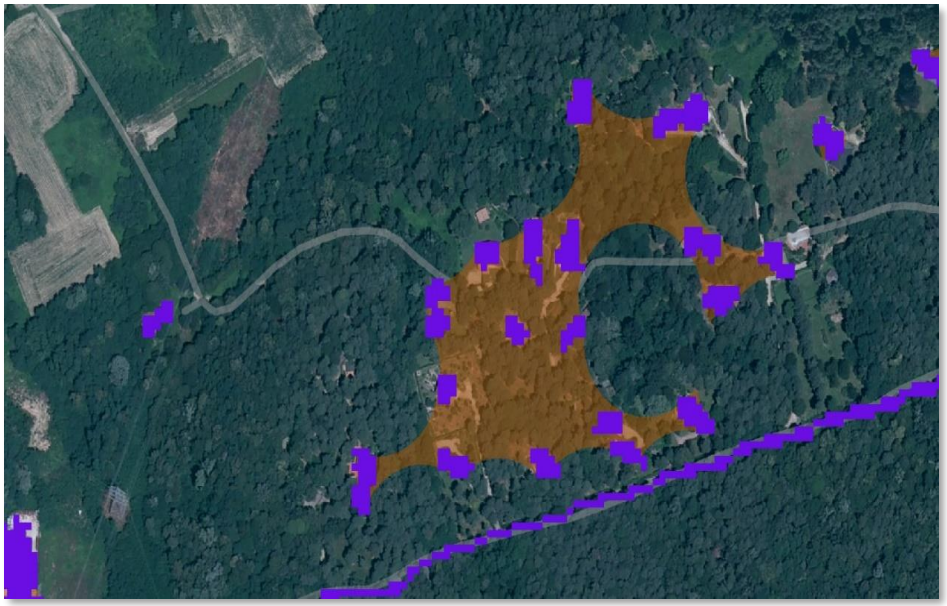


Benefici per la popolazione

Capitale naturale

The value of the world's ecosystem services and natural capital. (Costanza et al., 1997)

The economics of ecosystem and biodiversity (TEEB, 2010)



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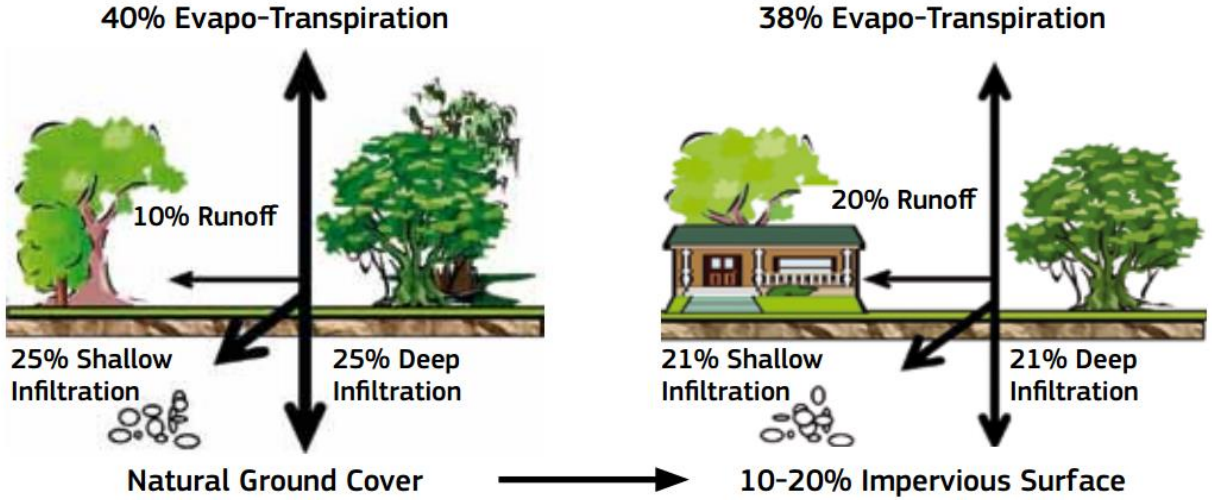
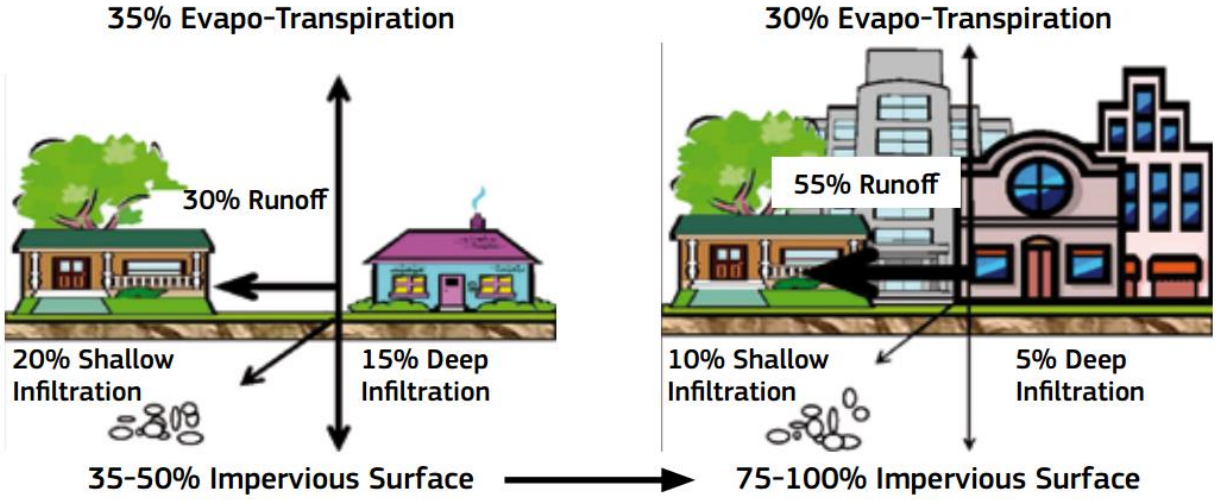
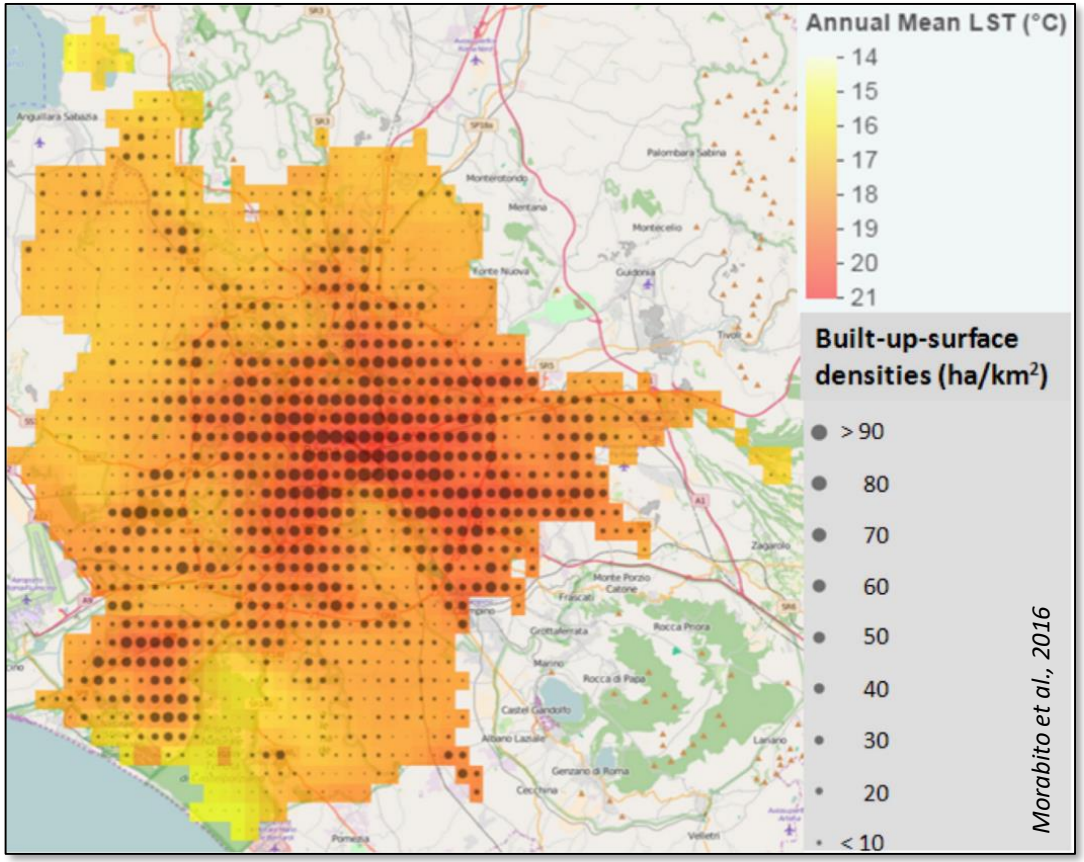
Una giornata per il SUOLO
#SoilDay 2016


95%
OF OUR FOOD COMES FROM OUR SOIL


40% Evapo-Transpiration
10% Runoff
25% Shallow Infiltration
25% Deep Infiltration
38% Evapo-Transpiration
20% Runoff
21% Shallow Infiltration
21% Deep Infiltration
Natural Ground Cover
10-20% Impervious Surface


35% Evapo-Transpiration
30% Runoff
20% Shallow Infiltration
15% Deep Infiltration
30% Evapo-Transpiration
55% Runoff
10% Shallow Infiltration
5% Deep Infiltration
35-50% Impervious Surface
75-100% Impervious Surface



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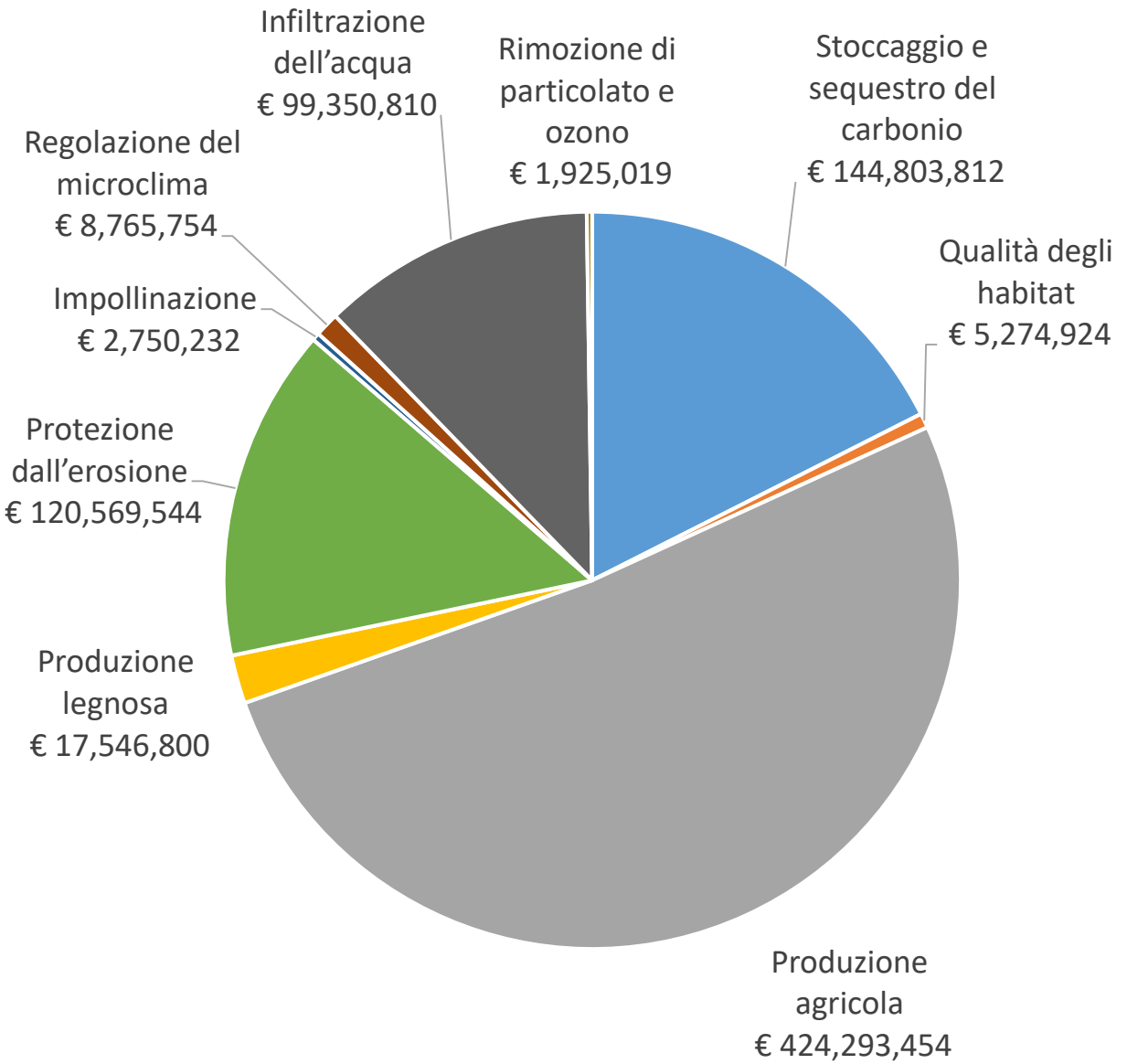
Aumento di 20 ettari per km^2 di suolo consumato -> aumento di 0,6 °C della temperatura superficiale

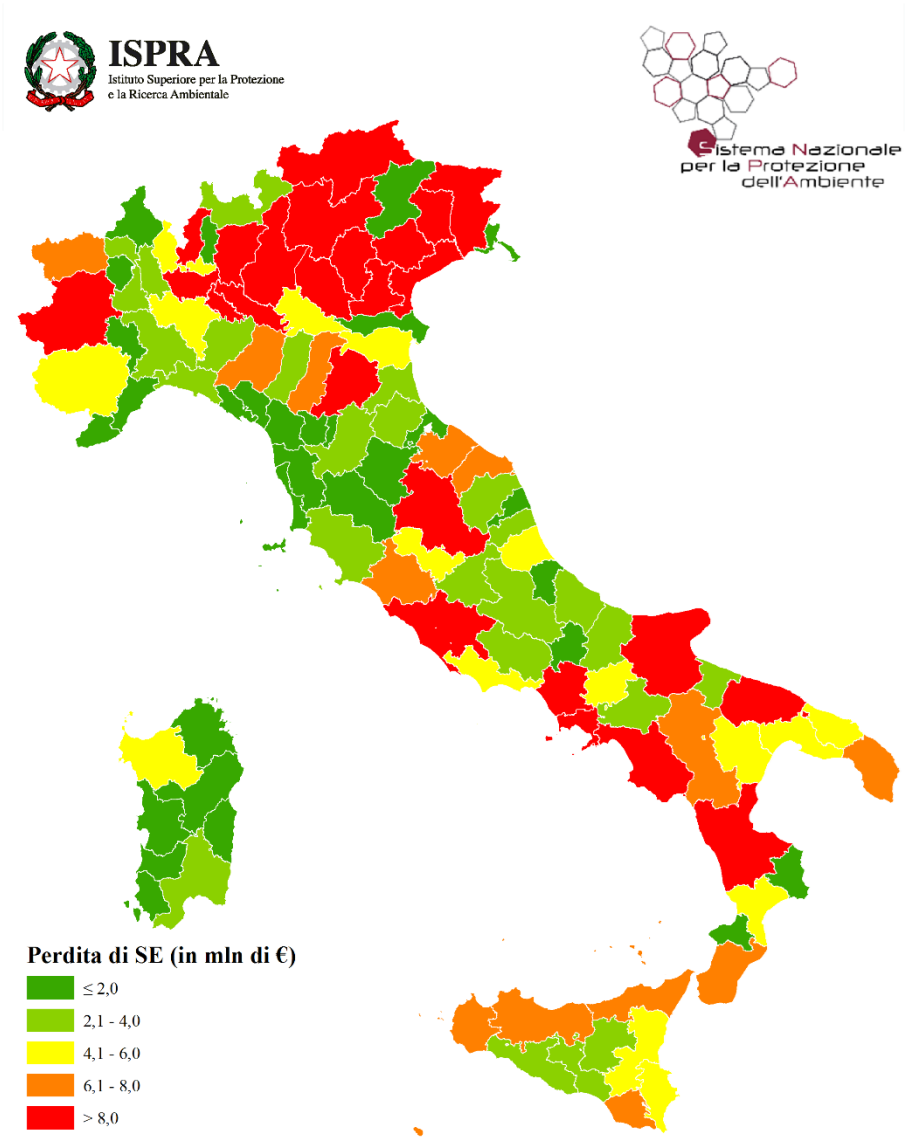
Una giornata per il SUOLO #SoilDay 2016

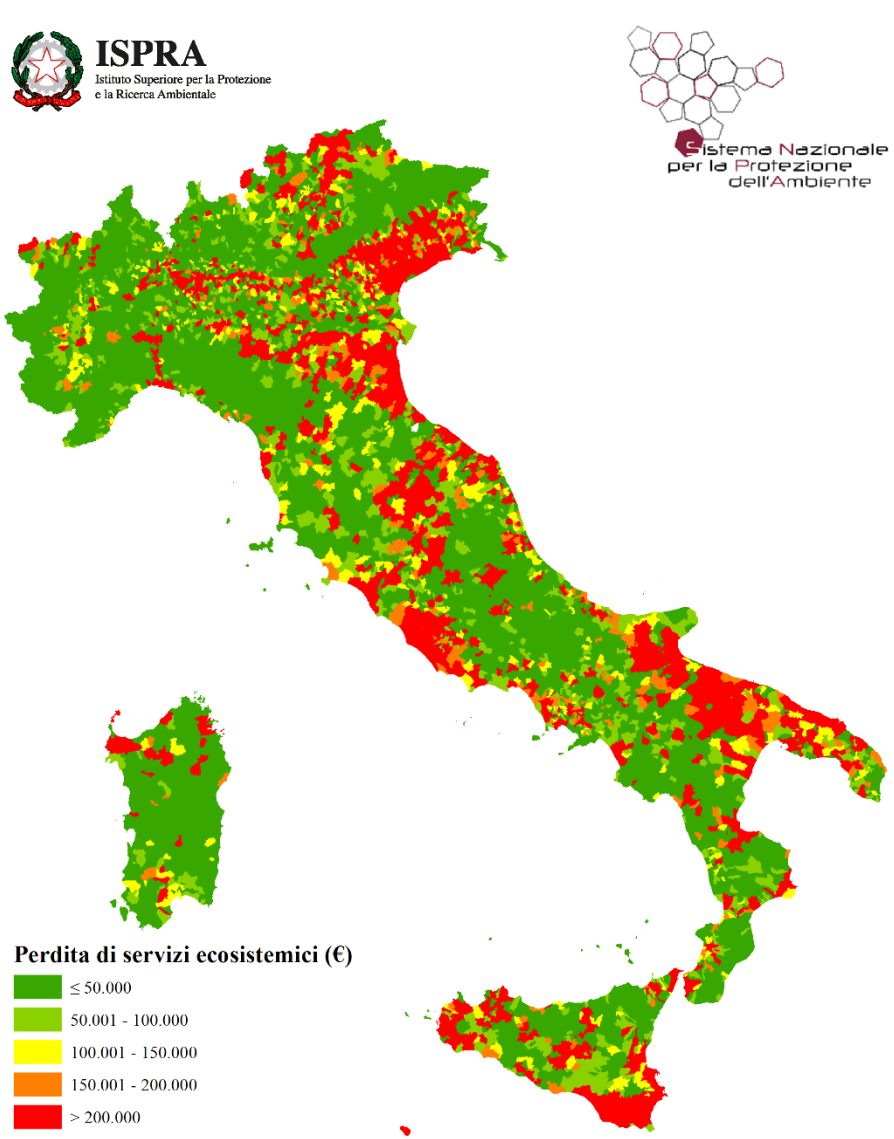
Quanto ci costa?

540-820 milioni di euro

Costi annuali aggiuntivi che si dovranno affrontare a livello nazionale a causa del consumo di suolo avvenuto **tra il 2012 e il 2015**







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Michele Munafò

michele.munafo@isprambiente.it

www.consumosuolo.isprambiente.it

twitter: @mic_mun