



CARISMAND

Culture And RIISK management in
Man-made And Natural Disasters

Parma 15-07-2015

*Landsat Brightness Temperature
Land consumption*

Summer Heat Risk Index: how to integrate recent climatic changes and soil consumption component

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ISPRA

OGRS'16, October 12-14, 2016,
Perugia, Italy

OGRS 2016
OPEN SOURCE GEOSPATIAL
RESEARCH & EDUCATION
SYMPOSIUM

*Open Source Geospatial Research & Education Symposium
OGRS is a meeting dedicated to sharing knowledge, new
solutions, methods, practices, ideas and trends in the field of
geospatial information through the development and the use
of free and open source software in both research and
education.*

Backgrounds

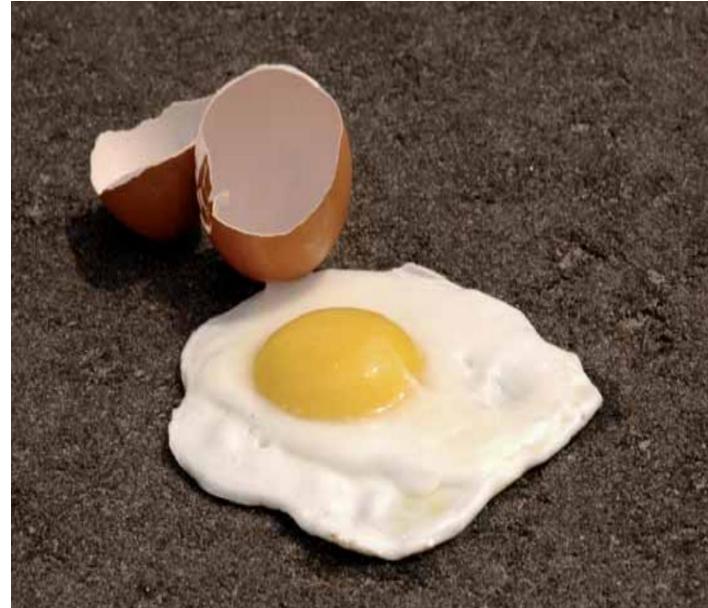
- Urban resilience is the keyword that links environmental thermal comfort and Land Consumption in relation to the climatic hazard on population in cities.
- Spatial risk assessment concerns the analysis of a risk outcome within a geographically bounded region as administrative unit.
- Do exist a methodological and operative framework where census, thermal/climatic and land consumption data are able to provide information to assess a summer heat-related hazard index for vulnerable people at different spatial scale?



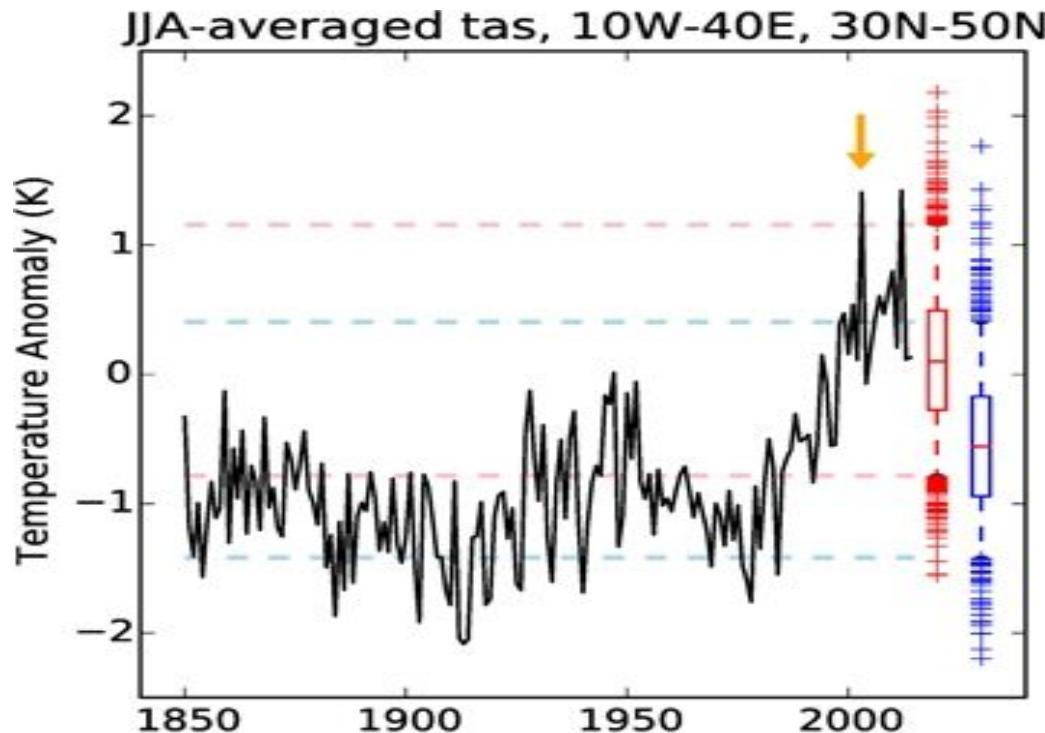
Image Source irational.org

Aims

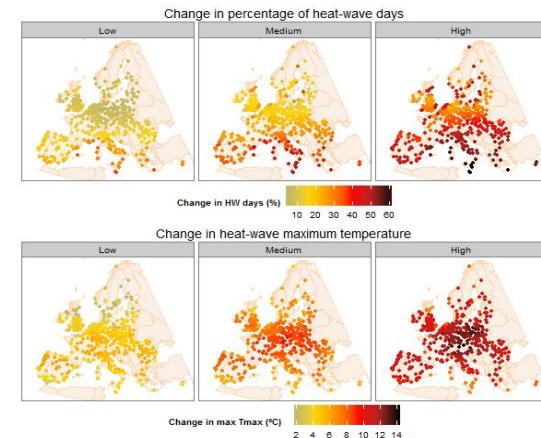
- **Describe the main components of the summer heat risk,** such as the thermal state/trend, population exposed, building density and land consumption.
- **Verify the validity of land consumption** as a proxy of urban heat vulnerability in reason to its link with urban heat island phenomenon (UHI).
- **Perform a spatial summer heat risk assessment** at different geographic scales but using the same risk assessment framework.
- **Share an operative and reproducible methodology** based on open data and using open source tools.



CLIMATIC HAZARD Summer thermal condition become a real risk for people.



Heat-wave hazard indices: change in percentage of heat-wave days (top) and change in the maximum temperature felt during a heat-wave (bottom) for a low (left), medium (centre) and high (right) impact scenario.



<http://www.ramses-cities.eu/>

Figure 1 from Attributing human mortality during extreme heat waves to anthropogenic climate change
Daniel Mitchell et al 2016 Environ. Res. Lett. 11 074006 doi:10.1088/1748-9326/11/7/074006

CLIMATIC HAZARD Worst “future”(?) scenario are NOW Italian case 2015

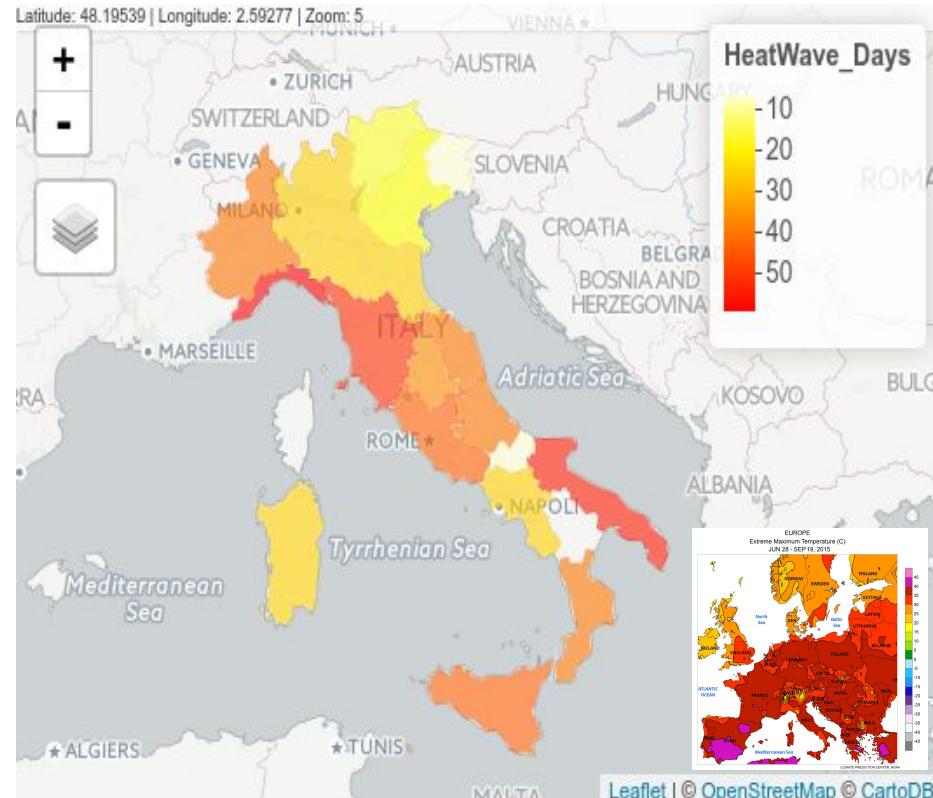
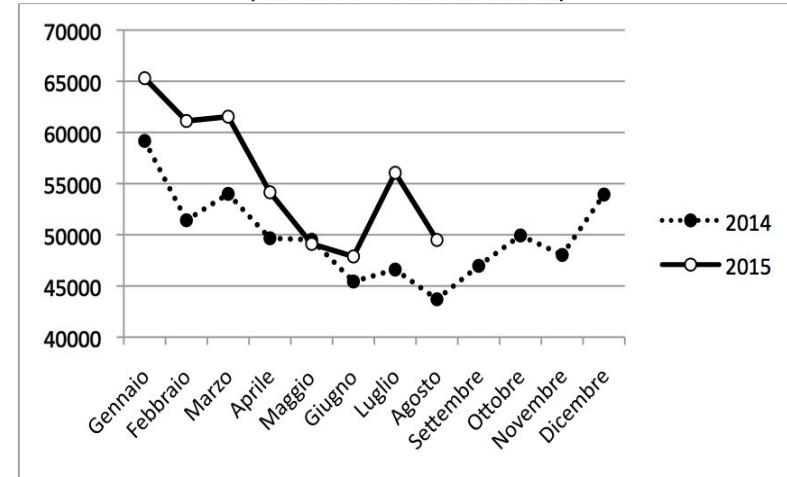


Fig. 1 - Italia: Frequenza mensile di morti. Anni 2014 e 2015
(Fonte www.demo.istat.it)



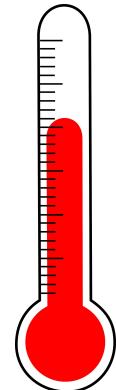
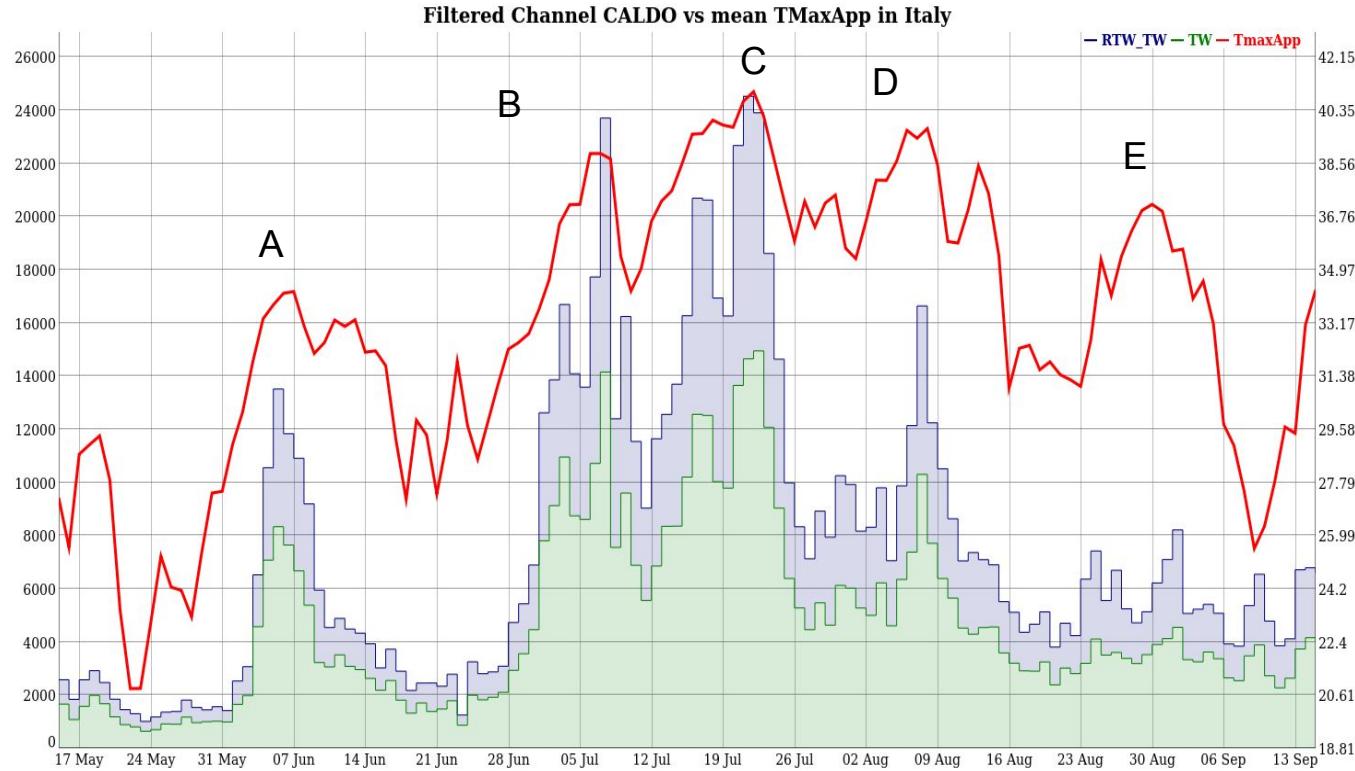
<http://www.neodemos.info/68-mila-morti-in-più-nel-2015/>

Image from Wiki Commons 2015 European Heat wave.

https://commons.wikimedia.org/wiki/Category:2015_european_heat_wave?uselang=de

CLIMATIC HAZARD: most urban perception but less awareness

Social media monitoring during Heatwave (15 May to 15 September 2015)



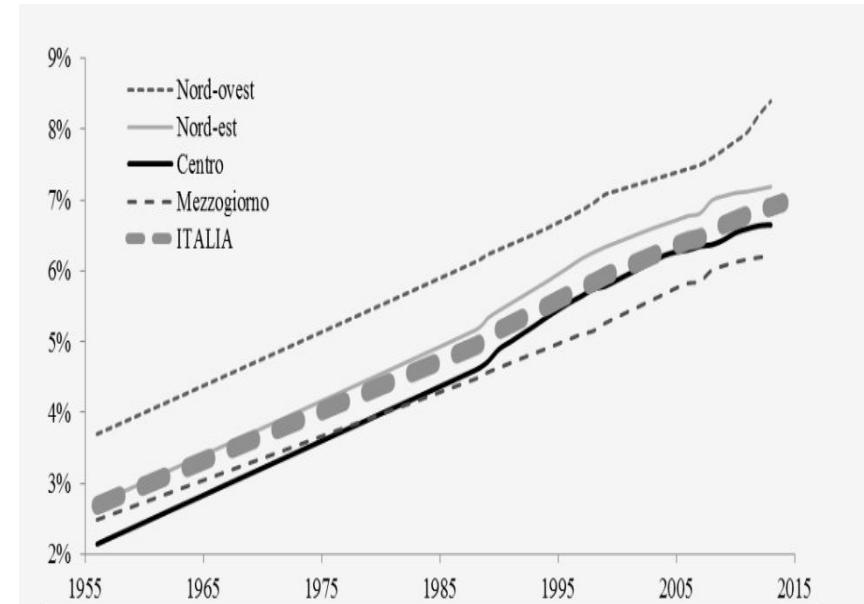
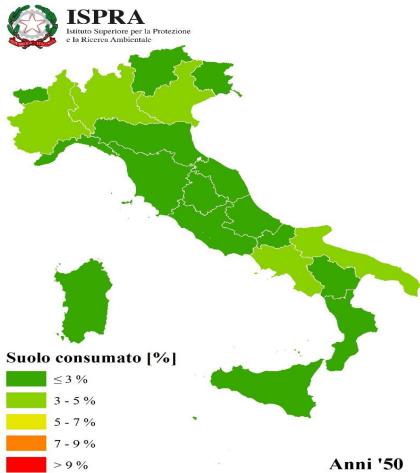
VULNERABILITY : Land consumption in urban areas



The expansion of built-up area (natural surface to artificial anthropized) which can be directly measured.

Definition source: [EEA](#), 1997, The concept of environmental space. Copenhagen <http://glossary.eea.europa.eu>

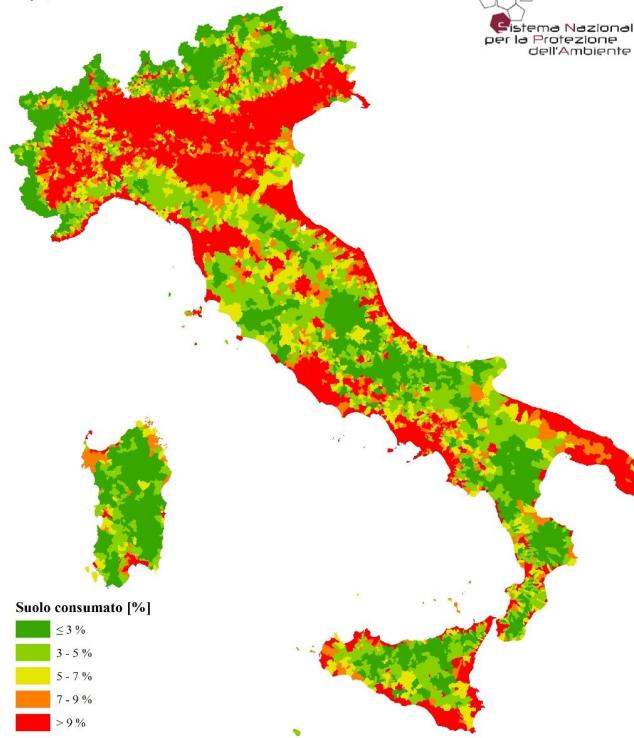
VULNERABILITY : Land consumption in Italy by regions and recent trends



- 21.100 km² (2015)

- 2,7% to 7%

VULNERABILITY : where land consumption in Italy by ISPRA



- 5.000 km² in urban areas
- 60% in rural areas

HAZARD & VULNERABILITY : Urban Heat Island

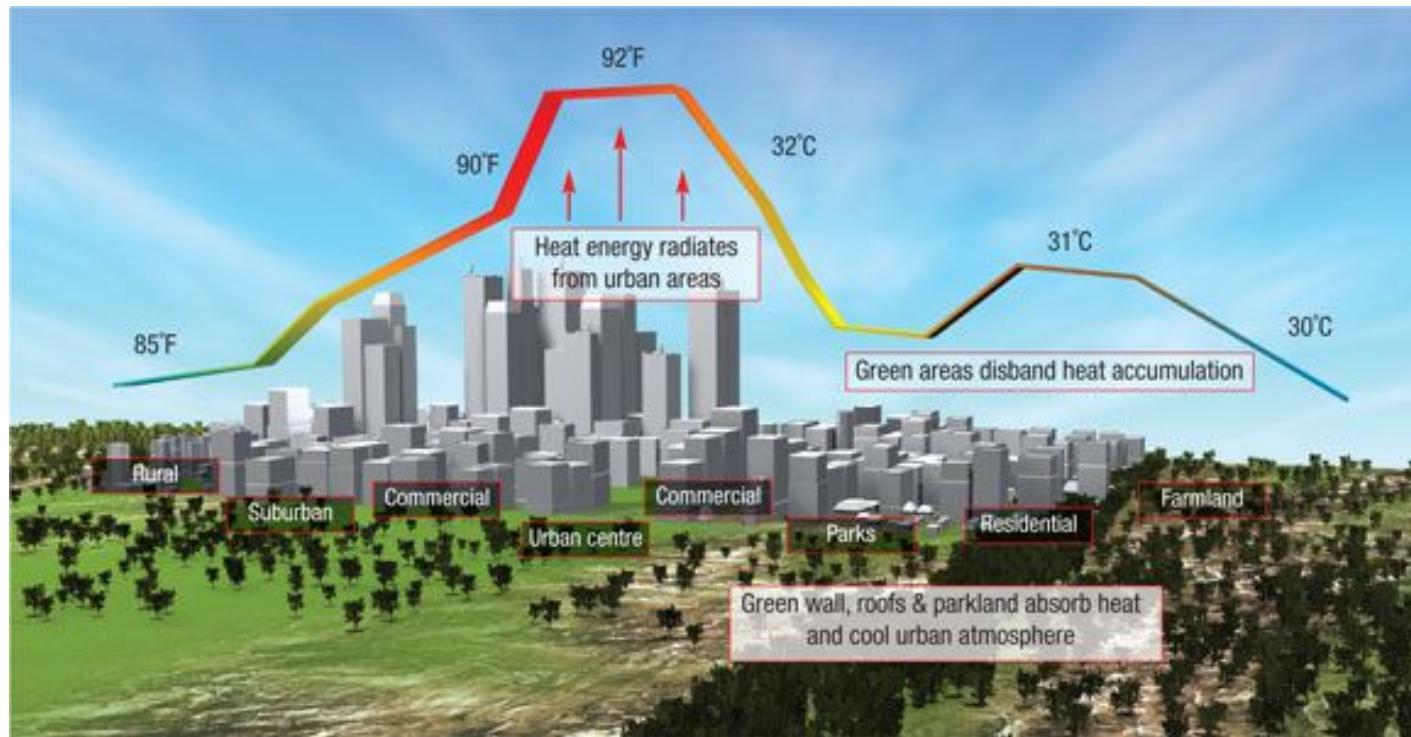
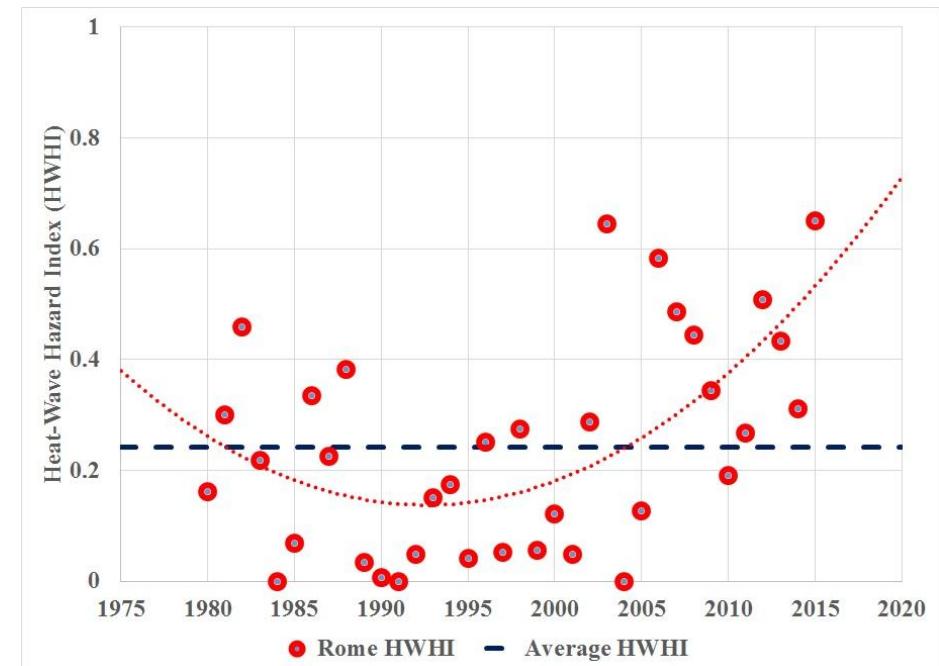
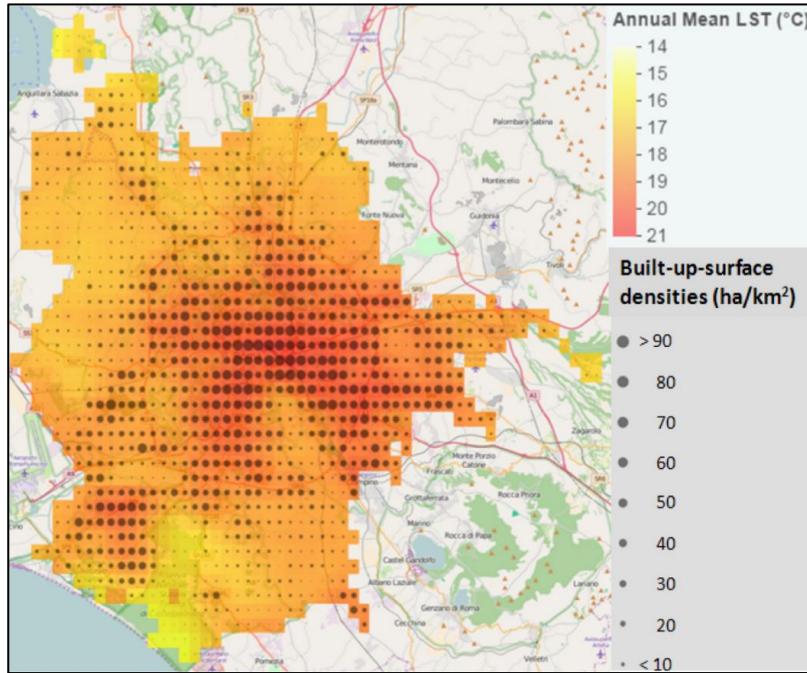


Image source: <http://actrees.org/wp-content/uploads/2015/06/Urban-heat-islands-infographic.png>

HAZARD & VULNERABILITY : Roma Land consumption ~ LST and Heatwave Index Trend in Rome



Morabito et al., PLoS One. 2015 Dec 29;10(12):e0144468.

DATA: the bunch of opendata sources environment, climate, census, remote sensing and urban elements.

The screenshot shows the homepage of ECA&D. At the top left is a yellow hexagonal logo with a grid of smaller dots. To its right is the text "European Climate Assessment & Dataset". Below the logo is a navigation bar with links: Home, FAQ, Daily data, Indices of extremes, Return values, Extreme events, and Project info. The main content area has a light beige background with some faint text and graphics.

E-OBS EU-FP6 project ENSEMBLES (<http://ensembles-eu.metoffice.com>)
www.ecad.eu/E-OBS/

The screenshot shows the homepage of NASA Landsat Science. It features the NASA logo at the top left. The main title "Landsat Science" is prominently displayed in large white letters against a dark background. Below the title is a navigation bar with links: Home, About, News, How Landsat Helps, Education, Images, Data, and Landsat 8. There are also social media links for Facebook and Twitter, and a search bar. The overall design is clean and professional.

NASA
http://landsat.gsfc.nasa.gov/?page_id=9

The screenshot shows the homepage of ISTAT. At the top left is the ISTAT logo with the text "Istat 90". The main navigation bar includes links for About Istat, Tenders and contracts, Job opportunities, Products, Tools, and Information. A search bar is located in the center. The main content area features a large image of rows of orange theater seats with red numbers (32, 34, 36, 38, 36, 38) on them. To the right of the image is a text box with the following text:
In the last Censuses innovation is at the forefront, not only in the collection methods, but also in returning information

ISTAT
<http://www.istat.it/en/population-and-housing-census>

The screenshot shows the homepage of the Regione Emilia Romagna Geoportale. At the top left is a large red "ER" logo. To its right is the word "Geoportale" in a large, bold, white font. To the right of "Geoportale" is the "community network EMILIA-ROMAGNA" logo. The top right corner has a link labeled "accedi". Below the main title is a horizontal banner featuring various environmental images like forests and water. The main menu below the banner includes links for Home, Catalogo, Mappe, Servizi, Applicazioni Gis, Archivio Cartografico, and Approfondimenti. The overall design is modern and user-friendly.

Regione Emilia Romagna Geoportale
<https://geoportale.regione.emilia-romagna.it/>

The screenshot shows the homepage of SINANET. At the top left is the SINANET logo. The main navigation bar includes links for Rete del Sistema Informativo Nazionale, Home, Rete SINAnet, INSPIRE, Progetti, Piani Fondali Nazionale ISONET, Documenti, INFORMAZIONE FOIA, Comunicati Stampa, and Sintesi. The main content area features a large image of a map titled "Cartografia_consumo_suolo_10m" with a small note: "Carta nazionale del consumo di suolo (edizione 2016, dae 2012 e 2015, risoluzione 10 m (v. 1.0) - 12/09/2016". Below the map is a download link: "BU_10m.tif - Zip archive, 1074589 kB (1100357784 bytes)".



ISPRa Banca dati del consumo suolo a 10 m
<http://www.sinanet.isprambiente.it/it>

TOOLS: R & Python & QGIS & GeoScience open source are used

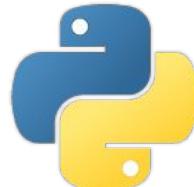


<https://github.com/jannes-m/RQGIS>

R <https://cran.r-project.org/web/views/Spatial.html>

R rLandsat8
<http://terradue.github.io/rLandsat8/>

PYTHON rasterstats
<http://pythonhosted.org/rasterstats/>

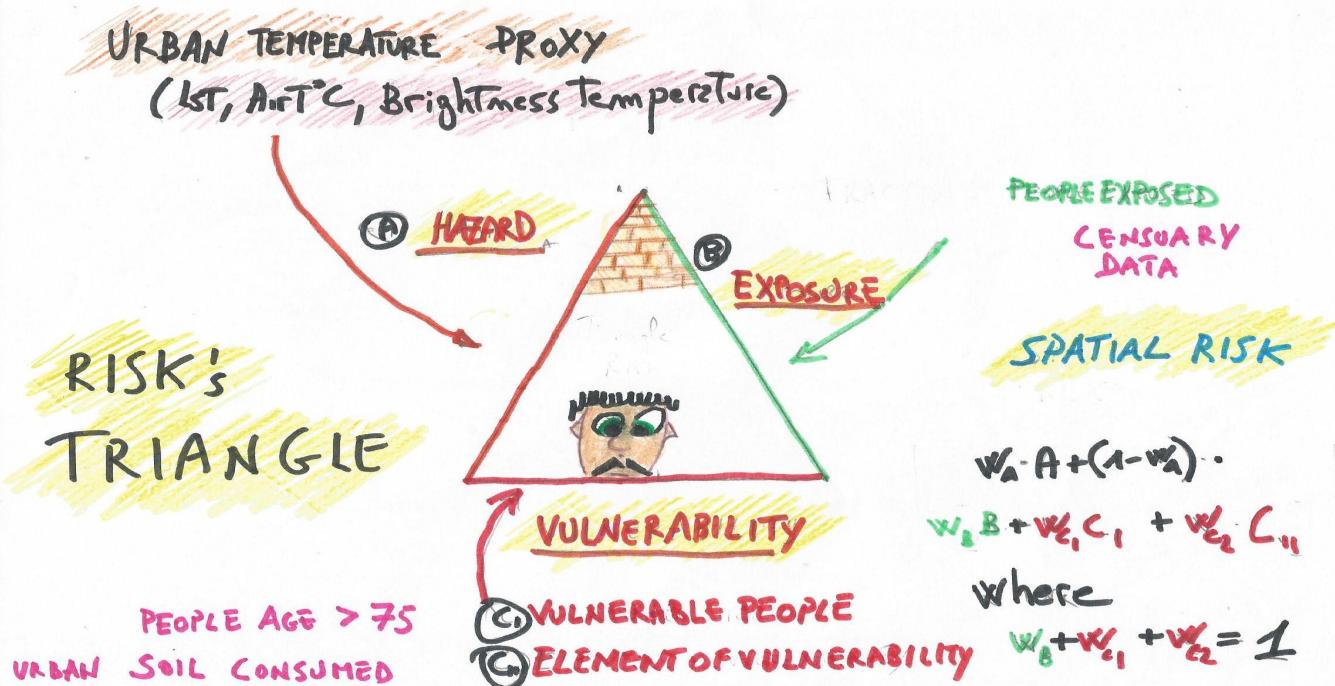


Semi-Automatic Classification Plugin (SCP)
<https://github.com/semitautomatiggit/SemiAutomaticClassificationPlugin>

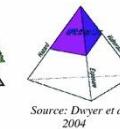
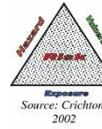


QGIS <http://www.qgis.org/it/site/>

SPATIAL RISK concerns the analysis of a risk for vulnerable people within a geographically bounded region

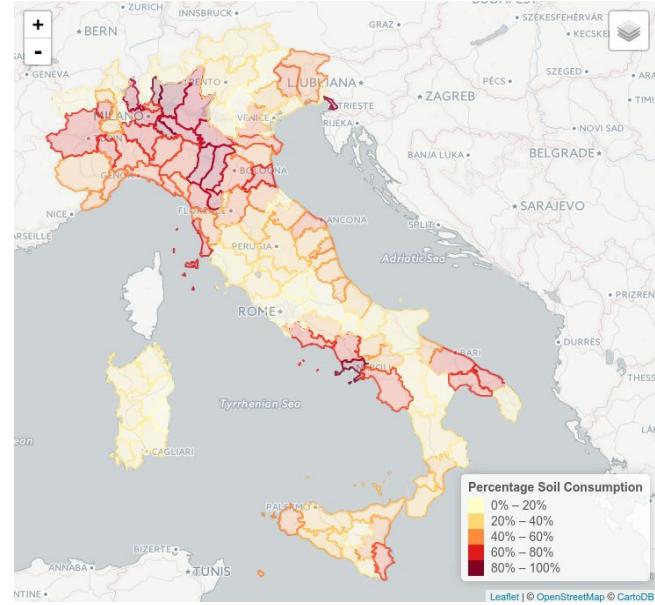
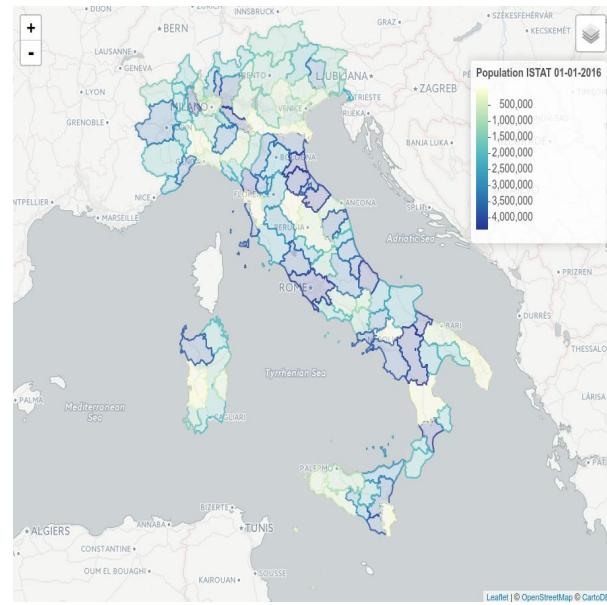
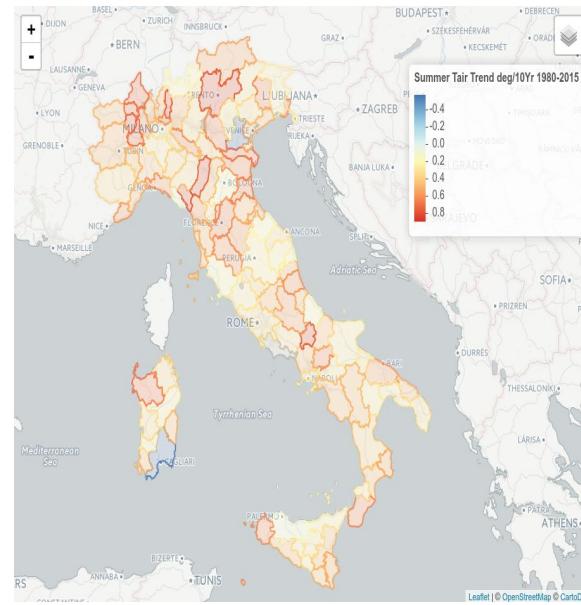


$$w_A \cdot A + (1-w_A) \cdot \\ w_B \cdot B + w_{C_1} \cdot C_1 + w_{C_2} \cdot C_2 \\ \text{where } w_A + w_{C_1} + w_{C_2} = 1$$



By using a proper weighting scheme and managing the information layers related to a specific risk in a spatial domain it is possible a spatial representation of itself in 5 or more classes.

SPATIAL RISK ASSESSMENT Summer heat risk at ADM2 scale in Italy

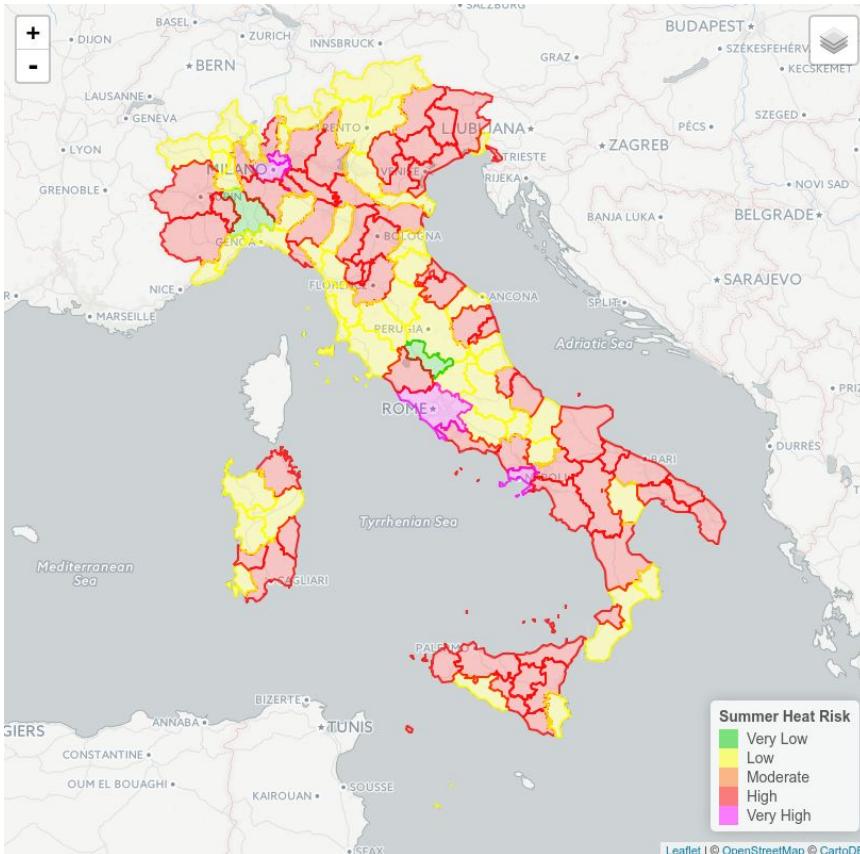


HAZARD
Decadal trend of EOBS
Tair °C/10yr 1980-2015
W_H 0.5

EXPOSURE
Population ISTAT (2015)
W_E 0.5

VULNERABILITY
% Land consumption ISPRA (2015)
W_V 0.5

SPATIAL RISK ASSESSMENT Summer heat risk at ADM2 scale in Italy



Summer Heat Risk Index

$$W_H \text{ norm}(H) + (1-W_H) * (W_E * \text{norm}(E) + W_V * \text{norm}(V))$$

Summer heat risk class

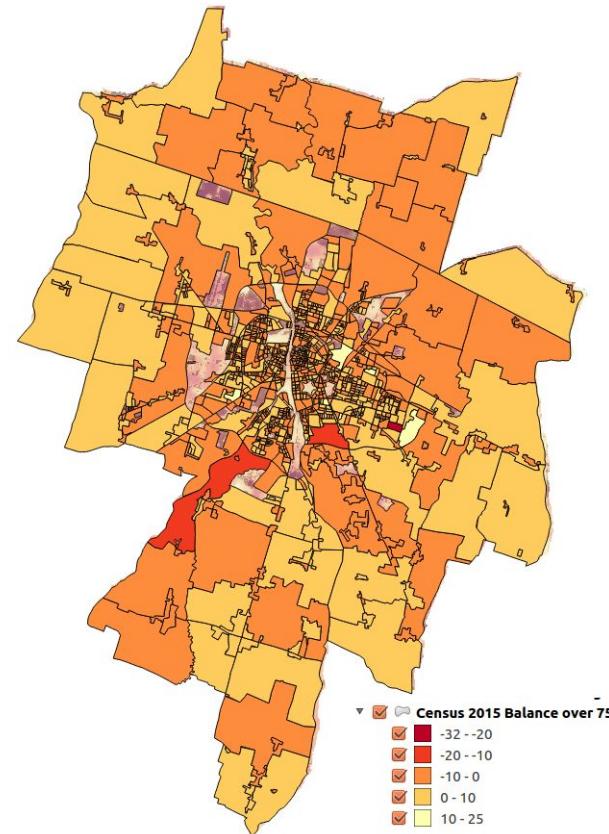
$$\text{SHRI} || 1-5$$

Geographical units are ranked by risk and the representation put in evidence where summer risk is clustered.
Urban dense areas are vulnerable to the increase of extreme heat summer condition

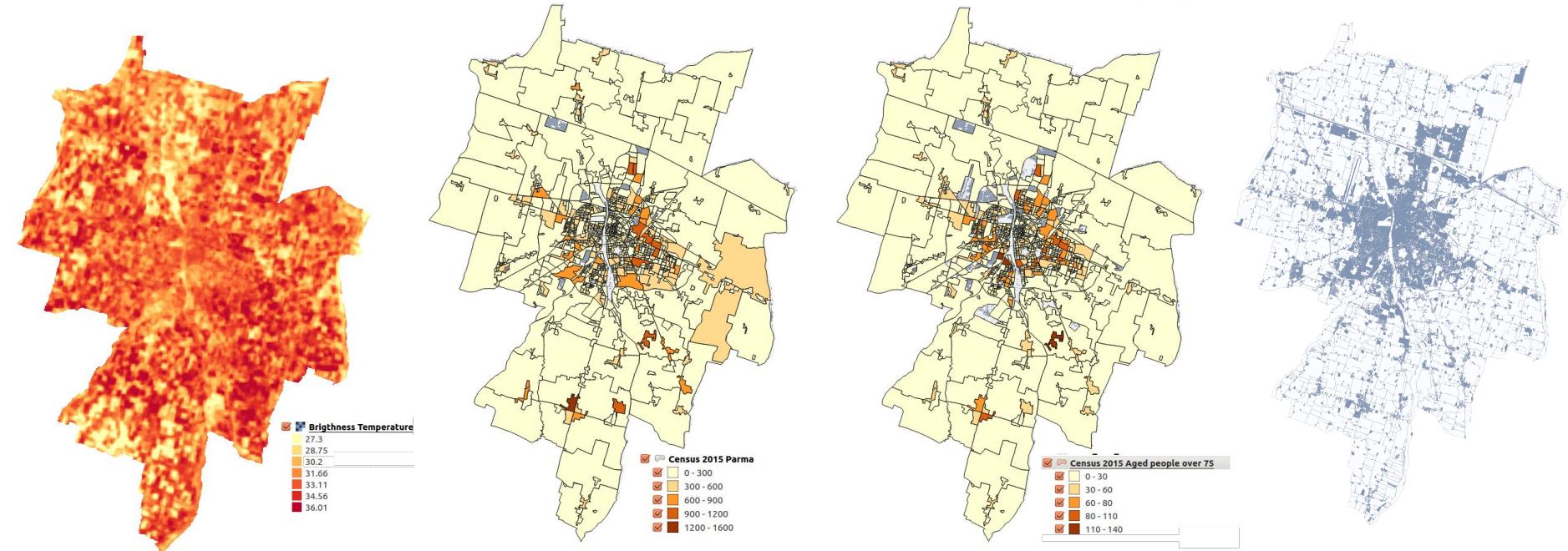
SPATIAL RISK ASSESSMENT Parma case in Italy Aged people excess of mortality >75

Università degli Studi di Parma, Dottorato
di ricerca in Ingegneria Civile e
Architettura, XXIX Ciclo, dottoranda

Patrizia Rota, *L'impatto del clima sulle
scelte urbanistiche. Strategie di
adattamento climatico nella pianificazione
della città media emiliana del II
dopoguerra: il caso Parma*, relatore prof.
Michele Zazzi, Tutor prof. Paolo Ventura,
coordinatore del Dottorato prof. Andrea
Carpinteri



SPATIAL RISK ASSESSMENT Summer heat risk at urban scale Parma case in Italy



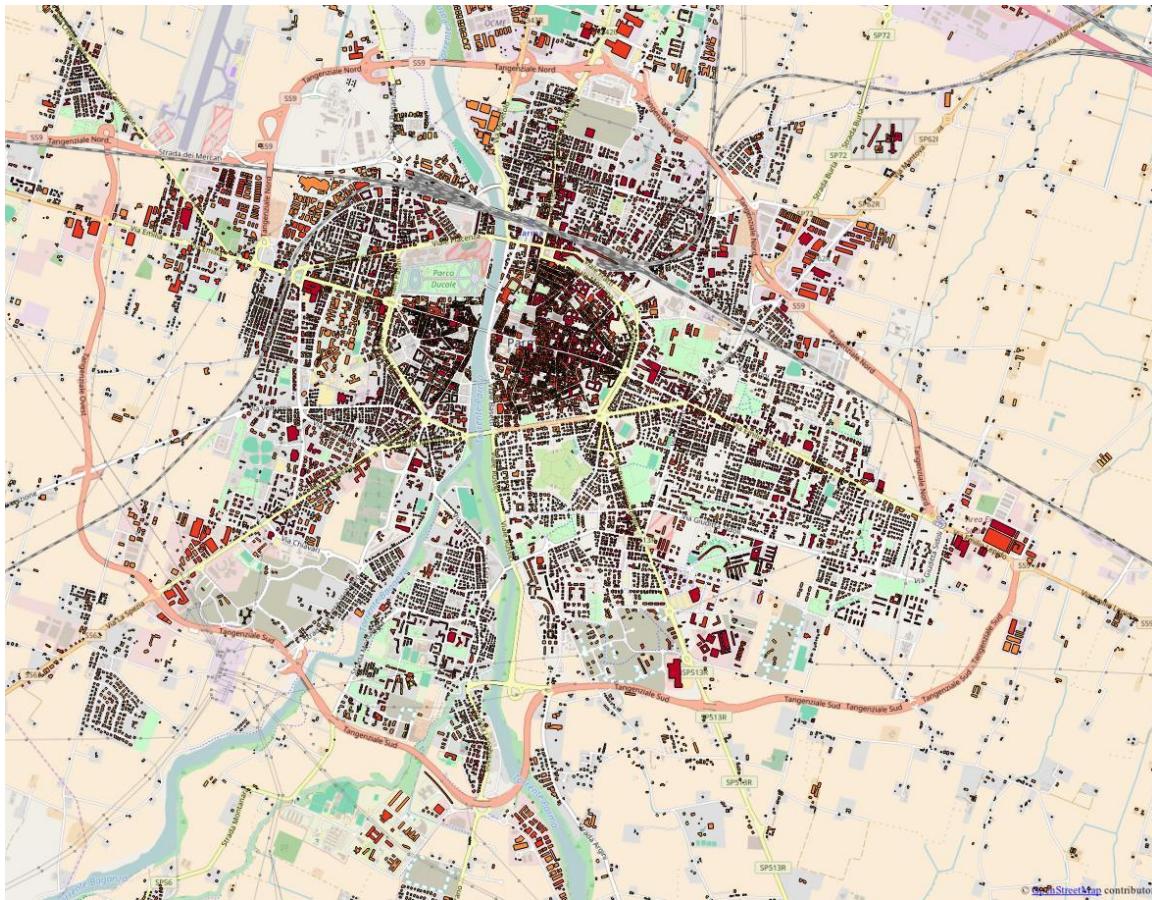
HAZARD
Landsat Brightness
temperature 15-07-2015
NASA W_H 0.5

EXPOSURE
Building Population Density
ISTAT W_E 0.33

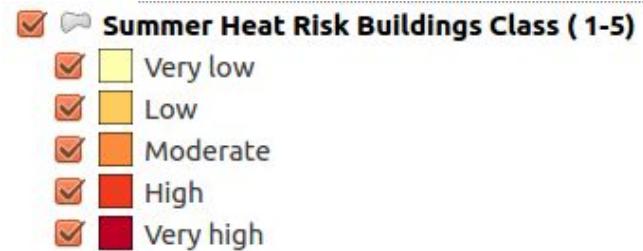
VULNERABILITY I
Building density
Pop > 75 year
ISTAT W_v 0.33

VULNERABILITY II
% Near Building >
200m
Land consumption
ISPRA W_v 0.33

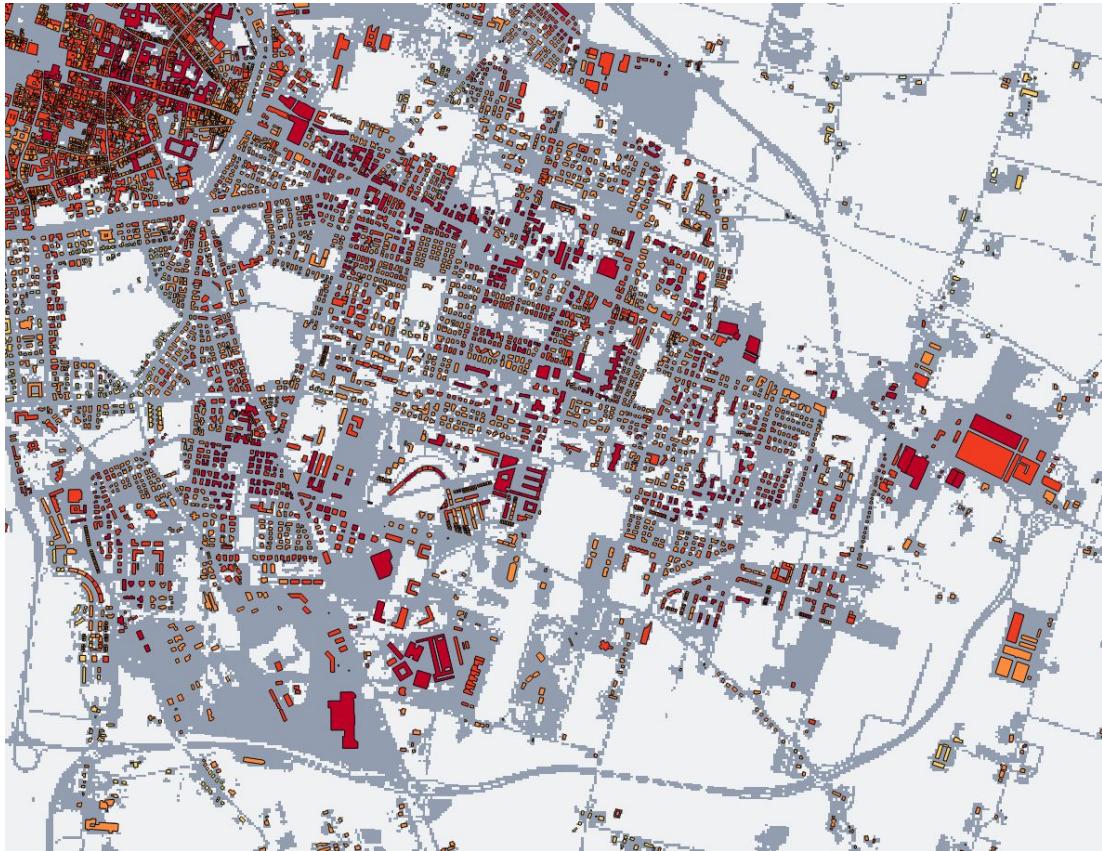
SPATIAL RISK ASSESSMENT Summer heat risk class for each building



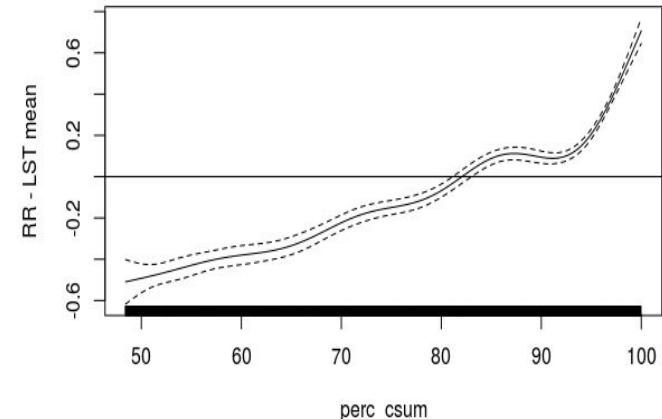
Disaggregating by building area census data, retrieving temperature from landsat and calculate land consumption around building is possible to compute risk and heat class risk at small scale by using same framework.



SPATIAL RISK ASSESSMENT Less land consumption less summer heat risk



Relation between relative surface temperature increase
and degree of soil sealing (% < 200m)



Dark grey: soil consumption

- Summer Heat Risk Buildings Class (1-5)**
- Very low
- Low
- Moderate
- High
- Very high

Conclusion

- Large geographic open data availability and open source tools allow to perform detailed urban spatial risk assessment for environmental issues in Italy.
- Risk evaluation by using Crichton's framework (2004) is very reliable and invariant spatial scale. Large scale and small scale analyses could have led in similar ways.
- Spatial representation of risk give a deep mapping for issues such as the urban summer heat risk.
- Land consumption demonstrate its importance in the italian urban context. Outdoor urban thermal comfort in summer have deep relationship with the urbanistic city features.
- Summer heat risk accounting for recent climatic variability (since 2000) become important and its impact have a strong spatial signature at large and local scales.

Contacts

Biometeorology

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ISPRA Land Consumption

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Data & Code: https://github.com/alfcrisci/ogrs_2016_SHRI_paper

This study was carried out in the field of the CARISMAND Project: *Culture And RISK management in Man-made And Natural Disasters*

 **CARISMAND**
Culture And RISK management in
Man-made And Natural Disasters

<http://www.carismand.eu/>

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HOME ABOUT CARISMAND TEAM ACTIVITIES GALLERY MEDIA CENTRE CONTACTS  INTRANET

LIVE The earthquake in Italy: stereotyped narratives and missing social science

About CARISMAND

- ✓ **Project Concept** - CARISMAND aims to deal with the issues of preparedness, response to disasters and after-crisis recovery which is inevitably influenced by cultural background...
- ✓ **Project Objectives** - Pursuing its goals towards culturally-informed solutions for disaster management...
- ✓ **Why is CARISMAND unique?** - CARISMAND comprehensively addresses a number of specific challenges and scope through a variety...
- ✓ **Who does CARISMAND concern?** - All CARISMAND activities are designed in such a way to be able to reach these

News


EMSC's 5 Visual Safety Tips for Good Practices after an Earthquake

You could help The Euro-Mediterranean Seismological Centre improve their safety tips by answering a few questions.

 AID & INTERNATIONAL DEVELOPMENT FORUM
Building Global Partnership in Disaster Relief, Food & Water Security

AIDF Global Disaster Relief Summit, 7-8 September 2016

The summit is organised by the Aid & International Development Forum and will take place in Washington DC, USA.



Deadly Italian Quake Highlights Continuing Struggle to Communicate Risk

An article by Edwin Cartlidge focusing on the issues of shaping a clear, non-misleading preparedness message to a population in the grip of a disaster.



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Consiglio Nazionale delle Ricerche