

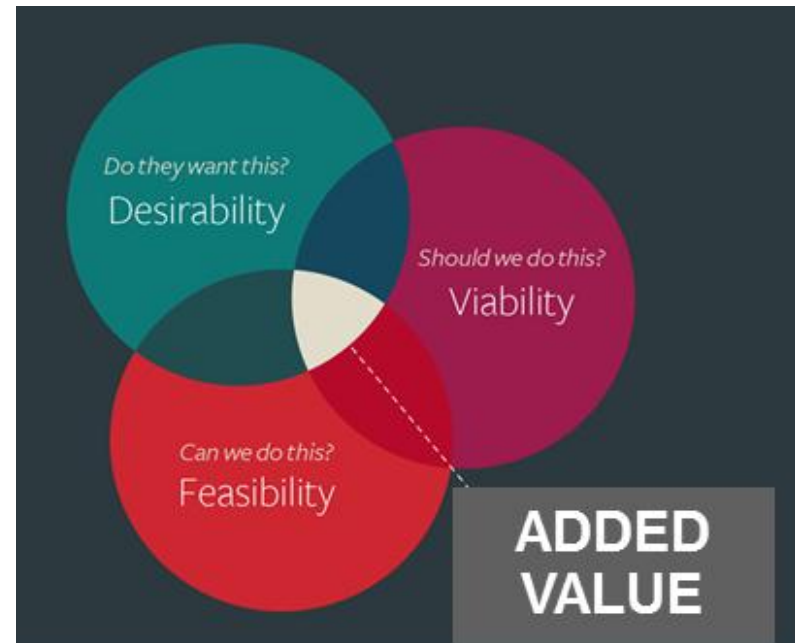
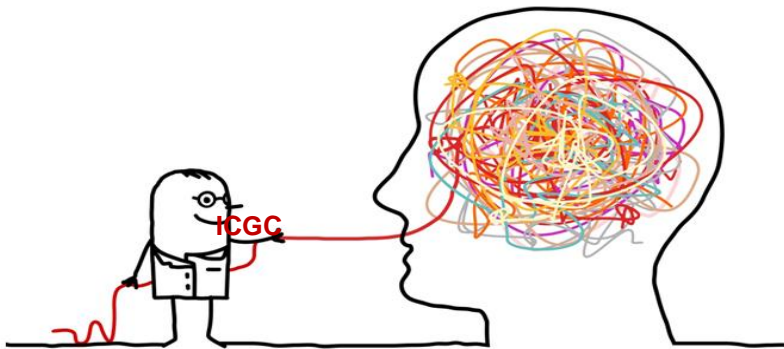
# “Urban ecosystem: from research to operational earth observation”

*Institute Cartographic and Geological of Catalonia*  
Dr. Jordi Corbera  
[jordi.corbera@icgc.cat](mailto:jordi.corbera@icgc.cat)



## INNOVATION AND EARTH OBSERVATION

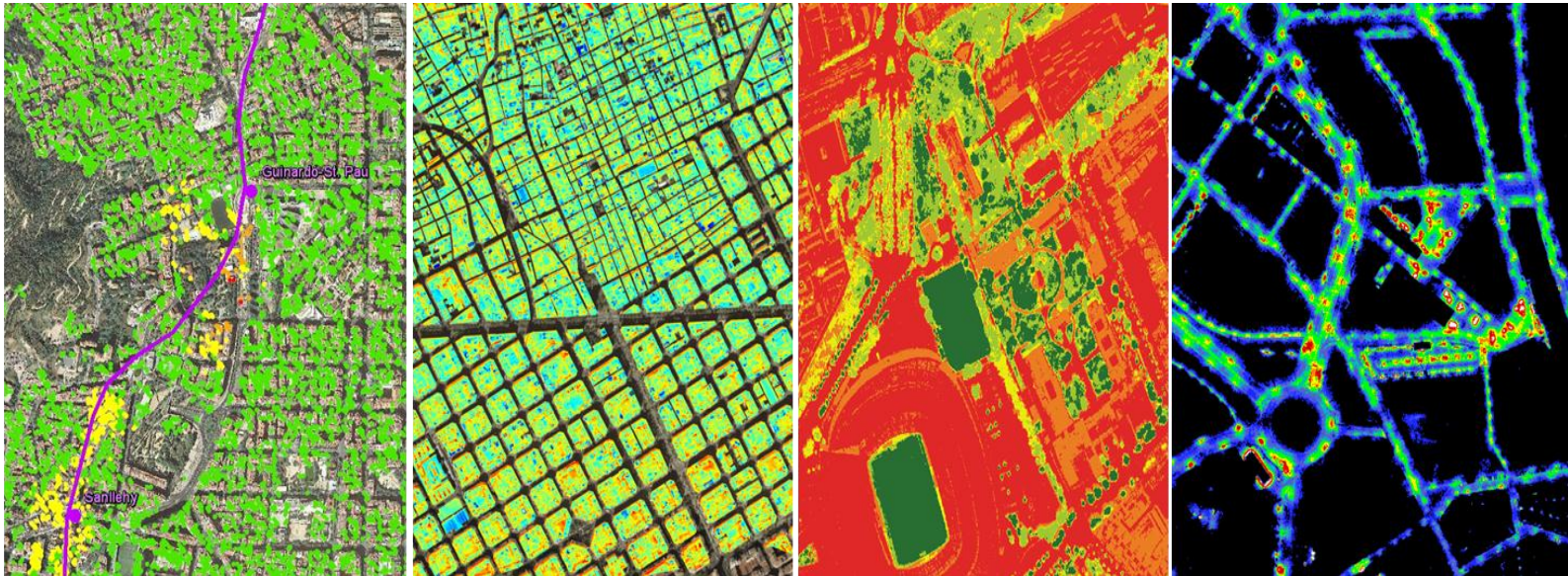
*“The myth of innovation is that brilliant ideas leap fully formed from the minds of geniuses. The reality is that most innovations come from a process of rigorous examination through which great ideas are identified and developed before being realized as new offerings and capabilities.” Tim Brown – Design by Change*



# HOW TO TRANSFORM DATA INTO INFORMATION AND KNOWLEDGE

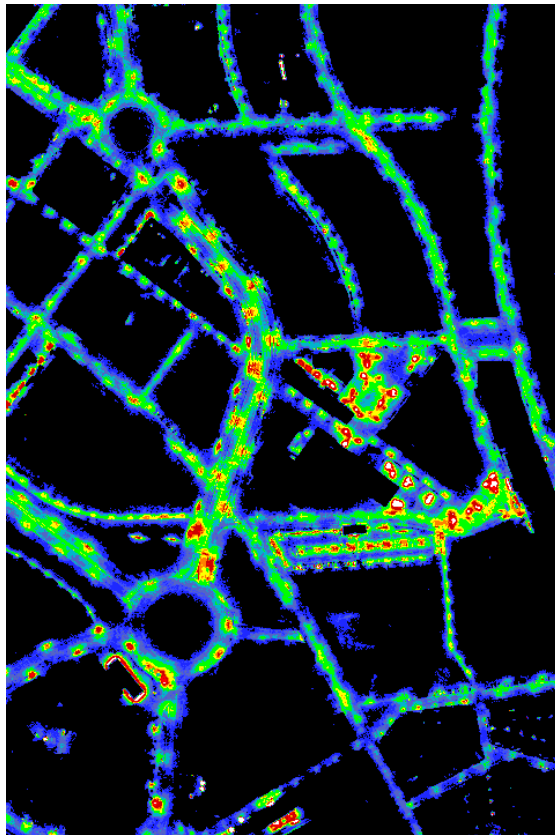
## ON URBAN ECOSYSTEM

SCIENCE + TECHNOLOGY + REAL CHALLENGES TO BE SOLVED = ADDED VALUE

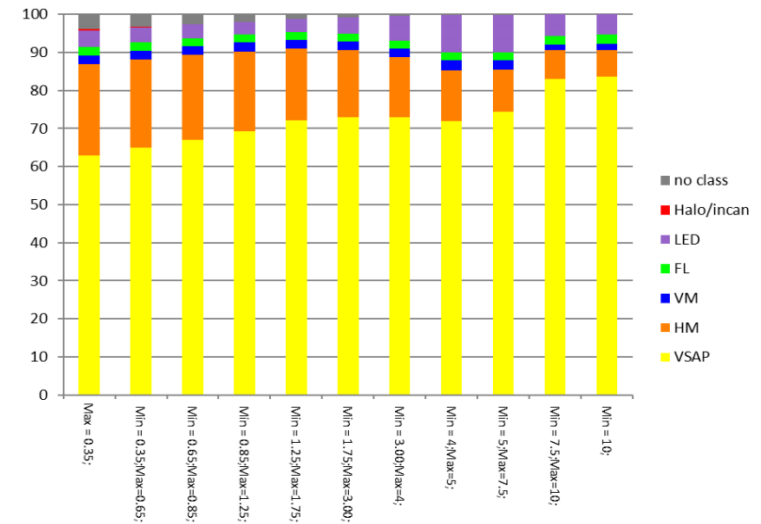
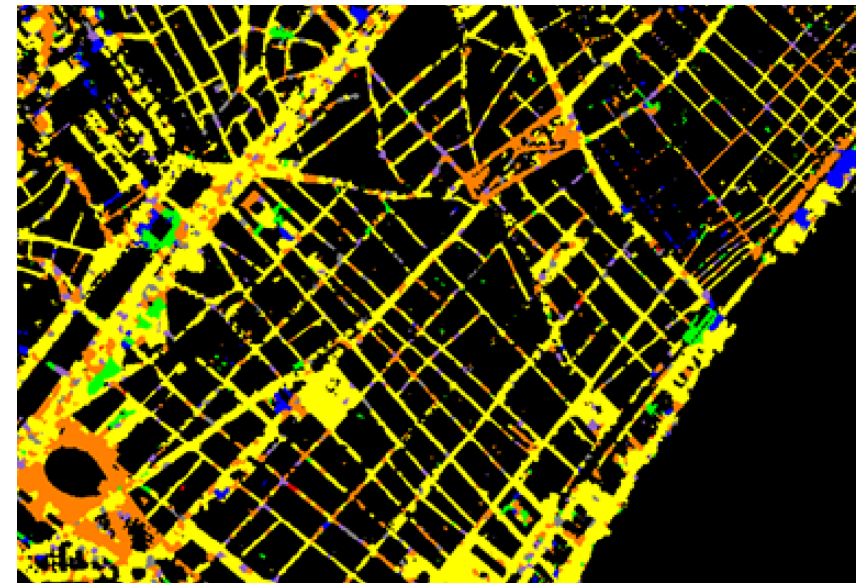
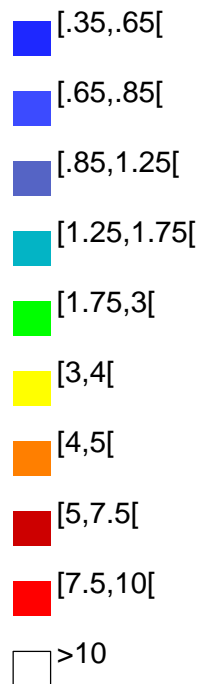


... some examples how to transform data into knowledge

# LUMINANCE MAP

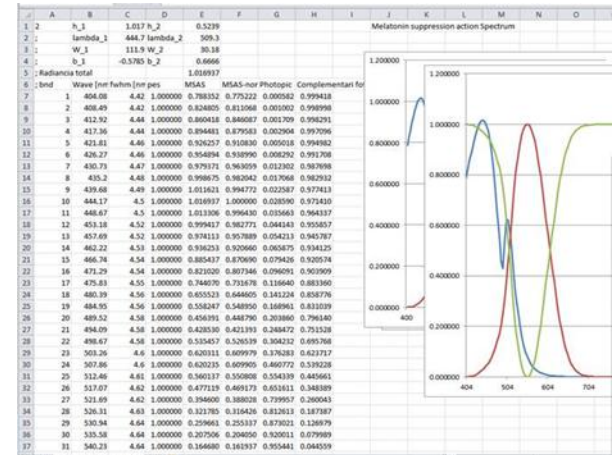


## Classification



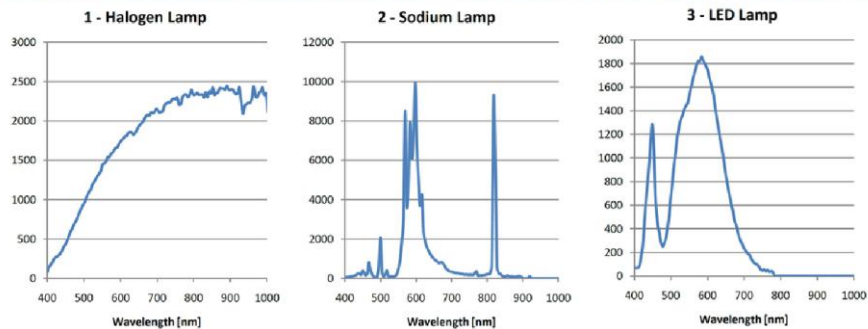
The analysis of luminance at night is performed **by ICGC in conditions of little or null moonlight**, so that the radiation captured by airborne sensors can be directly associated to artificial –human lighting. Own ICGC models allow us to retrieve values of luminance at candles per square meter ( $\text{cd} / \text{m}^2$ )

# LUMINANCE MAP



(Melatonin Suppression Active Spectrum)

# LUMINANCE MAP



ISPRS Journal of Photogrammetry and Remote Sensing xxx (2016) xxx-xxx



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## Ground-based hyperspectral analysis of the urban nightscape

Ramon Alamús<sup>a</sup>, Salvador Bará<sup>b,\*</sup>, Jordi Corbera<sup>a</sup>, Jaume Escofet<sup>c</sup>, Vicenç Palà<sup>a</sup>, Luca Pipia<sup>a</sup>, Anna Tardà<sup>a</sup>

<sup>a</sup> Institut Cartogràfic i Geològic de Catalunya (ICGC), Parc de Montjuïc s/n, 08038 Barcelona, Catalunya, Spain

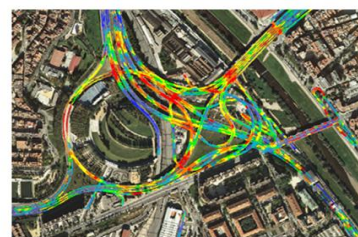
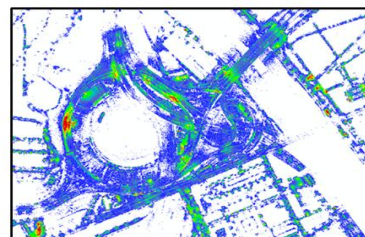
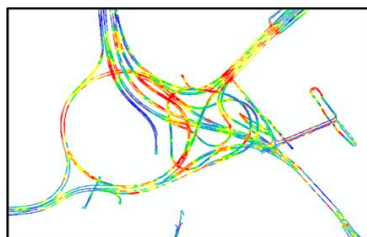
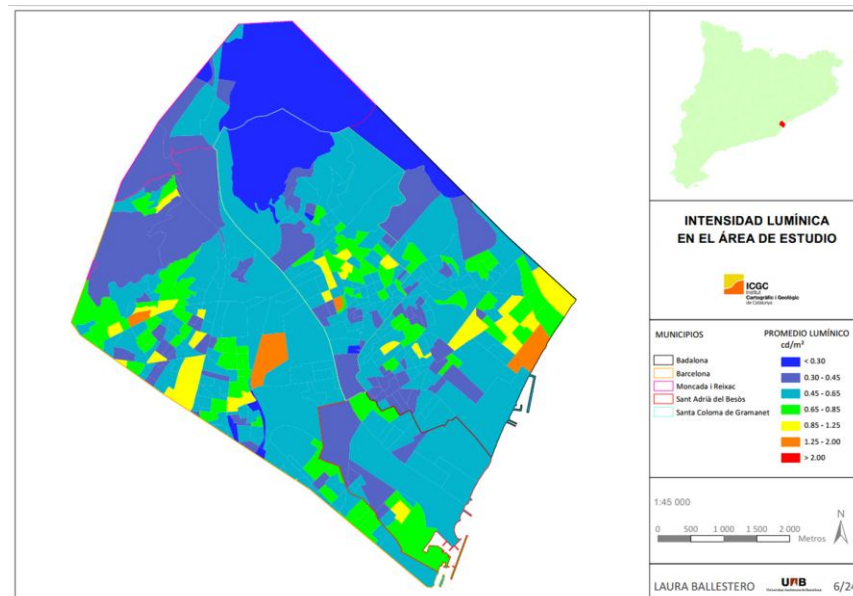
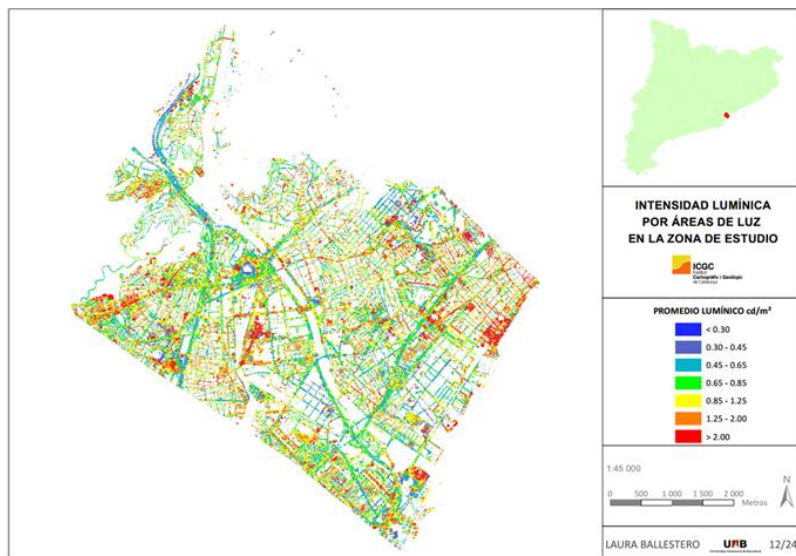
<sup>b</sup> Àrea de Òptica, Departament de Física Aplicada, Universidat de Santiago de Compostela, Santiago de Compostela, Galicia, Spain

<sup>c</sup> Departament d'Òptica i Optometria, Universitat Politècnica de Catalunya, Terrassa, Catalunya, Spain

any	VSAP	HM	FLU	VMCC	Total
2012	8472	37736	9753	2815	58776
2014	4839	36871	2148	772	44630
Variació [%]	43%↓	2%↓	78%↓	73%↓	24%↓

Any	2.5-3 cd/m <sup>2</sup>	3 - 4 cd/m <sup>2</sup>	4 - 5 cd/m <sup>2</sup>	5-7.5 cd/m <sup>2</sup>	7.5-10 cd/m <sup>2</sup>	Més 10 cd/m <sup>2</sup>	Total > 2.5 cd/m <sup>2</sup>
2012	998613	490995	136395	91917	25524	28008	1771454
2014	861246	249021	285534	24048	6456	10161	1436466
Variació [%]	14%↓	49%↓	109%↑	74%↓	76%↓	64%↓	19%↓

# LUMINANCE MAP



## PROMEDIO LUMÍNICO cd/m<sup>2</sup>

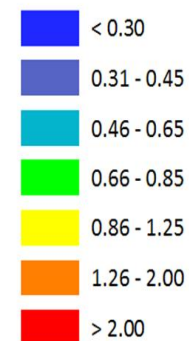
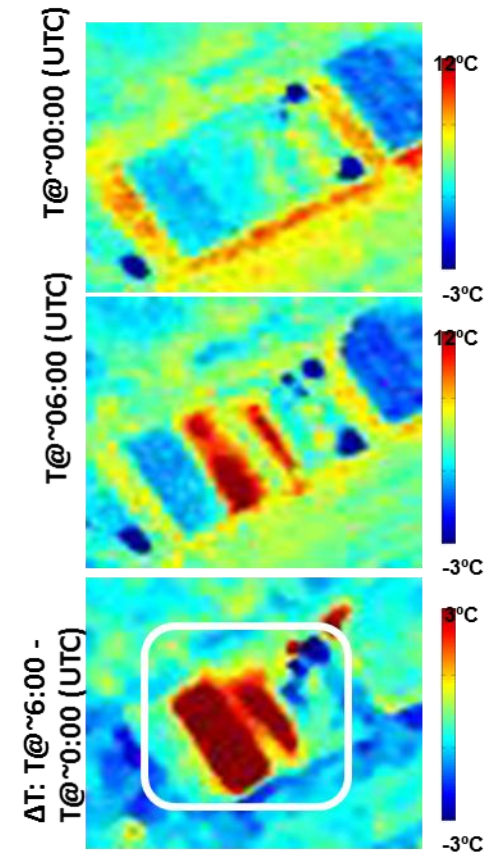
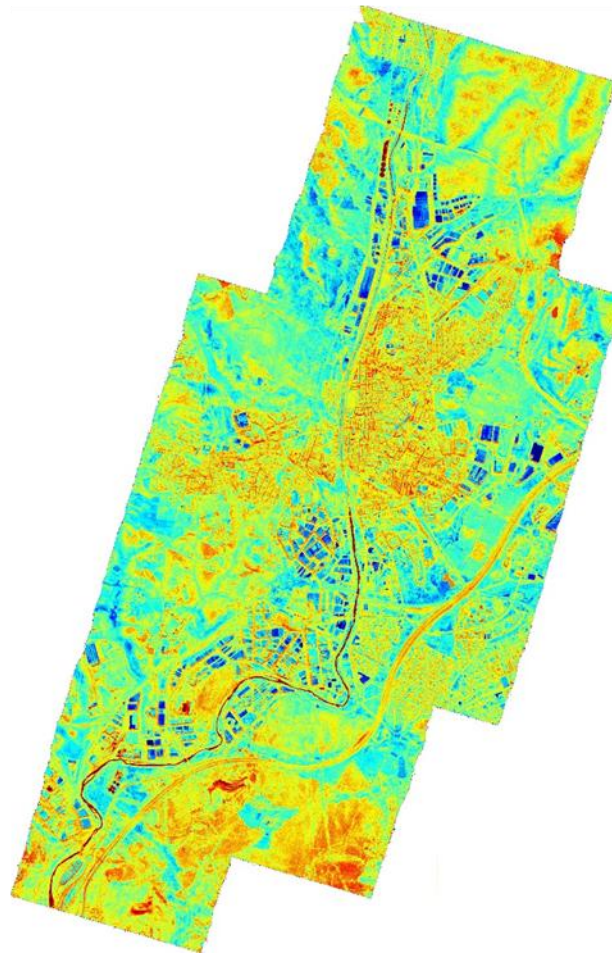
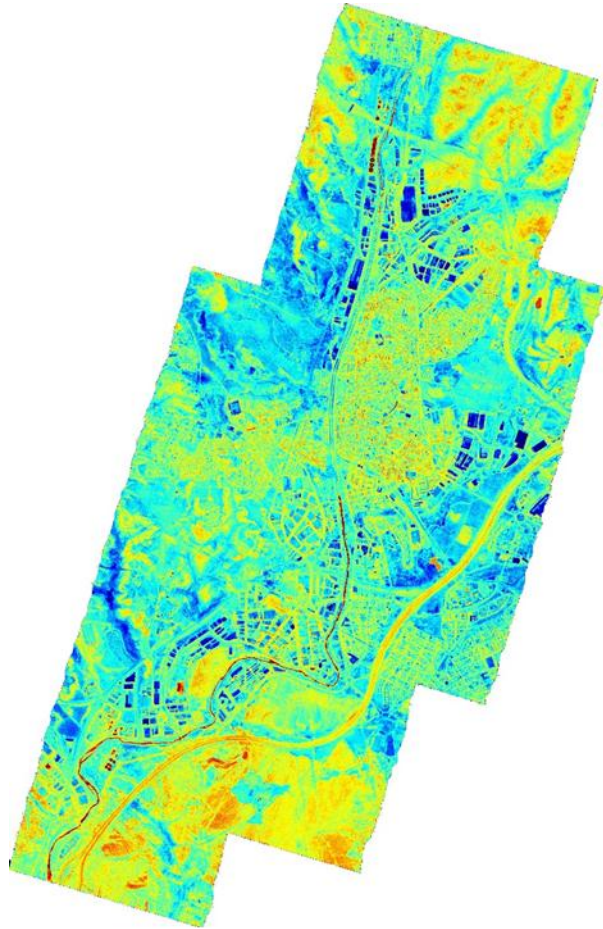


Ilustración 37. a) Detalle de la elevada intensidad luminosa del nudo de la Trinidad en Barcelona en el mapa de promedios. b) Detalle de la elevada intensidad luminosa del nudo de la Trinidad en Barcelona en el mapa de luminancia. c) Detalle de la elevada intensidad luminosa del nudo de la Trinidad en Barcelona en la ortofoto de Cataluña.

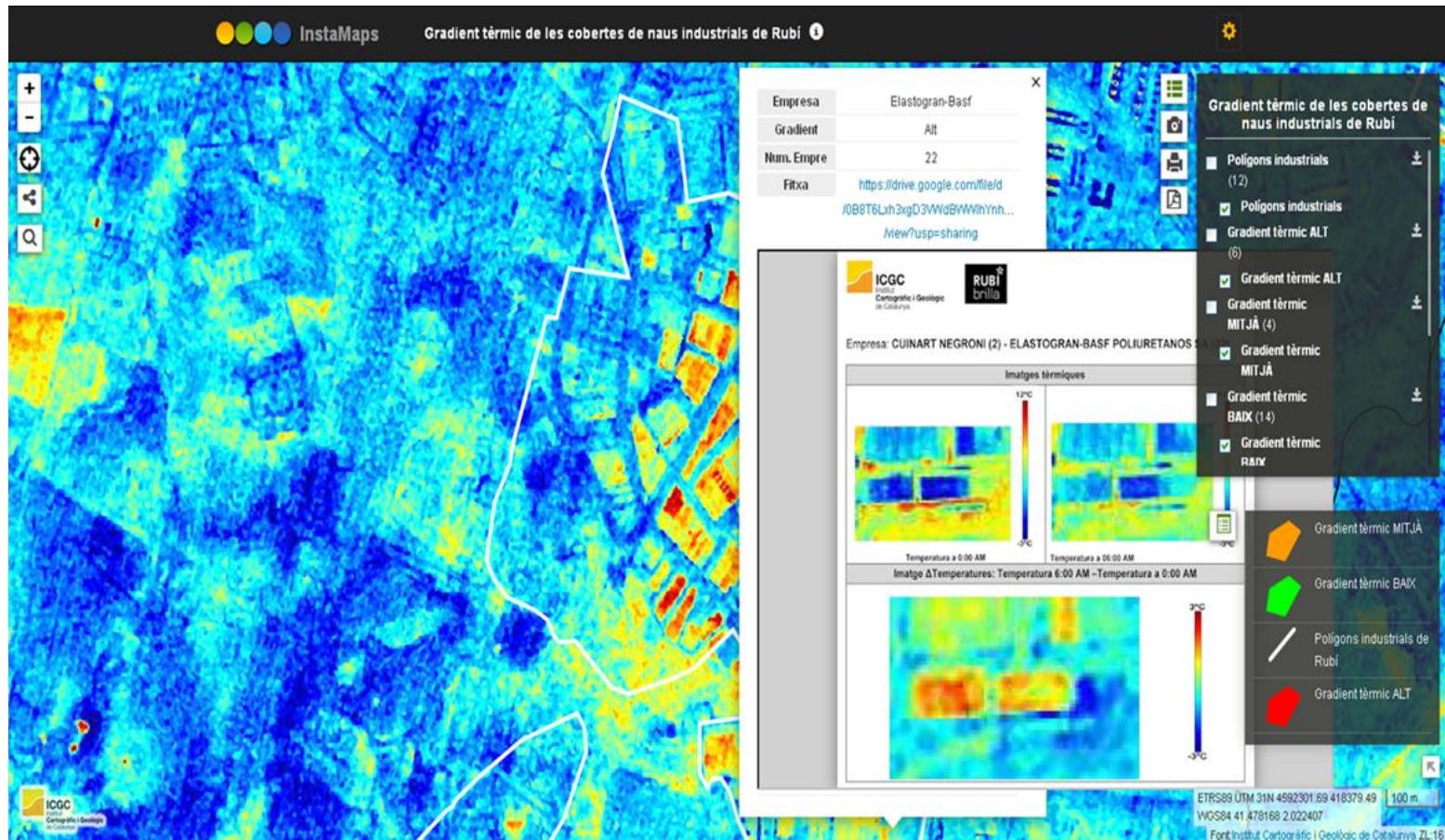
# ENERGY LEAKS

The analysis of very high resolution hyperspectral thermal information at two different times, allow us to surveillance energy leaks on covers for a better management and isolation actions with an accuracy of 0.2 °Kelvin





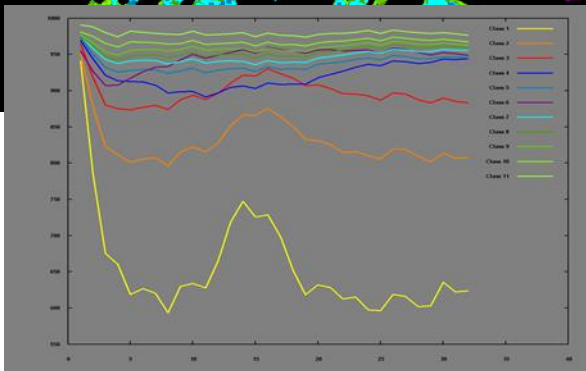
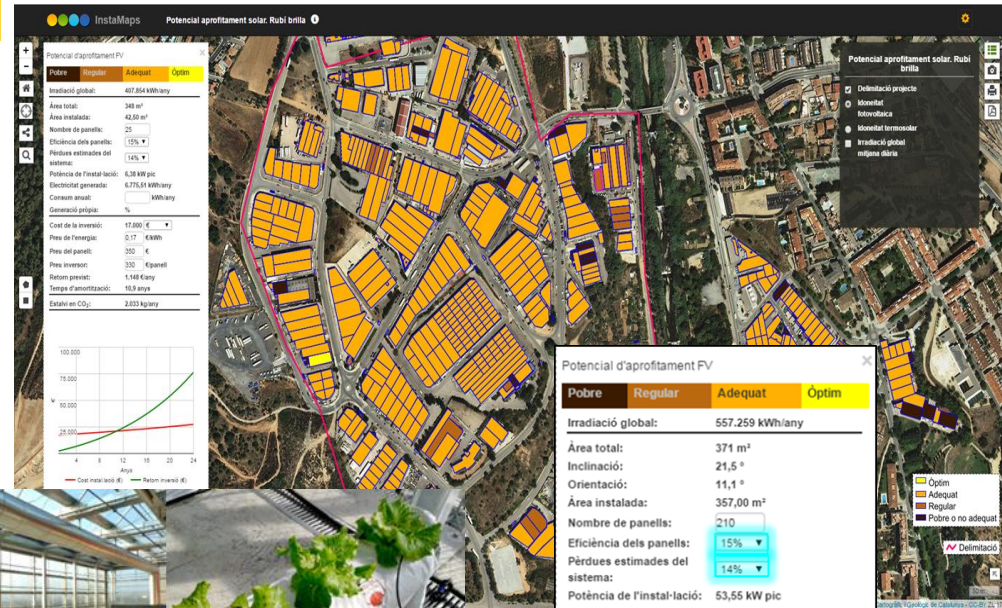
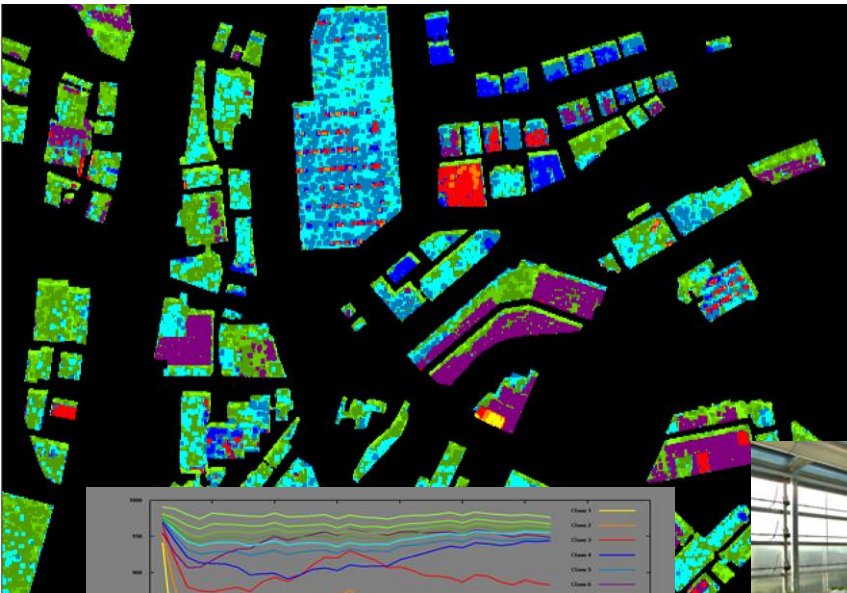
# ENERGY LEAKS



<http://www.instamaps.cat/geocatweb/visor.html?businessid=15d048cb784dc2ac3e13b4f2f0a725df&id=441212&title=Eficiencia-energica-de-les-cobertes-de-naus-industrials-de-Rubi>

# URBAN COVERS

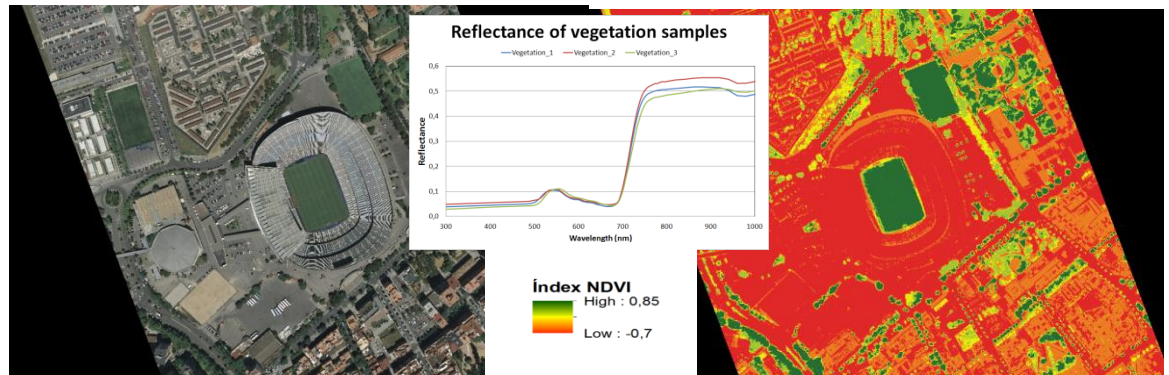
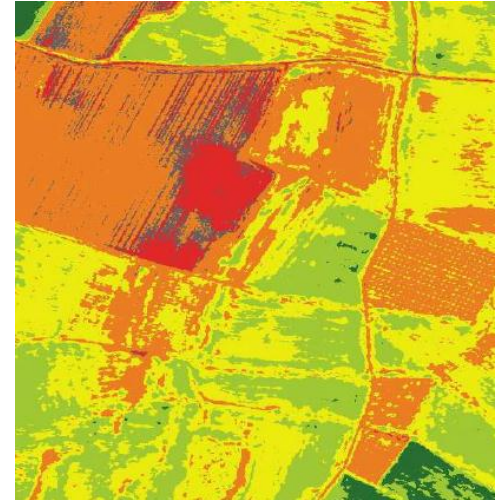
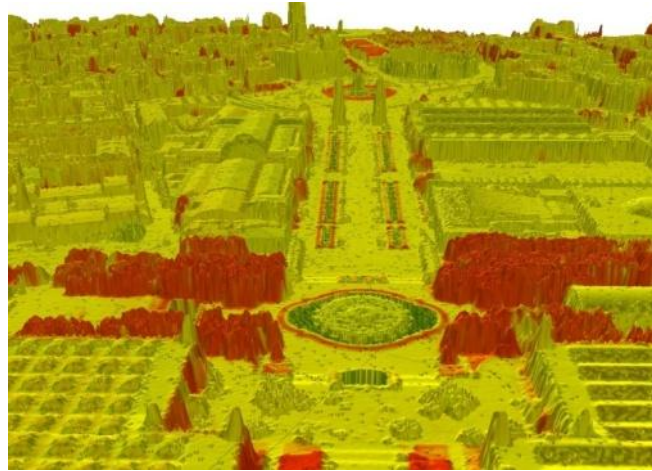
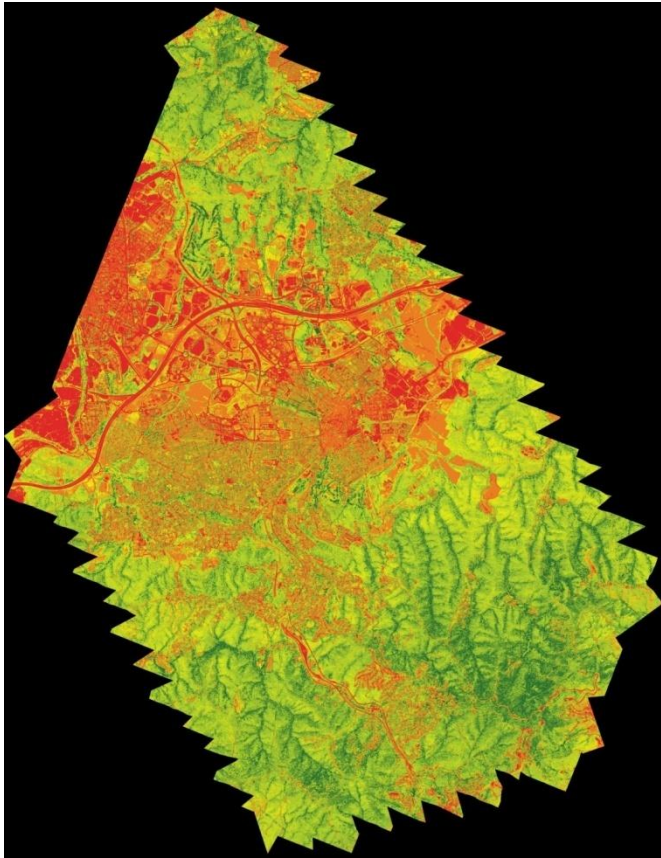
Modelling solar trajectory and topographic and urban models, a geoservice has been developed to evaluate the availability or solar potential on urban and peri-urban covers



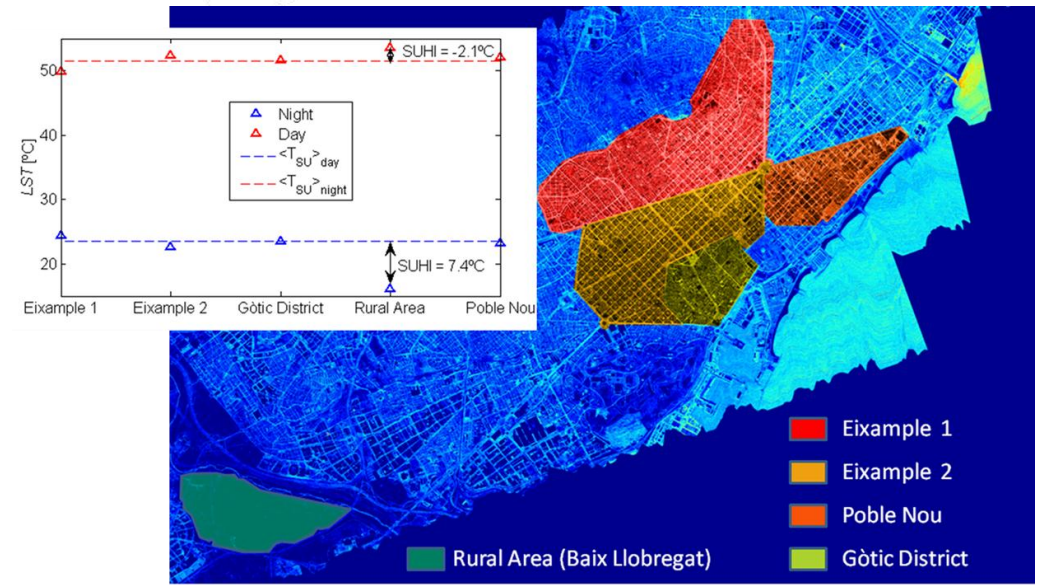
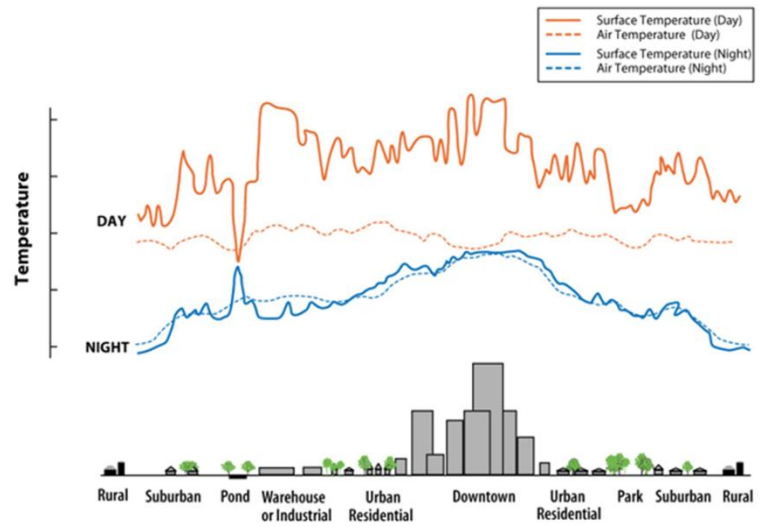
[http://www.instamaps.cat/geocatweb/visor\\_psolar.html?businessid=41d5e2fb2b981a65c871e47bfc84ce56](http://www.instamaps.cat/geocatweb/visor_psolar.html?businessid=41d5e2fb2b981a65c871e47bfc84ce56)

# URBAN GREEN

Urban green could be derived from ICGC's sensors with a GSD < 50 cm. Urban green knowledge in terms of allocation and health represent a key input in terms of urban sustainability and impacts of heat waves events

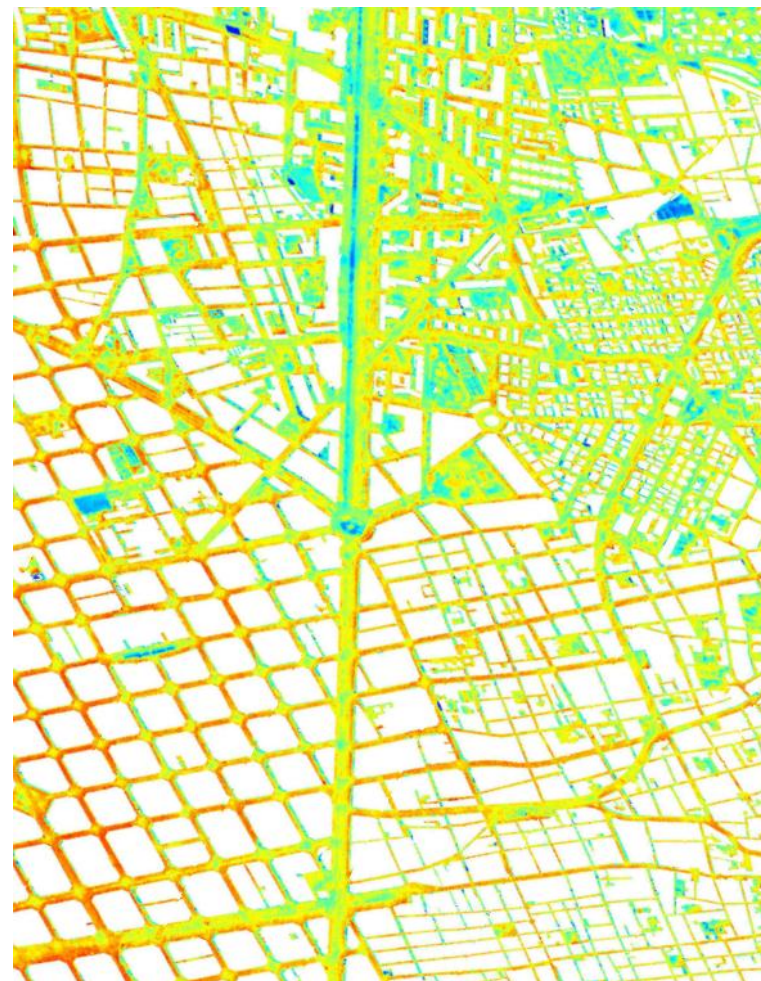
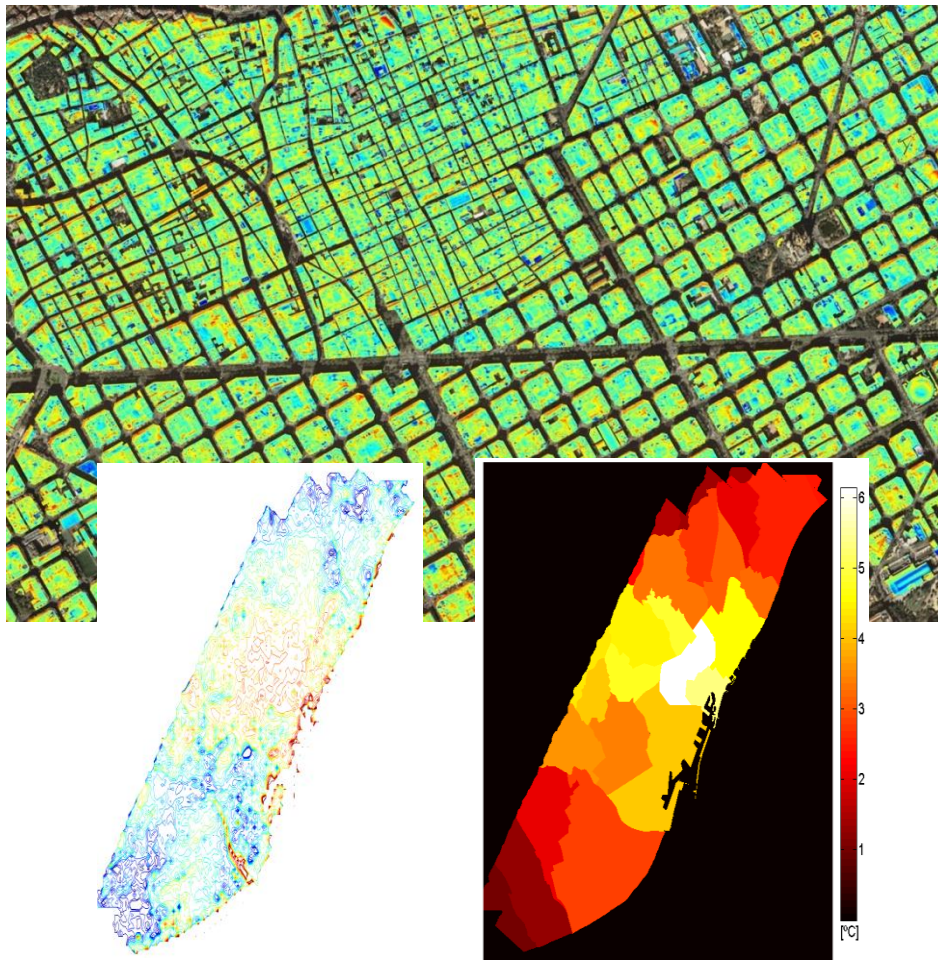


# URBAN HEAT ISLAND



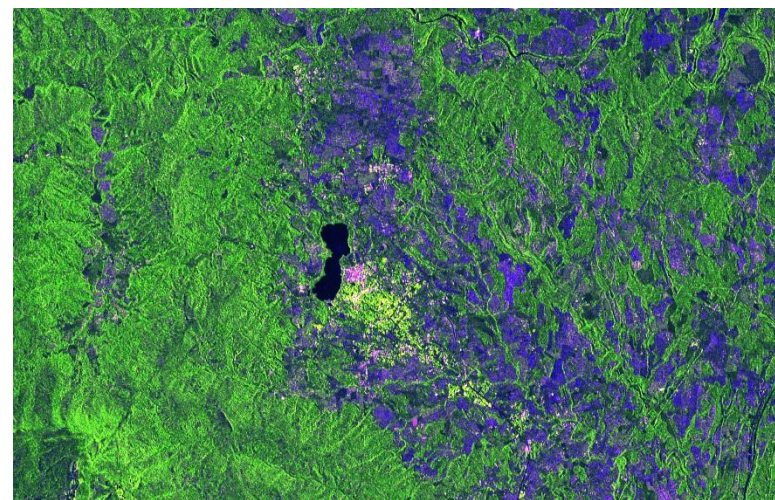
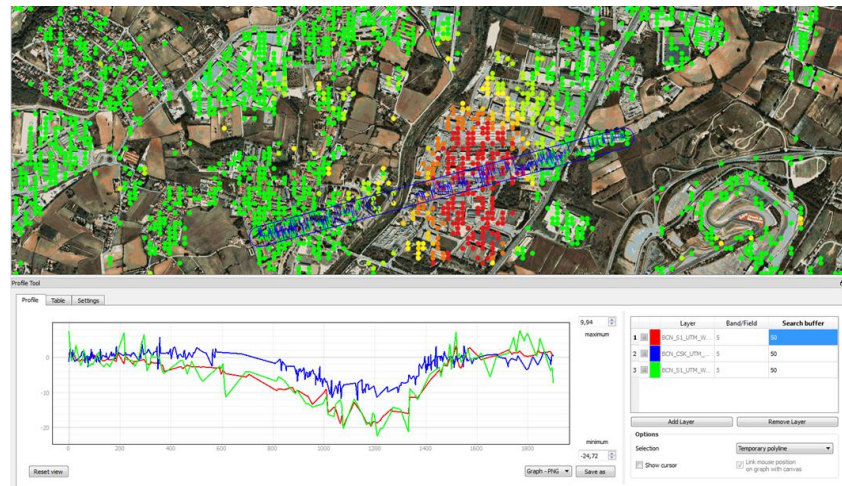
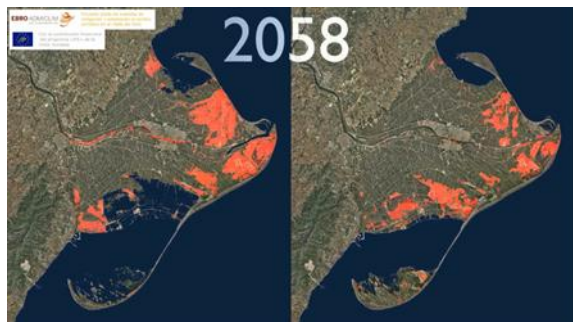
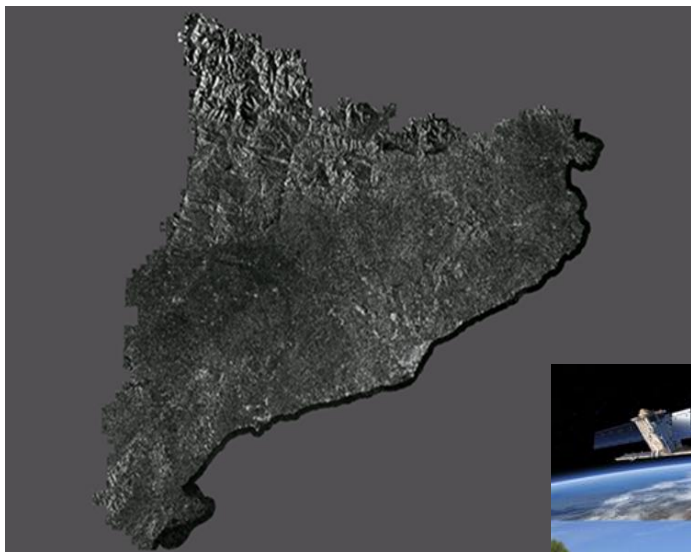
# URBAN HEAT ISLAND

On a synoptic, reactive and a very high resolution level, urban environments could be sensed and modelled to derive and analyze urban heat island phenomena

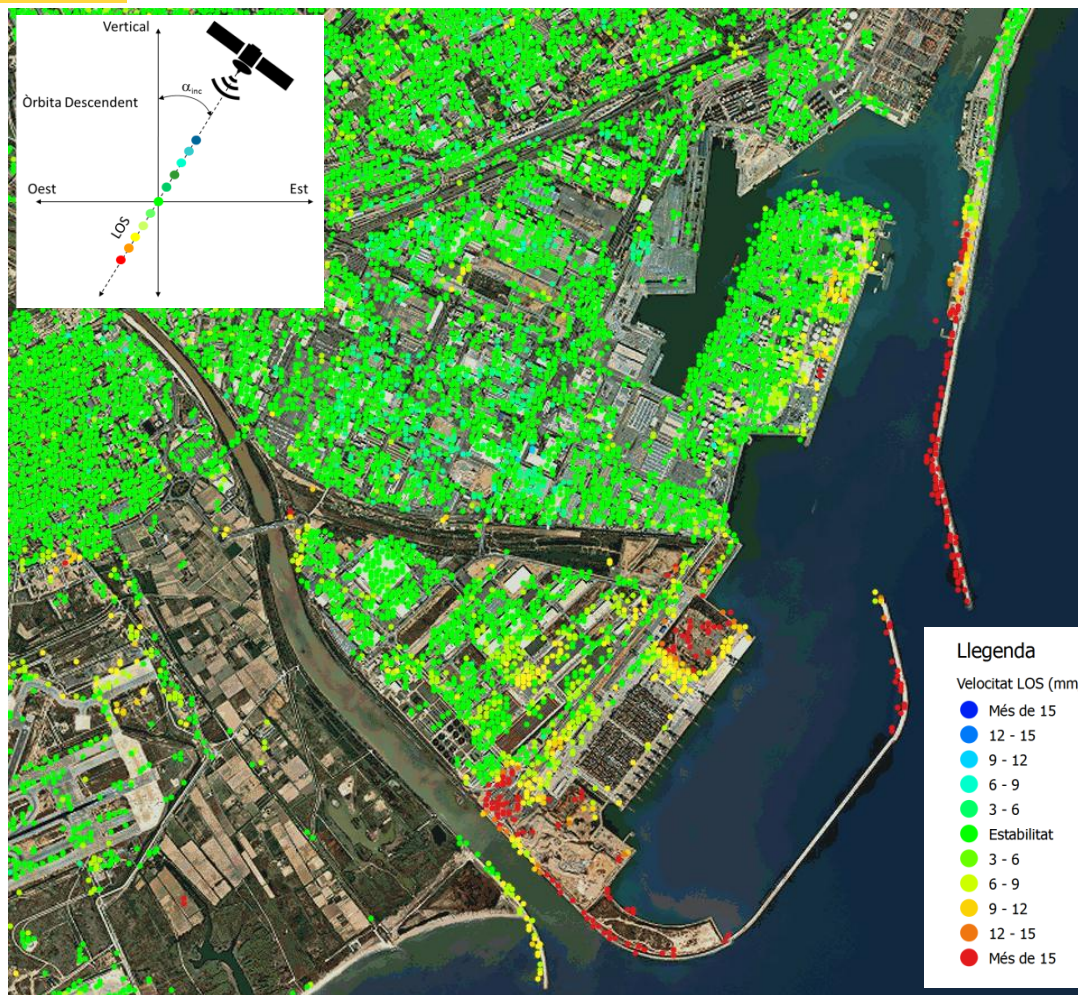
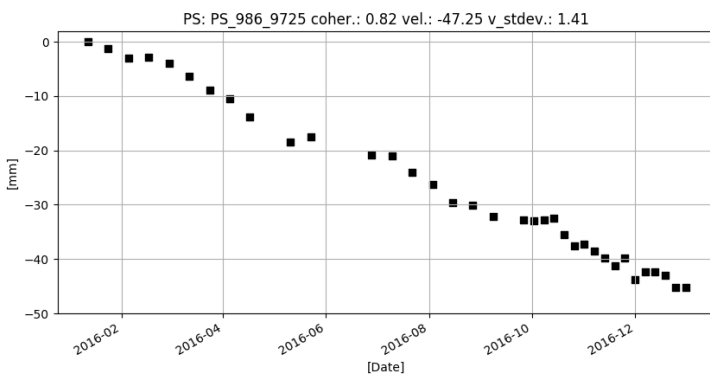
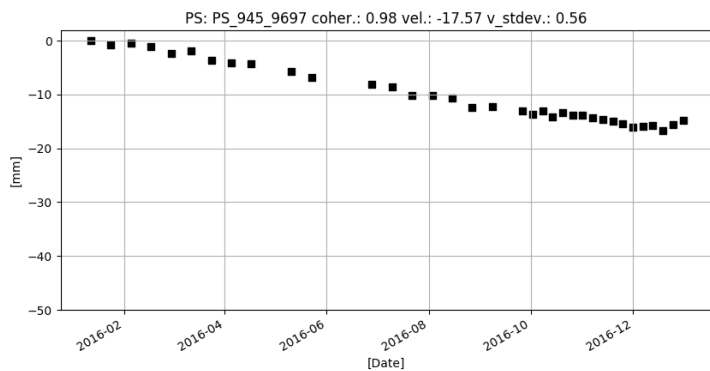


# WHAT ABOUT SATELLITE E.O. AND URBAN SUSTAINABILITY?

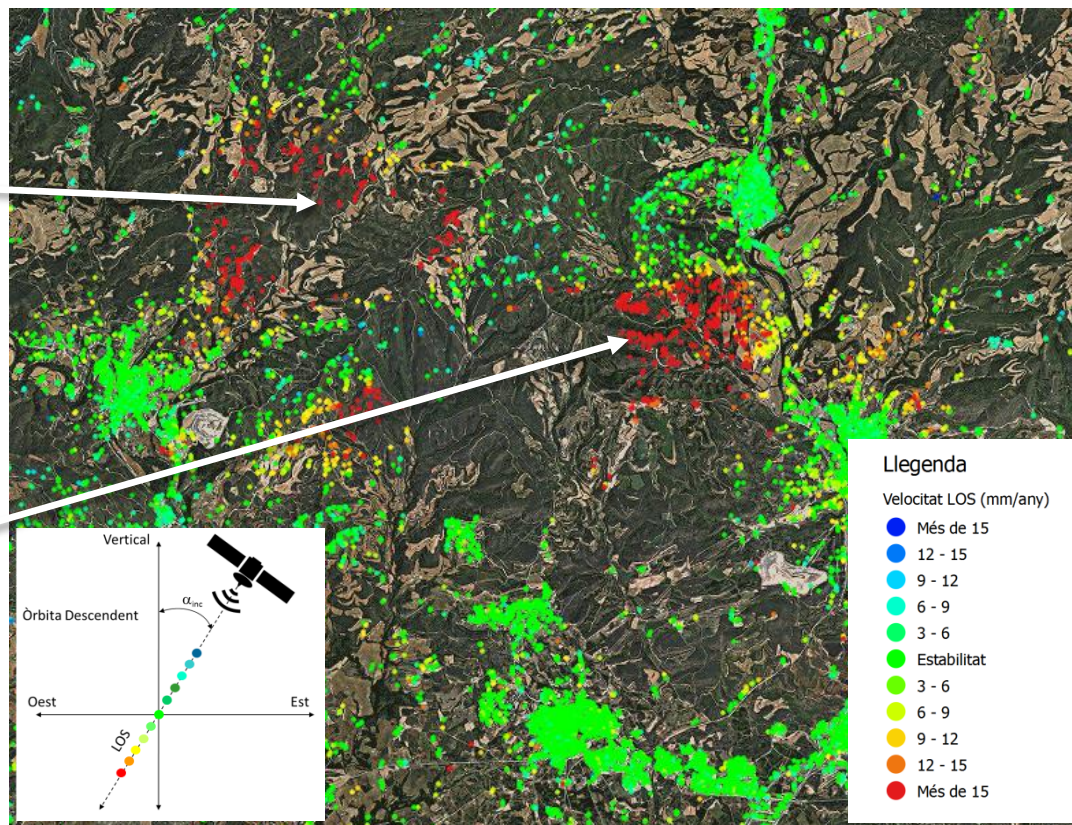
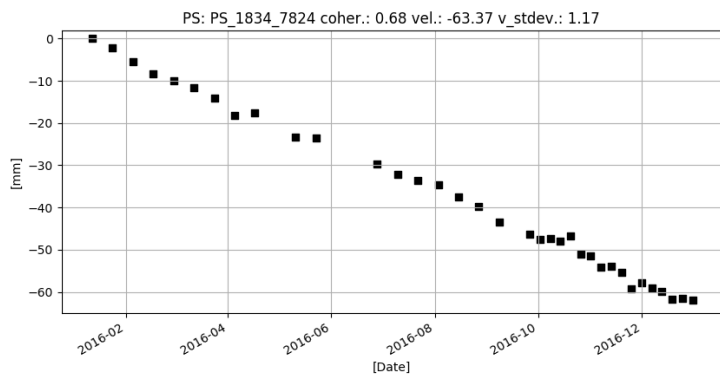
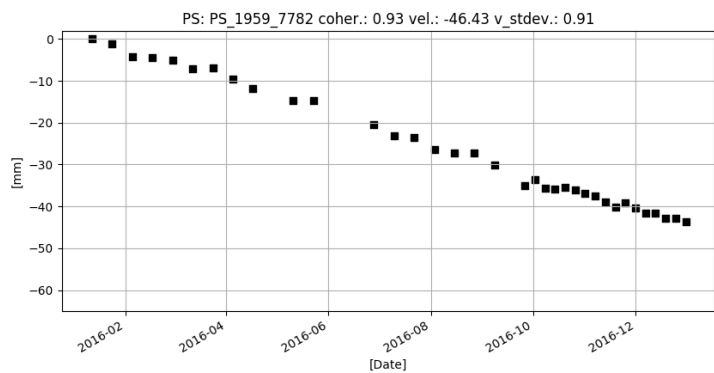
More than 30 years of experience from the ICGC' Remote Sensing Department to boost new research, and development programs into operational products and services based on satellite Earth Observation.



# WHAT ABOUT SATELLITE E.O. AND URBAN SUSTAINABILITY?



# WHAT ABOUT SATELLITE E.O. AND URBAN SUSTAINABILITY?





# LOCAL CLIMATE ZONES

Industrial PhD between University of Barcelona and ICGC on urban ecosystem and climate vulnerability and risk

Local climate zone (LCZ)	Sky view factor <sup>a</sup>	Aspect ratio <sup>b</sup>	Building surface fraction <sup>c</sup>	Impervious surface fraction <sup>d</sup>	Pervious surface fraction <sup>e</sup>	Height of roughness elements <sup>f</sup>	Terrain roughness class <sup>g</sup>
LCZ 1 Compact high-rise	0.2–0.4	> 2	40–60	40–60	< 10	> 25	8
LCZ 2 Compact mid-rise	0.3–0.6	0.75–2	40–70	30–50	< 20	10–25	6–7
LCZ 3 Compact low-rise	0.2–0.6	0.75–1.5	40–70	20–50	< 30	3–10	6
LCZ 4 Open high-rise	0.5–0.7	0.75–1.25	20–40	30–40	30–40	> 25	7–8
LCZ 5 Open mid-rise	0.5–0.8	0.3–0.75	20–40	30–50	20–40	10–25	5–6
LCZ 6 Open low-rise	0.6–0.9	0.3–0.75	20–40	20–50	30–60	3–10	5–6
LCZ 7 Lightweight low-rise	0.2–0.5	1–2	60–90	< 20	< 30	2–4	4–5
LCZ 8 Large low-rise	> 0.7	0.1–0.3	30–50	40–50	< 20	3–10	5
LCZ 9 Sparsely built	> 0.8	0.1–0.25	10–20	< 20	60–80	3–10	5–6
LCZ 10 Heavy industry	0.6–0.9	0.2–0.5	20–30	20–40	40–50	5–15	5–6
LCZ A Dense trees	< 0.4	> 1	< 10	< 10	> 90	3–30	8
LCZ B Scattered trees	0.5–0.8	0.25–0.75	< 10	< 10	> 90	3–15	5–6
LCZ C Bush, scrub	0.7–0.9	0.25–1.0	< 10	< 10	> 90	< 2	4–5
LCZ D Low plants	> 0.9	< 0.1	< 10	< 10	> 90	< 1	3–4
LCZ E Bare rock or paved	> 0.9	< 0.1	< 10	> 90	< 10	< 0.25	1–2
LCZ F Bare soil or sand	> 0.9	< 0.1	< 10	< 10	> 90	< 0.25	1–2
LCZ G Water	> 0.9	< 0.1	< 10	< 10	> 90	–	1

## BUILT SERIES



LCZ 1  
Compact high-rise



LCZ 2  
Compact mid-rise



LCZ 3  
Compact low-rise



LCZ 4  
Open high-rise



LCZ 5  
Open mid-rise



LCZ 6  
Open low-rise



LCZ 7  
Lightweight low-rise



LCZ 8  
Large low-rise



LCZ 9  
Sparsely built



LCZ 10  
Heavy Industry

0 100 m

## LAND COVER SERIES



LCZ A  
Dense trees



LCZ B  
Scattered trees



LCZ C  
Bush, scrub



LCZ D  
Low plants



LCZ E  
Bare rock or paved



LCZ F  
Bare soil or sand



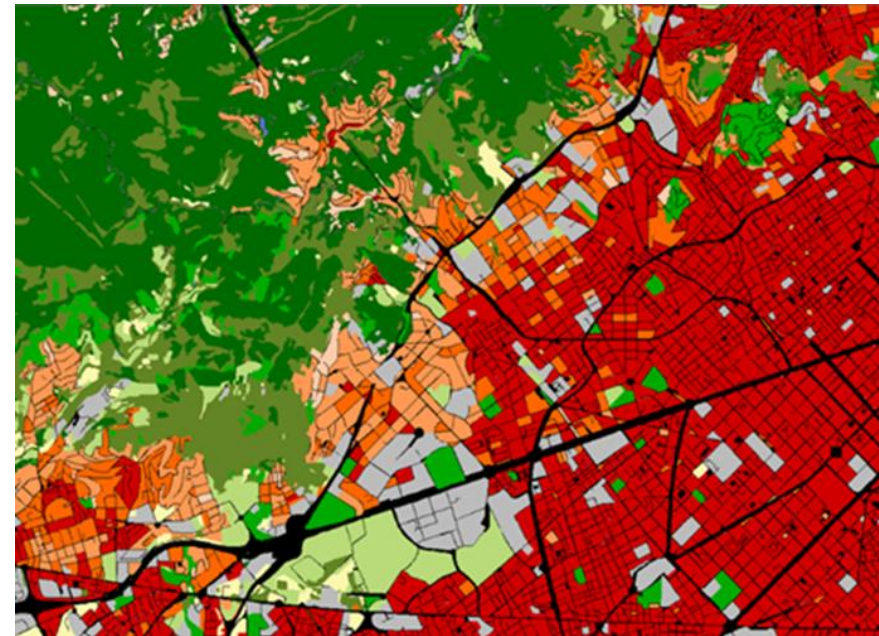
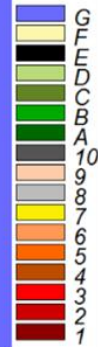
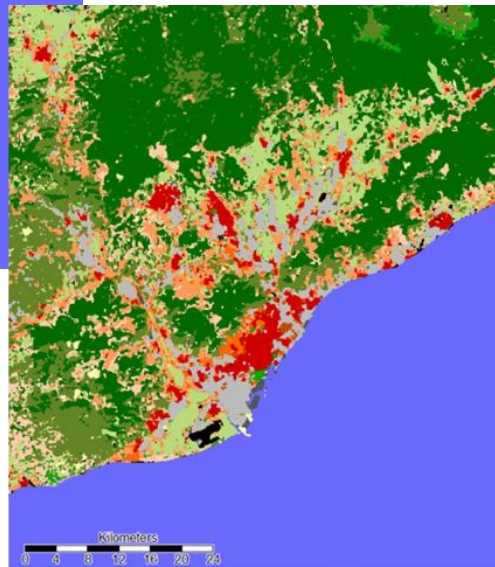
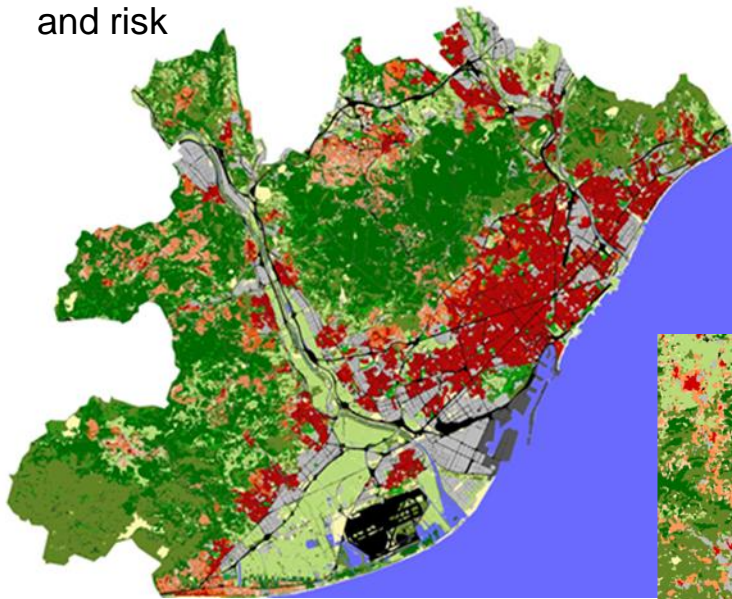
LCZ G  
Water

### Variable land cover properties

- b** bare trees (i.e., deciduous, leafless)  
increased sky view factor, reduced albedo
- S** snow cover (> 10 cm in depth)  
low admittance, high albedo
- d** dry ground (e.g., parched soil)  
low admittance, large Bowen ratio,  
increased albedo
- W** wet ground (e.g., waterlogged soil)  
high admittance, small Bowen ratio,  
reduced albedo

# LOCAL CLIMATE ZONES

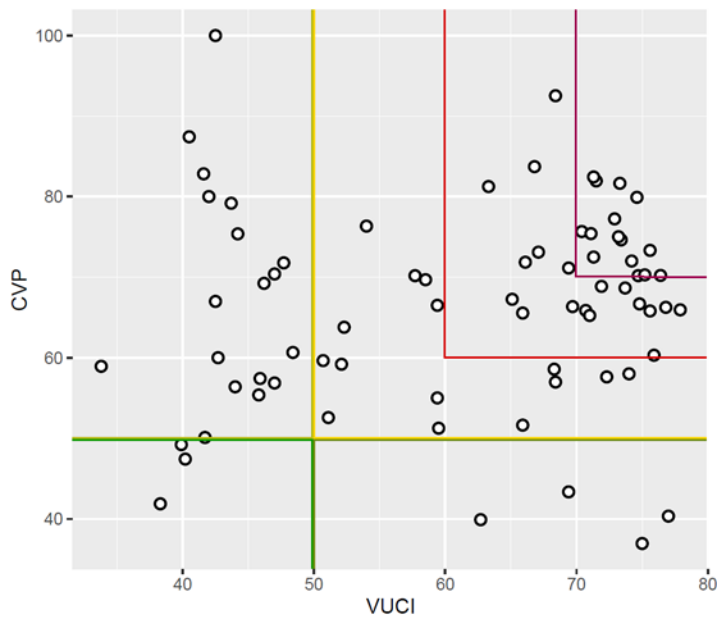
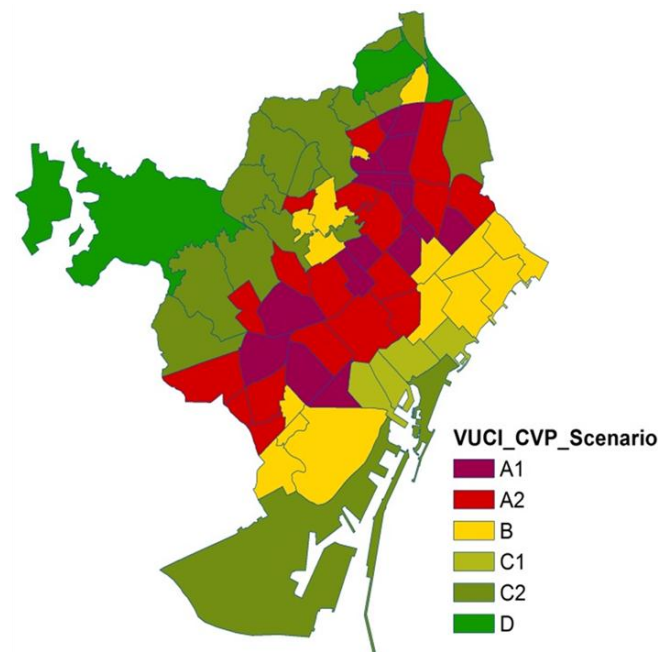
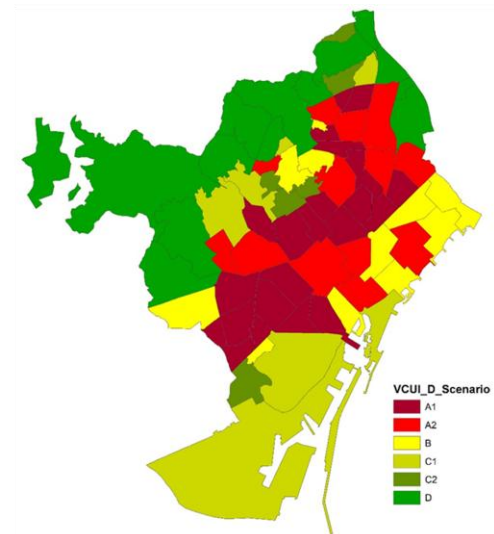
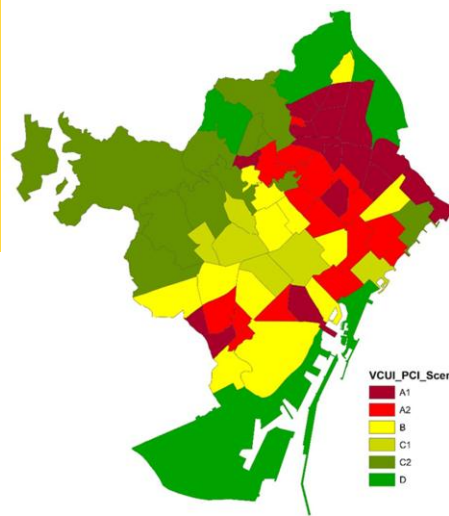
Industrial PHd between University of Barcelona and ICGC on urban ecosystem and climate vulnerability and risk



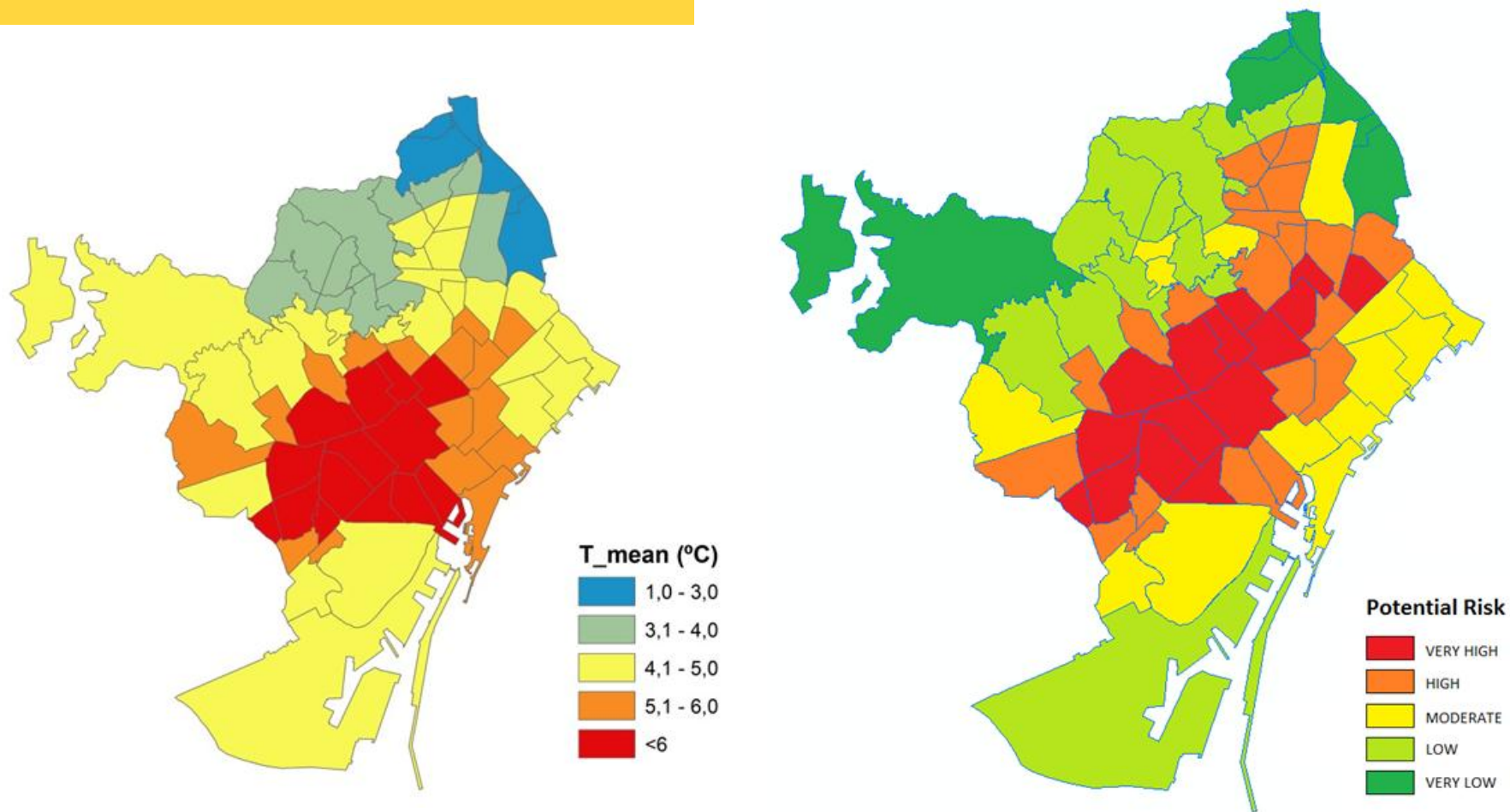
Local climate zone (LCZ)	Sky view factor <sup>a</sup>	Aspect ratio <sup>b</sup>	Building surface fraction <sup>c</sup>	Impervious surface fraction <sup>d</sup>	Pervious surface fraction <sup>e</sup>	Height of roughness elements <sup>f</sup>	Terrain roughness class <sup>g</sup>
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LCZ A Dense trees	< 0.4	> 1	< 10	< 10	> 90	3-30	8
LCZ B Scattered trees	0.5-0.8	0.15-0.75	< 10	< 10	> 90	3-15	5-6
LCZ C Bush, scrub	0.7-0.9	0.25-1.0	< 10	< 10	> 90	< 2	4-5
LCZ D Low plants	> 0.9	< 0.1	< 10	< 10	> 90	< 1	3-4
LCZ E Bare rock or paved	> 0.9	< 0.1	< 10	> 90	< 10	< 0.25	1-2
LCZ F Bare soil or sand	> 0.9	< 0.1	< 10	< 10	> 90	< 0.15	1-2
LCZ G Water	> 0.9	< 0.1	< 10	< 10	> 90	-	1

A new International Standard to mapping cities according its resilience to climate trends

# LOCAL CLIMATE ZONES



# LOCAL CLIMATE ZONES



# HOW TO TRANSFORM DATA INTO INFORMATION AND KNOWLEDGE

# OTHER E.O. ACTIVITIES

## màster en geoinformació



MOTS / <sup>3</sup>Cat-3



ICGC Institut Cartogràfic i Geològic de Catalunya		UNIVERSITY OF FLORIDA	
SUBJECTS			
	New trends and challenges on urban Earth Observation		
ring	EO_1:	Principles of Earth observation on Urban Areas	
ring	EO_2:	Technical and operational design Earth Observation on urban areas	
	Earth Observation Added Value chain		
ring	AD_1:	From data to information products and services	
ring	AD_2:	Direct and indirect impacts and benefits	
ring	Building Earth Observation Applications		
ring	AP_1:	Surveillance. Critical infrastructures and risk monitoring	
ring	AP_2:	Climate and Health	
ring	AP_3:	Thermal behavior and energy	
ring	AP_4:	Change detection and growth	
ring	25% of EOS Mission analysis and Design		
ring	MAD_1:	Problems to be solved: technical and operational approach	
ring	MAD_2:	Added value chain architecture and potential benefits	
ring	MAD_3:	Implementation plan and identification of end users	
ring	MAD_4:	Presentation, discussion and assessment	

**Second Barcelona Techno Week**  
**Course on nanosatèl·lites**  
 Institute of Cosmos Sciences, Barcelona  
 From 10th to 14th July 2017

[Presentation](#)
[Program](#)
[Registration](#)
[Information](#)
[Organizing Committee](#)
[Course lecturers](#)
[Social activities](#)
[Previous Editions](#)

**Course on nanosatèl·lites**

The second ICGC network will be devoted to the emerging field of nanosatellites. It will be an intensive 5-day "bootcamp", providing a comprehensive introduction to the basic concepts of nanosatellite design and construction.

- Keynotes, classes and field trips
- Industrial participatory (challenges and presentations)
- Poster session (from participants and industry)

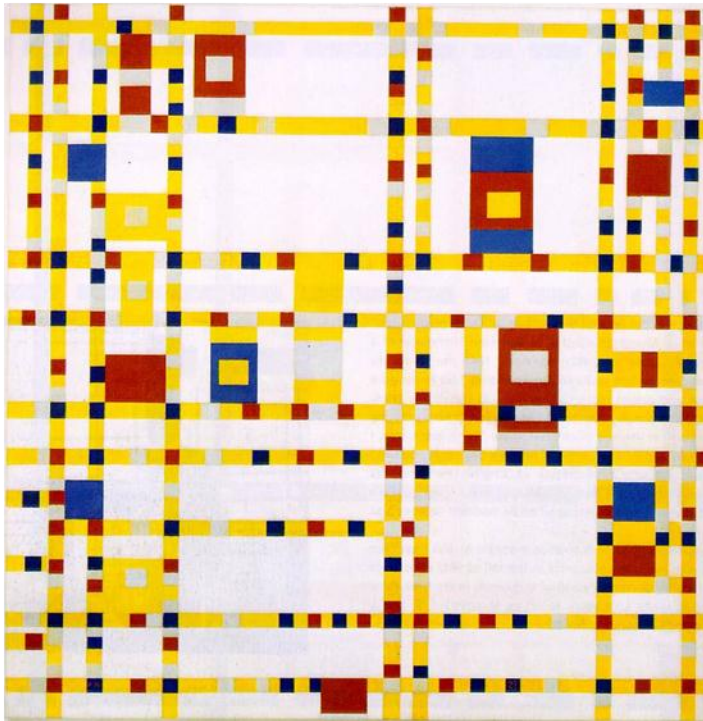
**Initiative**

**Collaboration**



**THANKS A LOT FOR YOUR  
ATTENTION**

*Piet Mondrian (1943):  
Broadway Boogie Woogie*



*ICGC (2012):  
Thermal Behaviour*

