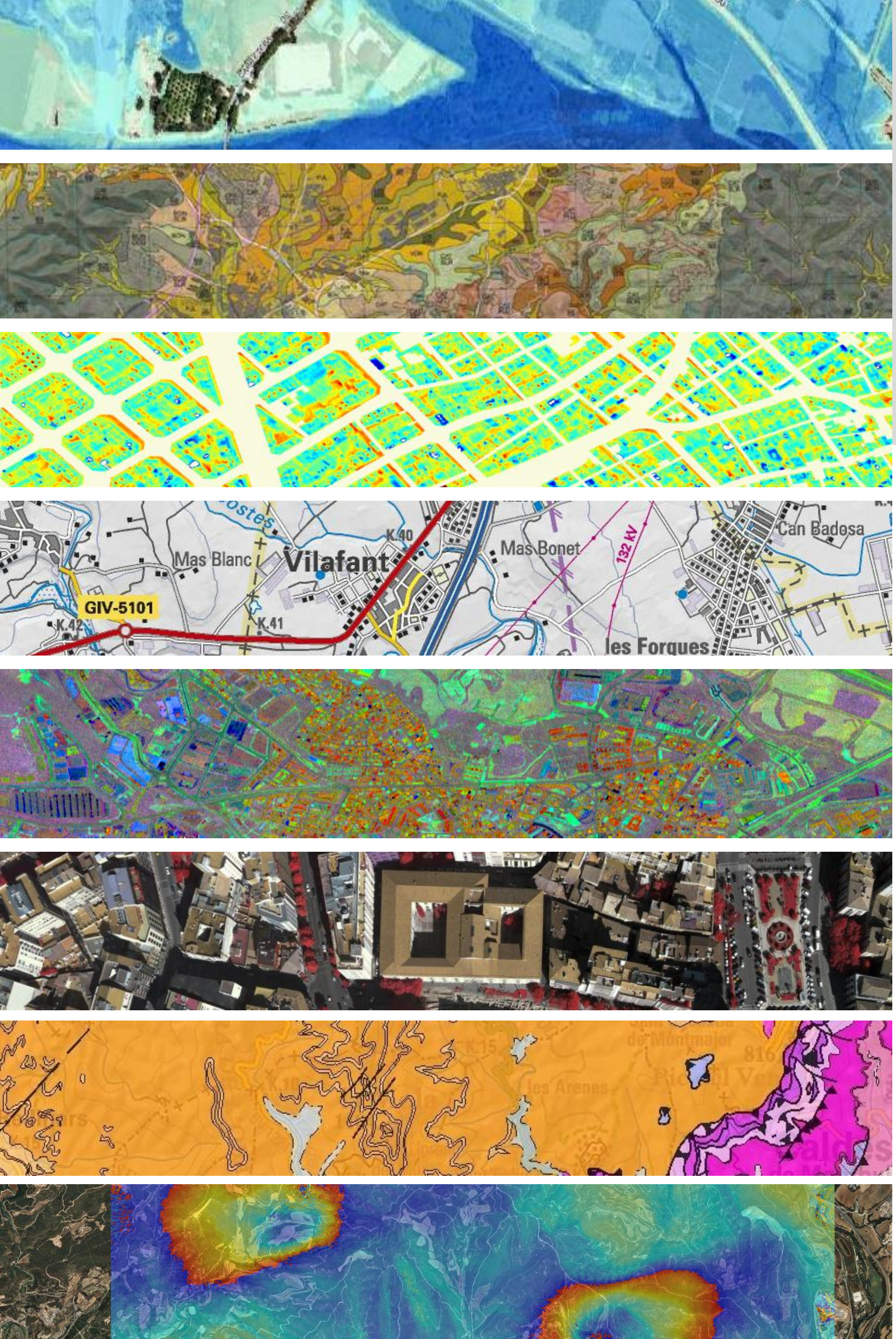


"Urban ecosystem: from research to operational earth observation"

Earth Observation Area (CS_PCOT)
Institute Cartographic and Geological of Catalonia
Dr. Jordi Corbera
jordi.corbera@icgc.cat

PCOT
Programa Català d'Observació de la Terra

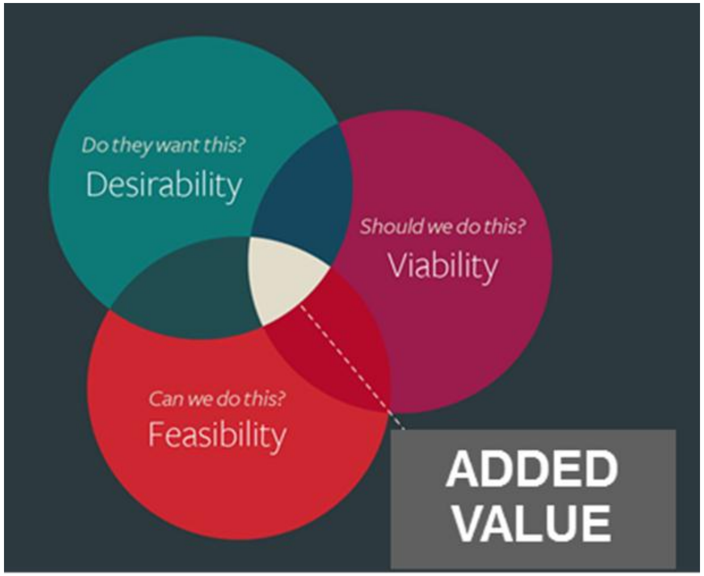
ICGC
Institut
Cartogràfic i Geològic
de Catalunya

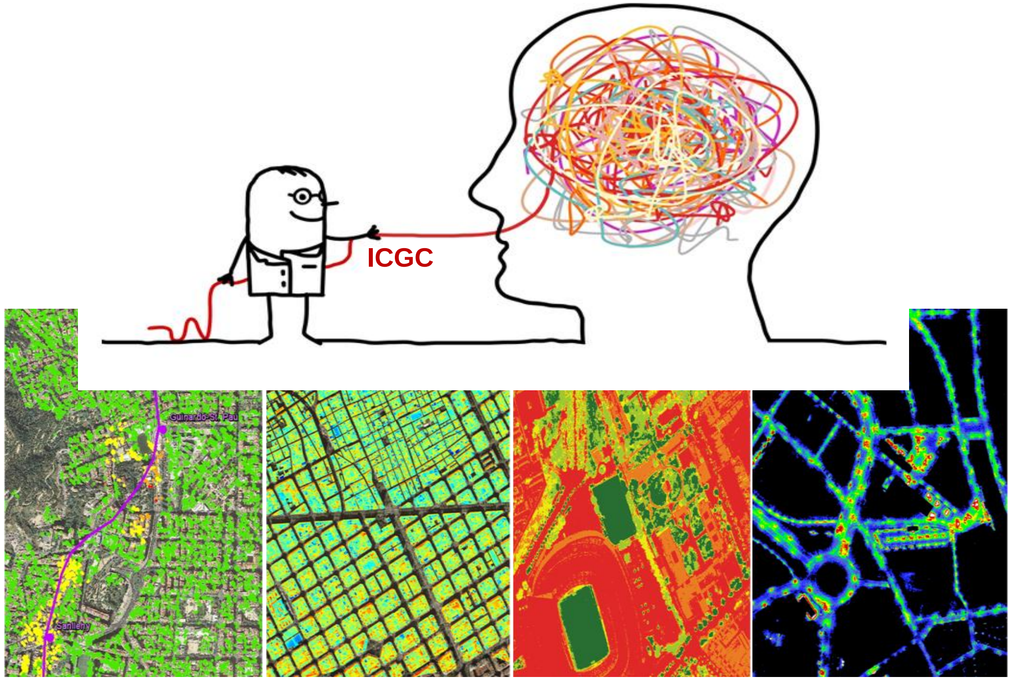
Generalitat de Catalunya

HOW TO TRANSFORM DATA INTO INFORMATION AND KNOWLEDGE

ON URBAN ECOSYSTEM

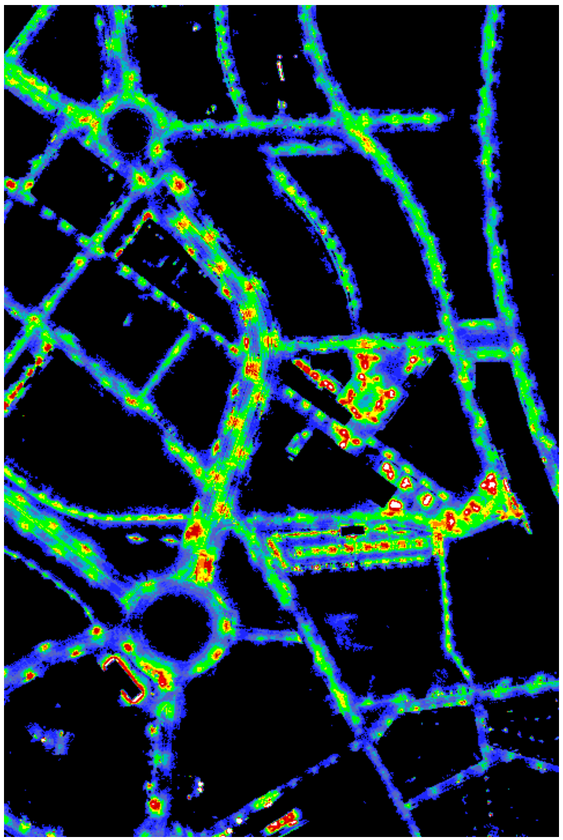
SCIENCE + TECHNOLOGY + REAL CHALLENGES TO BE SOLVED = ADDED VALUE





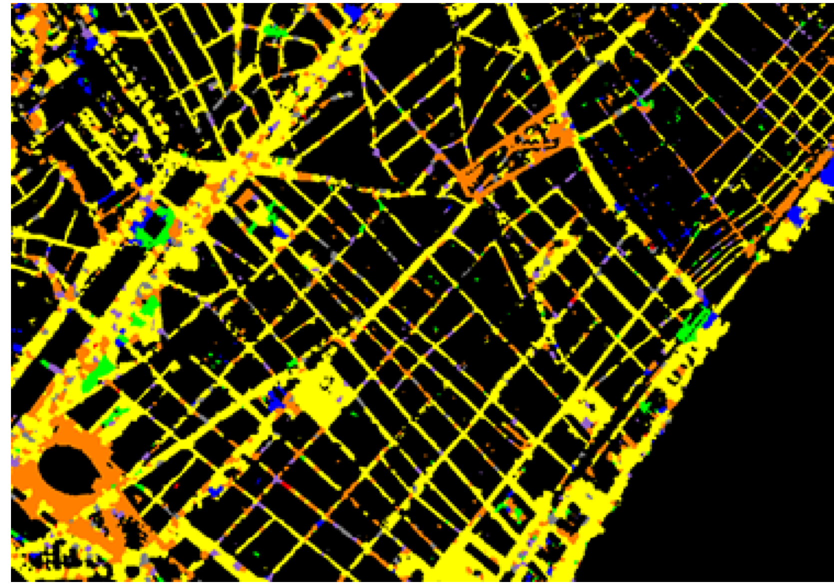
... some examples how to transform data into knowledge

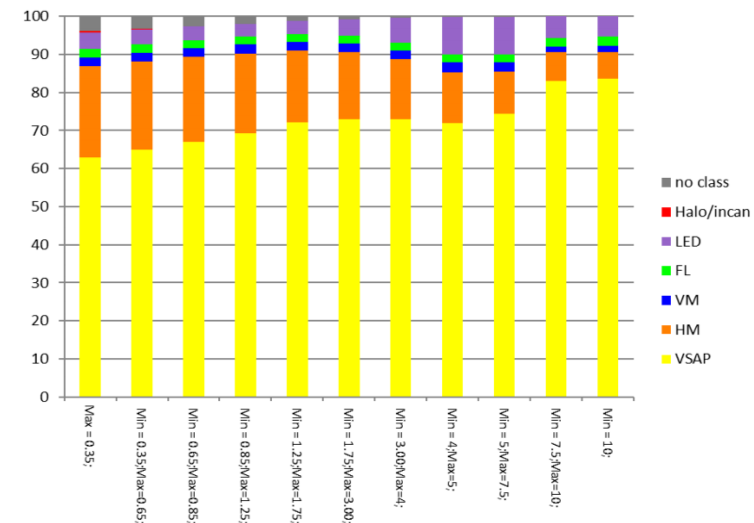
LUMINANCE MAP



Classification

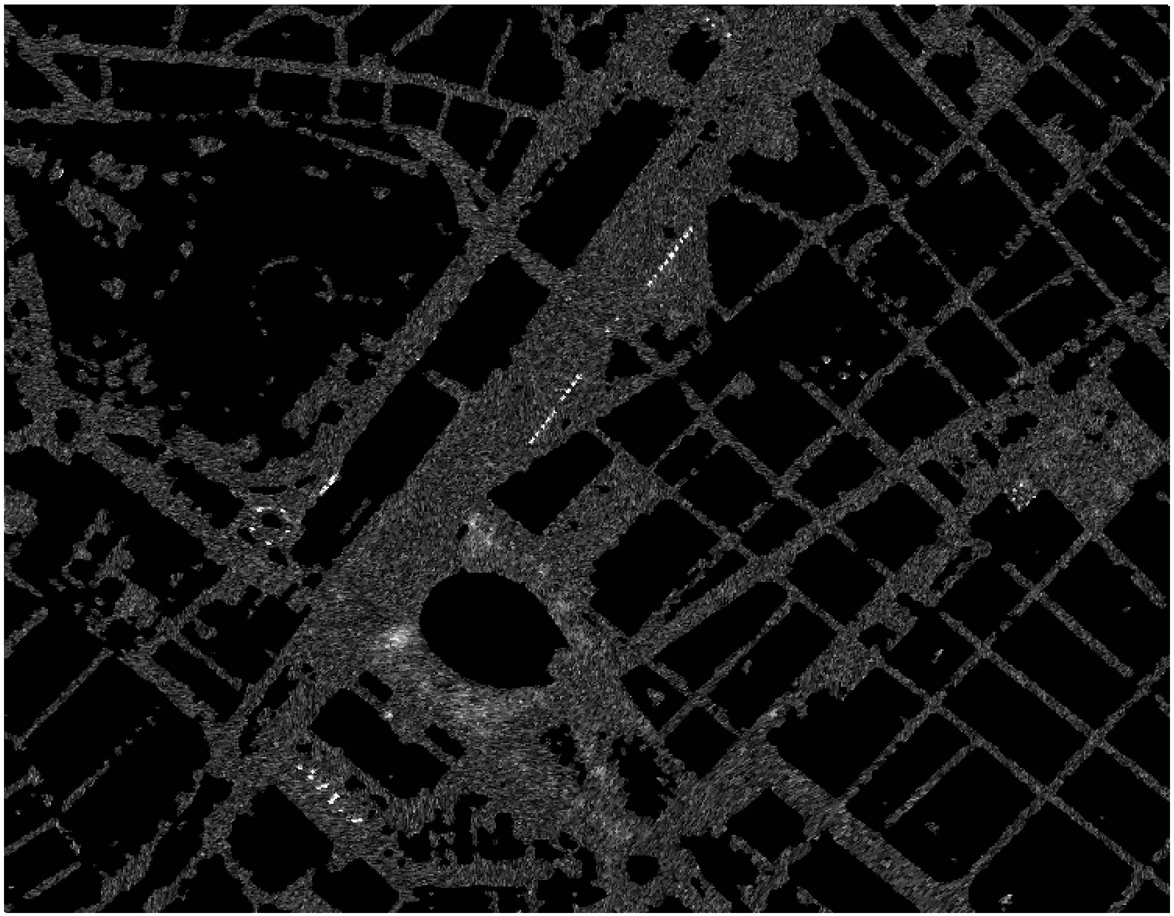
- [.35,.65[
- [.65,.85[
- [.85,1.25[
- [1.25,1.75[
- [1.75,3[
- [3,4[
- [4,5[
- [5,7.5[
- [7.5,10[
- >10

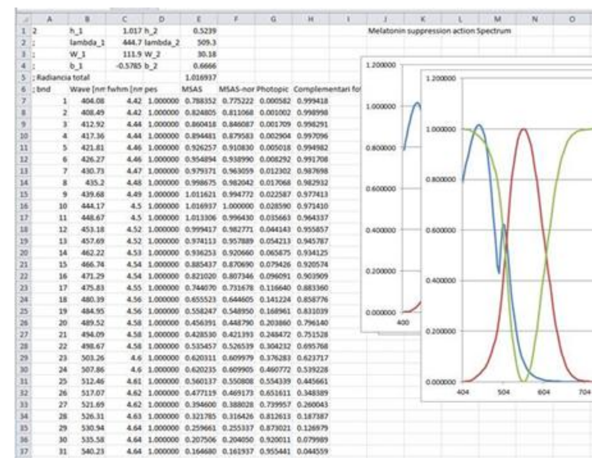




The analysis of luminance at night is performed **by ICGC in conditions of little or null moonlight, so that the radiation captured by airborne sensors can be directly associated to artificial –human lighting.** Own ICGC models allow us to retrieve values of luminance at candles per square meter (cd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

LUMINANCE MAP

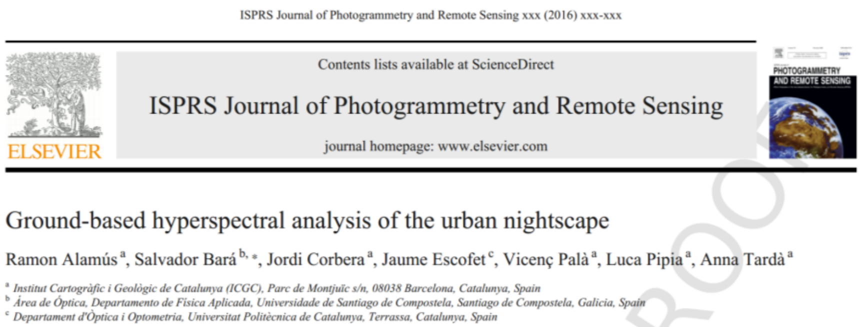




	A	B	C	D	E	F	G	H
1	2	h_1	1.017	h_2	0.5239			
2	;	lambda_1	444.7	lambda_2	509.3			
3	;	W_1	111.9	W_2	30.18			
4	;	b_1	-0.5785	b_2	0.6666			
5	; Radiancia total				1.016937			
6	; bnd	Wave [nm	fwhm [nm	pes	MSAS	MSAS-nor	Photopic	Complementari fo
7	1	404.08	4.42	1.000000	0.788352	0.775222	0.000582	0.999418
8	2	408.49	4.42	1.000000	0.824805	0.811068	0.001002	0.998998
9	3	412.92	4.44	1.000000	0.860418	0.846087	0.001709	0.998291
10	4	417.36	4.44	1.000000	0.894481	0.879583	0.002904	0.997096
11	5	421.81	4.46	1.000000	0.926257	0.910830	0.005018	0.994982
12	6	426.27	4.46	1.000000	0.954894	0.938990	0.008292	0.991708
13	7	430.73	4.47	1.000000	0.979371	0.963059	0.012302	0.987698
14	8	435.2	4.48	1.000000	0.998675	0.982042	0.017068	0.982932
15	9	439.68	4.49	1.000000	1.011621	0.994772	0.022587	0.977413
16	10	444.17	4.5	1.000000	1.016937	1.000000	0.028590	0.971410
17	11	448.67	4.5	1.000000	1.013306	0.996430	0.035663	0.964337
18	12	453.18	4.52	1.000000	0.999417	0.982771	0.044143	0.955857
19	13	457.69	4.52	1.000000	0.974113	0.957889	0.054213	0.945787
20	14	462.22	4.53	1.000000	0.936253	0.920660	0.065875	0.934125
21	15	466.74	4.54	1.000000	0.885437	0.870690	0.079426	0.920574
22	16	471.29	4.54	1.000000	0.821020	0.807346	0.096091	0.903909
23	17	475.83	4.55	1.000000	0.744070	0.731678	0.116640	0.883360
24	18	480.39	4.56	1.000000	0.655523	0.644605	0.141224	0.858776
25	19	484.95	4.56	1.000000	0.558247	0.548950	0.168961	0.831039
26	20	489.52	4.58	1.000000	0.456391	0.448790	0.203860	0.796140
27	21	494.09	4.58	1.000000	0.428530	0.421393	0.248472	0.751528
28	22	498.67	4.58	1.000000	0.535457	0.526539	0.304232	0.695768
29	23	503.26	4.6	1.000000	0.620311	0.609979	0.376283	0.623717
30	24	507.86	4.6	1.000000	0.620235	0.609905	0.460772	0.539228
31	25	512.46	4.61	1.000000	0.560137	0.550808	0.554339	0.445661
32	26	517.07	4.62	1.000000	0.477119	0.469173	0.651611	0.348389
33	27	521.69	4.62	1.000000	0.394600	0.388028	0.739957	0.260043
34	28	526.31	4.63	1.000000	0.321785	0.316426	0.812613	0.187387
35	29	530.94	4.64	1.000000	0.259661	0.255337	0.873021	0.126979
36	30	535.58	4.64	1.000000	0.207506	0.204050	0.920011	0.079989
37	31	540.23	4.64	1.000000	0.164680	0.161937	0.955441	0.044559

(Melatonin Supression Active Spectrum)

LUMINANCE MAP


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

Contents lists available at ScienceDirect

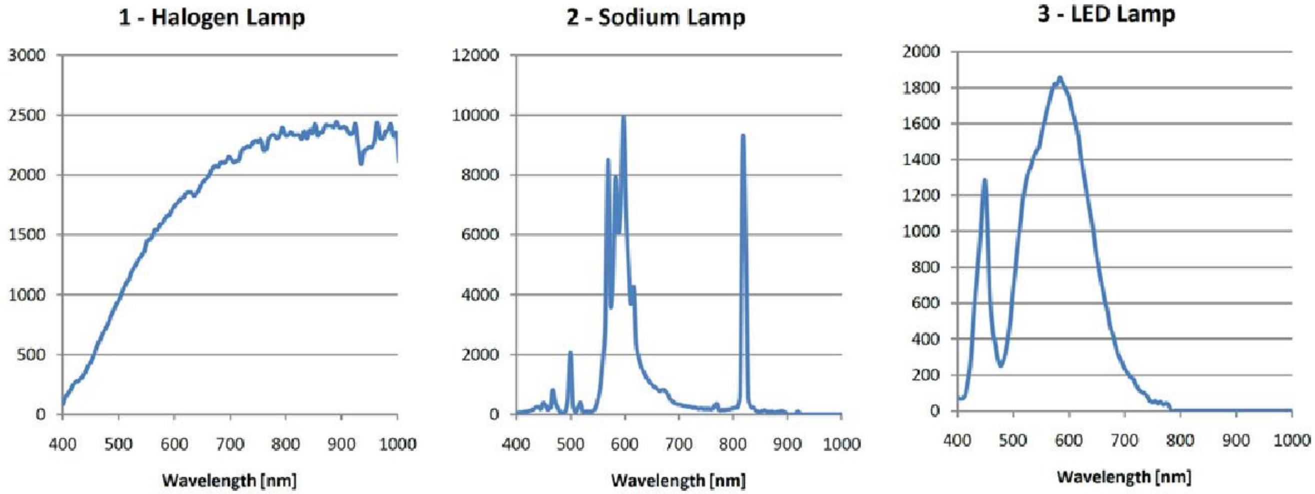
ISPRS Journal of Photogrammetry and Remote Sensing

journal homepage: www.elsevier.com

Ground-based hyperspectral analysis of the urban nightscape

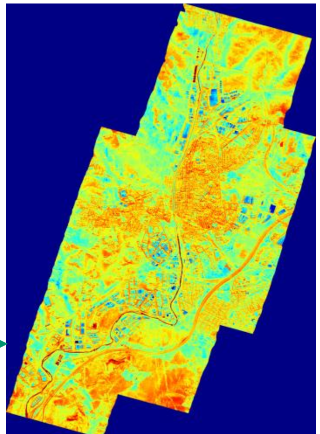
Ramon Alamús [a], Salvador Bará [b,*], Jordi Corbera [a], Jaume Escofet [c], Vicenç Palà [a], Luca Pipia [a], Anna Tardà [a]

[a] Institut Cartogràfic i Geològic de Catalunya (ICGC), Parc de Montjuïc s/n, 08038 Barcelona, Catalunya, Spain
[b] Área de Óptica, Departamento de Física Aplicada, Universidade de Santiago de Compostela, Santiago de Compostela, Galicia, Spain
[c] Departament d'Òptica i Optometria, Universitat Politècnica de Catalunya, Terrassa, Catalunya, Spain



ENERGY LEAKS

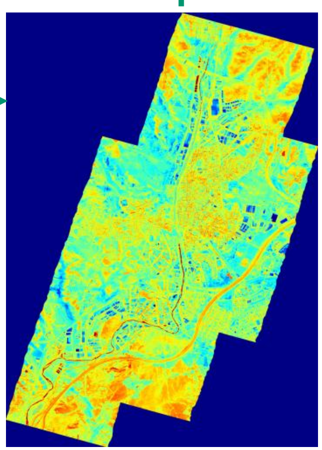
The analysis of very high resolution hyperspectral thermal information at two different times, allow us to surveillance energy leaks on covers for a better management and isolation actions with an accuracy of 0.2 ºKelvin



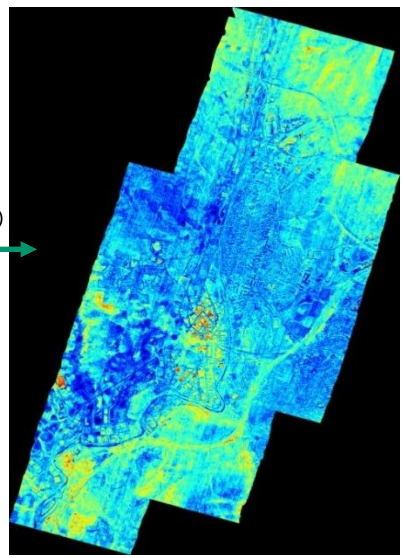
$T_{1\ 0.00}$ UTC

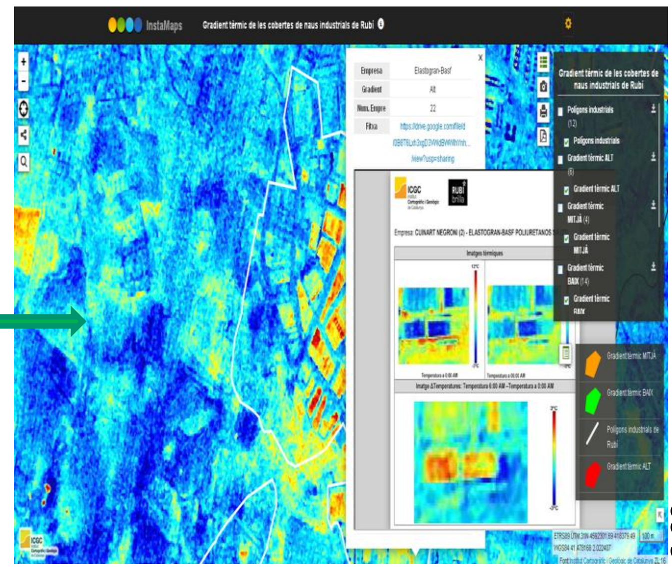
TASI capture

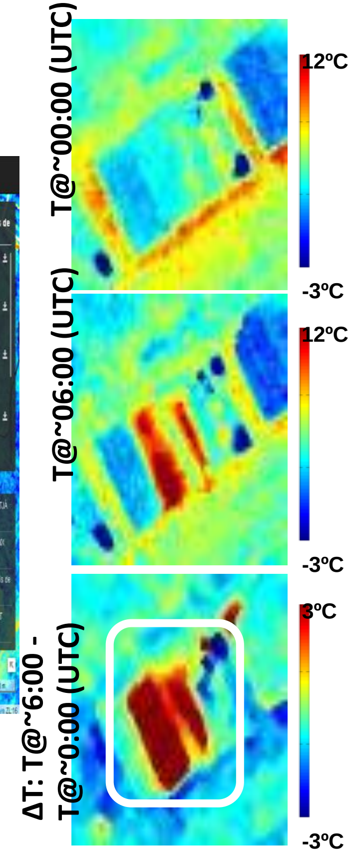
$\Delta T(t_2 - t_1)$



$T2_{6.00}$ UTC



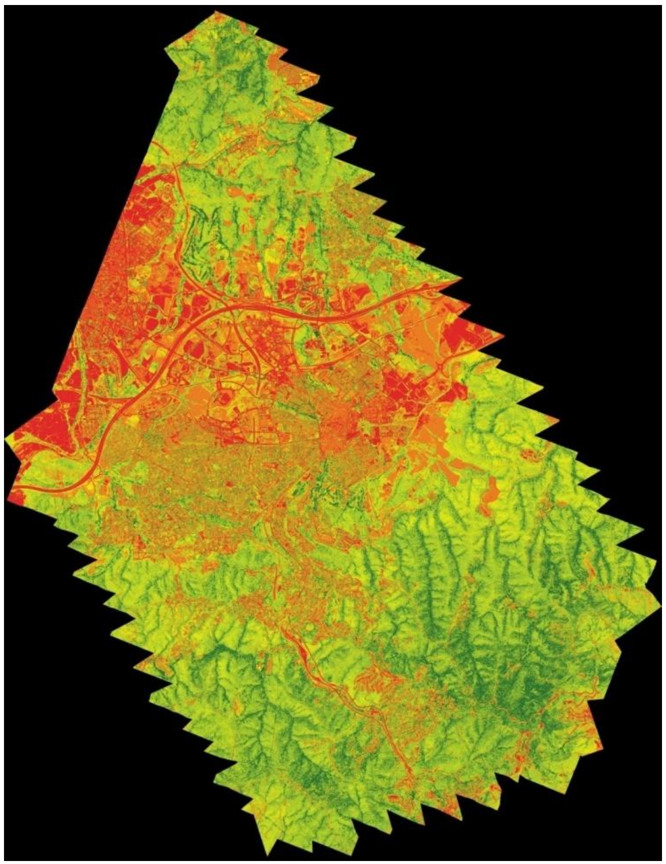


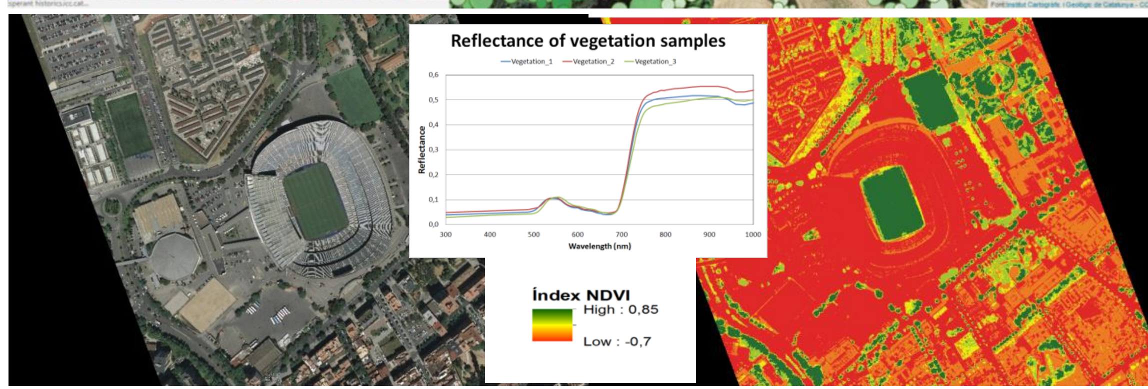


http://www.instamaps.cat/geocatweb/visor.html?businessid=15d048cb784dc2ac3e13b4f2f0a725df&id=441212&title=Eficincia-energtica-de-les-cobertes-de-naus-industrials-de-Rub

URBAN GREEN

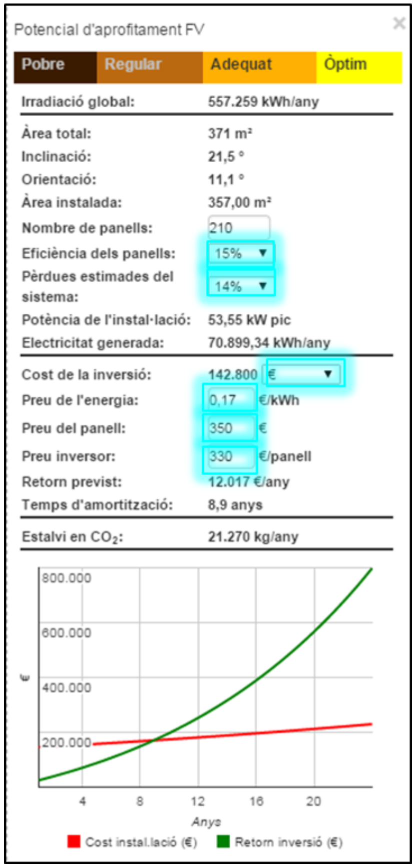
Urban green could be derived from ICGC's sensors with a GSD < 50 cm. Urban green knowledge in terms of allocation and health represent a key input in terms of urban sustainability and impacts of heat waves events





SOLAR POTENTIAL

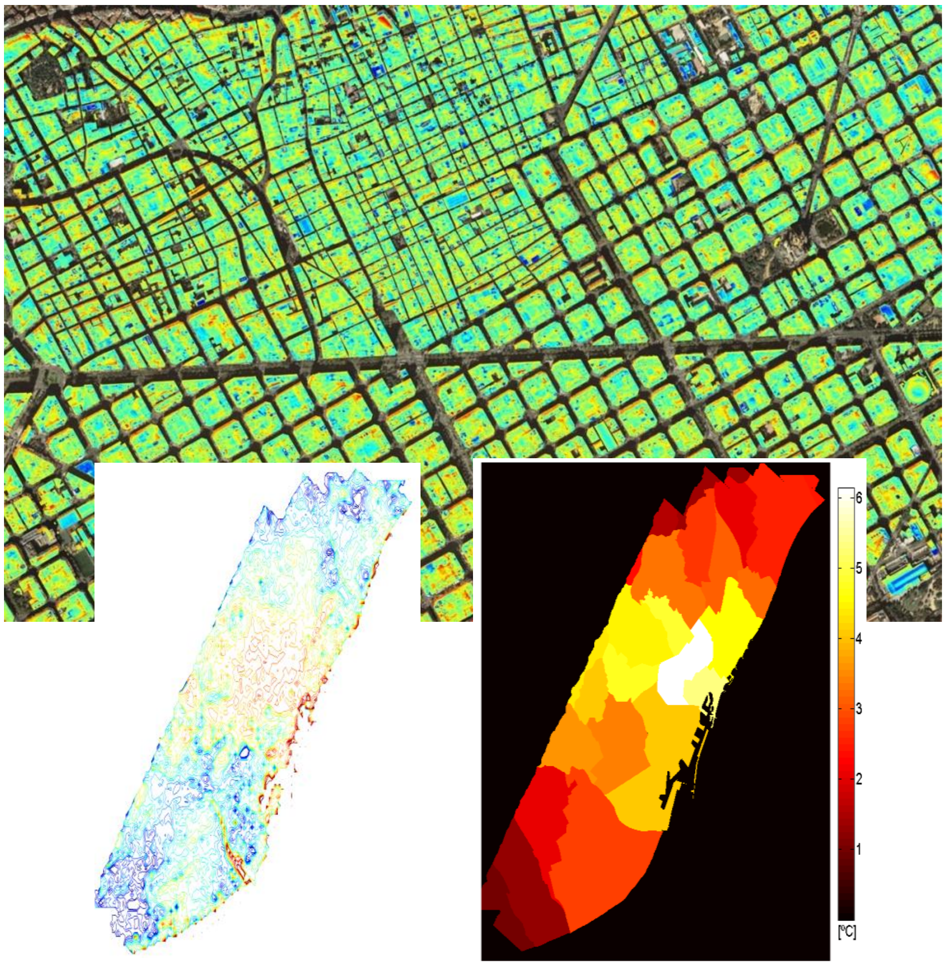
Modelling solar trajectory and topographic and urban models, a geoservice has been developed to evaluate the availability or solar potential on urban and peri-urban covers

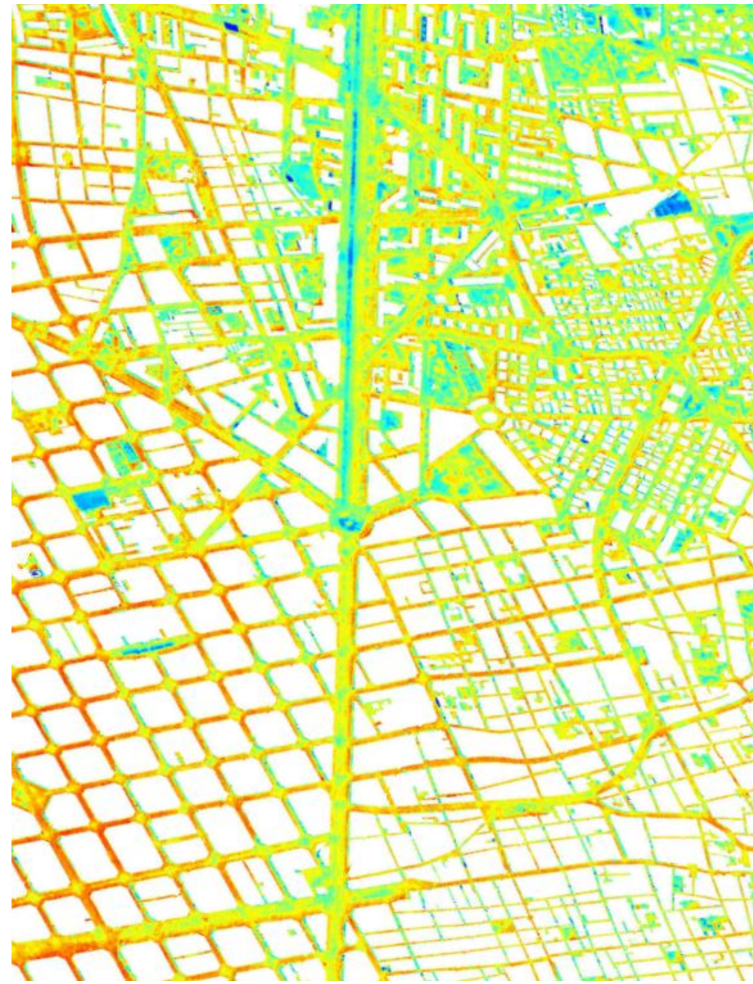


http://www.instamaps.cat/geocatweb/visor_psolar.html?businessid=41d5e2fb2b981a65c871e47bfc84ce56

URBAN HEAT ISLAND

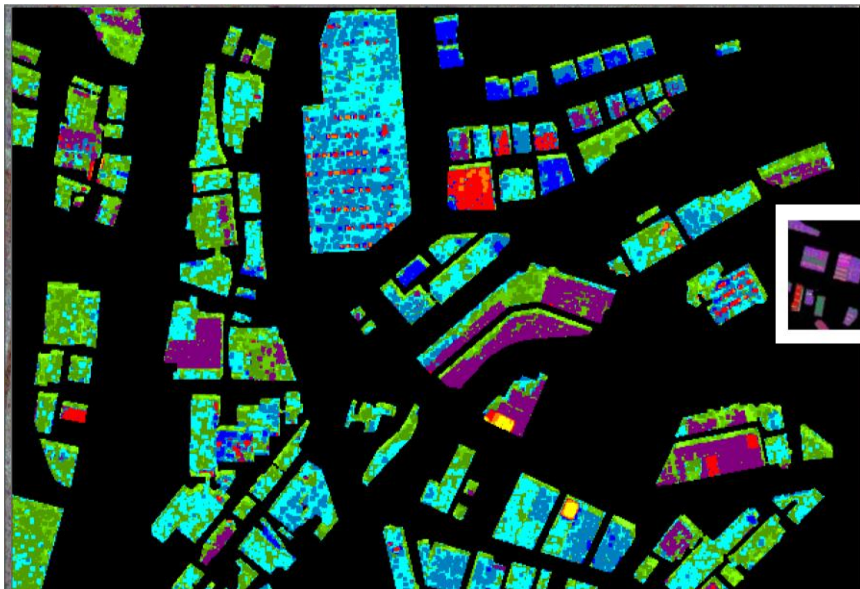
On a synoptic, reactive and a very high resolution level, urban environments could be sensed and modelled to derive and analyze urban heat island phenomena

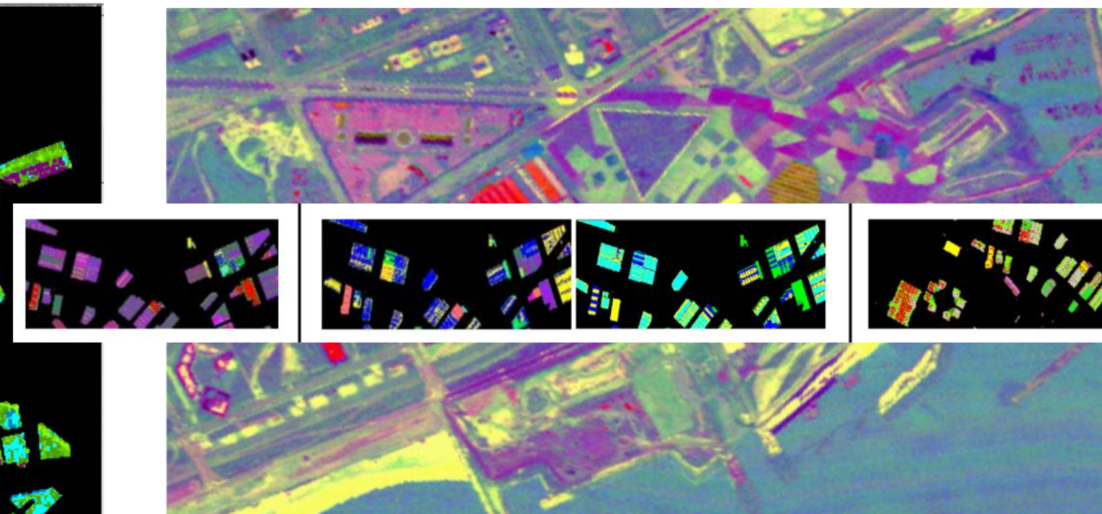


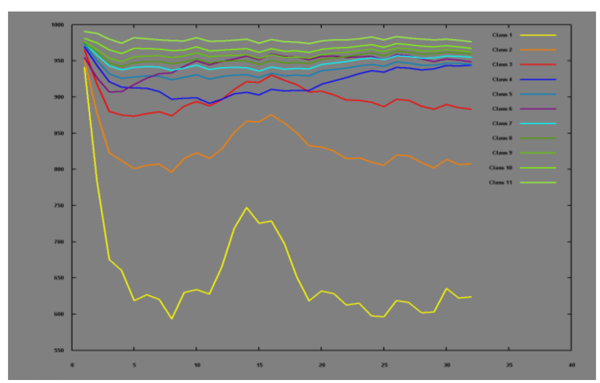


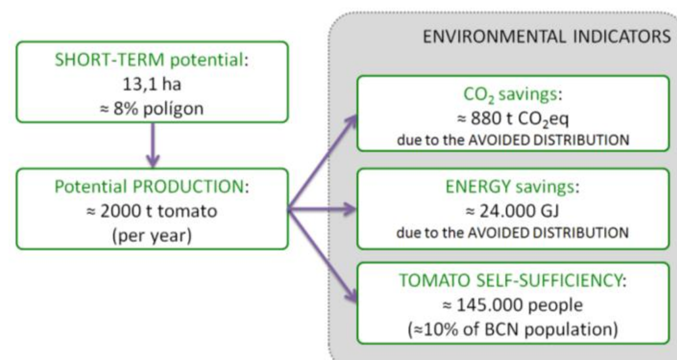
COVERS AND SUSTAINABILITY

On a research level, we are mixing the hyperspectral information from VNIR and TIR to classified covers and thermal behavior to evaluate the availability and potential uses of covers in particular for vertical farming



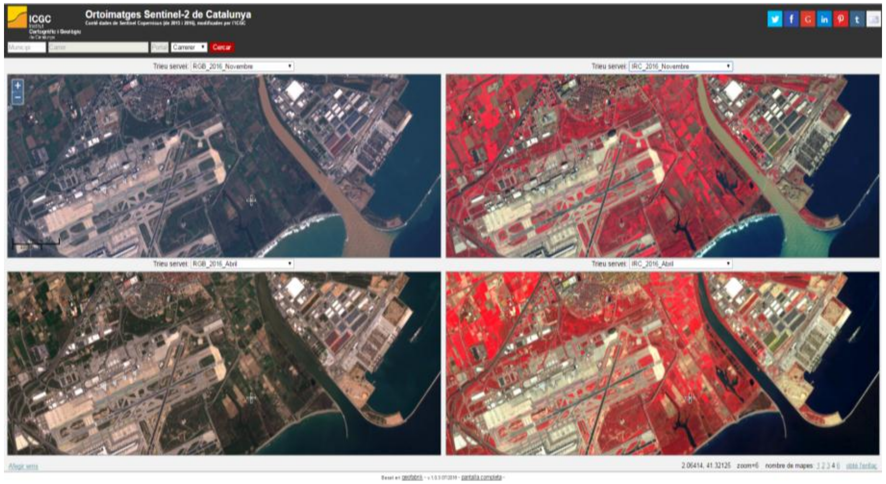


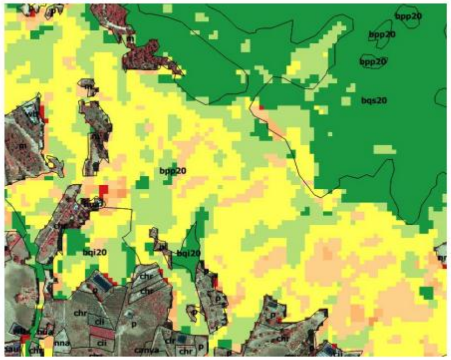




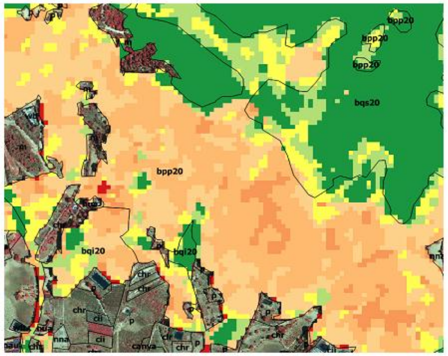
AND SATELLITE E.O.?

Orthoimatges RGB and IRC over
Catalonia: Sentinel 2 Geoservices

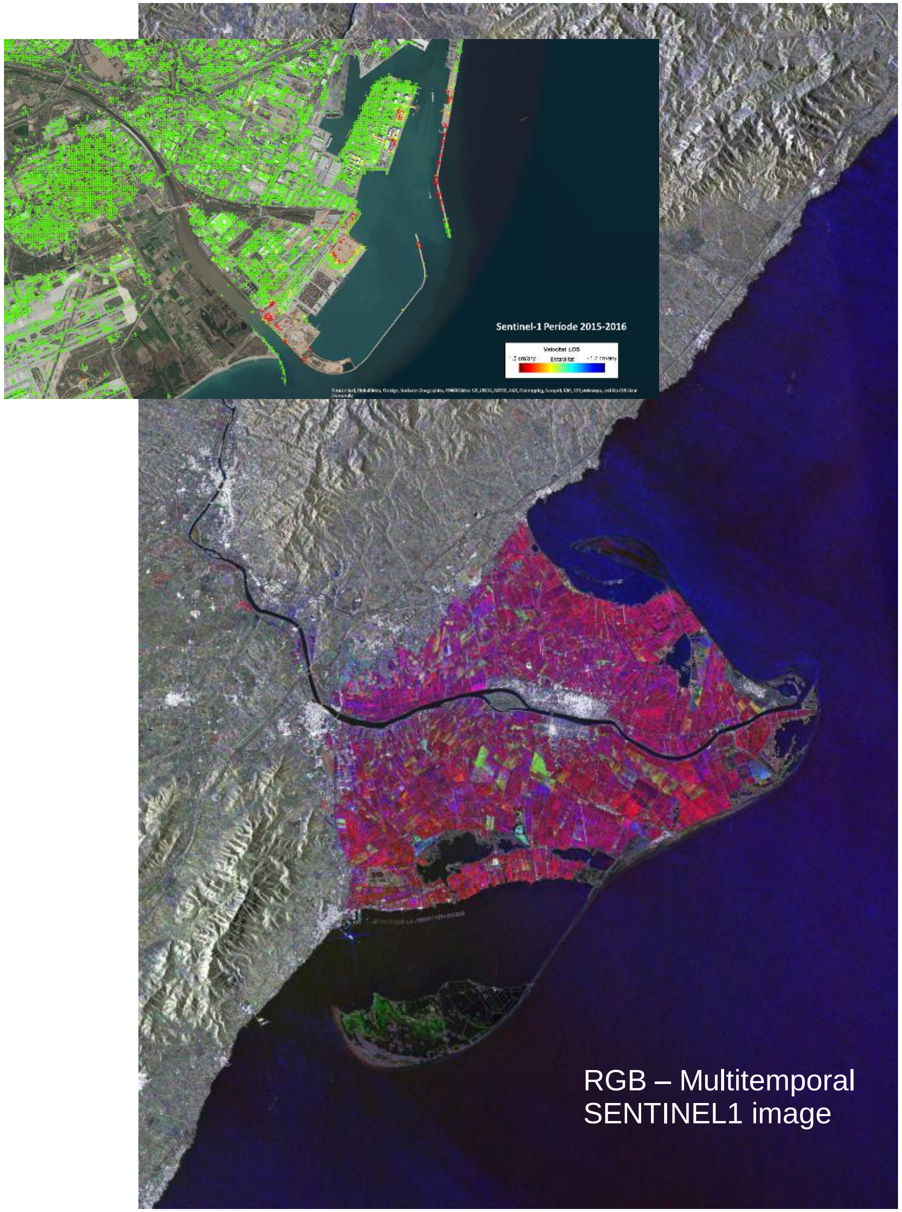




02-08-2015



26-08-2016

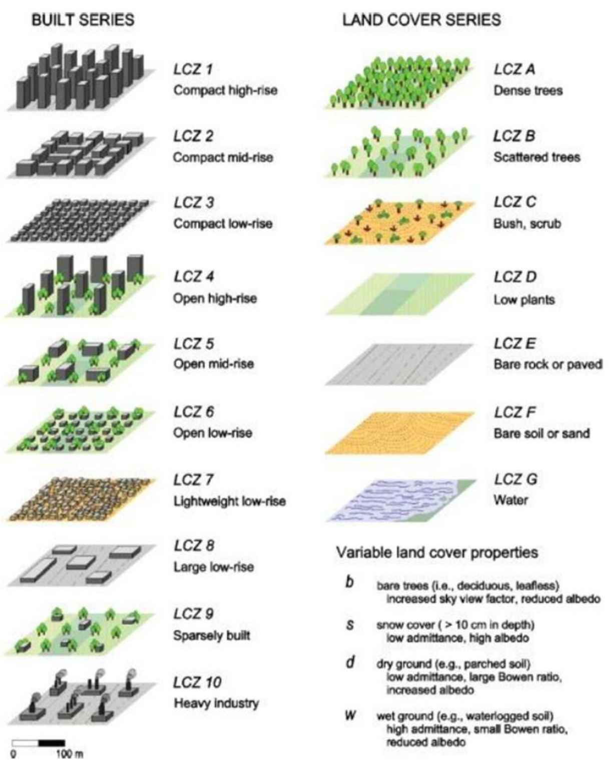


RGB – Multitemporal
SENTINEL1 image

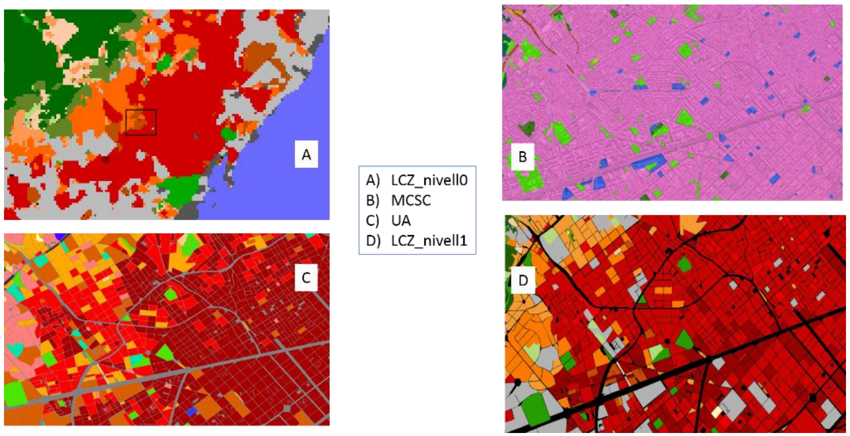
LOCAL CLIMATE ZONES

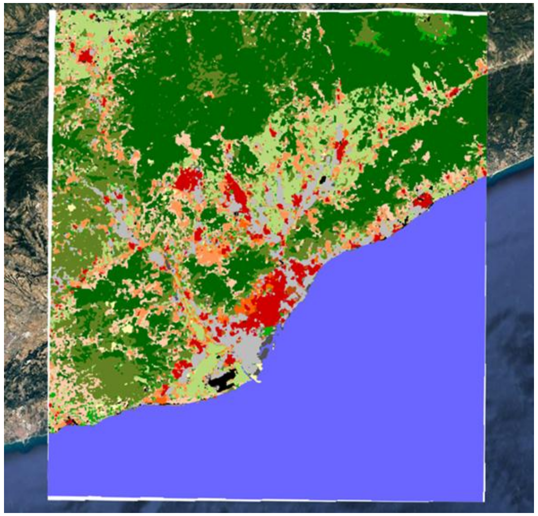
Urban areas constitute an ecosystem where climate trends are having, and will continue to have, big impact in the short, medium, and long term. Climate change in cities is more pronounced than global climate change specifically in the Mediterranean basin, mainly due to the addition of the heat island effect. The new classification proposed by Stewart and Oke (2012) named Local Climate Zones (LCZ) constitutes a standardization and generalization of urban and rural areas that have similar thermal characteristics.

Local climate zone (LCZ)	Sky view factor[a]	Aspect ratio[b]	Building surface fraction[c]	Impervious surface fraction[d]	Pervious surface fraction[e]	Height of roughness elements[f]	Terrain roughness class[g]
LCZ 1 *Compact high-rise*	0.2–0.4	> 2	40–60	40–60	< 10	> 25	8
LCZ 2 *Compact midrise*	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 midrise*	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

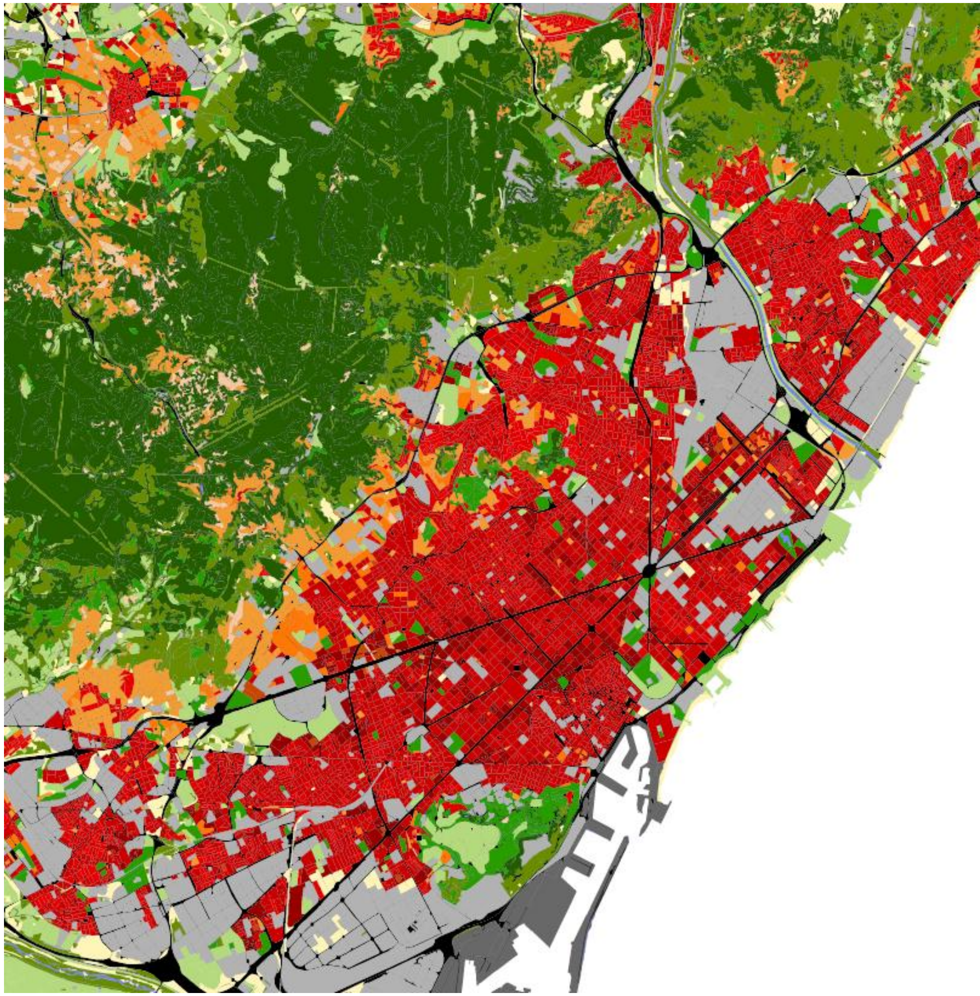


LOCAL CLIMATE ZONES





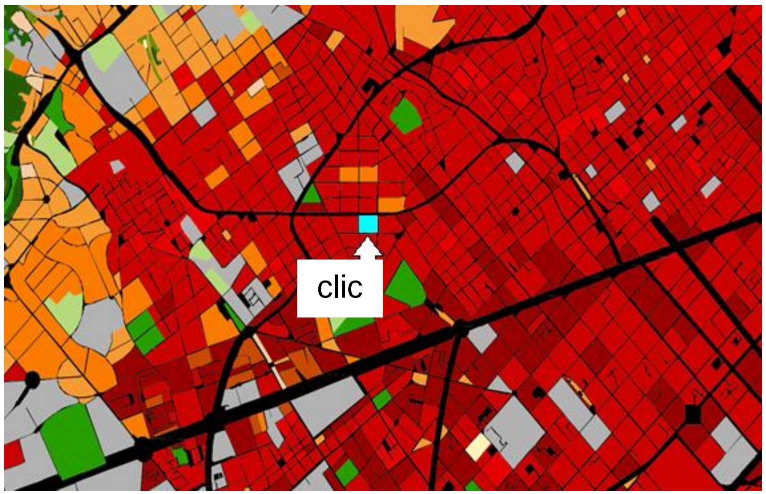
LCZ nivell 0 methodology from Landsat8/Sentinel2 imagery (Raster format results GSD=150m)



LCZ nivell 1 (Land Cover Land Use, Urban Atlas, DSM .....) -preliminary results- (vector shapes)

LOCAL CLIMATE ZONES

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



LEVEL	
EXCELLENT	
FINE	
GOOD	
BAD	
VERY BAD	

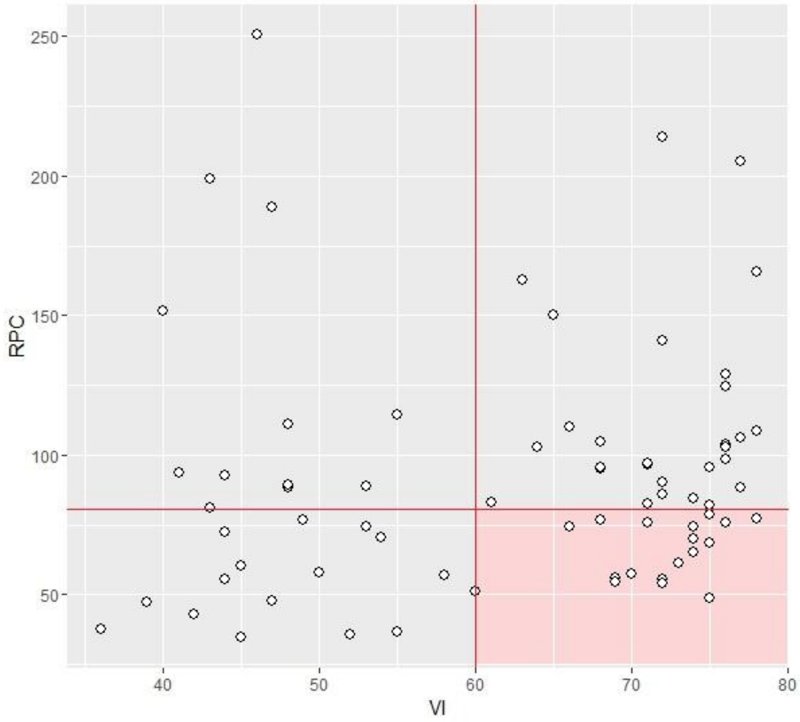
+

= **Risk** = Vulnerability (LCZ) x Dangerosity (Climate M.)x [Exposition]

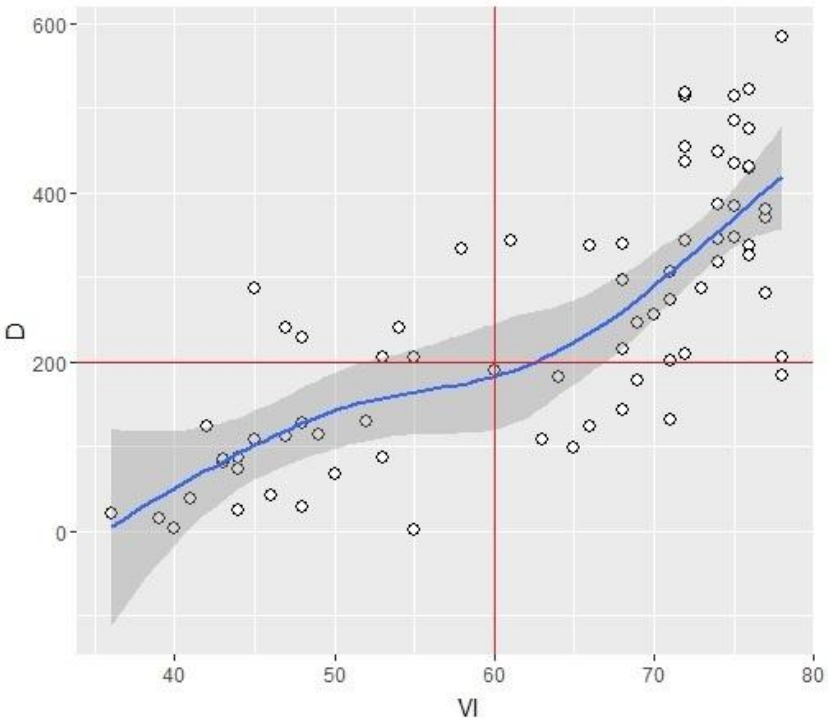
LCZ + Climate model Model = RISC	Exposició 1	Exposició 2
SCENARIO METEO 1		
SCENARIO METEO 2		
SCENARIO METEO #		

LOCAL CLIMATE ZONES

An also to evaluate geo equitativity



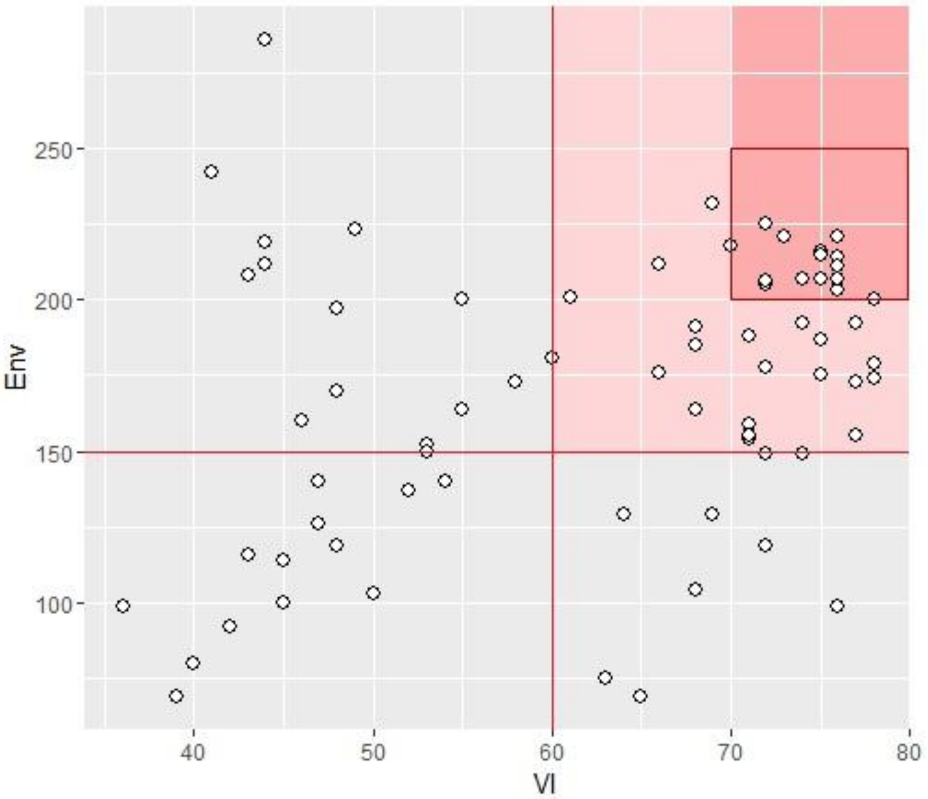
Per capita income / LCI (vulnerability index)



Population density / LCI (vulnerability index)

LOCAL CLIMATE ZONES

An also to evaluate geo equitativity

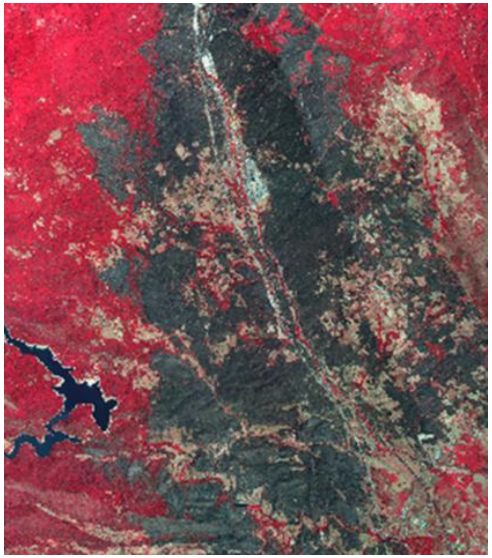


Aging índex (AI) / LCI (vulnerability index)

Neighbourhood	VI	AI (%)
Sants - Badal	78	200
El Camp d'en Grassot	76	207
L'Antiga Esquerra de l'Eixample	76	203
La Nova Esquerra de l'Eixample	76	214
Sant Antoni	76	221
Les Corts	76	211
La Sagrada Família	75	216
Camp de l'Arpa del Clot	75	207
Sant Martí de Provençals	75	215
Vilapicina i la Torre Llobeta	74	207
Porta	73	221
La Prosperitat	72	205
El Baix Guinardó	72	225
Navas	72	206
La Verneda i la Pau	70	218

HOW TO TRANSFORM DATA INTO INFORMATION AND KNOWLEDGE

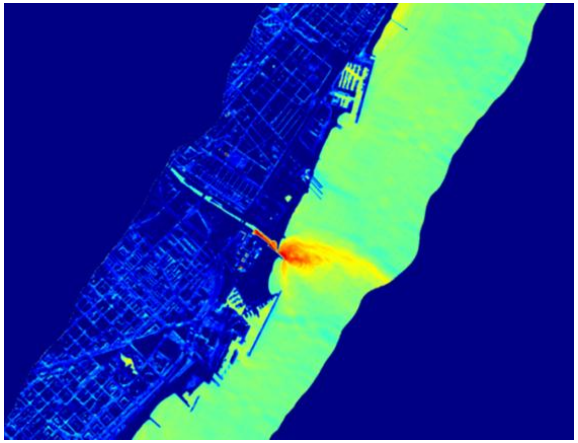
OTHER E.O. ACTIVITIES

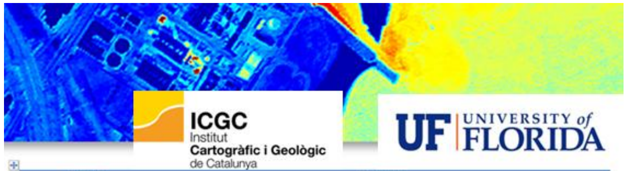


màster en geoinformació

ICGC Institut Cartogràfic i Geològic de Catalunya

UAB Universitat Autònoma de Barcelona

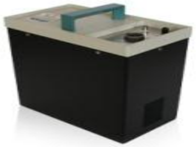


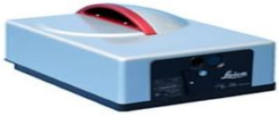


EFFORT	SUBJECTS
20% of EOS	**New trends and challenges on urban Earth Observation**
60% attended learning 40% assisted learning	EO_1: Principles of Earth observation on Urban Areas
60% attended learning 40% assisted learning	EO_2: Technical and operational design Earth Observation on urban areas
20% of EOS	**Earth Observation Added Value chain**
60% attended learning 40% assisted learning	AD_1: From data to information products and services
60% attended learning 40% assisted learning	AD_2: Direct and indirect impacts and benefits
35% of EOS	**Building Earth Observation Applications**
70% attended learning 30% assisted learning	AP_1: Surveillance Critical Infrastructures and risk monitoring
70% attended learning 30% assisted learning	AP_2: Climate and Health
70% attended learning 30% assisted learning	AP_3: Thermal behavior and energy
70% attended learning 30% assisted learning	AP_4: Change detection and growth
25% of EOS	**Mission analysis and Design**
40% attended learning 60% assisted learning	MAD_1: Problems to be solved: technical and operational ap
40% attended learning 60% assisted learning	MAD_2: Added value chain architecture and potential benefi
40% attended learning 60% assisted learning	MAD_3: Implementation plan and identification of end users
40% attended learning 30% assisted learning	MAD_4: Presentation, discussion and assessment

MOTS / ³Cat-3

CONCLUSIONS





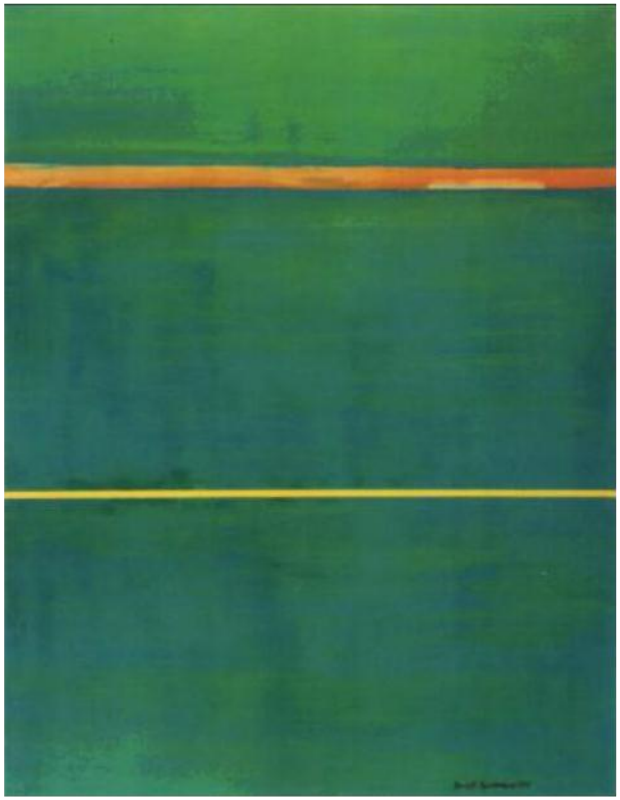
- Run your **own** observational platforms, sensors and competences is paramount to build up:

Science + Technology + challenges to be solved = Added Value

- However, **cross fertilization** is key to identify real challenges to be solved
- Operational Earth Observation means to manage the complexity of different skills, backgrounds, and professional competences to suit end user' needs
- Public Health is a key driver to create added value equation as well as to metrics geo-benefits

THANKS A LOT FOR YOUR ATTENTION

Barnett Newman (1949): Dionisius



ICGC (2014): Orthofoto 1:5.000