



UNIVERSITÀ
DEGLI STUDI
DELL'AQUILA



DICEAA
Dipartimento di Ingegneria
Civile, Edile-Architettura
e Ambientale

UNIVERSITY OF L'AQUILA - DICEAA

Civil, Construction-architectural And Environmental Engineering Department

***Multispectral images to
support the urban planning of
the city***

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STUDY AREA

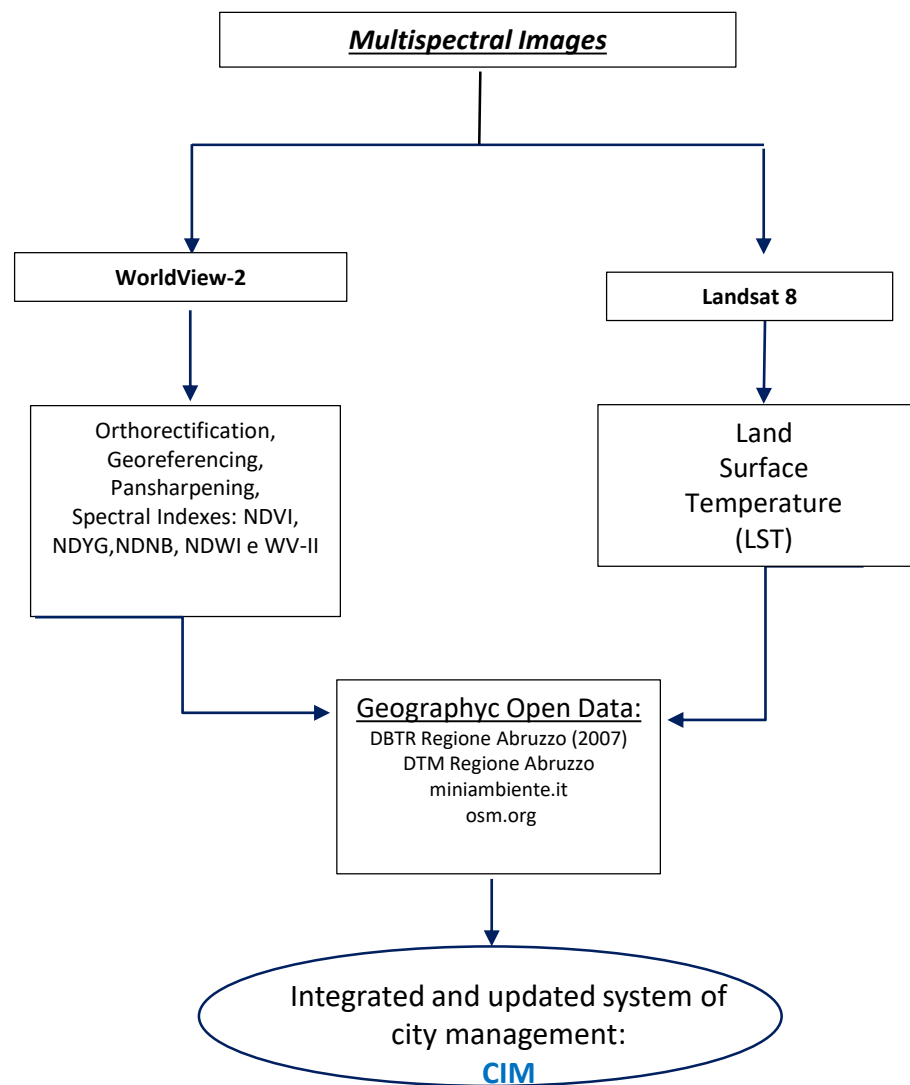


L'Aquila

The object of study is the Italian municipality of L'Aquila, as well as the capital of the province of the same name and of the Abruzzo region.



Workflow





Worldview II



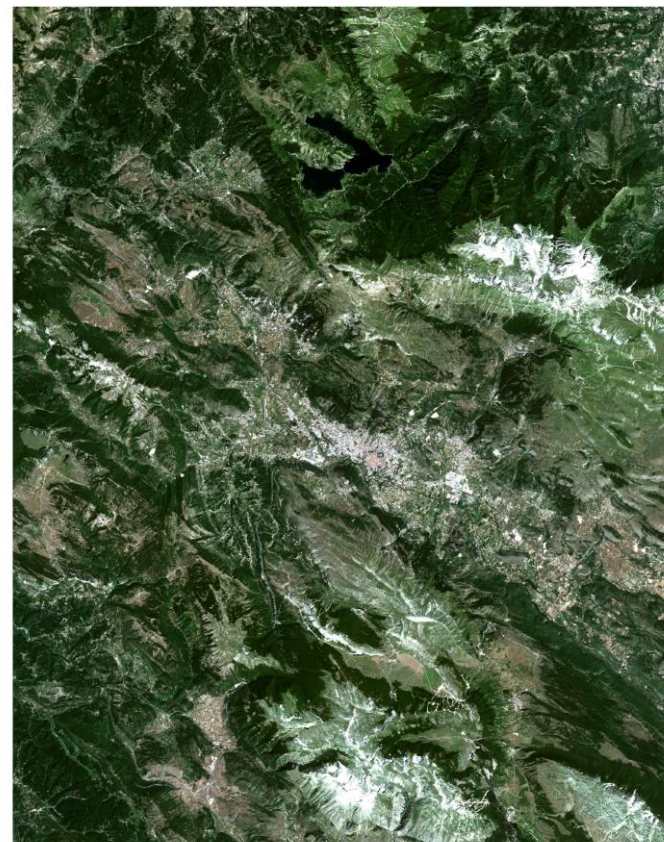
1. **COASTAL** Band (400-450 nm)
2. **BLUE** Band (450-510 nm)
3. **GREEN** Band (510-580 nm)
4. **YELLOW** Band (585-625 nm)
5. **RED** Band (630-690 nm)
6. **RED-EDGE** Band (705-745 nm)
7. **NIR1** Band (770-895 nm)
8. **NIR2** Band (860-1040 nm)

Dimensione Pixel:

- Pancromatico 0,46 metri
- Multispettrale 1,84 metri

Image: april 27, 2018

Landsat 8



1. **COASTAL AEROSOL** Band (435-451 nm)
2. **BLUE** Band (452-512 nm)
3. **GREEN** Band (533-590 nm)
4. **RED** Band (636-673 nm)
5. **NEAR INFRARED NIR** (851-879 nm)
6. **SWIR 1** (1566-1651 nm)
7. **SWIR 2** (2107-2294 nm)
8. **PANCHROMATIC** (503-676 nm)
9. **CIRRUS** (1363-1384 nm)
10. **THERMAL INFRARED (TIRS)1** (10600-11190 nm)
11. **THERMAL INFRARED (TIRS)2** (11500-12510 nm)

Dimensione Pixel:

- Pancromatico 15 metri
- Multispettrale 30 metri
- Termico 100 metri

Images: August 5, 2013
July 18, 2018
July 21, 2019

First studies

Normalized Difference Vegetation Index

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$



- Edificato o superfici impermeabili
- Suolo nudo o vegetazione assente
- Basso vigore della vegetazione
- Medio vigore della vegetazione
- Alto vigore della vegetazione



Normalized Difference Yellow Green

$$NDYG = \frac{(\text{Yellow} - \text{Green})}{(\text{Yellow} + \text{Green})}$$



- Assenza di tegole
- Coperture con presenza di tegole



Normalized Difference Nir 1 - Blue

$$NDNB = \frac{(\text{Nir1} - \text{Blue})}{(\text{Nir1} + \text{Blue})}$$



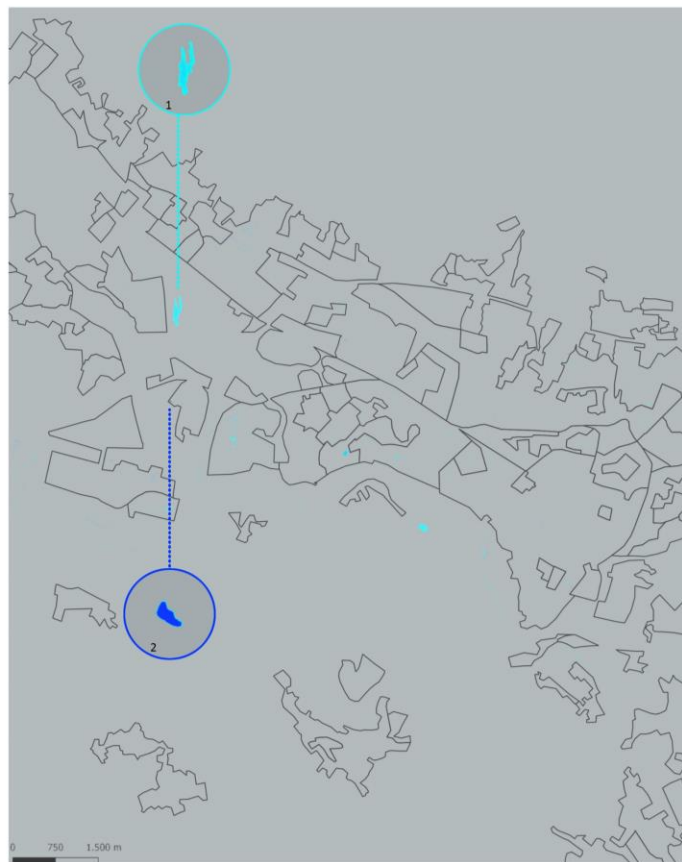
- Materiale in amianto o cemento scuro
- Assenza di amianto o cemento scuro





Normalized Difference Water Index

$$NDWI = \frac{(Coastal - Nir2)}{(Coastal + Nir2)}$$



- Assenza di acqua
- Presenza di acqua (laghetti, fiumi ecc.)
- Presenza di acqua (piscine)



Worldview New Iron Index

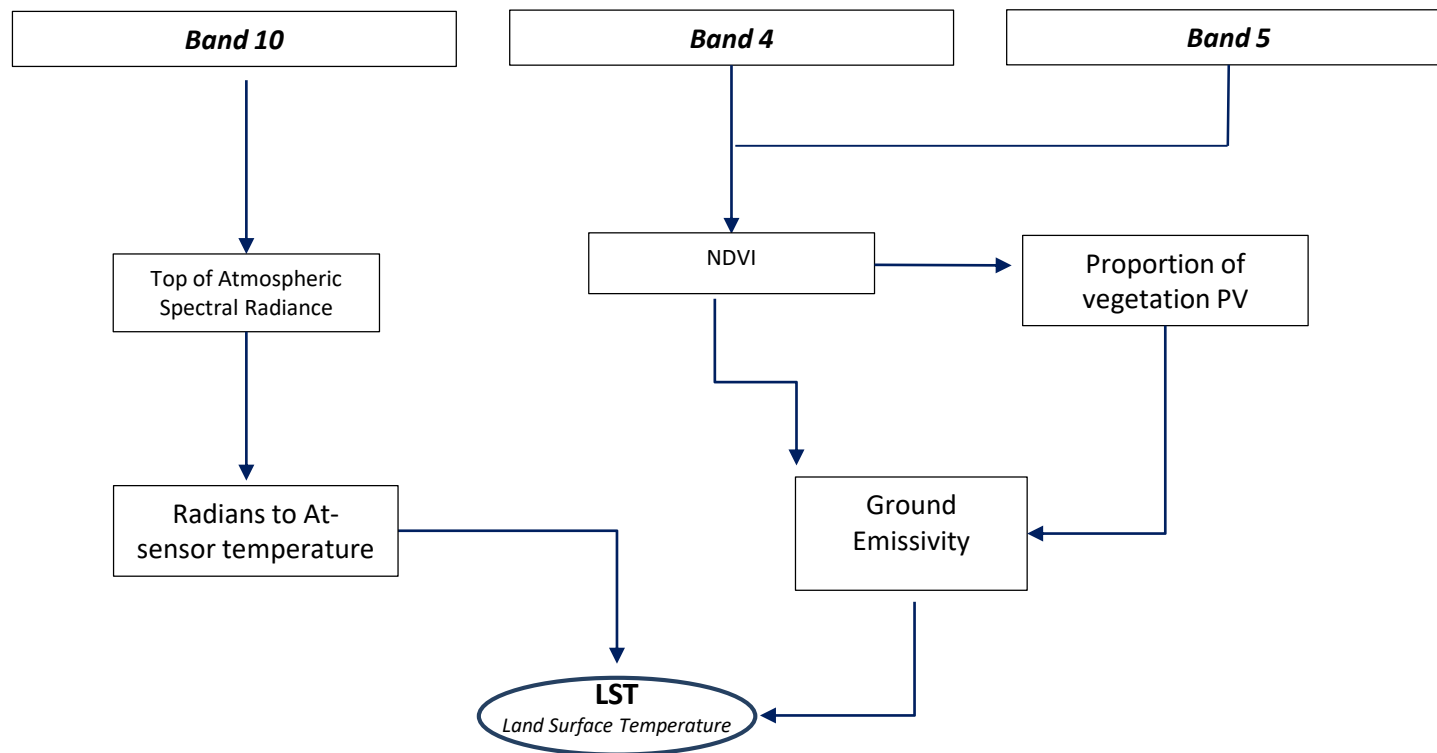
$$WV-II = \frac{(Green * Yellow)}{(Blue * 1000)}$$



- Presenza di ossido di ferro
- Assenza di ossido di ferro



Flowchart

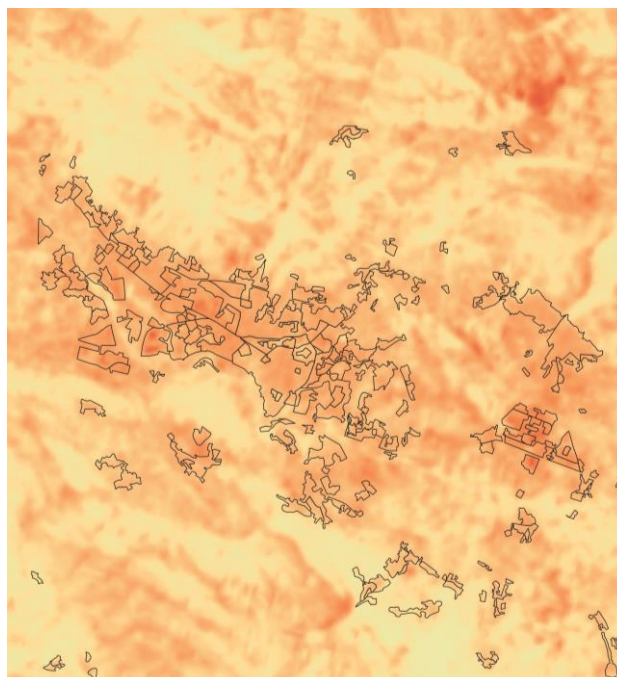


Thermal images

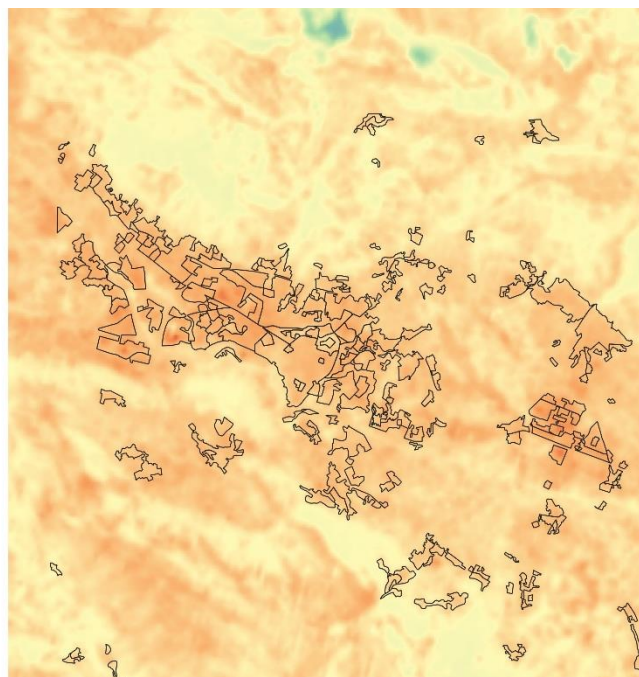
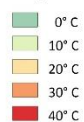
5 AGOSTO 2013

18 LUGLIO 2018

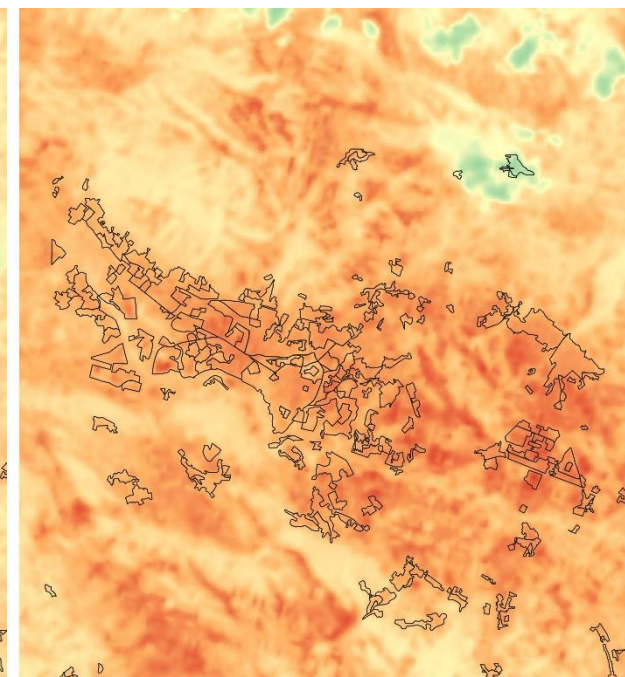
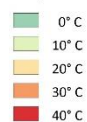
21 LUGLIO 2019



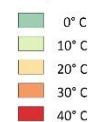
Temperature LST:



Temperature LST:



Temperature LST:



- Vigor of vegetation

OBJECTS	ATTRIBUTES						LST	LST	LST
	N D V I	N D W B	N D V I	N D W I	N D V I	N D W I	5 August 2013	18 Nov 2018	21 July 2019
Buildings		●	●		●				
Forest	●								
Crops	●								
Courtyards	●								
Urban Area									
Green	●						●	●	●
Water				●					
Roads									
Bridge									
Sidewalk									
Historic walls									
Railroad					●				



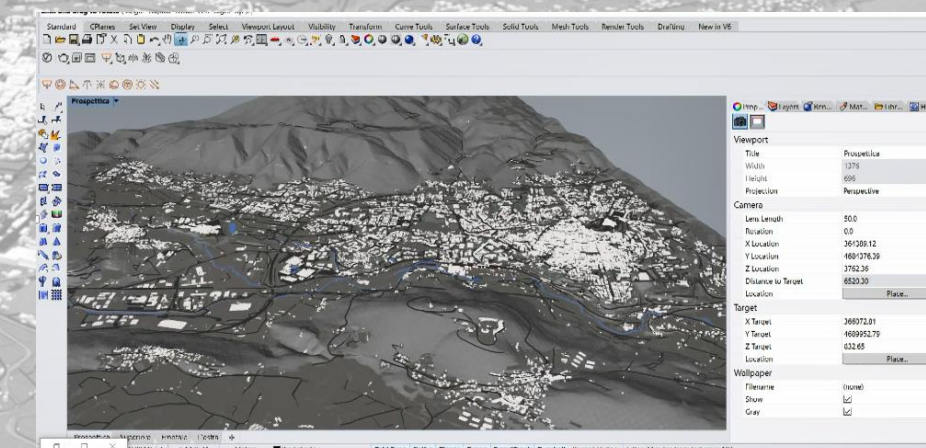
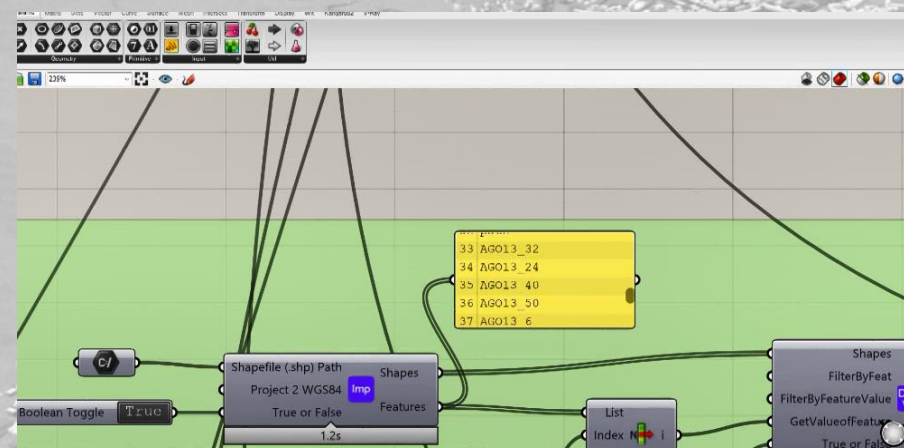
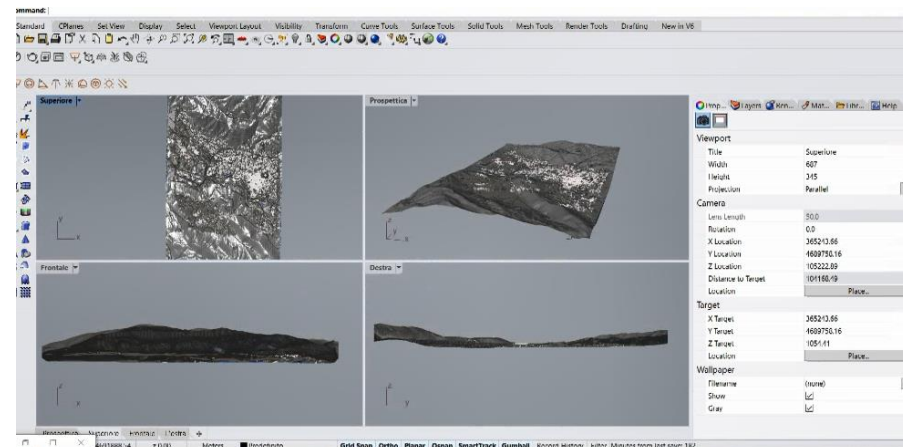
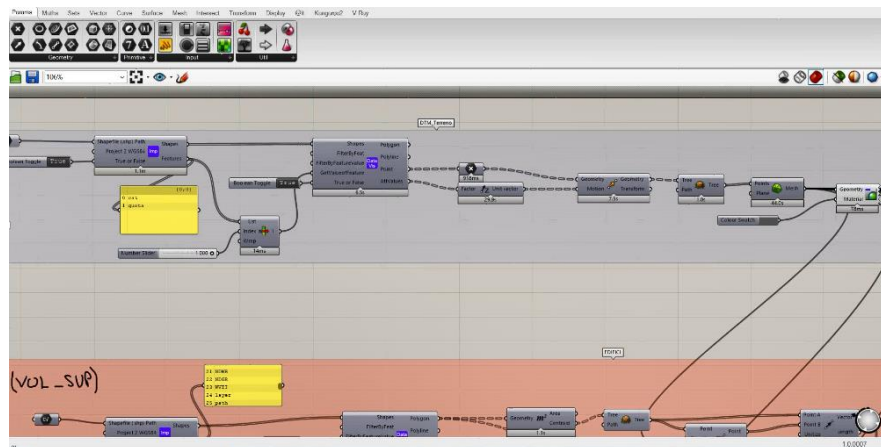
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ENEA



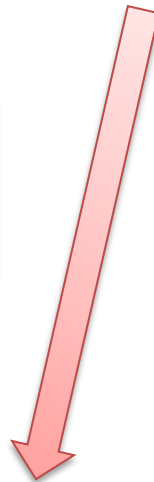
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Following steps: Further studies for CIM and UHI by means of new approaches and methods



Implement a fully automated
analysis procedure



development of new digital technologies
that consider the specificity of the area,
proposing diversified solutions
and the possibility of tracking their evolution
over time



Creation of
management models
useful for urban
planning



Studies of the heat island in relation
to the built-up area



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