

Asperity map of Italy The morphological complexity geo- location for a better CwRS image request

SIN spa Roma



Context

This task is included into the usual Innovation activities of AGEA-SIN for simplifying and speeding up the Geomatic procedures for IACS and particularly for CwRS

Lesson learnt: nomenclature...

- Asperity = roughness of surface; something of rough, harsh or severe
- Origin = Latin: Asperitas, Asperitatis 3° declension > Anglo-French > late middle English.....

CwRS processing issues

- Italy performs CwRS at 100%, using both satellite and airborne (26,000 skm of sat VHR and 100,000 skm of airborne yearly => around 35-40% of the territory)
- The success of this activity is strictly related to a fast and performing processing chain and the final geometric accuracy
- The higher Italian % of mountain hilly agronomic parcels, both for permanent and arable, requests particular attention and preciseness on this task

CwRS annual activity in general depends on:

1. Type of morphology (flat, hilly-mountain and real density of altitude variations)
2. Climate conditions (Cloud Cover persistency, latitude and solar periods, etc)
3. Control sampling choice (grid, polygons/dimensions, municipality boundaries, etc.)
4. Control strategy and target (Eligibility, Rural Development, Coupled crops, LFA, next EFA?, etc.)
5. Type of imagery adopted (resolution), processing and ancillary data availability

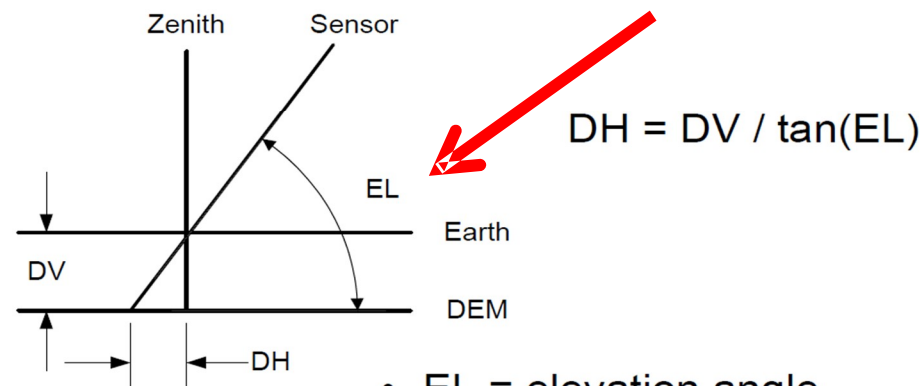
=> Choice of national controls ALWAYS aiming at a positive benefit/costs ratio RS/In Situ

(100% RS, 80%, 50%?, etc)

Cartographic accuracy after processing depends on:

1. Photogrammetric software used and GCPs precision/distribution
2. Morphologic complexity vs. Terrain (Surface) Digital Model used
3. Satellite acquisition angles, as defined in JRC specifications document “JRC IES/H06/C/PAR/par D(2012)(13923)”

Terrain displacement



- EL = elevation angle
- DV = vertical distance
- DH = horizontal distance

Low acquisition angles vs complex areas

When elevation angle is low (40° - 50°) and the sample zone presents morphologic complexity....results are often “locally” discouraging and needed of several processing iterations

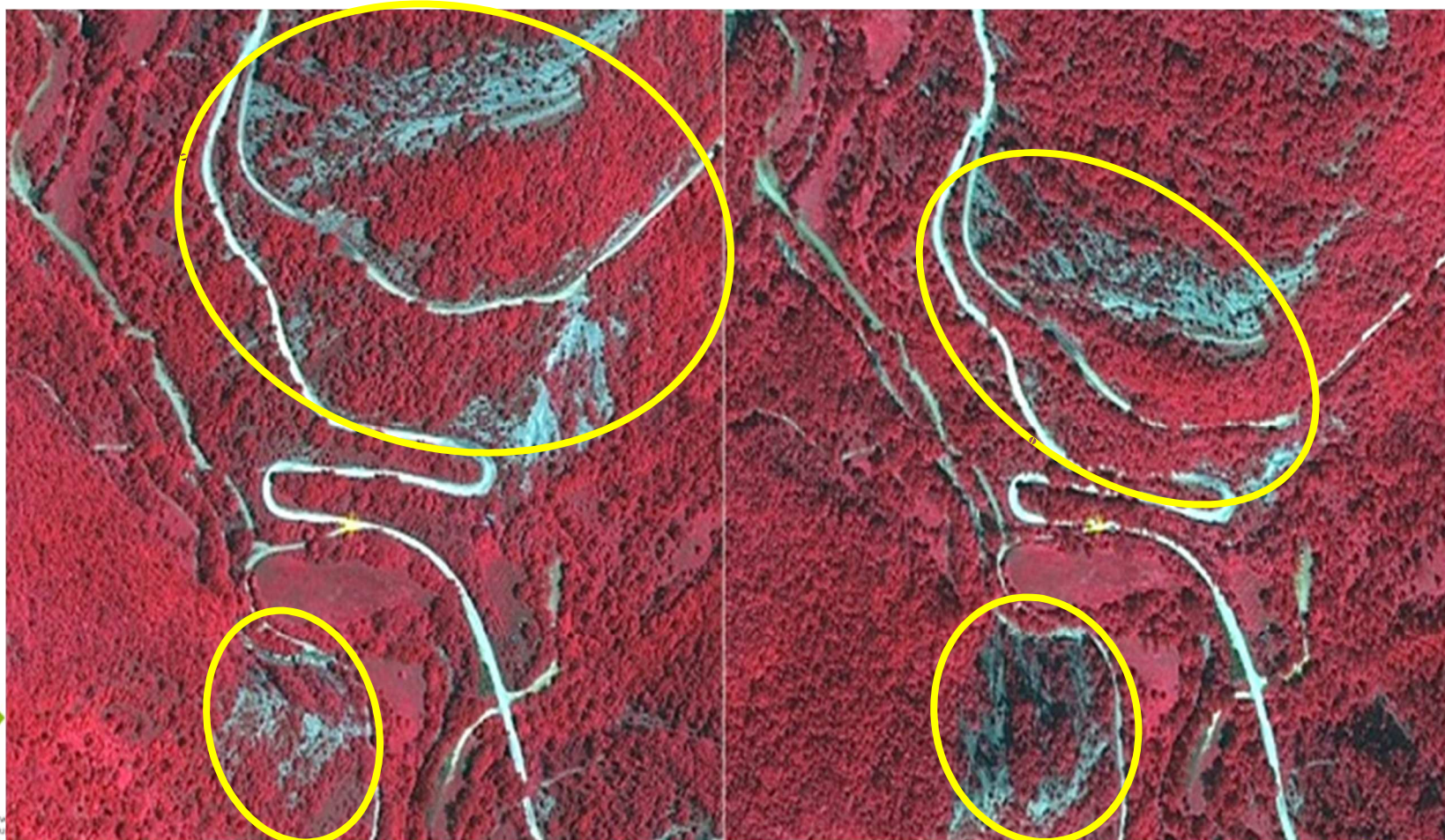


Low elevation

Vertical

Opposite low acquisition angles vs complex areas

When there are two opposite fields of view (low 40°- 50°) in complex areas (e.g. different dates for completion) at the first iteration clear distortions on the majority of the targets appear (parcels, roads, also landslides)

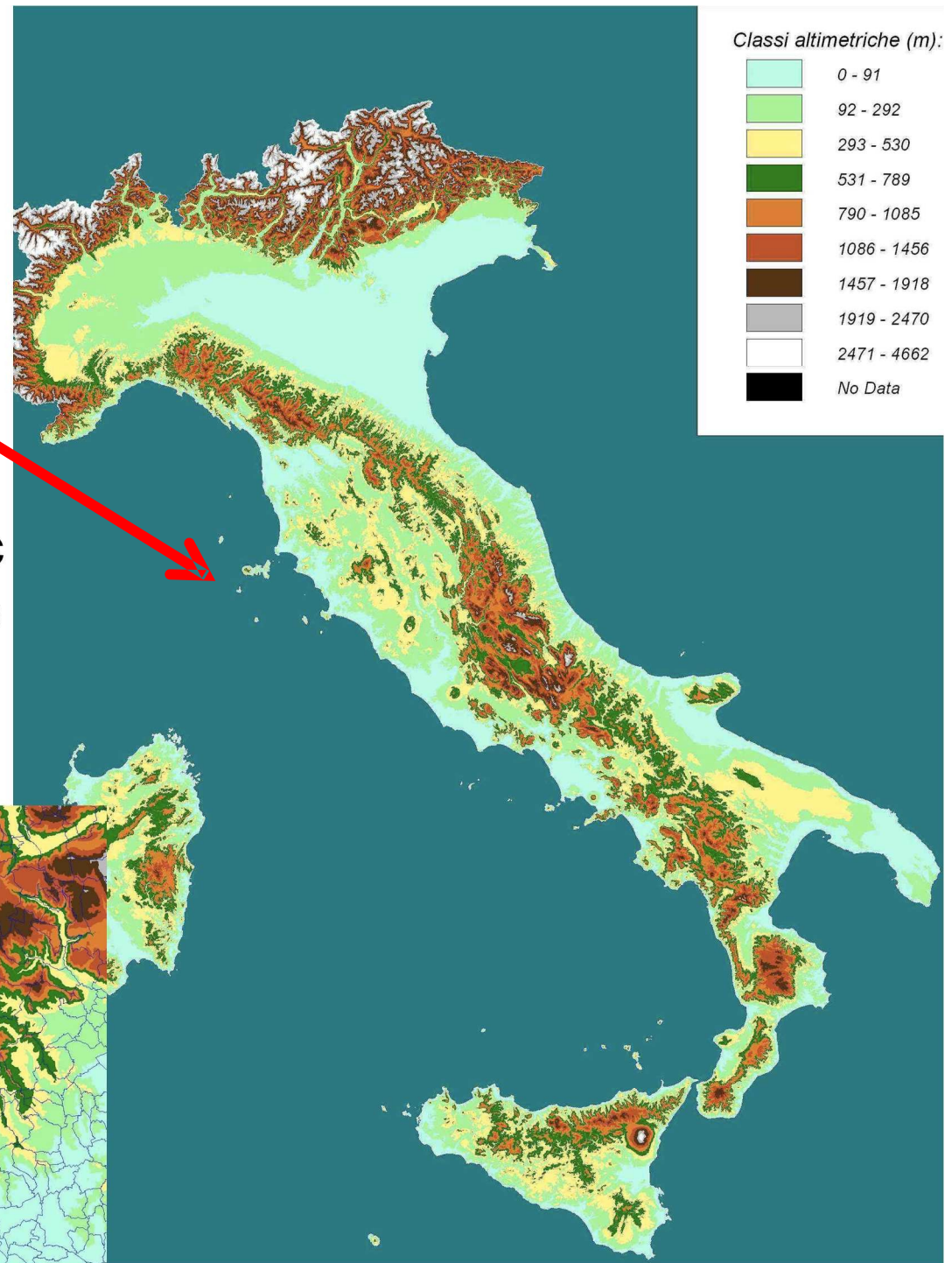


To find the real complex areas

What is the best solution....?

DSM/DTM for altitude and slopes only...?

Need: complete morphologic analysis for a suitable image planning request?



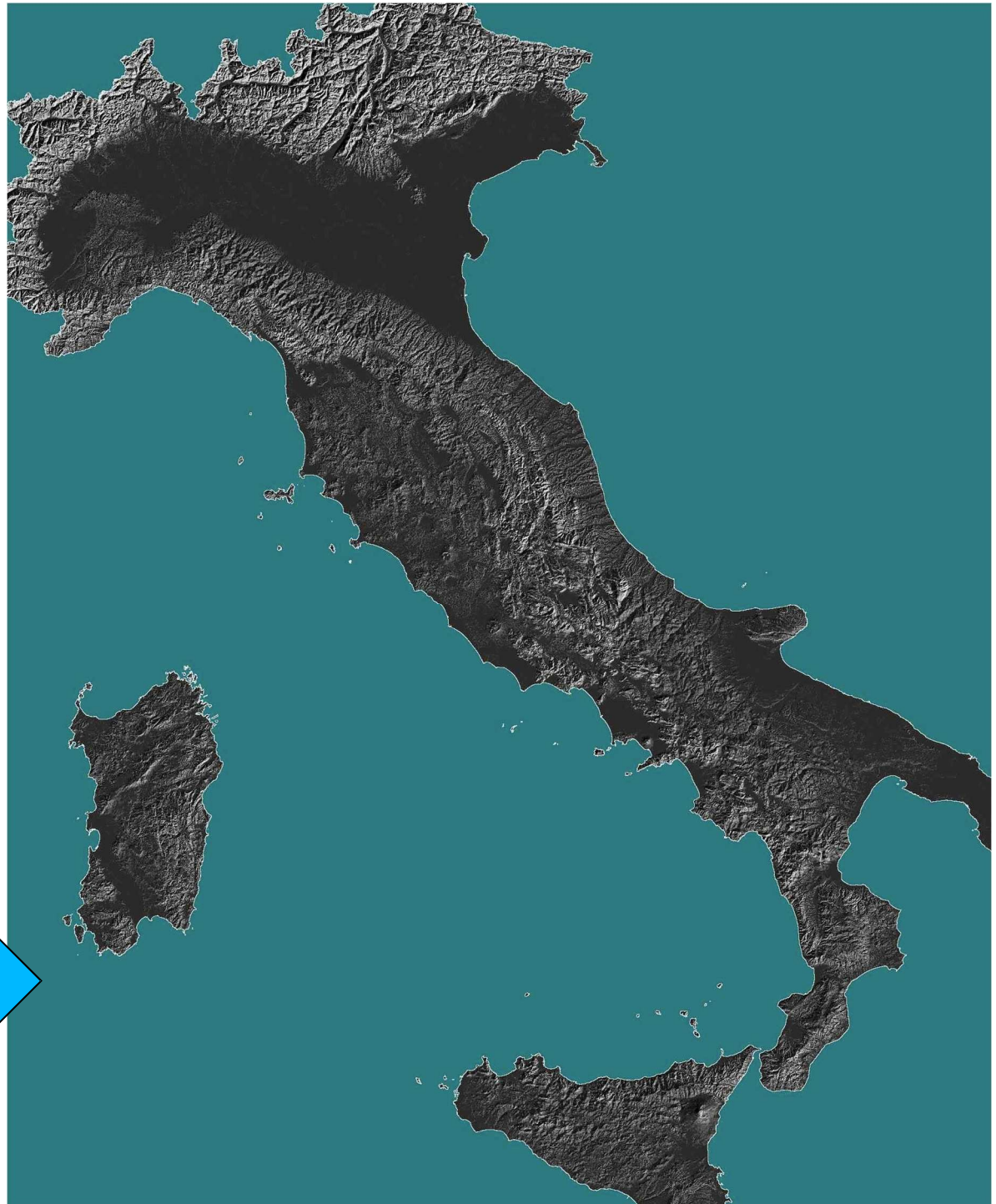
starting from
a national DSM....
Exposition Map

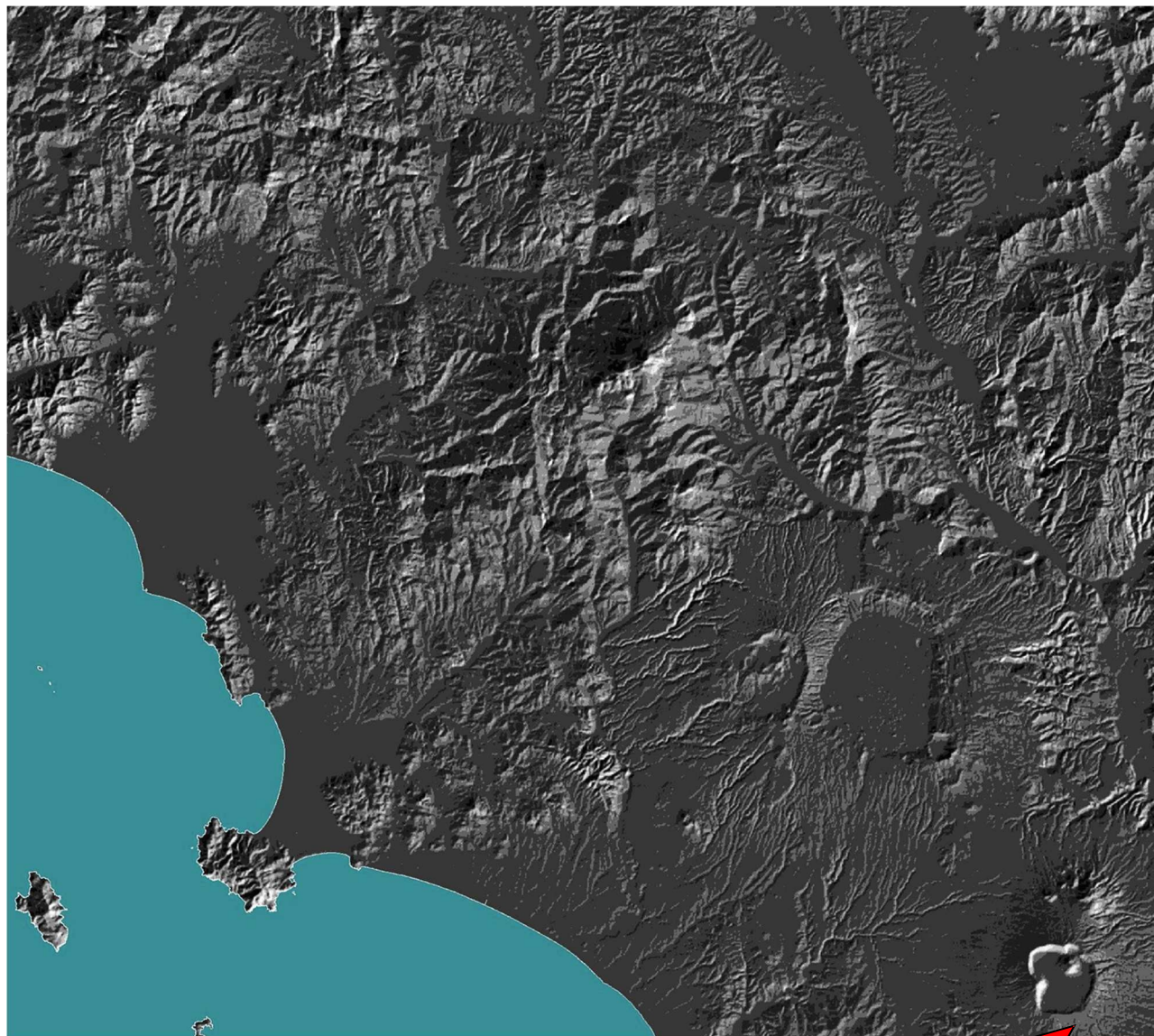
from simple
elevation- slopes
to
elevation-sloping/
orientation
(8 additional classes)



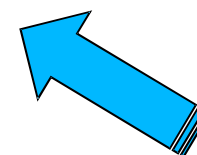
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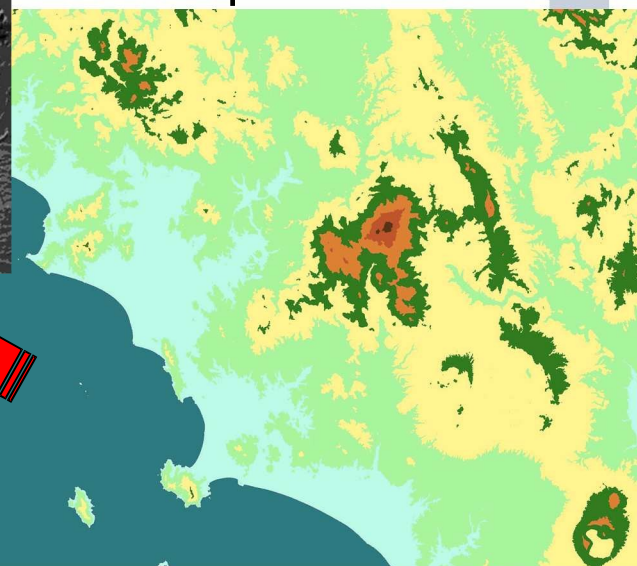




Exposition:
a better
representation
of the terrain
complexity



From Simple DSM
To more complex
Representations



Exposition map of Tuscany,
west Umbria and North Lazio

A solution

Asperity index as a new tool for terrain analysis (Riley et Alii 1999) and CwRS samples pre-classification

Target: morphological heterogeneity calculation for:

better Sample definition; better satellite elevation angles request; better and easier processing, better final cartographic accuracy

Asperity index:

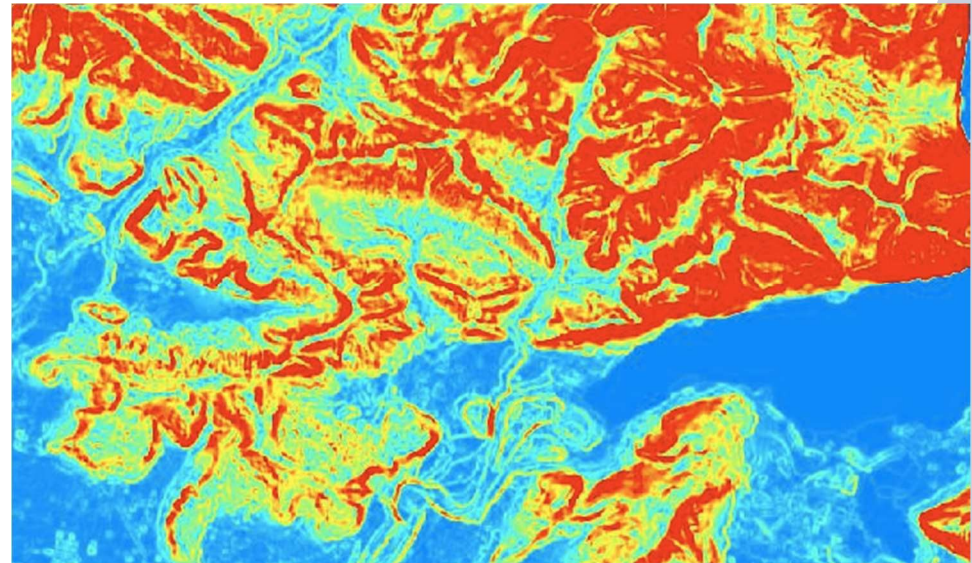
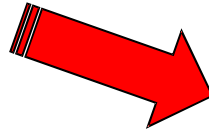
sum of elevation changes, inside a 3 X 3 pixel grid of DTM/DSM (depending on pixel size...) through RMSE analysis

Asperity map of Italy generation

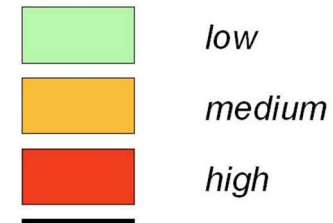
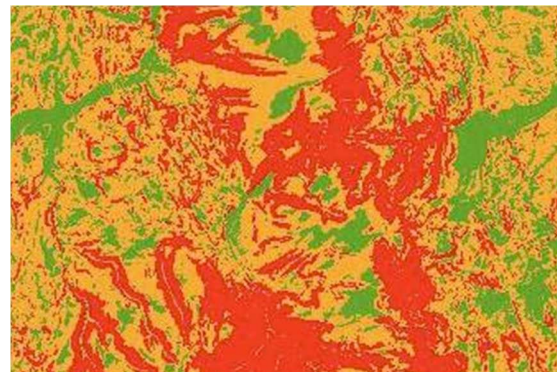
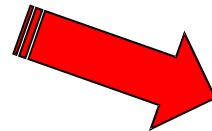
- **Starting data:** national DSM by air stereo couples 0,5m – declared accuracy +/- 4m Zed axis (test with SRTM already done last autumn)
- **Tool:** open Quantum GIS Raster/analysis/morphological index
- **Method:** RMSE autom. calculation of blocks 3x3 pixel => 60 x 60m (0,36ha) everywhere (300.000 skm)
- **Info resolution:** intrinsic morphologic variability for any block of 0,36 ha, basically more than 83 millions of calculated Blocks in Italy
- **Scale accuracy:** ranging from LPIS scale to cadastral map (1:10,000-1:2.000)
- **Working level:** around 280 “point values” for each cadastral map (LPIS refresh map unit)

1- The map of Indexes presents continuous levels of values (0;1), allowing very accurate and large scale geo-morphological definitions.

PROCEDURE -1



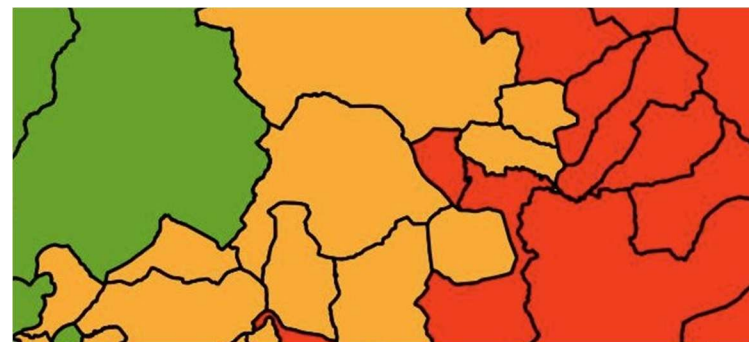
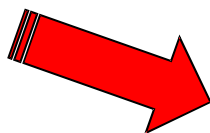
2-To simplify, three “interval classes “ were grouped (high, medium, low).



Procedure -2

3- At municipal level (Italian CwRS sample limits) further actions to be operational:

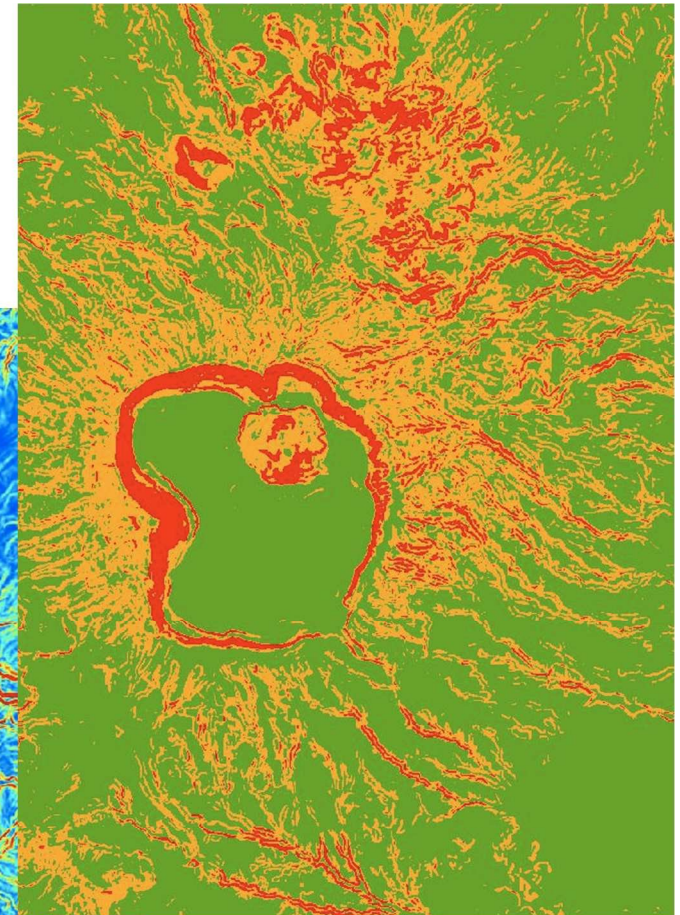
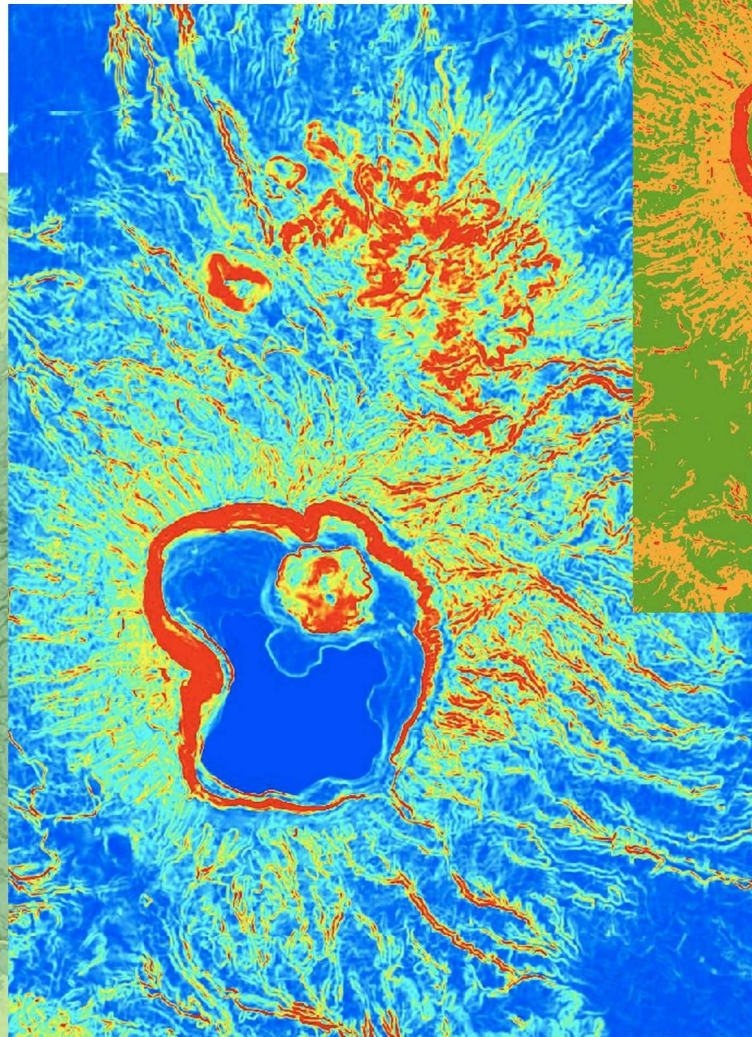
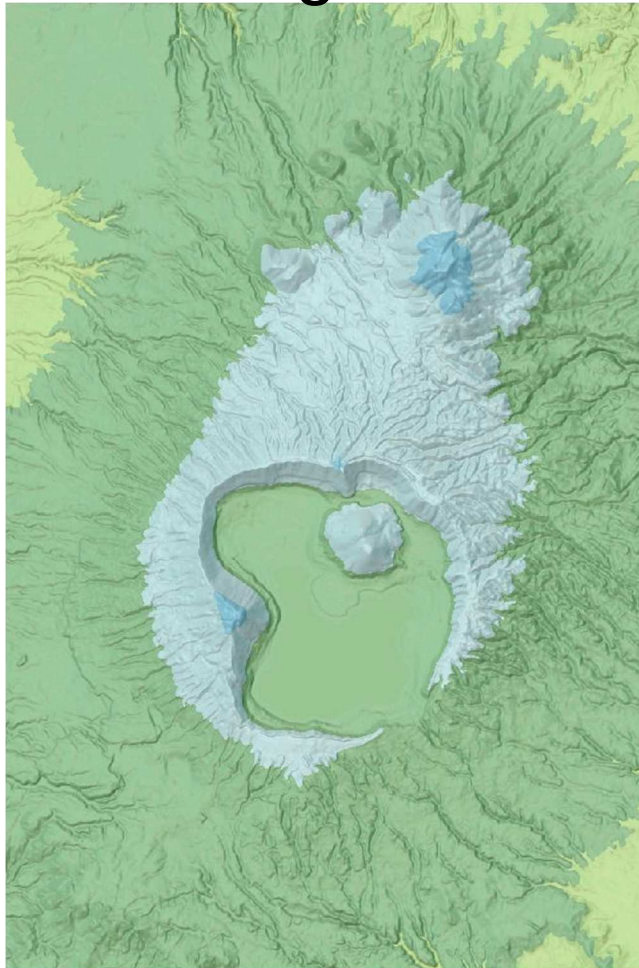
- Step1: if % of Municipality surface in high class is $>$ of % medium and low \Rightarrow **High class**
- Step2: apart from Step 1, if % of Mun. surface Medium is $>$ of Low \Rightarrow **Medium class**
- Step3: apart from Step 1 and 2, if % of Mun. surf. Low is $>$ of High and Medium \Rightarrow **Low class**
- Step4: apart from Step 1-2-3, if % of High class in Municipality is $>$ of Medium \Rightarrow **High class**
- Step5: apart from Step 1-2-3-4, if % Medium class in Mun. is $>$ of High \Rightarrow **Medium class**



Asperity Map example – different steps

Continuous levels

DSM original data



3 classes layer

Legenda

Municipal boundaries



Classes of Asperity

no data

LOW

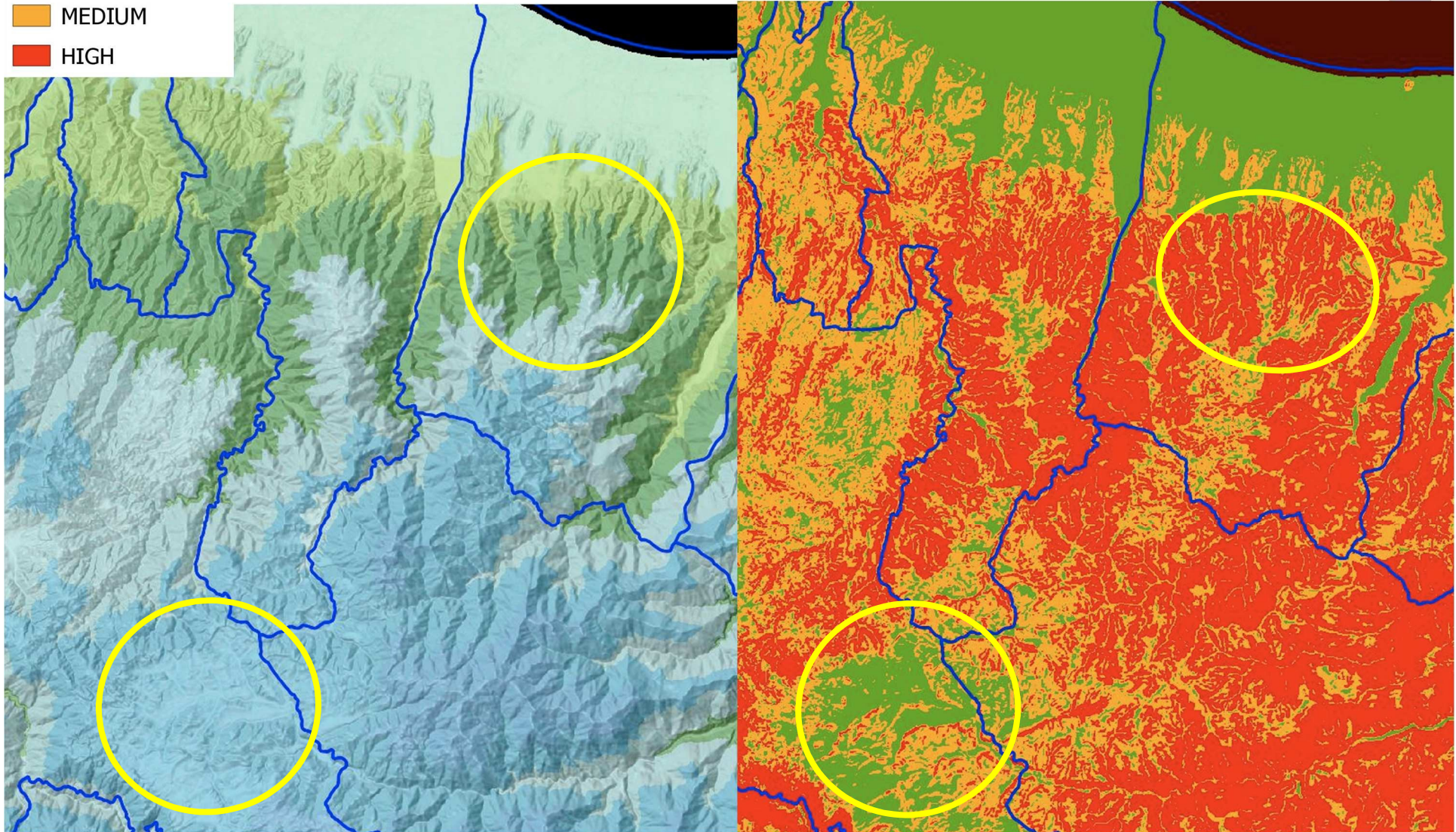
MEDIUM

HIGH

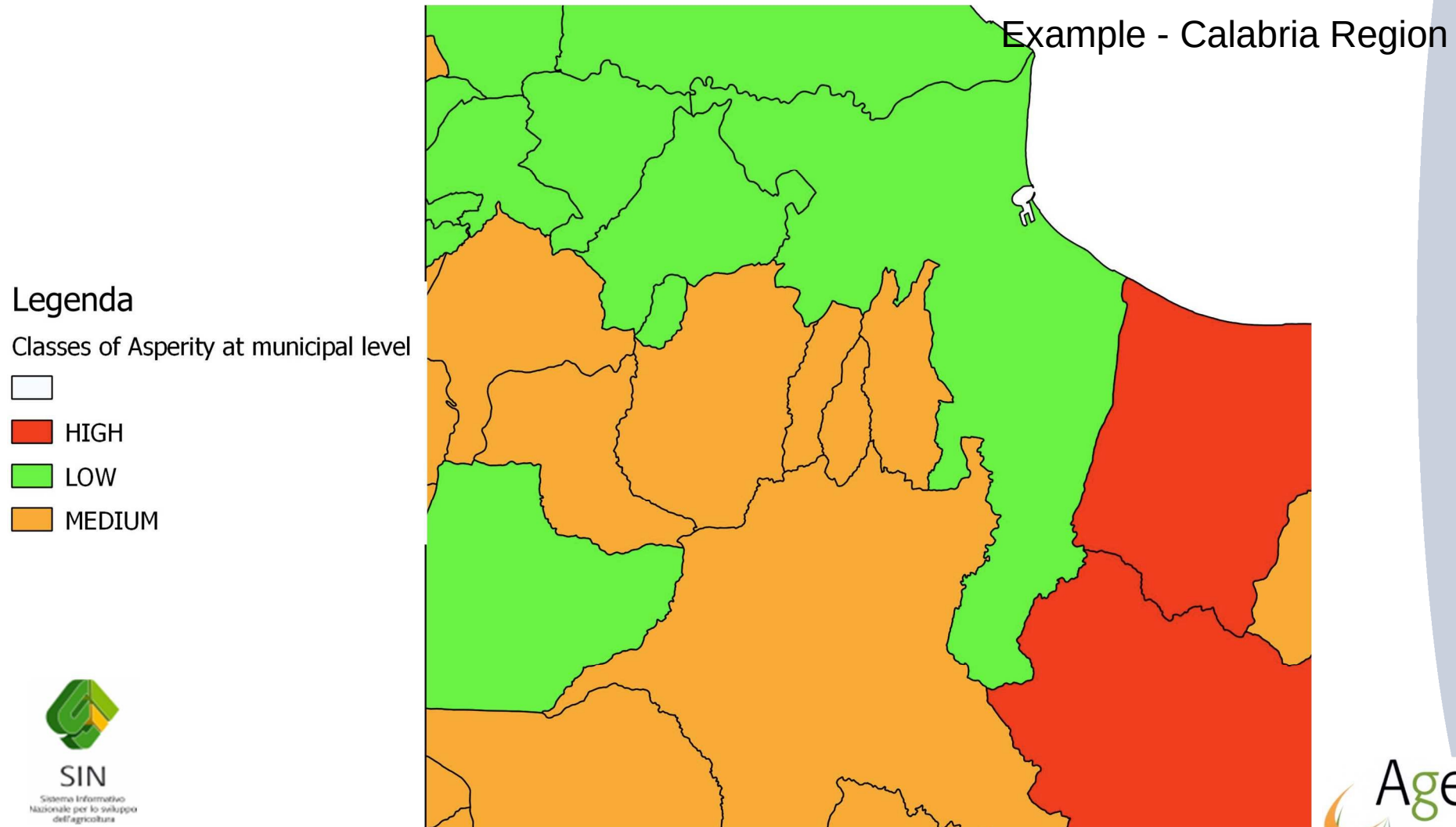
Example - Calabria Region

DSM

3 classes



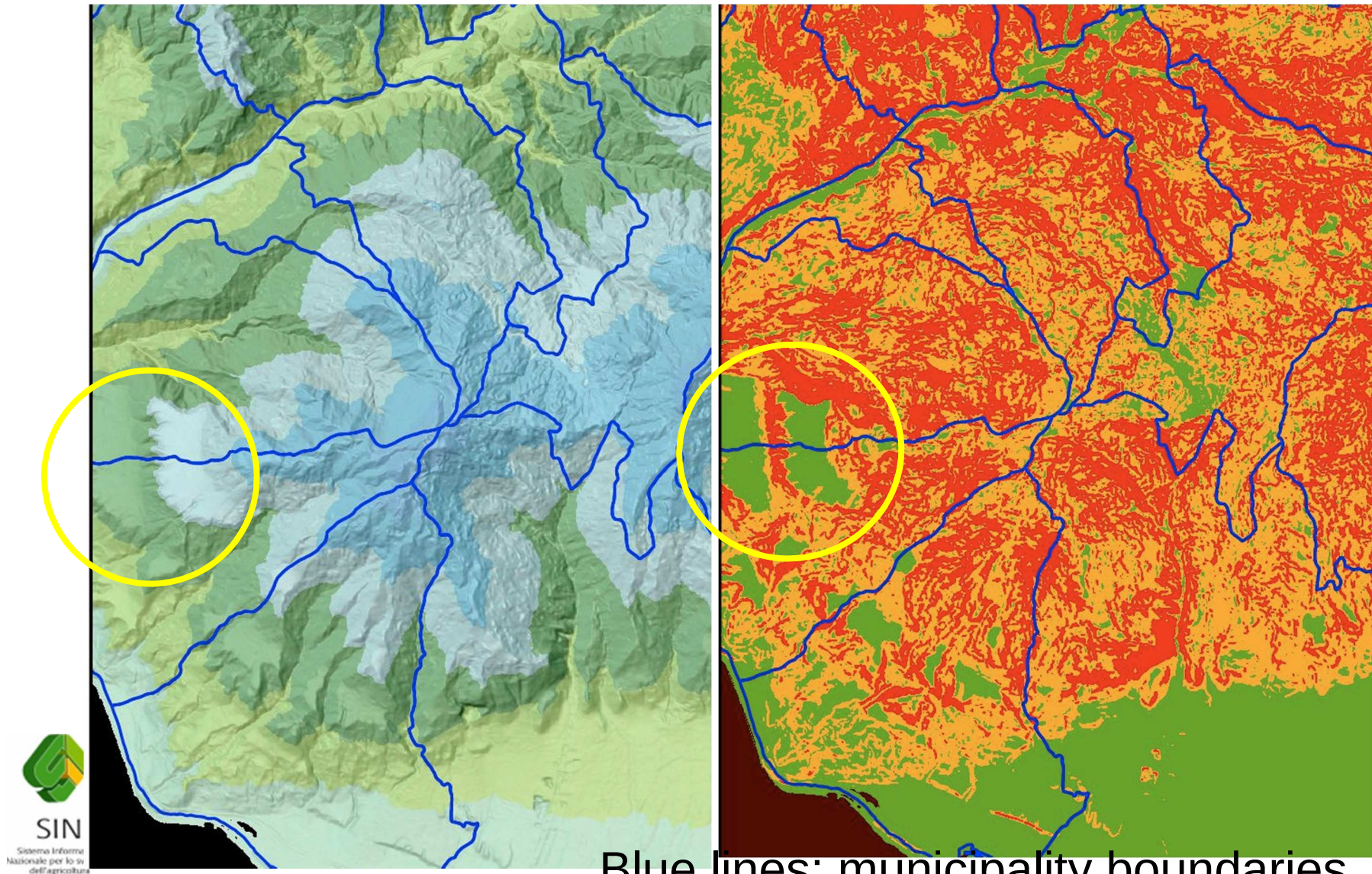
Municipality classification, if overlaid on possible/selected CwRS samples can help on tailored pre-selection of:
image acquisition, ancillary data selection, processing effort and costs, final accuracy



Example: mountain zones often do not coincide with complex areas...

DSM

3 classes

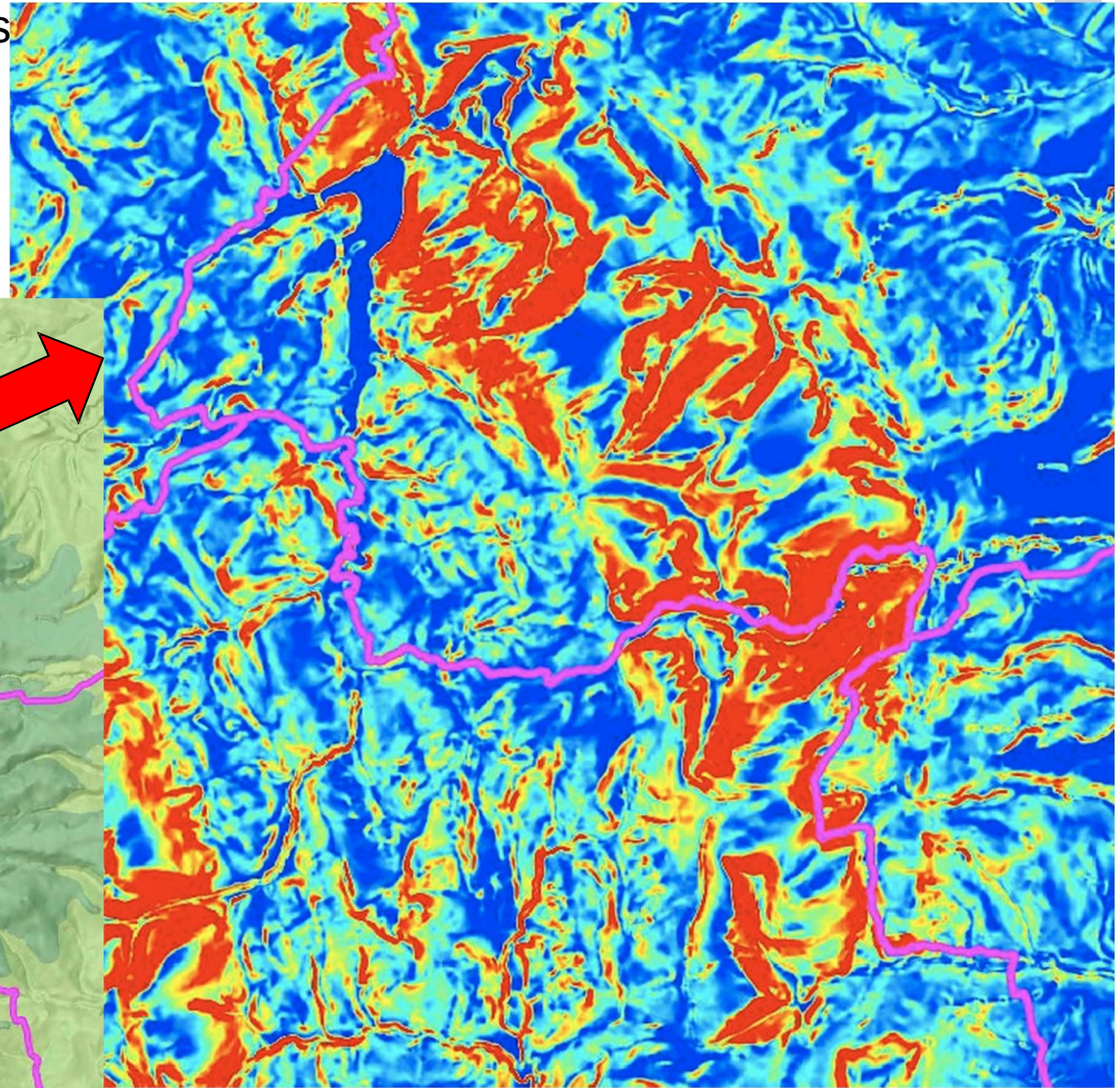
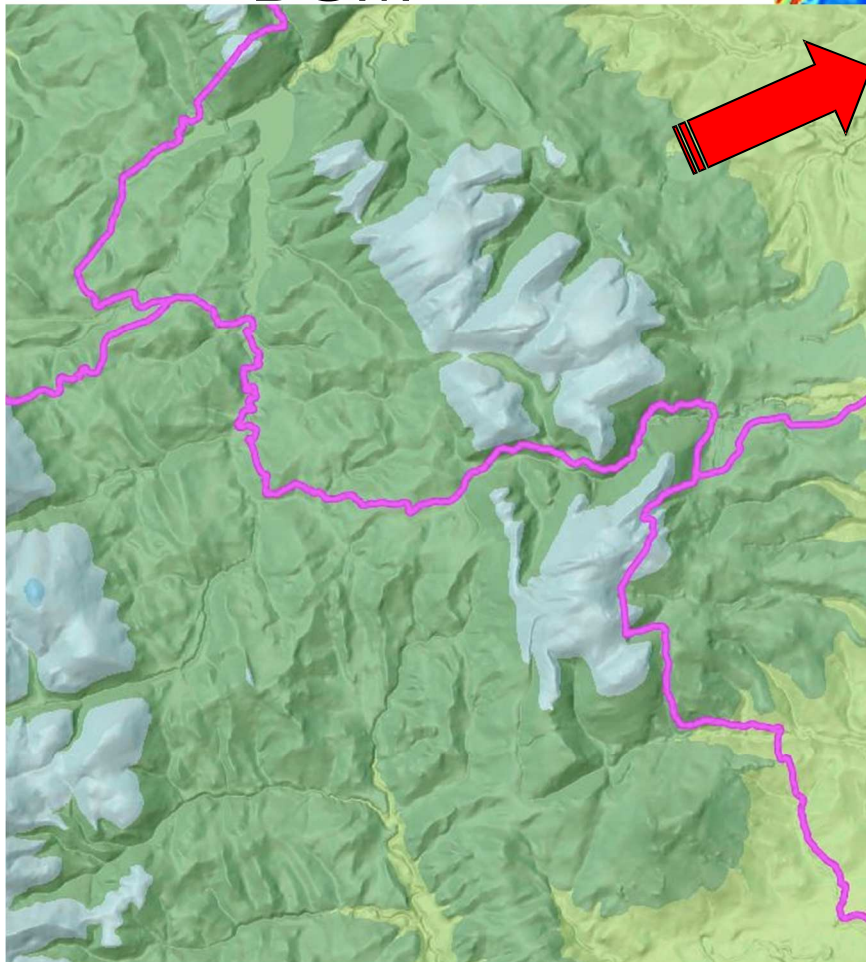


Blue lines: municipality boundaries

Example: fine and large scale land characterization Marche Region

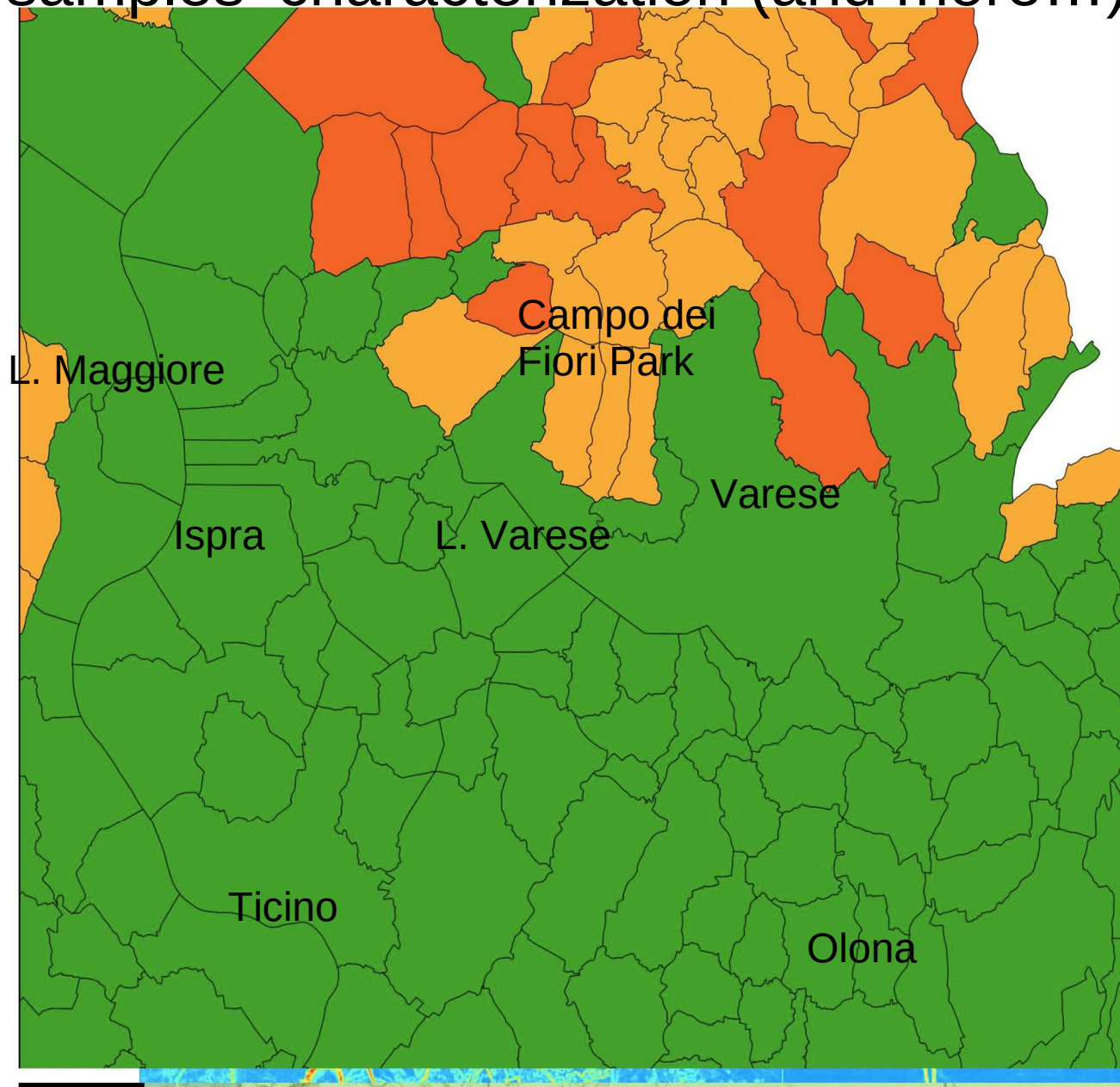
violet lines: municipality boundaries

DSM



Continuous layer detail

Geo-morphological dynamic data for samples' characterization (and more...)

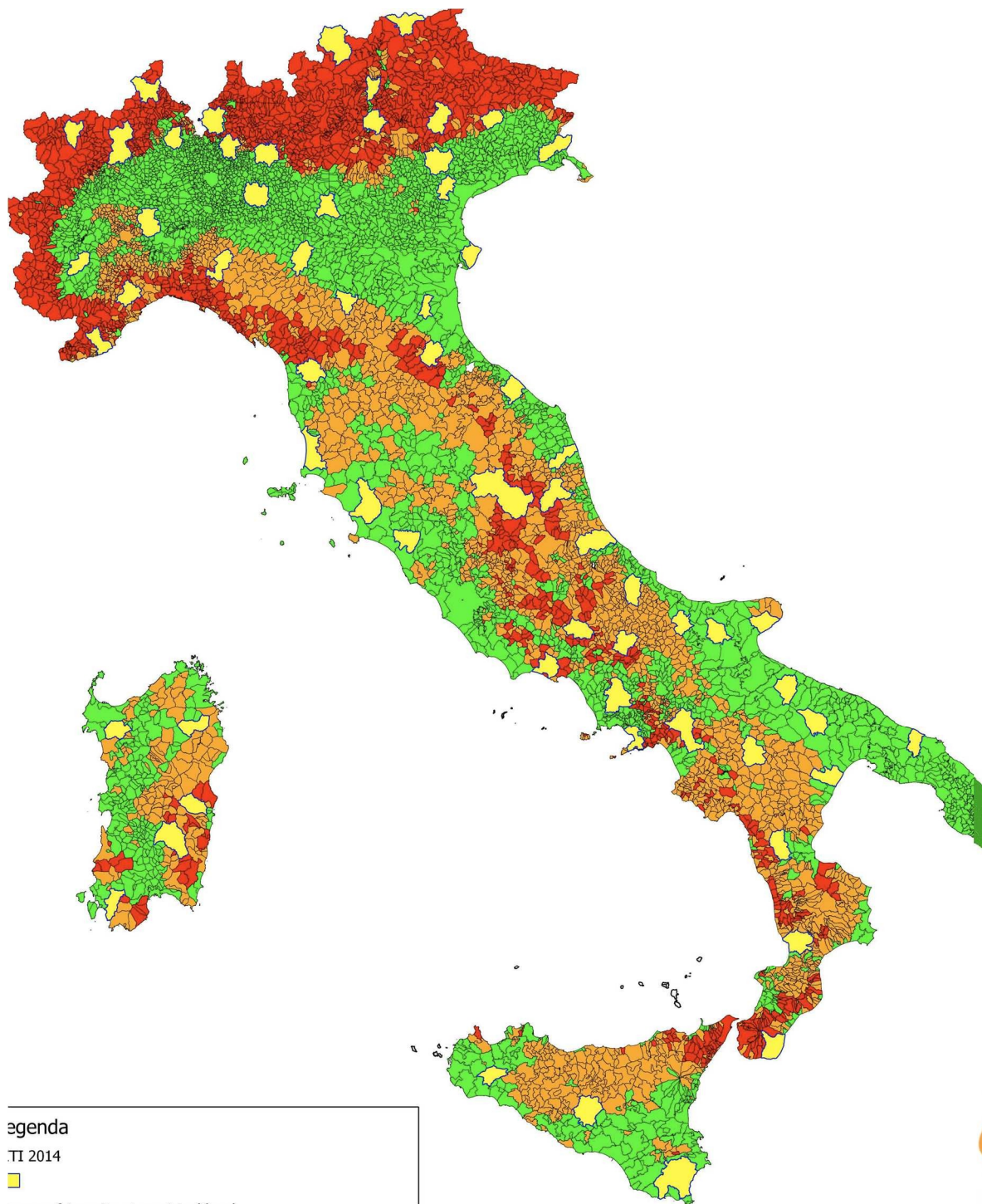


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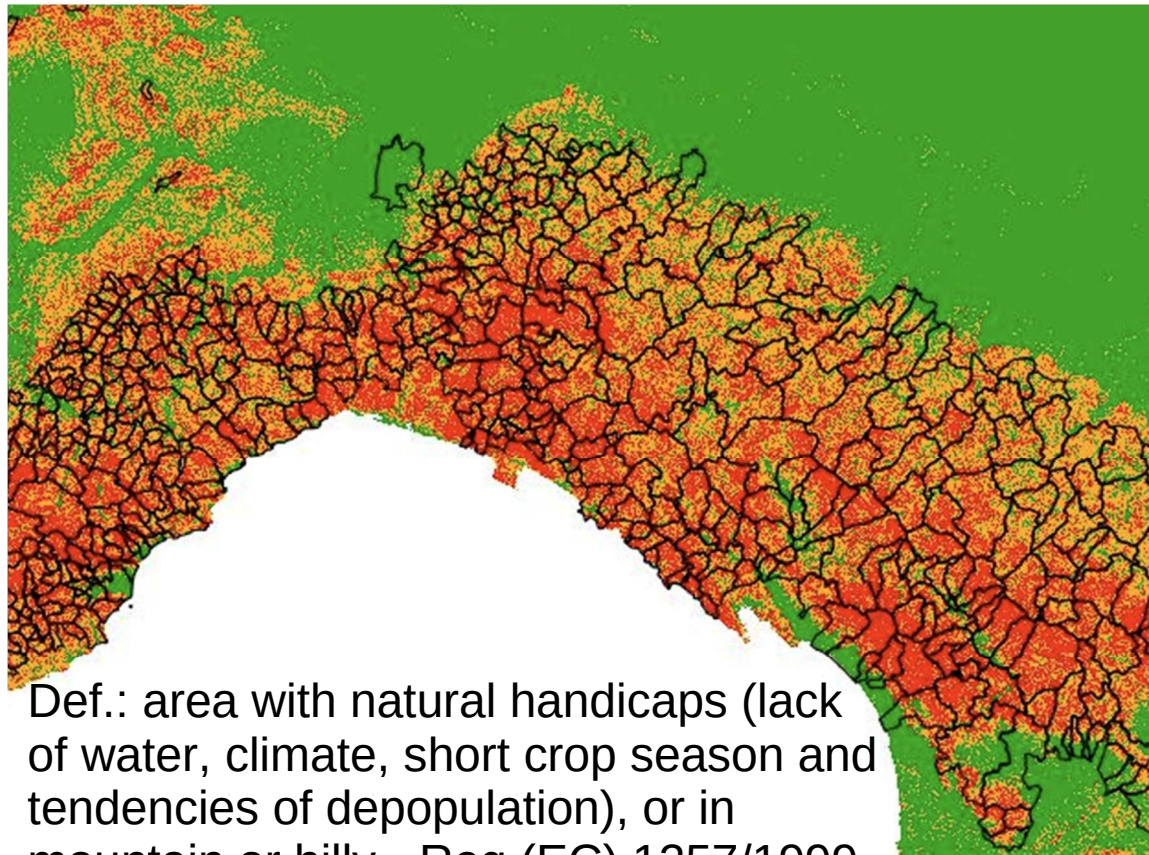
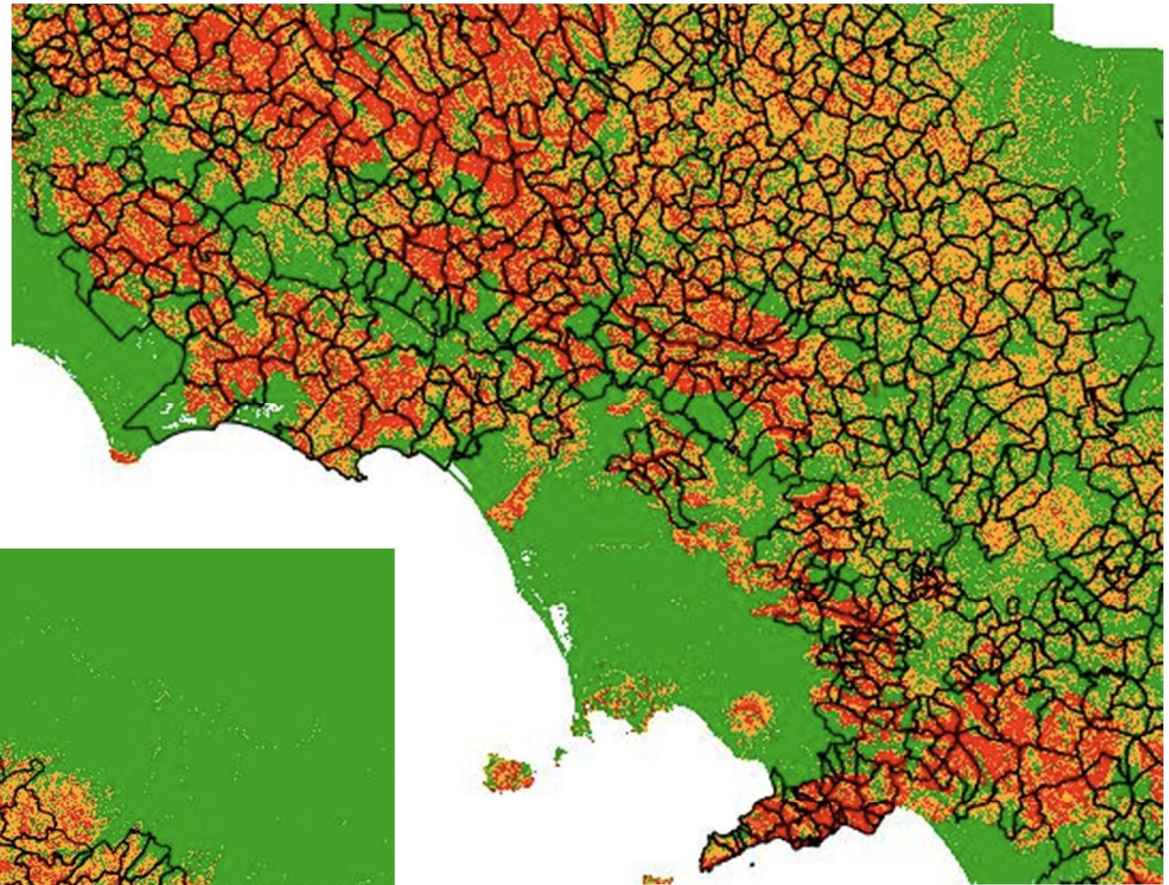
Italy Asperity map:

- 1- all index values;
- 2- operational classes
- 3- 2014 CwRS samples on municipality classification



Other applications:

better definition of Less
Favorable Areas index-
example
overlapping on existing
LFA municipalities
(art 18,19,20)



Def.: area with natural handicaps (lack of water, climate, short crop season and tendencies of depopulation), or in mountain or hilly - Reg (EC) 1257/1999

**Cultivation,
Transportation,
Commercialization
as major
handicaps when
ASPERITY is HIGH**

Conclusions and open questions -1

1. Enhanced 3D not expensive tools help in **sample complexity detection** and image's angle restriction to be requested (up 25% for 2014 –JRC regulation)
2. Italy has performed, through its DSM +/- 4m, the complete National **mapping of Asperity**, used for the 2014 VHR request to JRC (15 days/per job)
3. Due to the usual availability of cloud free imagery, could Italy ask for next campaigns (2015-20) **higher elevation angles for VHR acquisitions** (more than 60°), for **High/Medium-High Asperity** classes vs. possible reduced time windows?
4. Can we ask to differentiate in EU28 the enhanced acquisition % (e.g. up to 40-50%), dividing the positive and negative aspects at Member State groups?

Conclusions and open questions - 2

CwRS is and will be strictly related to
The next CAP policies;

VHR/HR data will be still necessary for
I and II pillar
national cost/effective CwRS

**Thanks to DGAgri/JRC... for maintaining
a long
and sustainable RS project**