GIS-based topographic classification of ITACA recording stations

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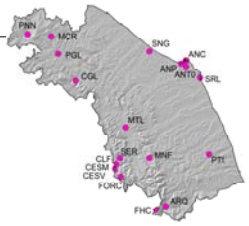
1 Input data

Digital Elevation Model DEM 20x20m (http://kharita.rm.ingv.it/dmap/)

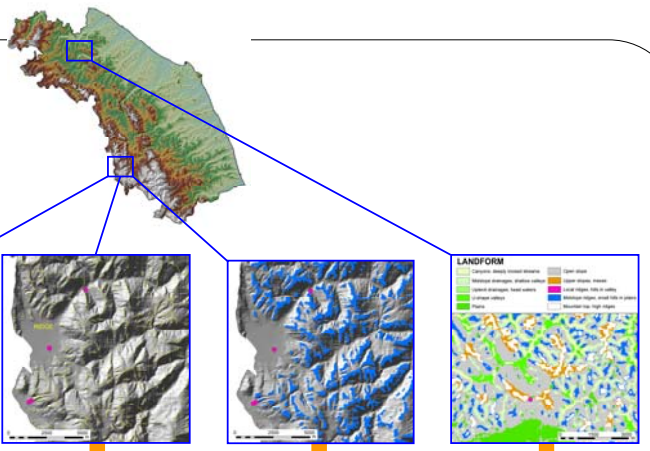
Recording station coordinates (http://itaca.mi.ingv.it/ItacaNet/)



2 Criteria for identification of critical topographic profiles

- **Critical slope map: critical ranges are defined as in EC8, (*standard GIS procedure*)**
- **Ridge map: identification of ridges and tops of elevations, (*)**
- **Elevation gradient map: height difference > 30m, as in EC8, (*)**
- **Landform map: 10 morphologic classes of the terrain, (*Jeness, 2006*)**

(*) (*implemented procedure, Pessina et al. 2010*)



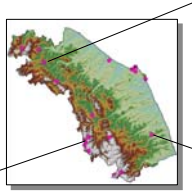
3 Table Statistical Analysis

A buffer polygon of 100 m -built around the station- is intersected with the topographic critical raster maps. Within each circle the software read the values of slope, ridge, ΔH30 and landform class and save them in a table, together with different statistic values: minimum and maximum value, range, mean, median and sum of the elevation data

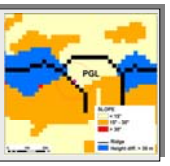
4 Results for Marche region

20 recording stations located on:
- **plain = 8**
- **slope = 7**
- **ridge = 2**

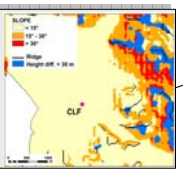
(uncertain classification = 3)



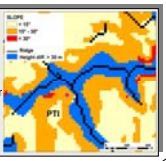
PEGLI
Slope > 15°
Ridge mean value:
MAX = 2r n. pixel
Elevation gradient > 30 m
EC8 classification: (T3)



COLFIORITO
Slope < 15°
Ridge: NO
Elevation gradient < 30 m
EC8 classification: T1



PETRITOLI
Slope > 15°
Ridge mean value:
< 2r n. pixel
Elevation gradient > 30 r
EC8 classification: (T2)



5 National scale analysis

30x30m resolution Global Digital Elevation Model ASTER instrument developed jointly by METI (Japan) and NASA (USA)
http://www.nasa.gov/topics/earth/features/aster-20090629.html
GeoTIFF file with geographic lat/long coordinates and a 1arcsecond grid; estimated accuracy is 20m at 95% confidence for vertical data

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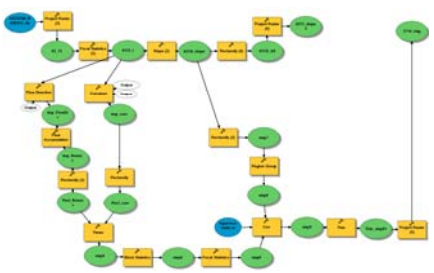
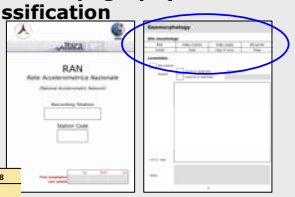


ArcMap procedure implemented with "Model builder" application for the evaluation of critical slope, ridge and elevation gradient maps (see Step 2)

6 Applications

ITACA Topographyc classification



CODE	LOCALITY	TOPOGRAPHY	EC8
ANC	Ancona	Plain	T1
ANP	Ancona Palombina	Plain (low % of ridge pixels)	T1
ANR	Ancona Rocca	Plain	T1
ANT0	Ancona_T0	Slope 15°-30° (lo9w % of ridge pixels)	T2
ARQ	Arquata del Tronto	Slope	T2
CESM	Cesi Monte	Not classified	NC
CESV	Cesi Valle	Plain	T1
CGL	Cagli	Slope > 15°	T2
CLF	Colfiorito	Plain	T1
FHC	Forca Canapine	Not classified	NC
FORC	Forcella	Slope	T2
MCR	Macerata Feltria	Not classified	NC
MNF	Monte Fiegni (Fiastra)	Slope > 15°	T2
MTL	Matelica	Plain	T1
PGL	Pegli	On the ridge of a 15°-30° slope	T3
PNN	Pennabilli	On the ridge of a limited 15°-30° slope	T3
PTI	Petritoli	Large 15°-30° slope, close to the ridge	T2
SER	Serravalle di Chienti	(at the base of) large 15°-30° slope	T2
SNG	Senigallia	Plain	T1
SRL	Sirolo	Plain	T1

ABSTRACT

Morphometric analyses of high resolution 20x20m digital elevation models (DEM), with the support of Geographic Information Systems (GIS), have been implemented to provide a practical tool for the identification of topographic sites possibly affected by relevant seismic amplification effects. Simple GIS functions are used to calculate slope parameters and to classify critical ranges of inclination, while the identification of ridges or reliefs with significant elevation gradients requires to devise more complex procedures, described in this work.
As a first step of this procedure, a method has been developed to perform analyses at national or regional scale. This approach identifies the simultaneous presence of zones of potential topographic amplification and of critical elements, such as recording seismic stations. To this end, critical slope and ridge detection maps have been elaborated for the whole national territory, based on the 30x30 m resolution GDEM (ASTER instrument built by METI and NASA).
Since topographic amplification effects depend not only on simple morphologic parameters of the sites, such as average slope angle, width and height of the relief, but also on the type of relief (isolated cliff or ridge) and on the location of the site relative to the relief, a deeper level of analysis has been tested to provide a more detailed landform classification (Topographic Position Index algorithm, Jenness (2006)). This procedure is very time consuming, therefore it is more easily applied to local scale investigations. Herein, we present an example of application of both procedures, with particular attention to the recording stations located on the Apennine mountains in Central Italy (Marche region). Once the testing phase of this procedure will be accomplished, it will be applied to the whole National territory for the topographic classification of the ITACA sites.

REFERENCES

Pessina V., Fiorini E., Paolucci R. "GIS-Based Identification of Topographic Sites in Italy with Significant Ground Motion Amplification Effects". 5th Intern. Conf. on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, May 24-29 2010

Jenness J [2006] Topographic Position Index (tpi_jen.avx) extension for ArcView 3.x, v. 1.3a. Jenness Enterprises. Available at: http://www.jennessent.com/arcview/tpi.htm.

DISCLAIMER

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