



Analyses of the geomorphologic processes of the Siena (Italy) Geosites by means of multitemporal DEMs derived from digital photogrammetry

M. Anselmi, P.L. Fantozzi and R. Salvini

University of Siena, Italy (anselmi4@unisi.it / Fax: +39 055 9119439)

Introduction/Objective

Geosites are defined as geologic or geomorphologic locations included in the natural heritage. Geosites safeguard can deal with the integration among onsite activities (both survey and restoration operations), geographic information system and multi-temporal remote sensing analysis. Purpose of the present study is the multi-temporal analysis of the past 50 years concerning to the Geosites by means of both series of panchromatic and full chromatic multi-temporal aerial photos, and recent high resolution Quick Bird satellite imageries.

Core

Ground Control Points (GCPs) needed for the orientation of satellite imageries were collected by means of DGPS measurements in static mode. The QuickBird imagery *Basic Bundle* (Pan + MS) type was both elaborated by data fusion and then orthorectified through rigorous methodologies by utilising ERDAS Imagine 8.7 software. Synthetic image was created PCI Geomatica 8.0 software starting from the QuickBird satellite imagery by applying an artificial parallax proportional to the digital terrain model. Afterwards the aerial photos were oriented as well as the satellite imagery by means of digital photogrammetric techniques directed to environmental study. Digital elevation models related to the different temporal intervals were calculated by utilising semi-automatic techniques, whilst multi-temporal land use/land cover data bases were carried out using photogrammetric analysis. Map Analysis procedures allowed to compare the data and rebuild the Geosites' geomorphologic evolution.

Results/Conclusions

The interpretation of multi-temporal images highlighted both significant morphologic and land use/land cover changes, which have seriously compromised the Geosites' naturalistic value in the last years. Moreover, both qualitative and quantitative analyses of these changes were performed by means of the series of multi-temporal remote sensing data. Methodologically speaking, the availability of *Basic Bundle* QuickBird image allowed to utilise rigorous geometric correction models, improved by DGPS survey.

References

- Batson R.M., Edwards K. & Eliason F.M. (1976), "Synthetic stereo and Landsat pictures", *Photogrammetric Engineering and Remote Sensing*, 42(10): 1279-1284
- De Dominicis V., Fantozzi P.L. & Guasparri G. (2004), "Valorizzazione e protezione dei Geositi della provincia di Siena: metodologie e tecniche di studio per il censimento, protezione e valorizzazione delle crete senesi", <http://www.geotecnologie.unisi.it/Geositi> (accessed 1/10/2004)
- Giusti F. (a cura di) (1993), *La storia naturale della Toscana meridionale*, Milano, 571
- Guasparri G. (1978), "Calanchi e biancane nel territorio senese: studio geomorfologico", *L'Universo*, 58: 97-140
- Heymann Y., Steenmans C., Croisille G. & Bossard M. (1994), *CORINE land-cover project - Technical guide*, European Commission Directorate General Environment, Nuclear Safety and Civil Protection ECSC-EEC-EAEC, Brussels, 136
- Kolbl O. (2001), *Technical specification for the elaboration of Digital Elevation Model*, Report Version 4, Ecole Polytechnique Fédérale de Lausanne, Department de Genie Rural, 26-32
- Methakullachat, D. (1994), "Synthetic Stereo Display and Calculation on a PC", *Report, School of Surveying and Mapping*, Curtin University of Technology, Perth, Australia, 43
- Ministero dell'Ambiente (1991 e 1992), "Servizio Conservazione della Natura, Direttiva Habitat 92/43 del 21 maggio 1992 e Legge 6 dicembre 1991, n. 394, Legge quadro sulle aree protette"

- NIMA (2000), National Imagery and Mapping Agency, Federation of American Scientists - Intelligence Resource Program "Digital Terrain Elevation Data [DTED]", <http://www.fas.org/irp/program/core/dted.htm> (accessed 1/10/2004)
- ProGEO (1995), "The European Association of Conservation of the Geological Heritage", <http://www.sgu.se/hotell/progeo> (accessed 1/10/2004)
- Repetti E. (1846), *Dizionario geografico fisico storico della Toscana contenente la descrizione di tutti i luoghi del Granducato Ducato di Lucca Garfagnana e Lunigiana*, Firenze, 1833-1846, 6 voll.
- Toutin, T. & Cheng, P. (2002), "Quickbird – a milestone for high resolution Mapping", *Earth Observation Magazine*, 11(4): 14-18
- USGS (2002), U.S. Geological Survey "National Elevation Dataset". <http://gisdata.usgs.net/NED/AccuracyQ2.asp> (accessed 1/10/2004)
- Wimbledon W.A.P., Andersen S., Cleal C.J., Cowie J.W., Erikstad L., Gonggrijp G.P., Johansson C.E., Karis L.O. & Suominen V. (1996), "Geological World Heritage: GEOSITES: a global comparative site inventory to enable prioritisation for conservation", in *Proceedings of the Second International Symposium on the Conservation of the Geological Heritage, Roma June 1996: Memorie descrittive della carta geologica d'Italia*.