Geomorphological mapping in urban areas

Brandolini, Pierluigi; Del Monte, Maurizio; Faccini, Francesco; Cattoor, Bieke; Zwoliński, Zbigniew; Smith, Mike

DOI
10.1080/17445647.2021.1952671

Publication date
2021

Document Version
Final published version

Published in
Journal of Maps

Citation (APA)
Brandolini, P., Del Monte, M., Faccini, F., Cattoor, B., Zwoliński, Z., & Smith, M. (2021). Geomorphological mapping in urban areas. *Journal of Maps*, *17*(4), 1-5. https://doi.org/10.1080/17445647.2021.1952671

Taylor & Francis
Taylor & Francis Group

Journal of Maps

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tjom20

Geomorphological mapping in urban areas

Pierluigi Brandolini, Maurizio Del Monte, Francesco Faccini, Bieke Cattoor, Zbigniew Zwoliński & Mike Smith

To cite this article: Pierluigi Brandolini, Maurizio Del Monte, Francesco Faccini, Bieke Cattoor, Zbigniew Zwoliński & Mike Smith (2021) Geomorphological mapping in urban areas, Journal of Maps, 17:4, 1-5, DOI: 10.1080/17445647.2021.1952671

To link to this article: https://doi.org/10.1080/17445647.2021.1952671

Published online: 30 Oct 2021.

JOURNAL OF MAPS
2021, VOL. 17, NO. 4, 1–5
https://doi.org/10.1080/17445647.2021.1952671

Taylor & Francis
Taylor & Francis Group

EDITORIAL

Geomorphological mapping in urban areas

Pierluigi Brandolini [a], Maurizio Del Monte [b], Francesco Faccini [a], Bieke Cattoor[c], Zbigniew Zwoliński [d] and Mike Smith[e]

[a]Genoa University, Genoa, Italy; [b]Sapienza University of Rome, Rome, Italy; [c]Delft University of Technology, Delft, Netherlands; [d]Adam Mickiewicz University, Poznań, Poland; [e]Ulster University, Belfast, UK

1. Background

Research into urban geomorphology is relatively recent (Brown et al., 2017; Rosenbaum et al., 2003; Zwoliński et al., 2017), and the discipline is gaining interest at an accelerating pace, as global research communities become aware of the increasing intertwinement of geomorphological and anthropogenic forces, and their interrelated effects on urban life and urban form.

Rapidly advancing disciplinary insights demand for continuous renewal, updating and assessment of the discipline's methods, techniques and approaches to recognizing and mapping landforms, processes and deposits in urban environments (Brandolini et al., 2019; Del Monte et al., 2016; Diao, 1996; Ferrando et al., 2021; Zwoliński et al., 2018). Indeed, geomorphological surveys in urban areas involve careful observations of morphology, particularly at the medium-large scale (Bathrellos, 2007; Eyles, 1997; Faccini et al., 2008). Additionally, insights from other sources, particularly historical and geographical documents as well as excavation and borehole data, are essential in order to identify, map and date landforms and deposits (Brandolini et al., 2018; Giardino et al., 2015; Lucchetti & Giardino, 2015). This process is particularly difficult due to the stratification of urban expansion phases (Luberti, 2018; 2019). In Europe these cities were often founded in historical times, expanded in the Middle Ages and progressively grew larger (Del Monte et al., 2013; Zwoliński et al., 2018), and entered a period of uncontrolled urban sprawl in the 20th century, and particularly after the Second World War, partly related to the development of the second houses, rural and suburban lifestyle, and tourism (Brandolini et al., 2017; Edgeworth et al., 2015). Moreover, changes in the earth's surface morphology lead to significant transformations of the urban space, forms are created as a result of artificial works and natural denudation and accumulation processes. In effect, there are also hybrid forms, negative and positive forms, concave and convex forms. Anthropogenic forms and deposits can both enrich and impoverish the complex morphological landscape and natural geodiversity of cities.

The fundamental basis of this special issue, is the capacity of urban geomorphological research to generate new insights into the effects of urban growth on geomorphological processes and landforms and vice versa, and their relationship to increasing geological risks (Mandarino et al., 2021), In addition, the dissemination of cultural geoheritage in urban areas must also be addressed (Pica et al., 2018; Reynard et al., 2017; Thornbush & Allen, 2018). Promoted within the initiatives carried out by the Working Group on Urban Geomorphology of the International Association of Geomorphologist (IAG), this Special Issue is devoted to geomorphological surveying and mapping applications in urban areas, addressed at highlighting the topographic features and geographical-physical conditions that drove the choice of settlement and subsequent urban development, as well as to evaluating the impacts of human intervention on geomorphological processes and landforms.

This Special Issue, collecting twenty-four case studies from around the world, offers an opportunity to share knowledge about geomorphological processes in urban areas and to prompt such debate, creating a gathering point for researchers and practitioners who deal with land planning and land management of risk mitigation measures as well as with the preservation and management of geocultural heritage, in a variety of morphodynamic and climatic contexts.

2. Overview of the papers in this special issue

The contributions, within the framework of the general theme "Geomorphological mapping in urban areas", addressed the following main topics:

- detection of geomorphological features driving the choice of settlements and subsequent development of urban towns;

CONTACT Pierluigi Brandolini brando@unige.it

- evaluation of the modifications and impacts of human intervention on geomorphological processes and landforms in urban areas;
- definition and selection of methods for geomorphological survey and mapping in urban areas;
- analysis of the geomorphological changes in urban areas and their relationships with archaeological and historical data;
- evaluation and mapping of geomorphological hazard/risk in urban areas to support planning and management of mitigation measures;
- promotion of geoheritage and geotourism in urban areas.

Original research in different geographical areas, mainly in the European Mediterranean region and Central Europe, and secondarily in Africa and North America was presented. Within some of the major urban areas in Italy, seven interesting case studies presented geomorphological maps of Rome (Vergari et al., 2020), Naples (Ascione et al., 2020), Alessandria (Mandarino et al., 2020), Pavia (Pelfini et al., 2020), Palermo (Cappadonia et al., 2020), in Genoa (Faccini et al., 2020) and Cagliari (Porta et al., 2020). These contributions pay particular attention to the application of the new geomorphological legend proposed by ISPRA/AIGeo (Campobasso et al., 2018), that was tested in different morphodynamic contexts, both coastal and fluvial. Still among Italy's big cities, Turin (NW Italy) is also presented, highlighting the mapping of alluvial terraces as evidence of the Holocene evolution of the River Po (Forno & Gianotti, 2020).

Two case studies deal with tourist cities representative of the Eastern Liguria Sea (NW Italy) such as Rapallo (Brandolini et al., 2020) and Chiavari-Lavagna (Roccati et al., 2020), whose coastal floodplains have been mapped with the aim of supporting urban area management, and highlighting the anthropogenic landforms that have increased geo-hydrological and coastal hazards.

Another coastal case study, relates to Rimini in the North Adriatic Sea (NE Italy), highlighting the factors which influenced the historical evolution of the town, relating them to anthropogenic features, with maximum peaks in natural changes probably matching periods of climate deterioration (Guerra et al., 2020).

Two maps presented for the central-southern Apennines (Italy), concern the exposure to landslides and the relationship of the spatio-temporal distribution of landslides to urban development in the urban centers of Castelsantangelo sul Nera in the Marche (Santangelo et al., 2020), Volturino and Motta Montecorvino in Apulia (Zumpano et al., 2020). The insightful case study of the city of Isernia (southern Italy) illustrates the relationships between landscape evolution and human occupation since the Middle Pleistocene, integrating geological-geomorphological investigation with archaeological data (Aucelli et al., 2020).

In Central Europe, within the Bohemia region (Czech Republic), the disappearance or modification of former man-made landforms has been studied, reviewing the transformation of ponds following industrial and agricultural activities (Frajer et al., 2020). The stages of the digital adaptation of the printed version of old geomorphological maps are discussed for the Upper Silesian industrial region (Szypuła, 2020).

Other five impressive case studies have been presented from Poland: the city of Torun has been studied by historical comparison of multitemporal maps from XVIII century as a significant case of disappearing features of the cultural landscape due to anthropogenic degradation of dunes within the city (Molewski, 2020); the city of Warsaw with the reconstruction of urban geomorphology of the Vistula River Valley using an ALS LIDAR DEM to map complex landforms with implications for flood management, geoarchaeology, and geoheritage conservation (Wierzbicki et al., 2021); the Krakow city center, where the changes in topography during the last millennium have been analysed using reconstructed paleotopography and urban archeology (Łajczak et al., 2020); the city of Wałbrzych representing a geomorphic landscape, heavily modified by nearly three centuries of industrial activity, related mainly to coal mining (Jancewicz et al., 2020); the city of Poznań by the mapping of geohazards (e.g. river floods, flash floods, mass movement, wind erosion) specific to an urban lowland area because of increasing climate change (Zwoliński et al., 2021).

In the African continent, two significant projects in the agglomeration of Antananarivo in Madagascar (Frodella et al., 2020) and Karthum in Sudan (Zerboni et al., 2020) were conducted, addressing aspects of urban geology and geomorphology, as well as geohydrological hazards in relation to an outstanding cultural and archaeological heritage.

Finally, an innovative contribution concerning the city of Vienna in Virginia (North America), located about 12 miles west of Washington D.C., focusing on geomorphological mapping and anthropogenic landform change in an urbanizing watershed using Structure-from-Motion photogrammetry and geospatial modeling techniques (Chirico et al., 2020).

3. Final remarks

The studies collected in this Special Issue summarize many interesting environmental and geocultural issues that can occur in urban areas, providing new perspectives and developments within geomorphological mapping both for scientific and applied

cartographic practice and research. They explore methods and techniques concerning how to map, monitor and assess ancient and recent morphological modifications due to human interventions and their impact on geomorphological processes.

As a consequence of these changes in such urban areas, a progressive increase in geohydrological risk with direct and indirect consequences for people is found, evidencing the crucial requirement to provide adequate and useful management indicators for land planners. Therefore, the study of the constraints and values of urban geomorphological evolution represents an urgent need and a challenge for our modern society. Finally, it should also be noted that the geoheritage of the city needs to be preserved, managed, and where appropriate, enhanced as a possible resource to promote tourism and geotourism as well as leisure activities.

Acknowledgements

We would like to thank all those who reviewed papers in this Special Issue, as well as the authors for their interesting and valuable research.

ORCID

Pierluigi Brandolini http://orcid.org/0000-0002-4009-6188
Maurizio Del Monte http://orcid.org/0000-0002-9564-3548
Francesco Faccini http://orcid.org/0000-0001-7624-1300
Zbigniew Zwoliński http://orcid.org/0000-0002-3252-3143

References

Ascione, A., Aucelli, P. P. C., Cinque, A., Di Paola, G., Mattei, G., Ruello, M., Russo Ermolli, E., Santangelo, N., & Valente, E. (2020). Geomorphology of Naples and the Campi Flegrei: human and natural landscapes in a restless land. *Journal of Maps*. https://doi.org/10.1080/17445647.2020.1768448

Aucelli, P. P. C., Valente, E., Di Paola, G., Amato, V., Cesarano, M., Cozzolino, M., Pappone, G., Scorpio, V., & Rosskopf, C. M. (2020). The influence of the geological–geomorphological setting on human settlements and historical urban development: the case study of Isernia (southern Italy). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1794989

Bathrellos, G. D. (2007, May 24–26). An overview in urban geology and urban geomorphology. Proceedings of the 11th international Congress, Athens, Bulletin of the Geological Society of Greece, XXXX, 1354–1364.

Brandolini, P., Cappadonia, C., Luberti, G. M., Donadio, C., Stamatopoulos, L., Di Maggio, C., Faccini, F., Stanislao, C., Vergari, F., Paliaga, G., Agnesi, V., Alevizos, G., & Del Monte, M. (2019). Geomorphology of the Anthropocene in Mediterranean urban areas. *Progress in Physical Geography*, 1–34. https://doi.org/10.1177/0309133319881108

Brandolini, P., Faccini, F., Paliaga, G., & Piana, P. (2017). *Urban geomorphology in coastal environment: man made morphological changes in a seaside tourist resort (Rapallo, eastern Liguria, Italy). Quaestiones Geographicae*, *36*(3), 97–110. https://doi.org/10.1515/quageo-2017-0027

Brandolini, P., Faccini, F., Paliaga, G., & Piana, P. (2018). Man-Made landforms survey and mapping of an urban historical centre in a coastal Mediterranean environment. *Geogr. Fis. Din. Quat*, *41*, 97–102. https://doi.org/10.4461/ GFDQ 2017.40.8

Brandolini, P., Mandarino, A., Paliaga, G., & Faccini, F. (2020). *Anthropogenic landforms in an urbanized alluvial coastal plain (Rapallo city, Italy). Journal of Maps*, 1–12. https://doi.org/10.1080/17445647.2020.1793818

Brown, A. G., Tooth, S., Bullard, J. E., Thomas, D. S. G., Chiverrell, R. C., Plater, A. J., Murton, J., Thorndycraft, V. R., Tarolli, P., Rose, J., Wainwright, J., Downs, P., & Aalto, R. (2017). The geomorphology of the Anthropocene: emergence, status and implications. *Earth Surface Processes and Landforms*, *42*(1), 71–90. https://doi.org/10.1002/esp.3943

Campobasso, C., Carton, A., Chelli, A., D'Orefice, M., Dramis, F., Graciotti, R., Guida, D., Pambianchi, G., Peduto, F., & Pellegrini, L. (2018). Aggiornamento ed integrazioni delle Linee guida della Carta geomorfologica d'Italia alla scala 1:50.000. Progetto CARG: modifiche ed integrazioni al Quaderno n. 4/1994. Quaderni serie III 13 (1).

Cappadonia, C., Di Maggio, C., Agate, M., & Agnesi, V. (2020). - Geomorphology of the urban area of Palermo (Italy). *Journal of Maps*, *16*(2), 274–284. https://doi.org/10.1080/17445647.2020.1739154

Chirico, P. G., Bergstresser, S. E., DeWitt, J. D., & Alessi, M. A. (2020). - Geomorphological mapping and anthropogenic landform change in an urbanizing watershed using structure-from-motion photogrammetry and geospatial modeling techniques. *Journal of Maps*, 1–12.https://doi.org/10.1080/17445647.2020.1746419

Del Monte, M., D'Orefice, M., Luberti, G. M., Marini, R., Pica, A., & Vergari, F. (2016). - Geomorphological classification of urban landscapes: the case study of Rome (Italy). *Journal of Maps*, *12*(sup1), 178–189. https://doi.org/10.1080/17445647.2016.1187977

Del Monte, M., Fredi, P., Pica, A., & Vergari, F. (2013). Geosites within Rome city center (Italy): A mixture of cultural and geomorphological heritage. *Geografia Fisica e Dinamica Quaternaria*, *36*(2), 241–257. https://doi.org/10.4461/GFDQ.2013.36.20

Diao, C. (1996). An approach to theory and methods of urban geomorphology. *Chinese Geographical Science*, *6*(1), 88–95. https://doi.org/10.1007/s11769-996-0039-9

Edgeworth, M., Richter, D. B., Waters, C., Haff, P., Neal, C., & Price, S. J. (2015). Diachronous beginnings of the anthropocene: The lower bounding surface of anthropogenic deposits. *Anthropocene review*, *2*(1), 33–58. https://doi.org/10.1177/2053019614565394

Eyles, N. (1997). Environmental geology of urban areas. Geological Association of Canada. Geotext 3.

Faccini, F., Giardino, M., Paliaga, G., Perotti, L., & Brandolini, P. (2020). *Urban geomorphology of Genoa Old City (Italy). Journal of Maps*, 1–14. https://doi.org/10.1080/17445647.2020.1777214

Faccini, F., Piccazzo, M., Robbiano, A., & Roccati, A. (2008). *Applied Geomorphological Map of the Portofino municipal territory (Italy). Journal of Maps*, *4*(1), 451–462. https://doi.org/10.4113/jom.2008.1023

Ferrando, I., Brandolini, P., Federici, B., Lucarelli, A., Sguerso, D., Morelli, D., & Corradi, N. (2021). Coastal Modification in Relation to Sea Storm Effects: Application of 3D Remote Sensing Survey in Sanremo

Marina (Liguria, NW Italy). *Water*, *13*(8), 1040, 1–19. https://doi.org/10.3390/w13081040

Forno, M. G., & Gianotti, F. (2020). The Turin fluvial terraces as evidence of the new Holocene setting of the Po River. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1768447

Frajer, J., Pavelková, R., Létal, A., & Kopp, J. (2020). Relics and transformation of former ponds in the urban environment of the historical region of Bohemia (Czech Republic). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1819900

Frodella, W., Spizzichino, D., Ciampalini, A., Margottini, C., & Casagli, N. (2020). Hydrography and geomorphology of Antananarivo High City (Madagascar). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1721343

Giardino, M., Mortara, G., Borgatti, L., Nesci, O., Guerra, C., & Lucente, C. (2015). Dynamic Geomorphology and Historical Iconography. Contributions to the Knowledge of Environmental Changes and Slope Instabilities in the Apennines and the Alps. In Engineering Geology for Society and Territory, vol. 8 '*Preservation of Cultural Heritage*' *(Lollino G. et al., Eds)*, 463–468. https://doi.org/10.1007/978-3-319-09408-3_81.

Guerra, V., Guerra, C., & Nesci, O. (2020). Geomorphology of the town of Rimini and surrounding areas (Emilia-Romagna, Italy). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1800527

Jancewicz, K., Traczyk, A., & Migoń, P. (2020). Landform modifications within an intramontane urban landscape due to industrial activity, Wałbrzych, SW Poland. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1805805

Łajczak, A., Zarychta, R., & Wałek, G. (2020). Changes in the topography of Krakow city centre, Poland, during the last millennium. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1823253

Luberti, G. M. (2018). Computation of modern anthropogenic-deposit thicknesses in urban areas: A case study in Rome. *The Anthropocene Review*, *5*(1), 2–27. https://doi. org/10.1177/2053019618757252

Luberti, G. M., Vergari, F., Pica, A., & Del Monte, M. (2019). Estimation of the thickness of anthropogenic deposits in historical urban centres: An interdisciplinary methodology applied to Rome (Italy). *The Holocene*, *29*(1), 158–172. https://doi.org/10.1177/0959683618804630

Lucchetti, S., & Giardino, M. (2015). Historical archives data for the reconstruction of geomorphological modifications in the urban area of Turin (NW Italy). In G. Lollino et al. (Ed.), *Engineering geology for society and territory 8*, (pp. 447–452). Springer International Publishing. https://doi.org/10.1007/978-3-319-09408-3_46.

Mandarino, A., Faccini, F., Terrone, M., & Paliaga, G. (2021). Anthropogenic landforms and geo-hydrological hazards of the Bisagno Stream catchment (Liguria, Italy). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1866704

Mandarino, A., Luino, F., Turconi, L., & Faccini, F. (2020). *Urban geomorphology of a historical city straddling the Tanaro River (Alessandria, NW Italy). Journal of Maps*, https://doi.org/10.1080/17445647.2020.1746420

Molewski, P. (2020). Anthropogenic degradation of dunes within a city: a disappearing feature of the cultural landscape of Toruń (Poland). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1736196

Pelfini, M., Brandolini, F., D'Archi, S., Pellegrini, L., & Bollati, I. (2020). *Papia civitas gloriosa:* urban geomorphology for a thematic itinerary on geocultural heritage in Pavia (Central Po Plain, N Italy). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1736198

Pica, A., Reynard, E., Grangier, L., Kaiser, C., Ghiraldi, L., Perotti, L., & Del Monte, M. (2018). GeoGuides, urban geotourism offer powered by mobile application technology. *Geoheritage*, *10*(2), 311–326. https://doi.org/10.1007/s12371-017-0237-0

Porta, M., Buosi, C., Trogu, D., Ibba, A., & De Muro, S. (2020). An integrated sea-land approach for analyzing forms, processes, deposits and the evolution of the urban coastal belt of Cagliari. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1719441

Reynard, E., Pica, A., & Coratza, P. (2017). Urban Geomorphological Heritage. An Overview. *Quaestiones Geographicae*, *36*(3), 7–20. https://doi.org/10.1515/quageo-2017-0022

Roccati, A., Mandarino, A., Perasso, L., Robbiano, A., Luino, F., & Faccini, F. (2020). *Large-scale geomorphology of the Entella River floodplain (Italy) for coastal urban areas management*. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1738281

Rosenbaum, M. S., McMillan, A. A., Powel, J. H., Cooper, A. H., Culshaw, M. G., & Northmore, K. J. (2003). Classification of artificial (man-made) ground. *Engineering Geology*, *69*(3), 399–409. https://doi.org/10.1016/S0013-7952(02)00282-X

Santangelo, M., Marchesini, I., Bucci, F., Cardinali, M., Cavalli, M., Crema, S., Marchi, L., Alvioli, M., & Guzzetti, F. (2020). - Exposure to landslides in rural areas in Central Italy. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1746699

Szypuła, B. (2020). Digital adaptation of the Geomorphological Map of Upper Silesian Industrial Region, Poland (1:50,000) – old map new possibilities. *Journal of Maps*, *16*(2), 614–624. https://doi.org/10.1080/17445647.2020.1800528

Thornbush, M. J., & Allen, C. D. (2018). *Urban Geomorphology, Landforms and Processes in Cities*. Elsevier. 362 p. https://doi.org/10.1016/C2016-0-02169-1.

Vergari, F., Luberti, G. M., Pica, A., & Del Monte, M. (2020). Geomorphology of the historic centre of the *Urbs* (Rome, Italy). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1761465

Wierzbicki, G., Ostrowski, P., Bartold, P., Bujakowski, F., Falkowski, T., & Osiński, P. (2021). Urban geomorphology of the Vistula River valley in Warsaw. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1866698

Zerboni, A., Brandolini, F., Mariani, G. S., Perego, A., Salvatori, S., Usai, D., Pelfini, M., & Williams, M. A. J. (2020). The Khartoum-Omdurman conurbation: a growing megacity at the confluence of the Blue and White Nile Rivers. *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1758810

Zumpano, V., Ardizzone, F., Bucci, F., Cardinali, M., Fiorucci, F., Parise, M., Pisano, L., Reichenbach, P., Santaloia, F., Santangelo, M., Wasowski, J., & Lollino, P. (2020). The relation of spatio-temporal distribution of landslides to urban development (a case study from the Apulia region, Southern Italy). *Journal of Maps*, https://doi.org/10.1080/17445647.2020.1746417

Zwoliński, Z., Hildebrandt-Radke, I., Mazurek, M., & Makohonienko, M. (2017). Existing and proposed urban geosites values resulting from geodiversity of

Poznań city. *Quaestiones Geographicae*, *36*(3), 125–149. https://doi.org/10.1515/quageo-2017-0031

Zwoliński, Z., Hildebrandt-Radke, I., Mazurek, M., & Makohonienko, M. (2018). Anthropogeomorphological Metamorphosis of an Urban Area in the Postglacial Landscape: A Case Study of Poznań City. In D. Allen & J. Thornbush (Eds.), *Urban Geomorphology. Landforms and Processes in Cities* (pp. 55–77). Elselvier. https://doi.org/10.1016/B978-0-12-811951-8.00004-7.

Zwoliński, Z., Jasiewicz, J., Mazurek, M., Hildebrandt-Radke, I., & Makohonienko, M. (2021). Spatial pattern of selected geohazards on the geomorphological map of Poznań impacted by climate changes. *Journal of Maps*, (in print).