

1 Article

2 **Mapping and Monitoring Urban Environment**
3 **through Sentinel-1 SAR Data: a case study in the**
4 **Veneto Region (Italy)**

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8 **Supplementary Material**

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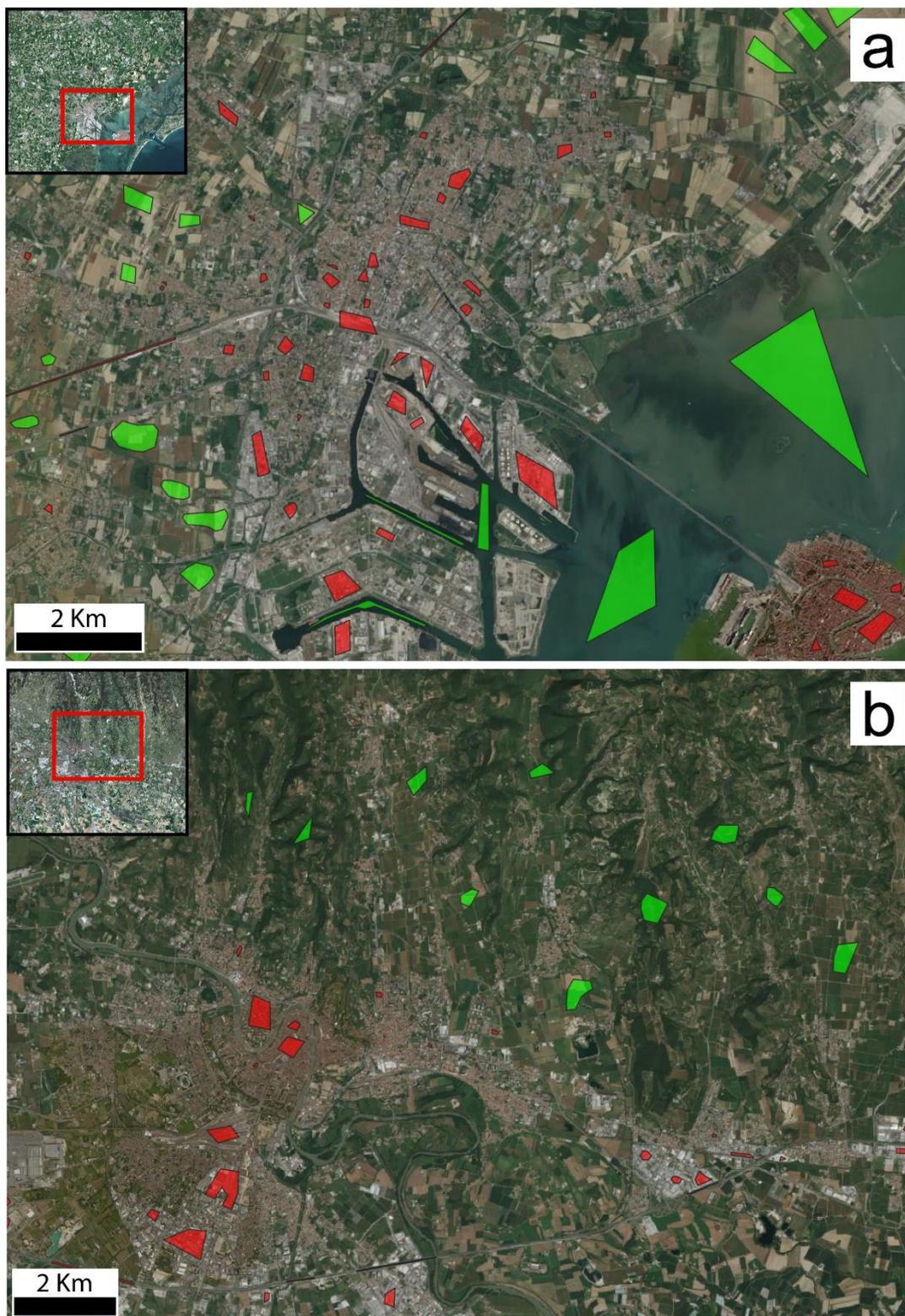
10 **Table S1.** Statistical analysis of ROIs areal extent. In this table we report the areal extent of all ROIs
11 used in our work, distinguishing from the study areas of Venice (Figure 3) and Verona (Figure 12a).
12 The ROIs display substantial differences in size between urban and non-urban classes, which is
13 usually not advisable for the ML classifier. However, such differences can be related to the actual
14 geographic distribution of urban environment over the target area (referred to as “urban footprint”
15 in this work), which resulted in values ranging between ~17-35% at this image scale. These values are
16 indeed similar to the extent of the “urban” class digitized for the ROIs (displayed in the last column
17 of this table).

	Extent of class “urban” (km ²)	Extent of class “non-urban” (km ²)	Total extent of ROIs (km ²)	% extent of class “urban”
Venice	3.721	25.477*	29.198	12.744
Verona	3.250	13.707	16.957	19.166

18 *in this case we excluded from the analysis the large ROI polygons digitized over the Venice lagoon, since,
19 having null coherence values, their areal extent should not affect the ML classifier.

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21 **Figure S1.** ROIs validation with high resolution satellite imageries. After digitizing ROIs over
22 Sentinel-2 images, we empirically validated our photointerpretation of ROIs with some of the high-
23 resolution satellite imageries available in QGIS, such as Bing Satellite (a) and Google Satellite (b). In
24 particular, (a) refers to the ROIs digitized for the Venice study area (Figure 3), and (b) refers to the
25 ROIs digitized for the Verona study area (Figure 12a). Although we performed an empirical
26 validation, we are confident that any potential mixed pixel included in the ROIs can be neglected.



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Table S2. CORINE land cover nomenclature. In this table we report the standard 3th-level CORINE land cover nomenclature, available at the CORINE references provided in the manuscript. Hence, in this table we highlight in blue those classes that were included in the “urban” pixels (see section 2.7 of the manuscript for details).

Level 1	Level 2	Level 3
1 Artificial surfaces	1.1 Urban fabric	1.1.1 Continuous urban fabric 1.1.2 Discontinuous urban fabric
	1.2 Industrial, commercial and transport units	1.2.1 Industrial or commercial units 1.2.2 Road and rail networks and associated land 1.2.3 Port areas 1.2.4 Airports
	1.3 Mine, dump and construction sites	1.3.1 Mineral extraction sites 1.3.2 Dump sites 1.3.3 Construction sites
	1.4 Artificial non-agricultural vegetated areas	1.4.1 Green urban areas 1.4.2 Sport and leisure facilities
2 Agricultural areas	2.1 Arable land	2.1.1 Non-irrigated arable land 2.1.2 Permanently irrigated land 2.1.3 Rice fields
	2.2 Permanent crops	2.2.1 Vineyards 2.2.2 Fruit trees and berry plantations 2.2.3 Olive groves
	2.3 Pastures	2.3.1 Pastures
	2.4 Heterogeneous agricultural areas	2.4.1 Annual crops associated with permanent crops 2.4.2 Complex cultivation 2.4.3 Land principally occupied by agriculture with significant areas of natural vegetation 2.4.4 Agro-forestry areas
3 Forest and semi-natural areas	3.1 Forests	3.1.1 Broad-leaved forest 3.1.2 Coniferous forest 3.1.3 Mixed forest
	3.2 Shrub and/or herbaceous vegetation association	3.2.1 Natural grassland 3.2.2 Moors and heathland 3.2.3 Sclerophyllous vegetation 3.2.4 Transitional woodland shrub
	3.3 Open spaces with little or no vegetation	3.3.1 Beaches, dunes, and sand plains 3.3.2 Bare rock 3.3.3 Sparsely vegetated areas 3.3.4 Burnt areas

		3.3.5 Glaciers and perpetual snow
4 Wetlands	4.1 Inland wetlands	4.1.1 Inland marshes 4.1.2 Peatbogs
	4.2 Coastal wetlands	4.2.1 Salt marshes 4.2.2 Salines 4.2.3 Intertidal flats
5 Water bodies	5.1 Inland waters	5.1.1 Water courses 5.1.2 Water bodies
	5.2 Marine waters	5.2.1 Coastal lagoons 5.2.2 Estuaries 5.2.3 Sea and ocean

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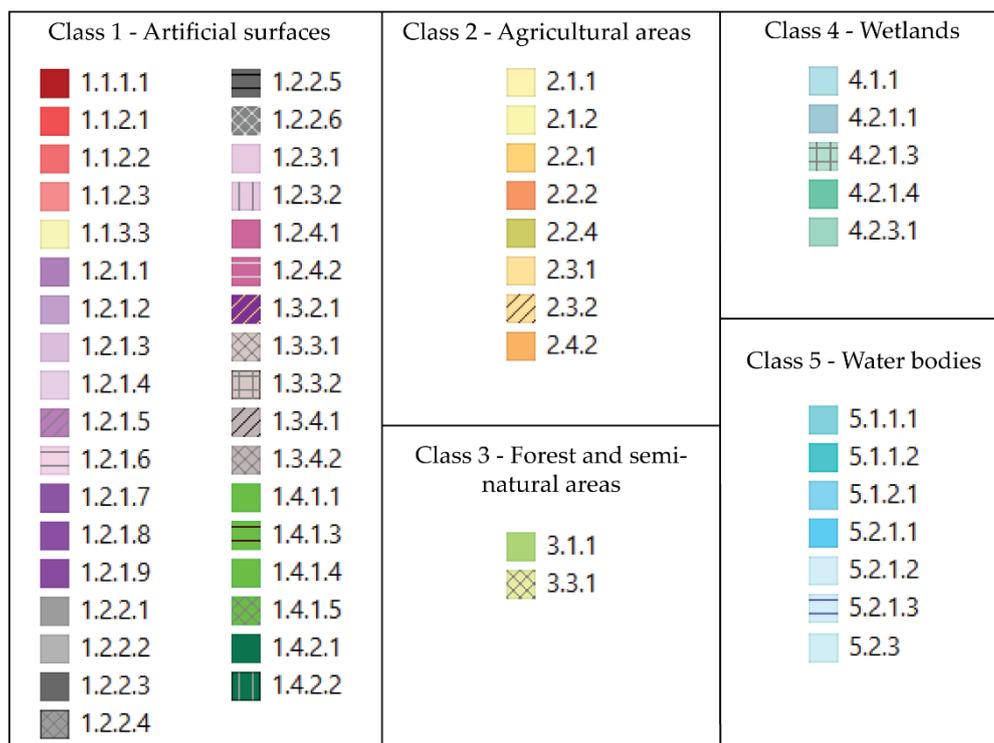
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Figure S2. Legend related to Figure 6a in the manuscript, displaying the CORINE classes included in the sample area only. Similarly to other countries, Italy has extended the CORINE land cover legend up to the 4th and 5th level, in order to better identify particular national or regional environmental characteristics (level 5th is available for classes 2 and 3 only). Hence, in this figure we display the specific legend from Figure 6 of the manuscript, reporting the 4th-level codes only. The 4th and 5th-level Italian nomenclature is available at [1] (see References below), whereas for easy access, the reader is referred to the 3th-level standard nomenclature and class descriptions defined in Table S2. For other 4th-level nomenclatures available in other countries, see [2] (see References below).



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42 **References**

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1. Ministero dell'Ambiente e della Tutela del Territorio - Direzione Protezione Natura. Manuale per la gestione dei Siti Natura 2000 (2005). Allegato 5, pp. 370–380. Available online: https://www.minambiente.it/sites/default/files/archivio/allegati/rete_natura_2000/manuale_gestione_siti_natura2000.pdf (accessed on 10 May 2020).

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