Invasive Species Mapping from Multi-Temporal Very High Resolution Satellite Images: the Case of *Ailanthus altissima*

What are invasive plants species?

Invasive plants species are non-native plants able to modify diversity and functioning of ecosystems, especially when they exhibit invasive tendencies competing with native species.

Ailanthus altissima (Mill.) Swingle (known as Tree-of-Heaven), particularly abundant in Murgia Alta Protected Area (Italy), as well in both Europe and North America, is causing impoverishment in natural ecosystems with biodiversity loss and consequent economic damages.


Ailanthus altissima (Mill.) Swingle

Remote Sensing in support of alien plant detection

Remote Sensing (RS) data and techniques can allow coverage of large areas repetitively, and also provide data for areas difficult or dangerous to reach. Thus, they represent an efficient add-on or even an alternative to in-field inspections in supporting reduction and monitoring of the negative impact of invasive species on the environment. A novel study confirmed the effectiveness of multi-spectral and multi-temporal Very High Resolution (2 meters spatial resolution) satellite data (i.e., Worldview-2 (WV-2)) in the framework of a two-stage hybrid classification scheme for the mapping of *A. altissima* in the Mediterranean area as an alternative when airborne hyperspectral data, commonly adopted, are unavailable.


(a)

(b)

(c)
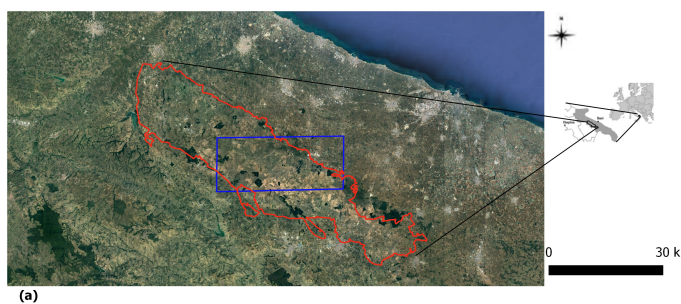
"Murgia Alta" Natura 2000 site. (a) Location and extension of "Murgia Alta" protected area in red line. The 500 km2 analyzed area in blue line. (b) WV-2 input image, 2 m resolution, October 5th, 2011. (c) WV-2 input image, 2 m resolution July 6th, 2012. False Colour Composite: Band 5, Band 7, Band 2.
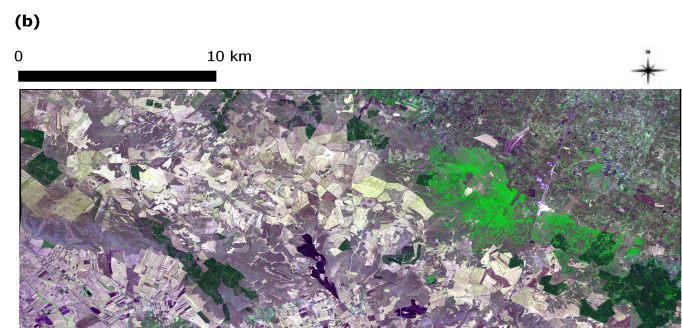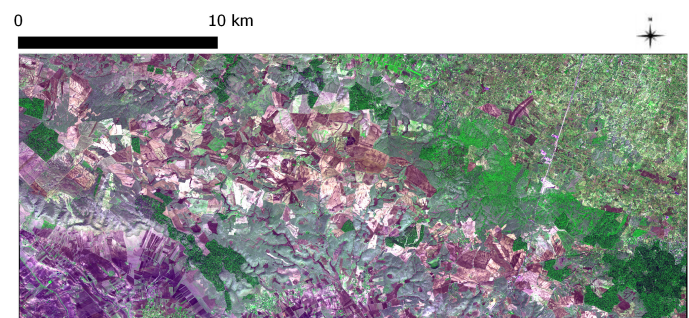
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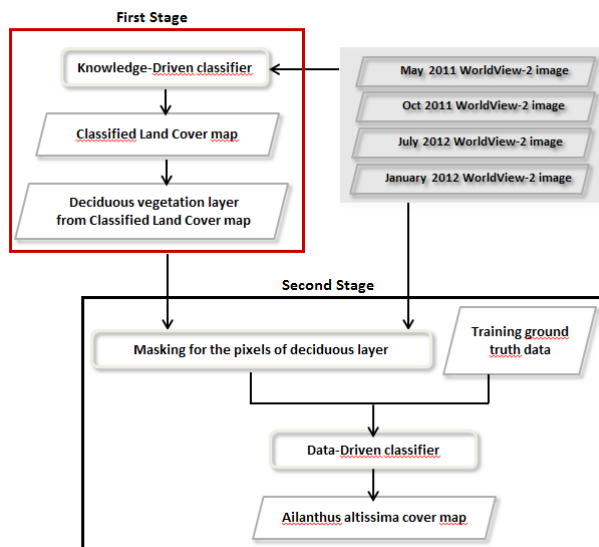

A two-stage hybrid classification scheme for invasive species mapping

The first classification stage uses a knowledge-driven learning procedure, which can provide a multiple class Land Cover (LC) map without requiring in-field reference data. The deciduous layer extracted from this LC map will be used as a pre-filter for the input data to the second classification stage. The latter is a supervised data-driven classifier which can discriminate two classes (i.e., *A. altissima* and other deciduous) by analysing only the pixels belonging to the deciduous vegetation layer of the LC map obtained in the first stage.

A. Altissima invasive species mapping

The two-stage approach proposed is novel and useful since it can reduce classification complexity, time and costs involved by in-situ reference data collection. Multi-temporal VHR data and the hybrid system suggested may offer new opportunities for invasive plant monitoring and follow-up of management decision.
Close-up images extracted from the final output map obtained from the July-October image pair. These images provide samples of the detection of true invasive pixels.

(a)

(b)

(c)
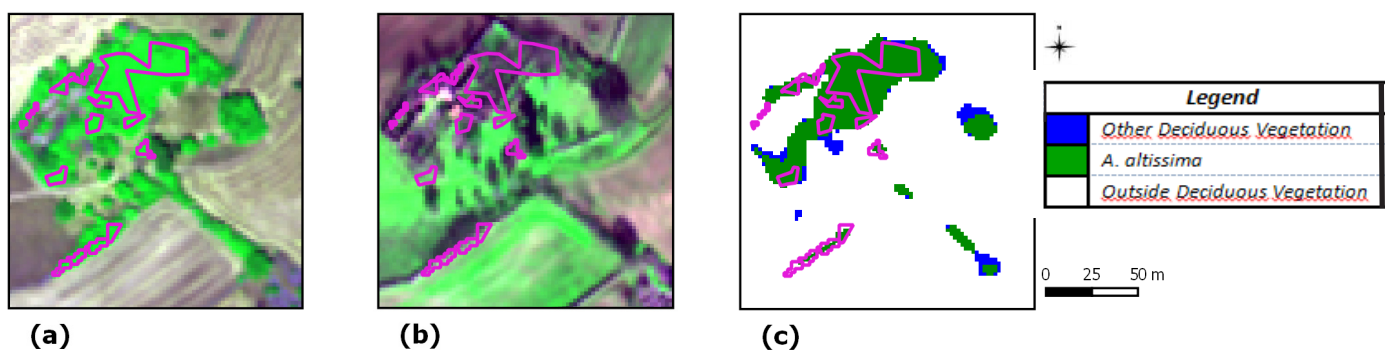
(a) WV-2 July and (b) WV-2 January images, False Colour Composite: Band 5, Band 7, Band 2. Deciduous plants can be observed. (c) A. altissima output map from second stage using the July–October image pair as input. In-field polygons of A. altissima, used for validation, are highlighted in magenta line.

References
Tarantino, C., Casella, F. , Adamo, M. , Lucas, R. , Beierkuhnlein, C., Blonda, P. (2018). "*Ailanthus altissima* mapping from multi-temporal very high resolution satellite images", ISPRS Journal of Photogrammetry and Remote Sensing, 147, 90-103, https://doi.org/10.1016/j.isprsjprs.2018.11.013