Sentinel-1 Potential for Land Cover Classification

Gottfried Schwarz, Octavian Dumitru, and Mihai Datcu
German Aerospace Center (DLR), Münchener Str. 20, 82234 Weßling, Germany

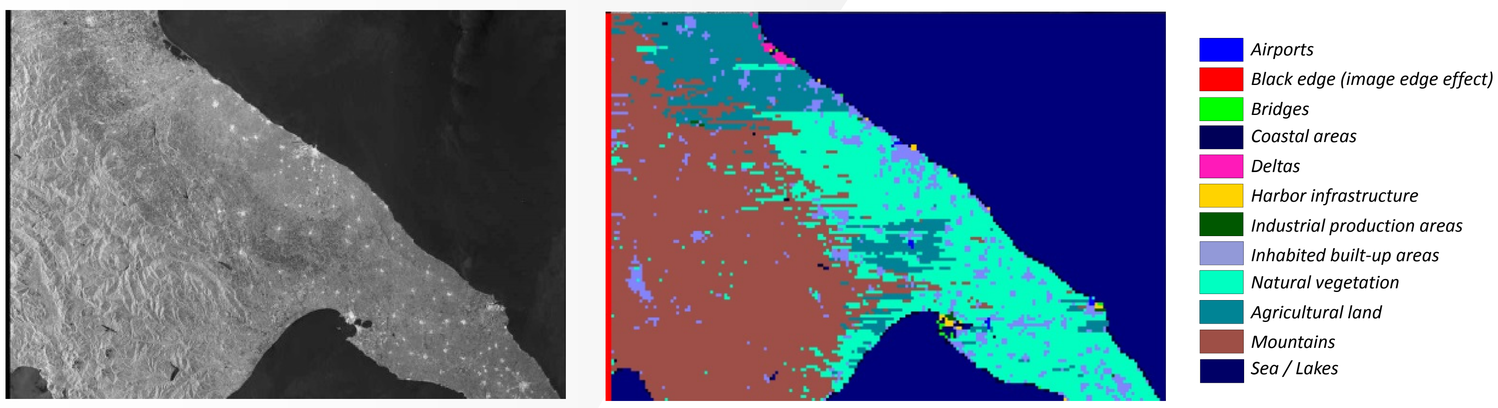
Abstract

One of the main applications of ESA's Sentinel-1 SAR data [1] is land cover analysis and classification. The regular repeat cycle imaging and the resulting time series of overlapping Sentinel-1 SAR images prompted us to develop reliable image classification tools that allow a quantitative inter-comparison of selected land cover areas. Our aim was to identify pre-defined land cover categories, and to observe the temporal evolution of these categories versus time.

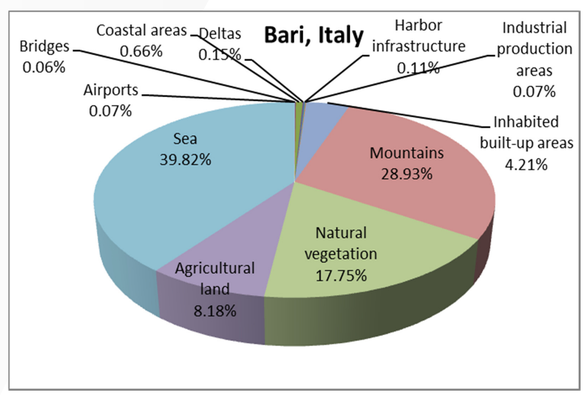
Data characteristics

We used Sentinel-1A IW mode data of GRDH product type with a pixel spacing of 10 m [1]. Due to the radiometric stability of the Sentinel-1 data, one can employ directly conventional image classification techniques. As a rule, we obtained from 5 to 10 semantic categories from each product. A typical example for 11 semantic Earth surface cover categories is shown below depicting a scene acquired over Bari, Italy together with the resulting quantitative classification results [2].
These results can be compared with Earth surface cover classification results as seen by the multispectral Sentinel-2A instrument [1]. As an example, we used the 10 m pixel spacing RGB bands of a sub-scene acquired over central Greece where we could retrieve 10 Earth surface cover categories (see below).
As a result, we can confirm that the image classification results of Sentinel-1 are comparable to multispectral Sentinel-2 classification results derived from images with the same pixel spacing.

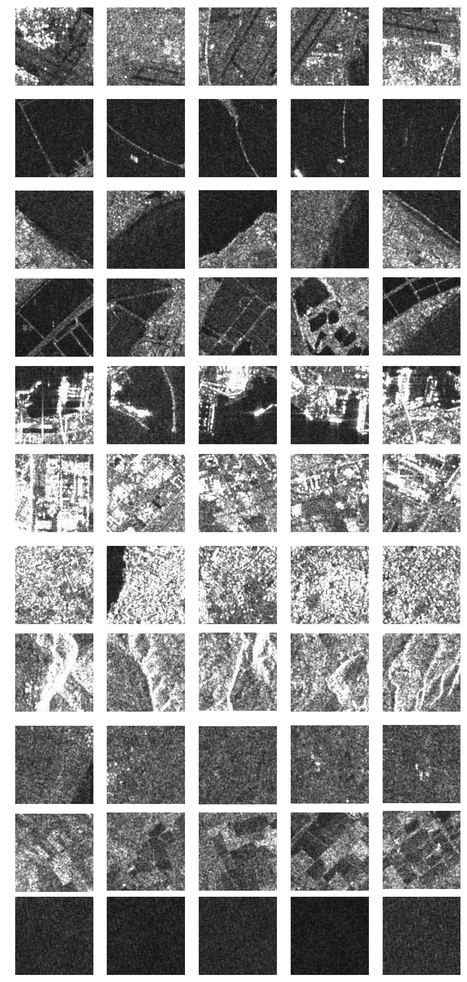
Results



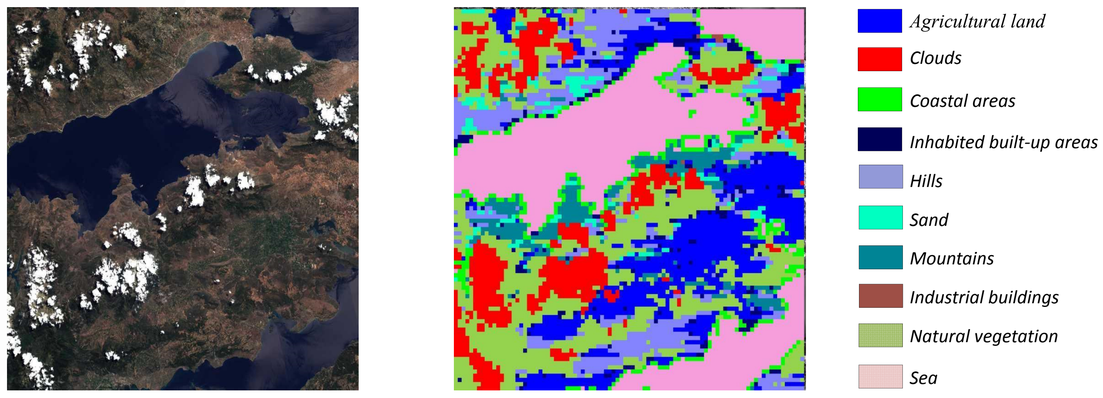
Sentinel-1A quick-look view (left) and its patch classification map (right) for an image of Bari, Italy



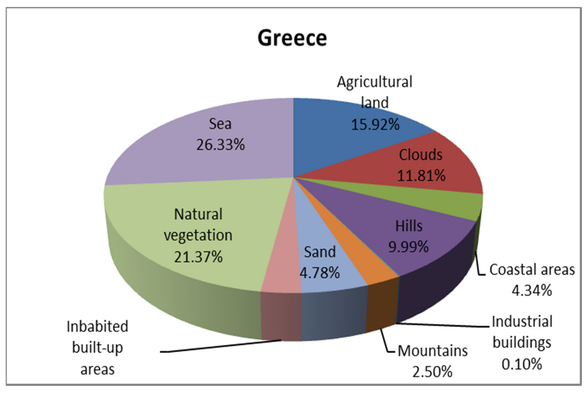
Diversity of categories retrieved from an image of Bari, Italy



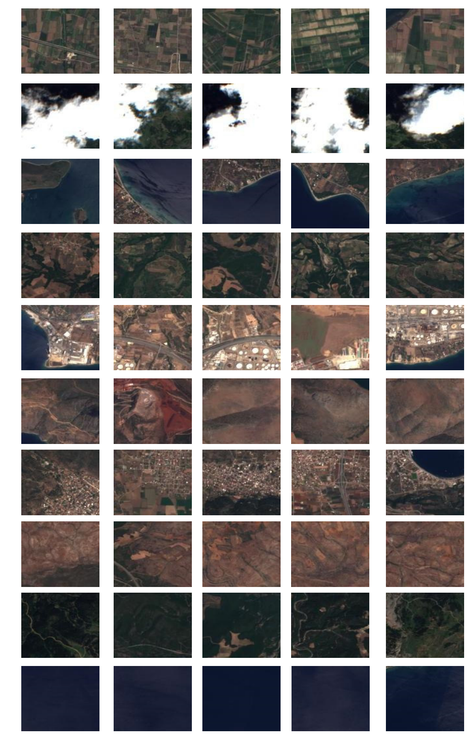
Five examples for each category retrieved from a Bari image. From top to bottom: *Airports, Bridges, Coastal areas, Deltas, Harbor infrastructure, Industrial buildings, Inhabited built-up areas, Mountains, Natural vegetation, Agricultural land,* and *Sea*



Sentinel-2A quick-look image (left) and the "patch-based" classification map (right) for a quadrant-image of Greece



Diversity of categories retrieved from a central Greece quadrant-image



Five examples for each category retrieved from a Greece quadrant-image. From top to bottom: *Agricultural land, Clouds, Coastal areas, Hills, Industrial buildings, Mountains, Inhabited built-up areas, Sand, Natural Vegetation*, and *Sea*

Conclusion

The use of this semantic catalogue was the basis for obtaining quantitative classification performance results including the basic confusion matrix approach as well as the widely known precision/recall figures-of-merit. Our results demonstrate that SAR images can be classified with good reliability once we know more about the general land use principles of the target area under study.

References

[1] Sentinel-1 Copernicus Open Access Hub, 2017. Available: https://scihub.copernicus.eu/
[2] O. Dumitru, G. Schwarz, and M. Datcu, *SAR Image Land Cover Datasets for Classification Benchmarking*, JSTARS, 2017, under review.

Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

DLR – German Aerospace Center
Remote Sensing Technology Institute
D-82234 Weßling
http://www.dlr.de/

REMOTE SENSING TECHNOLOGY INSTITUTE