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Lithology Mapping with Satellite, Fieldwork-based Spectral data, and Machine Learning: the case study of Beiras Group (Central Portugal)

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The lack of cartography increases the problematic of poor knowledge of geological resources and land management in regions that could benefit greatly from this information. Remote sensing has been an invaluable mean of obtaining data to perform geological mapping objectively and with high scientific accuracy. In Portugal, there is a large gap of cartographic information at 1:50 000 scale throughout the territory, so this work intends to complement this problem through a set of techniques and methodologies applied to a study of a region of Grupo das Beiras.

Spectral databases serve as an initial tool for any methodology involving spectral analysis, namely for the development of cartography methods and quick characterization of rock samples.

To address these issues, a multispectral analysis of january and july 2015th scenes with low cloud cover and atmospheric corrections (level 2) was obtained from Landsat 8 (LS8). Certain statistical tests such as ANOVA and Tukey's were applied to both images to clearly know whether significant differences exist between lithologies.

For the hyperspectral analysis, two sampling campaigns were carried out with the collection of rock samples of metasediments and granites and soil. The analysis was performed in fresh samples, crushed samples (2 mm - 500 μm; 500 μm - 125μm; <125 μm) and soil samples demonstrating a significantly different spectral behavior among various particle sizes in the hyperspectral signatures between fresh and crushed samples. X-ray fluorescence (FRX) was used to obtain geochemical data of major elements to validate the spectral results obtained. As a result, there were identified correspondences between the obtained hyperspectral data and the databases as well in the literature meaning that the spectral signatures of this research are consistent with the studied samples.

The creation of *machine learning* models is an emerging tool for cartography in which LS8

reflectance data was used for this elaboration. In this work and for this context the models proved to be useful and successful for the image classification from algorithms assigned for this function.