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| **Forest habitat mapping: comparison between single-date hyperspectral PRISMA and multi-date multispectral Planet and Sentinel-2** |
| The increasing availability of spaceborne hyperspectral satellite imagery opens for new opportunities in forest habitat mapping and monitoring. In this study, we explored the ability of PRISMA (PRecursore IperSpettrale della Missione Applicativa), the new hyperspectral satellite from the Italian Space Agency, to detect and correctly classify various forest habitat types distributed over a relatively small spatial extent (6000 ha) in a natural reserve in Central Italy. The case study deals with various level of spectral similarity, as the canopy dominant species of the target forest habitat classes are species of the same genus (*Quercus*, deciduous and evergreen species) or of different taxa (Pinus, Fraxinus). We performed a pixel-based classification with the Random Forest algorithm using a set of 28 spectral indexes computed on PRISMA bands. As comparison, we performed the RF classification using both single-date and a time series of Planet ad Sentinel-2 imagery, collected over the growing season, using the reduced set of spectral indices that can be calculated with two broad-band multi-spectral sensors, but across different decades. A Canopy Height Model was also used as input variable for the classification with the three sensors.  Our results showed that PRISMA considerably outperforms the two multispectral satellites on single-date classifications, with an overall accuracy of 82% compared to Planet’s 64% and Sentinel-2’s 68%. As for comparison with multi-date multispectral and single-date hyperspectral, 10-fold cross-validation results revealed that PRISMA and Planet both reach around 21% of error rate, while Sentinel-2 is around 19%. This proves that a combination of spectral indices calculated during the growing season can capture phenological or physiological differences among the targeted species, which consequently resulted in a signiﬁcant improvement in the classification accuracy of the multi-spectral sensors.  Ultimately, classification results from all three sensors were combined in the creation of probability maps for each forest class, thus identifying the areas which were classified with a higher degree of certainty by every satellite. |