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Assessing the Suitability of Multivariate Adaptive Regression Splines for Snow Cover Classification on Sentinel 2 MSI Data

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Reliable and accurate estimation of snow cover extent is of vital importance in order to have a comprehensive understanding for present and future climate, hydrological and ecological dynamics. Development of methodologies to obtain reliable snow cover information by means of optical remote sensing (RS) has long been one of the most active research topics of the RS community. On the other hand, rapid advances in RS technologies and instrumentation create gigantic and continuously growing supply of spatial data (i.e. big data) to analyze, which forces us, scientists, to position the machine learning issues within the area of RS, and to elaborate our work within the areas of data mining and model optimization. Based on a modified recursive partitioning methodology, multivariate adaptive regression splines (MARS) algorithm is a state-of-the-art nonparametric regression technique that can build flexible regression models for complex and high-dimensional nonlinear data. The main advantage of MARS is its ability to define the underlying functional relationships between a set of predictor variables and their response by simply and smoothly connecting piecewise linear regression functions, also known as basis functions (BFs). Selection of BFs is data-driven and specific to the problem in MARS, which makes it an adaptive regression procedure. It is also possible to extend the MARS algorithm to handle classification problems; however, its implementation in RS for image classification has been quite rare. In our previous pixel-based snow cover mapping efforts on MODIS data, MARS gave promising results (Kuter et al. 2017). Although misclassification of snow as cloud was observed at a certain degree, MARS produced better classification accuracies than traditional maximum likelihood approach. The main focus of this study is to fully exploit the potential of MARS algorithm for snow cover mapping on Sentinel 2 data. For this purpose, three Sentinel 2 images acquired over Turkey in December 2017, March 2018 and April 2018, representing the accumulation and melting periods of snow, are used. The images are classified by MARS algorithm under various model building configurations with four class labels as snow, cloud, land and water. Then, the classification performance of MARS models are assessed by using basic accuracy metrics derived from the associated error matrices. As indicated by the results, larger number of BFs and higher degrees of interaction should be preferred for multispectral image classification by multi-response MARS model.

References

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