Evaluation of Uncertainty in Classification Accuracy

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ABSTRACT

Land cover map derived from remotely sensed classification is universally used and it is probably the most important data in the terrestrial dataset. Many approaches have been shown to be very efficient and extensively used in automated land cover classification. However, the sensitivity and reliability of the classification output is an important subject for image classification. Classification accuracy in an inference process is always less than a desired accuracy in the actual classification process, thus this marginalized difference is considered as an element of uncertainty in the classification results. Failure to recognize uncertainty may lead to erroneous and misleading interpretations. Therefore, the objective of this research is to quantify the uncertainty of the classification accuracy by considering the impact of possible factors on image classification. Three classifiers, which include a Gaussian maximum likelihood classifier (GMLC), a backpropagation neural network (BPNN), and a supervised self-organizing map (SSOM) neural network, with the synthetic time-series images are used to evaluate the classification uncertainty. Furthermore, the Monte Carlo simulation technique is applied to assess the reliability of the classification output by focusing on the uncertainty associated with the input data and training data. The results show the unstable nature of the BPNN, which produces a large variation in the accuracy distribution. It can be assumed that the BPNN is unable to maintain variation in input and training data, whereas the GMLC and SSOM are more stable and robust. Although GMLC shows ability to control uncertainty in the classification accuracy, the results reveal that the highest classification accuracy and lowest variation of classification accuracy are obtained by SSOM.