Application of Artificial Neural Networks and Genetic Algorithms to the Retrieval of Snow Parameters from Passive Microwave Remote Sensing Data

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Monitoring the quantity, distribution and dry/wet state of snow provides vital information for applications such as weather and natural hazards forecasting, use of water resources for domestic and hydropower applications.

The retrieval of snow parameters from microwave remote sensing data is based on the inversion of relationships between the snow parameters and electromagnetic quantities. It is rarely possible to perform this inversion in a strictly analytical way and numerical techniques are often used. In some cases, the problem of inverting these relationships is solved by using a linear regression between the snow parameter of interest and a combination of electromagnetic quantities (e.g., Chang's algorithm for the retrieval of SWE). In other cases, iterative techniques based on the solution of the radiative transfer equation can be used (e.g., the HUT iterative inversion technique).

Numerical techniques such as Artificial Neural Networks (ANN) and Genetic Algorithms (GA) can also be used for the inversion of the radiative transfer equations. In this study we separately evaluate the capabilities of both ANN- and GA-based techniques to retrieve snow parameters from space-borne brightness temperatures at 19 and 37 GHz collected by the SSM/I and/or AMSR-E radiometers, with particular emphasis on snow depth. The two techniques are applied to different datasets collected over different areas and the results are compared with ground measurements. We also evaluate the advantages and disadvantages of the two techniques in terms of computational time and potential applications to retrievals of snow parameters close for near-real-time applications. We compare the performances of the ANN- and GA-based techniques with those of the most well known algorithms described in the literature: Chang's algorithm, the Helsinki University of Technology iterative algorithm and the Spectral Polarization Difference algorithm.