Nighttime cloud properties retrieval using MODIS and artificial neural networks

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The aim of this work is to develop a methodology for inferring water cloud macro and microphysical properties from nighttime MODIS imagery. This method is based on the inversion of a theoretical radiative transfer model that simulates the radiances detected in each of the sensor infrared bands. In this case, LibRadtran package (Mayer and Kylling, 2005) was used, which allows us the calculation of the radiation field in the Earth's atmosphere given a specified set of atmospheric and cloud parameters.

However, due to the complexity of this forward model, its inversion cannot be performed in an analytical way. To accomplish this task, we propose an operational technique based on artificial neural networks (ANNs), whose main characteristic is the ability to retrieve cloud properties much faster than conventional methods (Platnick et al., 2003, Gonzalez et al., 2002). Thus, the procedure is as follows: Using the theoretical radiative model, a Look Up Table (LUT) is generated for a great variety of surface, cloud and atmospheric conditions. This dataset is divided randomly into a training set (two-thirds of the items) and a test set (one third of the items) which are used to train the neural network in order to fit the inversion problem. In this study, multilayer perceptrons (MLPs) with two hidden layers are used, and the backpropagation with momentum method is used in the training process. Furthermore, to accelerate the convergence of ANN's, evolutionary techniques are used to search the ANN configuration that provides the best fit.

Furthermore, in order to check the robustness of the method, a sensitivity analysis is performed to evaluate the errors in the retrieved parameters as a consequence of the main uncertainties sources.

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Platnick , S. et al., (2003). "The MODIS cloud products: algorithms and examples from Terra". IEEE Trans. Geosc. Rem. Sens. Vol. 41, pp. 459-473