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On the role of VIS radiation for the ozone information retrieval from SCIAMACHY data by means of Neural Network algorithms

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Abstract

The observation of ozone concentrations from satellite platform, on a systematic and continuous basis, is crucial to understand and monitor processes that can play a fundamental role for the life on Earth. UV/VIS spectra from dedicated sensors, as, e.g., SCIAMACHY, OMI or GOME-2, can provide useful height-resolved information about ozone. The most interesting spectral intervals for ozone remote sensing are the ultraviolet Hartley and Huggins bands and the visible Chappuis band. Optimal Estimation based inversion schemes usually do not consider the latter interval, due to the interaction of aerosols, clouds and surface albedo with visible radiation; uncertainties in the knowledge of these latter parameters can lead to very large errors in the modelling of the atmospheric radiative transfer.

Neural Network (NN) algorithms represent an alternative approach for inversion problems in remote sensing. The effectiveness of NN algorithms for the retrieval of ozone concentration profiles from satellite data has been shown in recent studies. Moreover NNs determine the input-output relationship directly form the data, hence an explicit modelling of all radiative interactions can be avoided with this approach.

This paper aims at demonstrating that the use of VIS wavelengths using a Neural Network algorithm can significantly improve the accuracy of ozone retrievals. To achieve this goal we tried two different algorithms, the first trained to retrieve ozone concentration profiles, and the second to directly retrieve tropospheric ozone columns, both from SCIAMACHY Level 1 data. Satellite data were matched with ozonesondes measurements to obtain input-output pairs for the net; we also considered the use of synthetic spectra to enrich the statistics of the datasets. Comparisons between two neural architectures, one using only UV wavelengths and one using both UV and VIS wavelengths, have been made for the two algorithms. The design stage of the Neural Networks, including the preparation of training dataset and input selection by means of an Extended Pruning technique, is here discussed. The algorithms were tested on independent datasets. The results show that, with the use of VIS radiation, the accuracy of the retrievals, especially in the troposphere, can be improved up to the 20%.