ELS-XV-2015 Abstracts
ELS-XV-2015-115
Electromagnetic & Light Scattering XV 2015, Leipzig

Solving inverse problems in polarimetric remote sensing

O. Dubovik

CNRS, Universite Lille-1, Laboratoire d'Optique Atmospherique, Villeneuve d'Ascq, France (oleg.dubovik@univ-lille1.fr)

Remote sensing is a major tool for studying the interactions of solar radiation with the atmosphere and surface and their influence on the Earth radiation balance. One of the challenges in implementing remote sensing is the development of a reliable inversion procedure required for deriving information about the atmospheric or surface component interaction with the measured radiation. The inversion is particularly crucial and demanding for interpreting high complexity polarimetric measurements where many unknowns should be derived simultaneously. Numerous publications offer a wide diversity of inversion methodologies suggesting somewhat different inversion methods. Such uncertainty in methodological guidance leads to excessive dependence of inversion algorithms on the personalized input and preferences of the developer. The detailed reviews of inversion methods can be found in various textbooks, however, the textbook often do not provide the reader with sufficient explanations of existing alternatives and as to which method and why it should be chosen for a particular application.

This presentation attempts to provide a view that outlines unified principles addressing such important aspects of inversion optimization as accounting for errors in the data used, inverting multi-source data with different levels of accuracy, accounting for a priori and ancillary information, estimating retrieval errors, clarifying potential of employing different mathematical inverse operations (e.g. comparing iterative versus matrix inversion), accelerating iterative convergence, etc. The described concept uses the principles of statistical estimation and suggests a generalized multi-term Least Square type formulation that complementarily unites advantages of a variety of practical inversion approaches, such as Phillips-Tikhonov-Twomey constrained inversion, Kalman filters, Newton-Gauss and Levenberg-Marquardt iterations, etc. In addition the concept allowed the development of rather innovative and practically efficient retrieval procedures. One of recent examples is the multi-pixel retrieval concept - a simultaneous optimized fitting of a large group of image pixels with additional constraints limiting the time variability of surface properties and spatial variability of aerosol properties. This principle provides a possibility to improve retrieval for multiple observations even if the observations are not exactly co-incident or co-located.

The proposed methodology has resulted from the multi-year efforts of developing inversion algorithms for retrieving comprehensive aerosol properties from both ground-based and satellite remote sensing observations (Dubovik and King, 2000; Dubovik 2004, Dubovik et al. 2008, 2011).

The illustrations of methodology are provided using AERONET and POLDER/PARASOL observations.