Geophysical Research Abstracts
Vol. 17, EGU2015-3529, 2015
EGU General Assembly 2015

Modelling uncertainty due to imperfect forward model and aerosol microphysical model selection in the satellite aerosol retrieval

Anu Määttä, Marko Laine, and Johanna Tamminen
Finnish Meteorological Institute, Helsinki, Finland (anu.maatta@fmi.fi)

This study aims to characterize the uncertainty related to the aerosol microphysical model selection and the modelling error due to approximations in the forward modelling. Many satellite aerosol retrieval algorithms rely on pre-calculated look-up tables of model parameters representing various atmospheric conditions. In the retrieval we need to choose the most appropriate aerosol microphysical models from the pre-defined set of models by fitting them to the observations. The aerosol properties, e.g. AOD, are then determined from the best models. This choice of an appropriate aerosol model composes a notable part in the AOD retrieval uncertainty. The motivation in our study was to account these two sources in the total uncertainty budget: uncertainty in selecting the most appropriate model, and uncertainty resulting from the approximations in the pre-calculated aerosol microphysical model.

The systematic model error was analysed by studying the behaviour of the model residuals, i.e. the differences between modelled and observed reflectances, by statistical methods. We utilised Gaussian processes to characterize the uncertainty related to approximations in aerosol microphysics modelling due to use of look-up tables and other non-modelled systematic features in the Level 1 data. The modelling error is described by a non-diagonal covariance matrix parameterised by correlation length, which is estimated from the residuals using computational tools from spatial statistics. In addition, we utilised Bayesian model selection and model averaging methods to account the uncertainty due to aerosol model selection. By acknowledging the modelling error as a source of uncertainty in the retrieval of AOD from observed spectral reflectance, we allow the observed values to deviate from the modelled values within limits determined by both the measurement and modelling errors. This results in a more realistic uncertainty level of the retrieved AOD. The method is illustrated by both simulated data and by real data from OMI/Aura instrument. The satellite retrievals are validated against daily averaged AERONET sun photometer data.

Reference: A. Määttä, M. Laine, J. Tamminen, and J. P. Veefkind: Quantification of uncertainty in aerosol optical thickness retrieval arising from aerosol microphysical model and other sources, applied to Ozone Monitoring Instrument (OMI) measurements, Atmospheric Measurement Techniques, 7, pages 1185-1199, 2014.