Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG39-P10 会場:コンベンションホール 時間:5 月 19 日 18:15-19:30

衛星リモートセンシングにおける一般化されたエアロゾル特性推定あるゴリズムの開発
Development of generalized satellite remote sensing algorithm for aerosol properties.

橋本 真喜子 1*, 中島映至 1, 竹中栄晶 1, 日暮明子 2
Makiko Hashimoto1*, Teruyuki Nakajima1, Hideaki Takenaka1, Akiko Higurashi2

1 東京大学大気海洋研究所, 2 国立環境研究所
1Atmosphere and Ocean Research Institute, 2National Institute for Environmental Studies

In late years, high accurate multiple-wavelength, multiple-angle observation data have been obtained by grand-based spectral radiometers and multi wavelength imager sensors on board the satellite. Associated with the situation, the optimized multi-parameter remote sensing method by Bayesian theory has become popularly used(Turchin and Nozik, 1969; Rodgers, 2000; Dubovik *et al*., 2000). With the progress of computing technology, this method has being combined with radiation transfer calculation numerically solved each time in iteration for solution search, without using LUT (Look Up Table), as shown by successful examples of a flexible and accurate remote sensing (Dubovik *et al*., 2011).

We are developing a new Bayesian type inversion method, which combine the MAP method (Maximum a posteriori method) in Rodgers (2000) with the Phillips-Twomey method (Phillips, 1962; Twomey, 1963) as a smoothing constraint for the state vector.

Defining a radiance (measurement) vector at TOA by L and a geophysical (state) parameter or vector determining radiance by u, we express the observation as follows: $L = f(u) + e$, where e is the error caused by several error sources (observation error, modeling error in radiance and error in numerical calculation), and f is the forward operator to model the observation. L and u are defined in the target region determined by spatial and temporal dimensions, (x, y, t). Then, the cost function (E) is expressed as the sum of those of MAP method and of Phillips-Twomey method:

$$E = (L - f)^T S_e^{-1} (L - f) + (u - u_a)^T S_e^{-1}(u - u_a) + \mathrm{SUM}_k[\, w_k\, |A_k + D_k\, u|^2]$$

where, T is the transposed matrix, S_e and S_a are the covariance matrix for the observation operator, respectively. u_a is a priori (climatic) value. A_k indicates boundary condition in a certain region. D_k is a quadratic differential operator for structural valuables. w_k is a factor chosen to give appropriate relative weighting to the constraints. To minimize the cost function, we used a Newton method, and the solution may be obtained by several iterations. In our algorithm, L is the radiance observed by satellite and u is the aerosol properties: as of now, the aerosol optical depth (AOT) of fine particles, sea salt particles and dust particles, and the soot fraction in fine particles.

We conducted numerical tests for the retrieval of aerosol properties for GOSAT CAI imager data, to test this algorithm. In this test, we used the simulated radiance data observed by a satellite (5 by 5 grid) using a radiation transfer calculation model, Rstar code (Nakajima and Tanaka, 1986, 1988) assuming wavelengths of 380, 674, 870 and 1600 [nm], atmospheric condition of the US standard atmosphere, fine particle AOTs as 0.2, sea salt particle AOTs as 0.0 and dust particle AOTs as 0.1 for all grids.

For the test, we set to our algorithm each initial and a priori value, (0.001, 0.1) for fine particles and (0.001, 0.5) for dust particles, respectively. We gave the value corresponding to 10% error in measurements for S_e, and the value assuming that a priori AOT has |0.1| differences for S_a.

We calculated the difference between simulated true values and retrieval values of AOT; dAOT= [(retrieval value) - (true value)]/(true value). The result of the experiment shows the algorithm could retrieve AOT of fine and dust particles, and dAOT of fine and dust particles are about -0.15 and +0.07 under the present condition of test experiment, and it was confirmed that our new algorithm works and can derive AOT with a certain accuracy. We will test several other conditions by numerical test, and discuss the information content of several parameter needed for retrieval (e.g. S_e, S_a, w) and the boundary condition and errors included in the retrieval algorithm.

キーワード: 衛星リモートセンシング, エアロゾル
Keywords: Satellite remote sensing, Aerosol