Information operator approach applied to the retrieval of vertical distributions of atmospheric constituents from ground-based FTIR measurements

Cindy Senten (1), Martine De Mazière (1), Gauthier Vanhaelewyn (1), Corinne Vigouroux (1), and Robert Delmas (2)

(1) Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium, (2) Laboratoire de l'Atmosphère et des Cyclones (LACy), Université de La Réunion, France

The retrieval of information about the vertical distribution of an atmospheric absorber from high spectral resolution ground-based Fourier Transform infrared (FTIR) solar absorption spectra is an important issue in remote sensing. A frequently used technique at present is the optimal estimation method. This work introduces the application of an alternative method, namely the information operator approach (Doicu et al., 2007; Hoogen et al., 1999), for extracting the available information from such FTIR measurements. This approach has been implemented within the well-known retrieval code SFIT2, by adapting the optimal estimation method such as to take into account only the significant contributions to the solution. In particular, we demonstrate the feasibility of the method when applied to ground-based FTIR spectra taken at the southern (sub)tropical site Ile de La Réunion (21˚S, 55˚E) in 2007. A thorough comparison has been made between the retrieval results obtained with the original optimal estimation method and the ones obtained with the information operator approach, regarding profile and column stability, information content and corresponding full error budget evaluation. This has been done for the target species ozone (O_3), methane (CH_4), nitrous oxide (N_2O), and carbon monoxide (CO). It is shown that the information operator approach performs well and is capable of achieving the same accuracy as optimal estimation, with a gain of stability and with the additional advantage of being less sensitive to the choice of a priori information as well as to the actual signal-to-noise ratio.

Keywords: ground-based FTIR, solar absorption spectra, greenhouse gases, information operator approach

References

Doicu, A., Hilgers, S., von Bargen, A., Rozanov, A., Eichmann, K.-U., von Savigny, C., and Burrows, J.P.: Information operator approach and iterative regularization methods for atmospheric remote sensing, J. Quant. Spectrosc. Radiat. Transfer, 103, 340-350, 2007.

Hoogen, R., Rozanov, V.V., and Burrows, J.P.: Ozone profiles from GOME satellite data: description and first validation, J. Geophys. Res., 104(D7), 8263-8280, 1999.