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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Interference errors in infrared remote sounding of the atmosphere" *by* R. Sussmann and T. Borsdorff

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General comments.

The paper is devoted to a quantification of a special kind of errors in estimates of vertical profiles (i.e., vertical distributions) of gases using their high resolution IR spectra; the title properly reflects the matter of study and the abstract is coplete. In principle this "inverse" problem can be solved and several approaches have been proposed during last few decades. The most popular approach and mathematical formalism were developed in papers by C. Rodgers (for microwave case and later on for IR) and B. Connor with co-authors (see a very representative list of references). This general approach was applied to analysis of atmospheric gases (started with ozone and carbon monoxide and extended to other species). The paper is well written and structured. The paper under review represents a valuable study of a special issue in analysis and deserves

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to be published. This paper has a discussional nature; several spectroscopical groups develop their own concrete retrieval codes and a publication would stimulate a fruitful discussion and improvement of the techniques.

Specific comments.

The most original issue and starting point of the study, offered by the authors, is a generalisation of x from the target profile to a state vector that takes into account all parameters to be retrieved. This action converts a relatively simple equation (1) to a general (7). Then the authors extracted a term called "the interference error" and a generalized "interference kernel matrice". This is a key step and should be discussed by the retrieval community. To my mind it is an interesting idea. In the following 3.3 and 3.4 sections details of the profile retrievals are described.

A strong point is an application of the proposed generalization to measured infrared absorption spectra. The instrument is a standard Bruker 120 HR and this anlysis can be applied to several other instruments of this type, installed at the NDACC network. Carbon monoxide is used as a target gas. Unfortunately, profiles of this gas undergo the largest changes between the boundary layer and free troposphere. In normal conditions they are relatively smooth in the free troposphere. The location of the instrument at the altitude of 2964 m a.s.l. is not perfect; it misses the polluted boundary layer. From the other hand, it is not bad as a starting point of study. It would be highly interesting to re-do this analysis for spectra with polluted boundary layer and strong vertical gradient around ˜ 2 km of altitude and for cases with corresponding aircraft profiles. Using SFIT-2 retrieval code is a good decision, because it is the most common tool in use.

The following part of the paper describes analysis of randomly selected 156 spectra recorded after 1994. The number of spectra looks high enough. Again, it should be noted, that the H2O interference for the Zugspitze is weaker, than for spectra, recorded from the sea level. Results of a similar study for those spectra would be different.

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A weak point of the paper is a "bulk" consideration of the retrieved and aircraft profiles. Meanwhile, special cases of high humidity, layers polluted by forest fires, etc., should be selected and analysed separately, with references to back trajectories and/or satellite data.

A proper choice of microwindows is important. A result of an experiment with widening a standard RRC microwindow to include 2158.11 cm-1 H2O line can be easily predicted, it looks trivial, but, probably, this exercise is useful as an illustration. It may be noted that an optimisation of microwindows would be a matter of a special publication. Moreover, this would be the best way to minimize all retrieval errors, including interference errors. Hopefully, this paper will stimulate investigations of this type.

Finally, this paper is devoted to a very special, but important, issue and is useful for a relatively narrow IR retrieval community. However, a publication in ACP is possible, it is a fast way to make the results known for members of this community. There is a great interest from atmospheric chemists, climatologists, modelers to results of profiling that are being conducted by spectroscopic groups. An on-line discussion of specific details is highly appreciated.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 13027, 2006.

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