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Atmos. Chem. Phys., 7, 3537-3557, 2007
www.atmos-chem-phys.net/7/3537/2007/

Technical Note: Interference errors in infrared remote sounding of the atmosphere

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Abstract. Classical error analysis in remote sounding distinguishes between four classes: "smoothing errors," "model parameter errors," "forward model errors," and "retrieval noise errors". For infrared sounding "interference errors", which, in general, cannot be described by these four terms, can be significant. Interference errors originate from spectral residuals due to "interfering species" whose spectral features overlap with the signatures of the target species. A general method for quantification of interference errors is presented, which covers all possible algorithmic implementations, i.e., fine-grid retrievals of the interfering species or coarse-grid retrievals, and cases where the interfering species are not retrieved. In classical retrieval setups interference errors can exceed smoothing errors and can vary by orders of magnitude due to state dependency. An optimum strategy is suggested which practically eliminates interference errors by systematically minimizing the regularization strength applied to joint profile retrieval of the interfering species. This leads to an interfering-species selective deweighting of the retrieval. Details of microwindow selection are no longer critical for this optimum retrieval and widened microwindows even lead to reduced overall (smoothing and interference) errors. Since computational power will increase, more and more operational algorithms will be able to utilize this optimum strategy in the future. The findings of this paper can be applied to soundings of all infrared-active atmospheric species, which include more than two dozen different gases relevant to climate and ozone. This holds for all kinds of infrared remote sounding systems, i.e., retrievals from ground-based, balloon-borne, airborne, or satellite spectroradiometers.

Final Revised Paper (PDF, 8737 KB) | Discussion Paper (ACPD)

Citation: Sussmann, R. and Borsdorff, T.: Technical Note: Interference errors in infrared remote sounding of the atmosphere, Atmos. Chem. Phys., 7, 3537-3557, 2007. | Bibtex | EndNote | Reference Manager