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A method to account for the temperature sensitivity of TCCON total column measurements

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The Total Carbon Column Observing Network (TCCON) consists of ground-based Fourier Transform Spectrometer (FTS) systems all around the world. It achieves better than 0.25% precision and accuracy for total column measurements of CO_2 [Wunch et al. (2011)]. In recent years, the TCCON data processing and retrieval software (GGG) has been improved to achieve better and better results (e. g. ghost correction, improved a priori profiles, more accurate spectroscopy).

However, a small error is also introduced by the insufficent knowledge of the true temperature profile in the atmosphere above the individual instruments. This knowledge is crucial to retrieve highly precise gas concentrations. In the current version of the retrieval software, we use six-hourly NCEP reanalysis data to produce one temperature profile at local noon for each measurement day. For sites in the mid latitudes which can have a large diurnal variation of the temperature in the lowermost kilometers of the atmosphere, this approach can lead to small errors in the final gas concentration of the total column.

Here, we present and describe a method to account for the temperature sensitivity of the total column measurements. We exploit the fact that H_2O is most abundant in the lowermost kilometers of the atmosphere where the largest diurnal temperature variations occur. We use single H_2O absorption lines with different temperature sensitivities to gain information about the temperature variations over the course of the day. This information is used to apply a posteriori correction of the retrieved gas concentration of total column.

In addition, we show that the a posteriori temperature correction is effective by applying it to data from Lamont, Oklahoma, USA (36,6°N and 97,5°W). We chose this site because regular radiosonde launches with a time resolution of six hours provide detailed information of the real temperature in the atmosphere and allow us to test the effectiveness of our correction.

References: Wunch, D., Toon, G. C., Blavier, J.-F. L., Washenfelder, R. A., Notholt, J., Connor, B. J., Griffith, D. W. T., Sherlock, V., and Wennberg, P. O.: The Total Carbon Column Observing Network, Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 369, 2087–2112, 2011.