Geophysical Research Abstracts
Vol. 18, EGU2016-13494, 2016
EGU General Assembly 2016

The Zugspitze radiative closure experiment: quantification of the near-infrared water vapor continuum from atmospheric measurements

Andreas Reichert, Ralf Sussmann, and Markus Rettinger
KIT/IMK-IFU, Garmisch-Partenkirchen, Germany (andreas.reichert2@kit.edu)

Inaccuracies in the description of atmospheric radiative processes are among the major shortcomings of current climate models. Especially the contribution by water vapor, the primary greenhouse gas in the Earth's atmosphere, currently still lacks sufficiently accurate quantification. The main focus of our study is on the so-called water vapor continuum absorption in the near-infrared spectral range, which is of crucial importance for atmospheric radiative processes. To date, the quantification of this contribution originates exclusively from laboratory experiments which show contradictory results and whose findings are not unambiguously transferable to atmospheric conditions. The aim of the Zugspitze radiative closure study is therefore to obtain, to our knowledge for the first time, an exact characterization of the near-infrared water vapor continuum absorption using atmospheric measurements. This enables validation and, if necessary, improvements of the radiative transfer codes used in current climate models.

The closure experiment comprises near-infrared spectral radiance measurements using a solar absorption FTIR spectrometer. These measurements are then compared to synthetic radiance spectra computed by means of a high-resolution radiative transfer model. The spectral residuals, i.e. the difference between measured and calculated spectral radiances can then be used to quantify errors in the description of water vapor absorption. Due to the extensive permanent instrumentation available at the Zugspitze observatory, the atmospheric state used as an input to the model calculations can be constrained with high accuracy. Additionally, we employ a novel radiometric calibration strategy for the solar FTIR spectral radiance measurements based on a combination of the Langley method and measurements of a medium-temperature blackbody source. These prerequisites enable accurate quantification of the water vapor continuum in the near-infrared spectral region, where previously no precise measurements under atmospheric conditions were available. Our results allow resolving the present contradiction between the predictions of the widely used MT_CKD continuum model and current laboratory studies.

Acknowledgements: Funding by the Deutsche Bundesstiftung Umwelt (DBU) and the Bavarian State Ministry of the Environment and Consumer Protection (contracts TLK01U-49581 and VAO-II TP I/01) is gratefully acknowledged.