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UT/LS Water Vapor Measurements Using a Photoacoustic Detector

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In spite of the paramount importance of water vapor in the atmosphere, there still exists a need for new fast and robust detectors for high sensitive, selective water vapor detection with wide dynamic range and capability of long-term unattended operation in the UT/LS region. A photoacoustic water vapor detector (WaSul-Hygro) for airborne UT/LS measurements operates on-board a commercial aircraft (Airbus A340-600 of Lufthansa) within the project CARIBIC since May 2005. Laboratory tests were demonstrated that the WaSul-Hygro detector characteristics fulfill all the requirements of atmospheric applications: its minimum detectable mixing ratio is as low as 0.3 ppm at 200 hPa air pressure; it measures the water vapor in interference-free mode, so the components existing in the atmosphere do not affect the detector measurement accuracy; it has a wide dynamic range (from 0.2 ppm up to a few thousand ppm); and its response time is ˜30 sec.

In this presentation we summarize the experiences of the 20 month airborne measurements of WaSul-Hygro. We present a comparative study of the characteristics of the WaSul-Hygro detector and a Buck CR-2 detector, which also operates on-board the aircraft within the same instrument container. It will be proven that the photoacoustic detector measures the atmospheric water vapor mixing ratio with comparable accuracy as the Buck CR-2 instrument, but with significantly better response time and higher selectivity. Case study of the water vapor distribution measurement during one flight of WaSul-Hygro is presented.

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