

## ***Interactive comment on “An intercomparison of HO<sub>2</sub> measurements by Fluorescence Assay by Gas Expansion and Cavity Ring–Down Spectroscopy within HIRAC (Highly Instrumented Reactor for Atmospheric Chemistry)” by Lavinia Onel et al.***

**Anonymous Referee #2**

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This paper presents an intercomparison in the HIRAC chamber of two different instruments designed to measure HO<sub>2</sub> radical concentrations: a Laser-Induced Fluorescence - Fluorescence Assay by Gas Expansion (LIF-FAGE) instrument, and a near IR Cavity Ring-Down Spectroscopy (CRDS) instrument. The LIF-FAGE instrument was calibrated using the standard water vapor photolysis technique, and this calibration factor was compared to one derived from the loss of HO<sub>2</sub> due to self-reaction at high concentrations in the HIRAC chamber at two different pressures. This aspect of the manuscript reproduces similar experiments done by Winiberg et al. (Atmos. Meas.

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Tech., 8, 523-540, 2015) that helped to confirm the accuracy of the water-vapor photolysis calibration method.

The new aspect of the manuscript involves the inclusion of the CRDS instrument and the intercomparison with the LIF-FAGE instrument. Although the CRDS instrument requires an accurate knowledge of the HO<sub>2</sub> absorption cross section, it is a more absolute measurement technique in comparison to the indirect LIF-FAGE technique, which measured HO<sub>2</sub> after chemical conversion to OH by reaction with added NO. Much of the manuscript involves a description of the CRDS instrument and the determination of the absorption cross section of HO<sub>2</sub> in the near IR. Simultaneous measurements of HO<sub>2</sub> by both instruments in the HIRAC chamber at both 150 and 1000 mbar were in good agreement depending on the value of the absorption cross section used by the CRDS instrument. Overall, the two instruments appear to agree to within 20

The paper is well written and suitable for publication after the authors have addressed the following:

Page 7: Although Winiberg et al. demonstrated that the calibration factor derived from the self-reaction of HO<sub>2</sub> is independent of the water vapor concentration (when the rate constant for the HO<sub>2</sub>+HO<sub>2</sub> reaction accounts for the water dependence of the reaction), the LIF-FAGE calibration factor is sensitive to the water vapor concentration due to quenching of the OH fluorescence. This should be clarified and the dependence of the calibration factor on the concentration of water should be explicitly given. Did the authors calibrate the FAGE instrument using the flow tube method under the water vapor conditions typically used in the HIRAC chamber?

Page 9: Why were the FAGE measurements across the diameter of the HIRAC chamber done using different HO<sub>2</sub> radical sources compared to the Cl<sub>2</sub> radical source used for the main experiments?

Pages 18-19: The authors should clarify the method used to generate the linear fits shown in Figures 8 and 9. Are they unweighted linear regressions, or a bivariate

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weighted fit that takes into account the corresponding uncertainties associated with each measurement?

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