Geophysical Research Abstracts
Vol. 14, EGU2012-11379-2, 2012
EGU General Assembly 2012
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HONO/NO_x ratio as a tool for the estimation of HONO levels in global models: Field Measurements Comparison and Global Impact

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The contribution of HONO photolysis to the radical budgets and ozone photochemical formation has been under increasing scrutiny in the last decades. However, owing to the so fare incomplete knowledge of HONO daytime sources, models significantly underestimate HONO levels. Previous studies showed that HONO/NO_x ratio is a reasonable measure of HONO levels and that a strong unknown HONO daytime source can be revealed from the high HONO/NO_x ratios obtained in these studies during afternoon. In this study, several data sets of different filed measurement campaigns distributed all over the globe which encountered a wide variety of atmospheric conditions within the last decade were investigated. From these studies, a median global HONO/NO_x ratio were calculated, which were found to reasonably simulate the measured HONO levels based on the measured NO_x levels, both on the ground and in gradient measurements studies. Using a 3D chemistry-climate global model and applying an iterative correction of the simulated HONO/NO_x to reach the derived global value of HONO/NO_x ratio, much reasonable HONO levels were also obtained, in comparison to the default case, which considers only the reaction of OH+NO=HONO as the sole source of HONO, which significantly underestimate HONO levels. The increase of HONO levels as a result of employing this global HONO/NO_x ratio was found to have a significant impact on HO_x ($OH+HO_2$) and also on the secondary oxidation products (e.g, O_3, PAN) only in high NO_x polluted regions. The impact of using these realistic HONO levels on aerosol formation in global models will be also discussed.