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Assessing the impact of NO_2 photo-excitation at global scale

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It is well known that hydroxyl radicals are the single most important oxidant in the atmosphere and plays an important role in the formation of ozone. Li et al. (2008) recently reported that the bimolecular reaction of electronically excited NO_2 with water can lead to substantial OH production. Previous results of Crowley and Carl (1997) suggested that the photo-excitation chemistry of NO_2 producing OH radicals is not relevant for atmospheric applications, presenting a reaction rate for the photo-excited NO_2 with H_2O an order of magnitude lower than Li et al. (2008). Such different reaction rates have lead to several authors to analyze the impact of these new chemistry reactions within air quality modelling simulations. Wennberg and Dabdub (2008) analyzed the impact of the new chemistry in the southern California for a summer episode in 1987. The authors used both reaction rates and reported and enhancement of O_3 formation by as much as 55 ppbv with the chemistry of Li et al. (2008). On the other hand, Sarwar et al. (2009) argued that the previous results of Wennberg and Dabdub (2008) were limited to assess the impact of the new chemistry on contemporary emissions. Sarwar et al. (2009) implemented the new chemistry within CMAQ model and assess the impact in the U.S during July 2001 and 2002. The authors reported an increase of O_3 production in some urban areas but significantly smaller than those reported by Wennberg and Dabdub (2008). Finally, Ensberg et al. (2010) have studied the impacts of the new chemistry on air pollution control strategies in southern California.

From all the previous results, it is important to analyse the impact of NO_2 photo-excited chemistry on a global scale. It has been shown that the emission regime plays an important role on the impacts of the chemistry as can be seen from Wennberg and Dabdub (2008), Sarwar et al. (2009) and Ensberg et al. (2010) results. In the present contribution a global simulation with an online chemical transport model is analyzed with and without the new chemistry of photo-excited NO2 with the strong chemistry of Li et al. (2008) and the limited chemistry of Crowley and Carl (1997). Special attention is focused on different regimes observed in both urban and rural areas around the world.

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