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Absolute rate constant and $O(^3P)$ yield for the $O(^1D)$ $+N_2O$ reaction in the temperature range 227 K to 719 K

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Abstract. The absolute rate constant for the reaction that is the major source of stratospheric NO_x, $O(^1D)+N_2O \rightarrow$ products, has been determined in the temperature range 227 K to 719 K, and, in the temperature range 248 K to 600 K, the fraction of the reaction that yields $O(^3P)$. Both the rate constants and product yields were determined using a recently-developed chemiluminescence technique for monitoring $O(^1D)$ that allows for higher precision determinations for both rate constants, and, particularly, $O(^3P)$ yields, than do other methods. We found the rate constant, k_{R1}, to be essentially independent of temperature between 400 K and 227 K, having a value of $(1.37\pm0.11)\times10^{-10}$ cm^3 s^{-1}, and for temperatures greater than 450 K a marked decrease in rate constant was observed, with a rate constant of only $(0.94\pm0.11)\times10^{-10}$ cm^3 s^{-1} at 719 K. The rate constants determined over the 227 K–400 K range show very low scatter and are significantly greater, by 20% at room temperature and 15% at 227 K, than the current recommended values. The fraction of $O(^3P)$ produced in this reaction was determined to be 0.002 ± 0.002 at 250 K rising steadily to 0.010 ± 0.004 at 600 K, thus the channel producing $O(^3P)$ can be entirely neglected in atmospheric kinetic modeling calculations. A further result of this study is an expression of the relative quantum yields as a function of