Referee 1

In the following, we list the comment (black), our reply (blue) and indicate which changes have been made to the manuscript (red).

The manuscript reports on an experimental kinetic study of the OH + SO_2 + M reaction. The experiments were performed in a pulsed laser photolysis (PLP)/laser-induced fluorescence (LIF) setup with OH production from photolysis of H_2O_2, HNO_3, or HONO and time-resolved detection of OH with LIF. Rate constants were determined under pseudo-first order conditions with respect to OH. The excess concentration of SO_2, which is critical for the second- and third-order rate constants, was carefully determined with UV absorption spectroscopy. Neat N_2 or mixtures of N_2 with H_2O were used as bath gases, and it was found that H_2O is a particular efficient collider leading to a notably increased rate constant. In general the rate constants were found to be in the falloff range at the chosen conditions (T = 220–333 K, p = 14–742 Torr), and their pressure dependence was parameterized in terms of Troe expressions. These results were implemented in the chemistry part of an atmospheric general circulation model to assess the influence of atmospheric water content. It was found that the atmospheric lifetime of SO_2 is probably lower than previously assumed in nearly all regions of the atmosphere. Overall, this manuscript is a fine piece of work combining very carefully performed laboratory experiments with adequate parameterizations of rate constants and atmospheric modeling calculations. The scientific problem addressed is timely, and the methods used are adequate and state-of-the-art. The results are carefully discussed and compared with those from other works, and the paper is excellently written. There is almost nothing to complain. Hence, I recommend acceptance of the manuscript for ACP after minor, mainly technical revisions.
We thank the referee for this highly positive assessment of our manuscript.

General: The authors should carefully check the consistent use of rate constant symbols. Sometimes the temperature dependence $(T/300)^n$ is included in the rate constant, sometimes it is not (cf. e.g. the use of $k_{1,0}^{N2}$ in the abstract and introduction section and its use in eqs. (3–6).
We now use rate constant symbols consistently throughout the manuscript, using, where possible the full form (see example below)
....with $k_{1,0}^{H2O} = 1.65\times10^{-30}\ (T/300\ K)^{-4.90}\ cm^6\ molecule^{-2}\ s^{-1}$

Also, in the abstract, nothing is said about the T dependence of $k_{1,0}^{H2O}$ whereas the temperature exponent o = 4.90 on page 11 (bottom). This must be corrected. Also better use $(T/300\ K)^n$ instead of $(T/300)^n$ etc.
We now list the temperature dependence in the abstract and have added "K" to the (T/300 K) term
....with $k_{1,0}^{H2O} = 1.65\times10^{-30}\ (T/300\ K)^{-4.90}\ cm^6\ molecule^{-2}\ s^{-1}$

lines 58, 183, 312: Shouldn't "photo-excitation of SO_2" better read "photo-dissociation of SO_2"?
No, photoexcitation (which may or may-nor result in dissociation) was deliberately chosen as the do not want to rule out the possibility that non-dissociated, excited states of SO_2 also react.

line 61: Check parentheses in rate constant symbols.
Typos corrected
Line 61 (now 62): high-pressure ($k_{1,\infty}$) and low-pressure ($k_{1,0}$)

line 97: In line 92, the volume of the quartz reactor is given (500 cm^3). So it would be better to give the flow rate for typical *T* and *p* also in units $cm^3\ s^{-1}$ instead of $cm\ s^{-1}$. The reader does not know the length of the reactor. Are with these flow rates really fresh(!) gas samples photolyzed at each laser pulse (with 10 Hz repetition rate).

We did not mention that the axis of flow-direction and laser-beams are prependicular to each other and that the reactor is tubular. We now clarify this:

The average linear-velocity of gas flowing through the tubular reactor was kept at ~ 8−9 $cm\ s^{-1}$ by adjusting the total volume flow rates. As the flow direction and laser-beams (0.8 cm diameter) are perpendicular to each other, a linear velocity of over 8 cm^{-1} ensures that a fresh gas sample was photolyzed at each laser pulse (10 Hz) and the volume of gas imaged onto the PMT is replenished between pulses.

eq. (5): One (in the denominator is missing.

The typo has been corrected.

Line 345: $k(T,p) = \frac{(x_{N_2} k_{1,0}^{N2}\left(\frac{T}{300}\right)^{-n} + x_{H_2O} k_{1,0}^{H2O}\left(\frac{T}{300}\right)^{-o})[M] k_{1,\infty}\left(\frac{T}{300}\right)^{-m}}{(x_{N_2} k_{1,0}^{N2}\left(\frac{T}{300}\right)^{-n} + x_{H_2O} k_{1,0}^{H2O}\left(\frac{T}{300}\right)^{-o})[M] + k_{1,\infty}\left(\frac{T}{300}\right)^{-m}} F$