Correction to "The ancient oxygen exosphere of Mars: Implications for atmosphere evolution" by Zhang et al.

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Zhang et al. [1993] describe some calculations of the hot atomic oxygen corona density around Mars for several solar EUV flux levels, with evolutionary effects in mind. As a part of this calculation, they used thermal upper atmosphere and photochemical equilibrium ionosphere models as input to the two-stream nonthermal exosphere computation developed by *Nagy and Banks* [1970]. The code results include information on the upgoing flux and energy spectrum of superthermal oxygen atoms produced by the dissociative recombination of ionospheric O_2^+. From these, altitude profiles of the atomic oxygen corona are obtained, as are estimates of the escaping "hot" oxygen flux. The total hot oxygen escape flux can be derived by integrating the upgoing spectrum at the exobase over the energy range above the ~2 eV energy at which atomic oxygen has the escape velocity from Mars.

While the altitude profiles of the coronal densities and the upgoing oxygen spectra in Figure 6 of *Zhang et al.* [1993] are as calculated, the results of the integrations of the escape fluxes of the atoms mentioned in the text and shown in Figure 8 are incorrect. The correct values are $\sim 6 \times 10^{24}$ s^{-1} for the 1x present EUV case, $\sim 3 \times 10^{25}$ s^{-1} for the 3x present EUV case, and $\sim 8 \times 10^{25}$ for the 6x present EUV case. A corrected version of Figure 8 is given below.

Of perhaps greatest concern is the impact of these revised numbers on the evolutionary calculations of *Luhmann et al.* [1992], who had used the erroneous values. Since the only quantity involved is the neutral atomic oxygen escape flux, no result relating to the loss from direct ion pickup from the bulk upper atmosphere including the associated ion pickup sputtering rates is affected. Moreover, because the evolutionary escape rates are heavily weighted by the latter losses in the early epoch of strongest solar EUV flux, it is estimated that the total escape rate over time obtained by *Luhmann et al.* [1992] is only of the order of ~15-30% larger than it should be. It is considered that this amount is much smaller than other errors inherent in the calculation due to the use of highly uncertain models of the solar EUV history, the solar wind history, the Martian atmosphere history, and even the planetary magnetic field history. In particular, errors in the solar EUV history can easily have order of magnitude effects because of the compound manner in which the EUV flux enters the physics of loss.

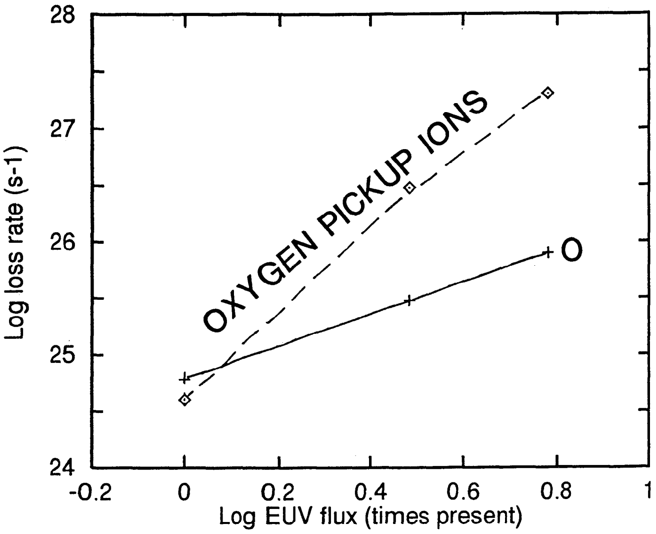

Figure 1. Corrected version of Figure 8 of *Zhang et al.* [1993], showing the revised estimates of the hot O escape rate compared to the pickup ion production rate.

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