1.5% h^{-1} and 4.0% h^{-1} for clean and polluted atmospheres, respectively, during July at mid-northern latitudes. The major difference in rates are a result of higher concentration levels of free radicals in the hydrocarbon rich polluted atmospheres. In a similar manner, Altshuller (1979) predicted the rates of homogeneous oxidation of sulfur dioxide to sulfate in the clean troposphere using concentration predictions of the pertinent free radicals from a two dimensional global model by Fishman and Crutzen (1978). A sample result from this study showing the latitudinal and seasonal dependence of the rate of SO_2 oxidation is presented in Figure 7; the variability in rate being predominantly due to availability of UV solar intensity which drives the free-radical production process. The solar radiation dependence of SO_2 conversion rate has also been observed in field measurements within power plants plumes (Husar et al., 1978), but should be viewed cautiously in light of the complicating factors introduced by the dispersion and local chemistry of the primary source emissions.

The most important impact on SO_2 homogeneous gas phase reactions has come from recent experimental determinations of the reaction rate constants of SO_2 with HO_2 (Graham et al., 1979; Burrows et al., 1979) and SO_2 with CH_3O_2 (Sander and Watson, 1981). As a result of these recent determinations, HO_2 and CH_3O_2 must be considered as questionable contributing sources to oxidation of SO_2 in the atmosphere. Therefore, in the theoretical estimates of SO_2 oxidation rates, by Calvert et al. (1978), and by Altshuller (1979), only the hydroxyl radical portion of the contribution is now accepted as established, in view of these recent experimental rate constant determinations. This results in maximum established SO_2 oxidation rates of the order of 1.5% h^{-1} for both clean and polluted atmosphere during July at midnorthern latitudes, a factor of 2.5 less than previous theoretical estimates for polluted atmospheres. The revised rate is equivalent to a diurnally averaged rate of the order 0.4% h^{-1}. Field measurements on the rates of SO_2 oxidation indicate that maximum SO_2 oxidation rates of the order of 10% h^{-1} are typical of many atmospheric pollution scenarios. Our present knowledge of homogeneous SO_2 gas-phase reactions does not sufficiently account for the rates observed. Smog chamber studies have demonstrated that some species other than HO radical oxidizes SO_2 (Kuhlman et al., 1978; McNelis et al., 1975). Alternate