reported, including a number of negative values. For such surfaces, Sheih et al. (1979) have proposed sulfate deposition velocities comparable to those for sulfur dioxide. However, at present, because of the large uncertainty in v for particulate sulfate, little can be said about seasonal variations in this parameter.

2.2.3   Summary

To summarize: there are several theoretical reasons why dry deposition velocities for both gaseous and particulate sulfur could have a significant seasonal variation. However, for sulfur dioxide, this variation is probably rather small, as far as long-range-transport modeling is concerned. Summertime values have been typically observed to be in the range of 0.4 to 0.8 cm s^{-1}. Wintertime observations (Table 2) indicate a "representative" range of 0.1 to 0.4 cm s^{-1}. The few available data suggest that this latter range is also representative of the deposition of particulate sulfates to smooth surfaces. However, for rougher surfaces and vegetation, the picture is so confusing at present that little can be said concerning seasonal variations in the particulate dry deposition velocity.

3.   Atmospheric Chemical Transformations

3.1   General Considerations

Both laboratory studies and computer simulations of atmospheric chemical reactions have shown that gas-phase homogeneous, as well as heterogeneous, reactions are potentially important for oxidation of sulfur dioxide to sulfates in polluted air--see, for example, Calvert et al. (1978) and Beilke and Gravenhurst (1978).

Homogeneous reactions can lead to conversion rates as high as 4% h^{-1} in the summertime, largely due to attack of sulfur dioxide by hydroxyl, hydroperoxy and alkylperoxy radicals (Paper 1, this report). The seasonal dependence of homogeneous reactions has been discussed by a number of authors, and is reasonably well-understood. Thus, Altshuller (1979), on the basis of computer modelling studies, found that while seasonal effects are small at