2 EVIDENCE OF LOCAL AND MESOSCALE EFFECTS

Because different atmospheric factors may be at play, near-source effects of plumes from individual point sources will be discussed separately from the effects of urban or area sources.

2.1 Plumes from Individual Point Sources

Chimney plumes have on occasion been tracked out to several hundred kilometers, especially under "dry" conditions (Millan and Chung, 1977; Husar et al., 1978; Williams et al., 1980). The latter two papers discussed the dispersion of chimney plumes on the scale of interest, and have shown the importance of such factors as diurnal variations in the structure of the boundary layer and wind shear. The importance of nearby sources will depend partly upon the rate of oxidation of SO_2 to sulfates. A recent summary of data on the chemical transformation rates that occur during plume transport has been given by Newman (1980), for the case of sulfur dioxide oxidation. The following general conclusions emerge from a consideration of Newman's survey paper, and some other investigations as indicated below.

The SO_2 oxidation rate in the absence of liquid water is usually small, typically about 1% h^{-1}. Limited data indicate that, under summertime conditions, the NO_x conversion rate to nitrates is several times the SO_2-to-sulfate rate (Forrest et al., 1980; Richards et al., 1980). Although the exact role of heterogeneous reactions is unclear, the evidence suggests that homogeneous gas-phase processes are certainly important, and can lead to SO_2 transformation rates up to about 4% h^{-1}. The quality of the "dry" oxidation rate data so far has been such that parameterizations beyond simple first-order processes have not been justifiable, although Gillani et al. (1980) have recently proposed an interesting expression derived from their data from a number of power plant plumes, which seems to predict rather well SO_2 oxidation rates from solar radiation, mixing height and ambient ozone concentration data.

Chemical transformation rates under very humid conditions, of relevance during rain, are uncertain, because of the absence of direct