

European sulfur dioxide emissions. For example, over the entire period of record, both the average deposition (or concentration in precipitation) at all stations and the emissions of sulfur dioxide have increased. Nevertheless, the absence of a good year-to-year or pentade-to-pentade parallelism between emissions and concentration of pollutants demonstrates the complexity of the entire system.

On the other hand looking at the nitrogen oxides, the slowly rising nitrogen oxide emissions in North America seem to parallel the increase in the nitrate concentration in precipitation. Although the trends in both emissions and pollutant concentration of nitrogen oxides have been relatively small, they appear to be somewhat more regular, and in phase, than the trends in sulfur oxides. It should be remembered that the conversion of gaseous nitric oxide (NO) and nitrogen dioxide (NO₂) to nitrates is believed to be much faster than sulfur dioxide to sulfate and that sources at ground level constitute a larger fraction of the nitrogen oxides emissions than the sulfur oxides emissions. Therefore, it is expected that a greater proportion of the nitrogen emissions would be deposited over eastern North America. However, analyses of monitoring data cannot completely support this contention, because only a small fraction of the emitted nitrogen is wet deposited. It is unknown how much of the large balance is dry deposited or exported from the continent.

6.3.2 The Annual Cycle

The most obvious and consistent temporal variation at nearly all monitoring stations is the annual cycle in sulfate concentration and, to a lesser extent, acidity in precipitation. Several examples are given to illustrate this cycle. Monthly values of four chemical species in precipitation from the Pennsylvania State University MAP3S site over a three year period have been subjected to a rigorous statistical analysis. This data shows a significant annual cycle for all species except ammonium ion (NH₄⁺). At Chalk River just west of Ottawa, Canada, a marked seasonal variation shows up for the hydrogen and sulfate ion, but the nitrate ion remains fairly constant throughout the year.