**Stratospheric NO**\(_x\)

- Direct input from aircraft is small
- Natural nitrous oxide, N\(_2\)O, major source

\[
\text{N}_2\text{O} + h\nu \rightarrow \text{N}_2 + \text{O}(^{1}\text{D}) \quad (\lambda < 220 \text{ nm})
\]

\[
\text{N}_2\text{O} + \text{O}(^{1}\text{D}) \rightarrow 2 \text{NO} \text{ or } \text{N}_2 + \text{O}_2 \quad (~1:1)
\]

**Catalytical Ozone destruction**

\[
\text{NO} + \text{O}_3 \rightarrow \text{NO}_2 + \text{O}_2
\]

\[
\text{O}_3 + h\nu \rightarrow \text{O} + \text{O}_2
\]

\[
\text{O} + \text{NO}_2 \rightarrow \text{NO} + \text{O}_2
\]

Net: \( \text{O}_3 + \text{O}_3 \rightarrow 3 \text{O}_2 \)
Stratospheric Chemistry III: NO$_y$ chemistry

Figure 7.1. Schematic diagram of odd-nitrogen interactions in the stratosphere.
Figure 7.6. Vertical distribution of NO$_y$ and its constituents in the stratosphere and lower mesosphere determined using an interferometer (ATMOS) flown on the Space Shuttle. The observations are for May 1, 1985, at sunset (from Russell et al., 1988).
Stratospheric Chemistry IV:

NO distribution

FIGURE 3.11: Total column densities of NO₂ and HNO₃ in the stratosphere as a function of latitude in the Northern Hemisphere. (○, summer; •, winter. (Adapted from Coffey et al., 1981))
Stratospheric ozone chemistry, summary

Figure 14.8. Relative contribution of various chemical families (NO$_X$, HO$_X$, ClO$_X$, BrO$_X$, and O$_X$) to the destruction rate of odd oxygen in the stratosphere, calculated by the NASA/GSFC 2D model as a function of latitude and altitude for June conditions (courtesy of C. H. Jackman, NASA).