ABSTRACT

The relative importance of direct stratospheric injections of chlorine from the Solid Rocket Motors on the Space Shuttle and other spacecraft such as the Titan IV have been assessed previously. The possibility that the tropospheric exhaust (2/3 of the total for the Shuttle SRM) would eventually enter the stratosphere and contribute to ozone depletion has not been evaluated. A three-dimensional chemical transport model is used to simulate the fate of the tropospheric component of the Shuttle exhaust: its dispersion, wet removal in convective events, and possible entrainment into the stratosphere. For any reasonable value for the efficiency of removal in deep, wet, cumulus convection, more than 99.5% of the soluble chlorine injected below 200 mbar is removed in the first three months. The fraction entering the stratosphere is less than 0.2% in both summer and winter seasons. Additional evidence from microphysical models and from analyses of the chlorine budget of the stratosphere argues that soluble chlorine from the troposphere cannot contribute significantly to stratospheric chlorine. In summary, only direct stratospheric injection of chlorine (i.e., fuel burned in the stratosphere) is potentially important; the tropospheric emissions from perchlorate-fueled SRM (e.g., Space Shuttle, Titan IV) are unlikely to impact stratospheric ozone.