



Re-examining polar ozone loss: Do polar stratospheric clouds really control chlorine activation?

K. Drdla

NASA Ames Research Center, Moffett Field, CA, USA (Katja.Drdla@nasa.gov)

The formation of polar stratospheric clouds (PSCs) is generally assumed to be a necessary prerequisite for the chlorine activation that leads to polar ozone depletion. The assumptions about PSC chemistry and microphysics that are necessary for PSCs to control chlorine activation are examined in this paper. These assumptions are all shown to be inconsistent with existing laboratory data and field observations; with updated assumptions, chemistry on solid-phase PSCs is orders of magnitude less efficient. Observed chlorine activation is shown to be more consistent with chemistry occurring on background liquid-phase aerosol than on PSCs. To describe liquid aerosol chemistry, a new parameter, the chlorine activation threshold temperature or T_{ACL} , is introduced; T_{ACL} can be used in place of T_{NAT} (the temperature at which solid-phase PSCs can form by condensation of nitric acid trihydrate, NAT), which is currently used to determine the temperature threshold necessary for chlorine activation and ozone loss. While T_{ACL} is similar to T_{NAT} for typical mid-stratosphere conditions, changes in altitude, HNO_3 , H_2O , or aerosol loading all introduce differences between T_{NAT} and T_{ACL} . These differences illustrate the errors introduced by incorrectly assuming that NAT PSCs cause chlorine activation. For example, NAT PSC chemistry will overpredict chlorine activation and ozone loss at altitudes above 20 km. Furthermore, NAT PSC chemistry will incorrectly estimate the response of the ozone layer to future stratospheric changes.