



HOW DO NOCTILUCENT CLOUDS INFLUENCE THE CHEMISTRY OF THE UPPER MESOSPHERE?

B. J. Murray, J. M. C. Plane

School of Environmental Sciences, University of East Anglia (b.murray@uea.ac.uk / Fax:
+44-1603-507719

There is growing evidence that noctilucent clouds (NLC) play an important role in the chemistry of the upper mesosphere. Their volumetric surface area appears to be sufficiently large for heterogeneous reactions to compete with their gas-phase counterparts, so long as their uptake coefficients are large enough. Dramatic depletions, of up to an order of magnitude, in both Fe and atomic O have been observed in the vicinity of NLC. This paper will describe a laboratory and modelling study in order to explain these phenomena. The uptake of atomic O and Fe on a characterised low-temperature ice surface (80 to 155 K) was studied in a fast flow-tube.

The uptake of atomic O is strongly dependent on temperature and the O₂ concentration below 140 K. Nevertheless, when the uptake of O on ice is modelled in our 1-D mesosphere/lower thermosphere model, the direct loss of O on a typical NLC is too slow by about 2 orders of magnitude. It therefore seems most likely that the observed depletion of O is caused by a significant (factor of 5) increase in the odd hydrogen species (H, OH and HO₂) around the cloud, since these species remove O catalytically. The sources of additional odd hydrogen are most likely the Lyman-alpha; photolysis of enhanced gas-phase H₂O around the clouds, and the photolysis of ice particles themselves. In this paper we will discuss the chemical signatures observable from rockets and satellites, which can be used to test this hypothesis.

In contrast the uptake of atomic Fe on low temperature ice is much more efficient. The uptake coefficient is between 0.01 and 0.1 and exhibits a positive temperature

dependence. When the uptake of Fe is modelled in our 1-D high latitude Fe model, it is clear that heterogeneous chemistry can provide an explanation for the observations.