CHEMISTRY OF METHANE AND RELATED HYDROCARBONS IN THE ATMOSPHERE OF MARS.

F. Lefèvre, *LATMOS, Paris, France (franck.lefevre@latmos.ipsl.fr)*, **E. Hébrard,** *Laboratoire d'Astrophysique de Bordeaux, Bordeaux, France,* **F. Forget**, *Laboratoire de Météorologie Dynamique, Paris, France*.

Objectives:

The possible detection of methane on Mars [1,2,3,4] has revived the possibility of past or extant life on this planet, despite the fact that an abiogenic origin is thought to be equally plausible. An intriguing aspect of the recent observations of methane on Mars is that methane concentrations appear to be locally enhanced and change with the seasons [3,4,5]. This contradicts the logic that a gas of lifetime much longer (~330 years) than the time required for global mixing should have a constant and spatially uniform distribution [6]. We will review in this paper our current understanding of the methane photochemistry. Assuming a methane source exists at the surface of Mars, we will present its expected distribution in the atmosphere, and investigate the possible processes that could lead to methane variability. These mechanisms could for instance involve atmospheric chlorine, interactions of methane with the surface, or electrochemical processes. Finally, we will examine the chemistry of the hydrocarbons produced by the degradation chain of methane, such as formaldehyde (CH_2O), methanol (CH_3OH), or ethane (C_2H_6). These species are often cited as measurable markers of a possible Martian hydrocarbon chemistry, and are among the key targets of the next Exomars Trace Gas Orbiter mission. Using three-dimensional simulations, we will determine what quantities of these products can be expected from the amounts of methane currently detected on the planet.

Method:

We have employed an updated version of the LMD Global Climate Model with interactive photochemistry, extensively described in [7]. Hydrocarbon and chlorine chemistries have recently been implemented in the model, as well as other various improvements that will be detailed in the presentation. This new version of the GCM provides a comprehensive description of the chemistry of CO_2, CO, oxygen, hydrogen, hydrocarbons, and chlorine by means of 31 species and 107 chemical or photolytic reactions.

References:

[1] Krasnopolsky et al., Icarus 172, 537 (2004). [2] Formisano et al., Science 306, 1758 (2004). [3] Mumma et al., Science 323, 1041 (2009). [4] Fonti et al., Astron. Astrophys 512, A51 (2010). [5] Geminale et al., Planet. Space Sci., in press. [6] Lefèvre and Forget, Nature 460, 720 (2009). [7] Lefèvre et al., J. Geophys. Res. 109, (2004).

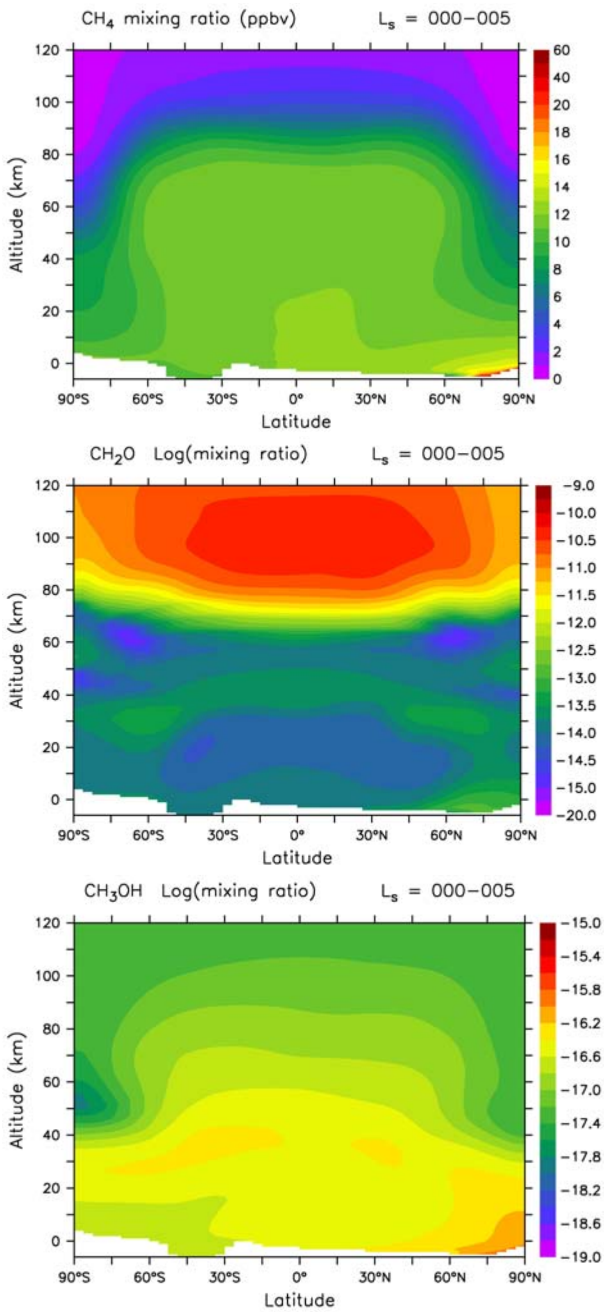

Figure 1. Zonally-averaged distributions of methane (top), formaldehyde (middle), and methanol (bottom) calculated by the GCM for L_s = 0-5°. The model includes a local source of methane at the surface which maintains an equilibrium value of 10 ppbv.