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# Change in methane surface flux due to seasonal variations on Mars

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Recently, Webster et al. (2015, 2018) reported in situ detection of methane performed by the Curiosity rover at Gale crater. The measurements covering a 5-Earth year period showed strong seasonal variations of CH4 background levels which reach a maximum at the end of the northern summer. The interpretation of these observations and the study of methane outgassing scenarios require an understanding of gas transport in the martian subsurface.

In this work, methane transport through porous martian subsurface is studied using a 1D diffusive model. The porous medium is treated as a series of parallel cylindrical pores and a diffusion equation taking into account Knudsen flow and molecular diffusion is solved with a Crank-Nicolson scheme. As diffusion process is not efficient to transport gas on short time scales, we only consider methane emission scenarios consistent with the destabilization of shallow subsurface reservoirs and observations of short lived CH4 plumes. In addition, the role of adsorption on gas transport is investigated. Results show that the flux is strongly dependent on the pressure gradient. On the other hand, it is less sensitive to temperature changes even if it increases slightly during warmer seasons due to the temperature dependence of the diffusion coefficient. Consequently, this change in the flux magnitude with temperature is investigated to determine if the seasonal CH4 variations observed by Curiosity at Gale crater could be linked with the diffusion of methane from shallow sources.

Finally, it is important to note that methane outgassing scenarios are strongly dependent on the subsurface environment and new constrains could be provided by current and future missions such as InSight and ExoMars.