MODELING MSL MEASUREMENTS OF MODERN MARTIAN METHANE. Amber V. Britt[1] and Shawn Domagal-Goldman[2], [1]NASA Goddard Space Flight Center 8800 Greenbelt Rd. Greenbelt MD 20771, email: ambervbritt@gmail.com, [2]NASA Goddard Space Flight Center 8800 Greenbelt Rd. Greenbelt, MD 20771, email: shawn.goldman@nasa.gov.

Introduction: The presence of methane in the Martian atmosphere has been a photochemical mystery , in particular following the claims of high concentrations (24±10 ppb) and significant temporal and spatial variability based on Earth-based observations of Mars[1]. These variations – on the timescale of Martian seasons - were inconsistent with photochemical models[2] that suggest the lifetime of methane on Mars should be ~300 years. Missions like Mars Science Laboratory (MSL) have since then, shed some light on this methane mystery, with various measurements taken with the Sample Analysis at Mars instrument (SAM). SAM has detected lower CH_4 concentrations, but also has observed variations in the CH_4 concentrations. This variance in signal suggests a very localized source at the surface with a seasonal dependence that we have investigated using modeling techniques.

Methods: We utilized a 1D photochemical model to produce steady-state atmospheric simulations; we calculated the surface flux needed to sustain methane at the highest and lowest MSL measured methane concentrations. We also used time dependent calculations corresponding with solar angle calculations to evaluate the time dependence and seasonal dependence of methane in simulated atmospheres (Figure1). Our findings suggest that it is theoretically possible to build up methane on time scales consistent with MSL measurements using the required methane fluxes calculated from steady-state simulations. We will calculate the fluxes of methane needed to sustain the background methane measurements taken by SAM, and discuss what sources could create these methane fluxes. Similarly, we will calculate the fluxes needed to create a temporary spike and a temporary deduction in methane concentration measured by SAM, according to the timescales between methane measurements.

Conclusion: This work could help constrain the different sources of methane near the surface, and reconcile the measurements with photochemical modeling. The background concentrations of methane measured through most of the MSL mission, could be explained by the UV driven degradation of Martian organics near the surface. We suggest that by starting at these background concentrations it is possible to create MSL methane concentrations on short time scales consistent with observations.

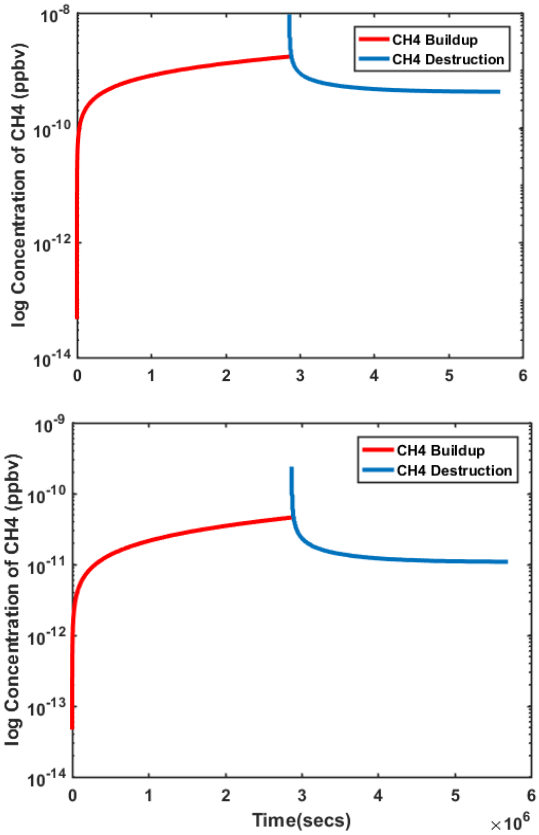

Figure 1: The temporal response to changing CH_4 fluxes. We let the CH_4 build-up starting at model default concentration (~$5x10^{-14}$) and ran it for one month at the fluxes required to produce the measured CH_4 concentrations within one month. We then started with the measured CH_4 concentration and ran the model with our default flux for one month.

References: [1] M. J. Mumma et al. (2009) *Science*, *323*, 1041-1045. [2] K. Zahnle, R. Freedman, D. Catling (2011) *Icarus*, *212*, 493-503.