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SUSTAINABILITY OF AN ARTIFICIAL MARTIAN ATMOSPHERE

Abstract

In light of the United Arab Emirates Mars Mission (EMM Hope), the Mohamed Bin Rashed Space Center (MBRSC) has funded several research proposals to understand why and how Mars is losing its atmosphere. This is important in terms of space exploration and the future projects of having Martian bases for astronauts. One of the proposals is to simulate the buildup of an artificial Martian atmosphere and looking at its sustainability over time. The Martian atmosphere is mostly carbon dioxide by about 95%. The remaining gases are nitrogen (3%), argon (1.6%), and the remainder, just trace amounts of oxygen, water vapor, and other gases. It is only one percent of that of the Earth's atmospheric density. This does not help to protect the planet from the Sun's radiation, nor does it do much to retain heat at the surface. The highest atmospheric density of Mars is equal to that found at about 35 km above the Earth's surface. The buildup of the artificial Martian atmosphere was simulated by injecting/inducing gases into it and looking into its sustainability over time despite the low surface gravity of Mars and the lack of a magnetosphere. The injection of gases was done using two different scenarios: (1) impulsive type of injection to resemble rocket exhaust due to landing and liftoff of rockets, and (2) a continuous injection type of mechanism to simulate habitat venting due to building a living base for future Martian astronauts or mining due to the extraction of minerals from the Martian soil. In both scenarios, we used a neutral atmosphere (no solar wind stripping) and an ionized type of atmosphere to take into account solar wind stripping. The simulations were done analytically using a Maxwell-Boltzmann distribution. Several MATLAB programs were used to do the calculations. In this paper, we will show that in both situations that the atmosphere is steady until a time when it decreases afterword rapidly. The period that the atmosphere maintains its steadiness is approximately four months. The details of both scenarios will be outlined along with future work that will include several injections points spread over all the surface of Mars.