Using global warming to create conditions for life on Mars

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Injecting synthetic "super" greenhouse gases into the Martian atmosphere could raise the planet's temperature enough to melt its polar ice caps and create conditions suitable for sustaining biological life. In fact, a team of researchers suggests that introducing global warming on the Red Planet may be the best approach for warming the planet's frozen landscape and turning it into a habitable world in the future.

The major natural greenhouse gases are water vapor, which in the cloudless case causes about 60-70% of the greenhouse effect on Earth, carbon dioxide (about 26%) and ozone. Minor greenhouse gases include methane, nitrous oxide, sulfur hexafluoride (SF6) and halocarbons such as perfluoromethane, freon and other CFCs. Greenhouse gases are gaseous components of the atmosphere that contribute to the greenhouse effect.

Margarita Marinova, then at the NASA Ames Research Center, and colleagues propose that the same types of atmospheric interactions that have led to recent surface temperature warming trends on Earth could be harnessed on Mars to create another biologically hospitable environment in the solar system. In the February issue of Journal of Geophysical Research-Planets, published by the American Geophysical Union, the researchers report on the thermal energy absorption and the potential surface temperature effects from introducing man-made greenhouse gases strong enough to melt the carbon dioxide and ice on Mars.

"Bringing life to Mars and studying its growth would contribute to our

understanding of evolution, and the ability of life to adapt and proliferate on other worlds," Marinova said. "Since warming Mars effectively reverts it to its past, more habitable state, this would give any possibly dormant life on Mars the chance to be revived and develop further."

The authors note that artificially created gases--which would be nearly 10,000 times more effective than carbon dioxide--could be manufactured to have minimal detrimental effects on living organisms and the ozone layer while retaining an exceptionally long lifespan in the environment. They then created a computer model of the Martian atmosphere and analyzed four such gases, individually and in combination, that are considered the best candidates for the job.

Their study focused on fluorine-based gases, composed of elements readily available on the Martian surface, that are known to be effective at absorbing thermal infrared energy. They found that a compound known as octafluoropropane, whose chemical formula is C3F8, produced the greatest warming, while its combination with several similar gases enhanced the warming even further.

The researchers anticipate that adding approximately 300 parts per million of the gas mixture in the current Martian atmosphere, which is the equivalent of nearly two parts per million in an Earth-like atmosphere, would spark a runaway greenhouse effect, creating an instability in the polar ice sheets that would slowly evaporate the frozen carbon dioxide on the planet's surface. They add that the release of increasing amounts of carbon dioxide would lead to further melting and global temperature increases that could then enhance atmospheric pressure and eventually restore a thicker atmosphere to the planet.

Such a process could take centuries or even millennia to complete but, because the raw materials for the fluorine gases already exist on Mars, it

is possible that astronauts could create them on a manned mission to the planet. It would otherwise be impossible to deliver gigaton-sized quantities of the gas to Mars. The authors conclude that introducing powerful greenhouse gases is the most feasible technique for raising the temperature and increasing the atmospheric pressure on Mars, particularly when compared to other alternatives like sprinkling sunlight-absorbing dust on the poles or placing large mirrors in the planet's orbit.