MNSM – A Future Mars Network Science Mission

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Following ESA' s successful Mars Express mission, European efforts in Mars Exploration are now taking place within the joint ESA-NASA Mars Exploration Programme, starting in 2016 with the Trace Gases Orbiter (TGO) focusing on atmospheric trace gases and in particular methane, and with the Entry and Descent Module (EDM). In 2018, a joint NASA-ESA rover will perform sample caching as well as geological, geochemical and exobiological measurements of the surface and the subsurface of Mars. A number of missions for 2020 and beyond are currently under study. Among those, a possible candidate is a Mars Network Science Mission (MNSM) of 3-6 surface stations, to investigate the interior of the planet, its rotational parameters and its atmospheric dynamics. These important science goals have not been fully addressed by Mars exploration so far and can only be achieved with simultaneous measurements from a number of landers located on the surface of the planet such as a Mars Network mission. In addition, the geology, mineralogy and astrobiological significance of each landing site would be addressed, as three new locations on Mars would be reached.

Such Mars Network Science Mission has been considered a significant priority by the planetary science community worldwide for the past two decades. In fact, a Mars Network mission concept has a long heritage, as it was studied a number of times by ESA, NASA and CNES (e.g., Marsnet, Intermarsnet, Netlander and MarsNEXT mission studies) since 1990. Study work has been renewed in ESA recently with MNSM Science and Engineering Teams being set up to update the scientific objectives of the mission and to evaluate its technical feasibility, respectively. The current mission baseline includes three ESA-led small landers with a robotic arm to be launched with a Soyuz rocket and direct communications to Earth (no need of a dedicated orbiter). However, a larger network could be put in place through international collaboration, as several partners have expressed an interest to participate (e.g., Japan, Russia, China). Also, NASA' s 2016 GEMS one-station mission could be a very valuable precursor for MNSM, if selected as NASA' s next Discovery mission.

The proposed Mars Network Science Mission would focus on Mars evolution, providing essential constraints on geophysical, geochemical, and geological models of Mars' evolution and a better understanding of SNC meteorites and future returned Martian samples. Measurements on the seismology, geodesy, magnetic field and surface heat flow would reveal the internal structure, activity and composition of Mars, its thermal structure and its magnetic evolution. Meteorological surface measurements would allow monitoring the atmospheric dynamics at the boundary layer (coupled with orbital measurements) to infer the climate patterns. Such mission can also provide important insights into the astrobiological conditions of Mars, in particular its magnetic field, heat flow and climate evolution.

The Mars Network Science Mission represents a unique tool to perform new investigations of Mars, which could not be addressed by any other means. It would fill a longstanding gap in the scientific exploration of the Solar System by performing in-situ investigations of the interior of an Earth-like planet other than our own and provide unique and critical information about the fundamental processes of terrestrial planetary formation and evolution. The long-term goal of Mars robotic exploration in Europe remains the return of rock and soil samples from the Martian surface before eventually Humans explore Mars, but the Mars Network would provide the context in which returned samples should be interpreted.