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A Mars Landing Requirements Database to Support ExoMars Site Selection

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Achieving success at Mars requires identification of surface sites that fulfill the specified mission and science goals (e.g., depositional environments suitable for an exobiology-focused mission), while being subject to strict landing engineering constraints. As noted from past and current site selection processes, various, often independent, types of data processing, data analyses and scientific interpretations are used on a rather limited number of Mars locations (called thereafter the bottom-up approach). This potentially makes difficult some useful comparisons between the relevant findings, while necessary coordination of the various efforts deployed requires the setting up of an iterative framework of time-consuming discussion forums. In order to enhance landing site selection, it would therefore be beneficial to make available to the Mars community not only a consolidated set of data and high-level products such as landing risk maps or mission targeting maps, but also a clear process describing how to best reach the stated goals of site selection. This includes the definition and classification of requirements dealing with mission goals, science criteria, and engineering constraints.

Benefiting from a wealth of remote sensing and in-situ data on the Mars atmosphere, surface and subsurface, accumulated over the recent past, and with the perspective of several upcoming landed missions that will prepare for an eventual Mars sample return mission, there is now sufficient and timely information to build a Mars landing requirements database. We consider such database as an important pre-requisite for the selection of future landing sites in the context of the robotic Mars exploration programme, as it would constitute the main link between engineering constraints and science objectives within this programme, and could become an essential part of a broader roadmap for Mars exploration.

Inputs to the database are mission-related and science requirements for each mission scenario. These requirements are used in combination with consolidated mapping products to generate risk and mission targeting maps at various spatial resolutions. From those findings can be identified and characterised suitable sites for mission-specific purposes, allowing for subsequent, better constrained ranking of the solutions.

The Mars landing requirements database can be used as a standalone tool in order to constrain a number of landing scenarios, or in contribution to a landing site selection process for a specific mission. In contrast to the more classic bottom-up approach, the idea is here to use such top-down, scenario-based process to get a complete, preliminary view and identification of suitable sites at global then regional or local scale, using all possible information fed into a database, and taking risk to a mission and its scientific and engineering operations into account.

The results of such process can be merged with those of any bottom-up approach used for specific missions, with the end goal of narrowing down and optimising the search for viable landing ellipses and their ranking, which is of interest to the joint ESA/NASA Mars Robotic Exploration Programme.