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# 3D mapping of buried rocks by the GPR WISDOM/ExoMars 2020

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The main objective of ExoMars 2020 is to search for signs of past and/or present life on Mars. Because these signs may be beneath the inhospitable surface of Mars, the ExoMars Rover has on board a suite of instruments aiming at characterizing the subsurface. In particular, the Rover payload includes WISDOM (Water Ice Subsurface Deposits Observation on Mars), a polarimetric ground penetrating radar designed to investigate the shallow subsurface. WISDOM is able to probe down to a depth of few meters with a resolution of few centimeters; its main objective is to provide insights into the geological context of the investigated Martian sites and to determine the most promising location to collect samples for the ExoMars drill.

In this paper, we demonstrate the ability of WISDOM to locate buried rocks and to estimate their size distribution. Indeed, the rock distribution is related to the geological processes at play in the past or currently and thus provides clues to understand the geological context of the investigated site. Rocks also represent a hazard for drilling operations that WISDOM is to guide.

We use a 3D FDTD code called TEMSI-FD (which takes into account the radiation pattern of the antenna system) to simulate WISDOM operations on a realistic (both in terms of dielectric properties and structure) ground. More specifically, our geoelectrical models of the Martian subsurface take into account realistic values of the complex permittivity relying on published measurements performed in laboratory on Martian analogues. Further, different distributions of buried rocks are considered based on the size-frequency distribution observed at the Mars Pathfinder landing site and on Oxia Planum, the landing site currently selected for ExoMars 2020.

We will describe the algorithm we developed to automatically detect the signature of the buried rocks on radargrams. The radargrams are obtained simulating WISDOM operations along parallel and perpendicular profiles as planned for the ExoMars mission. Our ultimate goal is to show that WISDOM observations can be used to build a 3D map of the subsurface. We will also present experimental data obtained with a prototype of WISDOM to test our method.