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An electromagnetic induction study using network magnetometer data

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Planetary exploration follows in general a strategy starting with spacecraft flyby, followed by orbiter missions and in-situ exploration. It is well accepted that network of landers with in-situ science payload play an important role in the in-situ exploration phase. Among other techniques, electromagnetic soundings provide a relevant contribution to the study of the deep interior of the planet. They are based upon the determination of the impedance Z for frequencies down to 10-4 and even less. In the case of the Earth, impedances are estimated from simultaneous variations of the horizontal magnetic and electric fields recorded at a station. In the case of Mars, only magnetic variations can be recorded at such low frequencies, we present here a new method for impedance derivation from a network of at least three 3-components magnetometers. Consider a network of three stations arranged in a triangular configuration with a separation distance allowing the description of magnetic variations associated to sources of regional or hemispheric extent. Assume further that the primary source field at the surface of Mars can be approximated as a superposition of independent plane waves. The magnetic data series will be analysed using the method proposed by Pinçon and Lefevre (1991, 1992), and by Pinçon et al (2000). In this approach the determination of horizontal gradients of the magnetic field components is achieved by wave-vector identification. The resulting frequency wave vector spectrum of the magnetic field over the 3 stations network will be used to estimate the variation of the Mars inductive response as a function of frequency. In order to assess the performances with field data of the method we propose, we use minute values from Earth geomagnetic observatories (INTERMAGNET data). We always consider data from only three stations. We present results from studies done for several different regions of the Earth.