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Martian ionospheric conductivities in the magnetic pileup and crustal field regions

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The Martian ionosphere is permeated by an extremely variable magnetic field that results from both the interplanetary magnetic field and the palaeomagnetic fields that emanate from magnetized portions of the planet's crust. This spatially and temporally varying magnetic field directly affects the ion and electron gyrofrequencies. In turn, the magnetic field and gyrofrequencies, together with the collision frequencies and the electron concentration, determine the parallel, Pedersen and Hall conductivities that characterize current flow in the ionosphere. We present the findings of an investigation of these conductivities undertaken using data obtained by the Mars Global Surveyor (MGS) and Mars Express (MEX) spacecraft. The magnetic field data were collected by MGS during the aerobraking phase of its mission, while the modelled electron concentration is consistent with data obtained by MEX. Results are shown from a region with strong crustal fields and also from an area where the magnetic pileup region may be identified clearly. The altitudinal dependence of the calculated conductivities is generally characterized by three maxima, corresponding to ion Pedersen, electron Hall and electron Pedersen conductivity layers.