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Martian external magnetic field proxies

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Mars possesses no dynamic magnetic field of internal origin as it is the case for the Earth or for Mercury. Instead Mars is characterized by an intense and localized magnetic field of crustal origin. This field is the result of past magnetization and demagnetization processes, and reflects its evolution. The Interplanetary Magnetic Field (IMF) interacts with Mars' ionized environment to create an external magnetic field. This external field is weak compared to lithospheric one but very dynamic, and may hamper the detailed analysis of the internal magnetic field at some places or times. Because there are currently no magnetic field measurements made at Mars' surface, it is not possible to directly monitor the external field temporal variability as it is done in Earth's ground magnetic observatories. In this study we examine to indirect ways of quantifying this external field. First we use the Advanced Composition Explorer (ACE) mission which measures the solar wind about one hour upstream of the bow-shock resulting from the interaction between the solar wind and the Earth's internal magnetic field. These measurements are extrapolated to Mars' position taking into account the orbital configurations of the Mars-Earth system and the velocity of particles carrying the IMF. Second we directly use Mars Global Surveyor magnetic field measurements to quantify the level of variability of the external field. We subtract from the measurements the internal field which is otherwise modeled, and bin the residuals first on a spatial and then on a temporal mesh. This allows to compute daily or semi daily index. We present a comparison of these two proxies and demonstrate their complementarity. We also illustrate our analysis by comparing our Martian external field proxies to terrestrial index at epochs of known strong activity. These proxies will especially be useful for upcoming magnetic field measurements made around or at the surface of Mars.