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Solar forcing - implications for the volatile inventory on Mars and Venus. (Invited)

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Planets in the solar system are exposed to a persistent solar forcing by solar irradiation and the solar wind. The forcing, most pronounced for the inner Earth-like planets, ionizes, heats, modifies chemically, and gradually erodes the upper atmosphere throughout the lifetime of the planets. Of the four inner planets, the Earth is at present the only one habitable. Our kin Venus and Mars have taken different evolutionary paths, the present lack of a hydrosphere being the most significant difference. However, there are ample evidence for that an early Noachian, water rich period existed on Mars. Similarly, arguments have been presented for an early water-rich period on Venus. The question is, what made Mars and Venus evolve in such a different way compared to the Earth? Under the assumption of similar initial conditions, the planets may have experienced different externally driven episodes (e.g. impacts) with time. Conversely, internal factors on Mars and Venus made them less resilient, unable to sustain solar forcing on an evolutionary time-scale.
The latter has been quantified from simulations, combining atmospheric and ionospheric modeling and empiric data from solar-like stars (Sun in time). In a similar way, semi-empirical models based on experimental data were used to determine the mass-loss of volatiles back in time from Mars and Venus.
This presentation will review further aspects of semi-empirical modeling based on ion and energetic neutral atom (ENA) escape data from Mars and Venus - on short term (days), mid-term (solar cycle proxies), long-term (Heliospheric flux proxies, 10 000 year), and on time scales corresponding to the solar evolution.