



What can Venus and Mars tell us about Sun's direct influence on Earth's Atmosphere?

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Venus and Mars, Earth's sister planets, are similar but also very different compared to the Earth. The mass-density and surface properties bear certain commonality, but the atmospheric composition, the temperature and the surface pressure on Venus and Mars are very different compared to the Earth. Venus and Mars are arid planets with atmospheres dominated by a greenhouse gas CO₂ (>95%), while the Earth's atmosphere is dominated by molecular Nitrogen and Oxygen. The main greenhouse gas in the Earth's atmosphere is water, with a minor contribution of CO₂. Bearing these differences in mind, what can we possibly learn from Mars and Venus about the solar influence on the Earth's atmosphere? The answer can be found in how solar forcing affects a planetary atmosphere, more specifically the impact of solar EUV and solar wind variability on a planetary atmosphere.

The lack of a strong intrinsic magnetic field on Mars and Venus means that solar wind forcing has a global effect on the upper atmosphere of Mars and Venus. Conversely, the Earth's intrinsic dipole magnetic field alleviates the forcing to narrow zones near the magnetic poles. Results obtained from Venus and Mars orbiters imply that solar wind forcing leads to a long-term gradual removal of atmospheric constituents. New information from ESAs Mars Express and Venus Express orbiters suggests short-term solar wind forcing effects as well, especially in the polar region. While the impact of solar forcing on the "unprotected" planets Venus and Mars seems conceivable, one might argue that similar forcing effects are unlikely on a magnetically protected planet. Short-term "space weather" effects on the Earth's tropospheric circulatory system have been reported in the past, but the effects have usually been discarded using arguments that such a weak forcing is unlikely to have any implications whatsoever on the Earth's weather system. However, considering the forcing observed in e.g. the Venus polar region, solar forcing may have a significant effect on the Earth's polar region upper atmosphere as well.