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Atmospheric escape from Venus and Mars during rough space weather

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We study atmospheric escape from Venus and Mars during solar wind pressure pulses. During the current solar minimum we search the ACE satellite data for high pressure events in the solar wind, such as corotating interaction regions and coronal mass ejections. We predict their arrival at Venus and Mars by taking into account the flow velocity, the sun's angular rotation and the distance (radial and longitudinal) between ACE and each planet. We also use the Mars Express and Venus Express ASPERA-3 and 4 data, respectively, to identify which of these solar wind features that indeed reach each planet. Venus Express and Mars Express measurements are then used to compare the anti-sunward fluxes of heavy planetary ions during the passage of these events to the fluxes during quiet solar wind conditions. The planetary ion fluxes are observed to increase by a factor of $\sim$1.7 at Venus and by a factor of $\sim$2.5 at Mars, on average. Taking into account the occurrence rate and duration of these events at each planet we find that 30% of the total outflow from Mars and 50% of the total outflow from Venus takes place when solar wind pressure pulses impact on the planets. This can have important consequences for the total time-integrated outflow of plasma. We also discuss weather it is the increased solar wind dynamic pressure that causes the increase escape rate or if it is an effect of the concurrent rotation of the interplanetary magnetic field. The increased dynamic pressure means that solar wind plasma can penetrate deeper into the ionosphere and more effectively erode plasma. The magnetic field rotation causes the induced magnetosphere to reconfigure and change polarity, which could occur through substorm-like processes. During such processes plasma can be accelerated in the downstream direction through electrodynamic effects.