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Introduction: Data assimilation is a statistical technique that combines real-time or historical observations with a model's predictions to create a more accurate estimate of the actual state of a system. This technique is widely used to estimate an unknown state of the atmosphere of Mars [1, 2, 3]. Emirates Mars Mission (EMM) has a unique ability to provide the first-ever planet-wide picture of Mars' atmospheric dynamics and weather at a sub-daily time scale. This study represents a pioneering application of data assimilation techniques to understand the Martian upper atmosphere (~100-130 km) using observations from the Emirates Mars Ultraviolet Spectrograph (EMUS) onboard EMM. While data assimilation, using EMM observations, is already successful for the lower atmosphere of Mars [4], this work extends its application to a new and less explored region. The datasets used here are O column densities for the period of 114 sols that span Martian Year (MY) 36, Ls = 120° - 180°. These observations are assimilated using the Mars Planetary Circulation Model (MPCM)-a 3-dimensional, ground-to-exosphere (~250km) model. The observations are fed into a Local Ensemble Transform Kalman Filter (LETKF) data assimilation system, where they are statistically combined with the MPCM's predictions to create a robust representation of the upper Martian atmosphere. The LETKF scheme used in this study includes 36 ensemble members. This work will not only help set up the critical algorithmic infrastructure necessary for future assimilation research but also provide a new perspective to study the global scale dynamics of the Mars' upper atmosphere.

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