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Whole Atmosphere Model (WAM) is operated by NOAA’s Space Weather Prediction Center (SWPC) and simulates the whole atmosphere neutral compositions in real time, while WAM tended to have a positive bias compared to various observations. SpaceX Starlink constellation provides orbit-effective density measurements obtained by monitoring the dissipation of orbital energy. The multi-months density measurements were assimilated to WAM, using the Iterative Driver Estimation and Assimilation (IDEA) data assimilation technique. The study period, January–April 2023, covers four solar rotations, a severe G4 geomagnetic storm on 23 April, and several minor storms. Results show that the data assimilative WAM density (WAM-DA) effectively captured the Starlink orbit-averaged density during both quiet and storm time, with a root-mean-square error (RMSe) at 6.6%. In addition, a cross-comparison was conducted with the accelerometer estimates of neutral density from GRACE-FO. The good agreement (RMSe = 6.4%) between WAM-DA and GRACE-FO shows that the Starlink neutral density estimates can be used to improve the WAM neutral density outputs in the IDEA data assimilation scheme. A 2-day neutral density forecast has also been performed to evaluate the improvement in the forecast mode with the IDEA-estimated model heating. With the rapid growth in the number of spacecraft and debris objects in LEO (Low Earth Orbis), reducing neutral density uncertainty remains one of the most effective ways to improve orbit prediction and collision avoidance, and this study can be of benefit to improve thermospheric neutral density specification.
Poster session day
Wednesday, April 29, 2026
Poster location
20
Meeting homepage
2026 Space Weather Workshop
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