EGU24-20341, updated on 12 Feb 2025
https://doi.org/10.5194/egusphere-egu24-20341
EGU General Assembly 2024

Can we intercalibrate satellite measurements by means of data assimilation? An attempt on LEO satellites

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Understanding the dynamics of energetic electrons in the radiation belts is key to protect space borne equipment and astronauts on-board spacecraft missions. Therefore, global reconstruction of the near-Earth radiation environment should be available at all times, radial distances and geomagnetic latitudes. Low Earth Orbit (LEO) satellites provide a large data set of rapid observations of the radiation belt region over a wide range of magnetic local times (MLT). However, the use of this data set is rather complicated due to possible proton contamination of electron fluxes and the observation of electron precipitation, leading to high variability of electron measurements, considerable instrumental errors and the need for background correction. In this study, we present a new intercalibration method for satellite measurements of energetic electrons in the radiation belt region using a data assimilation approach. Our aim is to intercalibrate the electron flux measurements of the POES satellites NOAA-15,-16,-17,-18,-19 and MetOp-02 against RBSP observations for the period October 2012 to December 2013. For this, we use a reanalysis of the radiation belt region, obtained by assimilating RBSP and GOES electron data into 3-D Versatile Electron Radiation Belt (VERB-3D) code simulations via a standard Kalman filter. Since the reanalysis provides global reconstruction of the state of the system. We compare the POES/MetOp data with our reanlysis and estimate the flux ratios at each time, location and energy. These ratios are averaged over time and space to obtain energy dependent recalibration coefficients. In order to validate our results, we perform a traditional conjunction study between POES/MetOp satellites and the Van Allen probes. Similarly, we estimate flux ratios for all the found conjunctions and calculate the corresponding energy dependent recalibration coefficients. The conjunction coefficients and the DA estimated coefficients show very good agreement. Additionally, the use of data assimilation allows for improved statistics, as the number of possible ratios is considerably improved. The recalibration coefficients estimated using the our data assimilation approach leads to good resemblance and agreement between the recalibrated POES/MetOp data set and the RBSP observations.