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LANL*V2.0: global modeling and validation

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Abstract. We describe in this paper the new version of LANL*, an artificial neural network (ANN) for calculating the magnetic drift invariant L^*. This quantity is used for modeling radiation belt dynamics and for space weather applications. We have implemented the following enhancements in the new version: (1) we have removed the limitation to geosynchronous orbit and the model can now be used for a much larger region. (2) The new version is based on the improved magnetic field model by Tsyganenko and Sitnov (2005) (TS05) instead of the older model by Tsyganenko et al. (2003). We have validated the model and compared our results to L^* calculations with the TS05 model based on ephemerides for CRRES, Polar, GPS, a LANL geosynchronous satellite, and a virtual RBSP type orbit. We find that the neural network performs very well for all these orbits with an error typically $\Delta L^* < 0.2$ which corresponds to an error of 3 % at geosynchronous orbit. This new LANL* V2.0 artificial neural network is orders of magnitudes faster than traditional numerical field line integration techniques with the TS05 model. It has applications to real-time radiation belt forecasting, analysis of data sets involving decades of satellite of observations, and other problems in space weather.

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