Using a Neural Network Approach to Find Unusual Butterfly Pitch Angle Distribution Shapes

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A special kind of neural network referred to as a Self-Organizing Map (SOM) was previously adopted to identify, in pitch angle-resolved relativistic electron flux data provided by the REPT instrument onboard the Van Allen Probes, three major types of electron pitch angle distributions (PADs), namely 90o-peaked, butterfly and flattop (Souza et al., 2016), following the classification scheme employed by Gannon et al. (2007). Previous studies show that butterfly distribution can be found in more than one shape. They usually exhibit an intense decrease near 90° pitch angles compared to the peaks usually around 30° and 150°. Sometimes unusual butterfly PAD shapes with peaks near 45° and 135° pitch angles can be observed. These could be correlated with different physical processes that govern the production and loss of energetic particles in the Van Allen radiation belt. A neural network approach allows the distinction of different kinds of butterfly PADs which were not analyzed in detail by Souza et al. (2016). This study uses SOM methodology to find these unusual butterfly PAD shape during the interval between January 1, 2014 and October 1, 2015, during which Van Allen Probes orbit covered all MLT. The spatial and temporal occurrence of these events were investigated as well as their solar wind and magnetospheric drivers.

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