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Low-energy cosmic ray flux reconstruction using ground-based neutron monitors

Many attempts have been made to develop accurate techniques for calibrating ground-based detectors using data from satellite instruments. Those will allow to reconstruct the actual cosmic ray fluxes, which are not distorted by interactions with the Earth's atmosphere. Such methods will significantly enhance the capabilities of ground-based detectors for monitoring and forecasting space weather events and conditions, especially for stations located in polar regions. Unfortunately, there are currently no known techniques that have been proven effective in solving this problem and producing reliable results in practical applications. This is due to a variety of physical processes that occur during the interaction of cosmic rays with the Earth's atmosphere. Accurate accounting of all these effects is a difficult task, especially during turbulent events in a short period of time. We have used machine learning approach to overcome this challenges. Each selected neutron monitor was calibrated using a neural network that was trained using various optimization techniques. Several feature preprocessing algorithms were used to enhance the accuracy of the developed models. Data from the AMS-02, GOES-16, -17, and -18 satellite missions were used to train and test the models. After the training phase, these networks are able to calculate the low-energy cosmic ray flux based on individual count rates measured by ground-based detectors. The results of this study are presented and discussed.

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