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Cause of the exceptionally high AE average for 2003

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In this work we focus on the year of 2003 when the AE index was extremely high (AE=341nT, with peak intensity more than 2200nT), this value is almost 100 nT higher when compared with others years of the cycle 23. Interplanetary magnetic field (IMF) and plasma data are compared with geomagnetic AE and Dst indices to determine the causes of exceptionally high AE average value. Analyzing the solar wind parameters we found that the annual average speed value was extremely high, approximately 542 km/s (peak value $\sim$1074 km/s). These values were due to recurrent high-speed solar streams from large coronal holes, which stretch to the solar equator, and low-latitude coronal holes, which exist for many solar rotations. AE was found to increase with increasing solar wind speed and decrease when solar wind speed decrease. The cause of the high AE activity during 2003 is the presence of the high-speed corotating streams that contain large-amplitude Alfvén waves throughout the streams, which resulted in a large number of HILDCAAs events. When plasma and field of solar wind impinge on Earth's magnetosphere, the southward field turnings associated with the wave fluctuations cause magnetic reconnection and consequential high levels of AE activity and very long recovery phases on Dst, sometimes lasting until the next stream arrives.