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An automated identification method for Alfvénic streams and their geoeffectiveness

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Abstract

Previous statistical studies have found a close relationship between high-speed streams and high-latitude geomagnetic activity. The speed by itself would increase the geoeffectivity of the solar wind. But it is also believed that pure Alfvénic fluctuations, often found in the trailing part of the streams, play a role in the solar wind driving of geomagnetic activity by amplifying the north-south component of the magnetic field (B_Z), and thereby the dayside reconnection electric field. By automatically identifying slow and fast solar wind streams and by analyzing them for more than one solar cycle, we aimed to study the relation between speed, Alfvénicity, and B_Z in the solar wind.

1. Introduction

In this study we found out that streams, whose trailing parts are dominated by pure Alfvénic fluctuations, are the most geoeffective streams on average. However, it is not the pure Alfvénic fluctuations themselves which cause the streams to be more geoeffective. There is only a variation of about 10% in B_Z due to the Alfvénicity of the fluctuations. Instead the streams are more geoeffective because the pure Alfvénic fluctuations tend to occur during high-solar wind speed and strong interplanetary magnetic field. There is a substantial variation within the solar cycle of how Alfvénic the solar-wind streams are, and years with many extremely Alfvénic streams tend to have more days with moderately large geoeffectivity. The list of solar wind streams is included as extra material to this paper.

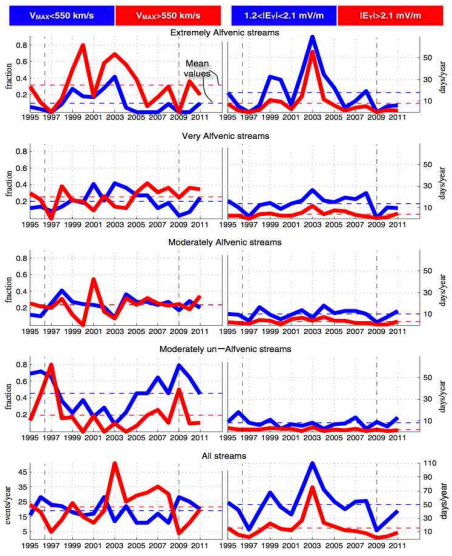

Figure 1: Yearly distributions of the solar wind speed and the east-west electric field from 1995 to 2011.