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Geoeffectiveness of interplanetary shocks controlled by impact angles: A review

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Abstract

The high variability of the Sun's magnetic field is responsible for the generation of perturbations that propagate throughout the heliosphere. Such disturbances often drive interplanetary shocks in front of their leading regions. Strong shocks transfer momentum and energy into the solar wind ahead of them which in turn enhance the solar wind interaction with magnetic fields in its way. Shocks then eventually strike the Earth's magnetosphere and trigger a myriad of geomagnetic effects observed not only by spacecraft in space, but also by magnetometers on the ground. Recently, it has been revealed that shocks can show different geoeffectiveness depending closely on the angle of impact. Generally, frontal shocks are more geoeffective than inclined shocks, even if the former are comparatively weaker than the latter. This review is focused on results obtained from modeling and experimental efforts in the last 15 years. Some theoretical and observational background are also provided.

Keywords: Solar disturbances, interplanetary shocks, shock impact angle, geomagnetic activity

Contents

1. Introduction

The Sun is the nearest star to the Earth. As a gigantic sphere of magnetized gas, the Sun is constantly active with large variations in its magnetic field. For example, based on historical and modern observations, it is well known today that the Sun presents a 22-year period of a dynamic solar cycle which corresponds to a double magnetic field reversal of its magnetic field polarity, but the time interval between two consecutive minima or maxima numbers of sunspots existing on the Sun's surface corresponds to approximately 11 years. However, these time

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