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HIGH SPEED SOLAR WIND STREAMS OVER THE LAST FOUR SOLAR CYCLES

Yana Asenovska, Simeon Asenovski

Space Research and Technology Institute – Bulgarian Academy of Sciences
e-mail: asenovski@space.bas.bg

Abstract

Studying the high speed solar wind streams (HSS) behavior over the course of a solar cycle (SC) can give a valuable knowledge about solar activity. Using the experimental data for the solar wind parameters close to Earth, the variation of the HSS over the last four SC (21÷24) is shown. While the HSS velocity and appearance for the SC 21÷23 have similar distribution – the maximum of both is around declining phase of solar activity cycle; the situation in SC 24 is not well defined. For the last 24 cycle 302 HSS events were isolated and their maximum speed was estimated.

Introduction

According to the flow properties, the near-Earth's solar wind generally is treated as a three component system: high speed streams (HSS), slow solar wind and streams associated with coronal mass ejections (CME) [1]. The frequency of occurrence and intensity of these three components depends strongly on the phase of the solar activity cycle, as large scale Sun's magnetic field modulates the expansion of the solar wind [2]. HSS are characterized with high speed (> 500 km/s), high proton temperature and low plasma density. They originate from coronal holes, which are unipolar open magnetic field areas [3–5]. HSS and CME are the main types of solar generated drivers that affect Earth. The strong sporadic storms during maximum are caused by CMEs [5, 6], and especially by magnetic clouds with strong and smoothly rotating magnetic field inside the structure providing prolonged periods of southward *Bz* [7].

Coronal holes are the largest and the most geoeffective during the sunspot declining phase [8], when a second maximum in the geomagnetic activity is observed (the first maximum is caused by CME).

High speed solar wind streams for solar cycles 21÷23

The periods of HSS for solar cycles 21÷23 are determined by several catalogues: [9–11]. In Fig. 1 and Fig. 2 averaged values of the maximum speed of

the HSS (red line), duration of the HSS (blue line) and sunspot number (black line) are presented.

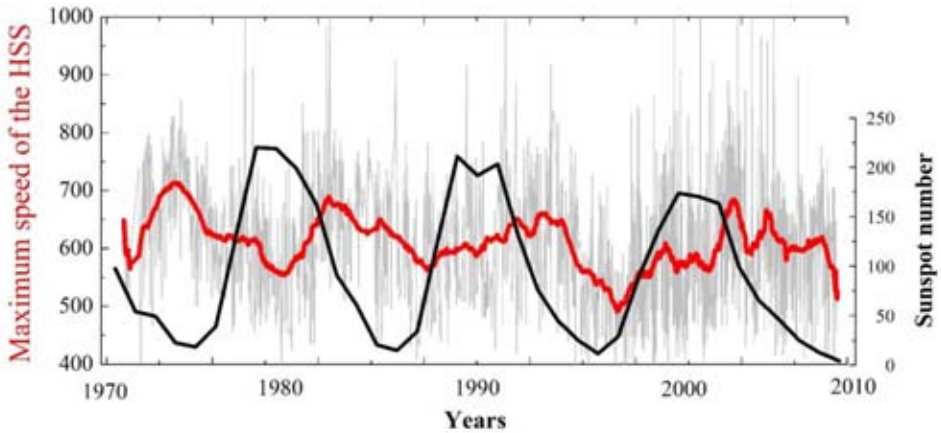

Fig. 1. Maximum speed of the HSS for solar cycles 21÷23

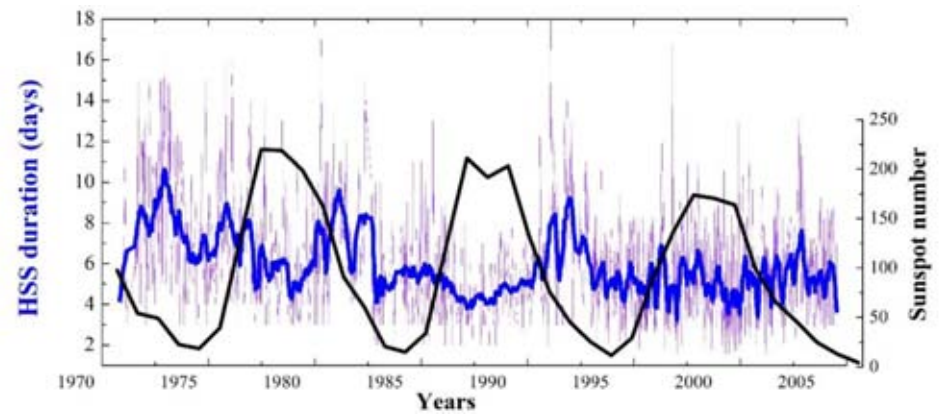

Fig. 2. Duration of the HSS for solar cycles 21÷23

High speed solar wind streams for 24 solar cycle

In order to characterize the HSS, we have used the hourly values of the plasma parameters gathered in OMNI data base (http://omniweb.gsfc.nasa.gov/) and the identifying criteria for a HSS which include an increase of the solar wind velocity by at least 100 km/s in no more than one day to at least 450 km/s for at least five hours along with high proton temperature and low plasma density.

For the last 24 cycles we have isolated 302 HSS events and estimated their maximum speed.

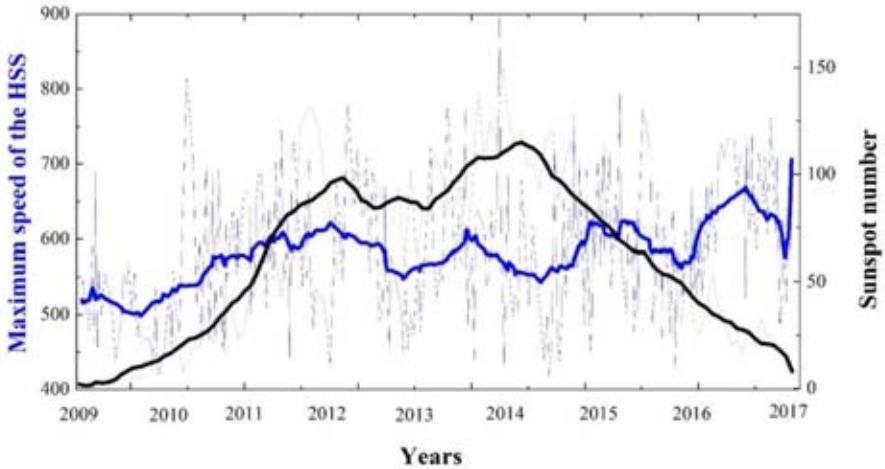

Fig. 3. Maximum speed of the HSS for 24 solar cycle

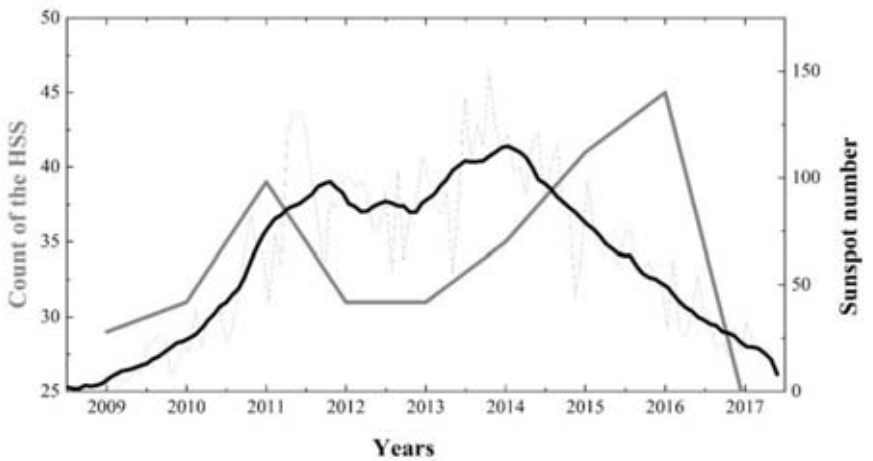

Fig. 4. Count of the HSS for 24 solar cycle

Conclusion

The results of the presented work can be summarized as:

- During the descending phase of the solar cycles 21÷23 the highest values of maximum HSS speed is observed.

- The duration of the HSS is the longest (8÷10 days) during the descending phase of the solar cycles 21÷23.
- 302 HSS events have been isolated for the last 24th solar cycle and their maximum speed was estimated.
- The profile of the maximum speed of HSS within the 24th solar cycle is different compared to the previous solar cycles and no maximum value is observed.
- The count of the HSS is the greatest during the descending phase of 24th solar cycle.

Acknowledgments

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ВИСОКОСКОРОСТНИ ПОТОЦИ БЪРЗ СЛЪНЧЕВ ВЯТЪР ПРЕЗ ПОСЛЕДНИТЕ ЧЕТИРИ СЛЪНЧЕВИ ЦИКЪЛА

Я. Асеновска, С. Асеновски

Резюме

Изучаването на поведението на високоскоростните потоци бърз слънчев вятър (БСВ) може да даде ценни сведения за слънчевата активност. Използвайки експериментални данни за параметрите на слънчевия вятър близо до Земята, тази работа показва вариациите на БСВ през последните четири слънчеви цикъла (21÷24). Докато появяването и скоростта на БСВ имат сходно разпределение за слънчевите цикли 21÷23 – максимални стойности и на двете периодът на спадане на слънчевата активност, то подобно поведение по време на 24 слънчев цикъл не се наблюдава. За последния 24 цикъл са определени 302 БСВ събития и са изчислени техните максимални скорости.