VARIATION OF THE SOLAR WIND SPEED IN SOLAR CYCLE 24

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Abstract: *Solar cycle 24 is characterized with extremely low activity in comparison with Solar cycles 21-23 and probably the most spotless days since Solar cycle 16. Most of the parameters determining solar activity, as 10.7 cm solar radio flux, the polar solar magnetic field, solar total irradiance, etc. reach their lowest values at a minimum between solar cycles 23–24. In this work it is presented variation of the solar wind parameters during the course of Solar cycle 24.*

ВАРИАЦИИ НА СКОРОСТТА НА СЛЪНЧЕВИЯ ВЯТЪР ПО ВРЕМЕ НА 24 СЛЪНЧЕВ ЦИКЪЛ

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Ключови думи: *Параметри на слънчевия вятър, Слънчева активност, 24 Слънчев цикъл*

Резюме: *24 Слънчев цикъл се характеризира с екстремално ниска активност в сравнение с активността на Слънчевите цикли 21–23 и вероятно с най-много дни без слънчеви петна. Повечето от параметрите определящи слънчевата активност, като 10.7 радиоизлъчване, слънчевото полярно магнитно поле, пълната слънчева радиация и др. достигат своите най-ниски стойности по време на минимума между 23 и 24 слънчев цикъл. В настоящата работа са разгледани вариациите на параметрите на слънчевия вятър по време на 24 Слънчев цикъл.*

Introduction

According to the flow properties and mainly to the speed, the solar wind can be decomposed to a three component system: high speed streams (HSS) – with high speed (V > 500 km/s), high proton temperature and low plasma density; slow solar wind – with speed V < 500 km; 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 [2]. HSS and CME are the main types of solar generated drivers that affect Earth. The strong sporadic storms during maximum are caused by CMEs [3,4].

In Fig. 1 are presented the main sources of the different solar wind component. CME originate from active regions (3) with or without filaments or regions of quiescent filaments [5, 6, 7]. HSS are amiitet from coronal holes (2), which are unipolar open magnetic field areas [3, 8, 9]. Coronal holes are the largest and the most geoeffective during the sunspot declining phase [10] (Phillips et al., 1995), when a second maximum in the geomagnetic activity is observed (the first maximum is caused by CME). Streamer belt structures (1) are main source of slow solar wind. In sunspot minimum the solar magnetic field is close to dipolar, almost aligned with the solar rotational axis, and the coronal streamer belt is close to the solar rotational equator. Slow solar wind propagates along the heliospheric current sheet which is the interplanetary projection of the coronal streamer belt separating magnetically the two solar hemispheres. The heliosphere is dominated by fast and much more geoeffective solar wind from super-radially expanding polar coronal holes which dominate during the sunspot minimum phase. Depending on the thickness of the heliosheet, a bigger or a smaller part of the Earth's orbit is situated inside it. If the heliosheet is thick enough, most of the time the Earth is immersed into it, with only short periods during which it is subjected to the fast solar wind from the polar coronal holes, due to the small wraps in the heliosheet.

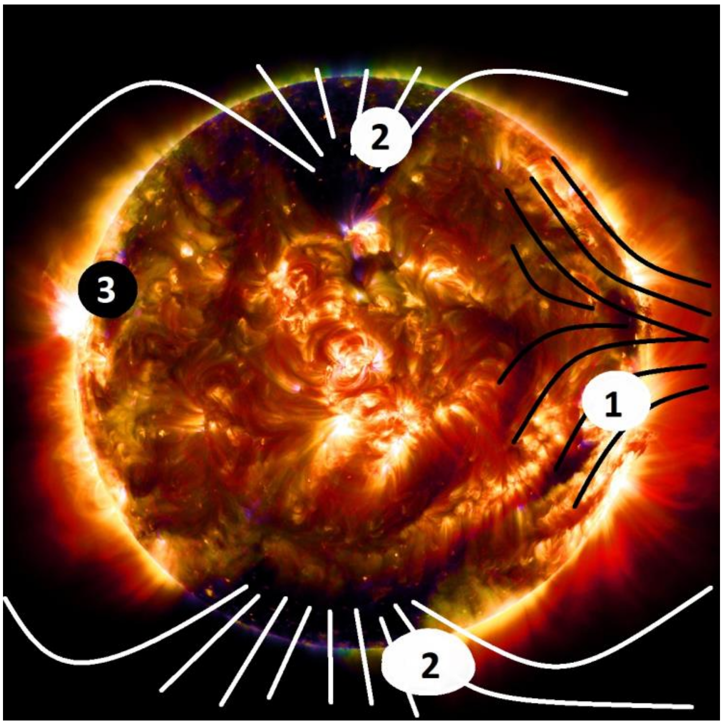

Fig. 1. Sources of the solar wind components: (1) streamer belt structures, (2) coronal holes, (3) active regions.

Solar cycle 24

Solar cycle 24 is characterized with extremely low activity in comparison with Solar cycles 21–23 (Fig. 2) and probably the most spotless days since Solar cycle 16.

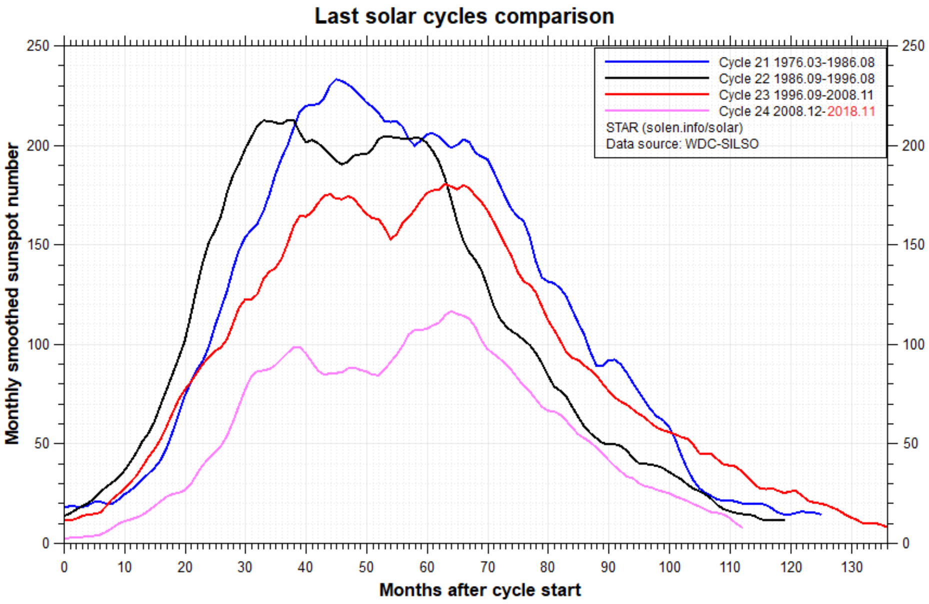

Fig. 2. Comparison of the monthly smoothed sunspot numbers for Solar cycles 21–24.

Solar wind parameters

In Fig. 1 are presented solar wind speed distribution during Solar cycle 24 together with smoothed sunspot number. It can be seen that there are no well-defined peaks at the cycle. In addition to this figure in Table 1 are shown the number of hours in six different solar wind speed groups.

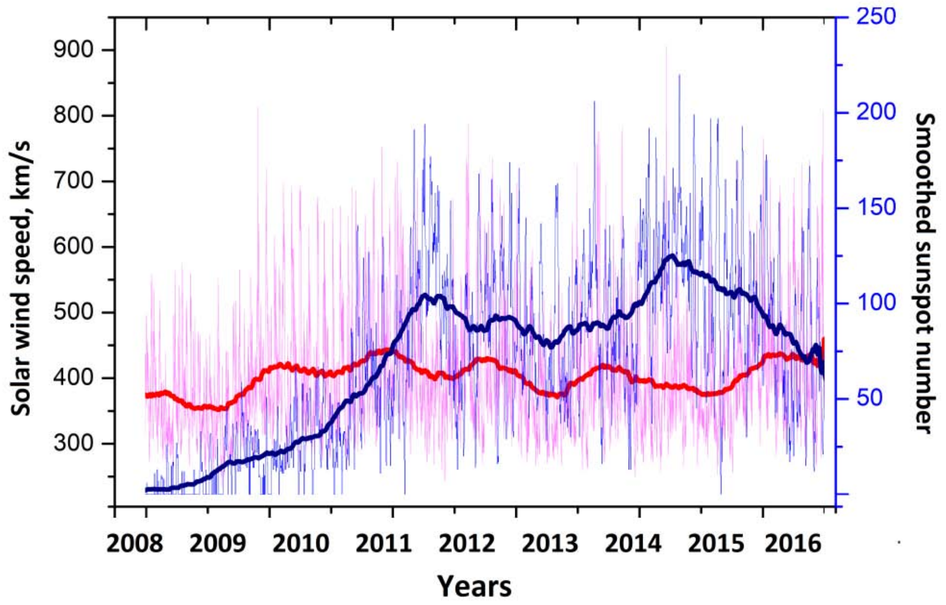

Fig. 3. Averaged solar wind speed (red line) vs sunspot number (blue line) during Solar cycle 24.

Table 1. Number of hours for six different solar wind speed groups

	<300	300-350	350-400	400-450	450-500	500-550
2008	401	1824	1487	1107	1006	876
2009	1151	3156	2182	1243	635	317
2010	569	2240	2380	1381	901	498
2011	344	1527	2491	1689	1061	672
2012	467	1928	2242	1977	974	511
2013	700	2268	2341	1493	854	568
2014	393	2242	2434	1836	1047	416
2015	297	1317	1848	1764	1460	894
2016	255	1254	1942	1650	1160	993
2017	134	1410	1991	1396	1033	870
2018	141	1195	1477	986	579	292

Conclusion

This study considers the averages of the solar wind speed at the Solar cycle 24. The conclusion remarks are:

- The time in which Earth is under the influence of solar wind with speed in the range 300–500 km/s is more than 80% of the total time at SC24
- During the last SC24 the averaged solar wind speed is under 500 km/s
- There are no well-defined peaks at the cycle.

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