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Reduced Solar Wind Speed During the Period 2006–2010

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Abstract. This period of low solar activity has its implication on the reduction of solar wind speed. Fast solar wind streams eminent from coronal holes are distinguished by the recurrence of the 27 days periodicity. The maximum solar speed dropped from 845 km/s in 2006 to 673 km/s in 2009, while the lowest wind speeds declined from 266 in 2006 to 249 in 2009. The average solar wind speed was 427 km/s in 2006 and was reduced to 367 km/s in 2009. The number of days with solar wind below 400km/s increased from 175 days in 2006 to 266 days in 2009. The general wind speed was declining from 2006 to 2009 and increased some time after the beginning of 2010 with the rise of cycle 24.

Keywords: Solar wind speed, Wolf-Gleissberg cycles, coronal holes, weak solar cycles

1 Introduction

The 12th international solar wind conference was held in France in 2009. It included numerous solar wind articles e.g. Hady and Samweel 2010. We are right now at the bottom of the Wolf- Gleissberg cycle (Fig. 1) where a series of 3-5 weak solar cycles usually dominate solar activity (Yousef 1995, 2006). Such low activity period induce low speed solar wind (Yousef 1998 and Yousef and Hady (2006). Low solar wind speeds of the order of 300km/s have been reported by Svalgaard et al. (2003). The present paper concentrates on studying the speed of the solar wind between 2006 and April the ninth 2010.

1.1 Variability of Solar Wind Speed

It was almost impossible to let the computer deal with the multitude of solar wind observational data. Other groups working on the solar wind whom we met at IAGA symposium Cairo 2009 also faced the same difficulty. Therefore we depended on the daily reported solar wind speeds from spaceweather.com. Fig. 2 (a and b) shows the annual status of the solar wind for the years (2006-2007) respectively. Note the 27 days periodicity mostly evident in the year 2006. Studies of the solar winds are very

important. Fig. 3 shows the minimums, averages and maximums annual solar wind speeds. It is clear that the minimum solar wind speeds were below 300 km/s for all of the five years. Note also that the average solar wind velocity was below 400 km/s for the year 2009 only.

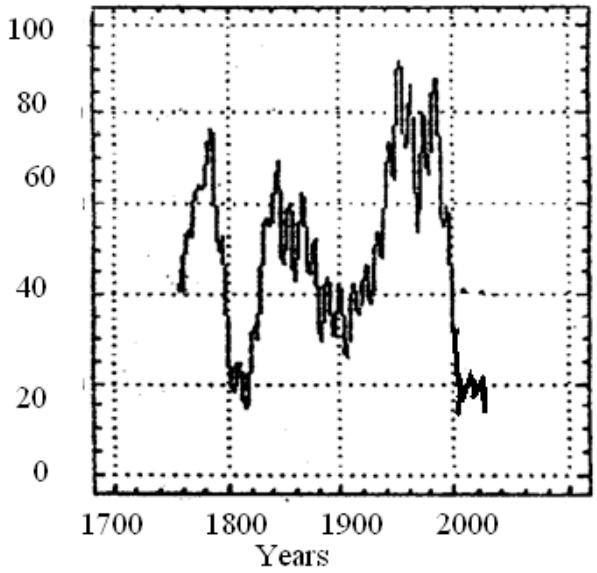

Fig. 1. Wolf-Gleissberg cycles evident in the time series of the smoothed sunspot number. The present decline of solar activity is shown analogous to 1800.

On sorting the solar wind speed for each year independently in an increasing order and plotting the data we obtain Fig 4. It is clear from this figure that there is a general form for the three years 2006, 2007 and 2008. On the other hand the plot for 2009 shows a maximum in the number of days where the wind speeds are below 400 km/s.

It is generally noticed from Fig. 5, which plots the solar wind velocity starting with the day 200 of the year 2008, all the year 2009 in addition to the first 83 days of 2010, that the solar wind speed dropped to 300km/s and below for a considerable time during this period between the two weak solar cycles 23 and 24. Similar drop was reported by Svalgaard et al. 2003. However the drop around 1900 was coincident with the 22 Hale magnetic cycle. If similar circumstances prevail, then we should expect a more pronounced drop at the tail of cycle 24 and rise of the still weak cycle to come, cycle 25. The impact of the reduced solar wind velocity on the shrinkage of the heliosphere is discussed by Yousef et al.2010.

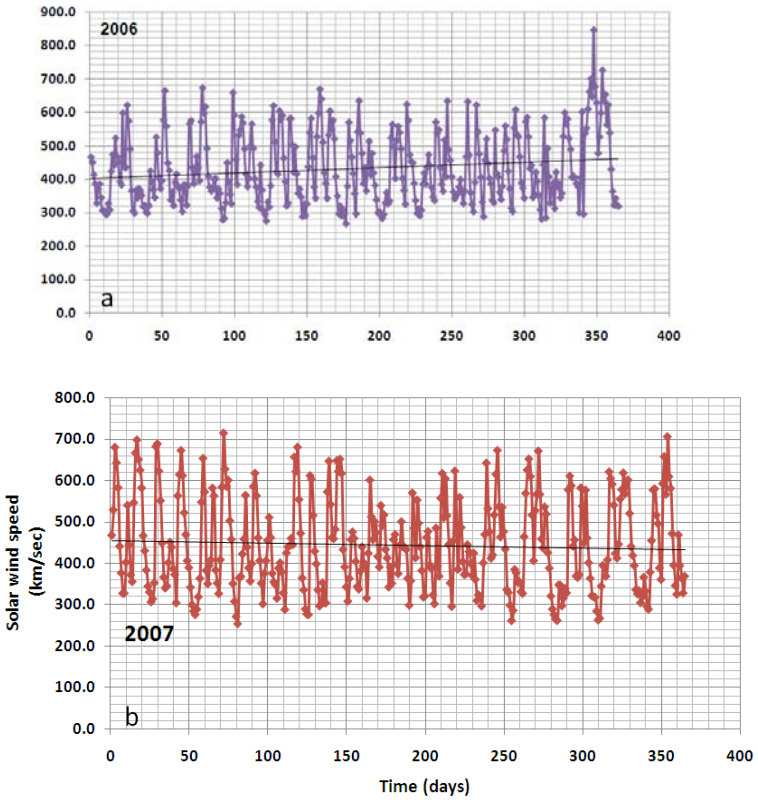

Fig. 2. Time series of solar wind speed in km/s for the years 2006 (*a: upper curve*) and 2007 (*b: lower curve*).

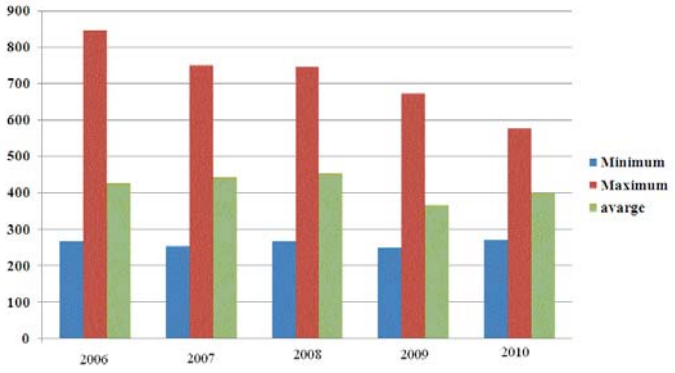

Fig. 3. Annual Solar wind speed in km/s histogram showing the minimum (*left*), maximum (*middle*) and average (*right*) for the period 2006–2010.

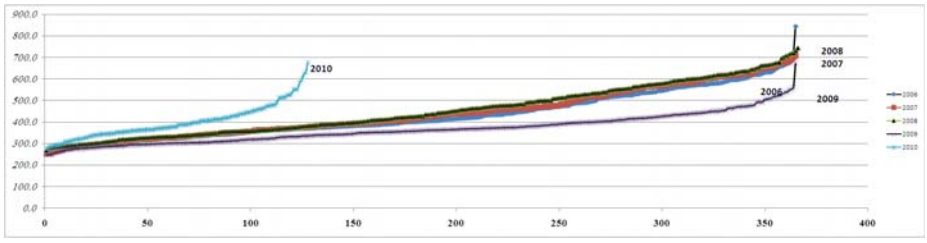

Fig. 4. Annual Solar wind speed in km/s. The figure gives the total number of days in a year were the solar wind speed is below a certain value on the Y axis. 2006, 2007 and 2009 have identical trends, 2009 is below them and 2010 show sharper trend.

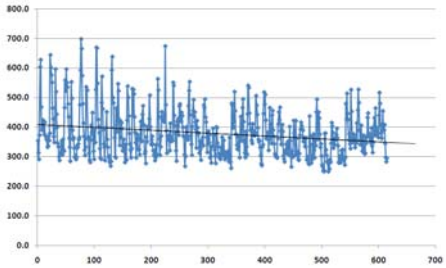

Fig. 5. Solar wind speed in km/s. Zero time is day 200 in 2008 till 83 days from 2010.

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