Danish Meteorological Institute
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Consistent minimum solar wind speed and sector boundary crossing dates list

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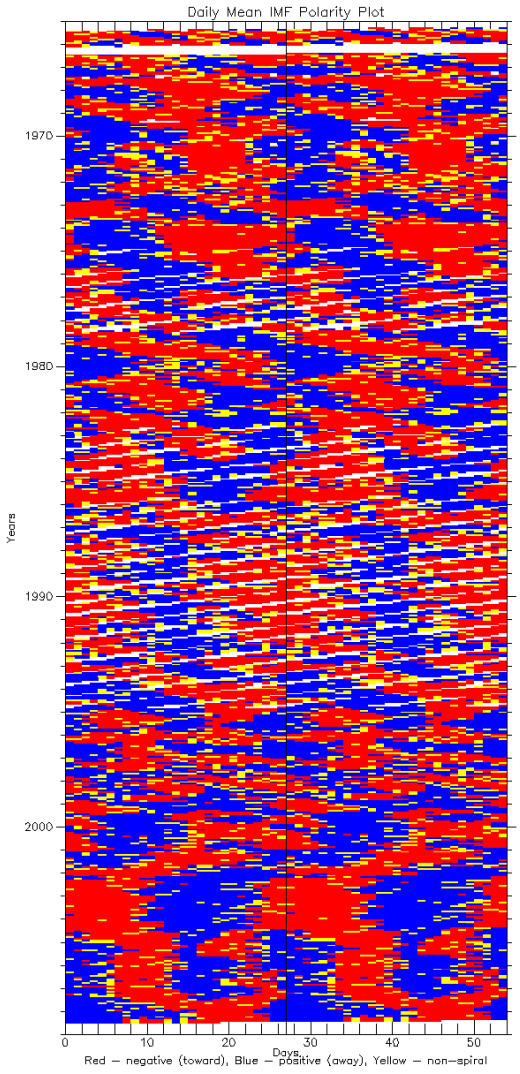

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Contents

1. Dansk resumé

En konsistent liste for geo-effektive datoer, til brug i sol-jord fysik forskning, fremstilles. Der bruges een liste for datoerne for sector boundary crossing og een liste for datoerne for minima i solvindens hastighed. De to lister er ikke altid sammenfaldende og der er i middel et offset på 1.5 dag imellem de to. Een samlet liste præsenteres hvori SBC datoerne er flyttet med 1.5 dage så at alle datoer på listen er konsistente. Huller i listen med solvindsens minima udfyldes ved hjælp af den justerede dato for SBCs hvis en sådan er til rådighed.

2. Abstract

A consistent list of geo-effective dates for use in solar-terrestrial physics is presented. Dates for sector boundary crossings appear to be shifted by on average 1.5 days relative to dates for solar wind minima and a joint list of dates is produced where SBC dates have been shifted by 1.5 days. Gaps in the solar wind minima list are filled using shifted SBC dates.

3. Introduction

3.1 Data and methods

Data for solar wind speed was obtained on the OMNIWeb site, at: http://omniweb.gsfc.nasa.gov/form/dx1.html. Daily-average data for the entire period 1964 (day 1)-2008 (day 146) were downloaded.

The sector boundary crossing dates were determined from the lists of '+/-' and '-/+' SBC dates from the Svalgaard list covering 1947-1978 available from NGDC at ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/SECTOR_BOUNDARIES/sector.bnd, and similar NGDC information from Daily Inferred Interplanetary Magnetic Field from Vostok Observatory 1957 - 1994 - where we use the data since 1978.

The solar wind minima were determined from the OMNI2 database, using a sliding filter on the solar wind speeds. The data from OMNI2 are not continuous - there are long periods with missing data, due, apparently to spacecraft orbit limitations. For instance, the period from early 1980s to early 1990s has such gaps. In order to use these data an interpolation was performed using splines to provide a uniform list of data, for eaze of analysis. Visual inspection of the splined curve verified that no extraneous maxima or minima had been generated by the procedure. Typically, multi-day intervals with missing data are interpolated to straight-line sections, which does not generate additional minima. A three-day smoothing was applied to the resulting curve to remove small wiggles unlikely to be important solar wind minima. A sliding window of 5 points was then applied to the record and if the middle point was a minimum it was adopted as a candidate minimum and placed on a list. This could cause points right at the edge of data-gaps to be elected for candidacy, but no erroneous minima will be placed in the middle of data gaps. Finally the list was searched for duplicates, so that a resulting adopted list of unique solar wind speed minima dates resulted.

This list was compared to the list of sector boundary crossing dates and a plot generated (Figure 3.1) showing the histogram of the difference between SBC dates and adjacent (within 6 days) SW minima dates. As can be seen from the figure, there is an abundance of differences in the 0 to 3 days range, and we conclude that solar wind minima occur on average 1.5 days before sector boundary crossing dates, which is an observation we next use to generate a consistent list of geo-effective dates.

The list of geo-effective dates is generated by joining the shifted list of SBC dates and the SW minima dates. We subtract 1.5 days from the original list of SBC dates. Then we inspect the joint list and select dates based on the following criteria: If an SBC date and a SW date agree to within 2.0 days we select the SW date and ignore the SBC date. If, within in a 2,0 day interval from a date on the joint list, there is only either one SW or one SBC date we adopt it.

The resulting list of unique dates is version 1 our 'list of geo-effective dates' and is available by request from the author of this report (pth@dmi.dk).

4. Discussion

It should be noted that the generated list is 'consistent' in the sense that the observed mean offset between sector boundary crossing dates and days of minimum solar wind speed has been removed. The resulting dates may be offset from the 'best geo-effective' dates for phenomena related to sector boundary crossings. The user must experiment with an offset, for best results.

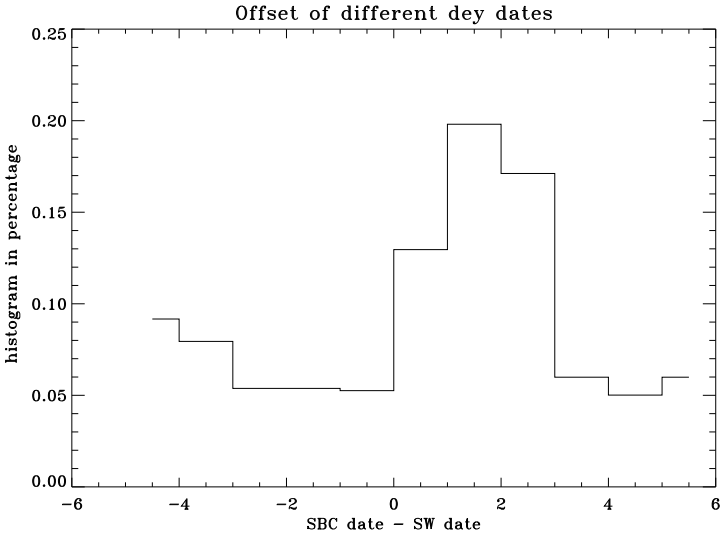

Figure 3.1: The offset in days of adjacent dates on a list of sector boundary crossing dates and a list of minima in the solar wind speed. It appears that SBCs occur about 1.5 days later than SW minima.

Possible suggestions for improvement of the list include using the depth of minima in the solar wind speed as an indicator of geo-effectiveness, and to be more careful in regions where known gaps in the SW record exist.

4.1 Previous reports

Previous reports from the Danish Meteorological Institute can be found on:
http://www.dmi.dk/dmi/dmi-publikationer.htm