



Reconstruction of geomagnetic activity and near-Earth interplanetary conditions over the past 167 yr – Part 3: Improved representation of solar cycle 11

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Abstract. Svalgaard (2014) has recently pointed out that the calibration of the Helsinki magnetic observatory's H component variometer was probably in error in published data for the years 1866–1874.5 and that this makes the interdiurnal variation index based on daily means, IDV(1d), (Lockwood et al., 2013a), and the interplanetary magnetic field strength derived from it (Lockwood et al., 2013b), too low around the peak of solar cycle 11. We use data from the modern Nurmijarvi station, relatively close to the site of the original Helsinki Observatory, to confirm a 30 % underestimation in this interval and hence our results are fully consistent with the correction derived by Svalgaard. We show that the best method for recalibration uses the Helsinki $Ak(H)$ and aa indices and is accurate to $\pm 10\%$. This makes it preferable to recalibration using either the sunspot number or the diurnal range of geomagnetic activity which we find to be accurate to $\pm 20\%$. In the case of Helsinki data during cycle 11, the two recalibration methods produce very similar corrections which are here confirmed using newly digitised data from the nearby St Petersburg observatory and also using declination data from Helsinki. However, we show that the IDV index is, compared to later years, too similar to sunspot number before 1872, revealing independence of the two data series has been lost; either because the geomagnetic data used to compile IDV has been corrected using sunspot numbers, or vice versa, or both. We present corrected data sequences for both

the IDV(1d) index and the reconstructed IMF (interplanetary magnetic field). We also analyse the relationship between the derived near-Earth IMF and the sunspot number and point out the relevance of the prior history of solar activity, in addition to the contemporaneous value, to estimating any “floor” value of the near-Earth interplanetary field.

Keywords. Geomagnetism and palaeomagnetism (time variations, secular and long term; instruments and technique) – interplanetary physics (interplanetary magnetic fields)

1 Introduction

This paper employs a number of different geomagnetic activity and sunspot indices which are listed, and briefly described, in Appendix A. A review of the reconstruction of conditions in the solar corona and heliosphere from geomagnetic activity was recently presented by Lockwood (2013): a central assumption of all such reconstructions is that a geomagnetic index has, in the past, always responded to varying interplanetary conditions in the same way as it has been observed to do during the space age. Consequently, Lockwood et al. (2013a) compiled the interdiurnal variation geomagnetic index based on daily means, IDV(1d), with the aim of making the construction as homogeneous as possible, such that its response to variations in the near-Earth interplanetary