Geosci. Instrum. Method. Data Syst. Discuss.,
doi:10.5194/gi-2015-33-AC1, 2016


Geoscientific Instrumentation Methods and Data Systems Discussions

# *Interactive comment on* "Forecasting auroras from regional and global magnetic field measurements" *by* K. Kauristie et al.

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Received and published: 29 April 2016

We thank the Referee for the valuable comments to improve our paper. Below we give our replies and suggestions for the modifications in the manuscript:

*P1 L18-23, clarifying the Abstract:

We agree, the first sentences in the Abstract are confusing. According to the recommendation of the Referee we suggest the following reformulation:

We use the connection between auroral sightings and rapid geomagnetic field variations in a concept for a Regional Auroral Forecast (RAF) service. The service is based on statistical relationships between near-real-time alerts issued by the NOAA Space Weather Prediction Center and magnetic time derivative (dB/dt) values measured by



five MIRACLE magnetometer stations located in Finland at auroral and sub-auroral latitudes. Our data base contains NOAA alerts and dB/dt observations from the years 2002-2012. These data are used to create a set of conditional probabilities, which. . .

*P2 L13-18, direct quote from Lilensten et al

We suggest the following modification:

According to Lilensten et al. (2008) "Space weather is the physical and phenomenological state of natural space environments. The associated discipline aims, through observations, monitoring, analysis and modeling, at understanding and predicting the state of the Sun, the interplanetary and planetary environments, and the solar and non-solar driven perturbations that affect them, and also at forecasting and nowcasting the potential impacts on biological and technological systems." Auroras are harmless. . .

*P5 L17, definition of bright auroras

We have to admit that we are a bit on a slippery ground with this statement. Unfortunately we do not have exact intensity calibration information for the cameras which were used in the validation of Auroras Now as reported by Mälkki et al. (2006). We know, however, that on those days (when the image intensifier of the camera was still new), the system was somewhat more sensitive than the human eye. So our optimistic conclusion in the report by Mälkki et al. was that in the 13% of cases when Anow failed the auroras were dim and thus not of interest for auroral tourism. Like explained in the concluding remarks (P12 L9-12), nowadays the situation is more complicated as optimally RAF should be able to serve both photographers with very sensitive cameras and observing with naked eye.

We suggest the following modification:

The analysis shows that in 86% of the cases when the dB/dt-threshold was exceeded also auroras were observed. In the 13% of the cases when Auroras Now! failed to spot the auroras, the intensities were typically dim or even below the sensitivity of human

eye.

*P5 L21, extrapolation of the threshold value

We suggest the following modification:

. . .in RAF they are determined by linear inter- and extrapolation from the corresponding values of Nurmijärvi and Sodankylä. The statistical study of Finnish all-sky camera recordings from years 1973-1997 by Nevanlinna and Pulkkinen (2001) shows that assuming a linear trend in the auroral occurrence probability according latitude is a good approximation at magnetic latitudes 63°-70°. At latitudes below 63° the evidence for a linear trend is less clear, but as all-sky observations from these latitudes are scarce in the analyzed data base, we use the linear relationship also there as the first approximation. The RAF stations with. . .

*P6 point 3, handling of alerts with less than 48 hour separation

Just for simplicity reasons each alert was handled as an individual case (i.e. alerts with less than 48 hour separation were handled similarly as the other alerts). Obviously improving this part of our approach would be a good topic for a future upgrading of the service with a larger NOAA data set.

We suggest the following modification:

. . .W/V was determined, where W is the number of hours when the threshold for auroras was exceeded and V is the total number of hours in the analysis (i.e. the number of issuances of the analysed alert type during the ten year period). The combined effect of subsequent alerts was ignored in the analysis as alerts with less than 48 hour separation were handled as independent separate cases.

*P9 L1, probability of exceeding the dB/dt threshold versus probability of auroras

We suggest the following modification to P7 L17-20 where we introduce the W/V plots for the first time:



In the following discussion we use the W/V value (in %) as a proxy for the auroral occurrence probability, although exactly speaking this value represents the probability of dB/dt excess above the given threshold. Figure 2 is an example plot on W/V for stations KEV and NUR during the next 48 hours after the NOAA ALTK04 and ALTK06 issuance times. According to this plot the probability for enhanced auroral occurrence is above 50% at KEV during $\sim$10 hours (0 hours) after the issuance of ALTK06 (ALTK04).

*P9 L10-17, how well noon curves indicate aurora during the following night

A good point. ALTK06 issuance around noon indicates $\geq$60% auroral probabilities for the coming night.

We suggest the following modification to the text:

The curves of night and dusk sector issuance times suggest that for the coming night V/W values are well above 50%. ALTK06 issuance around noon also indicates $\geq$60% auroral probabilities for the coming night (curves not shown). In the case of dawn sector issuances the on-going night is clearly more favourable for auroral spotting than the following night. In other words, if there is already high magnetic activity in the beginning of the dark time, it will likely continue during the nearest night hours. On the other hand, high morning activity does not strongly indicate that the next night $\sim$12 hours later will still show auroral displays.

*P9 L26, location of bands with enhanced activity

No, we mean that the band envelopes with +/- 2° the magnetic latitude of the station which has measured a dB/dt excess.

We suggest the following modification to the text:

In both parts the regions of enhanced auroral occurrence probabilities are shown as bands of cyan (W/V>50%) or green (W/V>70%) color overlaid on the Fennoscandian map. These bands are positioned at the latitudes of +/-2 degrees around the RAF stations where the forecast dB/dt exceeds the threshold of enhanced probability for

auroral occurrence (for an example, see Fig 7).

*P9 L30, location of bands with enhanced activity

Yes, we use the curves based on UT-binning.

We suggest the following modification to the text:

The forecast service checks the latest NOAA alerts every 15 min. If alerts of the correct type (ALTK04-09, ALTPX) have been issued during the previous 15 min the service checks the corresponding W/V-curves with UT-binning for delays of T0+3, T0+6, T0+9 and T0+12 (where T0 is the alert issuance hour) and draws the forecast maps accordingly.

*TECHNICAL COMMENTS

P3 L3: “geoefficiency” -> geoefficiency (in italics)

P2 L29 (with a few hours‘ delay) -> (with a few hours’ delay) (Although my Office refuses to make this change in Times font).

P3 L9 since 1980‘s. -> since 1980s.

P3 L2 capability of a structure -> capability of a solar wind structure

P5 L2 in early 2000. -> in early 2000s.

Inclusion of ALTPX (P9 L29): ALTPX alerts are introduced for the first time on P7 L6

P10 L4&7 promise -> forecast

P10 L19 level the case -> level in the case

P12 L6 recognition may, however, appear to be challenging, since -> recognition will not be straightforward, since

Thanks also for the non-serious comment!

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