

***Interactive comment on “Atmospheric electric field anomalies associated with solar flare/coronal mass ejection events and solar energetic charged particle “Ground Level Events”” by E. A. Kasatkina et al.***

**Anonymous Referee #3**

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The paper "Atmospheric electric field anomalies associated with solar flare/coronal mass ejection events and solar energetic charged particle "Ground Level Events" by Kasatkina et al describes the variations of the vertical component of the atmospheric electric field associate with major Ground Level Events related to three solar flares/CMEs occurred in 2001. The vertical electrical field,  $E_z$ , was measured at Apatity, Vostok, Voeikovo and Nagycenk stations. The station latitudes range from -89.3 to 63.8 degrees. The paper deals mainly with the data from April 15, 2001, the most complete and reliable set of data and presents two more cases in the same year.

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The authors give an overview of the measurements and interpretation of the vertical electric field variation existing in the literature, present their data and discuss possible mechanisms responsible for the detected variation of the electric field  $E_z$ .

The evidence of  $E_z$  variation at ground level related to Solar Flares/Coronal Mass Ejections are interesting and can have significant impact on other scientific fields. However, the paper needs to be revised before publication. Follow questions, comments and suggestions:

1) The only event detected at the 4 stations is April 15, 2001. The remaining 2 events are only detected at Apatity. Aside for the mentioned SSC at 00:40 UT on April 18 are the meteorological conditions available for the time period in which the  $E_z$  variations were detected on April 18 and Nov 4 2001? This is not explained in the paper.

2) If the April 18 and Nov 4 2001 are not completely reliable because of the lack of the meteorological conditions, it would be better change the abstract to say that April 15, 2001 shows clear evidence for  $E_z$  variation associated to SF/CME events and that the other two may support this hypothesis as well although .....

3) Page 3-4 The description of Fig. 1 need to be revised: 3.1) Why the authors do not comment on the positive increase detected at Apatity around 17 UT? This increase in  $E_z$  is somehow detected at Vostok as well. 3.2) Starting at about 18 UT another increase in  $E_z$  is seen by Vostok station and "corresponds" to that detected at Voeikovo. This increase has no correspondence at the Apatity station. Could the authors comment on that?

4) Page 4 - "Another solar eruption may be responsible for this event, but, unfortunately SOHO data are not available ....." . This is not completely true. Although LASCO/C2 data show a very high background due to the main eruption at 14:06 UT, the combined EIT/C2 difference images movie shows a brightening in EIT on the West limb at 18:04 UT, most probably from the same region of the 14:06 UT event. Ejection is also seen in C2 starting between 19:00 and 19:30 UT mainly on the south but from 20:47 the

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ejection is also seen spread all around the West limb. The second jump seen at 19:40 UT in the electrical field may be related to this later event. This would also agree with the variation of the field detected at Voeikovo starting at about 19 UT. Thus the statement about SOHO data needs to be revised.

5) Page 5 - "...the footprint of the magnetic line was outside the active magnetic region ...." . However Fig. 1 and 2 show intensity variations of  $E_z$  comparable to April 15th event. Please comment on that.

6)Page 7 - "Analysis of the LASCO SOHO (C2) Coronagraph pre-event ....." is not clear what the authors try to explain using the LASCO images. The LASCO/C2 images at 13:54 and 14:06 UT do not show the pre-CME streamer but a typical three parts structure CME, reminiscent of a pre-CME streamer structure..... Could the authors explain what do they mean with pre-CME structure?

7)Page 7 - "Such pre-CME streamers seem to appear before CME ...." See comment 6). Moreover the changing in the pre-CME "structure" very often can give a dimming in some UV lines. The brightening in white light data does not always imply a brightening of UV coronal lines. In Raymond et al (2003) paper the brightening of the UV lines, CIII and O VI lines, it is related to the flare more than to the pre-CME streamer expansion. As stated in the paper " The fact that C III brightening precedes X-ray brightening suggests that the dense transition region gas is heated by lower energy electron or protons". The brightening in these lines is seen before any detection of pre-CME streamer expansion. Are the authors suggesting a different explanation than Raymond,for the brightening of the UV lines?

Minor Changes:

- Table 1: Onset time of April 15 13:38 -> 13:32 UT " " April 18 02:30 -> 02:11 UT - Fig. 1: caption "- 2 protons with  $E > 1$ .... - 3 protons with  $E > 10$ ....- 4 protons with  $E > 100$ ."

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