

Visibility of Aurora Borealis from Slovenia



Fig. 1: Aurora borealis over mount Nuolja in Sweden on 24/25 January 2012. Credits: Alessandra Farina.

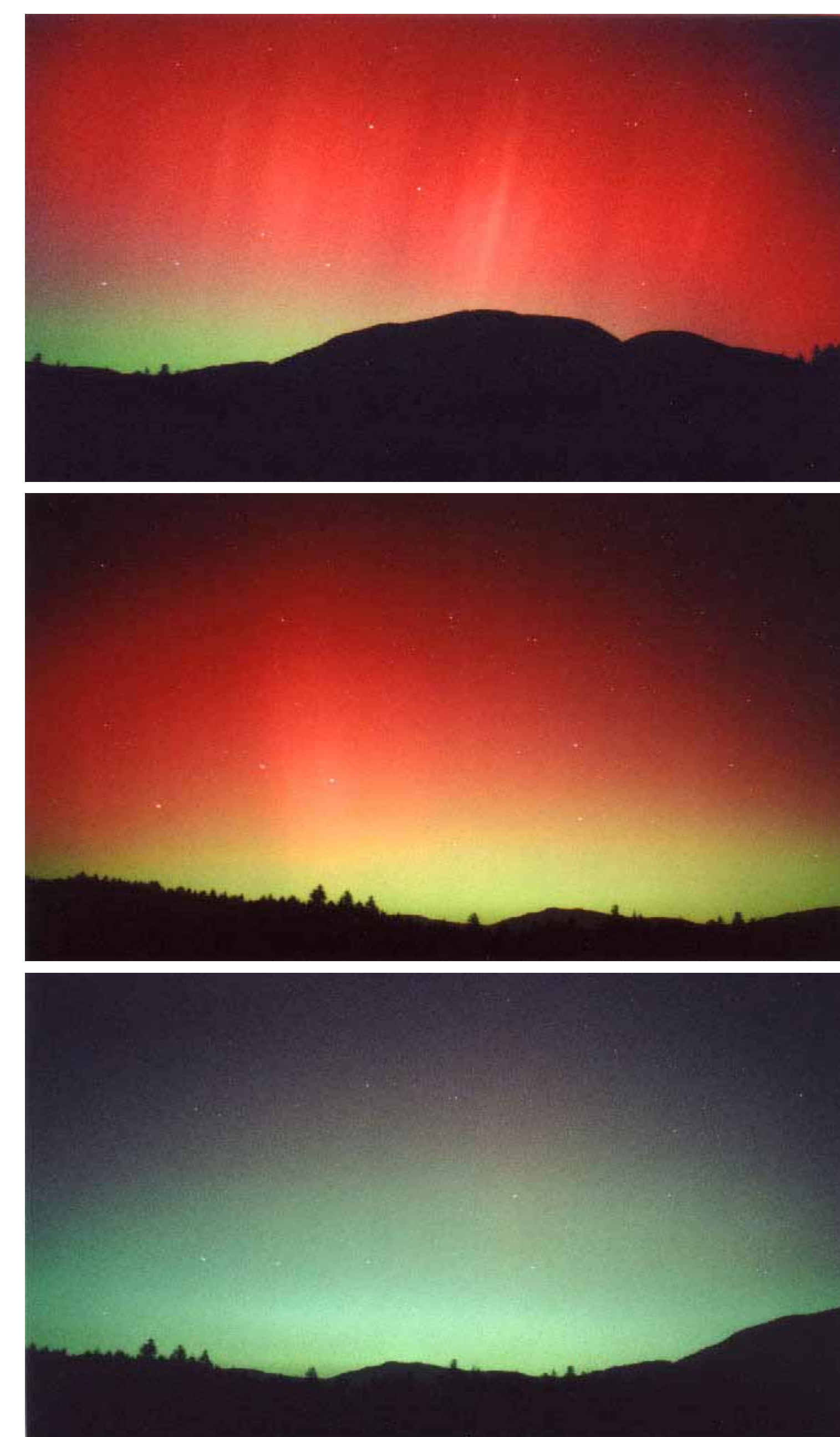


Fig. 2: Photos of aurora borealis occurring on the night between 20 and 21 November 2003 taken from Radmirje pri Ljubnem ob Savinji (Slovenia). Credits: Javor Kac.

Aurora borealis is a common phenomenon in high latitude (Arctic and Antarctic) regions. When particular conditions are fulfilled it can be also observed at lower latitudes, as in Slovenia. In our research we identified main parameters linked both to the Solar activity and to the interaction between the Solar wind and the Earth's magnetic field. We processed available data from satellites and ground-based stations for seven nights when auroras were observed in Slovenia between years 2000 and 2005. We obtained threshold values for aurora to be seen at our latitudes and finally tried to determine what is the frequency of auroras in Slovenia.

Problem overview

- When can be aurora borealis observed from Slovenia? Which are the main physical quantities measured by satellites or ground-based stations that should be monitored?
- Can we obtain threshold values for such quantities, exceeding which aurora can be seen in Slovenia?
- How many aurora borealis can be observed from our country? Is a (short term) prediction possible?

Data and methods

- Satellite data:
 - Advanced Composition Explorer:
 - ~ proton speed and density
 - ~ Solar wind magnetic field
 - NOAA Space Weather Prediction Center:
 - ~ sunspot number
 - ~ radio flux at 10.7cm wavelength
 - ~ Solar flares of C and M categories
- Internet data:
 - observations of auroras in Slovenia done by the MBK Team - Astronomical Society Orion
- Ground-based station data:
 - K (planetary) index
- Data research and systematic processing
- Data analysis and interpretation

Results

- Computed threshold values for main parameters:
 - v_{proton} (proton speed) ≈ 650 km/s
 - ρ_{proton} (proton density) ≥ 35 particles/cm³
 - B_z (magnetic field component) ≤ -25 nT
 - K index (geomagnetic activity on Earth) ≥ 8
- Using upper limits for K index and B_z we obtained eight more dates when prerequisites for observing aurora borealis in Slovenia were fulfilled in years from 2000 to 2005.

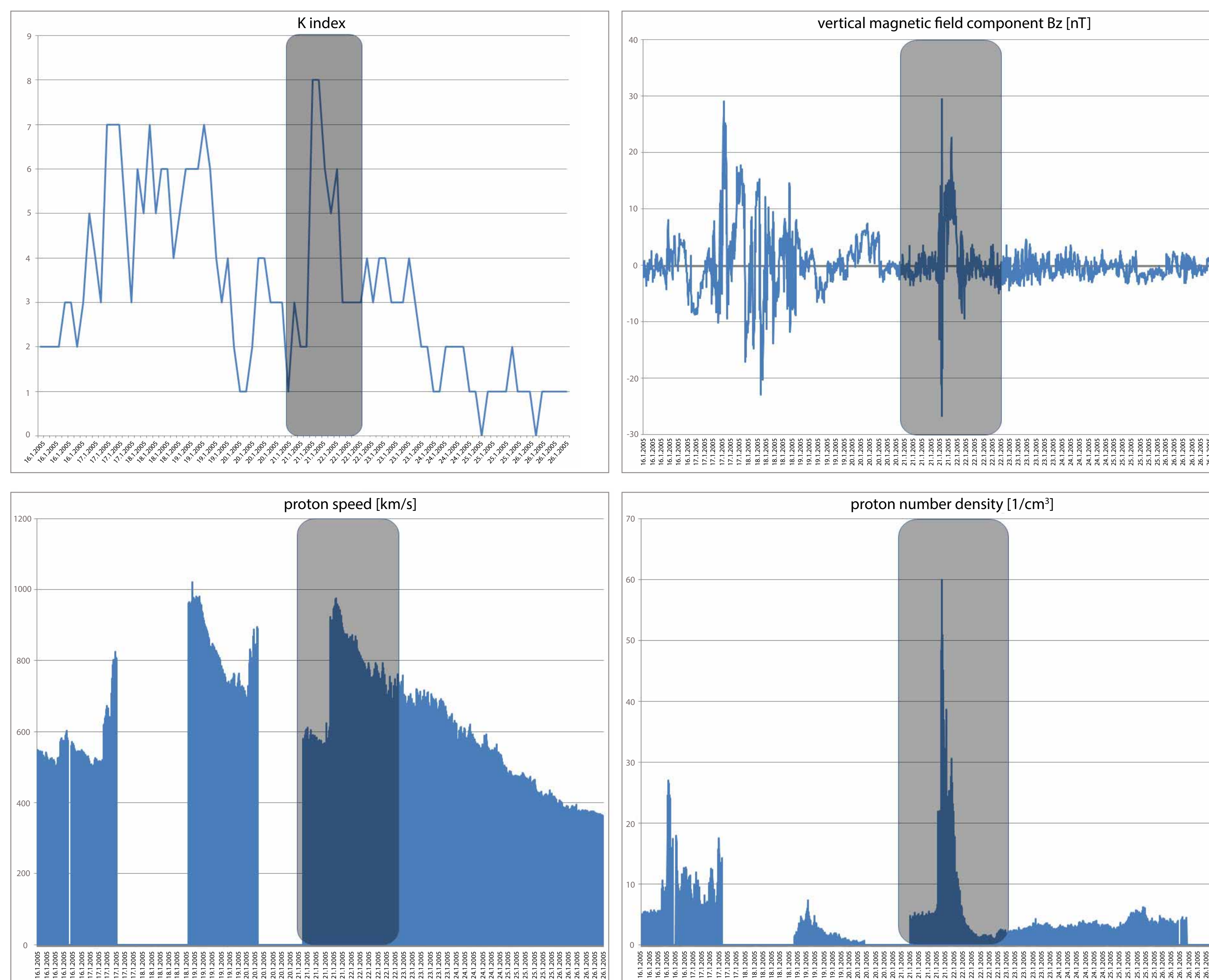


Fig. 4 : K index (upper left plot), vertical magnetic field component B_z (upper right plot), proton speed (lower left plot) and proton number density (lower right plot) measured between 16 and 26 January 2005. Data are from NOAA Space Weather Prediction Center and from the Advanced Composition Explorer (ACE). Shaded region on images marks the event of aurora. Aurora borealis was seen in Slovenia on the night of 21/22 January 2005 as a consequence of an X7.1 class Solar flare that occurred the day before.

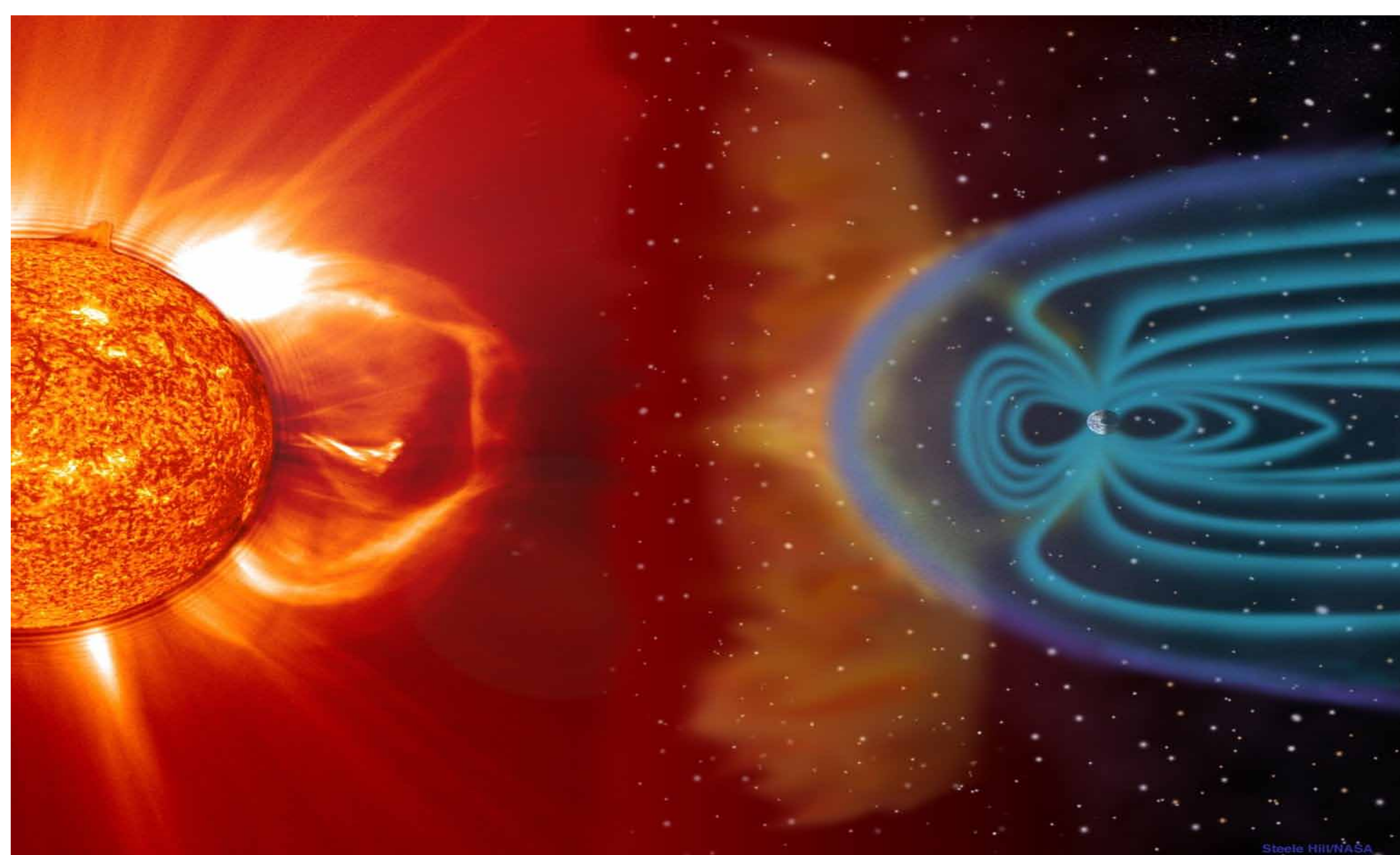


Fig. 3: Illustration of a massive solar explosion that impacts Earth's magnetosphere. Credits: NASA.

Conclusions

- Knowing the dates when aurora borealis was observed in Slovenia we searched the available satellite and ground-based data to obtain limit values for key physical quantities needed to observe this particular event from our latitudes.
- Forecasting auroras:
 - (globally) higher probability with a powerful Solar flare,
 - (locally) higher probability when K (planetary) index is higher and B_z lower than the computed threshold.
- Using computed threshold values on K index and B_z we obtained a mean of two-three days per year (in the period 2000-2005) when prerequisites for observing auroras from Slovenia were met.
- Threshold values could be used to obtain an alarm of increased probability of auroras in Slovenia. Geomagnetic activity data in Slovenia could be also obtained and used for monitoring and forecasting auroras.