

Name of research institute or organization:

Physikalisches Institut, Universität Bern

Title of project:

Neutron Monitors - Study of solar and galactic cosmic rays

Project leader and team:

Prof. E.O. Flückiger, project leader

Dr. R. Bütikofer

Project description:

The Cosmic Ray Group of the Division for Space Research and Planetary Sciences of the Physikalisches Institut at the University of Bern, Switzerland, operates an 18-IGY neutron monitor (NM, since 1958) and a 3-NM64 neutron monitor (since 1986) at Jungfraujoch. Neutron monitors provide key information about the interactions of the galactic cosmic radiation with the plasma and the magnetic fields in the heliosphere and about the production of energetic cosmic rays at the Sun, as well as about geomagnetic, atmospheric, and environmental effects. They ideally complement space observations. The neutron monitors at Jungfraujoch are part of a worldwide network of standardized cosmic ray detectors. By using the Earth's magnetic field as a giant spectrometer, this network determines the energy dependence of primary cosmic ray intensity variations in the GeV range. Furthermore, the high altitude of Jungfraujoch provides good response to solar protons ≥ 4.6 GeV and to solar neutrons with energies as low as ~ 250 MeV.

Figure 1 presents the measurements of the IGY neutron monitor at Jungfraujoch (lower panel) since 1958. This unique dataset reflects the variations of the primary cosmic radiation over four solar sunspot cycles. The galactic cosmic ray intensity shows an 11-year variation in anticorrelation with the solar activity characterized by the sunspot numbers plotted in the upper panel of the figure. The relative count rate of the IGY NM for 2002 is shown in Figure 2. In order to compare the cosmic ray variations with other solar-terrestrial phenomena, the Bartels solar rotation interval is chosen for the period of one cycle of the plot. The high variability of the data reflects the still active phase of sunspot activity cycle 23. However, no distinct 27-day recurrent variations can be identified. The records of the two NMs at Jungfraujoch are published in the form of data books, of special reports, and on a webpage (<http://kspc4.unibe.ch/nm>). In addition, the data are submitted to the World Data Centers in Boulder and Tokyo in electronic form. Together with the recordings of the worldwide network of neutron monitors they are used by the scientific community for a broad range of cosmic ray and solar-terrestrial research.

In spring 2002 the whole datataking software of both neutron monitors were renewed and the datataking PCs were connected to internet. These improvements make it possible for the neutron monitor measurements to be analysed in real-time and that breaks in the operation of a detector be reported instantly. In case of an interruption, repairs can now be made much faster. For better control of the stability of the electronics of the two neutron monitors, temperature and relative humidity probes were installed close to the detector and to the counter electronics. The modifications led to a clearly improved reliability in the operation of the two detectors.

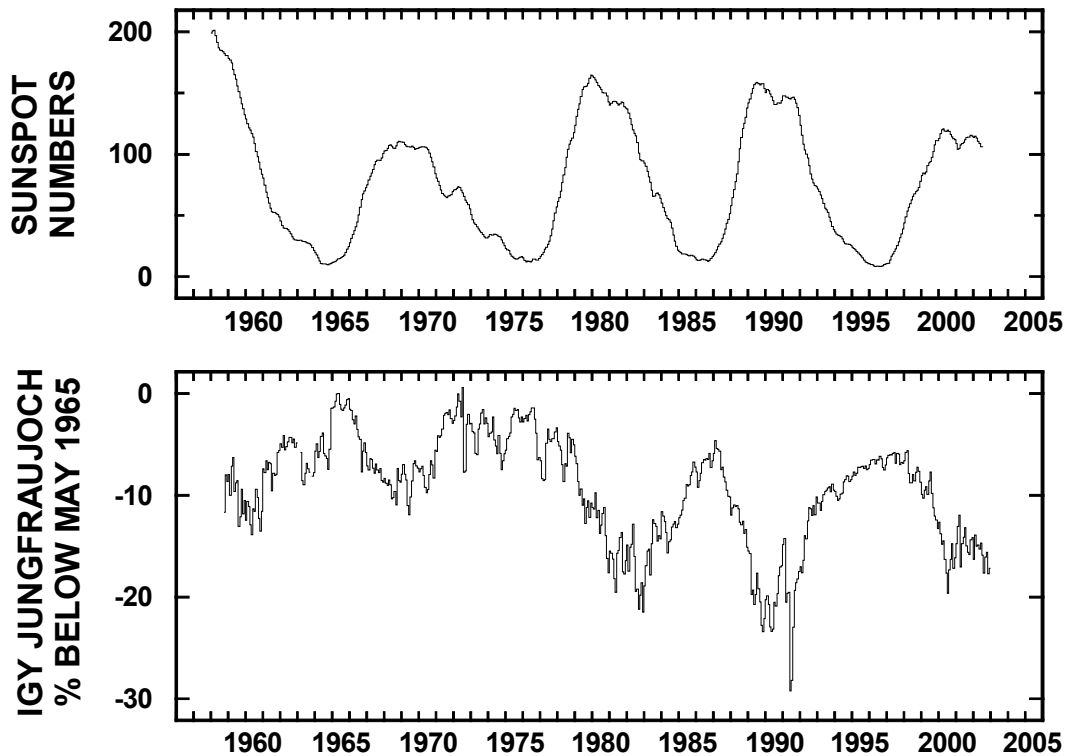


Figure 1: Smoothed sunspot numbers (top panel), and pressure corrected monthly average counting rates of the IGY neutron monitor at Jungfraujoch (bottom panel) for the years 1958-2002. The neutron monitor count rate is expressed in relative units with respect to May 1965.

In September 2002 a radiation-monitoring unit “Gamma Tracer” manufactured by Genitron Instruments GmbH, Frankfurt am Main, Germany, was installed in the housing of the NM64 neutron monitor. The measurements of this additional “Gamma Tracer” unit will be used to compare the environmental radioactivity at Jungfraujoch on the one hand with cosmic ray measurements made by the neutron monitors at Jungfraujoch and on the other hand with the environmental radioactivity measurements made at Gornergrat where an identical unit of “Gamma Tracer” is installed.

In 2002 the scientific work of our group with the Jungfraujoch neutron monitor data and with the data of the neutron monitors of the worldwide network was concentrated on the analysis of Forbush decreases and on research in the field of space weather. From this work, several contributions resulted for the 18th European Cosmic Ray Symposium in Moscow, Russia, in 2002.

As in previous years, we organized a training course for the “Institut Polaire Français - Paul Emile Victor, IPEV” (formerly “Institut Français pour la Recherche et la Technologie Polaires, IFRTP”) for technicians assigned to be responsible for the French NMs at Kerguelen and Terre Adélie during one year. Four technicians were trained at Jungfraujoch in the operation and maintenance of these detectors from October 22-24, 2002.

JUNGFRAUJOCH IGY CORRECTED DATA
Bartels Rotations 2299 - 2312

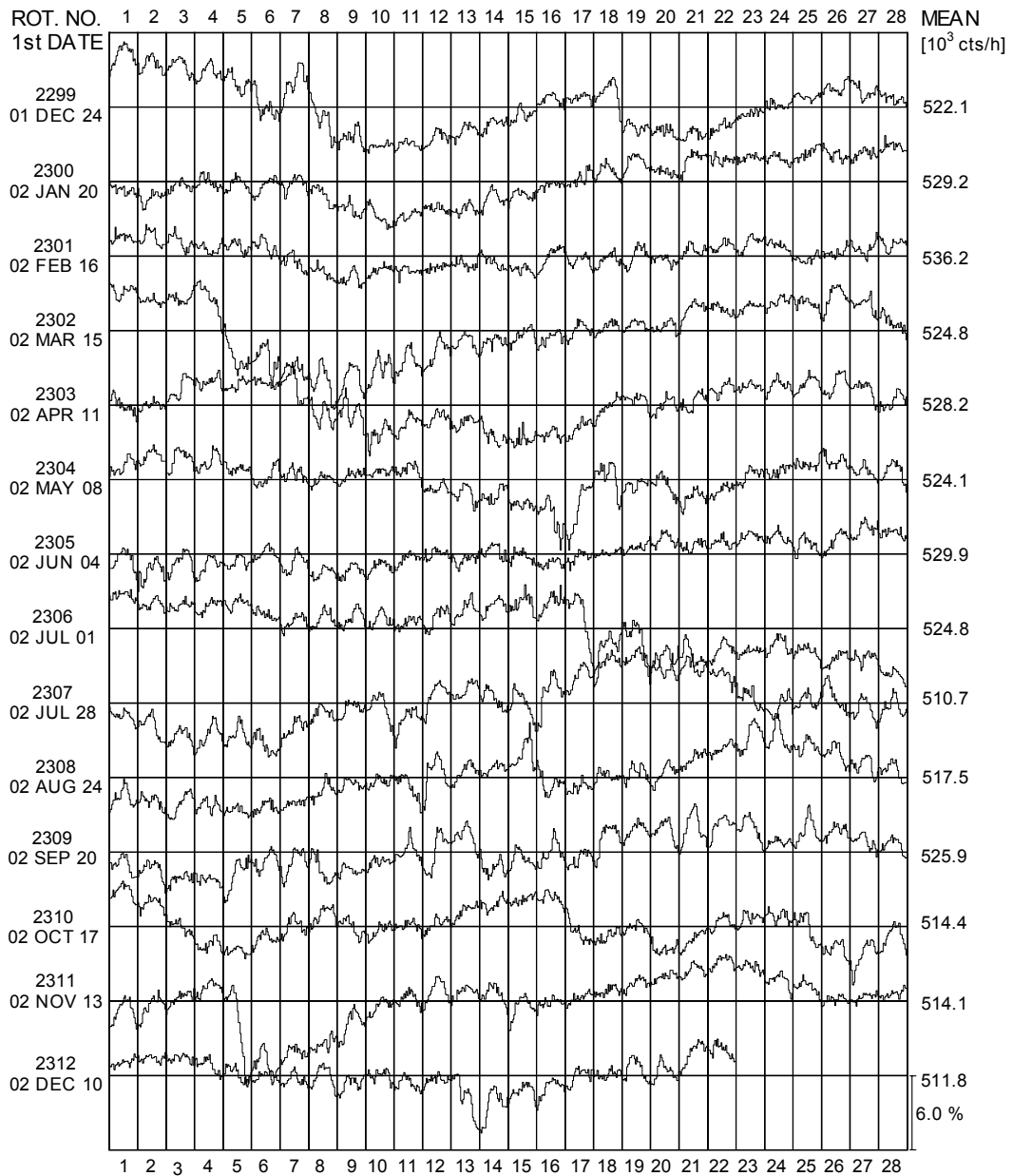


Figure 2: Pressure corrected relative hourly counting rate of the IGY neutron monitor at Jungfraujoch for 2002, plotted as the relative deviation from the average counting rate of the respective 27-day Bartels solar rotation period.

This research is supported by the Swiss National Science Foundation (grant NF 20-067092.01).

Key words:

Astrophysics, cosmic rays, neutron monitors; solar, heliospheric and magnetospheric phenomena

Internet data bases:

<http://kspc4.unibe.ch/nm>

Collaborating partners/networks:

International Council of the Scientific Union's (ICSU) Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)

World Data Centers A (Boulder), B (Moscow), C (Japan), International GLE database

Scientific publications and public outreach 2002:

Conference papers

Flückiger, E.O., On the Role of Cosmic Ray Measurements in a European Space Weather Programme, 18th European Cosmic Ray Symposium, Moscow, Russia, 8-12 July 2002, Symposium Program and Abstracts, 2002.

Despotashvili, M.A., E.O. Flückiger, and N.A. Nachkebia, Forbush Decreases and Solar Activity Dependence of the Galactic Cosmic Ray Recurrent Variation, 18th European Cosmic Ray Symposium, Moscow, Russia, 8-12 July 2002, Symposium Program and Abstracts, 2002.

Belov, A.V., R. Bütikofer, E.A. Eroshenko, E.O. Flückiger, V.A. Oleneva, and V.G. Yanke, Interplanetary Magnetic Field Disturbances with Particularly High Cosmic Ray Modulation Efficiency, 18th European Cosmic Ray Symposium, Moscow, Russia, 8-12 July 2002, Symposium Program and Abstracts, 2002.

Flückiger, E.O., R. Bütikofer, and M.R. Moser, Cosmic Ray Measurements at Jungfrauoch and Gornergrat, Proc. Workshop on 'Atmospheric Research at the Jungfrauoch and in the Alps', Davos, Switzerland, 20 September 2002, Swiss Academy of Sciences SAS, 54-55, 2002.

Watanabe, T., Cosmic-Ray Data Center Activity for Space Weather, Proc. 22nd ISTC Japan Workshop on Space Weather Forecast in Russia/CIS, Nagoya, Japan, 5-6 June 2002, Nagoya University STE Laboratory, Vol. 2, 109, 2002.

Data books and reports

Data Reports: Data of the 18IGY-Neutron Monitor Jungfrauoch, 01.01.-30.06.2002
Data of the 18IGY-Neutron Monitor Jungfrauoch, 01.07.-31.12.2002
Data of the 3NM64 Neutron Monitor Jungfrauoch, 01.01.-30.06.2002
Data of the 3NM64 Neutron Monitor Jungfrauoch, 01.07.-31.12.2002

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