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. Erwin Flückiger, project leader
Dr. Rolf 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 two standardized neutron monitors (NM) at Jungfraujoch: an 18-IGY NM (since 1958) and a 3-NM64 NM (since 1986). NMs provide key information about the interactions of 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 NMs 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 $\geq$ 4.6 GeV and to solar neutrons with energies as low as ~250 MeV.

In Figure 1 the measurements of the IGY neutron monitor at Jungfraujoch (lower panel) since the bringing into service in 1958 are shown. 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 number plotted in the upper panel of Figure 1. As the sunspot activity cycle 23 is on its decreasing phase the count rate of the IGY neutron monitor at Jungfraujoch shows a distinct increase in 2004. This tendency of increasing cosmic ray flux is also obvious from Figure 2 that shows daily mean values for 2004. As the Sun is less active the variability of the NM data was also less pronounced than during the preceding years. The sharp decrease of ~4% at the beginning of May 2004 was due to heavy snow fall at Jungfraujoch, and the increase one day later is caused by the removing of a layer of snow of ~50 cm from the roof of the detector housing. The short decrease of again ~4% at the end of July 2004 was seen by all Swiss neutron monitors (IGY and NM64 neutron monitor at Jungfraujoch, and special neutron monitor in Bern), and it was due to a short depression of the cosmic ray flux near Earth.

The records of the two NMs at Jungfraujoch are published on a webpage (http://cosray.unibe.ch), and in special reports. In addition, the data are submitted to the World Data Centers in Boulder and Tokyo in electronic form.

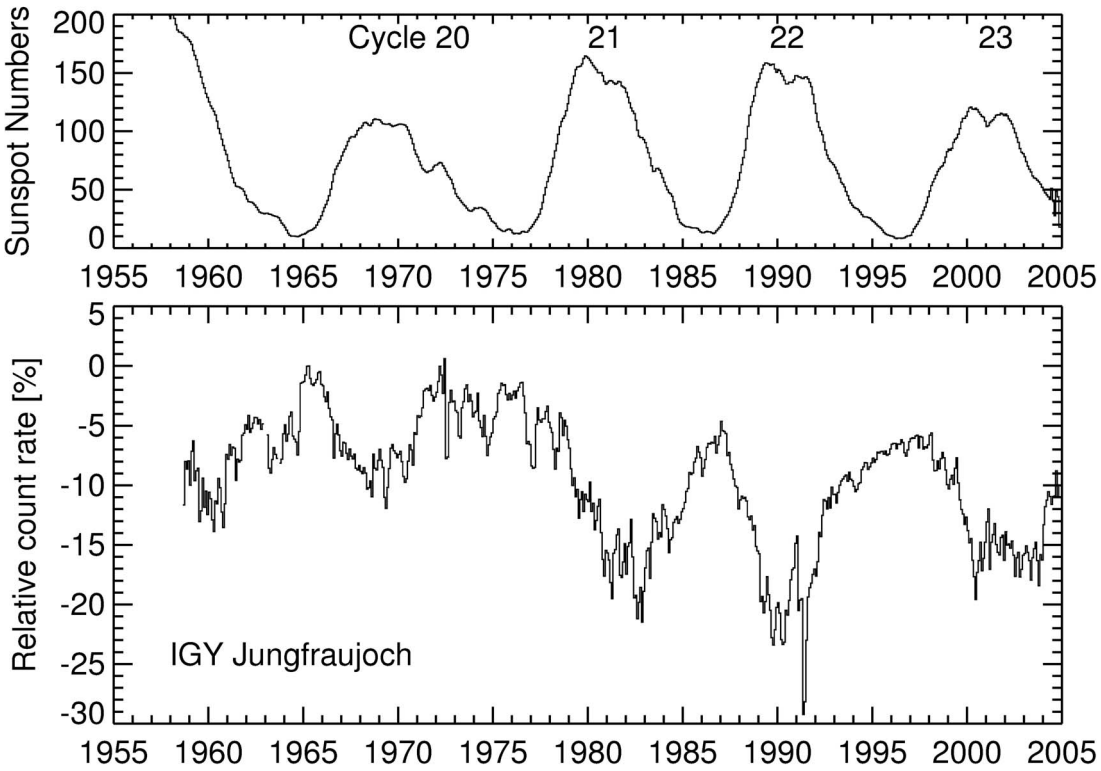

Figure 1: Smoothed sunspot numbers (top panel), pressure corrected monthly average counting rates of IGY neutron monitor at Jungfraujoch (bottom panel) for the years 1958-2002. The neutron monitor count rate is expressed in relative units with respect to May 1965.

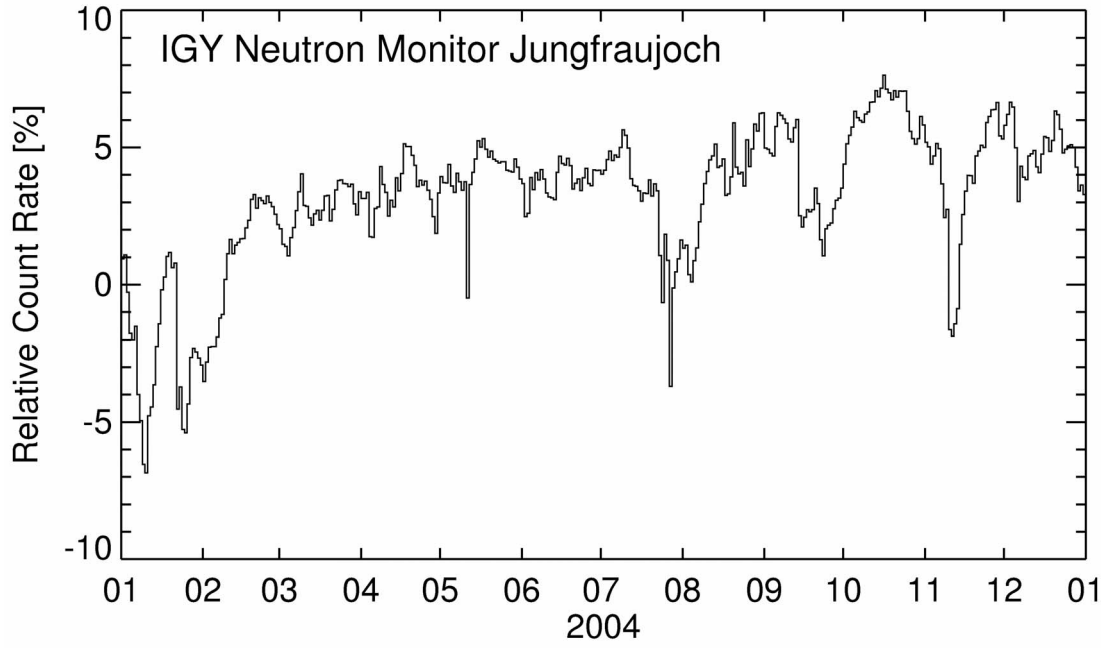

Figure 2: Pressure corrected relative daily counting rates of the IGY neutron monitor at Jungfraujoch for 2004.

Key words:

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

Internet data bases:

http://cosray.unibe.ch

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 2004:

Conference papers

Flückiger, E.O., R. Bütikofer, L. Desorgher, M.R. Moser, Y. Muraki, Y. Matsubara, T.Sako, H. Tsuchiya, and T. Sakai, The giant Forbush decrease in October/November 2003: Data analysis for the solar neutron detector at Gornergrat, 19th European Cosmic Ray Symposium, Proceedings, Florence, Italy, 2004, to be published in the International Journal of Modern Physics A.

Moser, M.R., E.O. Flückiger, R. Bütikofer, L. Desorgher, Y. Muraki, Y. Matsubara, T. Sako, H. Tsuchiya, and T. Sakai, The Extreme Solar Events and the Giant Forbush Decrease in October/November 2003: Analysis of Ground-based Cosmic Ray Data, 35th COSPAR Scientific Assembly, Paris, France, 2004.

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