Catalogue of LDE-type flares (1993–1994)

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Abstract. The Catalogue of LDE-type flares covers 25 years of LDE-type flare data (1969 – 1994). The continuation of the list of long-lasting SXR flares (LDE-type) is given in Table 1. The latter contains the list of LDE flares observed from July 1993 to June 1994, and ties in timewise with the previous paper (Antalová 1990); it is only available in a computer-file form. One considers temporal variations of the occurrence of the LDE flares, with SXR duration exceeding 2 hours, throughout the 22-nd cycle. Current studies of the heliosphere regard Coronal Mass Ejections (CMEs) as a principal phenomenon modifying its properties. CMEs are usually accompanied by dynamic activity phenomena (LDE–type flares, DBs and eruptive prominences). That is the reason why CMEs are implicitly incorporated in LDE–type flare list. Analysis of the LDE–type flare occurrence in solar cycles 20, 21 and 22 is published in the following papers:

- Periodicities of the LDE-type flare occurrence (1969 – 1992) in Antalová (1994).
- Cosmic-ray modulation and long-duration solar flare events, in Kudela et al. (1994).
- On the correlation between daily GCR intensity values and LDE–type flare index (1987, 1988, 1990 and 1992) in Antalová et al. (1995). The temporal changes found in a daily CNI–FI anticorrelation profile reflect the cyclic magnetic reversal of the Sun as well as the corresponding heliospherical topology.
- E–W distribution of Solar LDE–type Flares and Galactic Cosmic ray modulation (1969–1972) in Antalová et al. (1994) and Jakimiec et al. (1995).
- Role of LDE–type flares in the GCR Modulation (1969–1972) in Antalová et al. (1995)
- The magnetic reversal in the 21st solar cycle and LDE–type flares in Antalová (1996).

Key words: the Sun - flares

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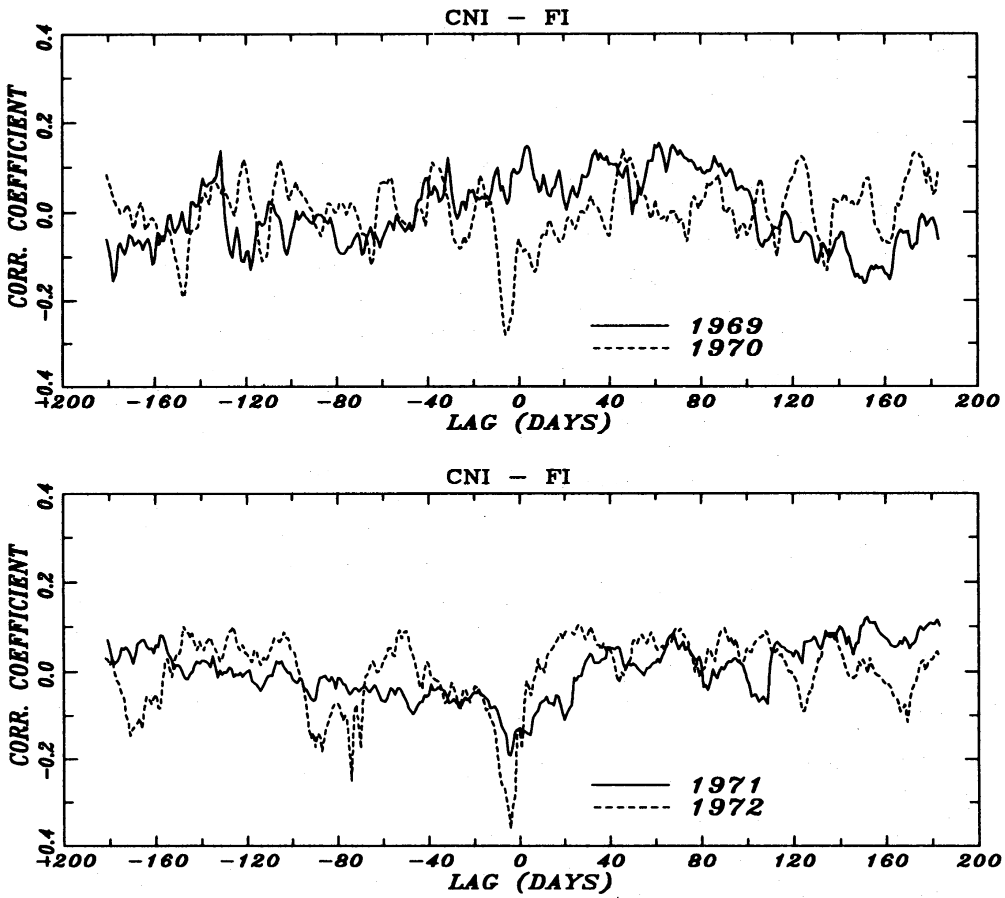

Figure 1. The results of an intercorrelation analysis between the daily Calgary Galactic Cosmic Ray intensity values (CNI) and daily values of LDE–type flare index (FI) over a period of 1969 – 1972. The figure is taken from Antalová et al. (1995). The CNI–FI anticorrelation is found to be statistically significant in post-maximum years, while no such anticorrelation is seen in the maximum year of the 20th cycle (1969). The maximum years of the 20th and the 22nd cycles exhibit similar absence of the anticorrelation between CNI and a non–flare SXR coronal flux (XBG).

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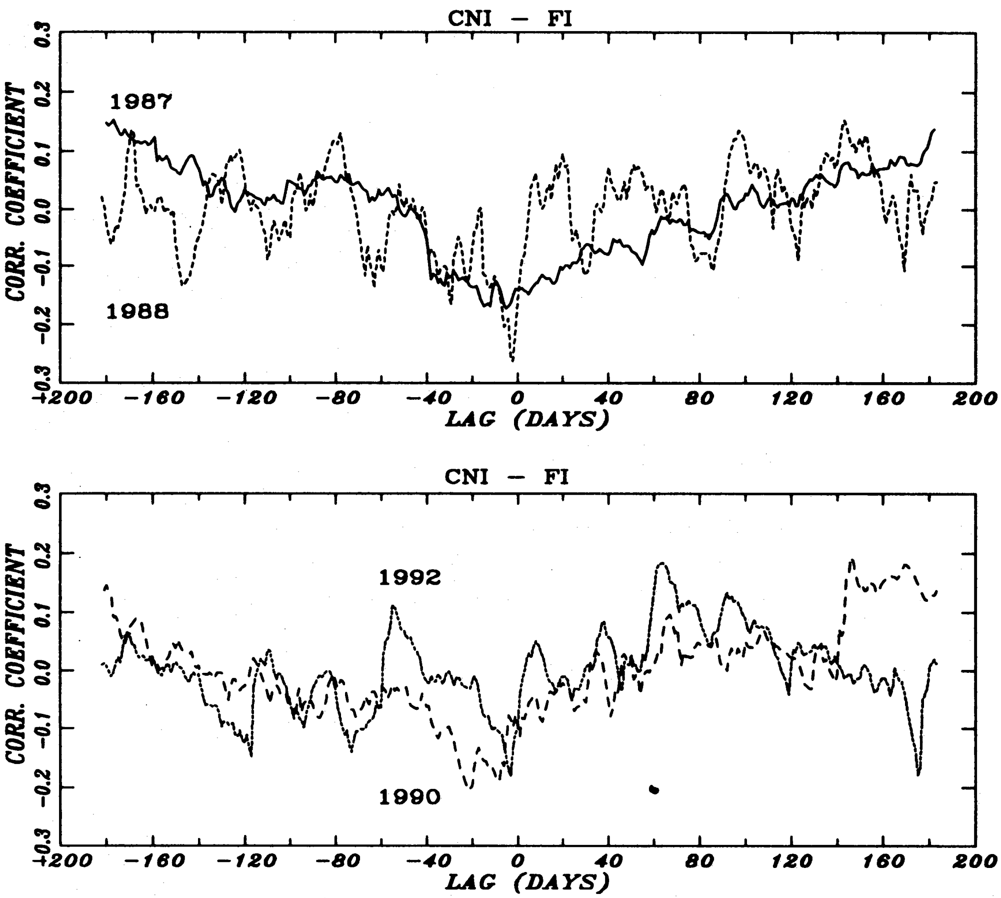

Figure 2. The results of the CNI–FI correlation analysis. The figure is taken from Antalová et al. (1995a). The correlation analysis between daily values of Calgary Galactic Cosmic Ray intensity (CNI) and LDE–type flare index (FI) reveals the following results: in all years under consideration, the CNI–FI anticorrelation is small, but statistically significant. The yearly CNI–FI trend depends on yearly heliospherical conditions and on their 22–year cyclical changes. At the onset of the 22–nd cycle (in 1987 – solid line) the CNI–FI relation had broad minimum (r = – 0.15), similar to the result for non–flare SXR background corona in 1987. In 1988 short-term CNI lag were found (r = – 0.23 at – 2 day). In 1992 the typical short–term CNI–FI lag (from – 1 to – 3 days) was found, indicating the presence of local heliospherical CNI modulation sources. In 1990, the CNI–FI correlation has two minima at – 22 day CNI lag r = -0.21 as well as at – 9 day CNI lags r = – 0.19 . Such 1990's double CNI–FI crosscorrelation minimum is consistent with the existence of two, amplitudinally balanced CNI modulation sources in the 1990's heliosphere. The first source seems to be a substantial Global Merged Interaction Region (GMIR) located in the outer heliosphere (its efficiency increased 22 days after the flare episode). The second source has a typical local short-term CNI lag (connected with flare, CME and DB energetics).

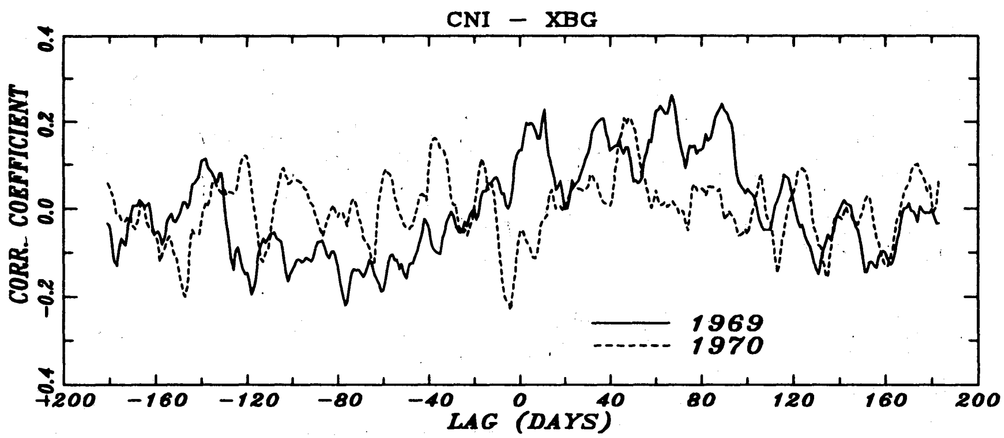

Figure 3. The results of the intercorrelation analysis between the daily Calgary Galactic Cosmic Ray intensity values (CNI) and daily solar SXR background (XBG - unresolved full-sun SXR GOES flux). The figure is taken from Antalová et al. (1995c, 1995b). **1969:** r = 0.00 at –5 days, no CNI–XBG correlation exists. **1970:** r = –0.06 at –25 day lag and r = –0.23 at –4 day lag.

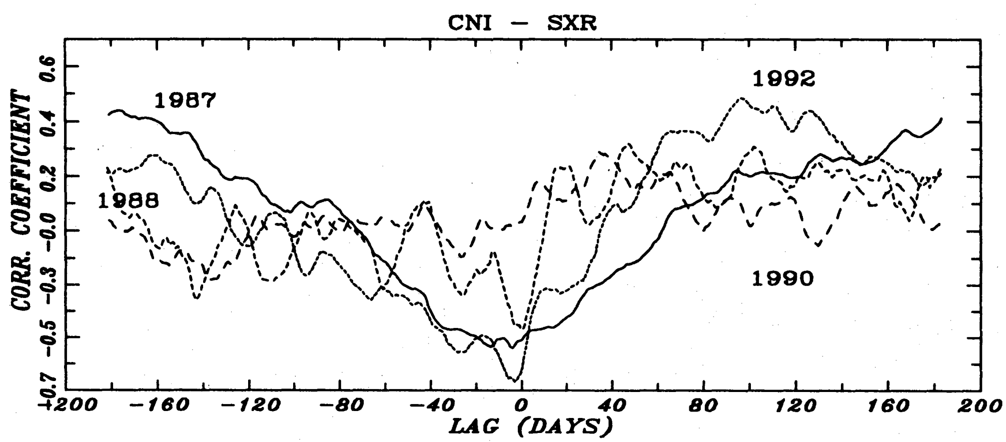

Figure 4. We have obtained the following anticorrelation coefficients for the years analysed: *1987 (solid line)* : r = – 0.49; *1988 (small dashed line)* : r = – 0.42; *1990 (large dashed line)*: almost no correlation, r = – 0.02; substantial heliospherical structure was GMIR, *1992 (dotted line)* : the best short-term CNI–XBG anticorrelation was found (r = – 0.62). The anticorrelation between CNI and XBG is statistically significant for 1987, 1988 and 1992 sequences. In 1990, no anticorrelation between CNI and XBG was found. The latter fact gives evidence for the Global Merged Interaction Region (GMIR) being the most dominant GCR modulation structure, while local heliospherical structures seemed to play in 1990 only the secondary role.