Abstract. Two remarkable intensity-time patterns in the 113 and 64 MHz single-frequency radio flux records during a type I noise storm and/or a type IV burst on 31 July, 1983 are studied. A comparison of the patterns at both frequencies reveals a high degree of resemblance and inherent common structure although the 64 MHz pattern was seen 40 min later than the 113 MHz pattern. An interpretation is given assuming a slowly uprising and thereby expanding clumpy plasma-magnetic field configuration which is (via accompanying coronal loops) two times illuminated by energetic electrons coming from the soft X-ray flare precursor source region of the H-alpha flares F1 and F2 (see Figure 1).

1. Introduction

On radio spectrograms different types of bursts and spectral fine structures are sometimes characterized by a phase correlation in the frequency-time plane; the resulting time delays of related phenomena range from fractions of a second up to minutes (Krüger, 1979).

We give an example of correlated intensity variations (‘patterns’) observed with a very large time delay (40 min) at 113 and 64 MHz. The observation is quantitatively described by analyzing high time-resolution records (0.062 s sampling rate) using statistical methods. In the discussion we present proposals for an interpretation in terms of noise storm chains, coronal mass ejections, and flare precursor phenomena. Additional soft X-ray data support a plausible explanation of the strange observation which invokes a close connection between X-ray and radio source regions.

2. Observations

On 31 July, 1983 the single-frequency patrol records of the Tremsdorf Observatory indicate weak noise storm activity at 234 and 113 MHz (right-handed circularly polarized). At 07 : 32 UT, a weak type IV burst starts at both frequencies, and in the decimeter-microwave range. Somewhat later, at 07 : 42 UT, the first of a sequence of three H-alpha flares in the course of the next hour is noted in the active region group NOAA No. 4263, 4267, and 4268 (Solar Geophysical Data, 1983). About 40 min later the radio event is observed at lower frequencies also. Figure 1 gives the meter-wave flux
Fig. 1. The meter wavelength radio flux intensity $I$ and the circular polarization degree $P$ of the 31 July, 1983 event (Tremsdorf Observatory). Intensity scales are given in solar units (1 s.u. = $10^{-22}$ W m$^{-2}$ Hz$^{-1}$). The sense of the circular polarization is indicated. The brackets in the top and the bottom of parts of the 113 and 64 MHz records denote the intervals of special interest. The arrows at the bottom time scale of the figure mark the onset times of the corresponding microwave burst and the H-alpha flares (Solar Geophysical Data, 1983). The table in the upper left corner gives flare coordinates and importances. Note that the saturation occurs at 60 s.u. for the sensitive 234 MHz record.

and polarization records, together with the starting times, heliographic coordinates, and importances of the related H-alpha flares. Below the 113 and 64 MHz records, bars mark the first 20 min intervals of the event. The ends of these intervals are characterized by a steplike flux increase (see the square brackets above the 113 and 64 MHz records in Figure 1).

Using Weissenau spectral records (kindly supplied by H. Urbarz) the discussed flux record intervals have been identified as noise storm continua with drifting chains and (in the late phase of the 64 MHz record) type III storm-like features (Urbarz, 1983, 1985). Near 113 MHz, and at 64 MHz immediately after the onset of the continuum, the emission becomes restricted in bandwidth.

3. Data Analysis

First, using high time-resolution digital 113 and 64 MHz records, the hypothesis has been tested that both intervals marked in Figure 1 represent a highly similar sequence of single bursts. By means of a special cross-correlation analysis (Kurths, 1986) the burst pattern can be divided (after a linear trend removal) into at least four strongly