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ORIGINAL ARTICLE

Geoeffectiveness and flare properties of radio-loud CMEs

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Abstract A detailed investigation on geoeffective CMEs associated with meter to Deca-Hectometer (herein after m- and DH-type-II) wavelengths range type-II radio bursts observed during the period 1997–2005 is presented. The study consists of three steps: *i*) the characteristics of m- and DH-type-II bursts associated with flares and geoeffective CMEs; *ii*) characteristics of geo and non-geoeffective radio-loud and quiet CMEs, *iii*) the relationships between the geoeffective CMEs and flares properties. Interestingly, we found that 92 % of DH-type-II bursts are extension of m-type-II burst which are associated with faster and wider geoeffective DH-CMEs and also associated with longer/stronger flares. The geoeffective CME-associated m-type-II bursts have higher starting frequency, lower ending frequency and larger bandwidth compared to the general population of m-type-II bursts. The geoeffective CME-associated DH-type-II bursts have longer duration ($P \ll 1$ %), lower ending frequency ($P = 2$ %) and lower drift rates ($P = 2$ %) than that of DH-type-IIs associated with non-geoeffective CMEs. The differences in mean speed of geoeffective DH-CMEs and non-geoeffective DH-CMEs (1327 km s^{-1} and 1191 km s^{-1}, respectively) is statistically insignificant ($P = 20$ %).However, the mean difference in width (339° and 251°, respectively) is high statistical significant ($P = 0.8$ %). The geo-effective general populations of LASCO CMEs speeds (545 km s^{-1} and 450 km s^{-1}, respectively) and widths (252° and 60°, respectively) is higher than the non geo-effective general populations of LASCO CMEs ($P = 3$ % and $P = 0.02$ %, respectively). The geoeffective CMEs associated flares have longer duration, and strong flares than non-geoeffective DH-CMEs associated flares ($P = 0.8$ % and $P = 1$ %, respectively). We have found a good correlation between the geoeffective flare and DH-CMEs properties: *i*) CMEs speed—acceleration ($R = -0.78$, where R is a linear correlation coefficient), *ii*) acceleration—flare peak flux ($R = -0.73$) and, *iii*) acceleration—Dst index intensity ($R = 0.75$). The radio-rich CMEs (DH-CMEs) produced more energetic storm than the radio-quiet CMEs (general populations of LASCO CMEs). The above results indicate that the DH-type-II bursts tend to be related with flares and geoeffective CMEs, although there is no physical explanation for the result. If the DH-type-II burst is a continuation of m-type-II burst, it could be a good indicator of geoeffective storms, which has important implications for space weather studies.

Keywords Coronal mass ejections · Type-II bursts, geoeffective radio-loud CMEs

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1 Introduction

The type-II radio bursts are the earliest evidence of shocks near the Sun and in the interplanetary medium (Gopalswamy et al. 2008a; 2008b). The meter wavelengths type-II radio

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