



## **Forbush decreases associated with coronal mass ejections or coronal holes in various phases of solar activity**

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Forbush Effects and Interplanetary Disturbances database created and maintained at IZMIRAN has been used to compare properties of Forbush decreases (FDs) observed during solar cycles 23-24, maximums of the cycles and the minimum between the cycles. The database provided 1677 isolated FDs since 1996 to 2015; 350 FDs caused by high speed streams from coronal holes (recurrent events) and 207 FDs caused by interplanetary disturbances from coronal mass ejections (sporadic events). The last two groups were selected with big reliability within the group of isolated FDs. Each FD was described by 6 parameters: FD magnitude, decrease rate, duration of main phase, maximum values of cosmic ray anisotropy and solar wind velocity and interplanetary magnetic field intensity. Statistical methods (distribution analyses, calculation of medians, interquartile ranges and means with 95% confidence intervals) were used to compare parameters of recurrent and sporadic FDs in the different phases of solar activity. The results revealed that sporadic FDs prevailed in the maximums of the cycles, recurrent FDs – in the minimum between the cycles. FD parameters (magnitude, decrease rate, anisotropy) are larger for sporadic events than for recurrent ones, especially in the maximums of the cycles. FD magnitude is greater in the maximums than in the minimum for sporadic events and it changes weakly for recurrent ones. Solar wind velocity is in average greater for recurrent events than for sporadic ones; it is larger for recurrent FDs in the minimum and for sporadic FDs – in the maximums. Magnetic field is stronger for sporadic FDs than for recurrent ones in the maximums and it is approximately equal for both types of events in the minimum. The duration of FD main phase is less in the maximums for both types of events; sporadic FDs develop significantly faster than recurrent ones in the maximum of cycle 23.