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Photospheric magnetic field structure changes and coronal mass ejection activity

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Magnetic fields play an important role in all solar activity processes. Solar photospheric magnetic fields significantly vary in scales and lifetime. Evolution of photospheric magnetic fields and corresponding coronal mass ejection activity are studied using SOHO/MDI, SOHO/EIT, and SOHO/LASCO observations. Coronal mass ejections observed by the Large Angle and Spectrometric Coronagraph Experiment aboard the Solar Heliospheric Observatory in the interval from 1996 to 2003 are used. An analysis has been made with the emphasis on the correlation between coronal mass ejections and solar photospheric magnetic field structure evolution. Spatial and temporal distributions of solar coronal mass ejections and associated photospheric magnetic field evolution for the rising phase of the 23-rd solar cycle are under consideration. Clustering properties were revealed for various phenomena of solar activity. Active regions were found distributed not at random but they form complexes of activity. The cluster structures were revealed in the time–space organization of active regions. Distribution of solar flares also shows evidence for connections with some active regions clusters. The cluster structure has been revealed in the time-space organization of coronal hole distribution. These clusters reflect the large-scale solar magnetic field distribution. The complexity and lifetime of all these clusters vary with solar cycle. There are periods when the character of coronal holes and active regions cluster distribution changes significantly on the solar disk. It is found that the evolution of photospheric magnetic fields during these periods is characterized by relatively sudden rearrangements of the structures of magnetic fields. Solar cycle variation of properties of coronal mass ejections (daily rate, velocity, acceleration, widths, angle position, mass, potential energy, speed, kinetic energy) and different type coronal mass ejections association with active regions and coronal holes clusters are analyzed for cycle 23 (1996-2003). The periods of rearrangements of cluster structures and their rela-

tion to coronal mass ejection activity processes are studied. It is found that periods of large scale photospheric magnetic field (traced by coronal holes) reorganizations are characterized by higher coronal mass ejection activity. Peculiarities of photospheric magnetic field structure changers in active regions at different phases of the solar cycle, the rearrangements in active region's magnetic fields that could lead to the coronal mass ejections are discussed. Influence of new magnetic flux emerging, helicity, and evolution of photospheric magnetic fields in active regions, which belongs to clusters and those, which are not, on the coronal mass ejections are studied. Positive-polarity and negative-polarity magnetic flux disbalance in active regions is analyzed. The results show that the initiation and evolution of different type coronal mass ejections involve complex magnetic field structures changes. The possible coronal mass ejection initiation mechanisms are discussed.