

Study of the effect of coronal mass ejections (CMEs) on space weather in two cycles of solar activity (cycles 23 and 24).

1. The principal aim of the project

Thanks to the SOHO satellite, we have been able to observe the solar atmosphere with very high sensitivity and resolution for over two decades. Along with the observations carried out by other satellites, a huge observational material has been obtained that allow us to study the change in solar activity over solar cycles 23 and 24 in many aspects, not only using the Wolf number. This is important because the Sun is currently in a phase of a marked decline in magnetic activity. This could have far greater consequences for the planet's climate than the widely presented greenhouse effect. The main goal of the proposed research is to analyze changes in various parameters of solar activity recorded over the last two decades. The result of the research may be important in the context of space weather forecasting in subsequent cycles of solar activity. There is a real possibility to recognize threats from the Sun during solar cycles characterized by different intensity of magnetic activity (long-term forecasting of space weather (at least decades)). This research may be revolutionary, for example in the context of planned manned missions to Mars.

2. Research Project Objectives

Coronal mass ejections (CMEs) were discovered in the early 1970s. They are huge eruption of magnetized plasma from solar corona. Very soon it became clear that they play a crucial role in a solar-terrestrial relationship. They are responsible for the most severe geomagnetic storms (disturbances in the Earth's magnetosphere). CMEs affect our environment in two ways: directly by hitting Earth's magnetosphere during their propagation in the interplanetary medium or indirectly generating fluxes of solar energetic particles (SEPs). Therefore, the current research will focus on CMEs and the parameters that influence their geo-efficiency. In the proposed project, by examining CMEs, we will search for new, better methods to predict the moment of the onset of geomagnetic disturbances and their intensity. We will also study the dynamic parameters of CMEs (such as mass and energy) which significantly determine the geo-efficiency of ejections. Importantly, these studies will be conducted for the last two cycles of solar activity. We know that these cycles differ significantly in many aspects. This research could be important in forecasting the evolution of solar activity in the coming decades.

3. Importance of the project

All issues included in the proposed study are crucial from the point of view of space weather and the potential change in solar activity in the coming decades. We live in the world of advanced technology that is highly sensitive to solar activity. CME can significantly disrupt life on Earth (energy grids, navigation systems, communication, space technology). Keep in mind that the problem of such interference affects not only the everyday life of society but also affects the sphere of security of states and their defense. Predicting the occurrence and intensity of geomagnetic disturbances is one of the most important aspects of studying our nearest star.