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SPACE WEATHER AND THE IMPACT OF ELECTROMAGNETIC DISTURBANCE ON FLIGHT DELAYS

Abstract

Space weather refers to the effects of solar activity and interplanetary material on Earth, including Solar Flares, Coronal Mass Ejections, Solar winds, and so on. These physical phenomena have a huge impact on the Earth's space environment and electronic equipment, which can lead to communication disruptions, grid faults, satellite lock-outs and airline crew health. Meanwhile, aviation activities have brought a lot of convenience to people's travel, and also greatly promoted the development of the world economy, culture and society. The delay or cancellation of flights will not only bring great inconvenience to passengers but also bring great economic losses to the airport and the airline company. Due to the access to flight data and the intersectionality of the research, the current international studies on flight delay mainly focus on air traffic control, tropospheric weather and airline decision-making, but few pay attention to the impact of space weather factors on flight operation (delay and cancellation) in a wide range. To rule out the impact of COVID-19 on the aviation industry, for the first time this study, based on a large number of flight data from China's five major hub airports from 2015 to 2019, conducted weighted average and correlation analysis on flight data, and analyzed and compared changes in space weather (Solar Flares, Coronal Mass Ejections and Solar Proton Events studied in this paper) and flight operations during quiet periods. Finally, the conclusion is drawn:(1) During space weather events, the flight cancellation rate of the five airports selected in the experiment increased significantly compared with the calm period. (2) To remove the interaction between space weather events more specifically and ensure the objectivity and reliability of the experimental results, 42 independent events were selected for analysis in this study. The study found that over time, the impact of space weather events on flight cancellation rates became less and the cancellation rate gradually returned to calm period levels. (3) Space weather disturbances to the ionosphere cause some ionospheric indices such as TEC, foF2 and AE to fluctuate for a short time which concludes that the fluctuation of the ionospheric indices is positively correlated with the flight cancellation probability. The findings enhance our comprehension of space weather and offer novel insights into the repercussions of commercial flight delays and cancellations. This advancement holds immense significance for humanity's profound exploration of space weather and comprehensive understanding of its phenomena.