

Probabilistic Risk Assessment of Solar Particle Events Considering the Cost of Countermeasures to Reduce the Aviation Radiation Dose

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Cosmic-ray exposure to flight crews and passengers, which is called aviation radiation exposure, is an important topic in radiological protection, particularly for solar energetic particles (SEP). We therefore assessed the risks associated with the countermeasure costs to reduce SEP doses and dose rates for eight flight routes during five ground level enhancements (GLE). A four-dimensional dose-rate database developed by the Warning System for Aviation Exposure to Solar Energetic Particles, WASAVIES, was employed in the SEP dose evaluation. As for the cost estimation, we considered two countermeasures; one is the cancellation of the flight, and the other is the reduction of flight altitudes. Then, we estimated the annual occurrence frequency of significant GLE events that would bring the maximum flight route dose and dose rate over 1.0 mSv and 80 μ Sv/h, respectively, based on past records of GLE as well as historically large events observed by the cosmogenic nuclide concentrations in tree rings and ice cores. Our calculations suggest that GLE events of a magnitude sufficient to exceed the above dose and dose rate thresholds, requiring a change in flight conditions, occur once every 47 and 17 years, respectively, and their conservatively-estimated annual risks associated with the countermeasure costs are up to around 1.5 thousand USD in the cases of daily-operated long-distance flights.

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