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Comparisons between Atmospheric Radiation Models and Data from Flights of CREAM during Quiet Time & Solar Particle Events

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Data from the CREAM (Cosmic Radiation Effects and Activation Monitor) experiments are presented from a wide range of flights including worldwide commercial jets at 33000 to 39000 feet, worldwide executive jet flights to 49000 feet and supersonic Concorde flights between UK and USA to 59000 feet. The CREAM detectors have been calibrated to give both aircrew dose (ambient dose equivalent) and neutron fluxes relevant to single event effects in avionics. This wide ranging data set is compared with some of the common models used to assess crew dose, such as EPCARD [1] and CARI [2], as well as the QinetiQ Atmospheric Radiation Model (QARM) [3], which uses atmospheric response functions generated by Monte Carlo radiation transport codes. Quiet-time data are reasonably well fit by the models, although there is considerable sensitivity to the input cosmic ray spectrum. However solar particle events present a challenge due to their variability in spectra, anisotropies and the often concurrent geomagnetic disturbances that alter the cut-off rigidities. The QARM model attempts to deal with these events by utilising both space data and ground level neutron monitor data as well as generating cut-off rigidities for disturbed geomagnetic field conditions. Reasonable fits have been obtained with the series of events observed from flights of CREAM on Concorde during September and October 1989. Events of the recent solar maximum are also examined, including the large event of 20 January 2005 during which ground level increases reached a factor 30, but flight data are very limited. The accuracy of such techniques will remain limited until flight monitors are widely deployed. To this end a compact monitor, QDOS, has been developed based on the experience obtained from CREAM.

Keywords: Cosmic rays, solar particle events, dose, single event effects

References

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