The projection of space radiation environments with a solar cycle statistical model

Myung-Hee Y. Kim (1), Francis A. Cucinotta (2), and John W. Wilson (3)

(1) Wyle Laboratories, Houston, Texas, 77058, USA

(2) NASA Johnson Space Center, Houston, Texas, 77058, USA

(3) NASA Langley Research Center, Hampton, Virginia, USA

A solar cycle statistical model has been developed to project sunspot numbers, which represent the variations in the space radiation environment. The resultant projection of sunspot numbers in the near future were coupled to space-related quantities of interest in radiation protection, such as the galactic cosmic radiation (GCR) deceleration potential (ϕ) and the mean occurrence frequency of solar particle events (SPEs). Future GCR fluxes have been derived from a predictive model, in which GCR temporal dependence, represented by ϕs was derived from GCR flux and ground-based Climax neutron monitor rate measurements over the last four decades. Results showed that the point dose equivalent inside a typical spacecraft in interplanetary radiation fields was influenced by solar modulation up to a factor of three. One important characteristic of sporadic SPEs is their mean frequency of occurrence, which depends on solar activity. Projections of future mean frequency of SPE occurrence were estimated from a power law function of sunspot number. In addition, the cumulative probabilities of SPE during short-period missions were defined with the continuous database of proton fluences of SPE. The analytic representation of energy spectra of SPE was constructed by the Weibull distribution for different event sizes. The representative exposure level at each event size was estimated, and the results will be used in developing guidelines for protection systems for astronauts during future space exploration missions.