Space Weather Hazards on Aviation Exposure: Development of WASAVIES (Warning System for Aviation Exposure to SEP)

Ryuho Kataoka[1]; Tatsuhiko Sato[2]; Yuki Kubo[3]; Daikou Shiota[4]; Seiji Yashiro[5]; Takao Kuwabara[6]; Hiroshi Yasuda[7]

[1] NIPR; [2] JAEA; [3] NICT; [4] STEL, Nagoya Univ.; [5] CUA; [6] University of Delaware; [7] NIRS

At flight altitudes, aircrews are subject to exposure to an enhanced level of cosmic radiations. Protection for them against these terrestrial cosmic radiations has been widely discussed since the issue of International Committee on Radiological Protection (ICRP) publication 60 in which this aircrew exposure is recognized as an occupational hazard. As a result of this discussion, many countries have issued regulations (or recommendations) setting an annual dose limitation for aircrews. The dominant source for enhancing the radiation doses at flight altitudes is the galactic cosmicrays (GCR), since they can penetrate deep inside the atmosphere while generating a cascade of secondary particles called air shower. Thus, several calculation codes have been developed for estimating the GCR doses at flight altitudes, and used for the regulatory purpose. On the other hand, solar energetic particles (SEP) can also reach to flight altitudes by producing secondary particles, and they can temporarily increase the radiation doses to great extent – occasionally by two orders of magnitude in comparison to the GCR doses. For such cases, not only afterward evaluation but also forecast of the radiation doses is desirable, since the SEP doses for one flight during a large solar flare can exceed 1 mSv, which corresponds to the annual dose limitation for public adopted in many countries. However, none of the existing system can be utilized for that purpose mainly because of the difficulties of the prediction of the SEP fluxes incident to the atmosphere. From these situations in mind, we are trying to develop a forecast system for the SEP doses named WASAVIES (WArning System for AVIation Exposure to Solar energetic particles). The basic strategy of WASAVIES is to: [1] detect ground level enhancement (GLE) onset by multiple ground-based neutron monitors (Kuwabara et al. SW 2006), and obtain the GLE, solar wind, and flare parameters to publish the preliminary forecast within one hour after X-ray flare detection, [2] within 6 hours after the flare onset, automatically obtain the CME parameters to predict the CME driven SEP profiles, [3] calculate the time-varying SEP fluxes incident to the atmosphere, [4] calculate the SEP and their secondary particle fluxes in the atmosphere using a database developed based on air shower simulation performed by the PHITS code (Sato et al. Radiat. Res. 2008), and [5] convert the particle fluence to radiation dose for human body using the dose conversion coefficients (Sato et al. Phys. Med. Biol. 2009). The present status of the development of WASAVIES will be reported, together with a brief summary of the currently operating systems for estimating the GCR and SEP doses.