

Exposure to the Atmospheric Ionizing Radiation Environment: Studies on Icelandic and Italian Civilian Aviation Flight Personnel

G. DE ANGELIS^{1,2,3}, M. CALDORA¹, M. SANTAQUILANI¹, R. SCIPIONE¹,
A. VERDECCHIA¹, V. RAFNSSON⁴, J. HRAFNKELSSON⁵, P. SULEM⁴,
and A. J. GUDJONSDOTTIR⁴

¹*Istituto Superiore di Sanita', Rome, I-00161, Italy*

²*Old Dominion University, Norfolk VA, 23529, USA*

³*NASA Langley Research Center, Hampton VA, 23681, USA*

⁴*University of Iceland, Reykjavik, 105, Iceland*

⁵*University Hospital, Reykjavik, 105, Iceland*

The largest source of data on human exposure to low dose rate radiation may be airline flight personnel, if enrolled for studies on health effects induced by the cosmic-ray-generated atmospheric ionizing radiation, whose total dose, increasing over the years, may cause delayed health effects, due to its so typical high-LET and highly ionizing neutron component. In this view, the Italian civilian airline flight personnel have been studied by analyzing their radiation exposure and associated effects. The study population includes all Italian civilian airline flight personnel, both cockpit and cabin crewmembers, whose work history records and actual flights (route, aircraft type, and date for each individual flight for each person where possible) were available. The dose calculations were performed along specific flight legs, taking into account the actual flight profiles for all different routes and the variations with time of solar and geomagnetic parameters. Dose values for each flight are applied to the flight history of study participants in order to estimate the individual annual and lifetime occupational radiation dose. Following the same protocol in terms of dose evaluation, a similar study has been performed for the Icelandic civilian aviation flight personnel. A comparative study of the exposure patterns of these two extreme populations has been performed. The Icelandic crewmembers, like only in the world their Canadian colleagues, always fly over or very close to the geomagnetic pole, and are this way exposed to high doses within each flight leg, whereas the Italian crewmembers, apart from transatlantic flights, are always flying close to the geomagnetic equator or anyhow quite far from the geomagnetic pole, receiving a small dose rates for each flight. Average dose rate values for aircraft types and routes have been obtained, and the annual individual dose for each crewmember is obtained by multiplying the average dose rates by the number of block hours for aircraft type flown each year. Analysis of particle spectra, dose rates and cumulative doses to crewmembers in relationship with different health outcomes for the two considered aircrew groups is in progress.

Keywords: Radiation; Earth; atmosphere; modeling; doses; aircraft.