II Cosmic radiation environment at aircraft altitudes and dosimetry

II.1 Cosmic radiation

The earth is continuously bombarded with high-energy ionising radiation from outer space. The intensity of the cosmic radiation is partly decreased by the magnetic field associated with the Sun's solar wind and by the Earth's magnetic field. Many important data on the cosmic radiation in general and near the Earth's surface were presented in a previous EURADOS Report on the topic [EUR96]. Some basic characteristics are repeated here and some further information is added on the influence of solar particle events and magnetic disturbances.

The cosmic radiation field (in the Earth´s atmosphere), to which aircraft crew members are exposed, has two different origins: energetic particles from the universe in general (usually referred to as galactic cosmic radiation) and from the Sun.

Galactic energetic charged particles (galactic cosmic radiation (GCR)) are mostly protons (~85 %) and helium ions (~12 %), the rest includes nuclei of all known elements and some electrons. Their energy extends up to about 10^{20} eV. The GCR interacts with the atmosphere producing secondary radiation, which together with the primary incident particles give rise to radiation exposure throughout the atmosphere decreasing in intensity with depth from the altitude of supersonic aircraft down to sea level.

The dose from GCR varies not only with altitude but also with the geomagnetic coordinates (longitude and latitude) being larger towards the poles and smaller near the equator. It also depends on the solar activity, which varies according to a cycle about 11 years long. The GCR contribution to the aircraft crew exposure is about 95 %. GCR exposure is fairly stable and predictable.

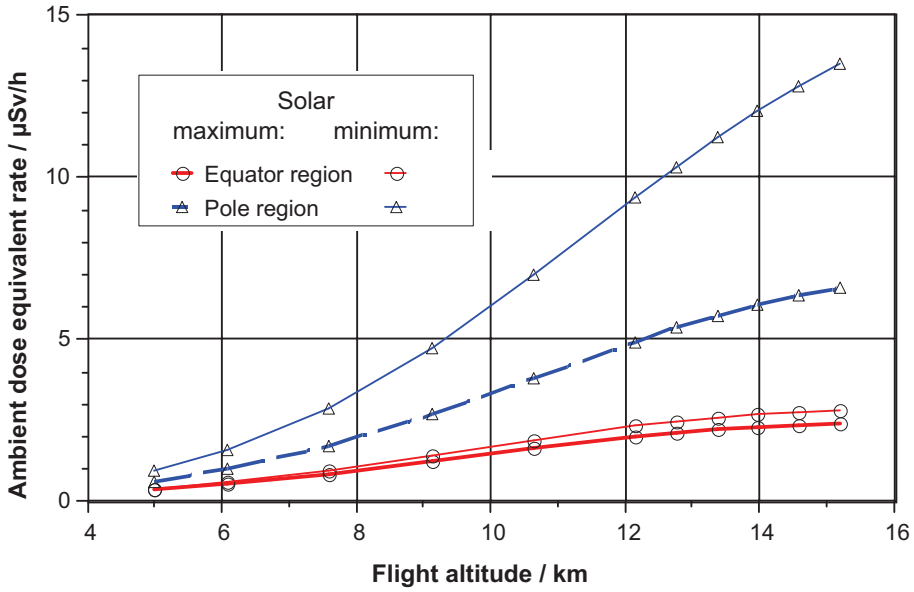

Figure II.1 Calculated ambient dose equivalent rate, dH*(10)/dt, for conditions close to solar maximum activity (Jan.1990) and close to solar minimum (Jan. 1998), both at zero-meridian (λ=0°) and geographic latitude ϕ of 0° (red lines) resp. 90°(blue lines).(For uncertainties in calculated values see CH.IV.6 and Ch.V.5)