# *Natural and anthropogenic radioactivity of Northern Ireland; variation in gamma dose rate*

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We are all exposed to radiation from natural and anthropogenic sources and additionally where man's activities have concentrated naturally occurring radioactive materials. The average annual dose to the UK population is 2.7 mSv, with 2.2 mSv of this, on average, coming from natural radiation[1]. Sources include exposure to radon gas, gamma rays from the ground, and to a much lesser extent, from anthropogenic sources such as nuclear discharges and atmospheric fallout. A national high-resolution aerogeophysical survey of Northern Ireland, the Tellus survey flown in 2005 and 2006, provided detailed information on natural and man-made radioactivity relating to: bedrock and superficial geology; soil and landscape; human activity such as waste associated with power generation, mineral extraction and landfills; and the distribution of $^{137}$Cs from atmospheric fallout. Gamma dose rate in air from all of these sources, estimated for 1 m above ground by the airborne survey (~ 1.2 million data points, Figure 1) showed a distribution largely reflecting the natural variation of K, U and Th. The arithmetic mean across Northern Ireland was 31 nGy h$^{-1}$, ranging up to 320 nGy h$^{-1}$ in the Mourne Mountains area of South Down. These results accord with, albeit on a much more detailed scale, two national terrestrial gamma-ray dose rate surveys conducted in 1989 which found arithmetic means of 34 nGy h$^{-1}$ and 23 nGy h$^{-1}$ for Great Britain and Northern Ireland respectively[2], [3].

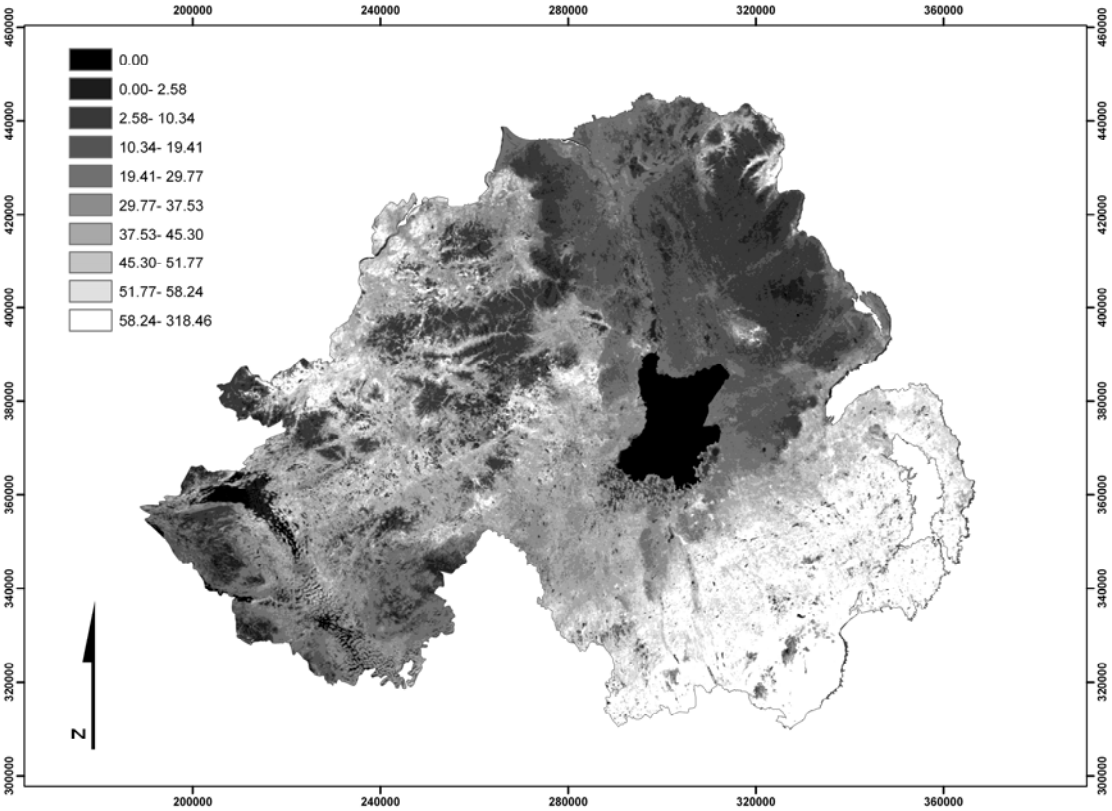


**Figure 1: Air absorbed gamma dose rate (nGy h$^{-1}$) for Northern Ireland determined by the Tellus aerogeophysical survey of 2005- 2006.** Crown Copyright 2009.

Technological enhancement of naturally occurring radioactive materials (TENORM)- for example at a power station at Carrickfergus where higher levels of Th and U, characteristic of a fly ash signature from coal fired power stations- was observed. Landfills also exhibit enhanced radioelement levels, in

conjunction with exhibiting electromagnetic apparent conductivity and magnetic anomalies (also acquired during the aerogeophysical survey), illustrating how a multidisciplinary approach can improve understanding of the environment.

Distribution patterns of the anthropogenic nuclide $^{137}Cs$ are consistent with wet deposition caused by bands of rain intercepting the Chernobyl plume in 1986 and longer-term atmospheric weapons testing fallout. Subsequent redistribution relates to landscape and soil type; in soils with large quantities of organic matter and few micaceous specific sorption sites, radiocaesium is held mainly on ion exchange sites from which it is readily and reversibly exchangeable and available to plants. This increased mobility in organic-rich soils has significance for Northern Ireland where approximately 14.7% of the total area is covered by peat.

The complex matrix of factors affecting radiation exposure to the public including variation in the natural baseline levels have never before been observed at such a detailed level, at a national scale.

*References*

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