Simulation of airborne gamma-ray data

Malte Ibs-von Seht
BGR, Geophysical Exploration, Hannover, Germany (m.ibs@bgr.de)

Planning and conduct of aircraft- or drone-based gamma-ray spectrometry surveys may raise the need to simulate and explore the radiation flux from the ground for airborne measurement geometries. Presented here is a simple yet powerful approach to simulating the count rates of gamma-rays measured with standard airborne detector systems and processed with the conventional window method.

The window method is based on energy windows within the gamma spectrum that are associated with the three naturally occurring radioelements potassium, uranium, and thorium. Various correction and processing steps are applied to the integral window count rates using system specific calibration parameters such as stripping ratios, sensitivities and background values to finally derive ground concentrations of the three elements. For a simulation of such gamma-ray data, the count rates produced by the sources to be simulated and recorded by a particular measuring system in a particular geometry must be calculated and noise with matching statistical properties be applied to them. This means that the well-known steps for airborne gamma-ray processing, described e.g. in IAEA (2003), have to be performed in reverse order. This approach reveals some interesting insights into the capabilities and limitations of the airborne radiometrics method.

The simulation process itself starts with the design of the simulated survey features. This includes the survey area location and size, the course and spacing of the survey lines and the sampling distance. From these parameters, a dataset is constructed that contains the positions of the sampling points. Also, the relevant system parameters are defined. In the next step, the radiometric conditions of the area are designed. This is done by discretizing the survey area in grid cells and assigning concentration values to each cell according to the desired ground source distribution. Count rates for each grid cell can now be calculated and the count rate grids are subsequently processed using a geometric response filter that simulates the footprint properties of the detector at the selected survey height. Finally, after applying noise of matching statistical properties to the filtered grids, they are scanned along the sampling positions, leading to a dataset that contains the simulated airborne gamma-ray data.

The simulated dataset can be utilized in various ways to explore the influences of survey, system, source and environmental parameters on the recorded window count rates. The benefit of the proposed approach is that common workflow procedures as preferred by the user can be directly applied to the data and the resulting maps can be inspected in the usual way. Furthermore,
processing algorithms and methods such as filtering and statistical levelling can be tested and optimised. In this contribution, the way the simulation works is outlined and the results are illustrated by means of various examples.