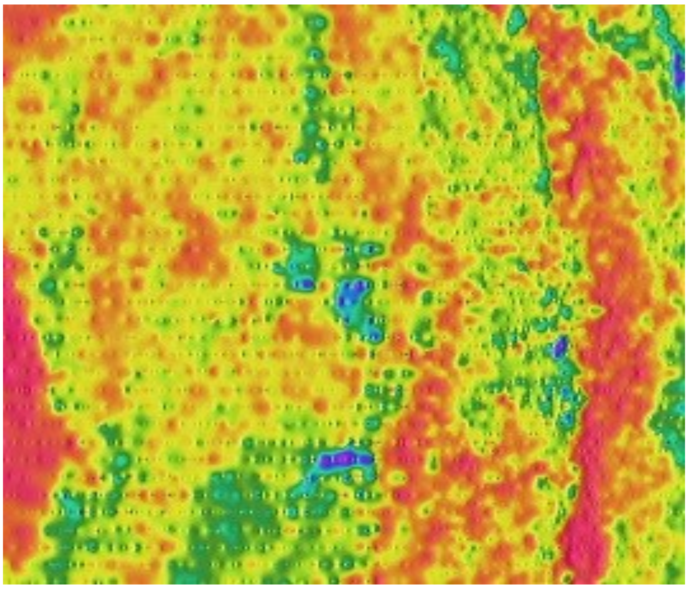
Product Brochure

GAMMA_Grid

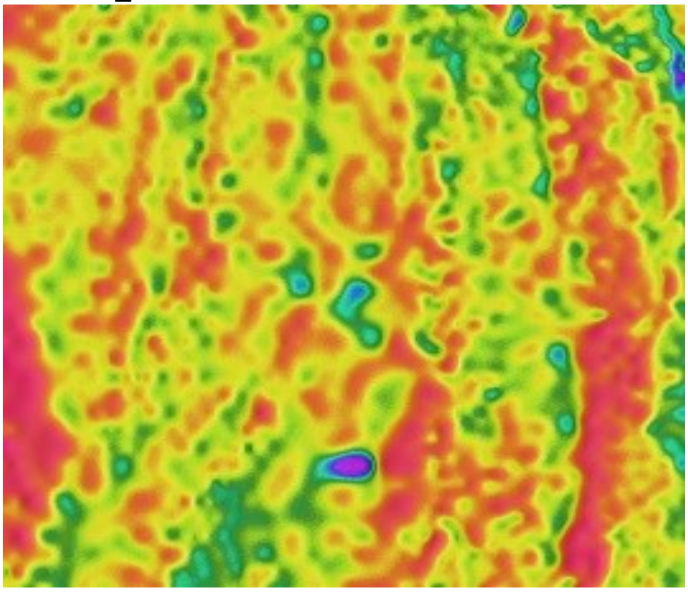
3D Inversion of Gamma-ray Data

GAMMA_Grid is a new method for the rigorous inversion of airborne gamma-ray spectrometric data to a regular grid of radioelement concentrations on the ground

Minimum curvature gridding



GAMMA_Grid inversion



(Data courtesy Geological Survey NSW)

Features

- Incorporates the directional sensitivity of rectangular detectors and the speed of the detector
- Inverts to a regular grid of concentrations on the ground
- Incorporates the 3D topography within the field of view of the spectrometer

Benefits

- Inverts directly from line data to a rectangular grid—no need for gridding
- Superior interpolation between flight lines
- Better anomaly definition and continuity
- Eliminates terrain effects

Motivation

The sensitivity correction in conventional processing is applied on a point-by-point basis, despite the fact that the "field of view" of an airborne detector can be a circle of up to 700 m diameter on the ground, depending on the height of the detector. This does not accommodate the height of the detector, or the 3D distribution of sources visible at the detector across uneven topography. The solution is to invert the airborne data to elemental concentrations on the ground in a rigorous way that accounts for the degradation of the gamma signal with distance from the source, the errors in the data, the distribution of radioelement sources in the ground, the response function of the detector, and the 3D topographic variations in the area.

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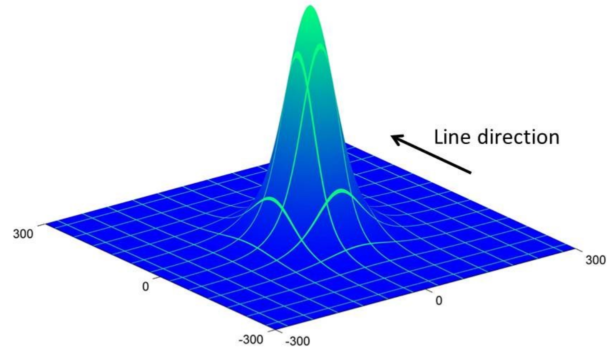
The Model

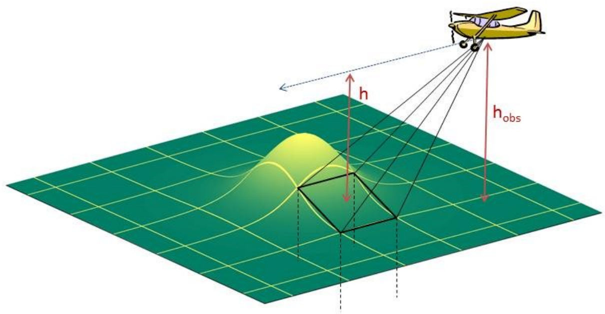
The method uses a source model comprising vertical rectangular prisms of uniform radioactivity and with the same horizontal dimensions as the required grid cell size. The top of each prism is a plane surface derived from a best-fit plane to the digital elevation model of the earth's surface within each grid cell area.



Source –detector response for a slab detector at 60 m height above a rectangular vertical prism

Incorporating the Errors

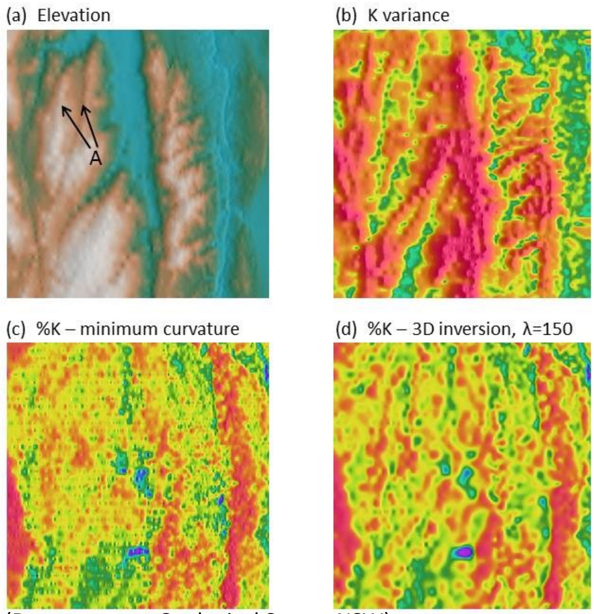
We use knowledge of the errors in the raw data (variance = mean count rate for Poisson-distributed counts), and trace the propagation of these errors through the conventional data processing procedures to estimate the errors in the final count rates. The data are weighted inversely as their variance during the inversion



Parameterization of the topography using prism sources with slanted top surfaces relative to the detector

Application to Airborne Data

The incorporation of the topography into the inversion can be clearly seen at A, and elsewhere, in the figure below. In the deeply-weathered Australian environment the tops of mountains and ridges, which are actively eroding and thus exposing fresh rocks and soils, often show higher K concentrations than other more deeply-weathered parts of the landscape. As the aircraft passes over a ridge, many of the sources within the field of view are further from the detector than is the case for a flat earth. In these circumstances conventional methods underestimate radioelement concentrations as the data are corrected for the height of the ground directly beneath the aircraft assuming flat-earth geometry. This effect is evident along the ridges at A – the 3D inversion is correctly identifying the increase in K concentration whereas the conventional processing is not.



(Data courtesy Geological Survey NSW)

Images from the SE Lachlan survey area: (a) digital elevation model, (b) K concentration variance, (c) K concentration (%) gridded using minimum curvature, and (d) K concentration gridded using 3D inversion

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