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Analysis of gamma-ray results at different field sites with varying conditions

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In the past gamma-ray measurements were used for geological survey from aircraft for mineral exploration or research of oil deposits in borehole. For these applications the relationships are described well between the physical measured parameter – the concentration of natural gamma emitter 40K, 238U and 232Th – and geological background. Based on these applications and knowledge in combination with adjusted sensor systems, gamma-ray measurements seem to be also a useful and fast tool for soil characterization. Data collection with airborne-gamma sensors is described in the literature for some case studies for soil characterization. The measured geophysical properties are used to derive soil parameters to create detailed soil maps for use e.g. in digital soil mapping (DSM) and monitoring of soils. Most of these relationships are site specific. Another option is gamma sensor systems on mobile sledges that can be towed by an off-road vehicle across fields. Thus recent systems provide a high rate of data collection and flexible application, which allows measurements not only at the field scale but also at the landscape scale. Therefore not only qualitative but also quantitative comparability is necessary. Differences in measuring results may result from technical aspects like sensor type or from natural influences during the measurement.

We did at first repeated measurements simultaneous with same and different sensor types. The results show, that sensors of same type and calibration show similar values. The data between different types of sensors show qualitative comparable structures but a quantitative offset. Because the sensors vary in size an optimal counting period has to be found for each sensor. Thus a suitable speed for towing measurements has to be taken into account for comparative measurements.
Another challenge in producing reliable data is exogenous conditions, like rainfall and resulting soil moisture or variations in dense of vegetation cover. Both attenuate gamma radiation from topsoil or can cause a dislocation of gamma emitter, depending of soil chemistry.
Measurements short after rainfall events can show differences in Uranium concentration in comparison to measurements under dry conditions. Radon, the daughter product of the Uranium decay series leaks from soil into the atmosphere and will accumulated after rain on the top of soil.
Repeated measurements at different times were done at field sites with different geological origin and variations in soil structure. Some of the field sites are more homogeneous than the others.
The measurements show similar structures with small variation between the ranges and clarity of structures, at field sites with clear differences in soil properties like the grain size distribution. Additional information e.g. soil moisture, vegetation, type of cultivation or surface roughness are necessary to interpret the field measurements.

In our talk we will present effects on gamma ray data quality based on data examples and our experiences concerning the measurement under field conditions. We will give recommendation for collection of reliable data.

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