GPS-BASED HANDHELD DEVICE FOR MAPPING CONTAMINATED AREAS

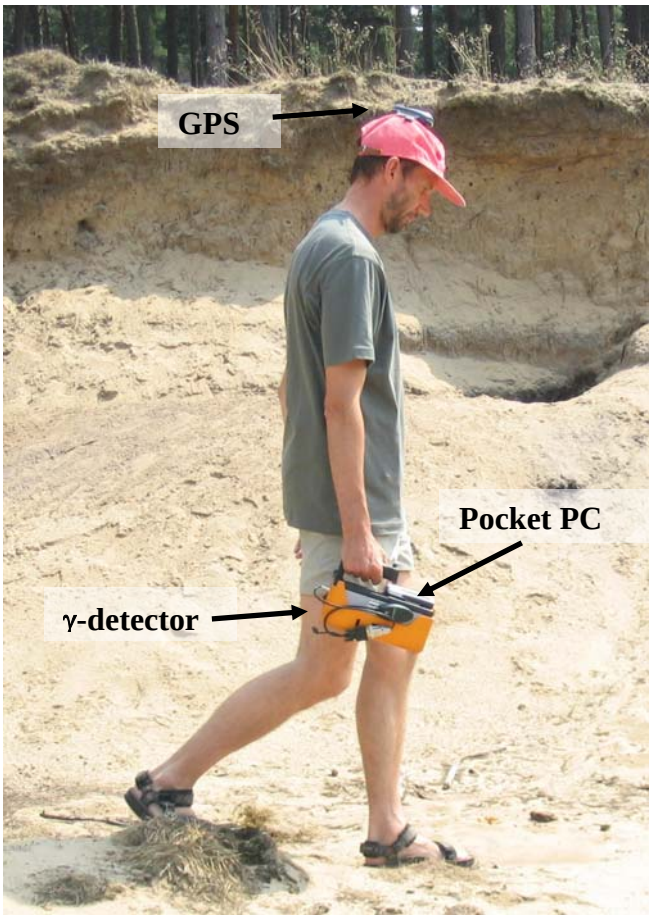
Background

Sometimes one is confronted with the challenge to map large areas with enhanced radioactivity. Examples are mine tailings or waste rock piles, deposits of the phosphate industry, flooding zones contaminated by effluents of plants processing ores containing enhanced natural radiation, nuclear accident sites etc. Car borne measuring equipment is not always an option, as the terrain might be rough and only accessible on foot. Airborne mapping with helicopters on the other hand is fast, but expensive, not readily available, shows difficulties with complex topography and lacks the necessary detail.

Objectives

The objective was to create a portable and easily useable tool for the real time logging of radiation and location data, allowing mapping the radioactivity by simply walking over any kind of terrain with the portable equipment and post processing the data in the office. We also assessed the performance of the GPS based system on contaminated sites with areas varying from less than a hectare to several tens of hectares, with respect to speed, precision and ease of use.

Principal results

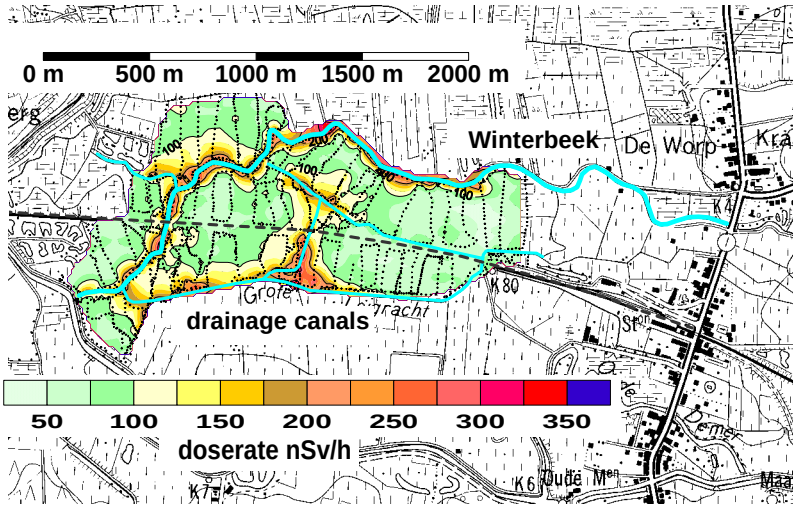


Portable equipment for mapping radioactively contaminated areas. The small GPS device, mounted on the cap on the head of the operator, transmits positional data to a pocket PC (PPC), attached to the handheld gamma detector. The gamma detector sends doserates to the PPC, creating a data log that can be post processed to obtain a map of the radioactive contamination.

Alternately, the serial data output of a standard portable gamma detector and of a small GPS device are transmitted wirelessly to a pocket PC (PPC). The operator carries the gamma detector, the GPS and the PPC around over the terrain (see figure), hence in situ creating a data log suited for post processing at the office. The time difference between position and radiation readout is never more than 1 s, which is acceptable considering the low moving speed of an operator on foot. The sampling period can be varied and has a minimum of 2 seconds, which allows changing the spatial density of the data points.

The data logging software was home made.

- The intrinsic positional precision of the system was found to be 5 to 10 m. It was derived by mapping a small area with a well known contamination.
- The system is easy to handle and relatively fast in use: about 45 hectares of very rough terrain were adequately mapped in 6 hours, by a single person. The figure shows the dose rate map of a flooding zone of the Winterbeek, contaminated by the liquid effluents of a phosphate plant.



An area of about 45 ha of very rough terrain, near the mouth of the Winterbeek near Molenstede, contaminated by the liquid effluents of a phosphate plant some 15 km upstream, was measured in a foot campaign of one day and then mapped. The bread crumb trail shows the 16 km long trajectory with about 1800 data points. The radium contamination appears to be concentrated along the main river and is also periodically transported up some of the drainage canals during periods with high rainfall.

Future developments

- The system will be enhanced to operate with most types of gamma detectors available at the radiation protection services of SCK•CEN
- For improving positional precision, the option of post processing the GPS data with readily downloadable differential GPS correction data will be investigated.
- A comparison of our dose rate map of the flooding zone of the Winterbeek with available aerial gamma data will be performed.
- The usefulness of the system as a tracer technique for identifying the frequently flooded zones of radioactively contaminated rivers such as the Winterbeek will be investigated. Precise knowledge of these flooding zones is very useful for delimiting zones in which to search for other kinds of contamination, for example heavy metals or chlorides.

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Main reference

J.Paridaens, "*GPS-based handheld device for measuring environmental gamma radiation and mapping contaminated areas*", International Congress Series, ICS 1276, Invited papers of the 6th International Conference on High Levels of Natural Radiation and Radon Areas,Osaka, Japan, 6 - 10 September 2004, in press