# Kartotrak v1.0 Features

Kartotrak is a comprehensive, all-in-one software solution designed for all those involved in nuclear remediation who need a precise preliminary characterization of their contaminated site.

The capacities of **Kartotrak** enable an integrated study, from sampling plan definition and data acquisition to contamination mapping and risk assessment.

Kartotrak is a GIS-based software which integrates a real-time data acquisition system, a data analysis and modelling workflow (through geostatistics) and reporting tools.
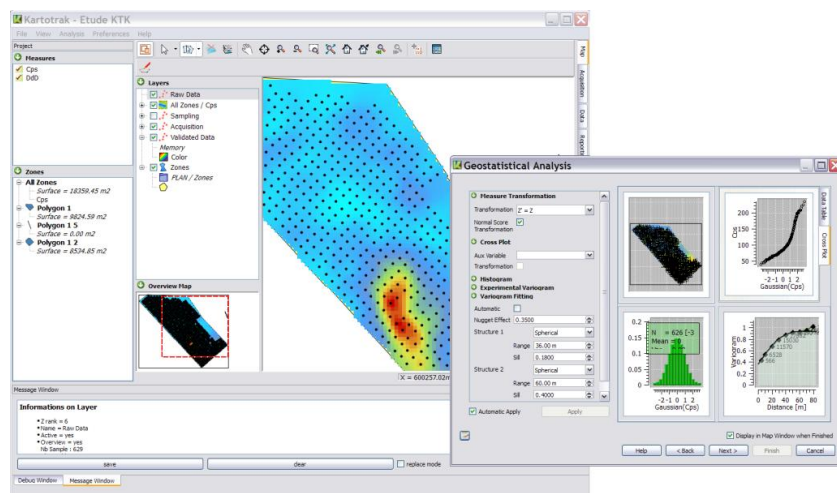
1. GIS-BASED INTERFACE

- Experience Kartotrak **ease-of-use**: the software is a **GIS**-based (Geographic Information Systems) application with a main display window from where all the applications are launched.

- Benefit from the usual **geographical tools**: display is organized in superimposed layers with all the attached functionalities: display/mask, add/delete, edit, move forward/backward, zoom in/out, scale, compass or graduation display, etc.), so that you customize the view to your own needs.

- Additional tools enable the precise control of items: measure of distances between points, angles between segments, polygon surfaces, highlight/mask/edition of samples or polygons, etc.

- **Polygons** are created to delineate specific areas (facility outlines, yards, etc.) and used for modeling.

- Enrich the scene with **vector or raster images**: besides the standard image file formats (bmp, gif, jpg, png, tif), Kartotrak may load many file formats including dxf, GeoTIFF, MapInfo or Shapefile.

- Take advantage of the dynamic link between the display window and the database allowing **automatic update** of the view with new data.

- Customize the display according to your **visual style guidelines**: symbol shape, color, size, color scales can be set.

2. DATA HANDLING

2.1. Data integration

- Easily import new data through **ASCII** or **csv** files, or more simply, by a **fast Copy/Paste** from an **Excel file**. Measures are loaded with their units. The detection limit of devices is also saved for further process.

- Choose the appropriate **coordinate system** among a full range of projection systems so that your data are correctly positioned on the map.

2.2. GPS connection

- **Locate any spot on site using a GPS**: the location is then automatically marked out by a symbol on the map.

  Connection is made between the software and the GPS (with NMEA output) through a specific interface.

2.3. Real-time data acquisition (optional)

- Experience seamless **real-time data acquisition** using Kartotrak specific interface.

  Connection is made between the software and the different measuring devices and a GPS so that you may **acquire data in a streaming way**.

  The position of the samples being acquired as well as their values are automatically stored in the database (if embedded in a truck taking continuous measurements) or through a simple click from the operator.

  (Kartotrak can connect with the following positioning and measuring devices:
  - o *NaI detector by ORTEC*
  - o *Germanium detector by CANBERRA*
  - o *DSP detector by SAPHYMO*
  Should your devices not appear in the above list, Geovariances offers development services to interface them with Kartotrak).

2.4. Database

- Differentiate data according to their types for a proper use: coordinates, measures, auxiliary variables, comments.

- Quickly **edit**, **remove** or **add measurements** or **samples** through a user-friendly spreadsheet.

- Trace the history of campaigns through their names. Several relevant measurement campaigns, possibly acquired at different time periods, may be added to the same project.

- Export input / output database to ASCII or csv file.

2.5. Data validation

Process sequentially your data from acquisition to validation thanks to a multi-level database:

- **Buffer Data**. Data being currently acquired (in real-time). It enables a quick check of new data before saving it, thus avoiding possible spoiling of the already existing database.

- **Raw Data**. Data you have saved and concatenated with previously existing campaigns.

- **Validated Data**. Dataset cleared from possible duplicates: too close data points are merged to avoid computation issues (choosing the average or the maximum value from the duplicates). Data below detection limit are also automatically processed (assigning to them either 0, the detection limit or half this limit).

3. SAMPLING DESIGN

- Prepare your sampling plan and automatically store target sample positions in the database.

- Set a pre-defined sampling design based either on regular rectangular or circular meshes, or set a random sampling design providing a given number of samples.

4. GEOSTATISTICAL PROCESSING

Benefit from a simplified and robust technology based on Geovariances' 25 years experience in geostatistical software development.

All the needed tools to perform data analysis and contamination characterization are grouped into a geostatistics workflow.

4.1. Data analysis

- Get instantaneous statistics on the contamination level, displayed in 4 views:

  - o **Basemap**: locate the sample points.

  - o **Histogram** with basic statistics: minimum, maximum, mean and standard deviation values. Assess the data global distribution and check the data transformation quality if performed (see below).

  - o **Experimental variogram** and **variogram model**: characterize the spatial variability of the contamination.

  - o **Cross-plot with an auxiliary variable**: helps in identifying different data populations.

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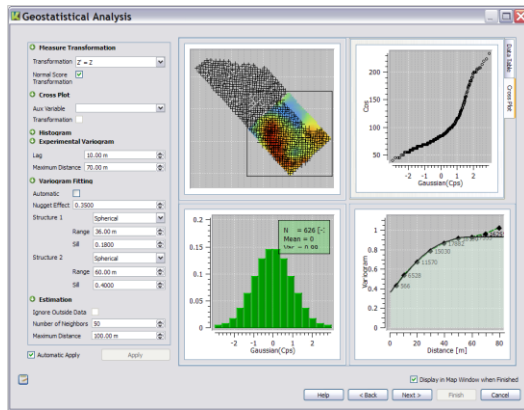
- Refine all calculated functions by tuning interactively the involved parameters.

- Benefit from the **dynamic link** between these 4 representations and thoroughly explore your data: when you highlight points in the base map or histogram bars, they are immediately highlighted in the other representations so that you can check their locations. You may also ignore some samples (erroneous or noticeable samples for instance) and instantaneously check the impact on the variogram and further maps.

- Transform input data by a simple click:
  o Use a **log transformation** to handle dissymmetric distributions and improve the structure identification while reducing the data variability.
  o Use a **normal score transformation** which is mandatory for computing probability or quantile maps.

4.2. Variography

- Experience Kartotrak **automatic variogram sill fitting** and instantaneously get a model well-suited to your data.

- By default, the model is constituted by a single spherical structure with or without a nugget effect. You may add a second structure if the contamination behavior is shown to be more complex (showing different behaviors at different scales) and set interactively the involved parameters (type - spherical, exponential or cubic, range, sill for each structure) to better fit the experimental variogram.
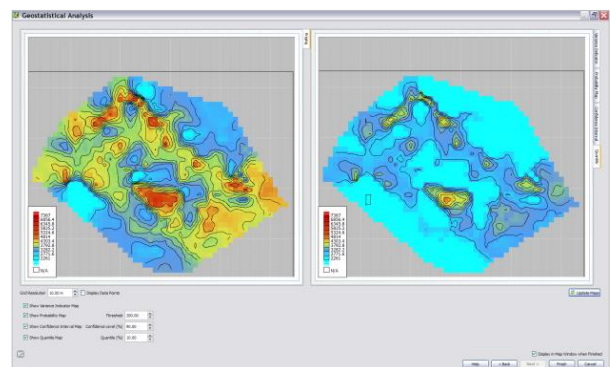
4.3. Estimation

- A moving neighborhood is used by default in the kriging process to optimize computing time. You may tune the number of neighbours as well as the size of the neighborhood to get more robust results.

- Maps are calculated on a grid with a default mesh. You may adjust the mesh size to your needs.

5. ESTIMATION AND RISK ASSESSMENT MAPS

- Make use of Kartotrak proven algorithms and produce maps which help in identifying hot spots, locating the areas to clean up, controlling costs, reducing uncertainty, optimizing further sampling locations, etc.
  o Produce **contamination maps** using ordinary kriging and estimate the contamination level all over the site with a high precision.
  o **Assess the precision of the maps** through a kriging variance indicator (calculated from the kriging standard deviation). This helps you in identifying poorly sampled areas that would require additional sampling.

- Make your **decision** with full knowledge of the facts: Kartotrak allows to **precisely assess contamination risks** using a robust technique based on gaussian transform. The following maps are produced:

  o The local **probability of exceeding a given threshold** helps in the estimation of the land surface which has a given probability to exceed the defined contamination threshold.
  o The local **quantile** according to a given frequency enables the elaboration of quick remediation scenarios with optimistic hypothesis (defining high quantiles) or pessimistic approaches (defining low quantiles).
  o The local **confidence interval width** helps you in identifying areas showing a strong

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variability (vicinity of hot spots, transition areas between low and high contamination levels, etc.).

6. REPORTING

Enjoy the efficiency of an **integrated word processor** and create your report as the project is built.

Kartotrak offers all the essential tools of a word processor: copy/paste from the data tables, message windows, GIS to the word processor, text edition and formatting, storage to pdf, odf or html documents, etc.

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