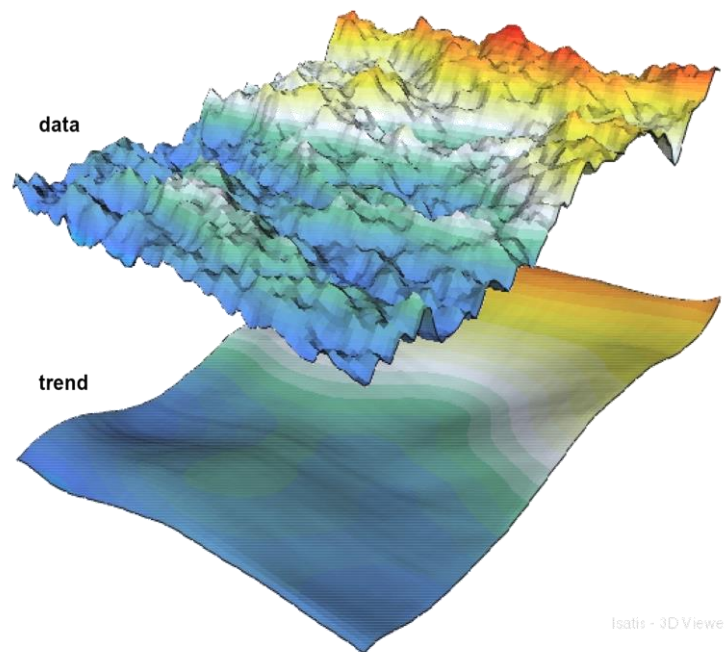




OIL & GAS / HOW TO...

COMPUTE QUICKLY A RELIABLE TREND



Spatial data sets show sometimes non-stationary properties, which can be explained by natural phenomena. For example, underground rock velocity increases with depth in consequence of sediments compaction.

Extracting a trend (low frequency component, very large scale variations) from a data set can be useful for many reasons: the trend can be used as input into a modeling process, it can be used to compute then work on stationary residuals, etc.

Here is described an **Isatis solution for computing quickly a reliable trend** from any data set, 2D or 3D, dense or not, regularly or irregularly sampled (scatter).

The solution is based on a least squares polynomial fit process implemented in the Quick Interpolation panel of Isatis.

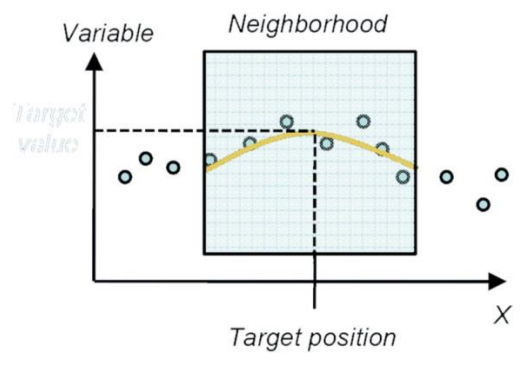


Introduction

What is Least Squares Polynomial Fit?

Least Squares Polynomial Fit consists in fitting, by least squares method, a polynomial to data contained within a given neighborhood centered on a target point.

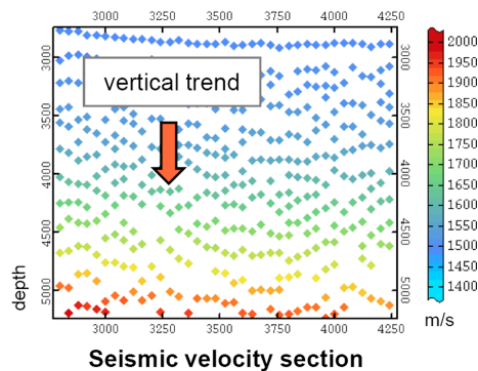
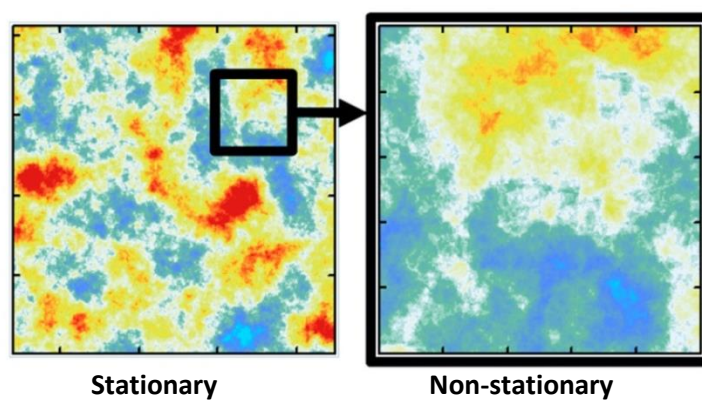
Repeating the fit operation on all target positions (output file) leads to a polynomial trend estimation.



What is non-stationary?

Non-stationary features observed on data sets can be of various types: mean, variance, structuration, etc.

Non-stationarity is firstly a question of observation scale:

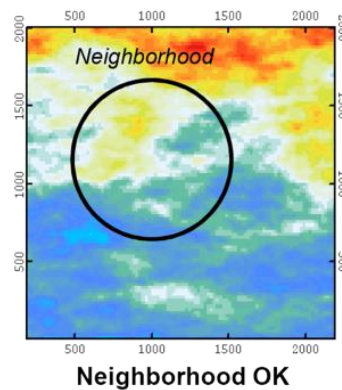
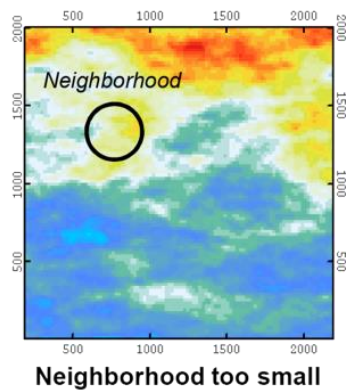
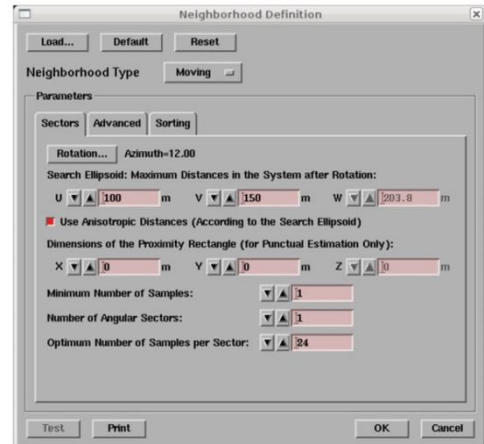


1. Neighborhood determination

Isatis implements a lot of options of defining moving neighborhoods involved in interpolation, estimation and simulation processes.

Dimensions, rotations, number of angular sectors, optimum number of points can be easily defined as well as some more advanced parameters.

The trend estimation solution presented here is based on polynomial fit by least squares method within a moving neighborhood. The dimensions of the neighborhood are set, more or less intuitively, by taking into account of the structural characteristics of the data. Estimating a trend is firstly a question of scale.



In other words, dimensions of the neighborhood are set according to short scale variations we want to avoid.

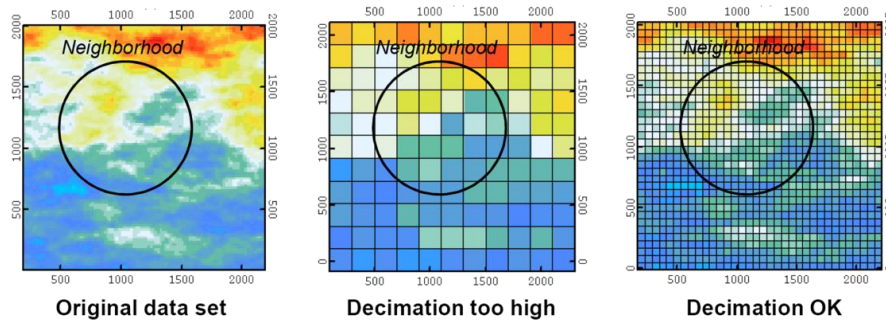
2. Decimation (for dense data sets)

Decimation rules

Once the dimensions of the neighborhood have been determined, it occurs sometimes that these dimensions would involve too many data samples in the least squares polynomial fit process, thus leading to very high computation time. It is in particular the case when processing dense data sets.

Then, decimating data set is necessary before running trend estimation process.

Decimation must be reasonable in the way that it must preserve a sufficient number of data samples within the neighborhood: at least around 15 in all directions. Otherwise strong numerical instabilities may be generated.



Decimation tools

In case of regularly sampled data (grid), decimation process is carried out by creating a coarse grid then migrating original data on it.

Grid data decimation:

- File → Create Grid File
Set the parameters of the decimation grid and save the grid
- Tools → Migrate → Point to Grid
Define the Input File as the original grid file and the Output File as the decimation grid

When facing with scatter data (irregular sampling), one decimation solution consists in using the Look for Duplicate option, which enables to select some samples separated by a given minimum distance.

Scatter data decimation:

- Tools → Look for Duplicates
Define the Input Variable Name as the input data and the New Selection Name as "selection decimation"
- Inform Minimum Distance
- Mask all Duplicates but First

3. Trend computation

Estimation of a trend can be achieved by least squares polynomial fit, which is a rather reliable and fast method.

Least Squares Polynomial Fit:

- Interpolate → Interpolation → Quick Interpolation
Define the Input File as the input data file (eventually decimated) and the Output File as the trend file (original data support)
Define the Interpolation Method: Least Squares Polynomial Fit.
Define the Least Squares Degree as 2
Select Applied to X, Y (& Z)

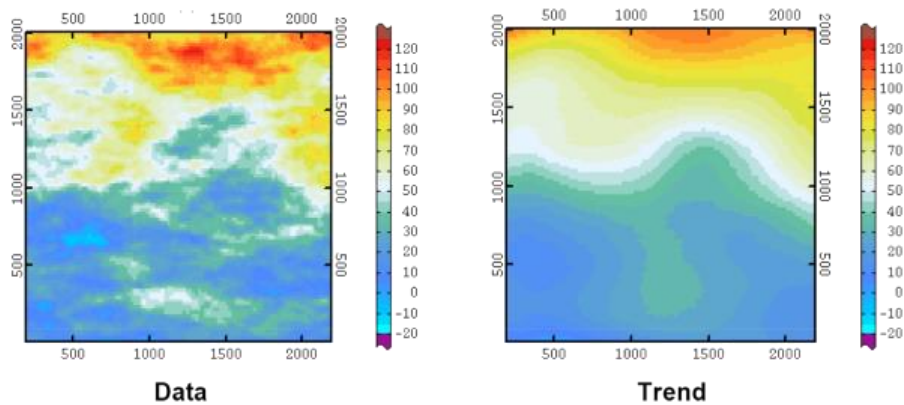


→ Neighborhood

Set the dimensions according to the neighborhood analysis conclusions (step 1)

Set the Optimum Number of Samples per sector to 1 000 000*

**A high value ensures that the neighborhood is well filled.*

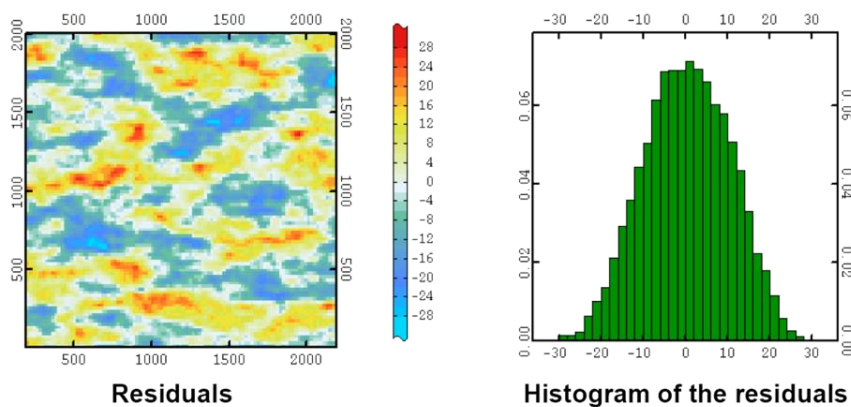


Please note that the Output File Support may be decimated too, if necessary.

4. Validation

Visual comparative inspection of the data and of the trend is the first and the more intuitive step for validating the trend estimation process.

As a complement, residuals, which correspond to the difference between data and trend, can be analyzed. Residuals should be stationary and zero-centered. This can be checked within the EDA (Exploratory Data Analysis) application window.



Let us help you implementing this workflow: contact our consultants at consult-oil@geovariances.com.