Geostats Rendezvous – Perth, 26-27 February 2013

LOCAL GEOSTATISTICS
- CONCEPTS & CASE STUDIES -

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(Geovariances)

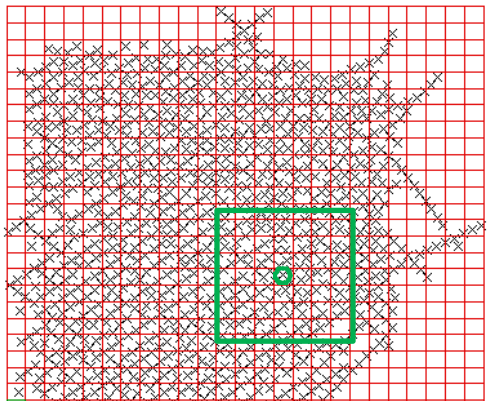
Geovariances
Where no one has gone before

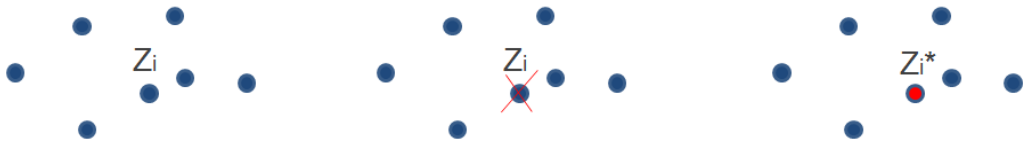
Context

- As presented yesterday
  - Most geostatistical algorithms rely on variograms
  - Variograms are usually assumed to remain unchanged through the area of interest
  - Really strong assumption!!
- Objectives
  - Show where to perform Local Geostatistics in ISATIS
  - Illustrate on a few examples from different fields of application
- Illustrations
  - Rainfall mapping → Varying sill & range
  - Seismic noise filtering → Varying range for noise
  - Mining resource estimation → Varying neighborhood

Local Geostatistics in Isatis (1/2)

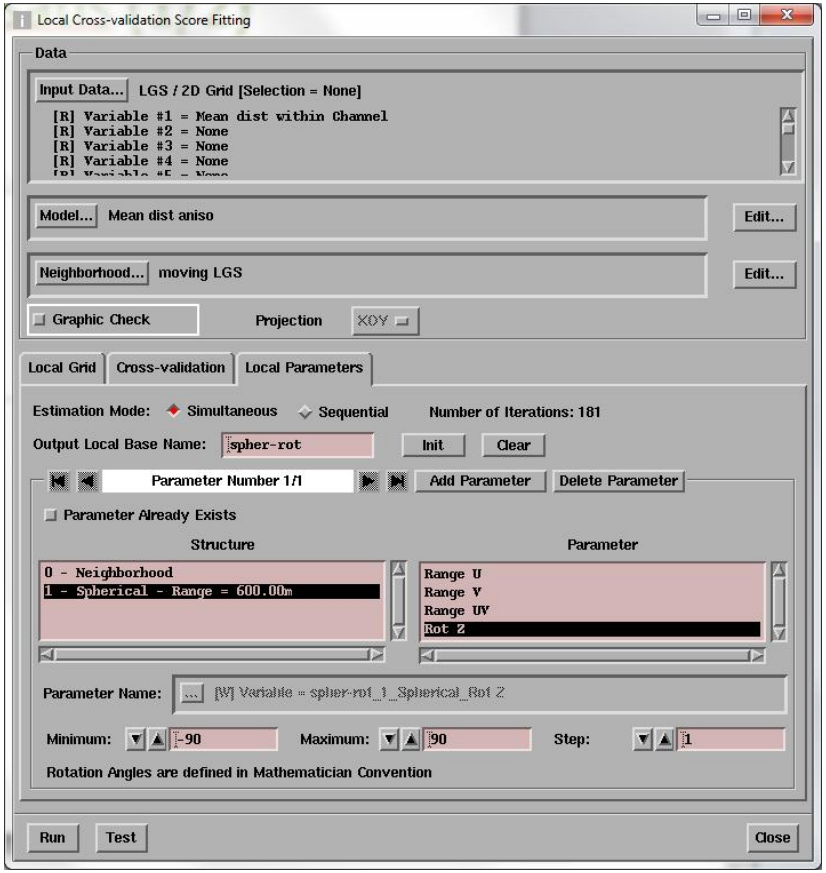
- Determination of parameters
  - Local Automatic Variogram Fitting (not shown)
  - Grid Operator (see later)
  - Local cross-validation (Statistics / LGS Parameter Modeling / Local Cross-validation Score fitting)





Cross-validation error = $Z_i - Z_i^*$

Cross-validation error min. → optimal parameters



Geovariances

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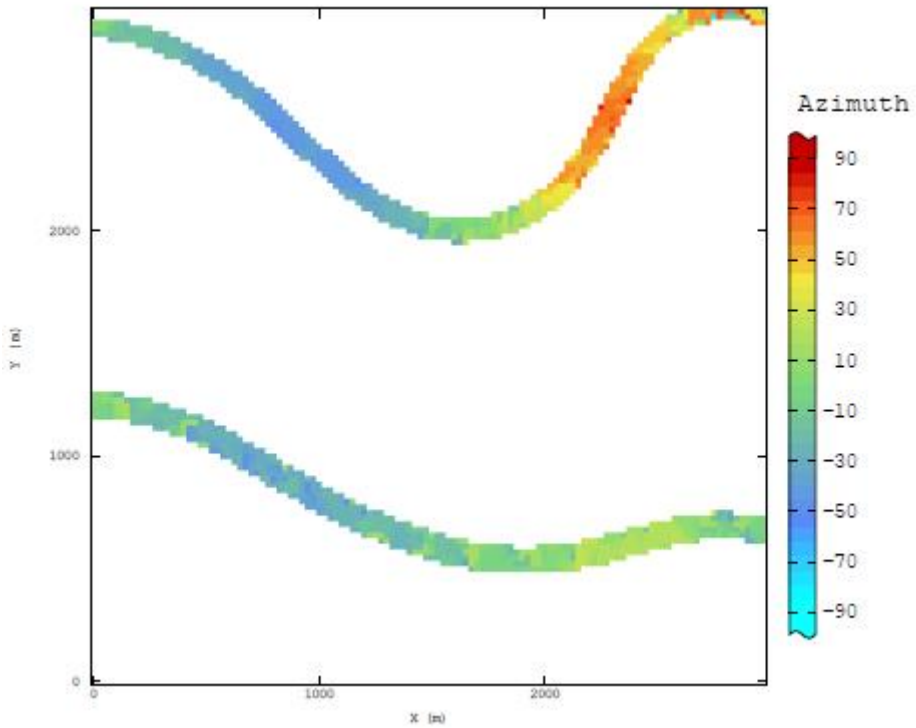
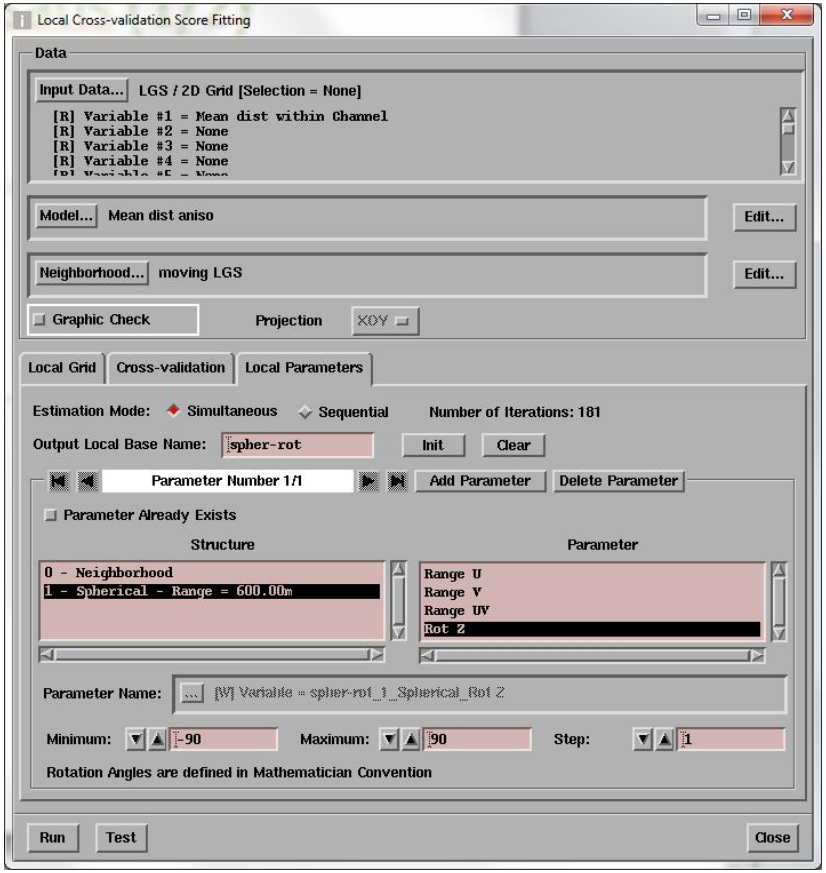
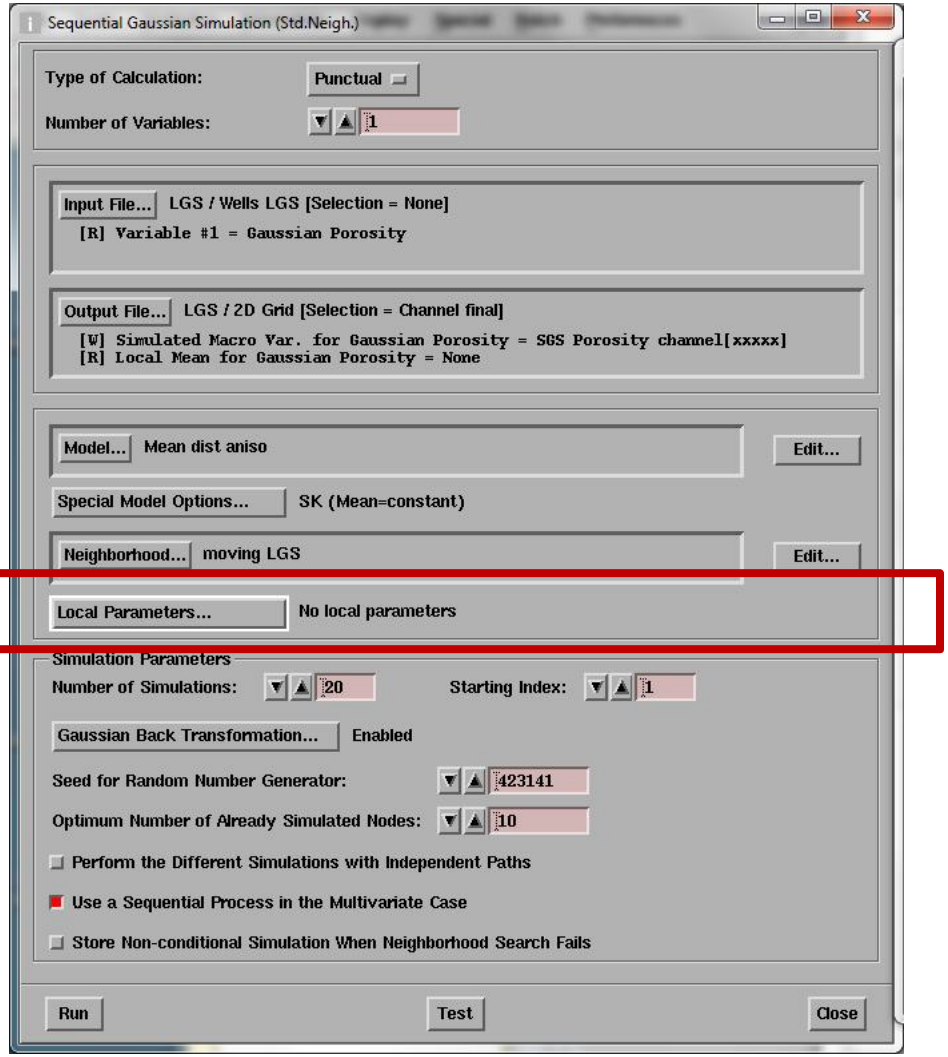


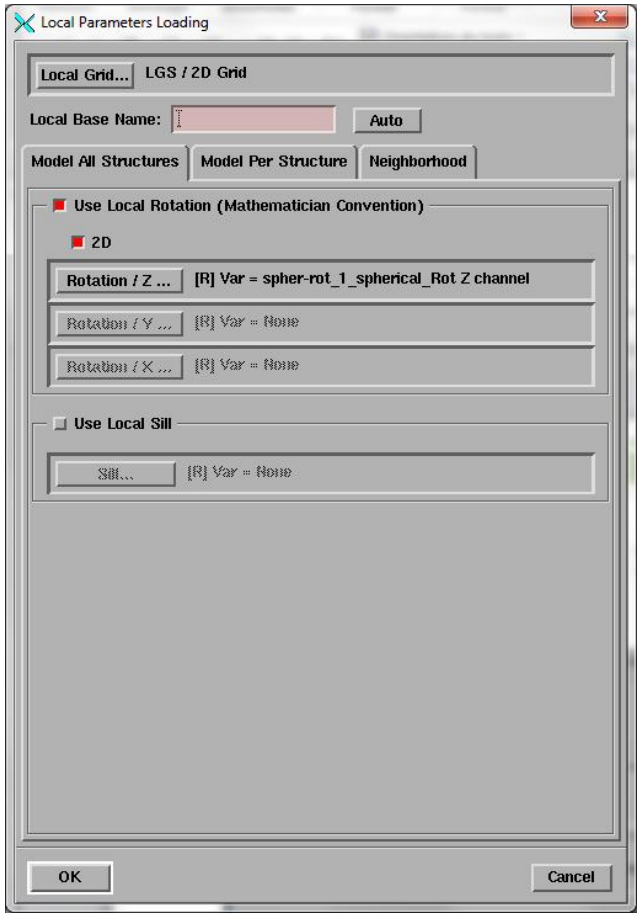


Geovariances

Local Geostatistics in Isatis (2/2)

- Use in Estimation and Simulation panels

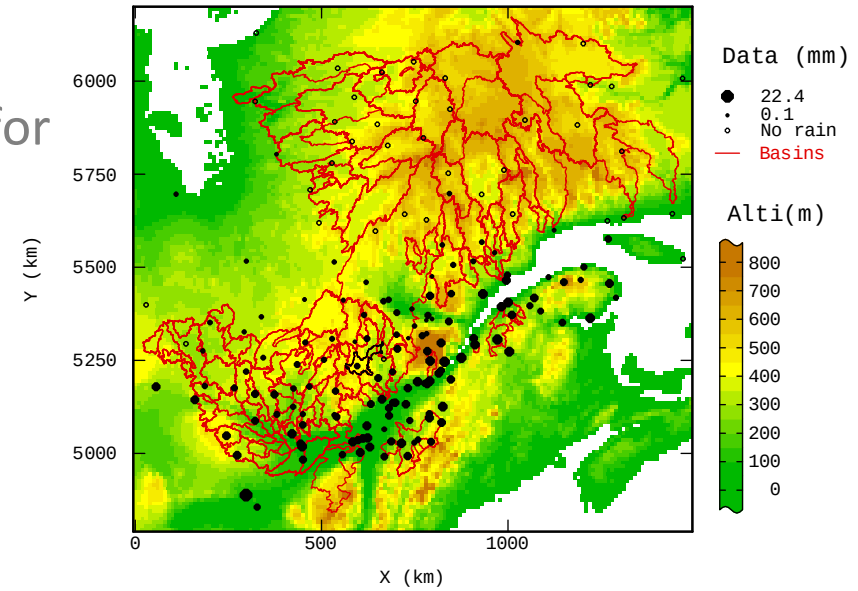




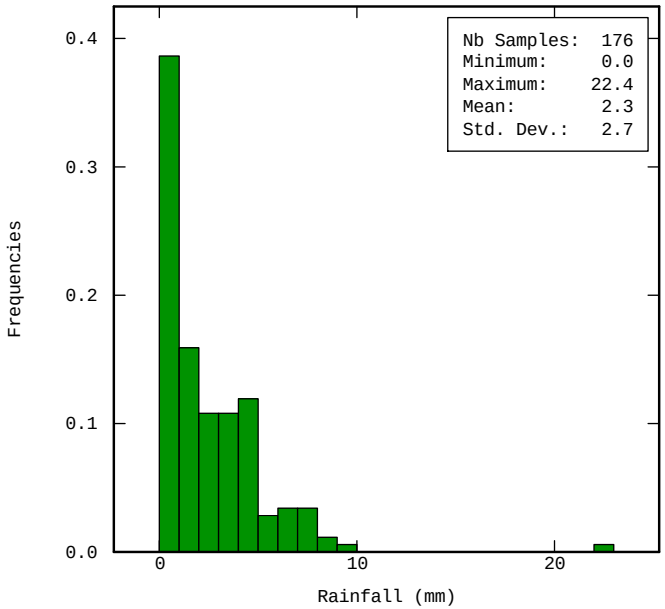
Geovariances

Case Study: rainfall mapping (Québec)

- Context
  - Daily precipitation: a key parameter for predicting hydropower generation in Québec (Canada)
  - Several modeling issues: scarce monitoring network, large spatial variability, local anisotropies, non stationarity, ...



- Input Data
  - Dataset from the « Réseau Météorologique Coopératif du Québec », a partnership initiative from the managers of meteorological networks.
  - Focus on daily precipitations for a specific day: January 18, 2009.

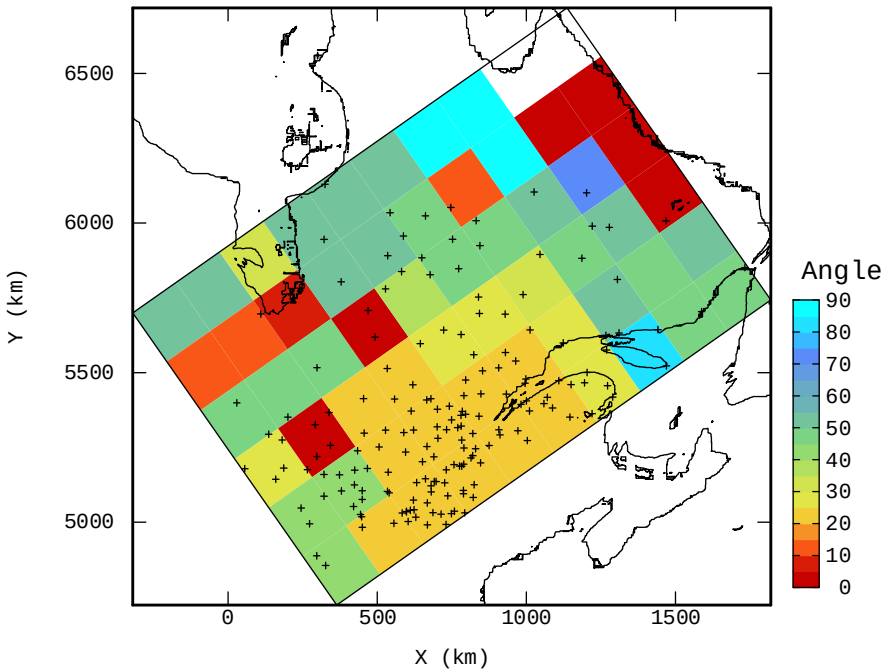


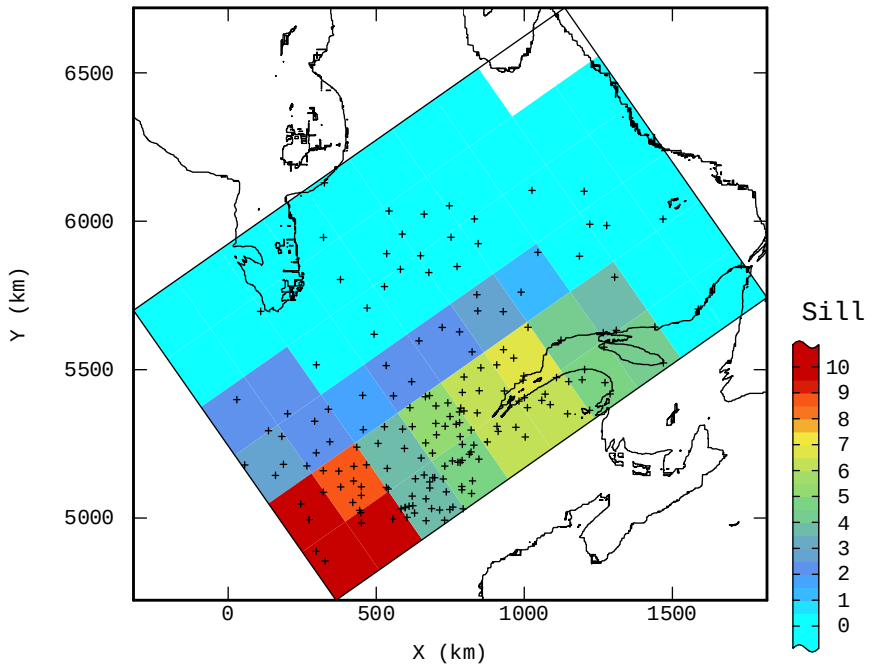
Geovariances

Hydro Québec

Case Study: rainfall mapping (Québec)

- Local parameters
  - Definition of an analysis grid, use of overlapping
  - Local parameter 1: main direction of anisotropy (local Cross-Validation)
  - Local parameter 2: variogram sill (computation of local variances)
  - Other local parameters: ranges (not shown)

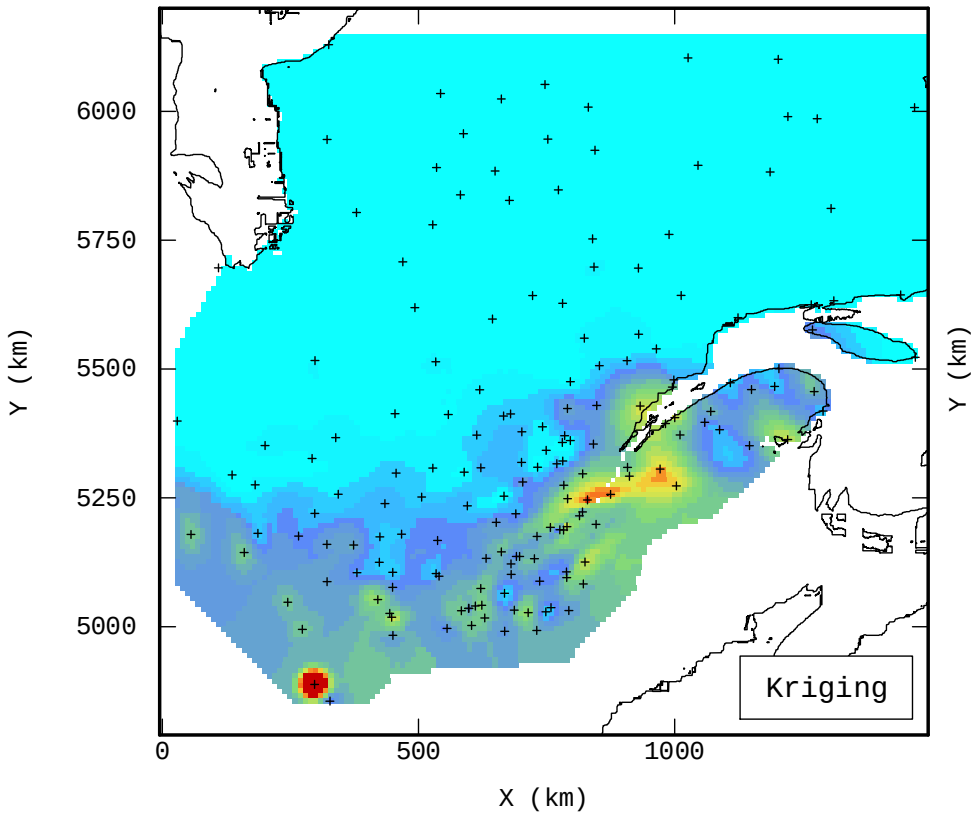


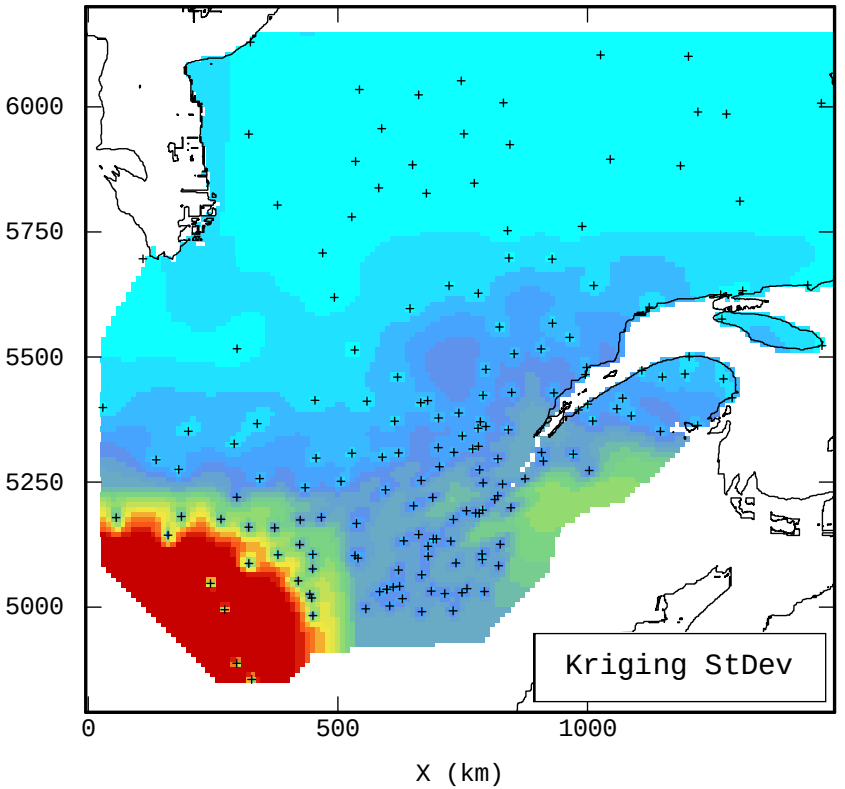


Geovariances

Case Study: rainfall mapping (Québec)

- Results: Kriging using local parameters and related standard deviation



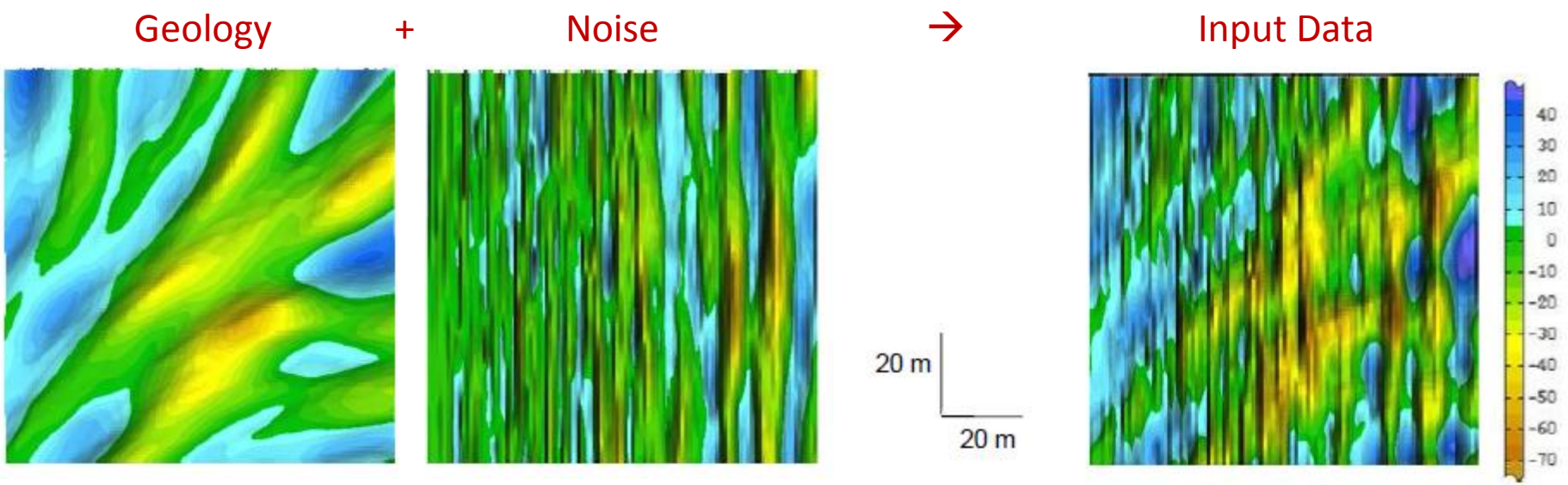


(work presented at geoENV 2010 conference)

Geovariances

Case Study: noise filtering

- Synthetic example with non stationary noise

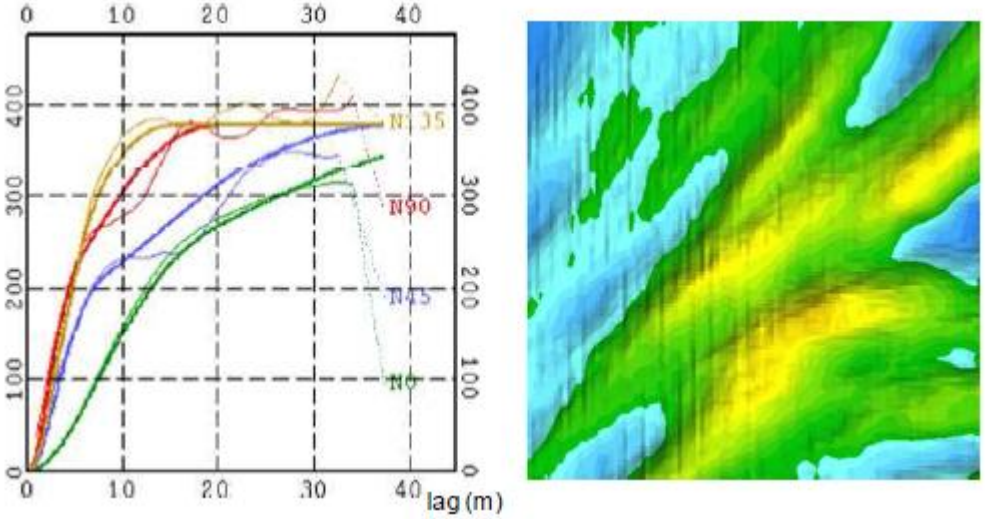


- Goal: removal of the short range zonal component!

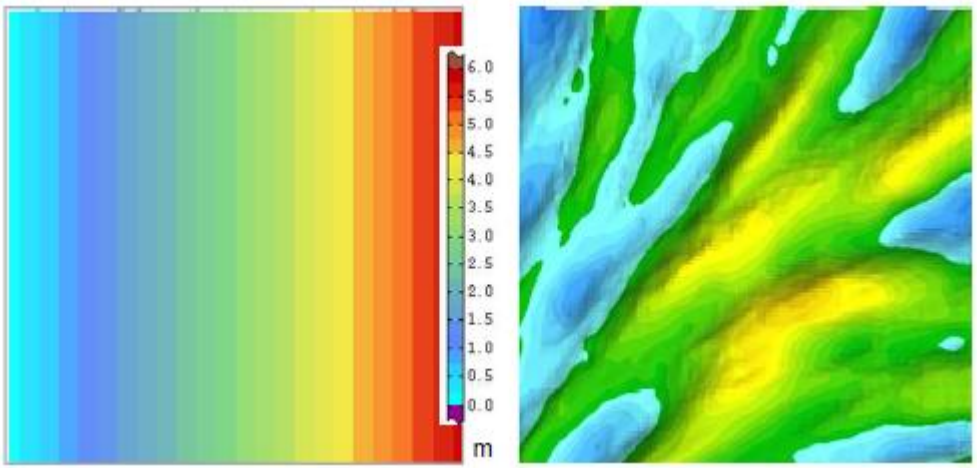
Geovariances

Case Study: noise filtering

- Classical factorial kriging



- Factorial kriging with varying IX range map for the noise

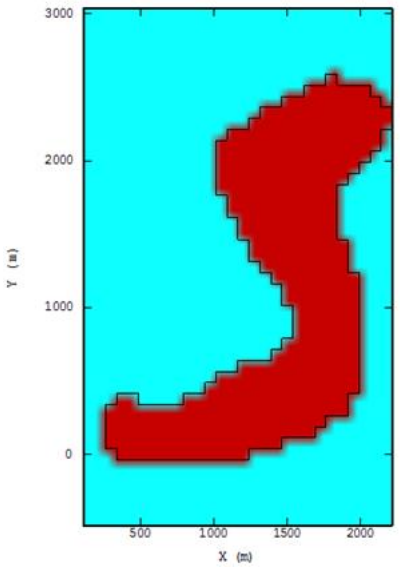


(work presented at IAMG 2009 conference)

Geovariances

Case Study: Carajas

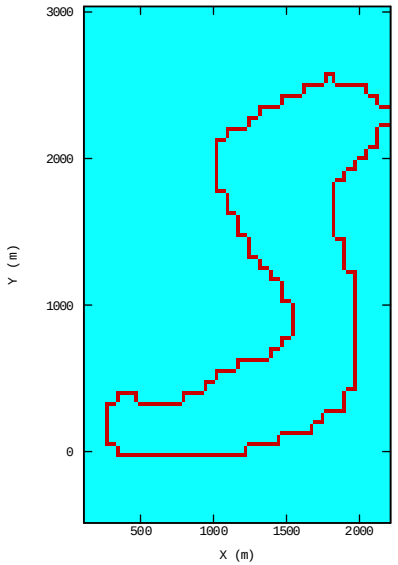
- The Carajas Mining Case Study
  - Case study based on a small portion of the mega-giant mine;
  - Soft friable enriched limonite upper part;
  - Geological controls result in strike of the ore body gradually changing from NS to EW;
  - **Objective**: controlling geometrically that gradual transformation through an auditable Isatis Trail.



Geovariances

Carajas LGS: step 1

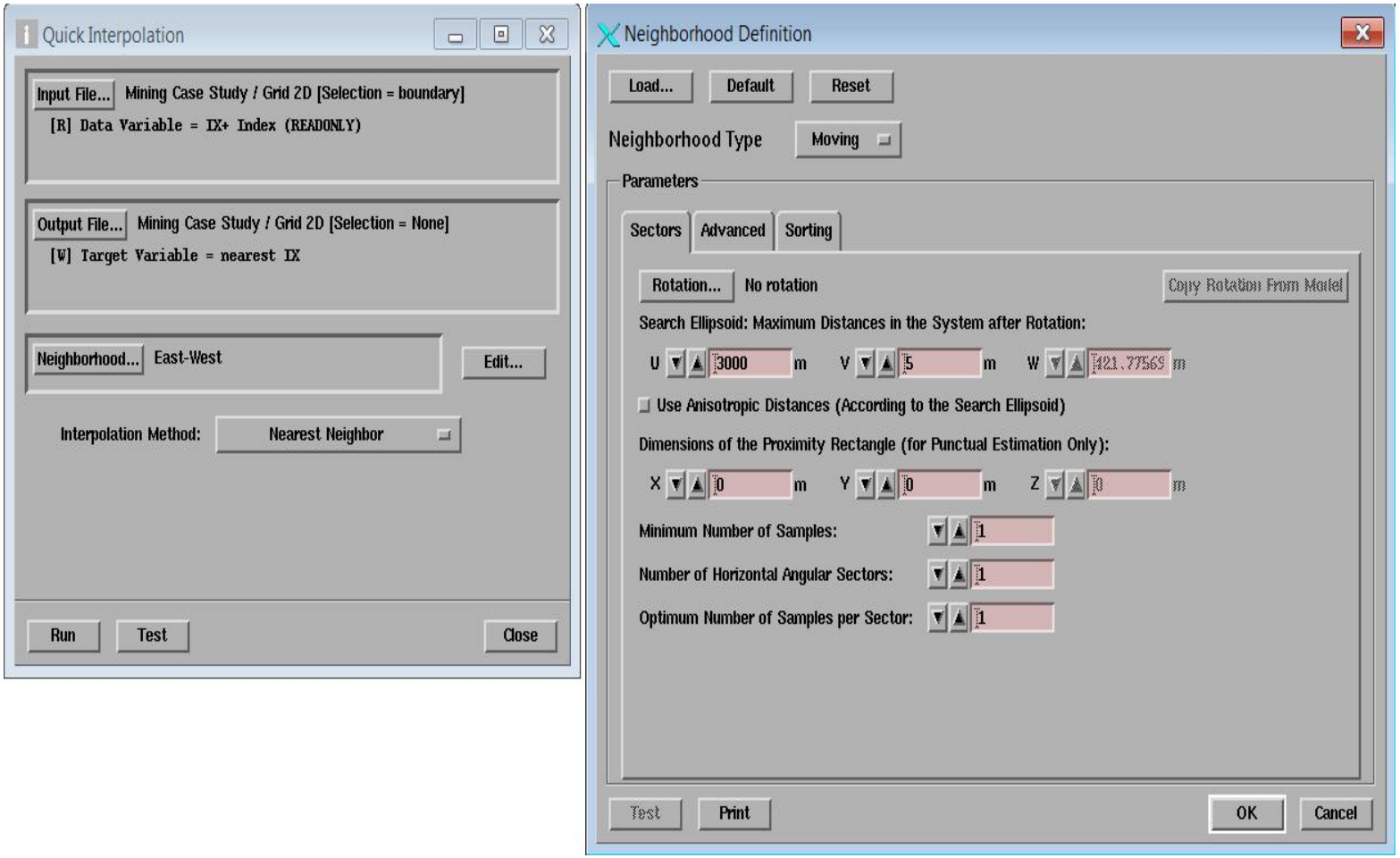
- Selecting blocks defining the boundary
  - Grid operator: erosion (C[1,1,0]);
  - Grid Calculator: selection – eroded orebody;
  - Display of Contact.



Geovariances

Carajas LGS: step 2

- Assigning IX and IY of closest block in the boundary



Geovariances

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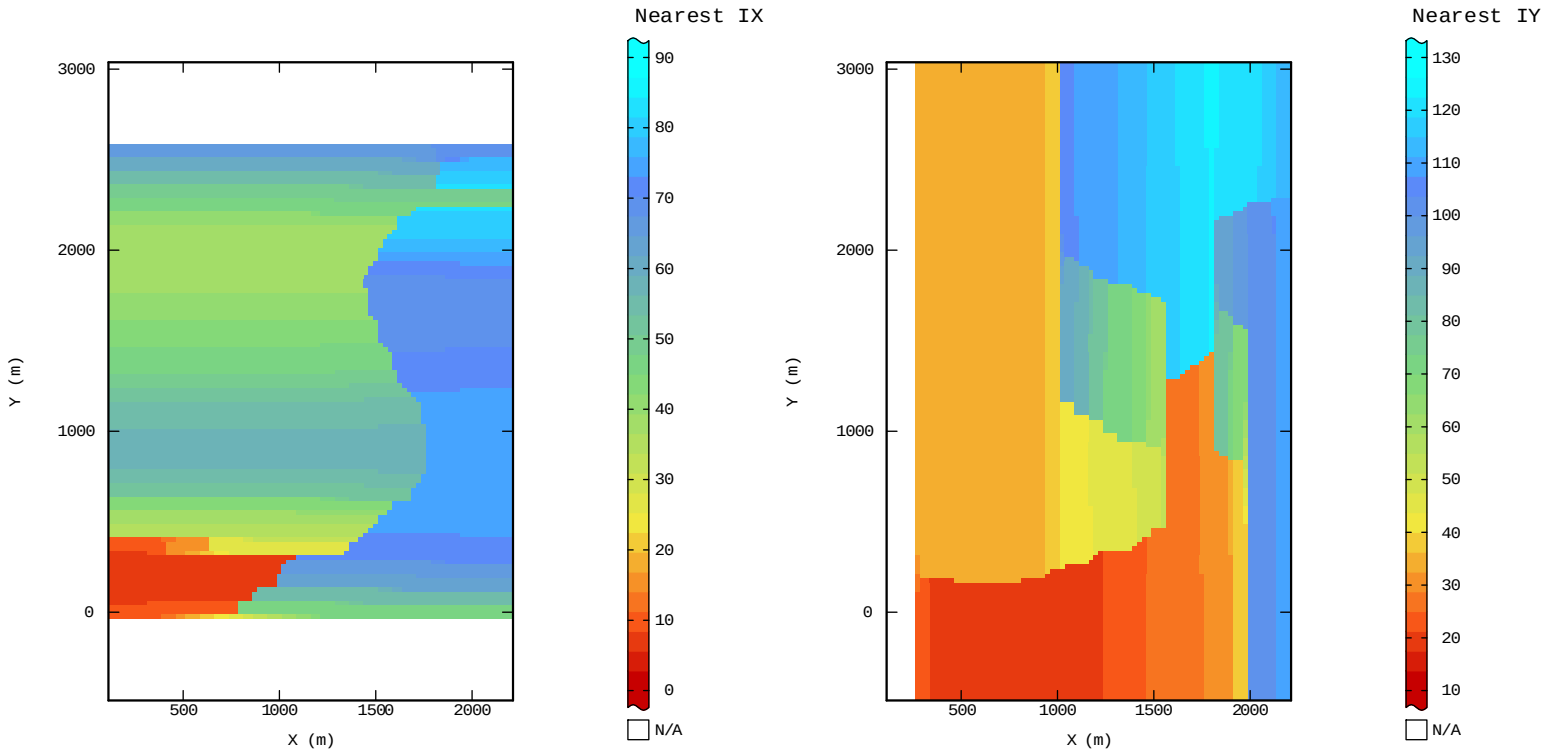
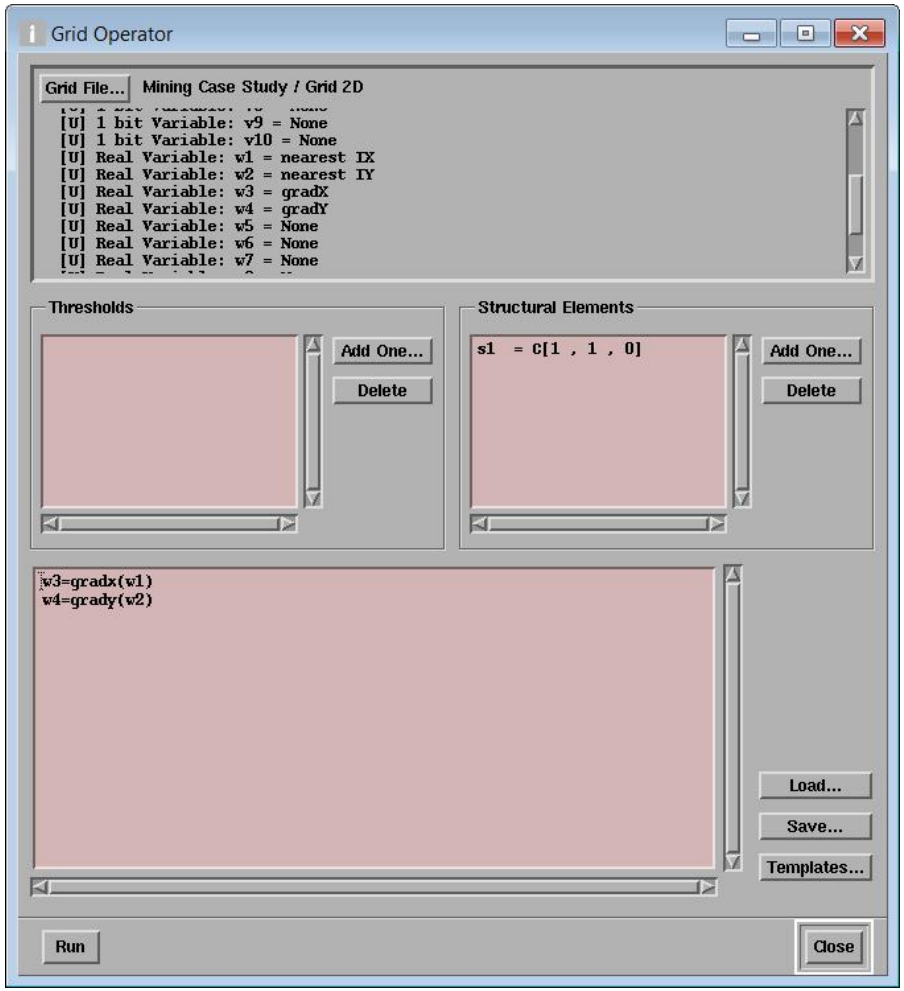


Geovariances

Carajas LGS: step 3

- Calculating the gradient of IX in X and IY in Y



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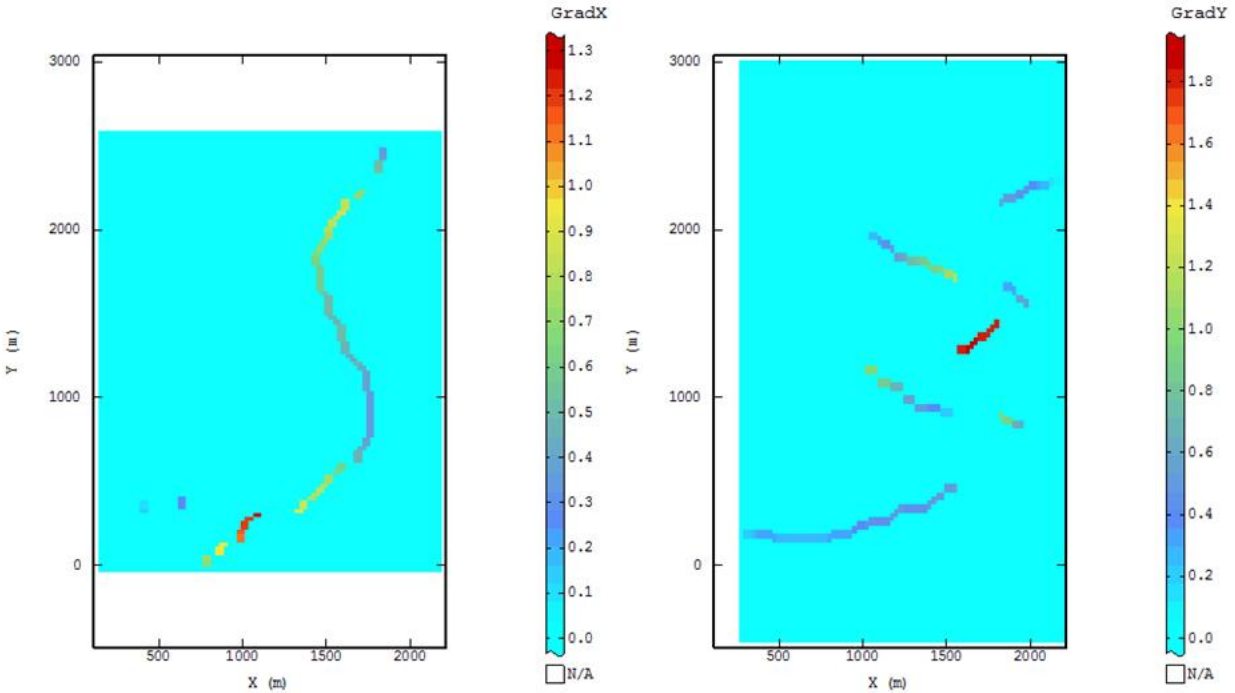
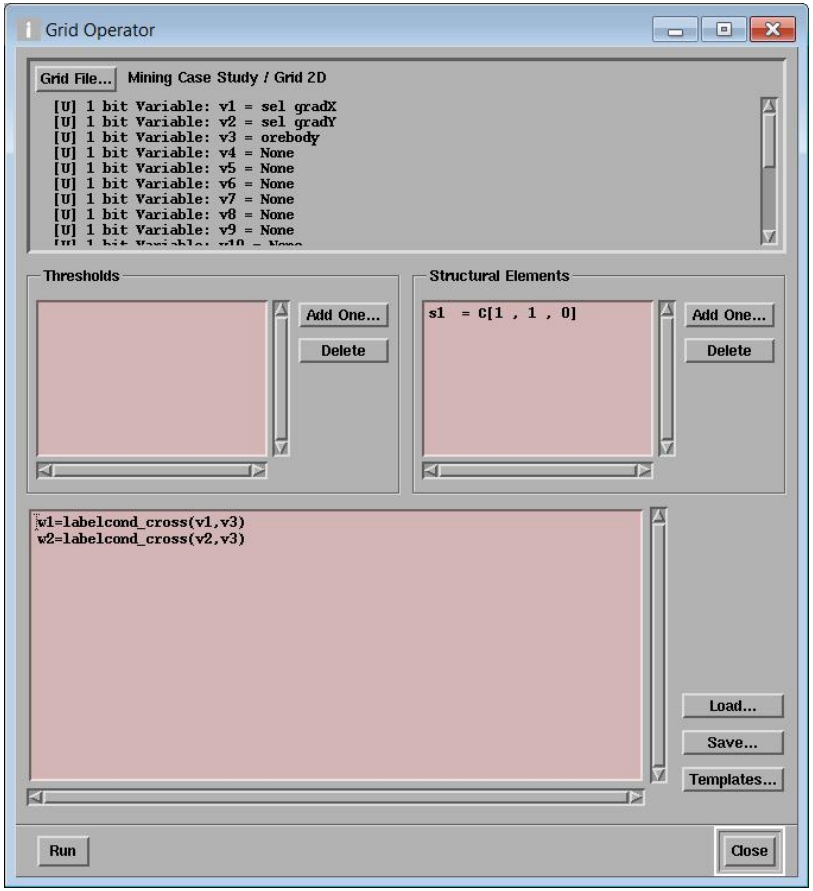


Geovariances

Carajas LGS: step 4

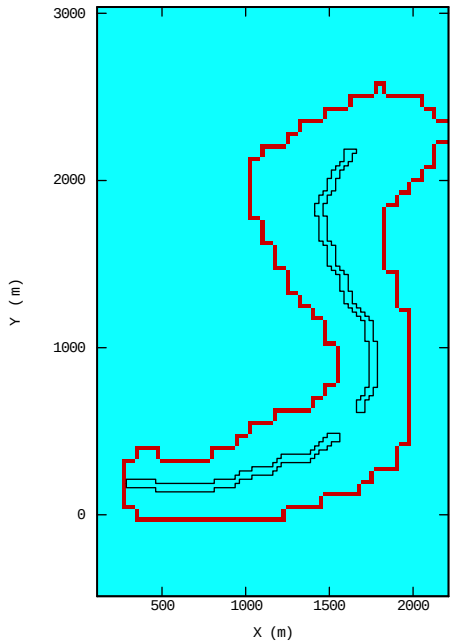
- Selection of largest connected component in X and Y (function label cond) and reunion



Geovariances

Carajas LGS: step 4

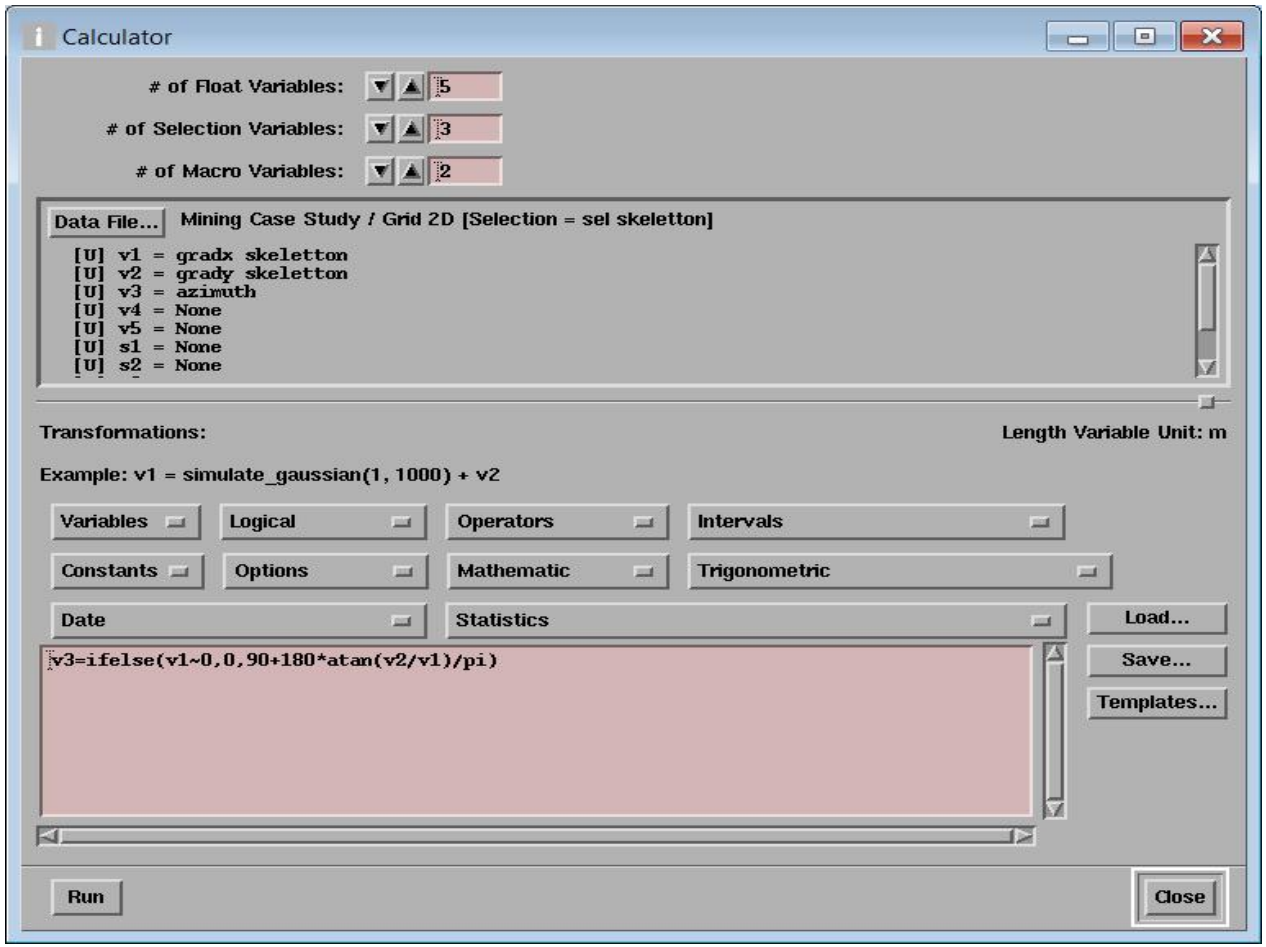
- Selection of largest connected component in X and Y and reunion (creation of sel skeleton)



Geovariances

Carajas LGS: step 5

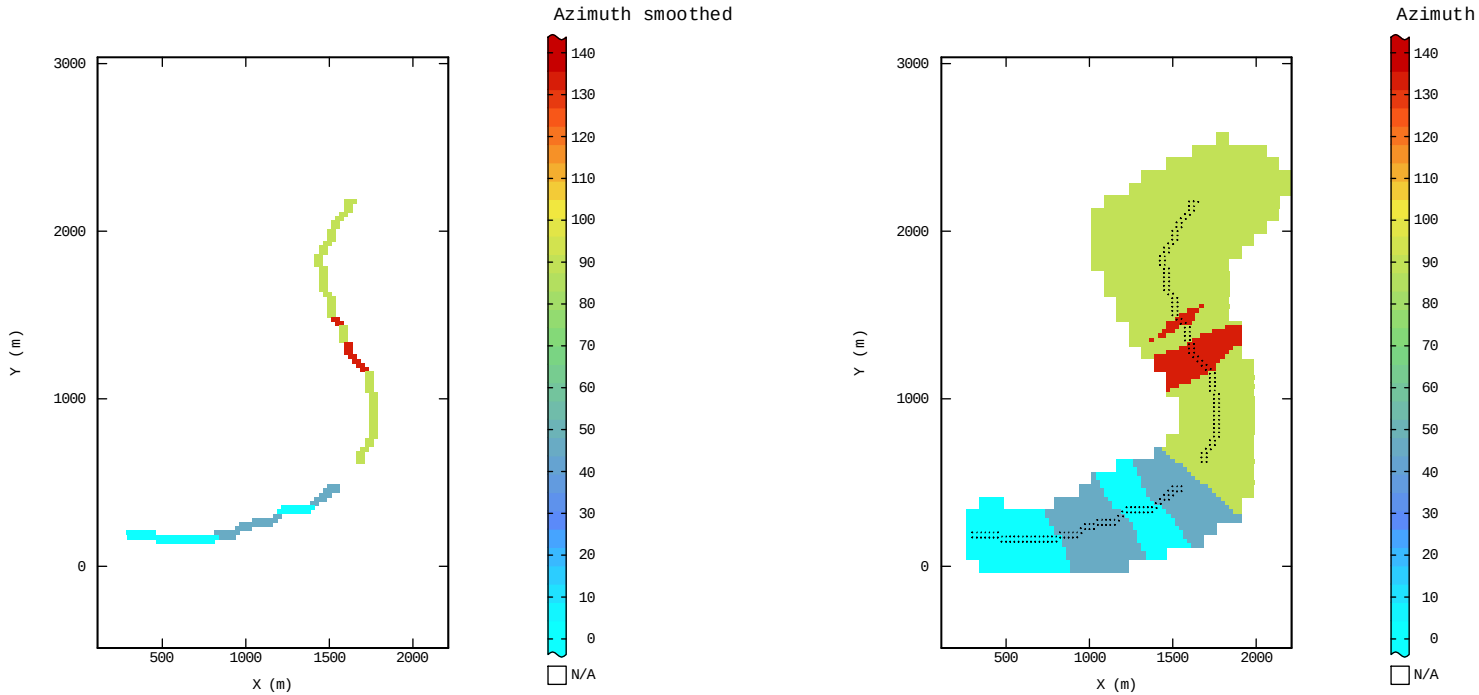
- Calculcation of gradX(sel), gradY(sel) and deduction of azimuth



Geovariances

Carajas LGS: step 6

- Smoothing of Azimuth and extension to nearest neighbours



- Using locally varying Azimuth in LGS definition of the neighbourhood

Geovariances

Conclusions

- Local Geostatistics: a pragmatic approach to address non stationarity of the spatial structure

- Remaining issues: how to account for locally varying parameters in:
  - Global change of support?
  - Simulations requiring gaussian transformation?? (varying sill)