Uncertainty and bathymetric DEM

Developing an Open Source QGIS solution

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✓ Generally limited information (if none) is conveyed concerning uncertainty of the DEM (global or at the cell level)
✓ Multiple sources of data needed to build a DEM
✓ Multiple acquisition and processing methods (Lead line, Single beam echosounder, multibeam, lidar, …)
✓ Multiple interpolation methods generate continuous surface
✓ Bathymetric grid used for multiple usages (hydrodynamic, geosciences, navigation)
✓ **Objective**: Implement methods and tools to generate an estimate of the uncertainty

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Methodology

Data selection/processing
- Characterization of individual dataset (metadata)
- Interpolation
  - Interpolated Bathymetric Surface
  - Estimation of the uncertainty (MC and/or BN)
- Residue
- Geostatistical analysis
  - Krigging of the "micro-morphology"
  - Krigging "error"
- Combining components
  - Produced DEM and its uncertainty layer

Bathymetry

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Each sounding dataset in SHOM BDB is characterized by a set of metadata.
- POSACC, SOUACC, TECSOU, QUALOT (IHO defined) are used to estimate the “error budget” of each individual dataset.
- Missing one of them, estimated by the date period (assuming precision is technology driven).
- Hypothesis of a radial distribution around the sounding.
On the effect of random errors in grided bathymetric compilations

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Bathymetric datasets

Randomly modified bathymetric datasets

Interpolation

Realization

Meta-data + Uncertainty propagation model

N times

Variogramme applied on the residue

GEOSTATISTICS

✓ Variogramme applied on the residue

EXPRESSING THE UNCERTAINTY

✓ 95 percentile – 5 percentile
✓ Any other expression
Results 1/3
Results 2/3
Results 3/3
Exemple of GUI
Viewing / Exploiting uncertainty
CONCLUSIONS
✓ An attempt to provide a tool to build bathymetric DEM with its corresponding layer of uncertainty
✓ Methodology built on “sound” mathematical background and adapted hydrographic assumptions
✓ Characterization of the source data relates to international standards (IHO)
✓ Nearly independent of the interpolation technique
✓ Open source solution / flexible coding

FUTURE WORK
✓ Improve a-priori characterization of the source data (e.g. vertical precision as a function of depth)
✓ Improve Bayesian network learning and results
✓ Improve performances (parallelization)
✓ Propose better ways to present the results
✓ BAG implementation