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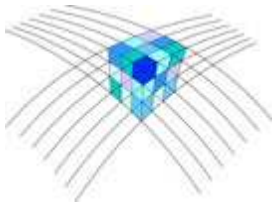
Virtualising large digital terrain model

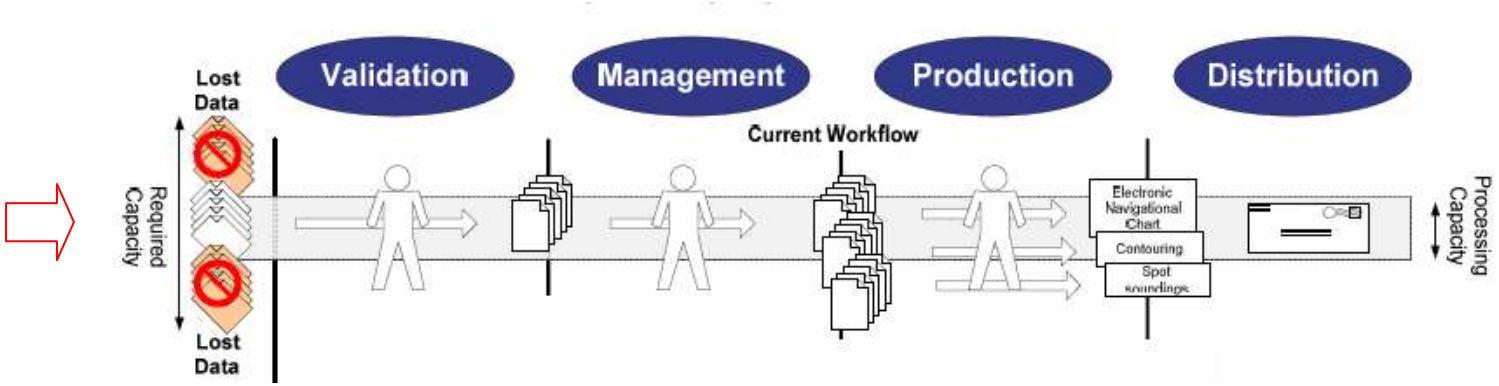
George Spoelstra



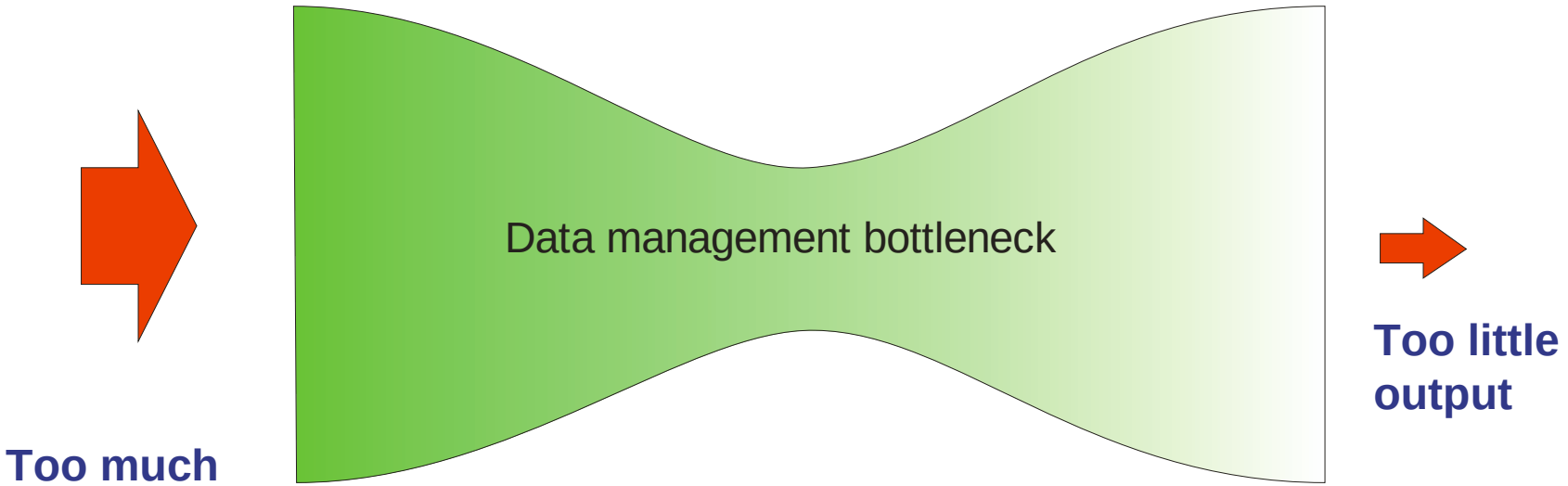
Presentation for the “Management of massive point cloud data: wet and dry" seminar of the Netherlands Geodetic Commission, November 2009

The Hydrographic data value chain

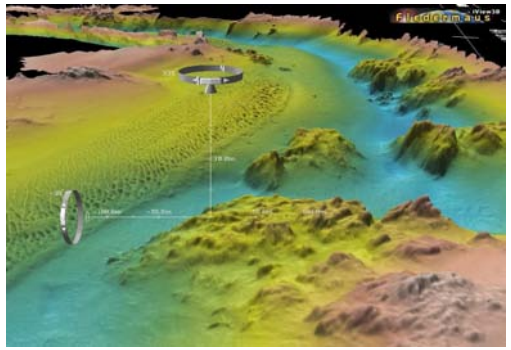
Data Acquisition



Data management bottleneck



Data Acquisition
Evolution of survey systems



time

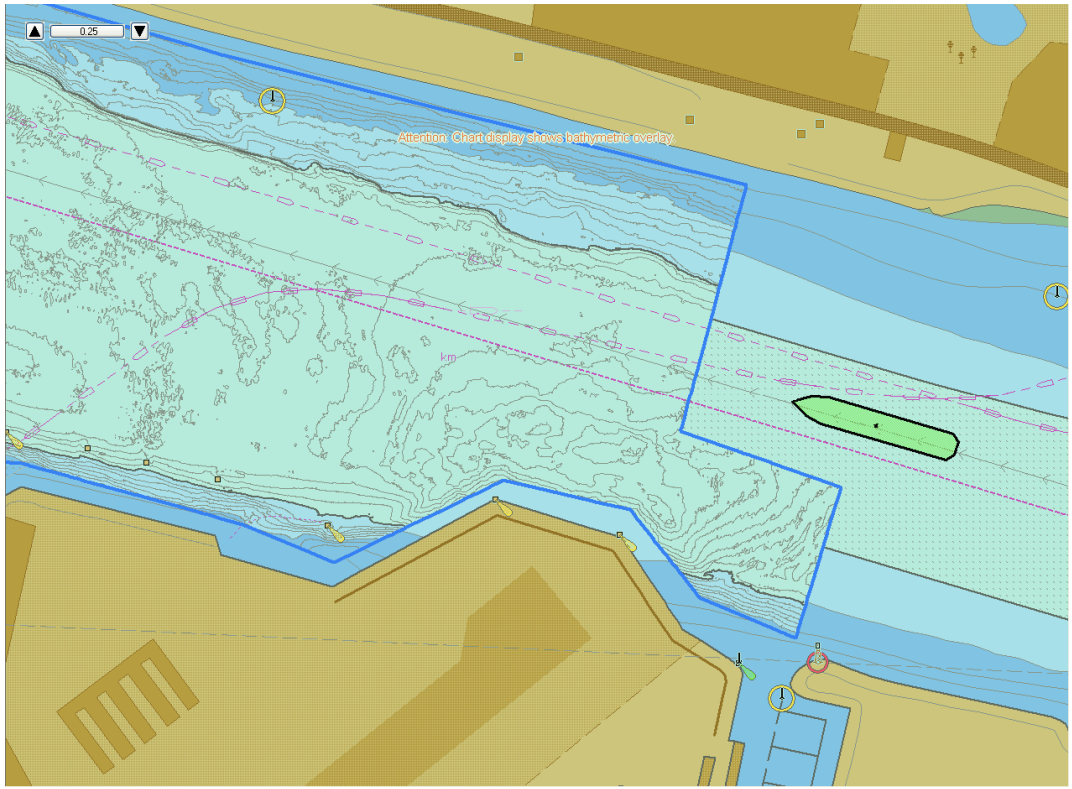
Data volumes

Wide range of users (customers)

Customer demands are changing

- More data
- Better quality
- Faster delivery
- Open standards

High density bathymetric products



Technology is not so much a problem but timeliness is!

Spatial data infrastructures

- Data producers must comply to SDI frameworks
- Use of open standards
- Internet technology
- Unknown customer

Flexibility

EMODNET project

- European Commission demand
- Building of an European Bathymetric Database
- Fully compliant with Inspire Directive
- Data access though the Internet
- Operational in 2012

EMODNET
The European Marine Observation and Data Network

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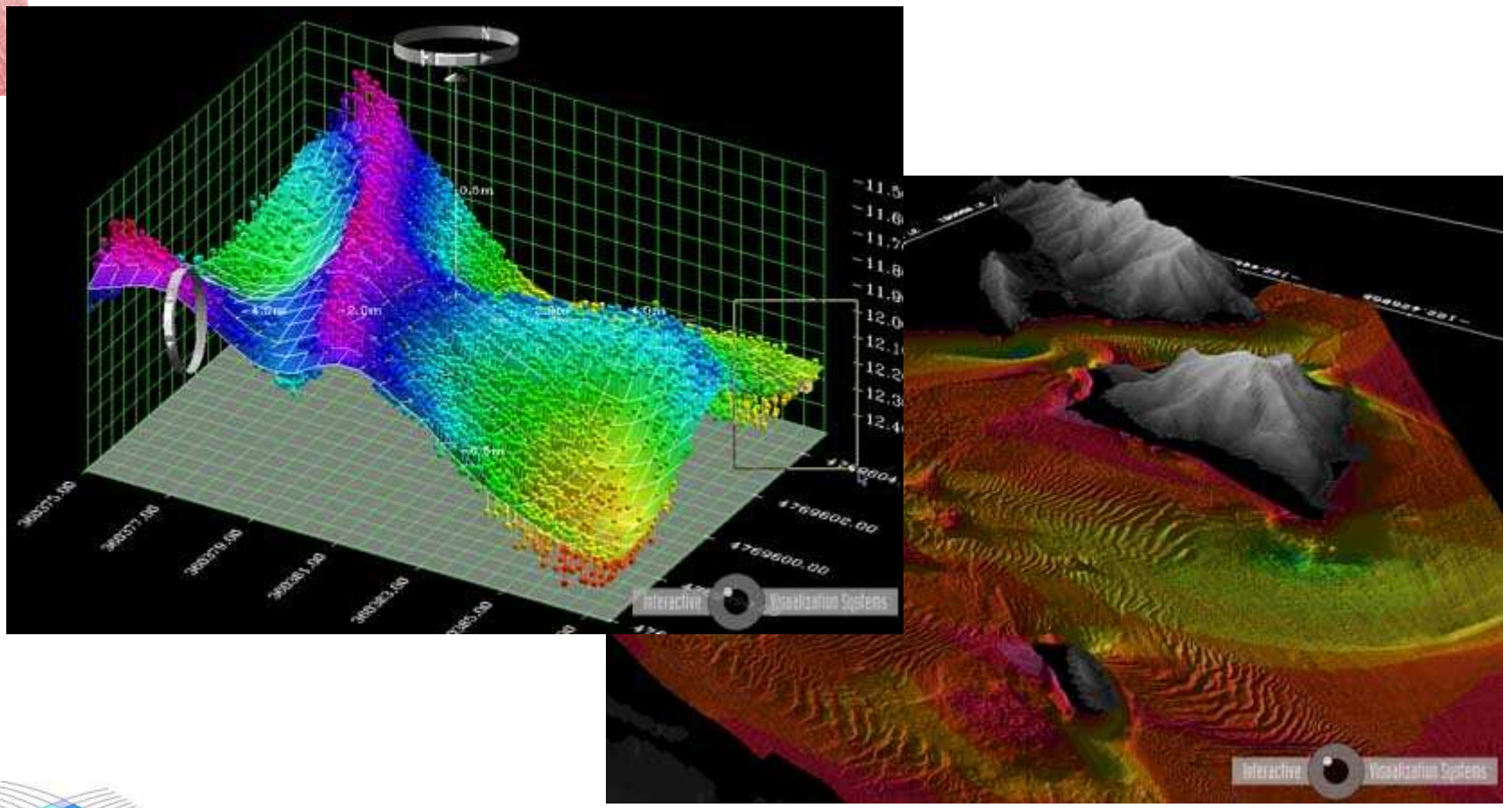
Today's solutions

- Focus on processing and analysis of MultiBeam (backscatter) information
- Tools like Fledermaus from IVS-3D provide a wealth of functionality
- The ALL operate on files
- Sufficient for project based work
- Not optimal as data management solution

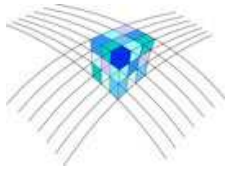
3D analysis



What is required?

- Spatial indexing
- Partitioning
- Pyramiding
- Lossless compression

Files + Spatial indexing
Partisioning
pyramiding
Lossless compression = DBMS



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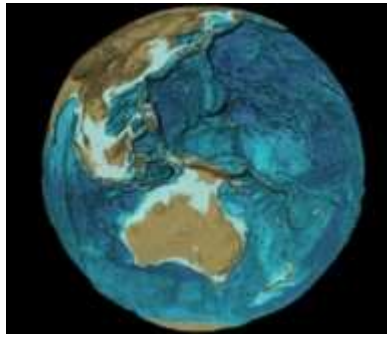
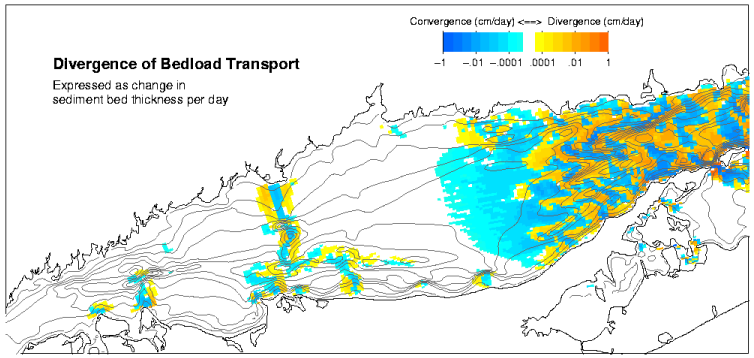
Large digital terrain models



- Not just 1 source file but many combined
- High resolution data
- The ETOPO1/GEBCO datasets are not very big (approximately 1 GB at 30 arc second spacing)
- SDIs will require more and better data
- Not as a 1 time project but maintained continuously
- Versatile data that can be used by different communities

Obligation to manage multiple models

- Different user needs (e.g. Morphology vs. safe navigation)
- Liability (history and process information)



Virtual Continuous Models (VCM)

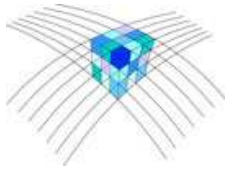
The solution is not to:

- Simplify the models (TINs or grids)
- Build alternative RDMS systems

But to:

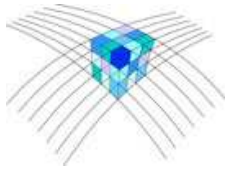
- Keep the data in its original form as much as possible
- Use open standards and available technology

ATLIS has implemented this as the VCM concept



The VCM concept

- Store survey data in an archive
- Store it only once
- Pay attention to metadata
- For each VCM that is required, store only:
  - Rules how to combine and de-conflict the source data
  - The required modeling
  - Set of convex hulls that spatially describe the components of the model
- Number of VCM is unlimited



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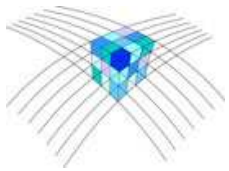
Rules

- The rule sets are defined as queries
- The sorted result of the query determines the stacking order of the source data
- Rules range from very simple (e.g. most recent on top)….

  to very complex (e.g. give me complete coverage of multi beam surveys that are collected around a certain time period)



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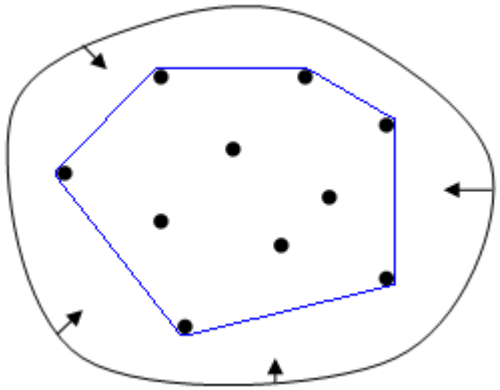
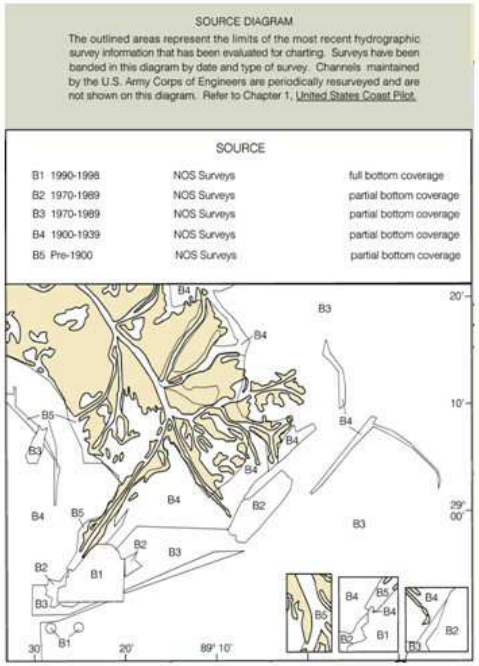
Convex hull set

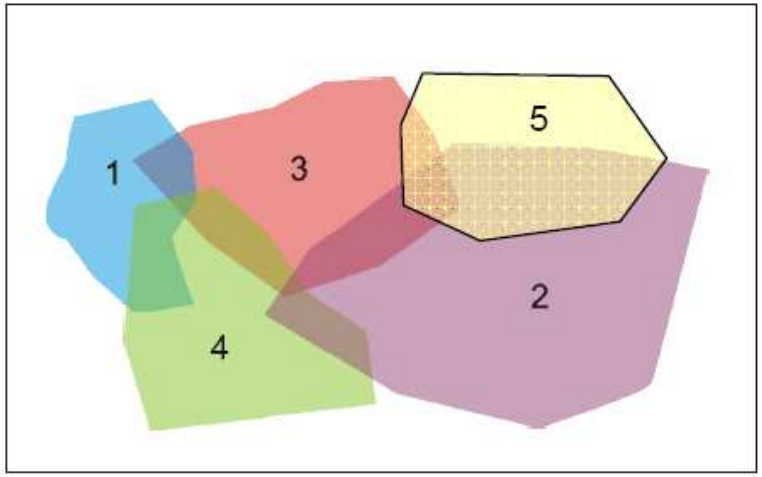
- Set of intersected and de-conflicted survey hulls (based on the specified rule)
- Can best be imagined as a source diagram as shown on nautical charts

Convex hull acts as a rubber band around a point cloud

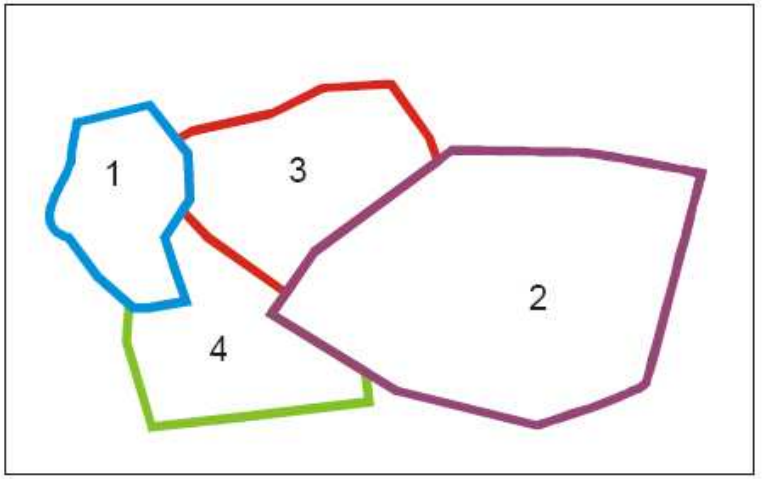




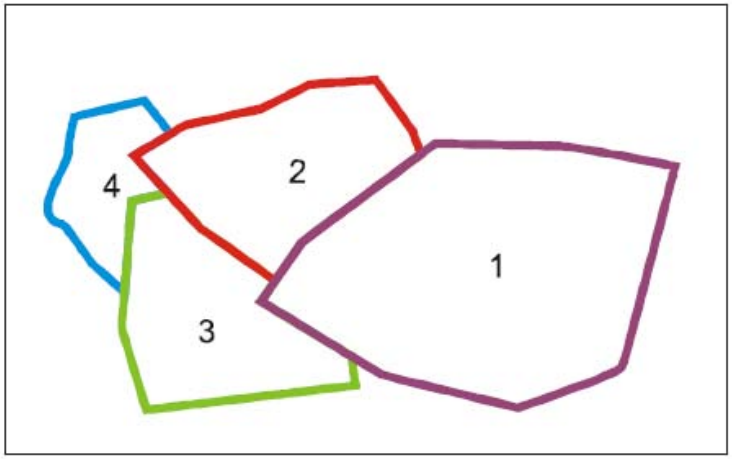
Different rules, different model



Archive



Model A



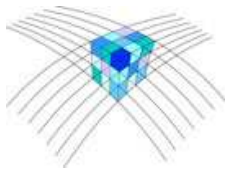
Model B

Modeling process

Optional steps may include:

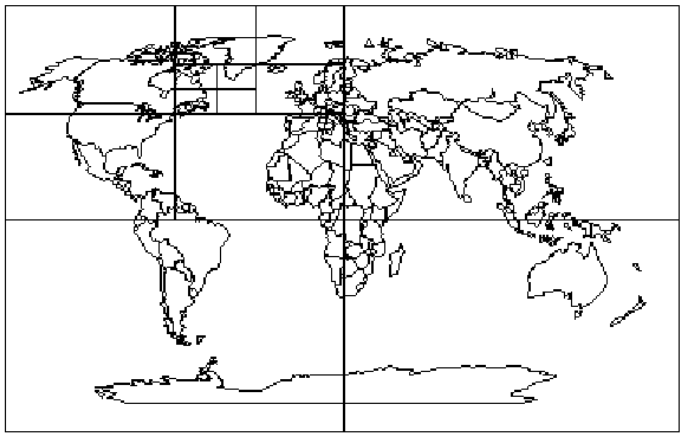
- Adjustment of vertical datum (based on separation models or fixed offsets
- Data validation (e.g. using CUBE)
- Data thinning
- Gap management

Modeling takes place on the source data and the result is stored in the archive



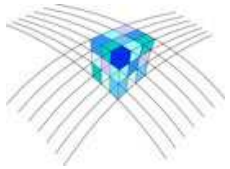
Performance

- Use of latest Oracle 11g technology
- Optimised spatial indexing and partitioning
- Use of HHCode technology on top of Oracle further enhances the performance



Challenges

- Source files will continue to grow
- More research is required to improve indexed access to large point clouds
- Oracle 11g is a vast improvement over earlier versions but geospatial industry must put as much pressure on Oracle to stay ahead of the sensor builders.



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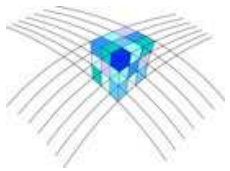
Conclusions

- File based management of large point cloud data sets is reaching its limitations
- Solution is provided by (open) DBMS systems
- ATLIS has developed the Virtual Continuous Model (VCM) concept to allow management of many different and large digital terrain models
- With the VCM concept organisations only have to store the point cloud data once. There is NO redundancy for each DTM
- More research is required to further improve indexing in open DBMSystems



Questions

spoelstra@atlis.nl