# GEOCUBES FINLAND

## A UNIFIED APPROACH FOR MANAGING MULTI-RESOLUTION RASTER GEODATA

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May 3, 2018
Geoinformatiikan tutkimuspäivä

# OPEN GEOSPATIAL INFORMATION INFRASTRUCTURE FOR RESEARCH - OGIIR

- Included on the roadmap for the Finnish Research Infrastructures (FIRI)
- Development project for years 2017 – 2019 funded by the Academy of Finland
- Project partners:
  - Finnish Geospatial Research Institute(FGI) in the National Land Survey of Finland (NLS)
  - University of Turku (UTU)
  - Aalto University (Aalto)
  - University of Eastern Finland (UEF)
  - Finnish Environment Institute (SYKE)
  - Geological Survey of Finland (GTK)
  - Natural Resources Institute Finland (Luke)
  - CSC - IT Center for Science Ltd (CSC)

# CORE DEVELOPMENT AREAS

| Service Component | Development Tasks | Responsible participants |
|---|---|---|
| 1. oGIIR Geospatial Data | • Improvement and harmonisation of core geospatial data sets<br>• Creation of enhanced data sets to support scientific research<br>• Establishment of oGIIR data service platform | Luke (leading), FGI, SYKE, GTK, CSC |
| 2. oGIIR Geocomputing | • Core GIS tools for high-performance geocomputing<br>• Integration of research and modelling software<br>• Integration of statistical and analytics software<br>• Framework for Big Data Analysis on geospatial data | FGI (leading), CSC, Aalto, UTU, Luke, SYKE, GTK |
| 3. oGIIR Knowledge Sharing Network | • Unified user interface and support<br>• Educational material on requested fields<br>• Expert networking and interaction channels | UTU (leading), Aalto, UEF, CSC, FGI, Luke, SYKE, GTK |



# *SERVICE COMPONENT 1: OGIIR GEOSPATIAL DATA*

**a) Improvement and harmonisation of core geospatial data sets**

- Data produced by the NLS
- Data sets produced by the multi-source National Forest Inventory by Luke
- Environmental data layers by SYKE
- Geological spatial data provided by GTK

**b) Creation of enhanced data sets to support scientific research**

- Processed user oriented data products upon themes that are particularly needed in scientific research

**c) Establishment of oGIIR data service platform**

- The metadata provision
- The data distribution service
- Data replication mechanisms
- Time snapshot archive for core geospatial data
- Research data archive

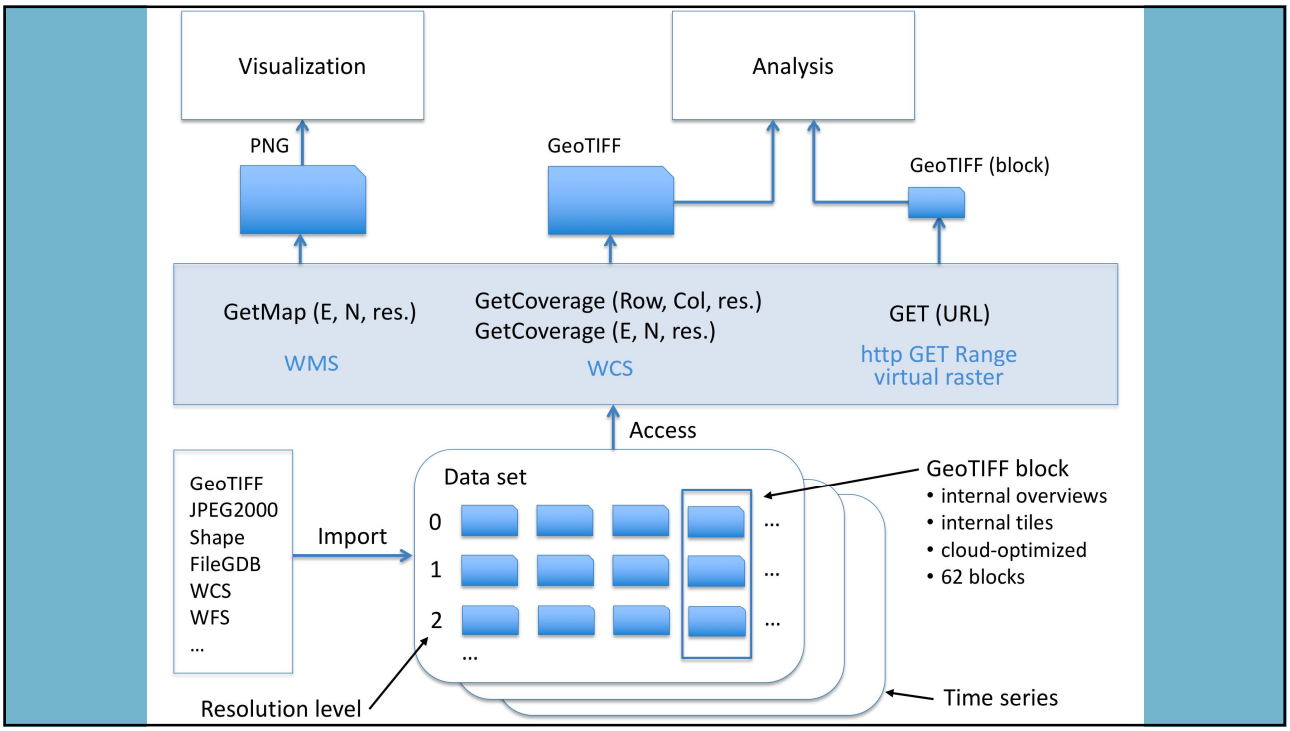
# GEOCUBES FINLAND

- An integrated and harmonized set of raster geodata resources made available in a cloud computing platform
- Harmonized in
  - Georeferencing
  - Resolution in multiple levels
  - Spatial subdivision
  - Access mechanisms
  - Format



# GEOCUBES FINLAND

- Fixed grid, based on ETRS-TM35FIN
- Resolutions: 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 m
- Divided in 62 blocks of 100 km * 100 km
- Available through http GET Range, virtual raster, WCS, WMS/WMTS
- Implemented as Cloud-Optimized GeoTIFF files
  - Internal overviews
- Processing by GDAL Python API
  - Geospatial Data Abstraction Library


Visualization
Analysis
PNG
GeoTIFF
GeoTIFF (block)
GetMap (E, N, res.)
WMS
GetCoverage (Row, Col, res.)
GetCoverage (E, N, res.)
WCS
GET (URL)
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GeoTIFF
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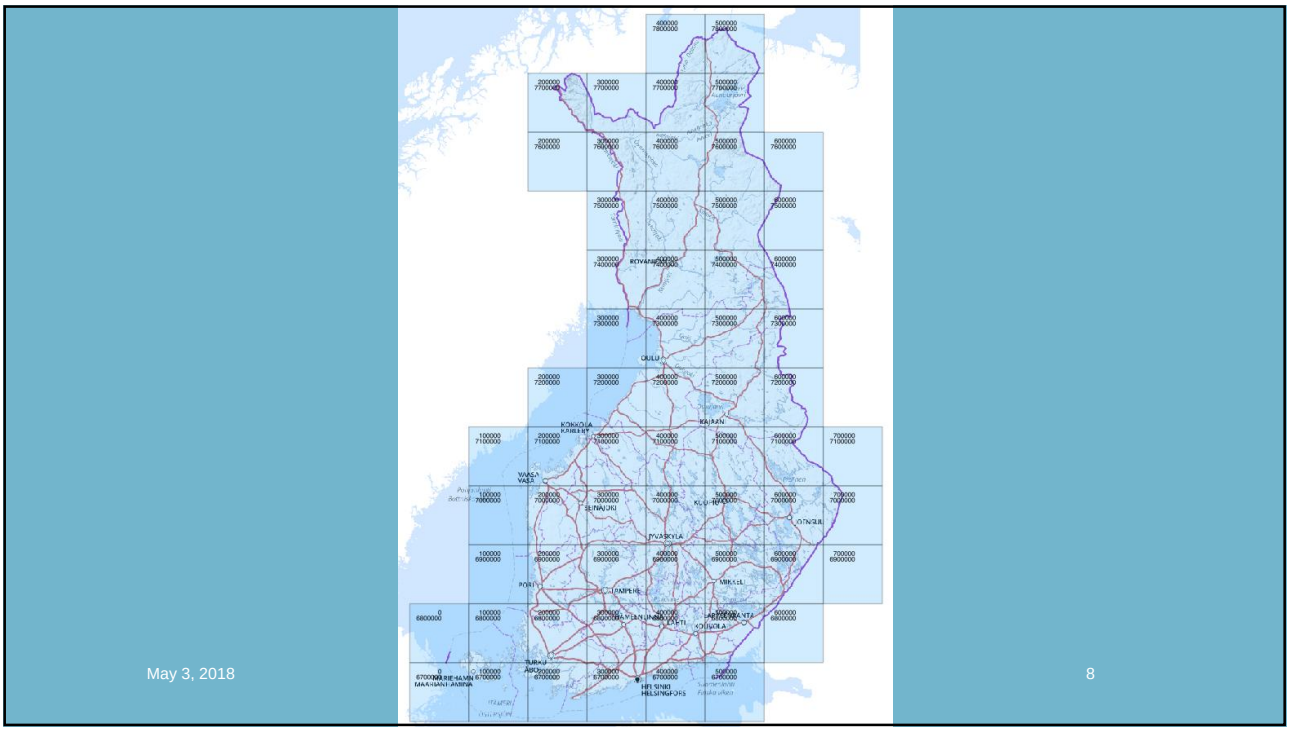
• internal overviews
• internal tiles
• cloud-optimized
• 62 blocks
Resolution level
Time series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# GEOCUBES CONTENT

- Soil map
  - Sources 1:20000, 1:200000 and 1:1M data sets
- CORINE Land Use
  - 2000, 2006, 2012
- DEM
  - 10 m source resolution
- Administrative units
  - Municipalities
- Auxiliary layers
  - Background map, ortophotos
  - Administrative units as vector data, on 4 levels



# CORINE: DIFFERENCES BETWEEN EDITIONS

- 2000 and 2006 resolution 25 m, 2012 resolution 20 m
- 2000 and 2006 origin N: 7836750, 2012 origin N: 7836760
- Classifications a bit different each year
  - 2000: 47 classes, 2006: 44 classes, 2012: 48 classes
  - For instance, Lakes 46 (2000), 43 (2006), 47 (2012)
  - Some difficulties in mapping values from edition to edition

# CORINE: IMPORT PROCESS

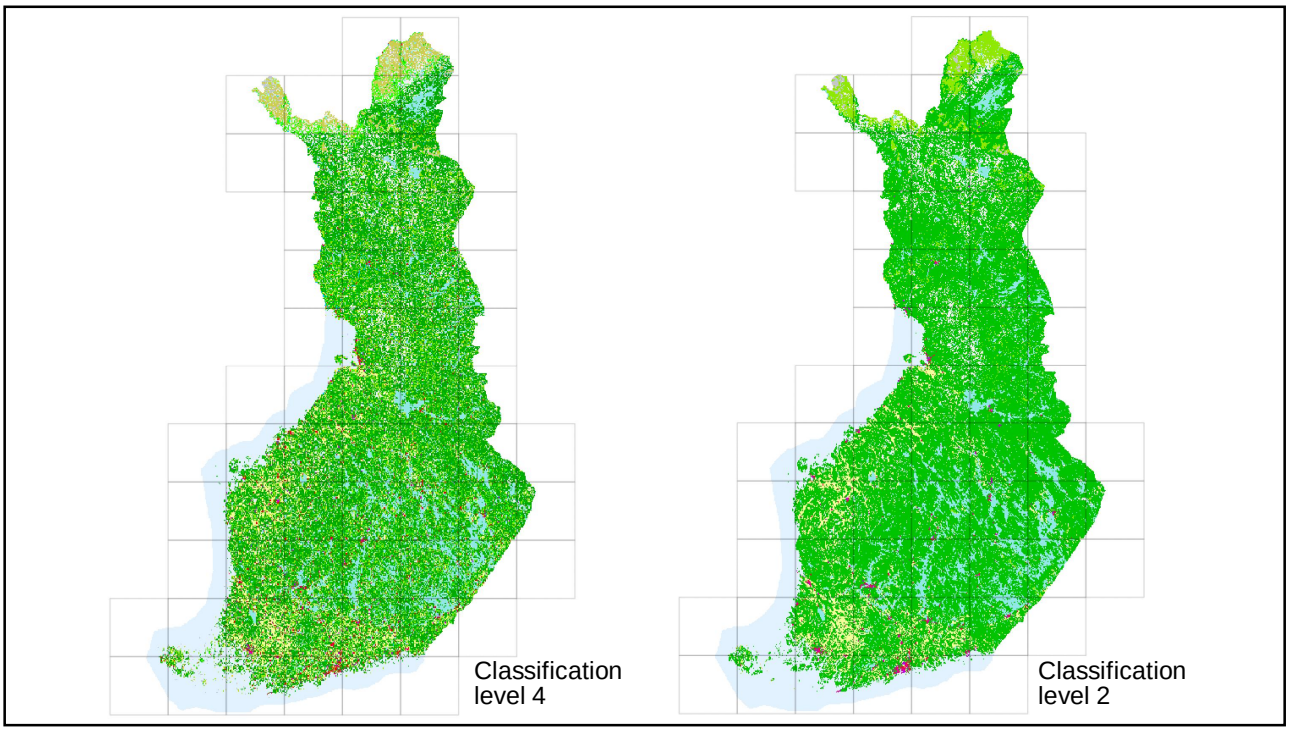
- Unifying classifications: 2000 -> 2006 -> 2012 and 2006 -> 2012
- Oversampling -> 5 m (2000 and 2006: ratio 5, 2012: ratio 4)
- Generalization 5 m -> 10 m, 20 m and 50 m
- Integration of classes in 10 m resolution (classifying level 3)
- Generalization 10 m -> 100 m and 200 m
- Integration of classes in 10 m resolution (classifying level 2)
- Generalization 10 m -> 500 m and 1000 m
- Transformation to Cloud-Optimized

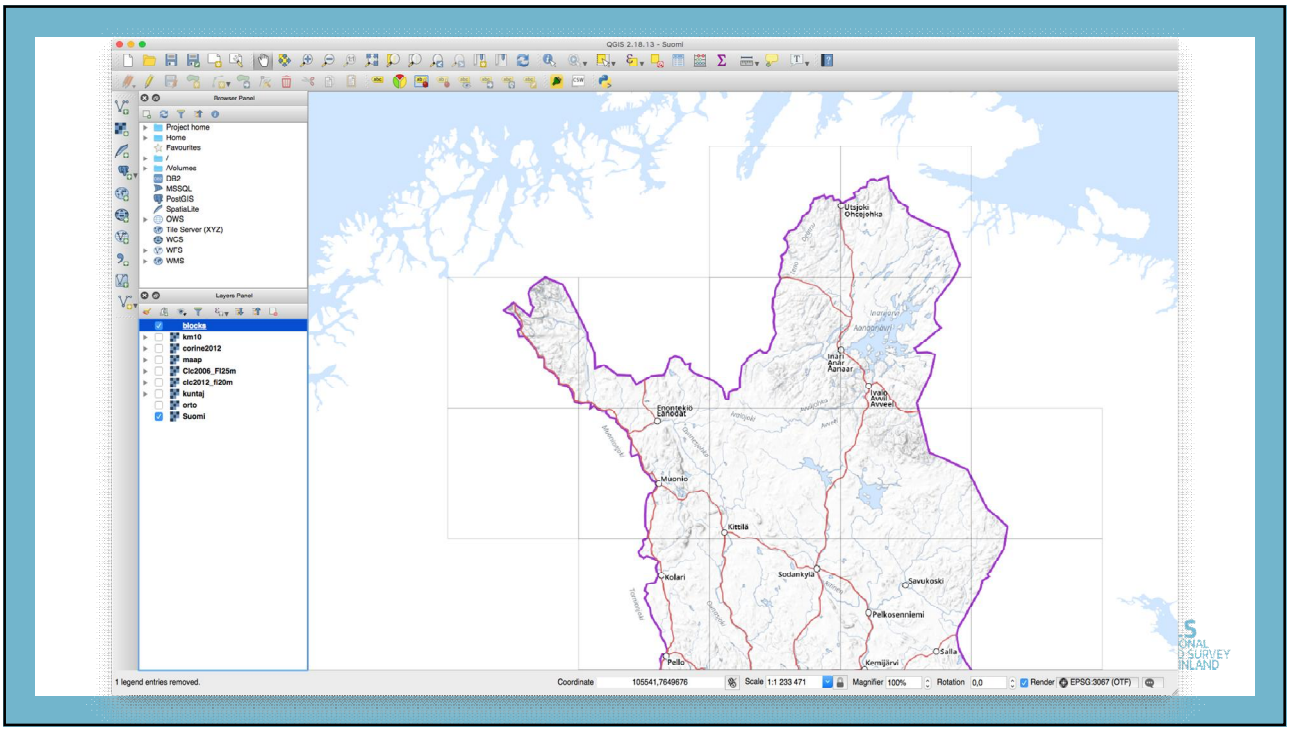
NLS NATIONAL LAND SURVEY OF FINLAND

# CORINE: INTEGRATION OF CLASSES

Classifying level 4: 48 classes (values 1-48)
Classifying level 3: 32 classes (values 101-132)
Classifying level 2: 15 classes (values 201-215)
Classifying level 1: 5 classes (values 251-255)

| Resolution | Classifying level |
|---|---|
| 10 | 4 |
| 20 | 4 |
| 50 | 4 |
| 100 | 3 |
| 200 | 3 |
| 500 | 2 |
| 1000 | 2 |


Classification level 4
Classification level 2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Enontekiö Lappodat
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Kolari
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Savukoski
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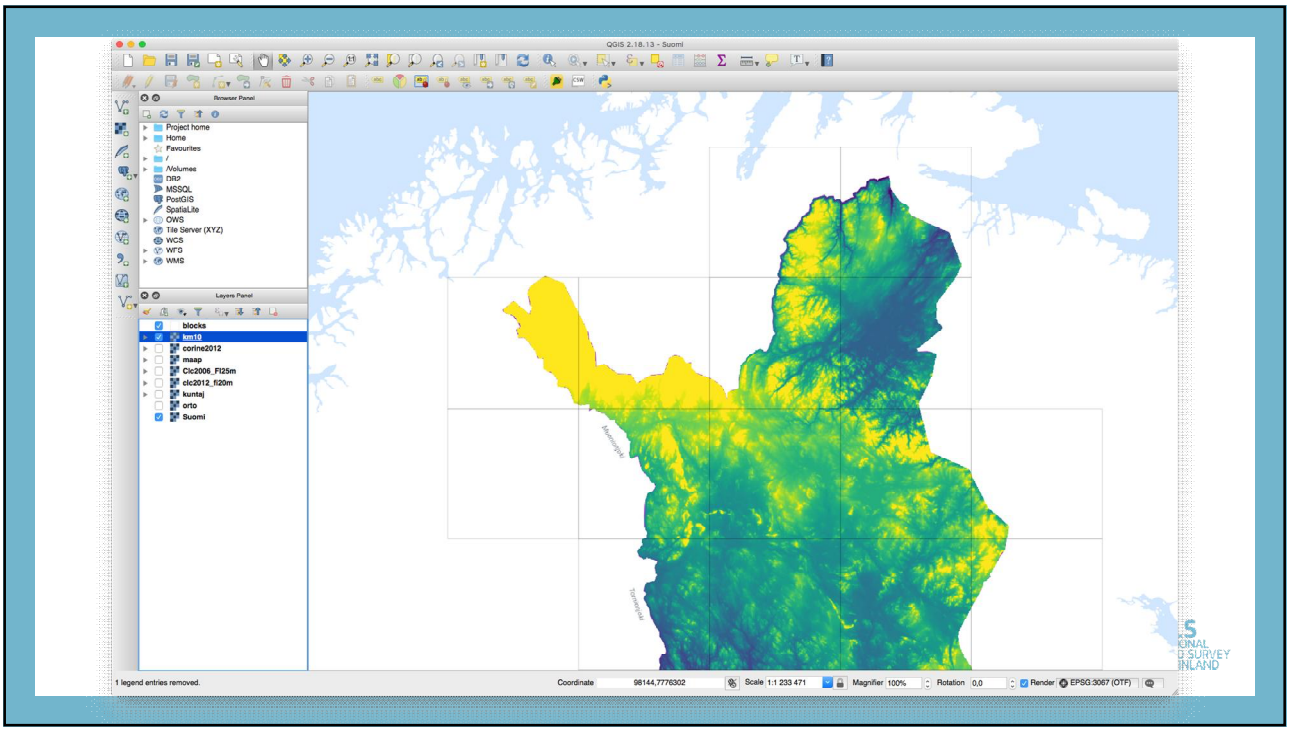
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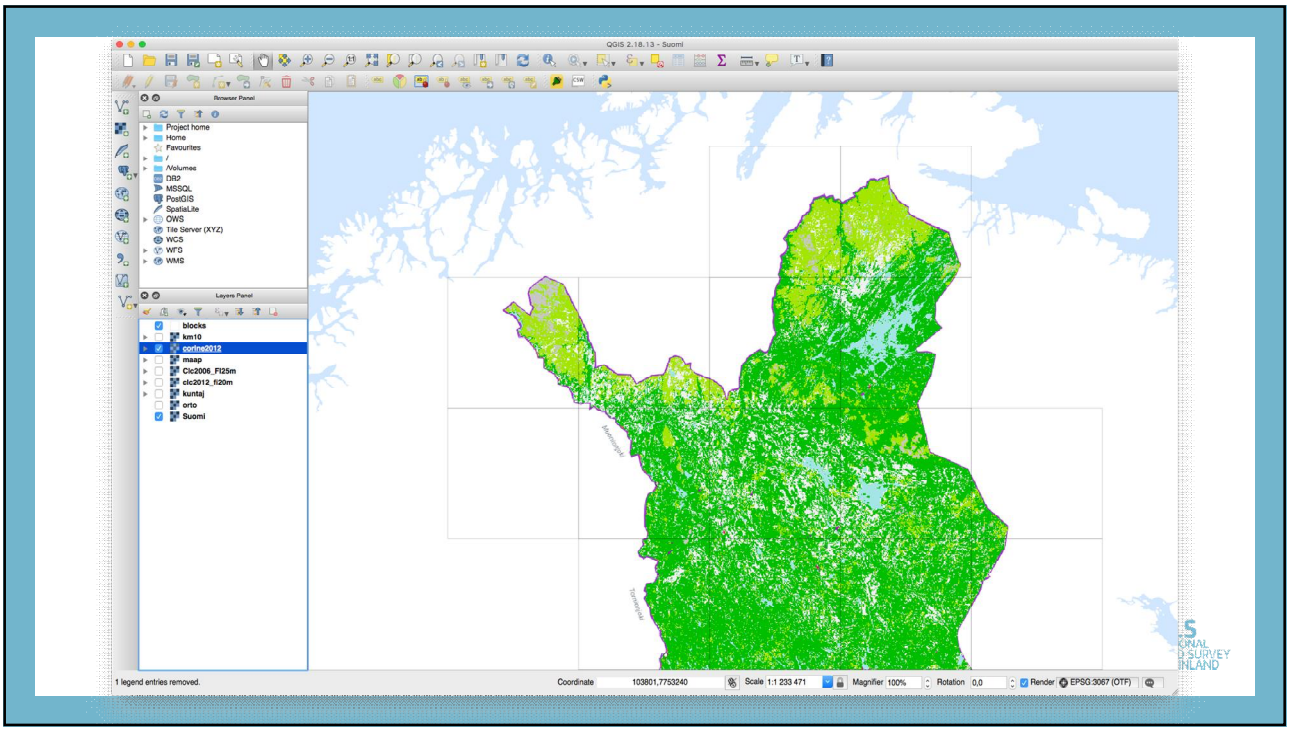
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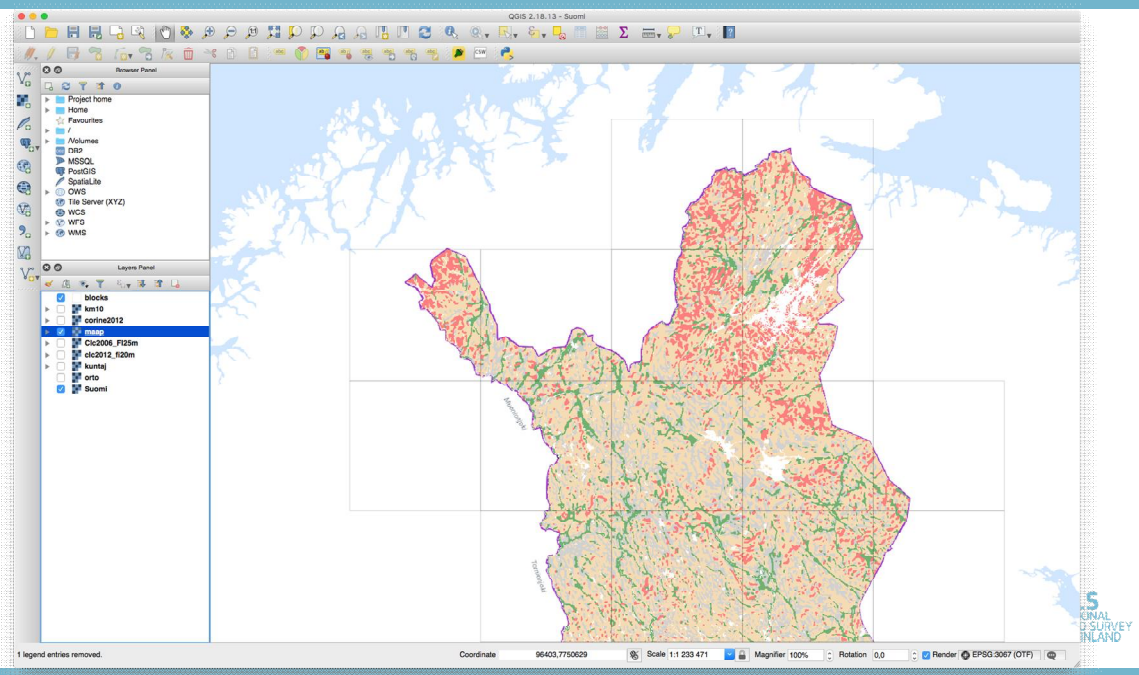


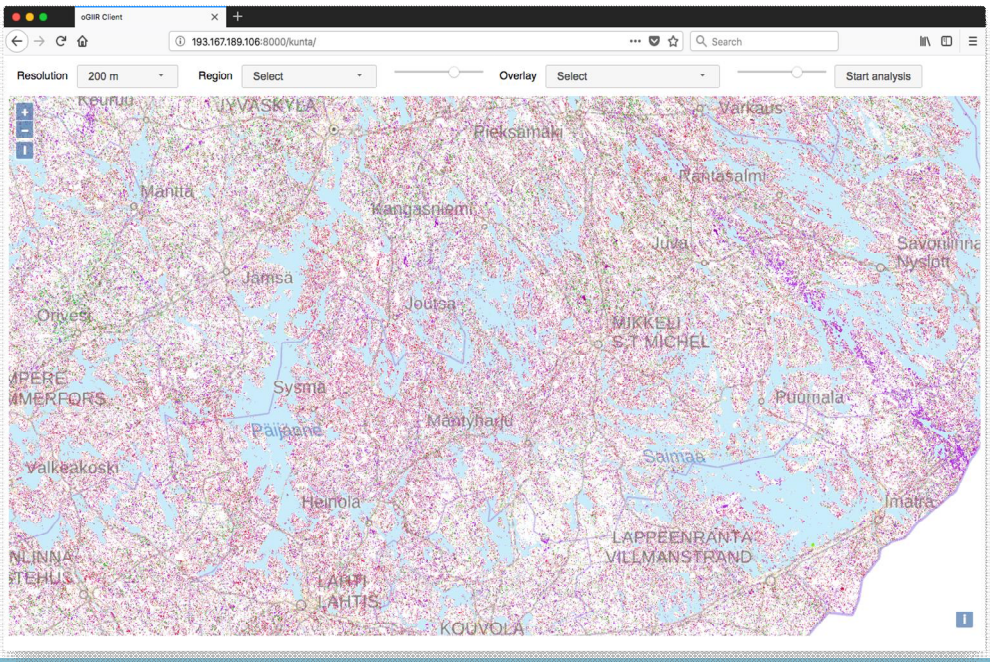

# GEOCUBES AS A DATACUBE

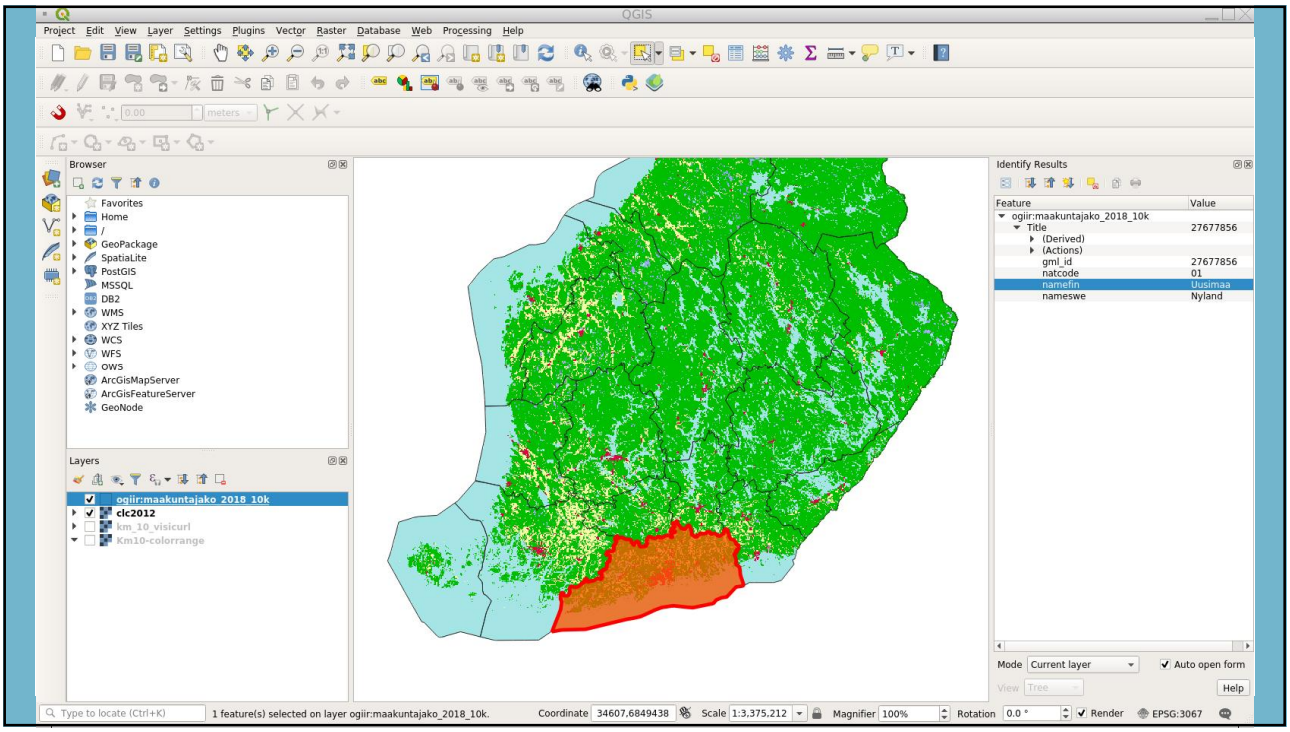
- Datacube: multi-dimensional raster array with equal access performance along all axes
- In geospatial context mostly applied in Earth Observation data
- Example: volumetric data with timeseries
- GeoCubes dimensions
  - Theme
  - Northing, Easting
  - Time (CORINE 2000, 2006, 2012)
- Resolution levels could seen as separate datacubes

# CLIENT PLATFORMS

- Web application
  - Visualisation via MapServer – MapProxy as PNG images
  - Visualisation accelerated by file cache
  - Access to server-side analysis functions on HPC platform
- QGIS
  - Fast access to Cloud-Optimized GeoTIFFs by http GET Range
  - Simple management of multiple blocks by virtual raster
  - Local visualisation and analysis (GDAL built-in)



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(Derived)
(Actions)
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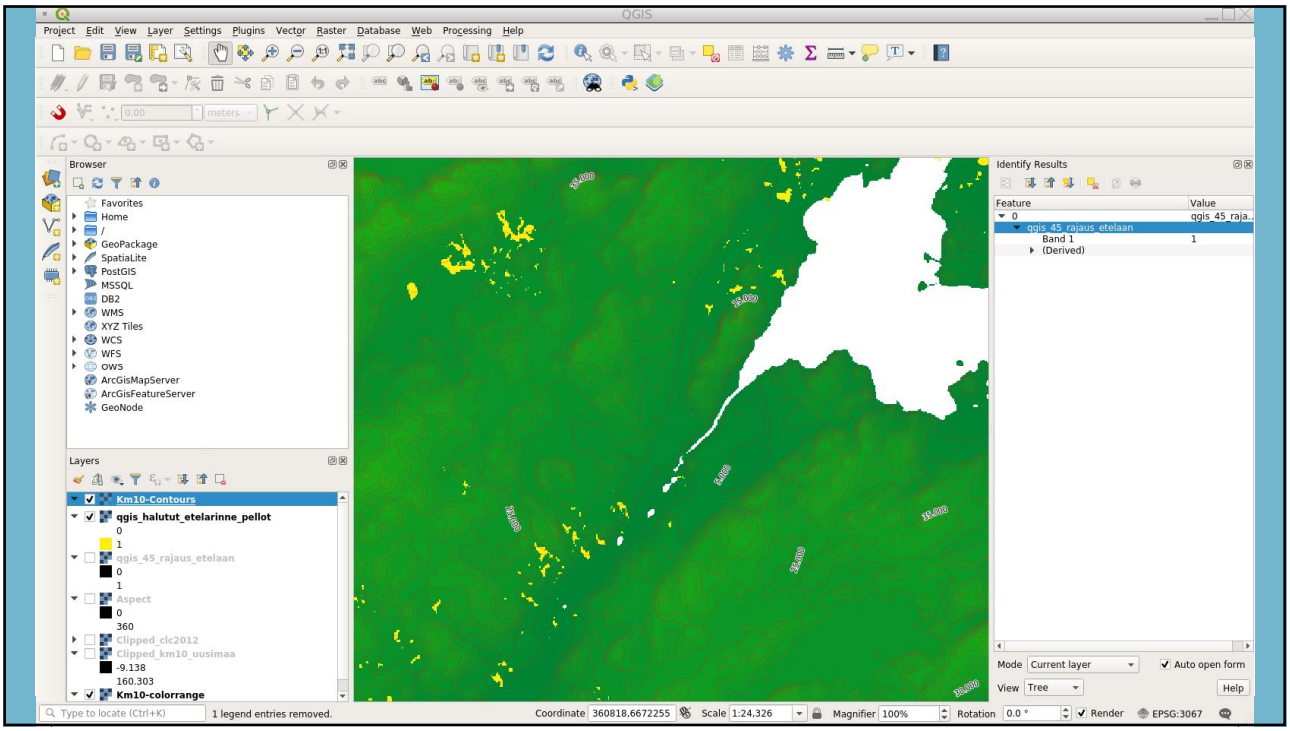
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Km10-colorrange
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# ANALYSIS ON HPC PLATFORM

- Flexibly configurable multi-core cloud-computing server instances
- Natural spatial partitioning based on blocks
- Parallel processing by Python sub-processes
- Interactive applications by utilizing an appropriate resolution level



# CONCLUSIONS

- Easy-to-use harmonised multi-layer, multi-resolution raster data storage, aimed at research community
  - Multi-resolution approach facilitates visualisation-oriented interactive geodata analysis
- Combined with HPC platform for fast analysis
- Resembles datacube concept with limited capabilities
- Future work involves for instance development of service-side analysis modules and web user interfaces; better integration with HPC tools
- Future development will be decided after discussions in the oGIIR Consortium

# THANK YOU!

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