HARMONIZED MULTIRESOLUTION GEODATA CUBE FOR EFFICIENT RASTER DATA ANALYSIS AND VISUALIZATION

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Geoinformatics and Cartography

GEOProcessing'2020
Nov 2020

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FINNISH GEOSPATIAL RESEARCH INSTITUTE
FGI

Agenda

GeoCubes Introduction
GeoCubes Content
GeoCubes API
GeoCubes Applications
Conclusion

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OF FINLAND

GeoCubes Introduction

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GEOCUBES FINLAND

- Developed as part of the oGIIR project
- An integrated and harmonized set of raster geodata resources made available in a cloud computing platform
- Harmonized on
  - Georeferencing
  - Resolution in multiple levels
  - Spatial subdivision
  - Access mechanisms
  - Format
- Loosely based on Data Cube concept

GEOCUBES FINLAND

- Fixed grid, based on ETRS-TM35FIN
- Resolutions: 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 m
- Divided in 60 blocks of 100 km * 100 km
- Implemented as Cloud-Optimized GeoTIFF (COG) files
  - Resolution levels both as internal overviews and as external files
- Processing by Rasterio
  - GDAL (Geospatial Data Abstraction Library)
- Available through
  - WCS, WMS/WMTS, http GET Range, virtual file (VRT), REST-API

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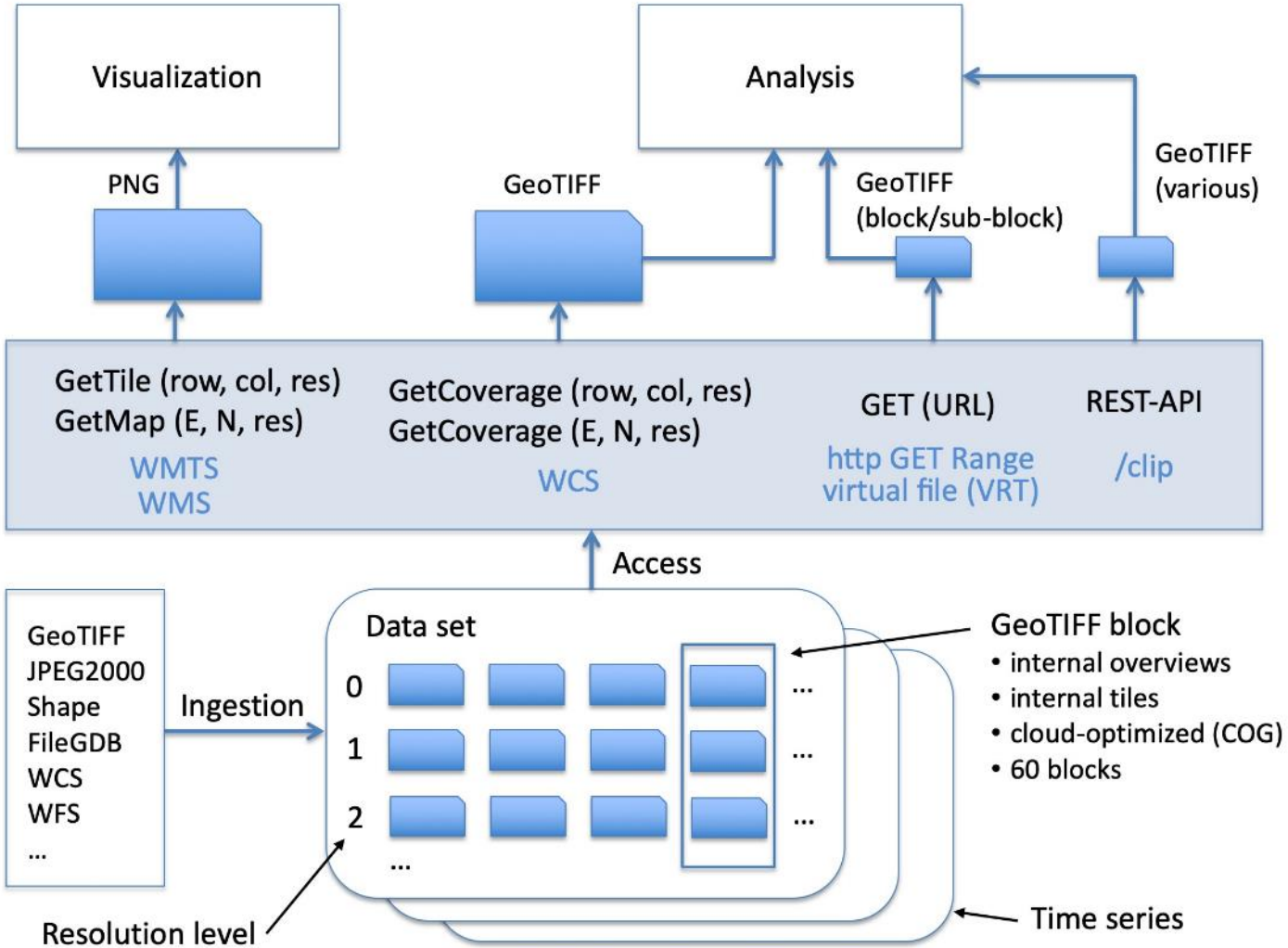
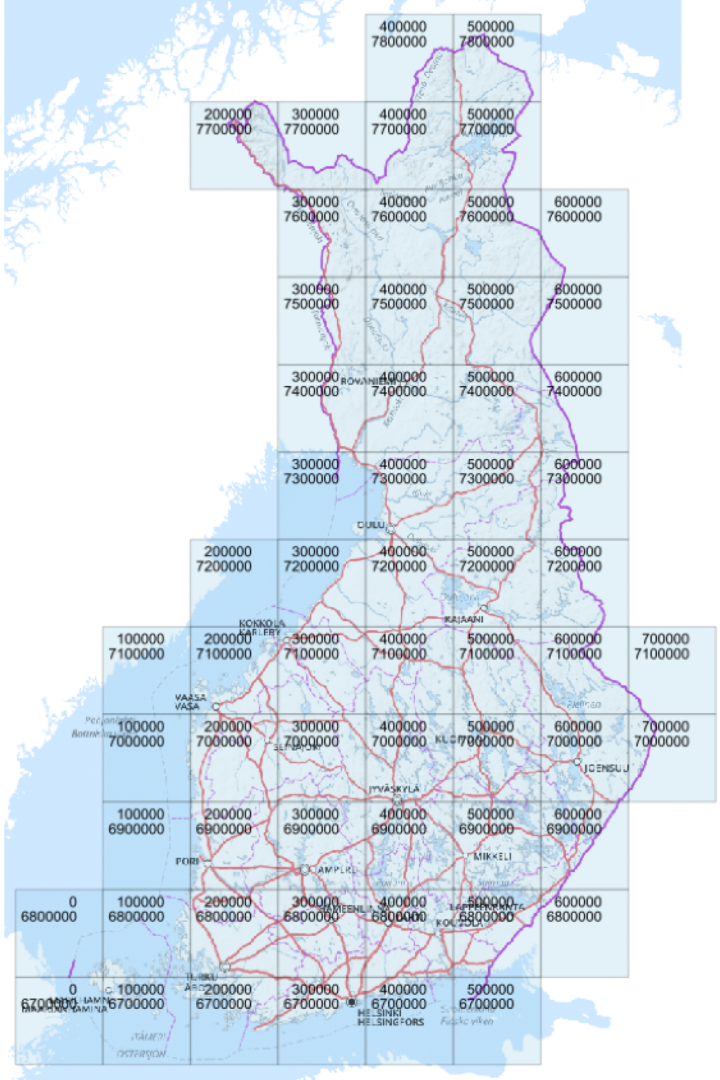

Visualization
Analysis
PNG
GeoTIFF
GeoTIFF
(block/sub-block)
GeoTIFF
(various)
GetTile (row, col, res)
GetMap (E, N, res)
WMTS
WMS
GetCoverage (row, col, res)
GetCoverage (E, N, res)
WCS
GET (URL)
http GET Range
virtual file (VRT)
REST-API
/clip
Access
GeoTIFF
JPEG2000
Shape
FileGDB
WCS
WFS
...
Ingestion
Data set
0
1
2
...
GeoTIFF block
• internal overviews
• internal tiles
• cloud-optimized (COG)
• 60 blocks
Resolution level
Time series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KOKKOLA
VAASA
JYVÄSKYLÄ
JOENSUU
PORI
MIKKELI
HELSINKI
HELSINGFORS

GeoCubes Content

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GEOCUBES CONTENT

- Surface deposits
  - Sources 1:20000, 1:200000 and 1:1M data sets
- CORINE Land Use
  - 2000, 2006, 2012, 2018
- DEM
  - 2 and 10 m source resolution
  - Slope, Aspect
- Forest inventory
  - Nine attributes; 2009, 2015
- Sea, Crop parcels
- Administrative units
  - Municipalities, counties, regions, country

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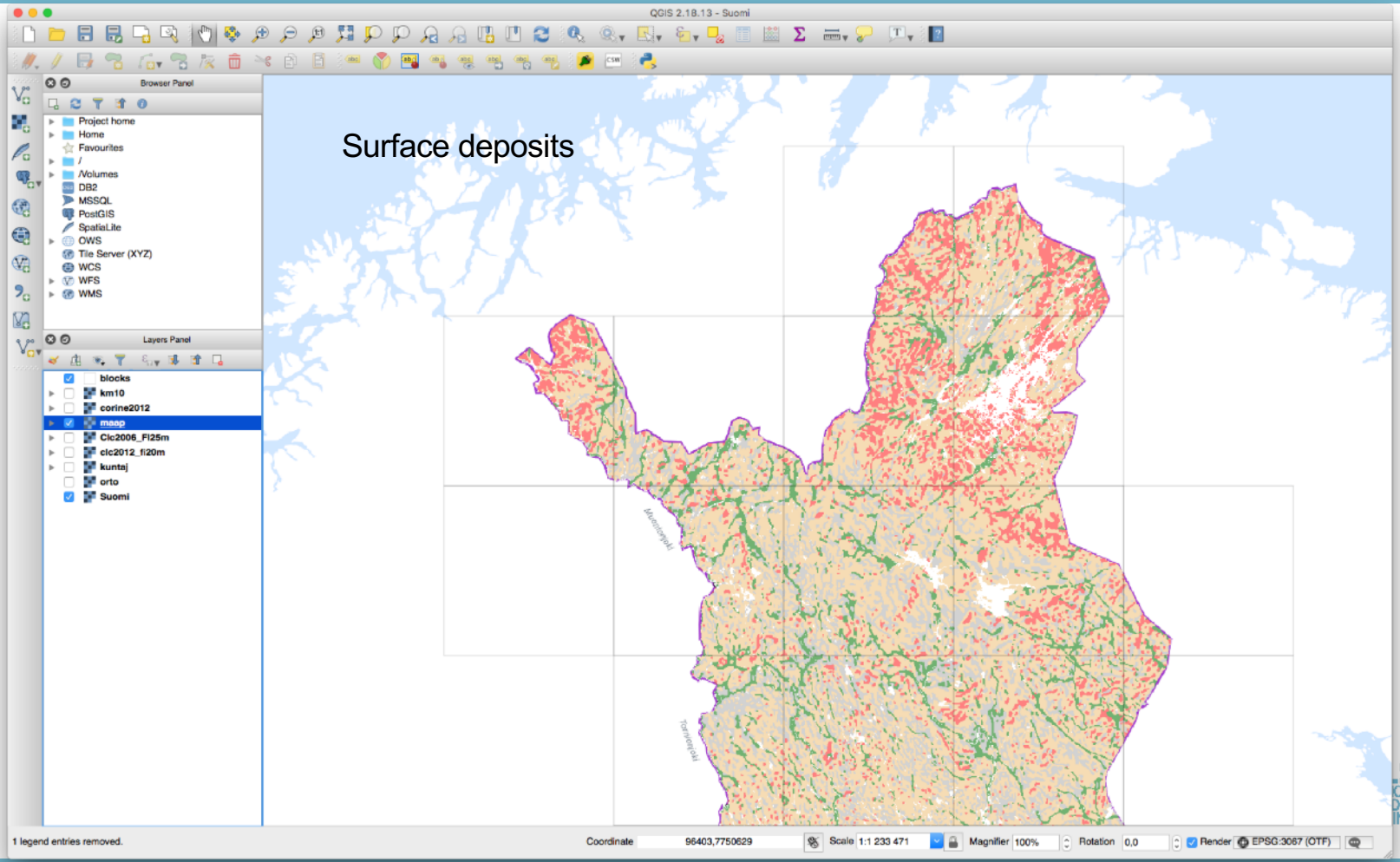
QGIS 2.18.13 - Suomi
Surface deposits
Browser Panel
Project home
Home
Favourites
/
/Volumes
DB2
MSSQL
PostGIS
SpatiaLite
OWS
Tile Server (XYZ)
WCS
WFS
WMS
Layers Panel
blocks
km10
corine2012
maap
Clc2006_FI25m
clc2012_fi20m
kuntaj
orto
Suomi
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Magnifier
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Rotation
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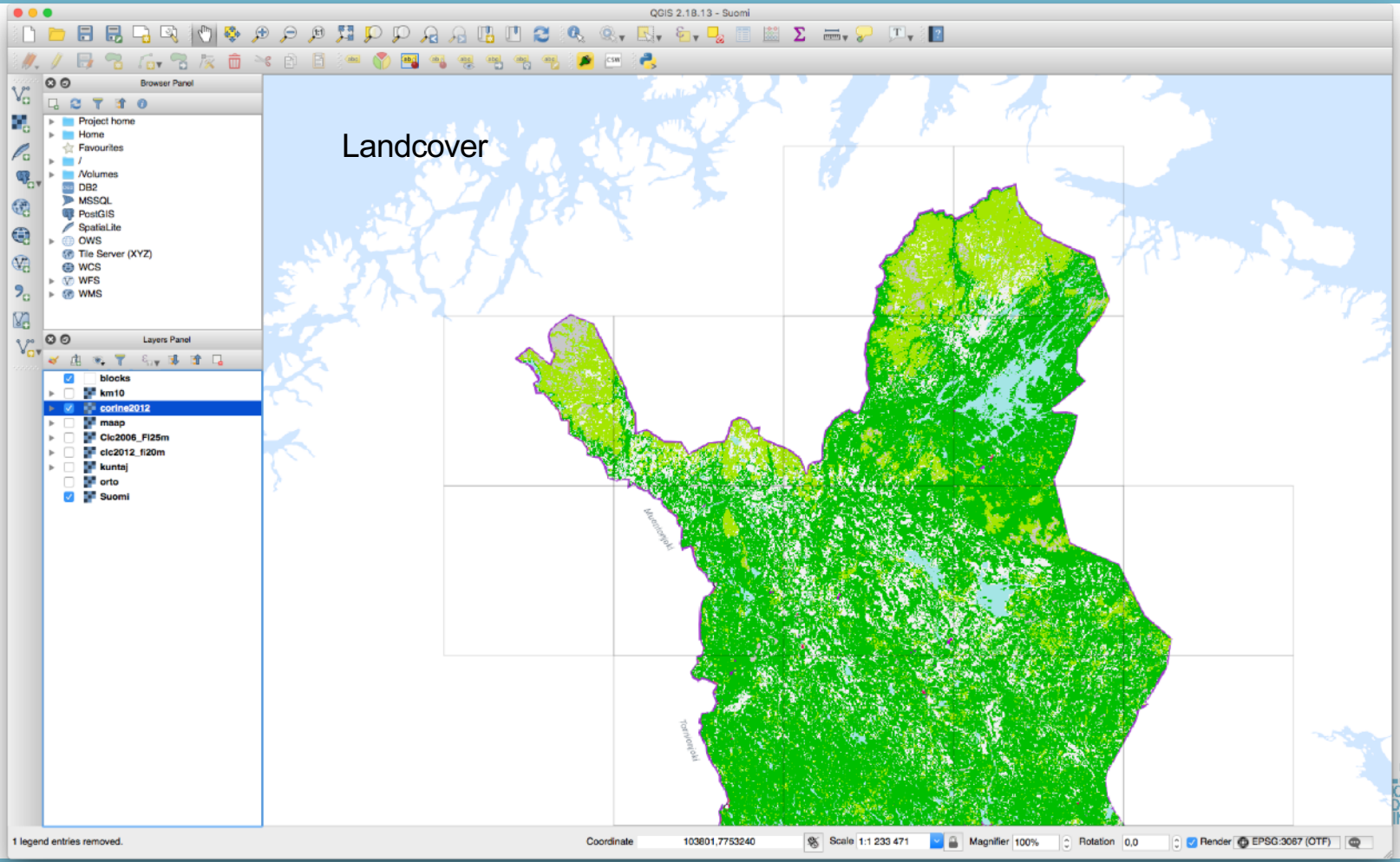
Render
EPSG:3067 (OTF)


QGIS 2.18.13 - Suomi
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Favourites
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DB2
MSSQL
PostGIS
SpatiaLite
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Tile Server (XYZ)
WCS
WFS
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corine2012
maap
Clc2006_FI25m
clc2012_fi20m
kuntaj
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Landcover
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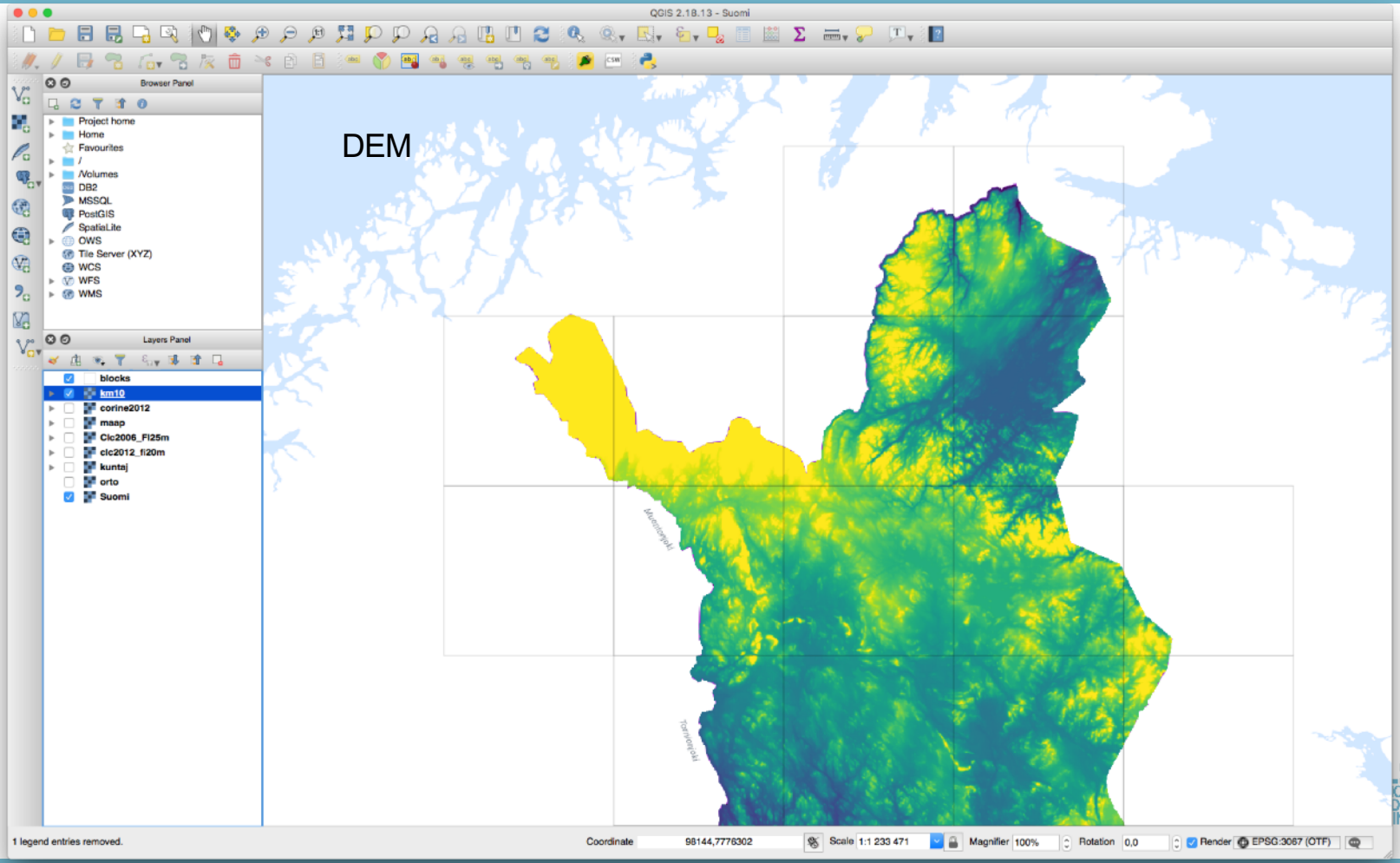
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Tile Server (XYZ)
WCS
WFS
WMS
Layers Panel
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Clc2006_FI25m
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DEM
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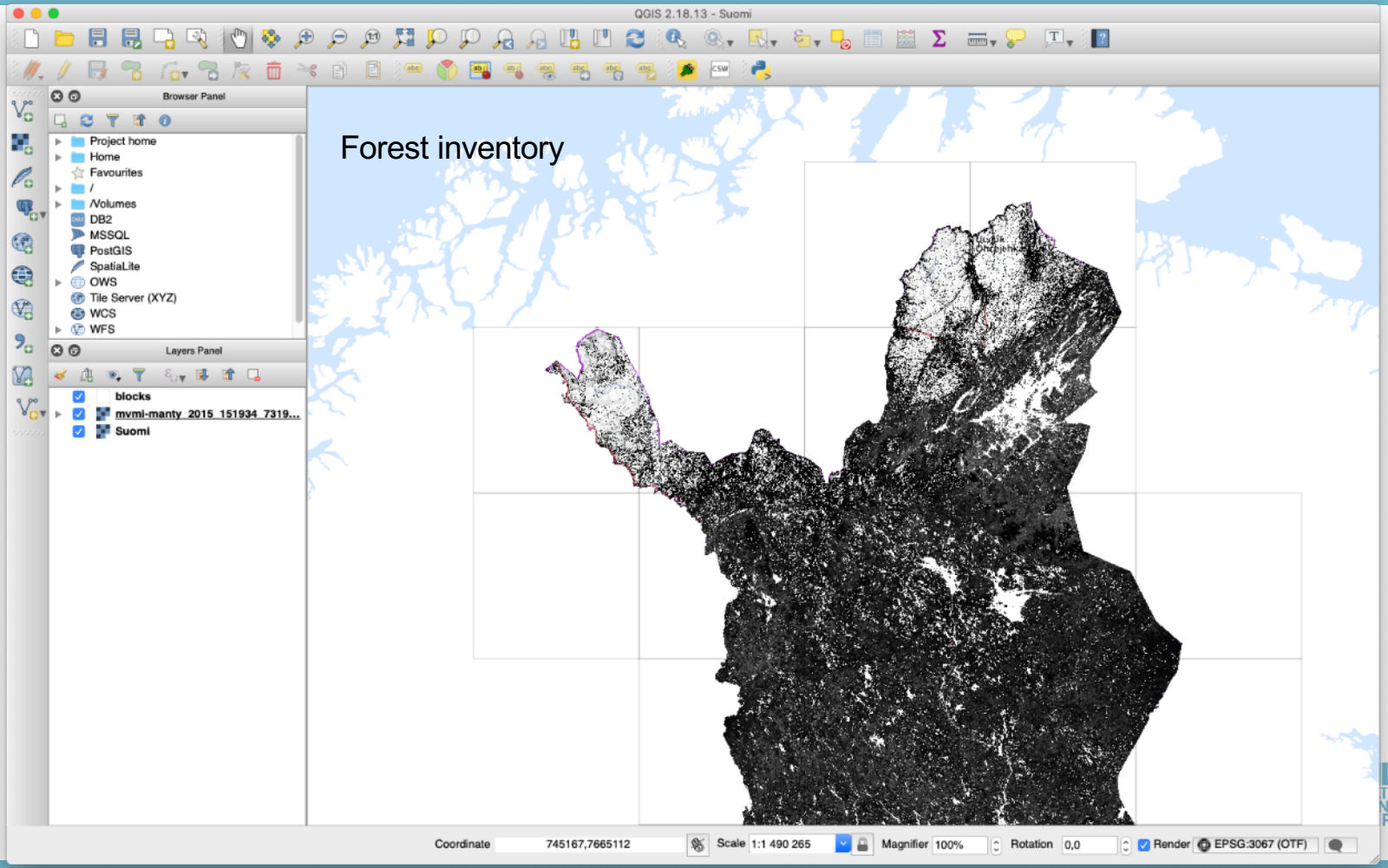
QGIS 2.18.13 - Suomi
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Project home
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Tile Server (XYZ)
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blocks
mvmi-manty_2015_151934_7319...
Suomi
Forest inventory
Coordinate
745167,7665112
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1:1 490 265
Magnifier
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Rotation
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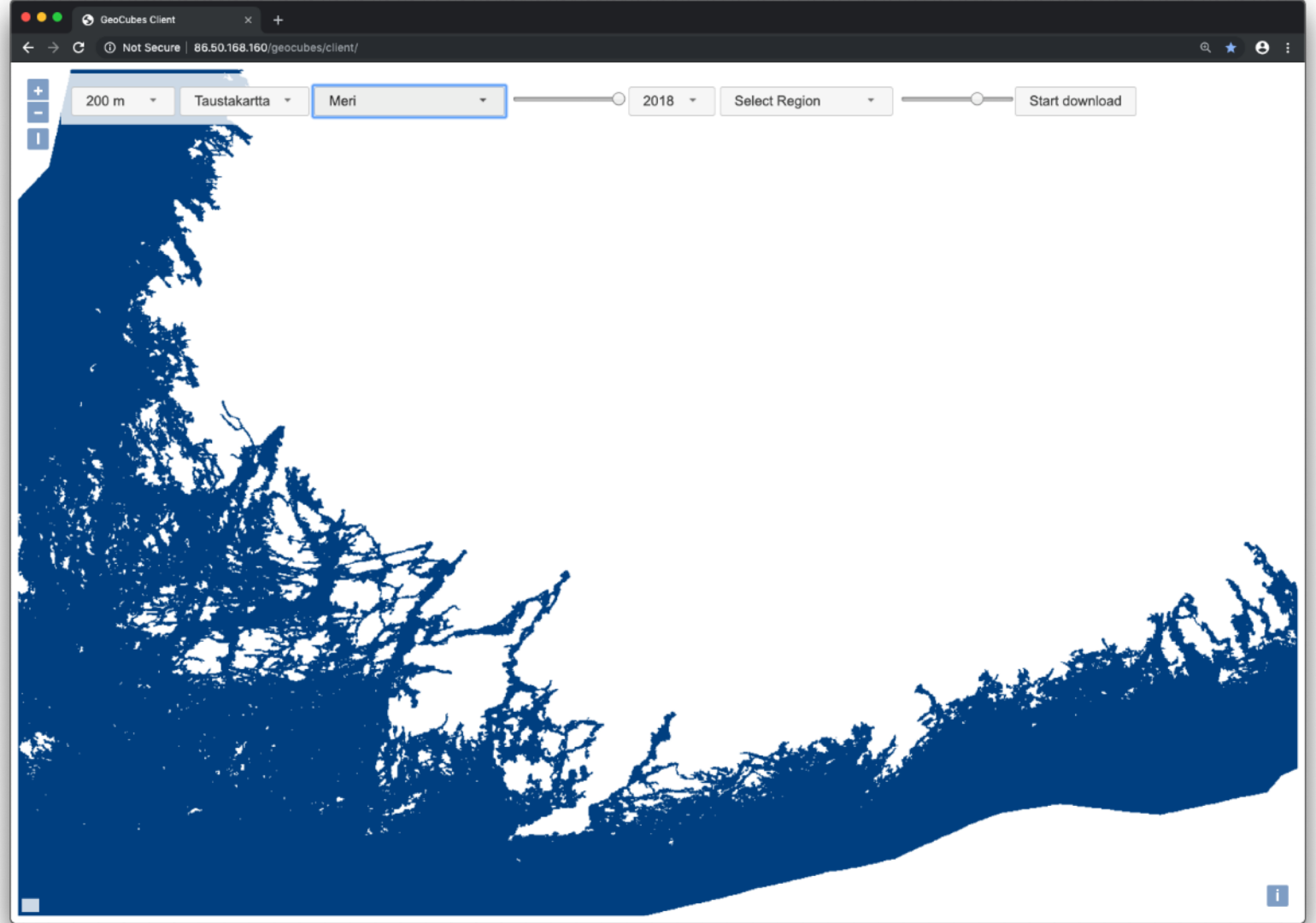
EPSG:3067 (OTF)


GeoCubes Client
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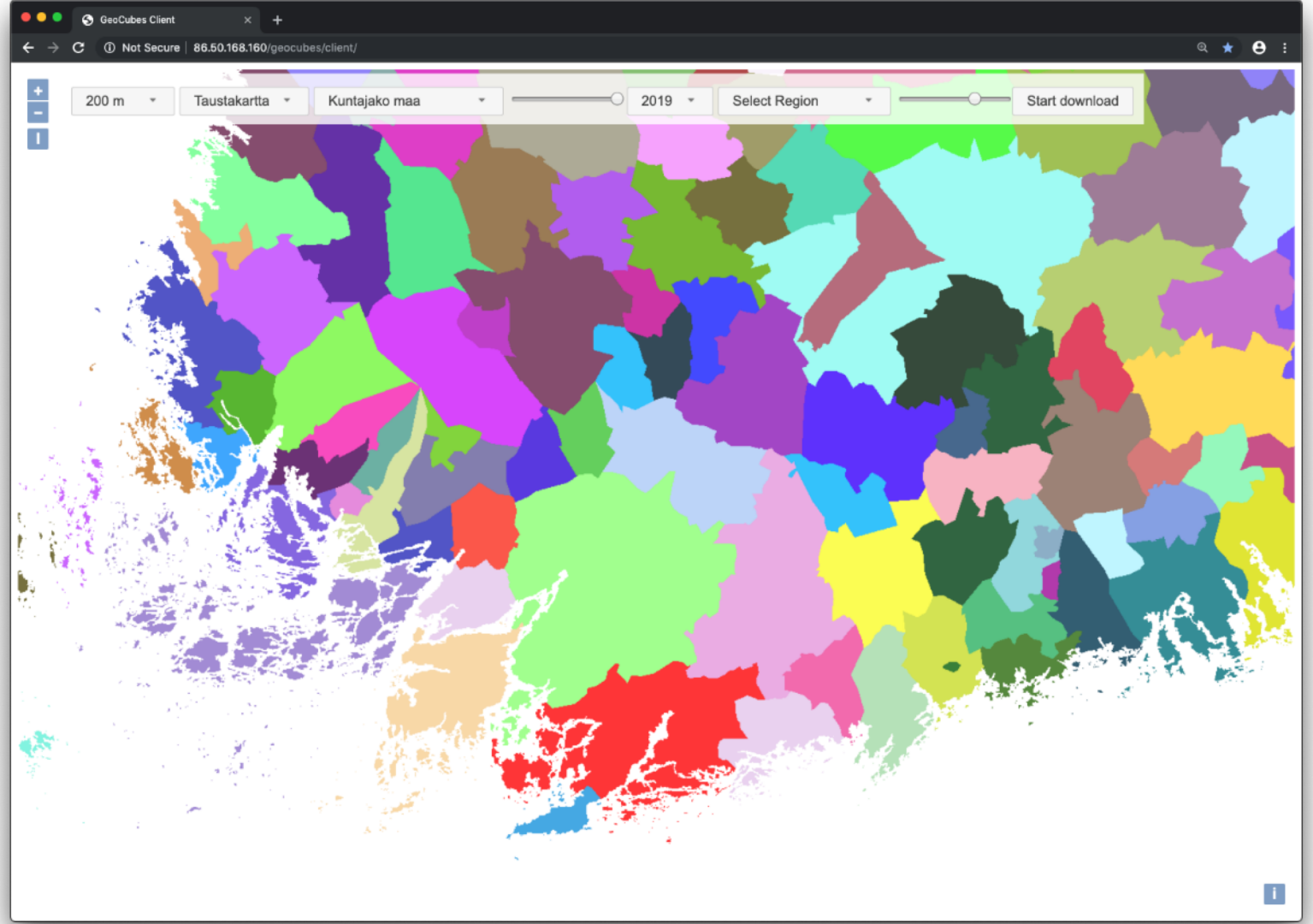
2018
Select Region
Start download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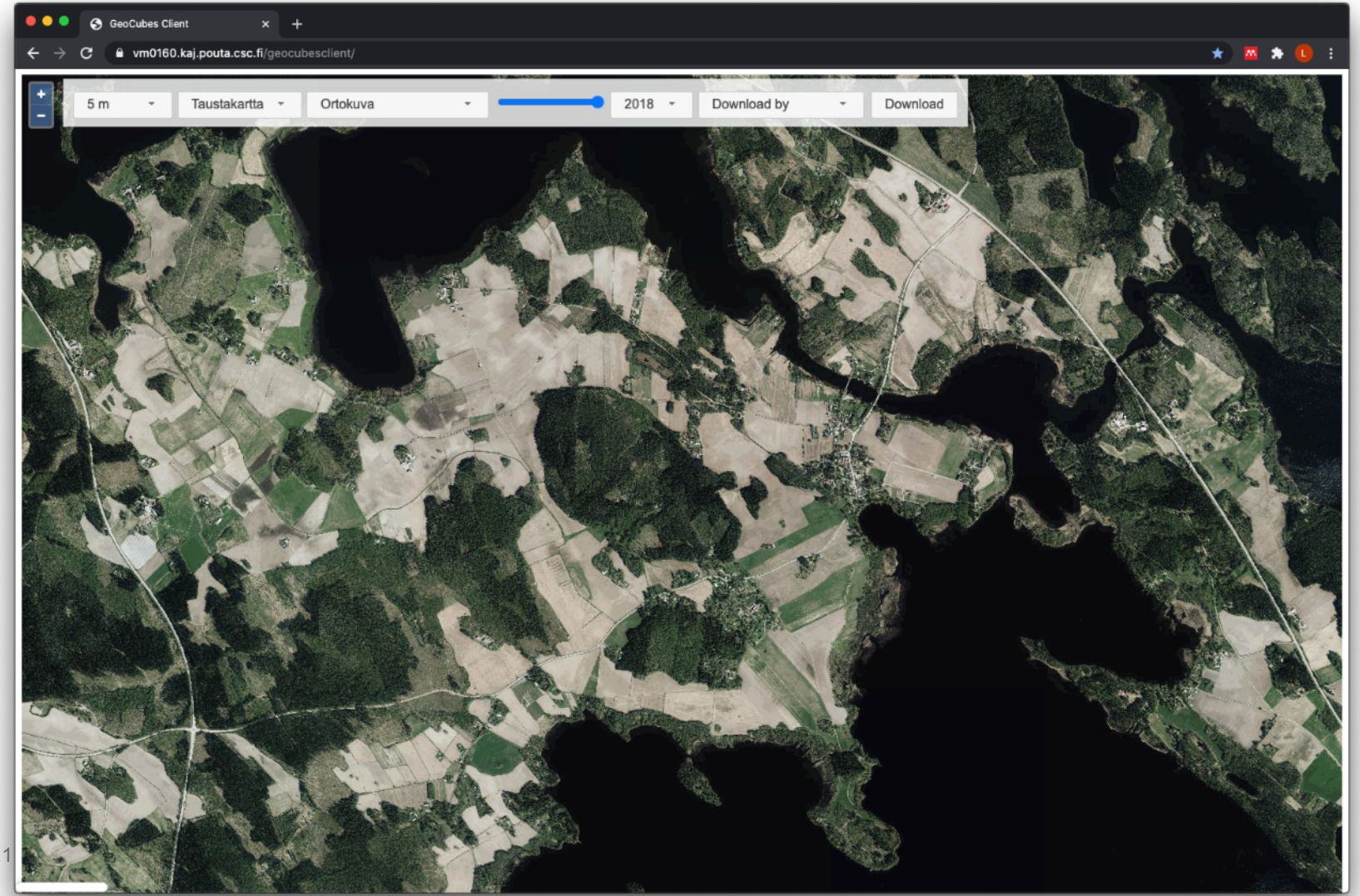
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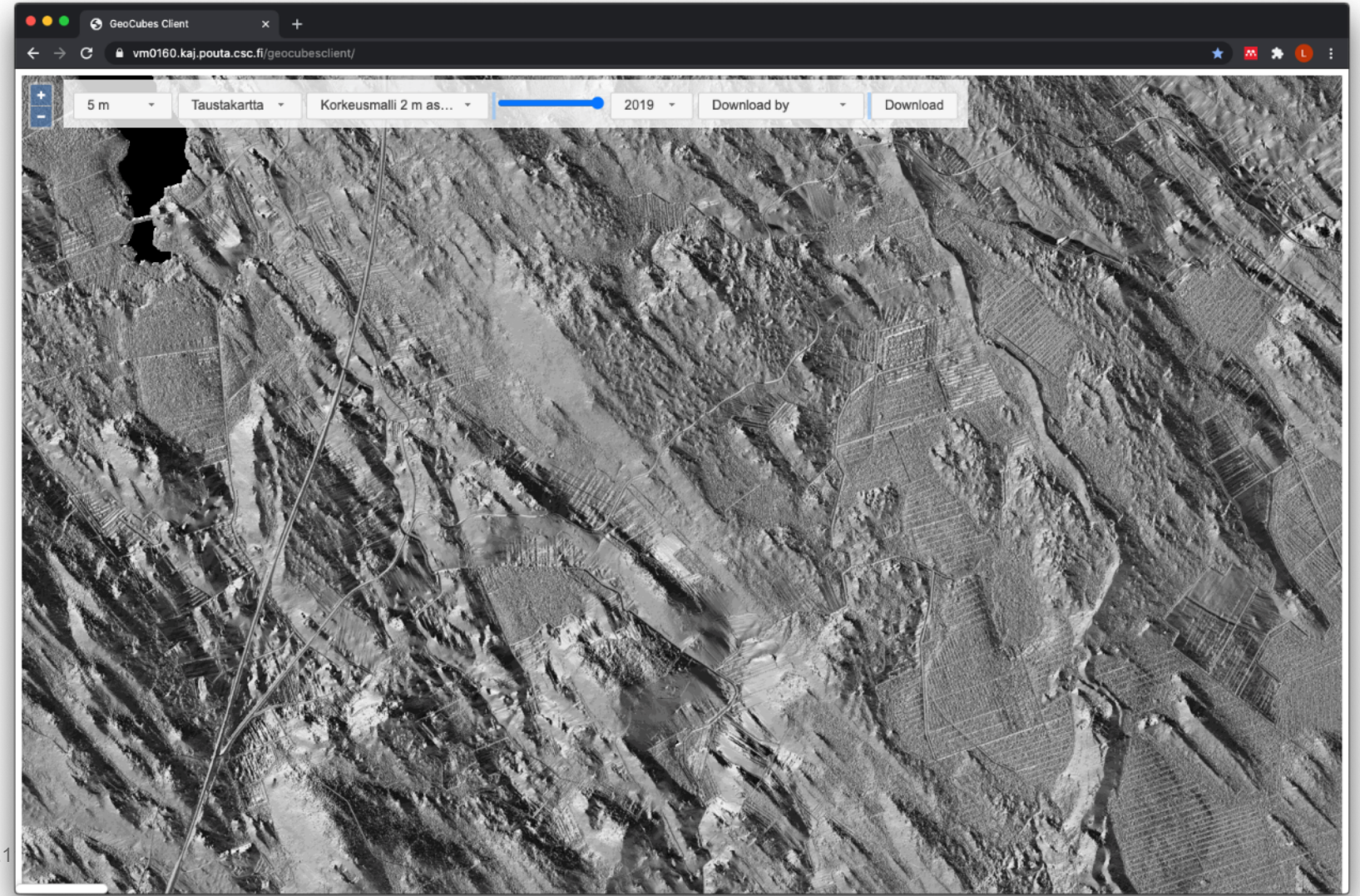
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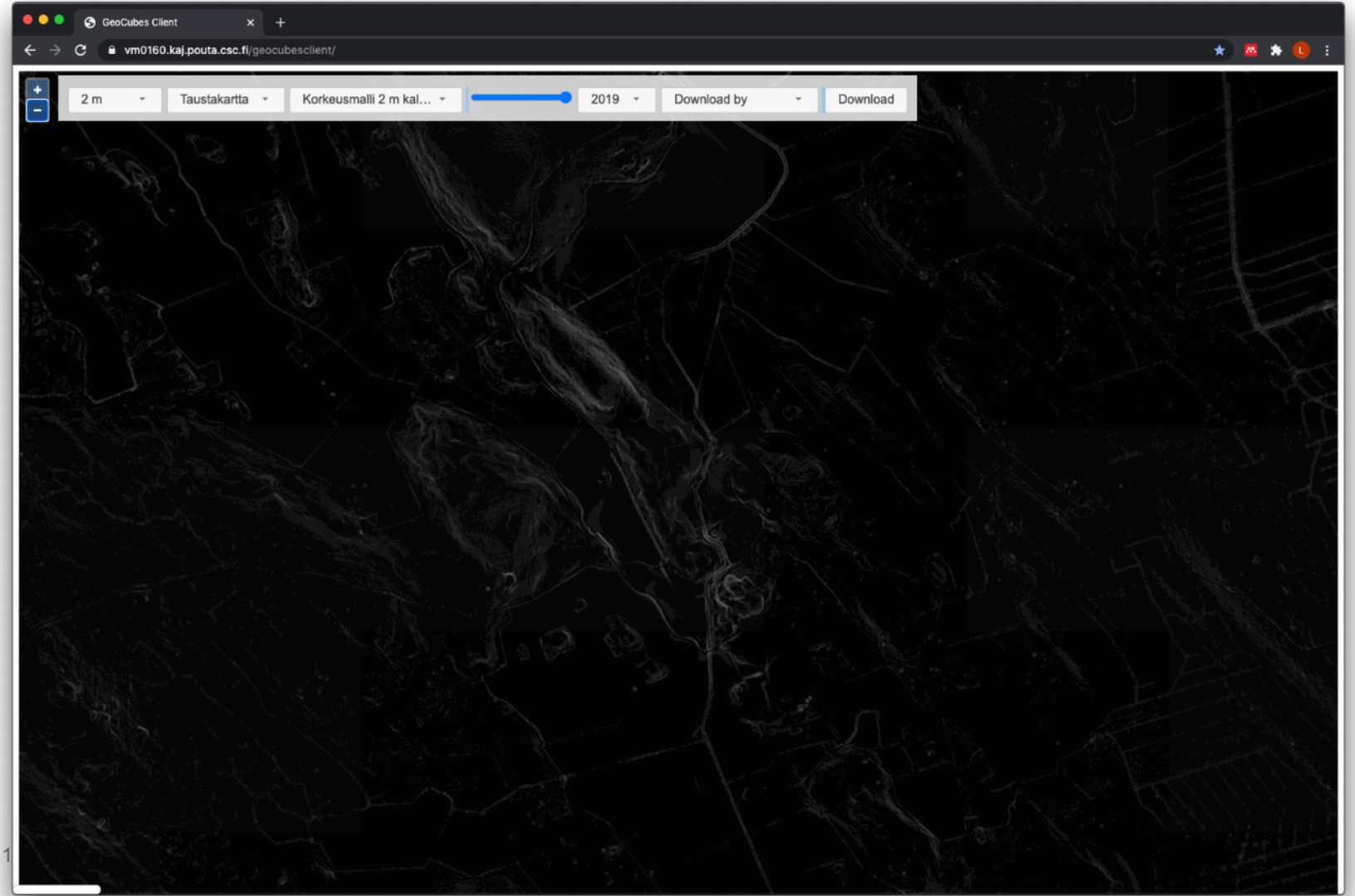
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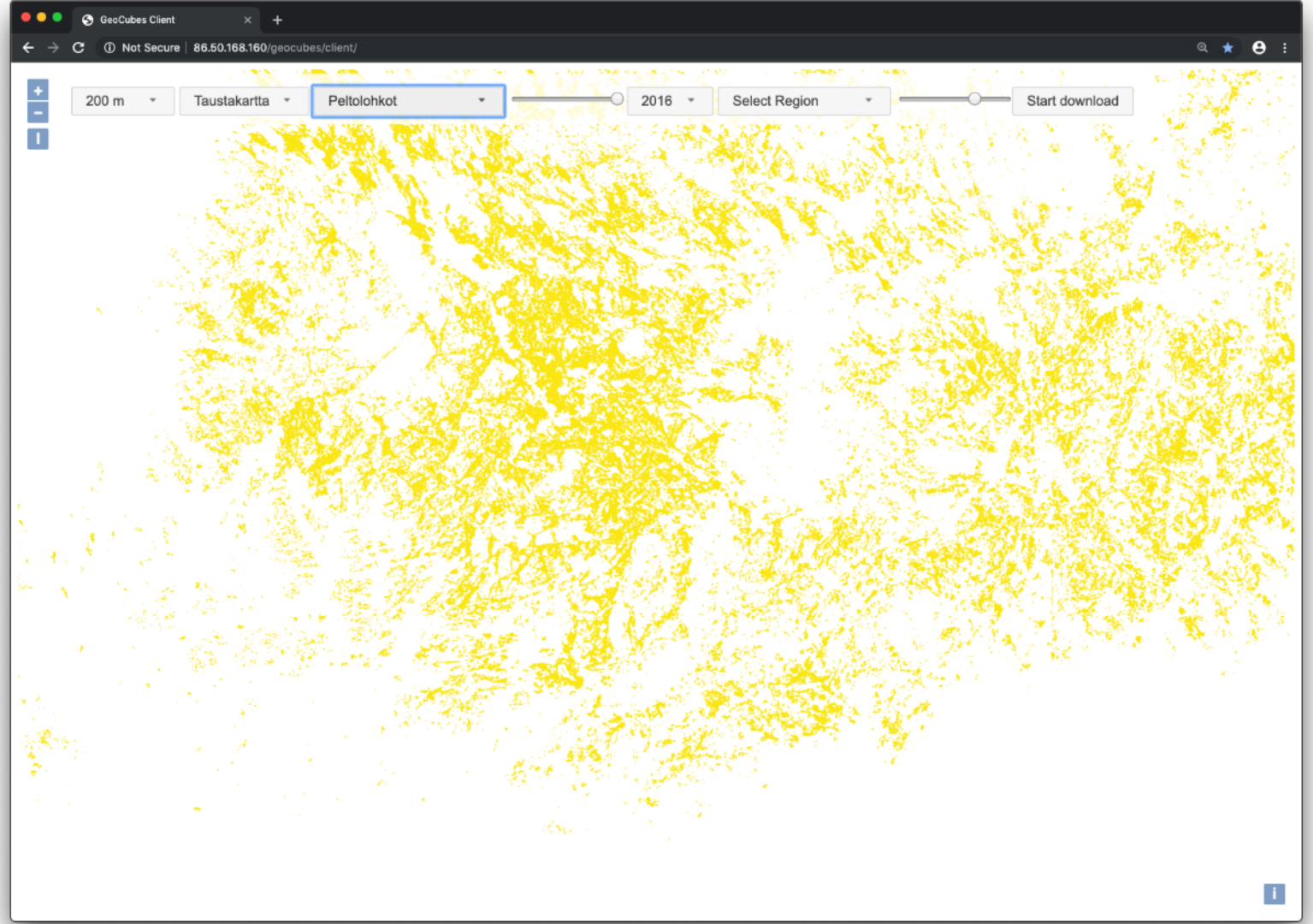
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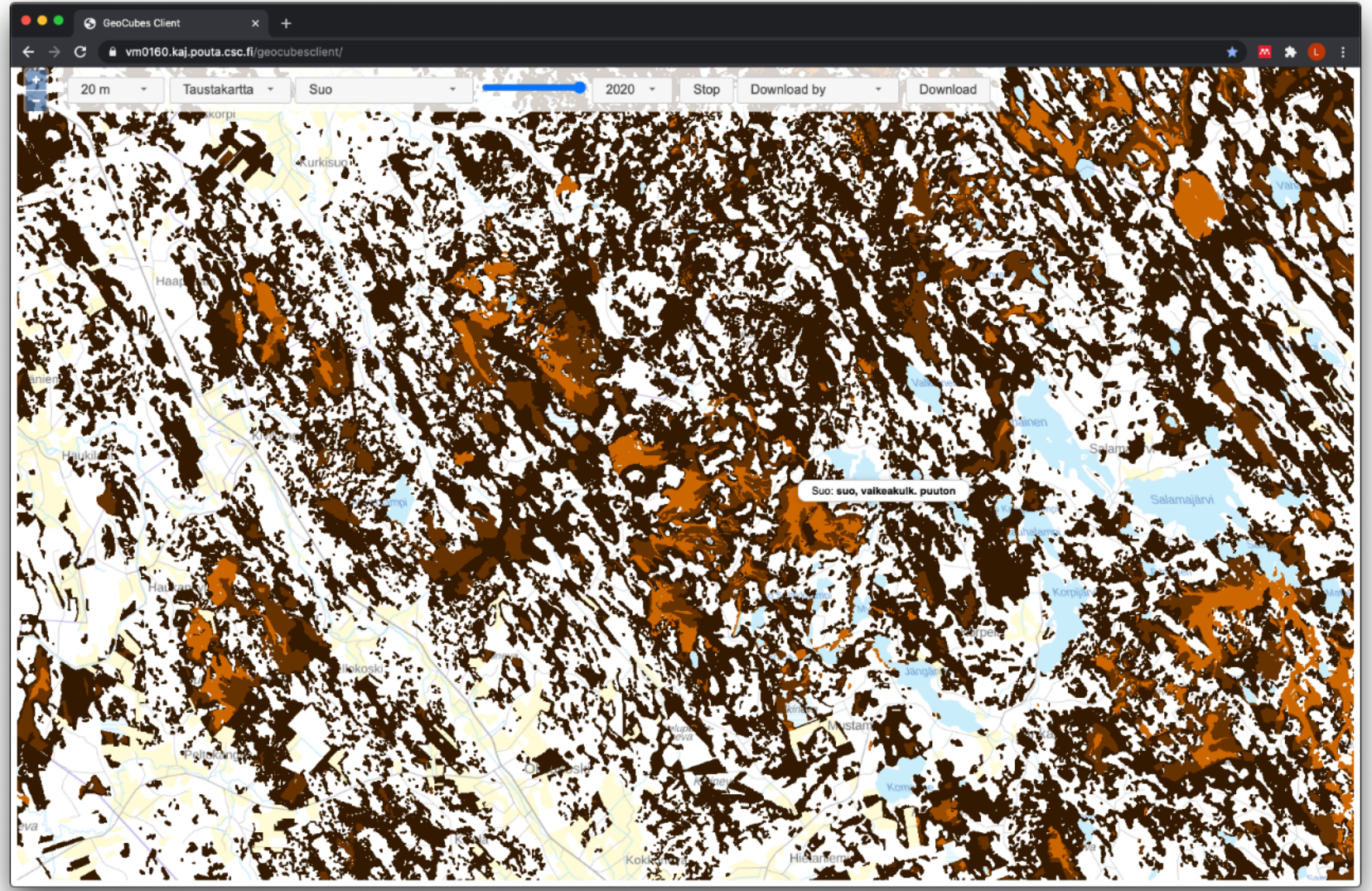
Start download


GeoCubes Client
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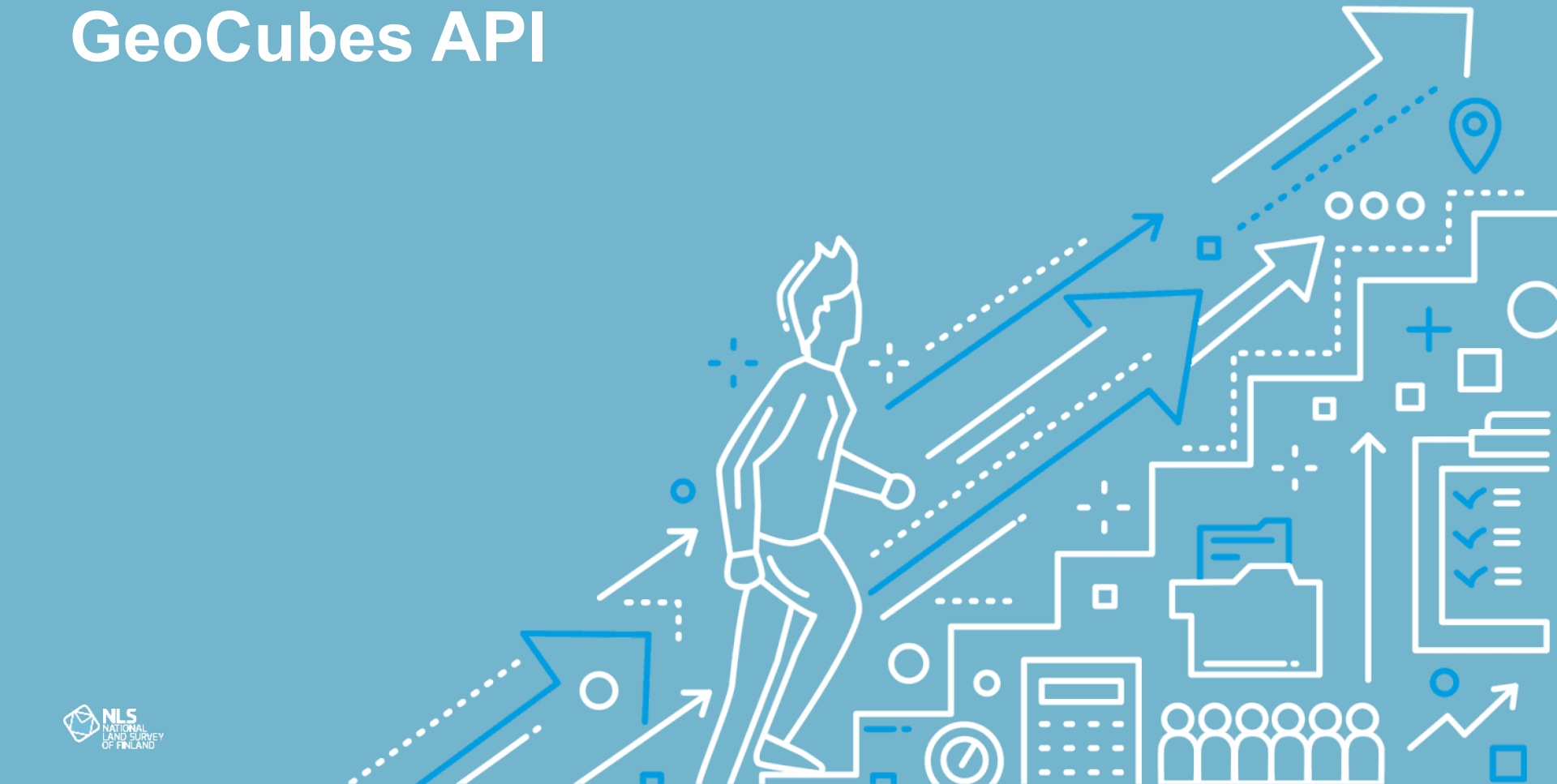
GeoCubes API



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GEOCUBES API

- **what to do /**
- **on which resolution level /**
- **with which content layer /**
- **where /**
- **when /**
- **how**

- /legend/1/all/389445,6759833/2016

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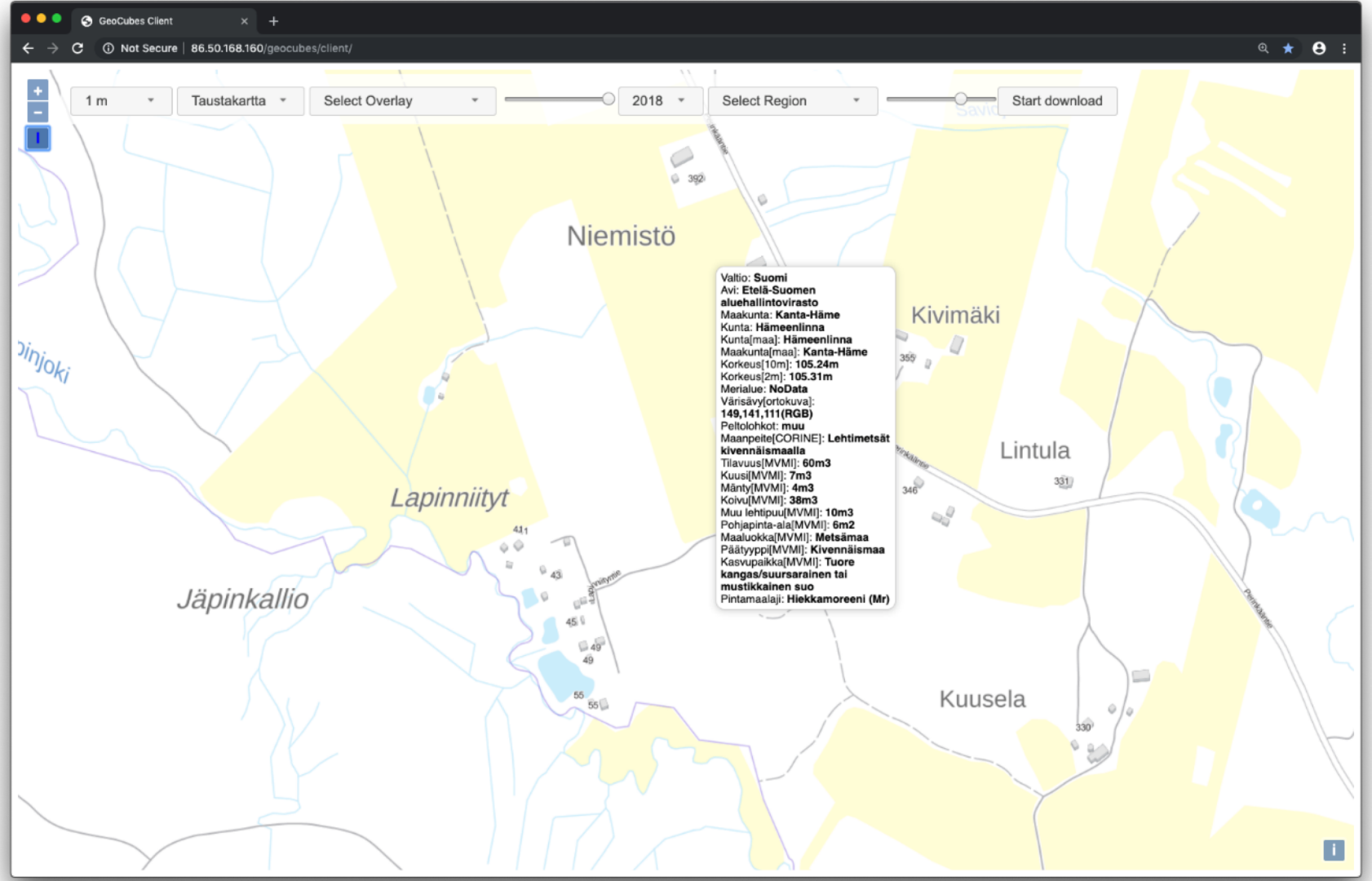
GeoCubes Client
Not Secure | 86.50.168.160/geocubes/client/
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Taustakartta
Select Overlay
2018
Select Region
Start download
Niemistö
Kivimäki
Lintula
Kuusela
Lapinniityt
Jäpinkallio
Valtio: Suomi
Avi: Etelä-Suomen aluehallintovirasto
Maakunta: Kanta-Häme
Kunta: Hämeenlinna
Kunta[maa]: Hämeenlinna
Maakunta[maa]: Kanta-Häme
Korkeus[10m]: 105.24m
Korkeus[2m]: 105.31m
Merialue: NoData
Värisävy[ortokuva]: 149,141,111(RGB)
Peltolohkot: muu
Maanpeite[CORINE]: Lehtimetsät kivennäismaalla
Tilavuus[MVMI]: 60m3
Kuusi[MVMI]: 7m3
Mänty[MVMI]: 4m3
Koivu[MVMI]: 38m3
Muu lehtipuu[MVMI]: 10m3
Pohjapinta-ala[MVMI]: 6m2
Maaluokka[MVMI]: Metsämaa
Päätyyppi[MVMI]: Kivennäismaa
Kasvupaikka[MVMI]: Tuore kangas/suursarainen tai mustikkainen suo
Pintamaalaji: Hiekkamoreeni (Mr)

GEOCUBES API, EXAMPLES

- /info/getDatasets
- /legend/listLabels/corine
- /clip/200/corine/kuntajako:734,761,834,433,224,444,927/2012
- /clip/200/maapera/bbox:203300,6653400,494700,6784600/2009/vrt
- /clip/20/km10/blocks:300000,6900000,300000,6800000/2018/vrt:mr
- /clip/50/mvmi-koivu/ polygon:386349,6900916,414254,6844794,497663,6848714, 521186,6904055,509403,6963231,452358,6964027,405703,6960192, 386349,6900916/2009

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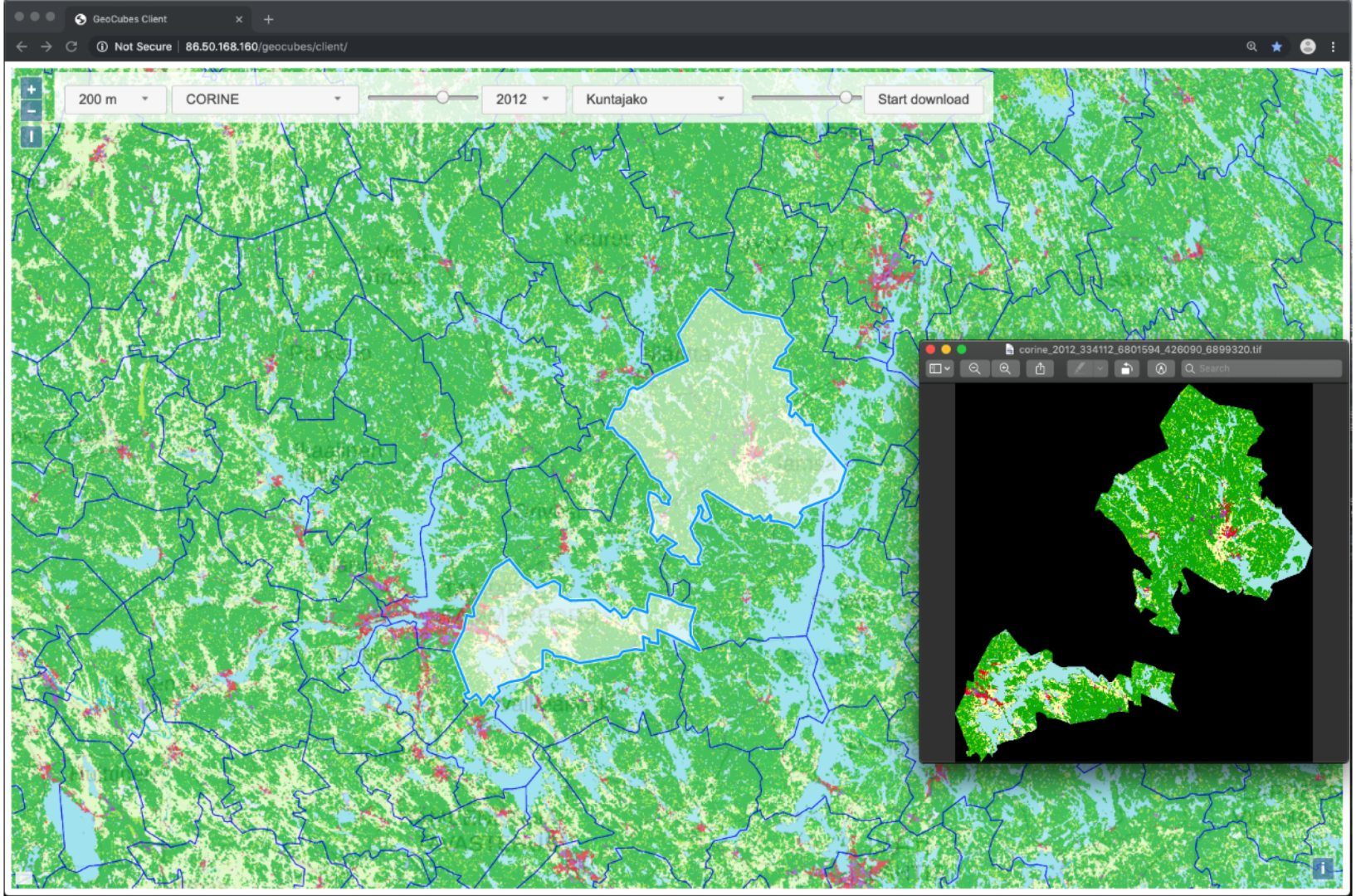

GeoCubes Client
Not Secure
86.50.168.160/geocubes/client/
200 m
CORINE
2012
Kuntajako
Start download
corine_2012_334112_6801594_426090_6899320.tif
Search

jupyter twelfth Last Checkpoint: Last Thursday at 4:19 PM (autosaved) Logout

File Edit View Insert Cell Kernel Help Trusted Python 3

Run Code

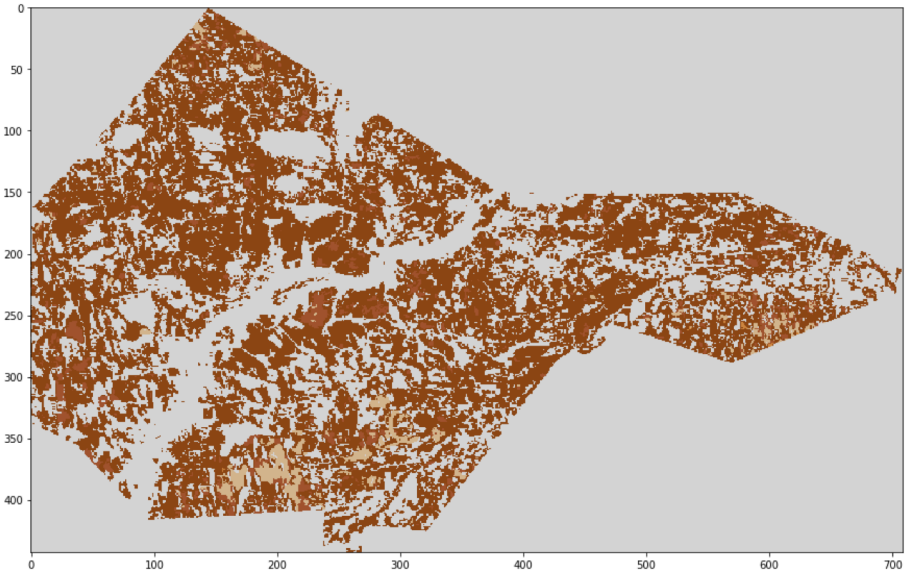
In [25]:
```
import rasterio
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.colors import ListedColormap
```

In [26]:
```
with rasterio.open("https://vm0160.kaj.pouta.csc.fi/geocubes/clip/100/suo/kuntajako:Tervola/2020") as ds:
    print(ds.width)
    print(ds.height)
    data = ds.read(1)
```

```
709
443
```

In [27]:
```
cmap1 = ListedColormap(['white','lightgrey'])
cmap2 = ListedColormap(['lightgrey', 'saddlebrown', 'sienna', 'peru', 'tan'])
```

In [28]:
```
fig, ax = plt.subplots(figsize=(15,15))
plot = ax.imshow(bg, cmap=cmap1)
plot = ax.imshow(data, cmap=cmap2)
```



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Trusted Python 3

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```

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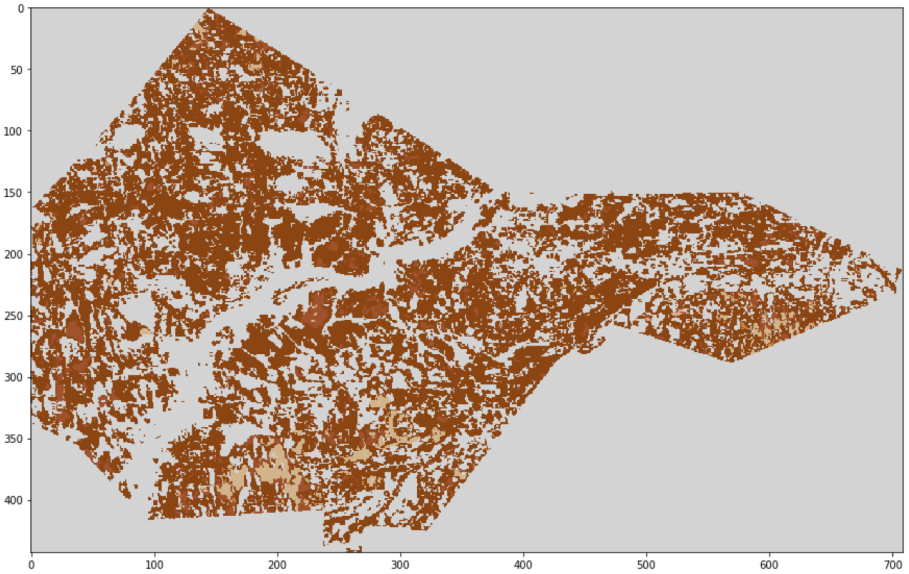

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```
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    data = ds.read(1)
```

```
709
443
```

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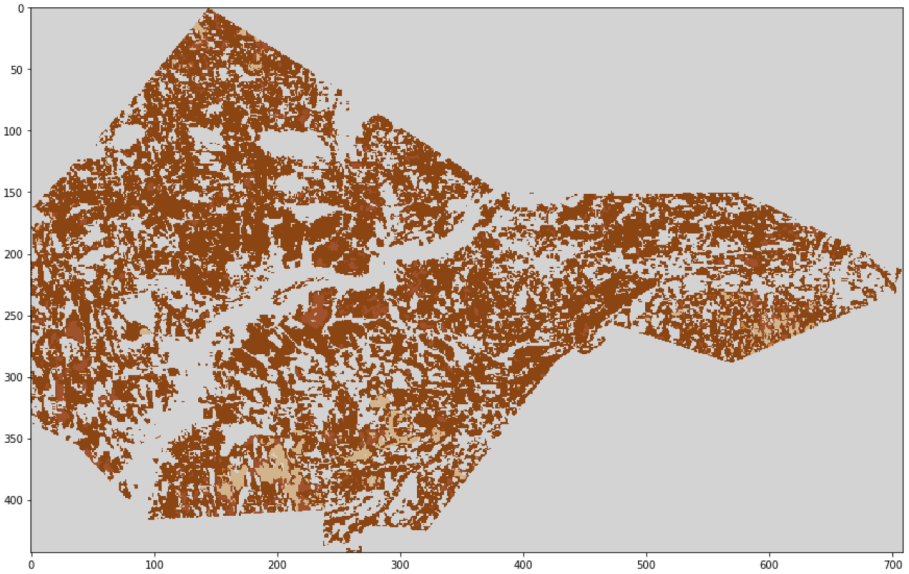

GeoCubes Applications

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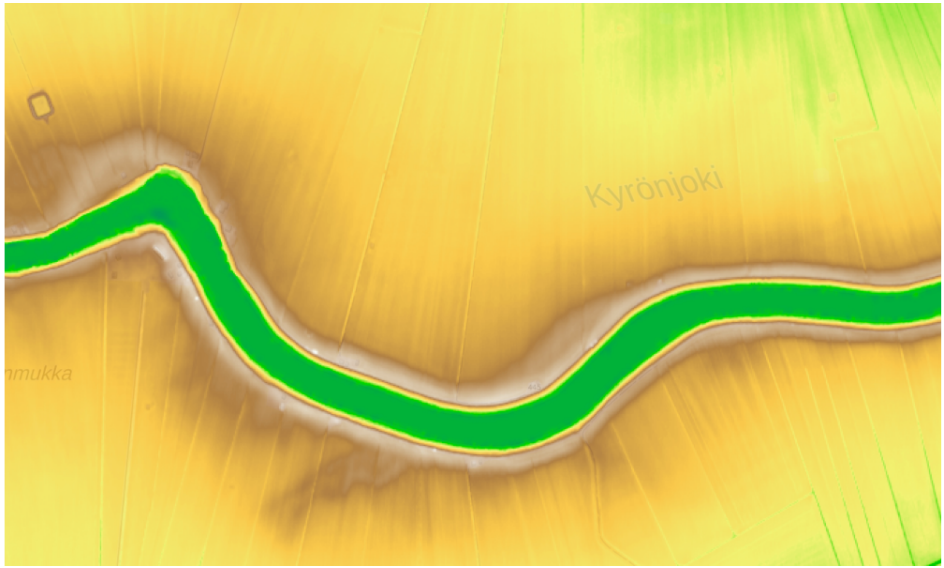
Detailed Visual Terrain Analysis



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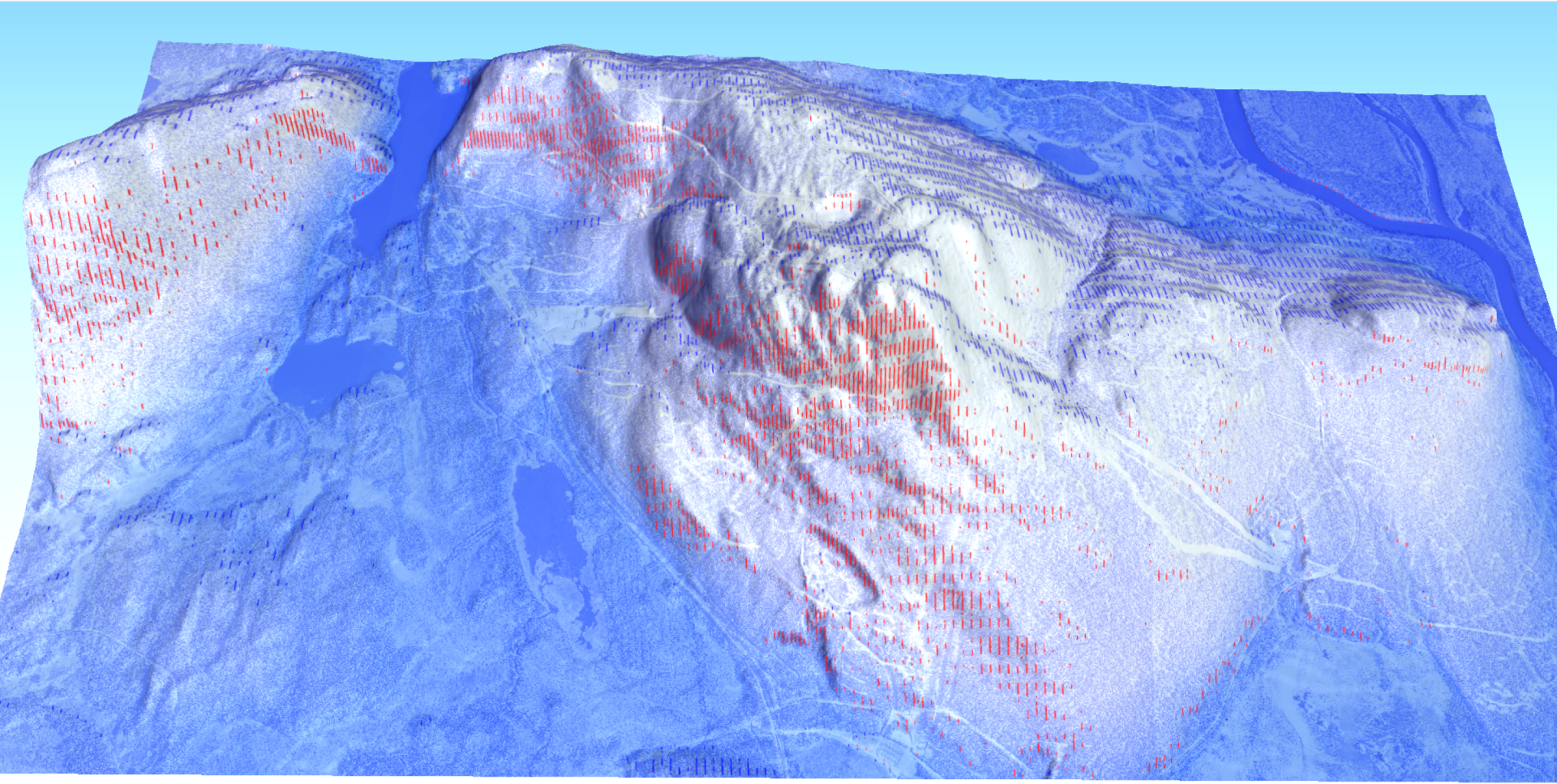
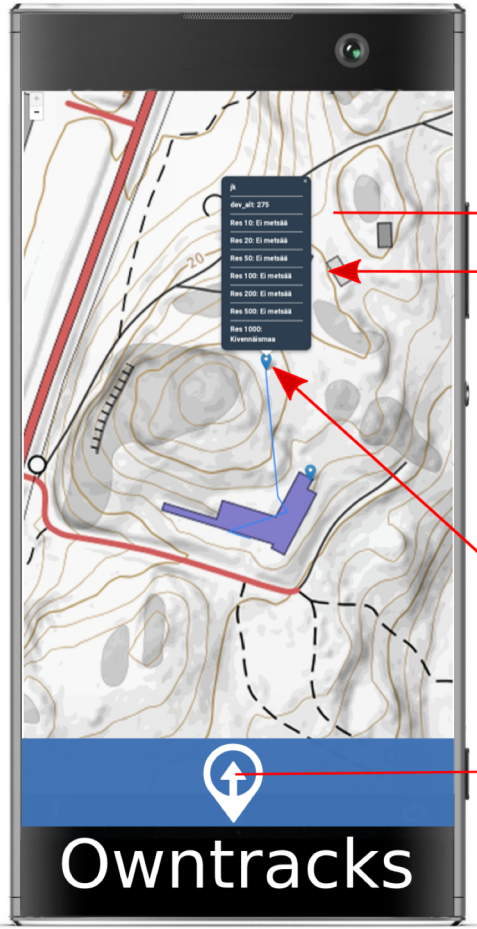
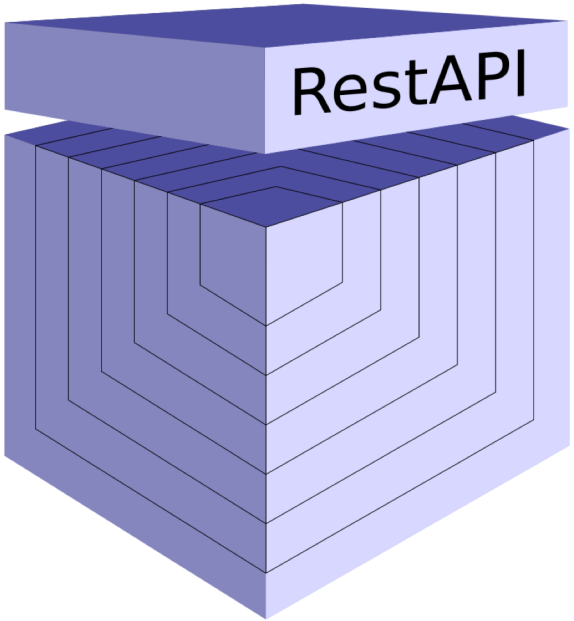




Mqtt broker



GeoCubes

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
- Custom API for flexible access and exploration
- Future work involves
  - importing more content layers, Baltic area?
  - further development of service-side analysis modules and web user interfaces
  - integration with HPC tools

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THANK YOU!

lassi.lehto@nls.fi

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