How we built a fast geospatial data analysis and reporting platform for the new forest economy

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https://landscape-geoinformatics.ut.ee

Arbonics™

Landscape Geoinformatics Lab

- Spatial Data Analysis
- Environmental Modelling and Spatial Machine Learning
- Geospatial Data Processing and Visualisation
- Environmental Remote Sensing

https://landscape-geoinformatics.ut.ee/

Arbonics™

Landowners: earn extra income from your land

Credit buyers: invest in nature-based carbon credits

https://www.arbonics.com/

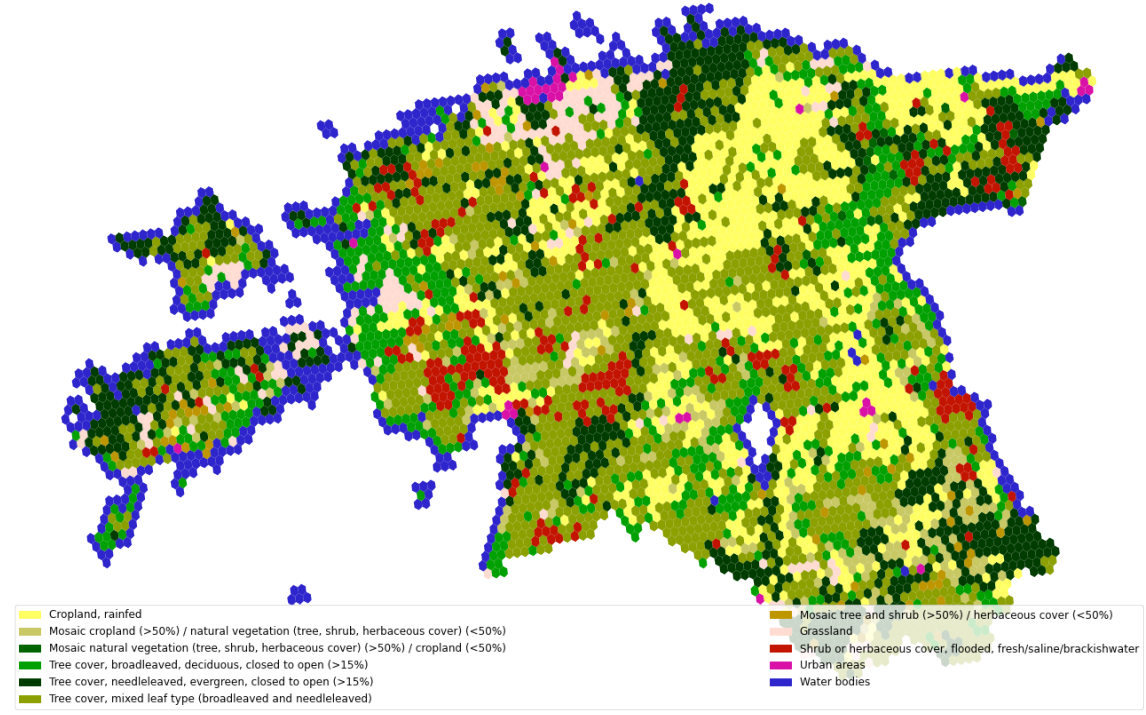
Challenge – Data Integration at varying scales

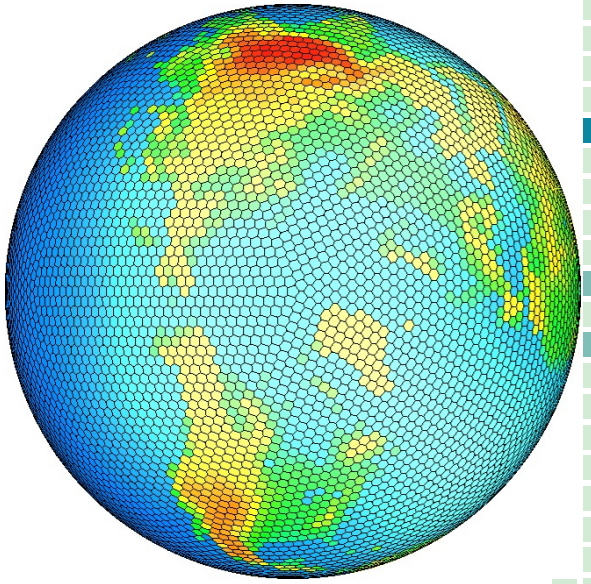
We need to **combine spatial and tabular data**, such as **raster** pixels and various **vector** geometries (points, lines, polygons) of cadastral / administrative units, agricultural fields, environmental registries data, **remote sensing** images etc. that **are varying** in size, shape and spatial **coordinate reference systems** into **uniform spatial units** for analysis, ML and modelling.

We also need to be able to **easily switch** between **tabular and spatial representation.**

HEXAGONS !

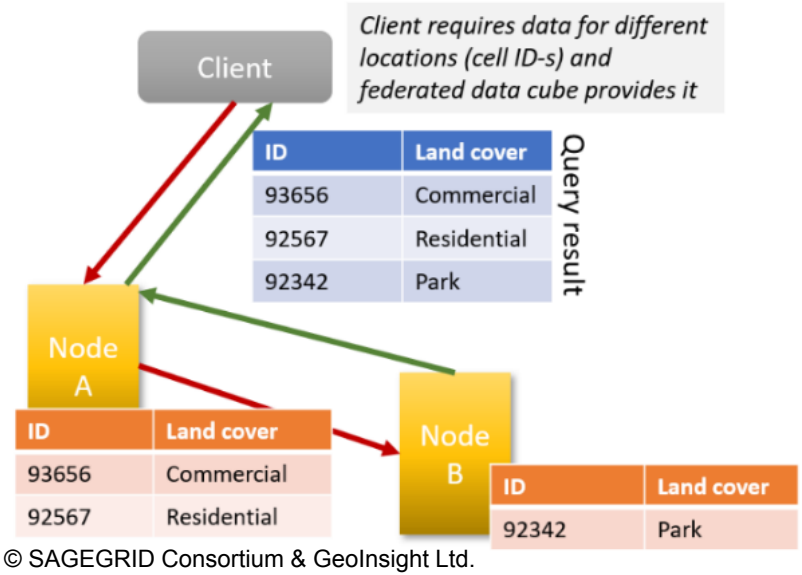
Copernicus C3S Landcover summary, in ca. 9 km^2 hexagons (ISEA7H L8)





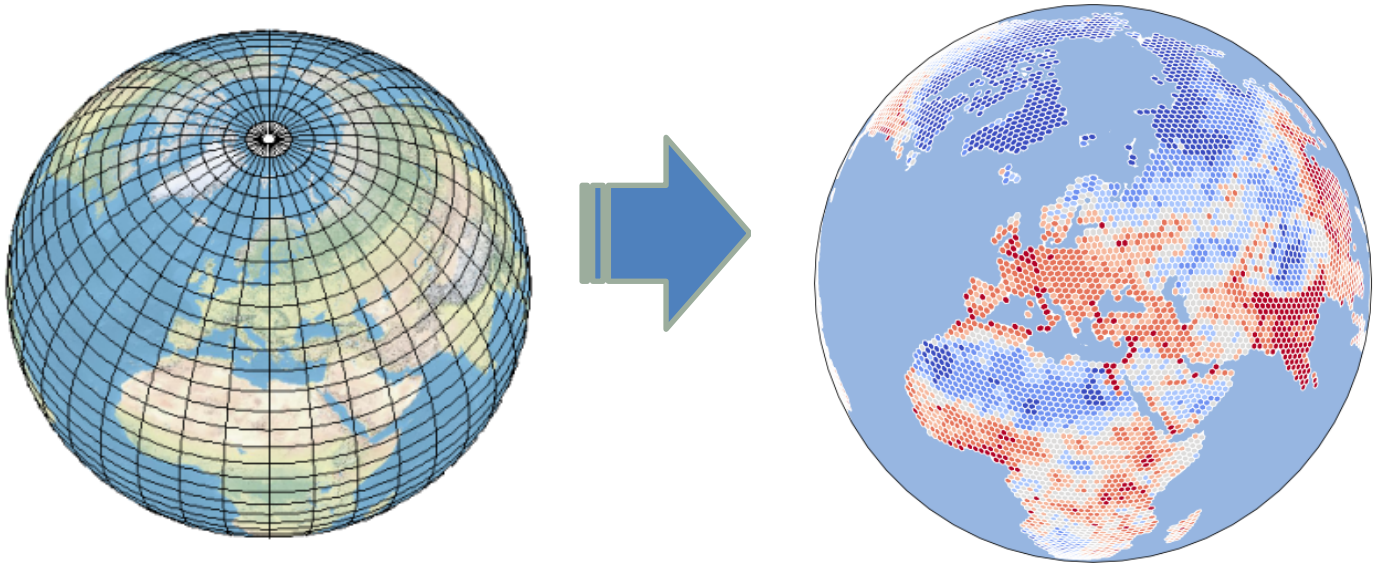
AI-generated unicorn!!!

Hexagons with a “System”



- grid cells as spatial base unit, have unique ID
- logic to convert between ID and geometry
- data stored and accessed in a distributed fashion, but easily aggregated

Discrete Global Grid System (DGGS)



Open Geospatial Consortium

"A Discrete Global Grid System is a spatial reference system that uses a hierarchical tessellation of cells to partition and address the globe."

OGC Abstract Specification, 2017

Suitability Analysis

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3 Suitability analysis

Methodology-based

Forest change

Forest change in last 10 years based on satellite imagery

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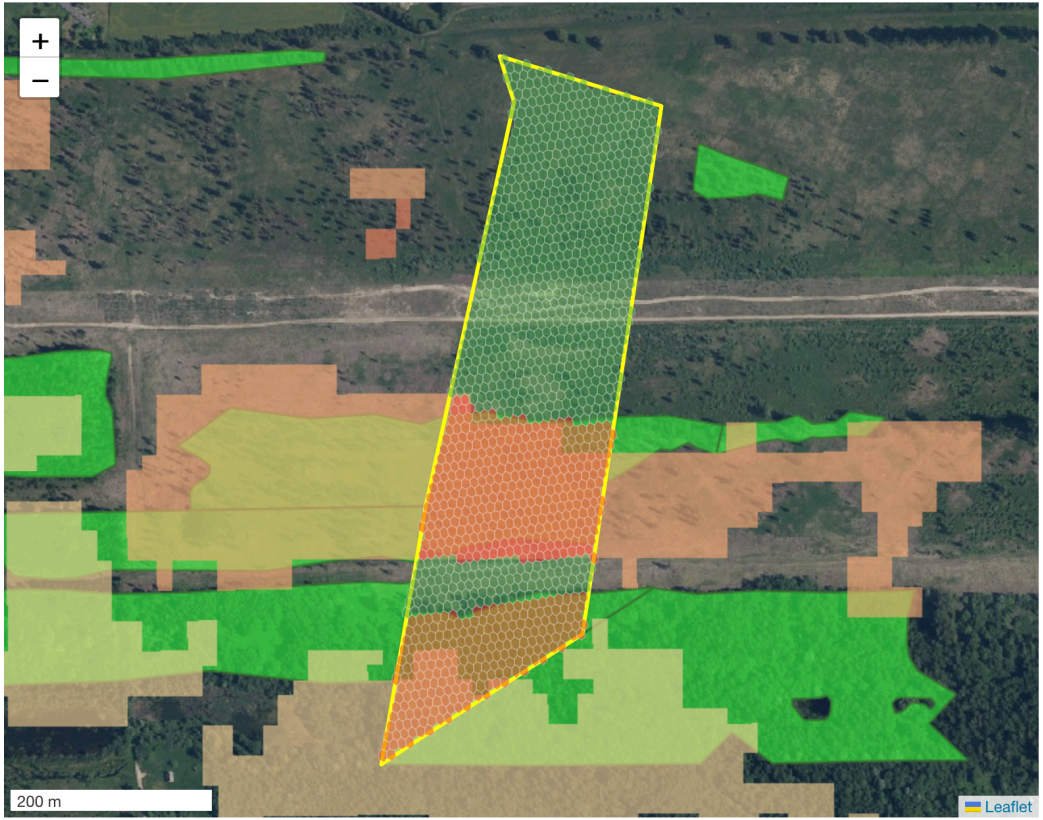
Forest registry

Peat extraction areas

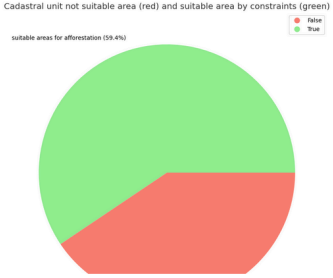


ISEA 7H reference grid cell area at analysis resolution (14): 75.2 m2 (0.008 ha)

cells	resolution	suitable	sum_area_ha	sum_ai
550	14	false	4.14	4136
806	14	true	6.06	6061

ISEA 7H HEX-based summary

Overall plot area 10.2 ha (hex); with 6.06 ha (hex) suitable declarable land and 4.14 ha (hex) NOT suitable due to constraints.



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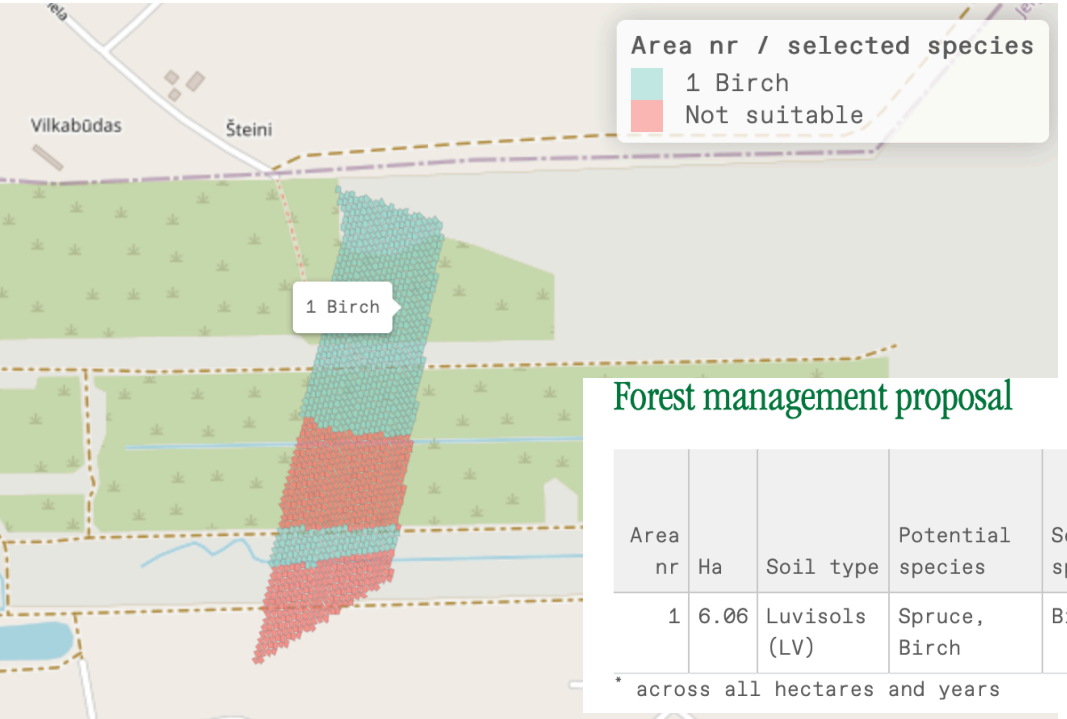
Carbon opportunity assessment



Forest management proposal

Area nr	Ha	Soil type	Potential species	Selected species	Planting density (trees/ha)	Total carbon credits earned (cc/area)	Carbon credit price (€/cc)	Potential carbon income* (€)
1	6.06	Luvisols (LV)	Spruce, Birch	Birch	1 500	996	50	49 804.22

* across all hectares and years

The Stack (Open Source FTW)

- Arbonics already active product in 3 countries, Estonia, Latvia, Finland
- on-demand analysis when the client calls in

- centre piece is Postgresql + DGGRID

- Geoserver
- Quasar/Vue.js app with Leaflet
- Google Cloud Platform
- Quarto markdown+code for custom client report

- Python backend (FastAPI, Rasterio, Geopandas, etc.)

DGGRID

General Information

DGGRID version 7.8 released April 21, 2023
Southern Terra Cognita Laboratory
www.discreteglobalgrids.org
Kevin Sahr, Director

DGGRID is a command-line application for generating and manipulating icosahedral discrete global grids (DGGs).

- https://github.com/sahrk/DGGRID 

- https://anaconda.org/conda-forge/dggrid 

- https://github.com/allixender/dggrid4py 

“Common Geography”

United Nations

“DGGS as a Common Geography will ensure that all statistical data is consistently geospatially enabled and that users can discover, access, integrate, analyse and visualise statistical information seamlessly for geographies of interest.”

United Nations Committee of Experts on Global Geospatial Information Management - The Global Statistical Geospatial Framework

Exec Summary

In smaller scales or lower resolutions works very well already.

- Tooling – actionable tools, software libraries and integrations
- ideal for data aggregation and data fusion from different sources (esp. different spatial resolutions and formats)
- extraction and tabular alignment for statistics and ML processing
- cell ID-based encoding of data allows targeted and seamless data selection
- Develop best practices for efficient workflows – conversion || indexing, storage & access

TARTU ÜLIKOOL
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Thank you ☺

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