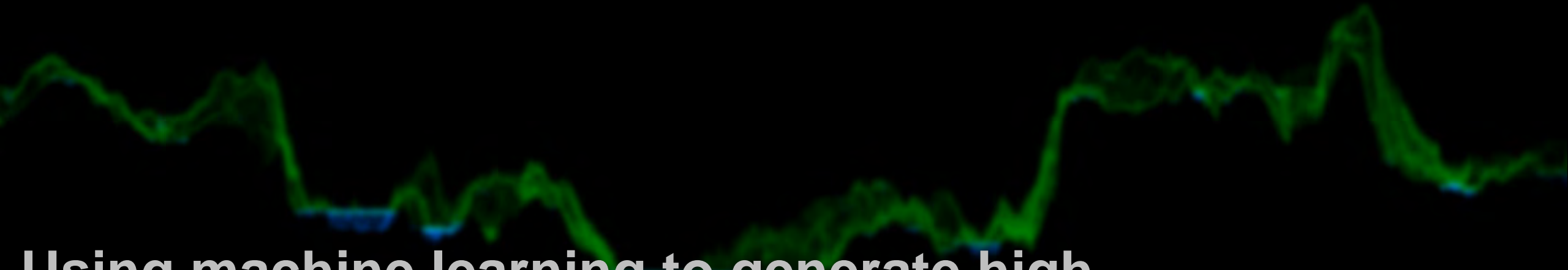




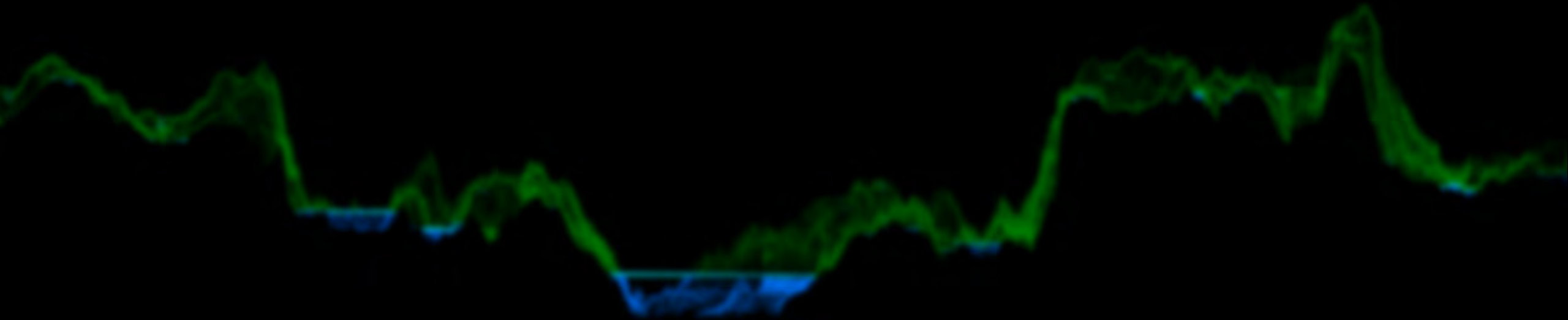
SCIENCE AND
EDUCATION **FOR**
SUSTAINABLE
LIFE



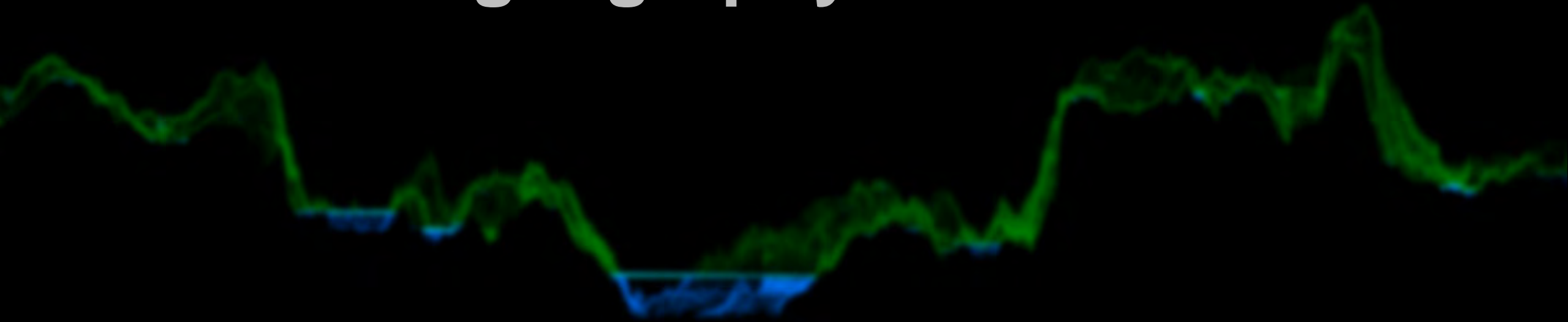
Using machine learning to generate high-resolution wet area maps for planning forest management

William Lidberg

- Background
- LiDAR
- Topographical modeling
- Machine learning
- Soil moisture



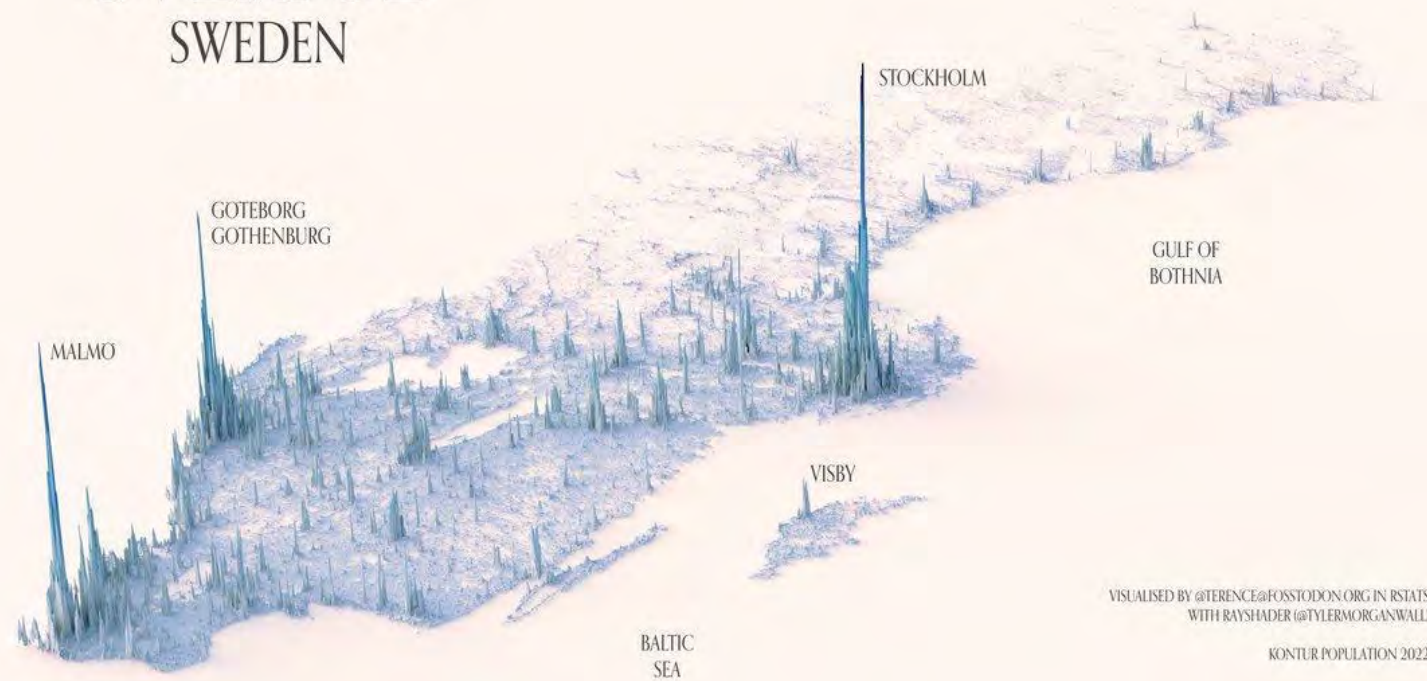
The geography of Sweden



POPULATION DENSITY MAP

SVERIGE

SWEDEN



VISUALISED BY @TERENCE@FOSSTODON.ORG IN RSTATS
WITH RAYSHADER @TYLERMORGANWALL

KONTUR POPULATION 2022



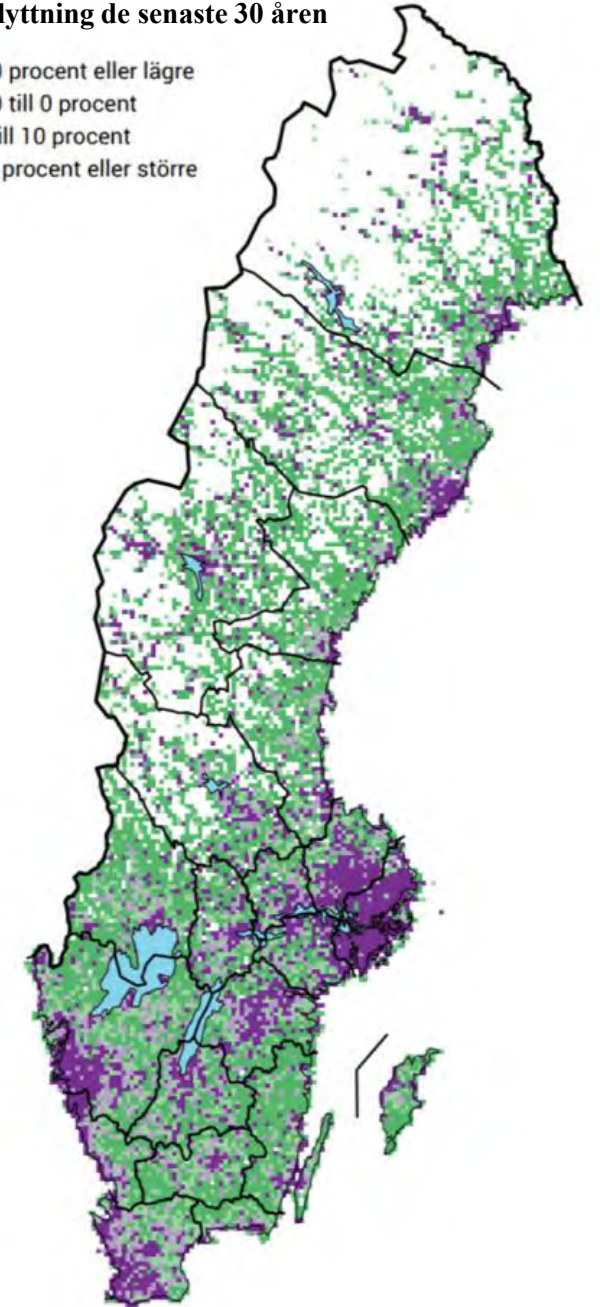
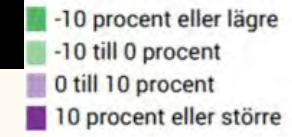
Schematisk karta över markanvändningen i Sverige



Källa: Lantmäteriet. Bearbetning, SCB



Förflyttning de senaste 30 åren



Källa: SCB

Forestry in Sweden

Harvester

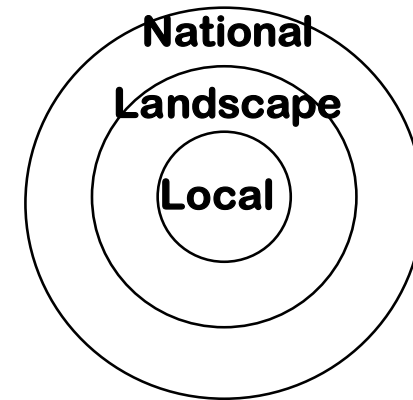


Forwarder

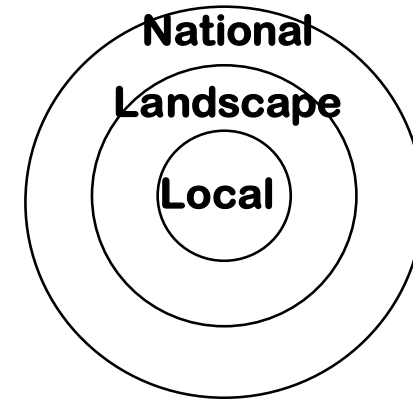
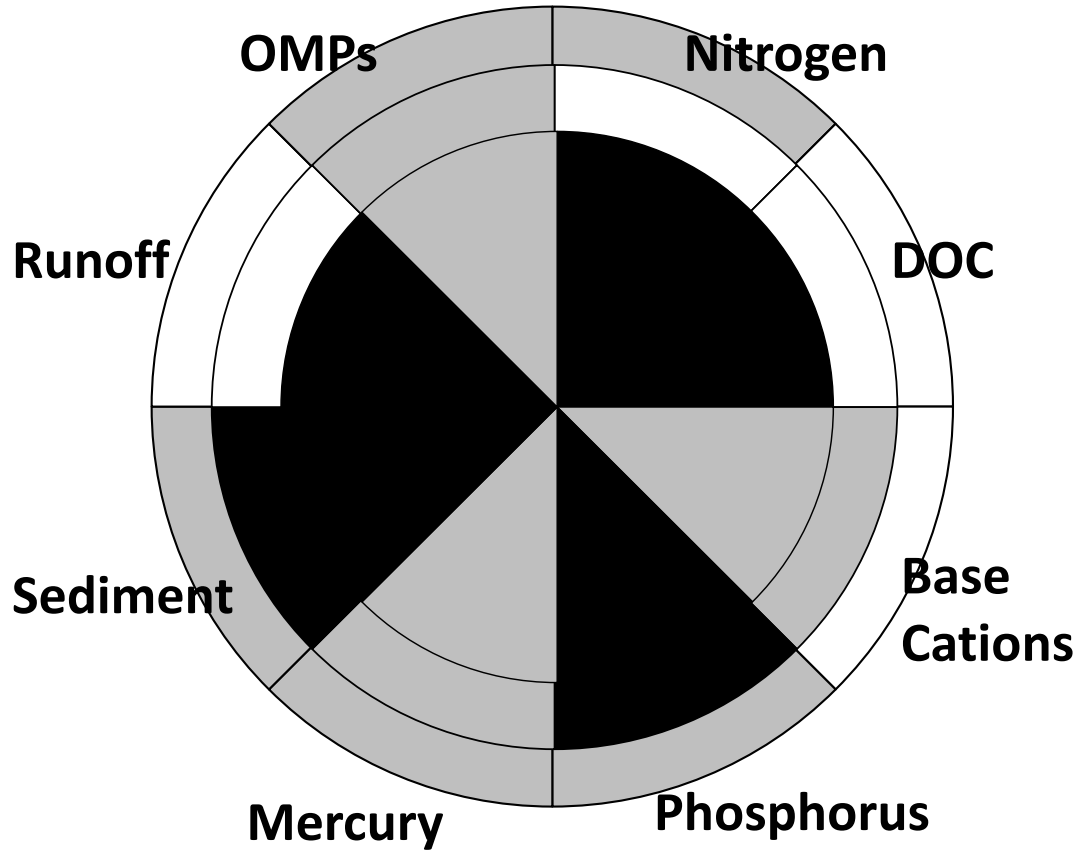


- Sweden provides 10% of global wood/pulp trade
- Intensive forest management
- Big machines
- Automation

Water quality issues in Swedish Forests



Water quality issues caused by forestry



Black means that forestry is the primary cause of deterioration in water quality.

Driving on forest soils



Compaction/Track formation



Decreased production



Change in hydrology/sedimentation



Kill plants & animals, destroy habitats



Leakage of N, P, Hg...

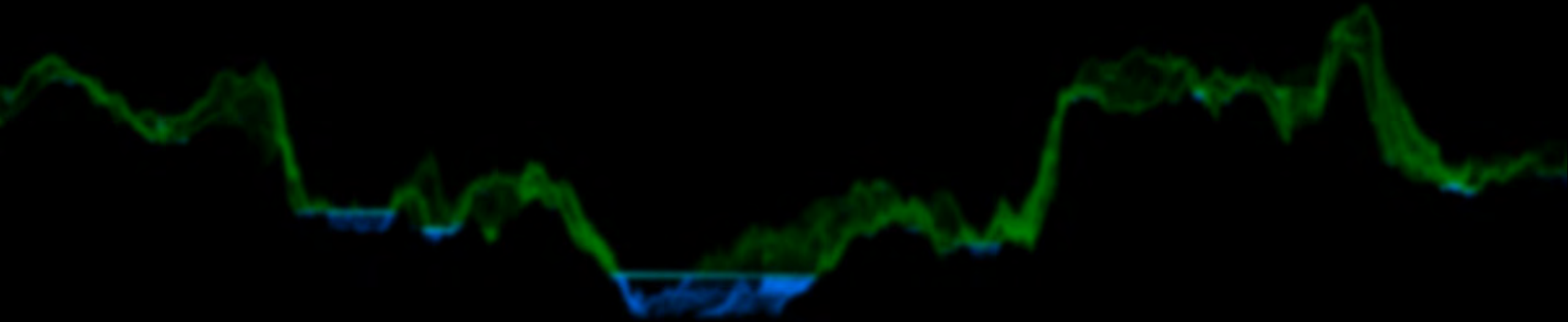


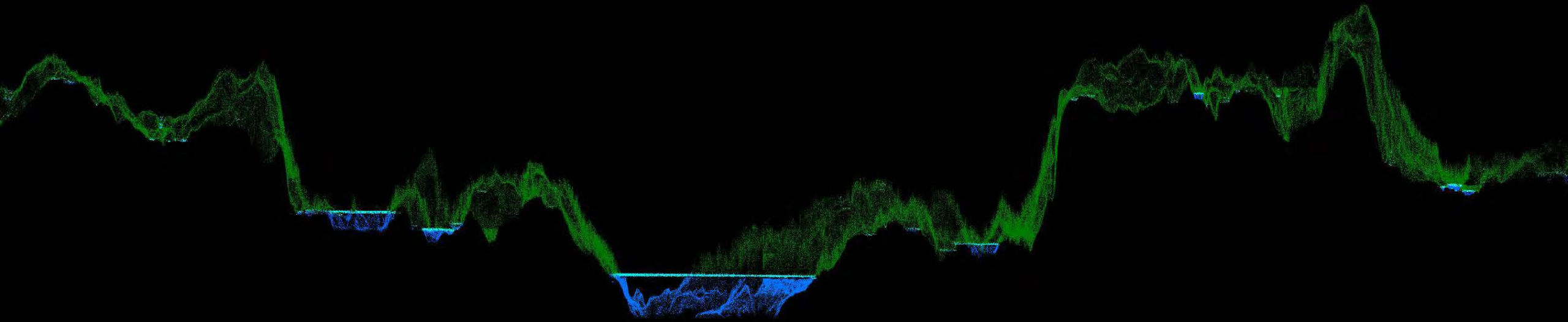
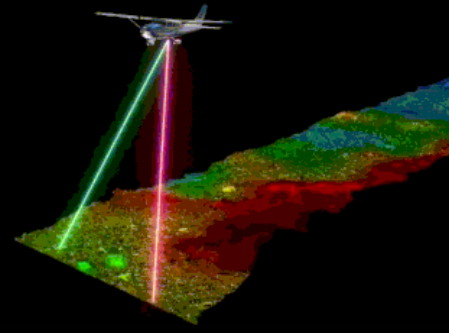
Environmental targets



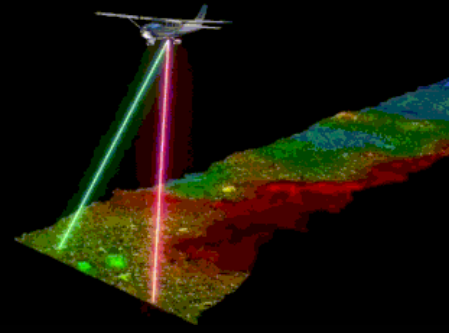
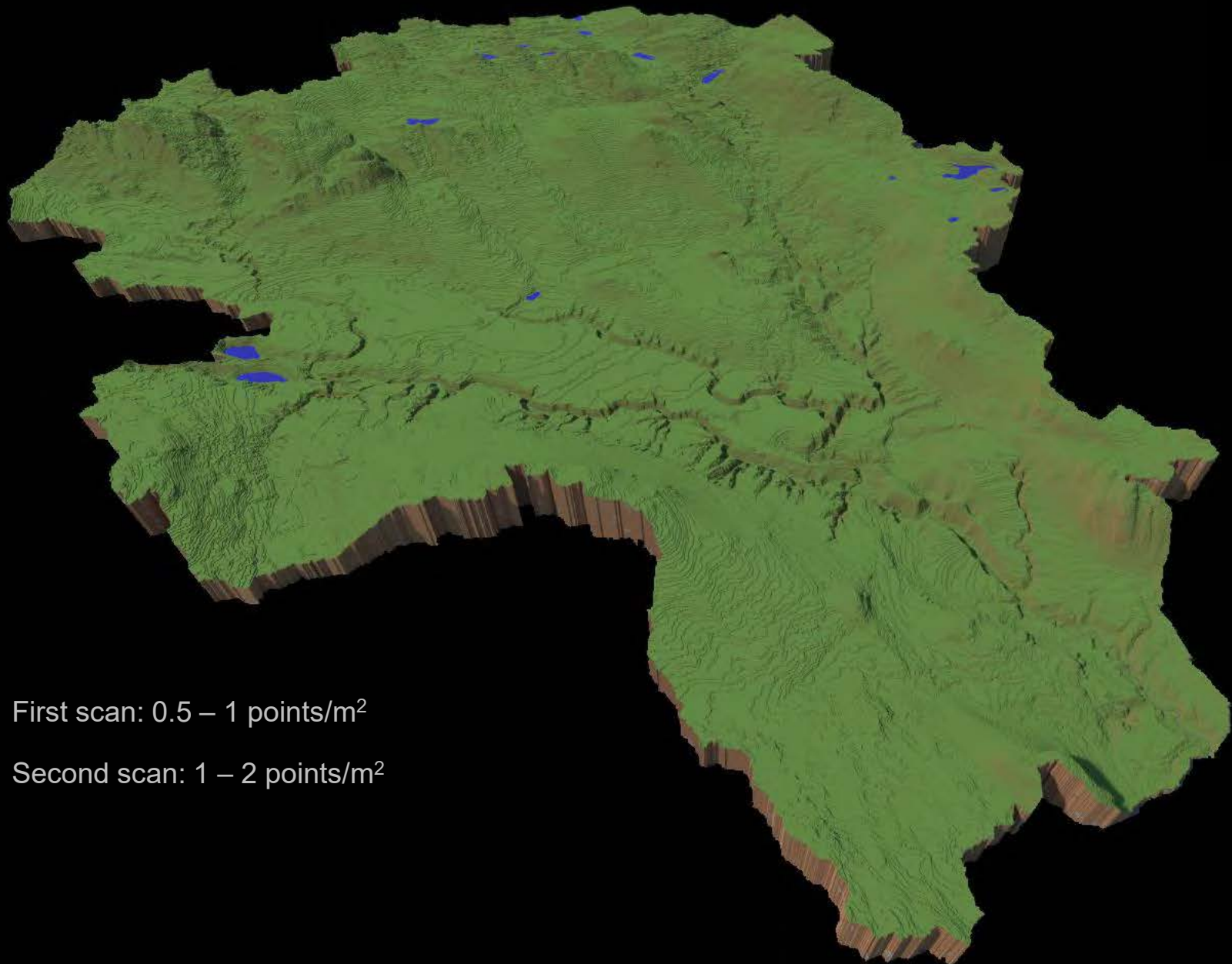


LiDAR



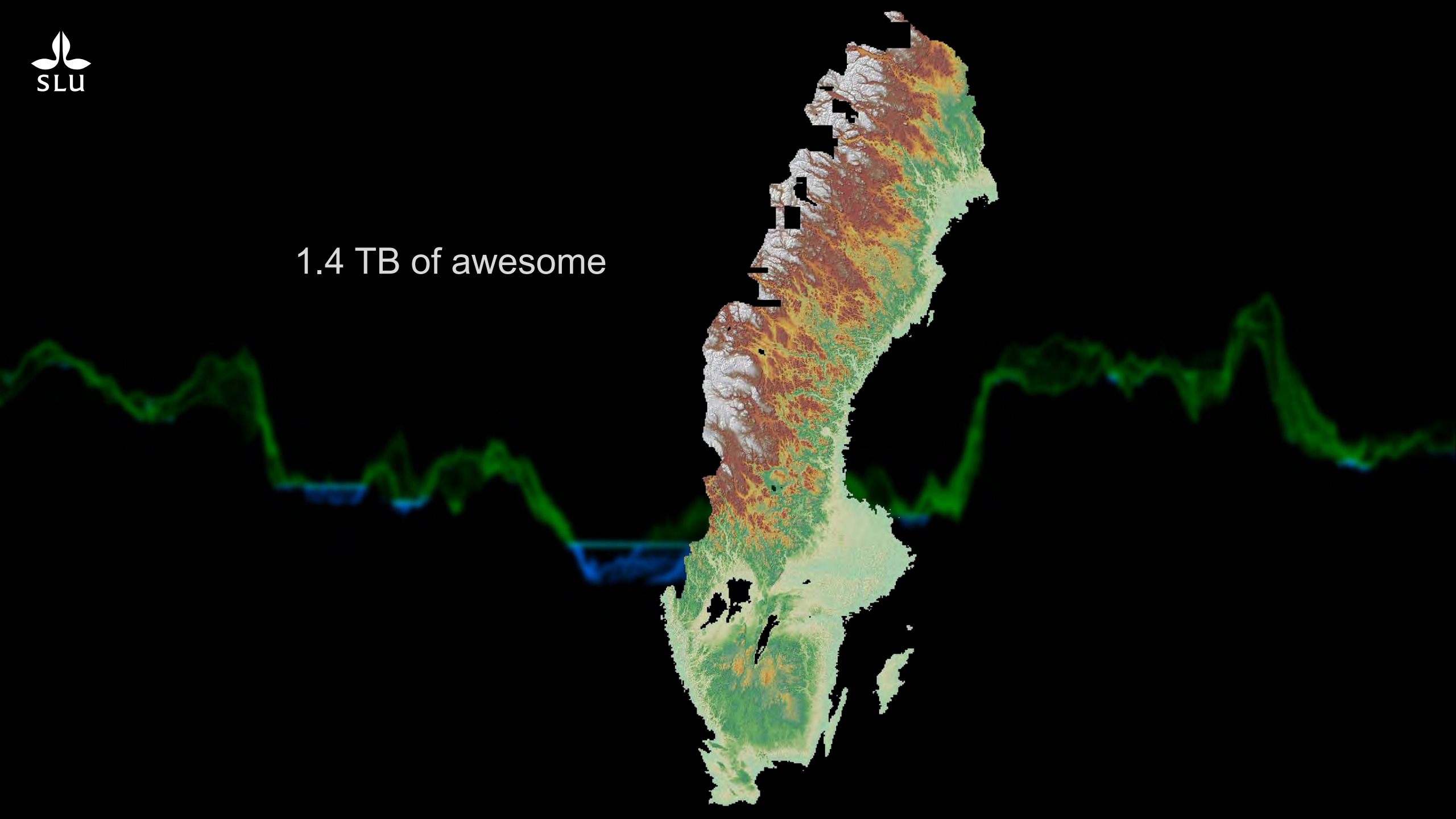




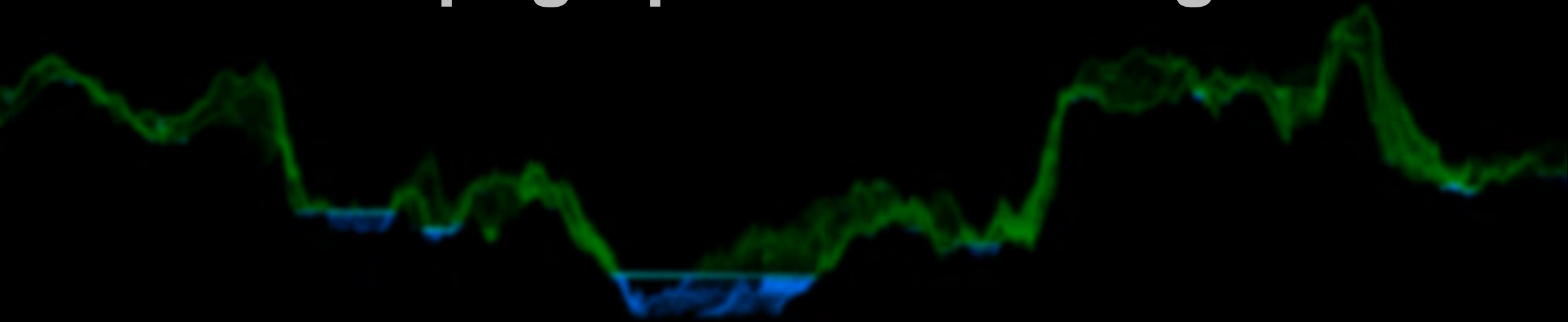


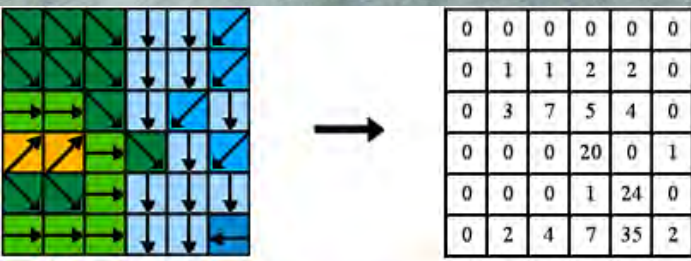
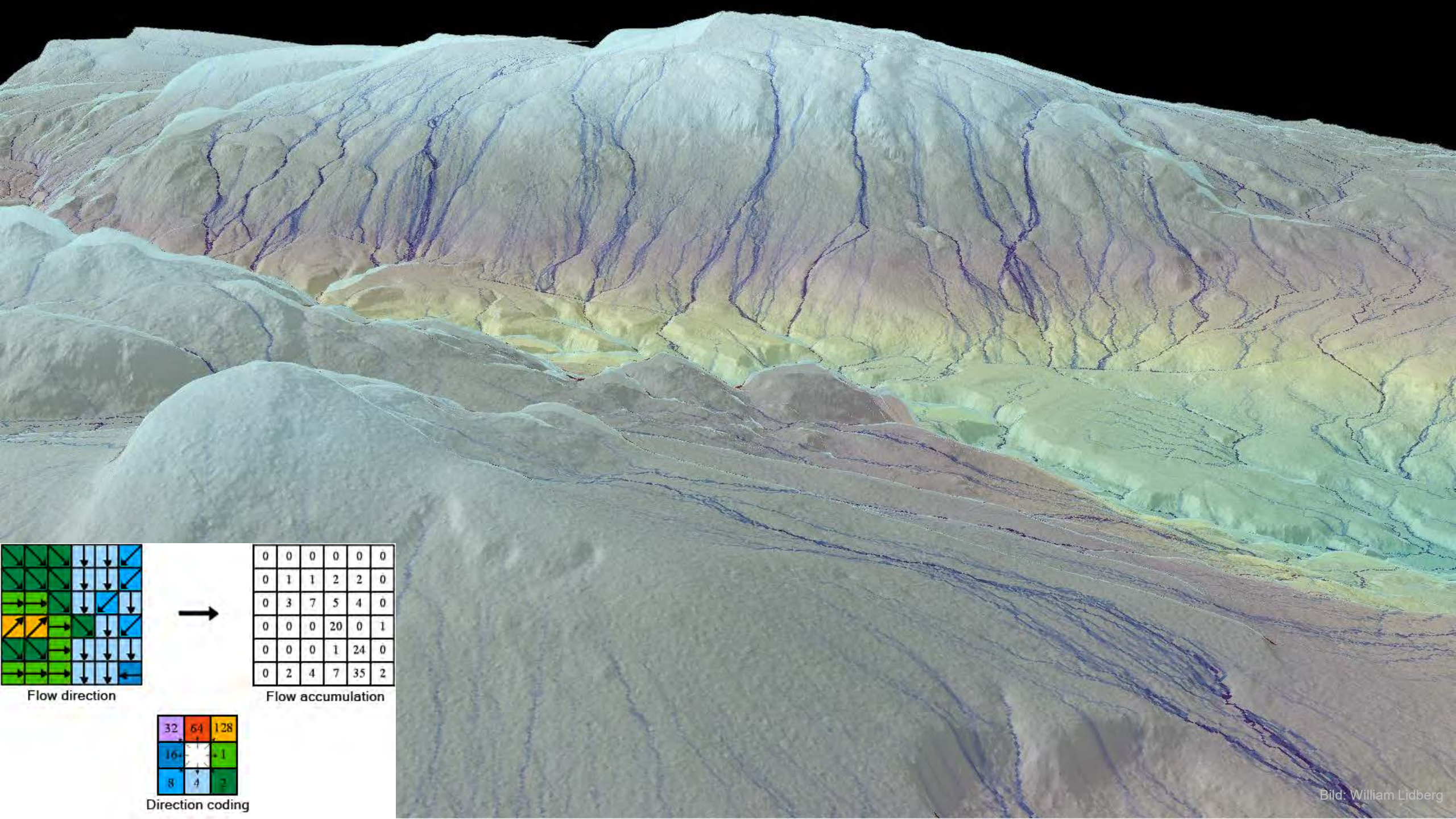
- First scan: 0.5 – 1 points/m²
- Second scan: 1 – 2 points/m²

1.4 TB of awesome



Topographical modeling



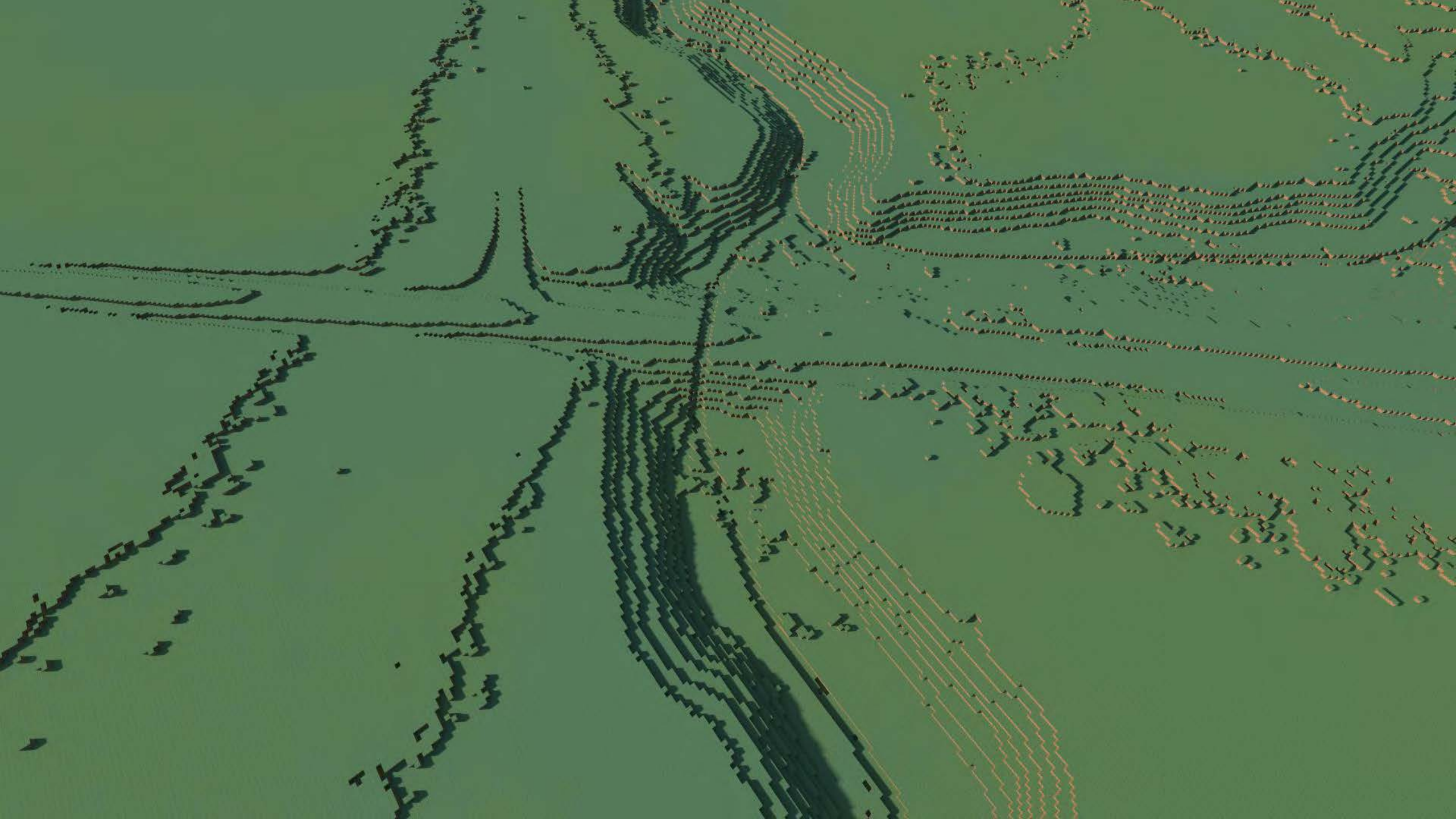


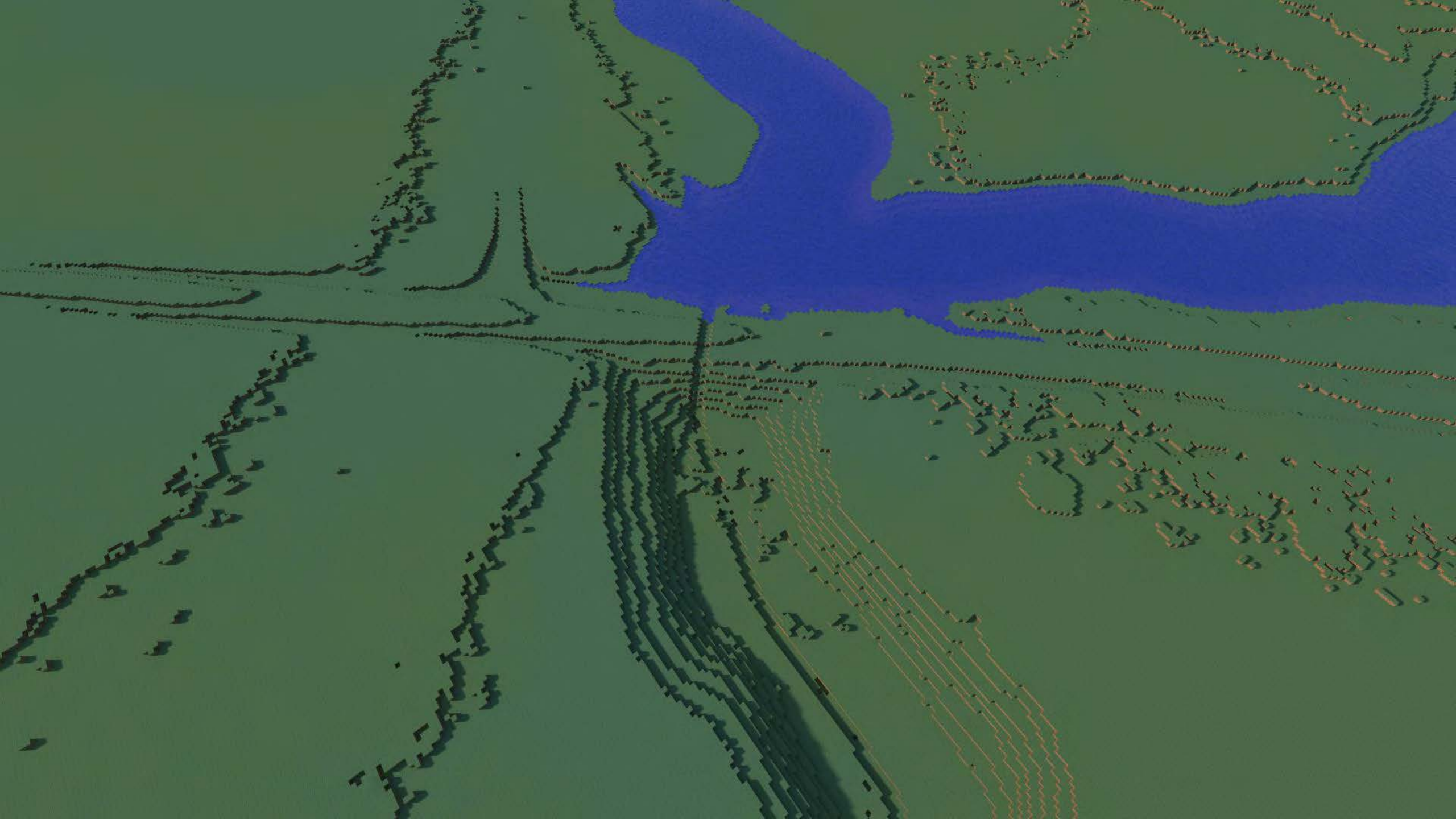
Flow direction

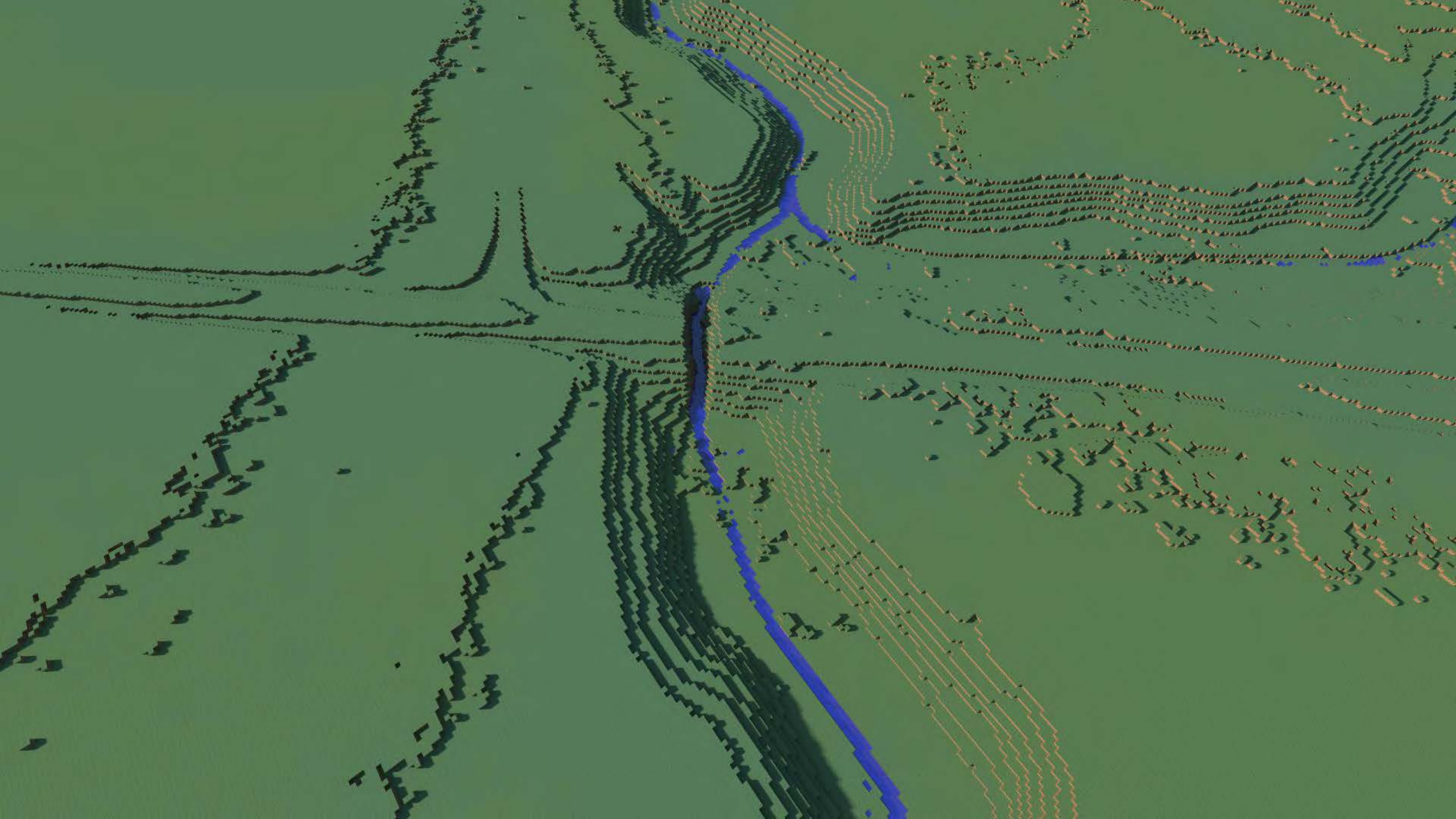
Flow accumulation

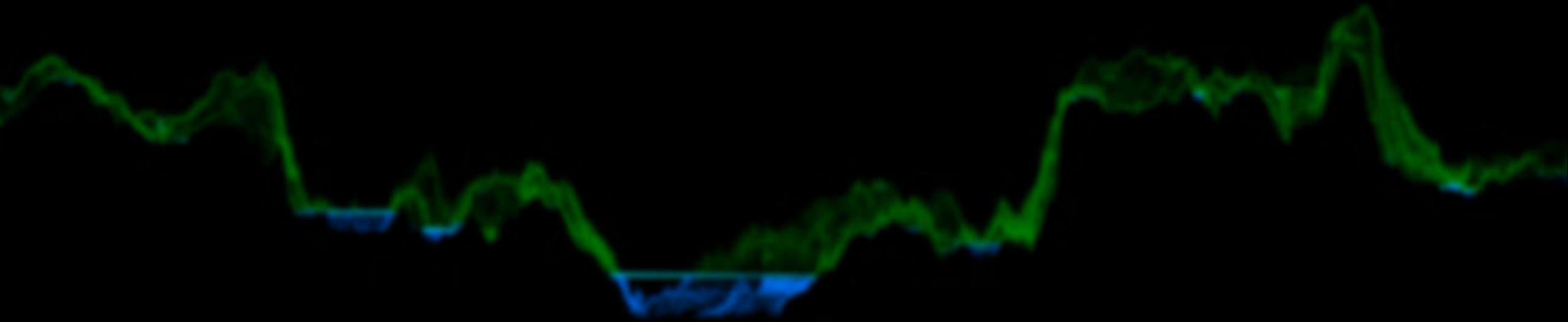


Direction coding

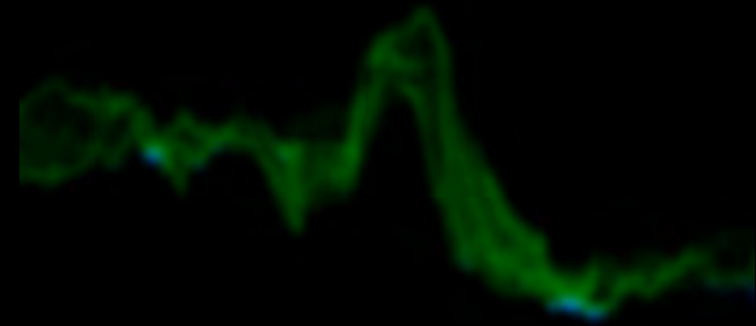






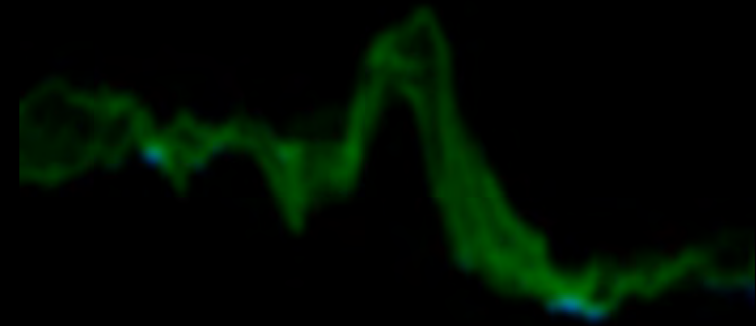
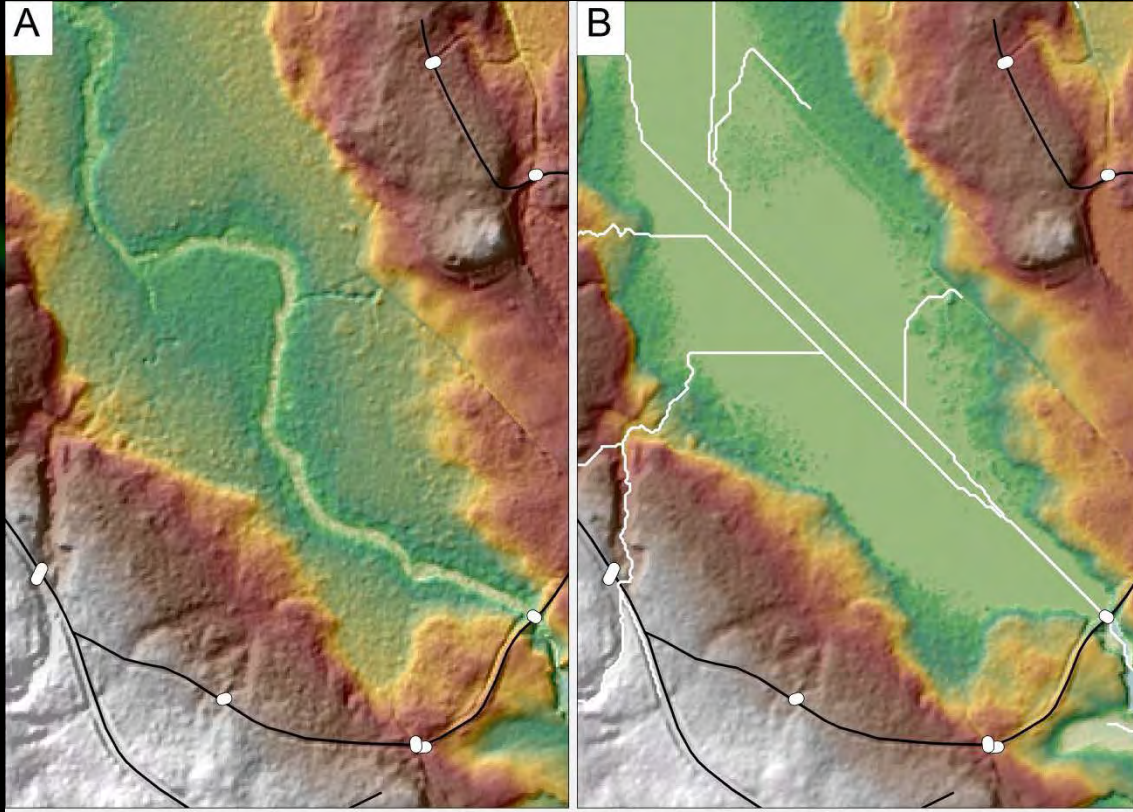


Original DEM



Original DEM

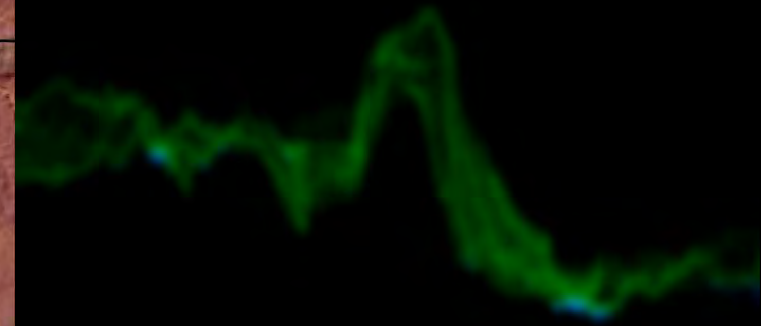
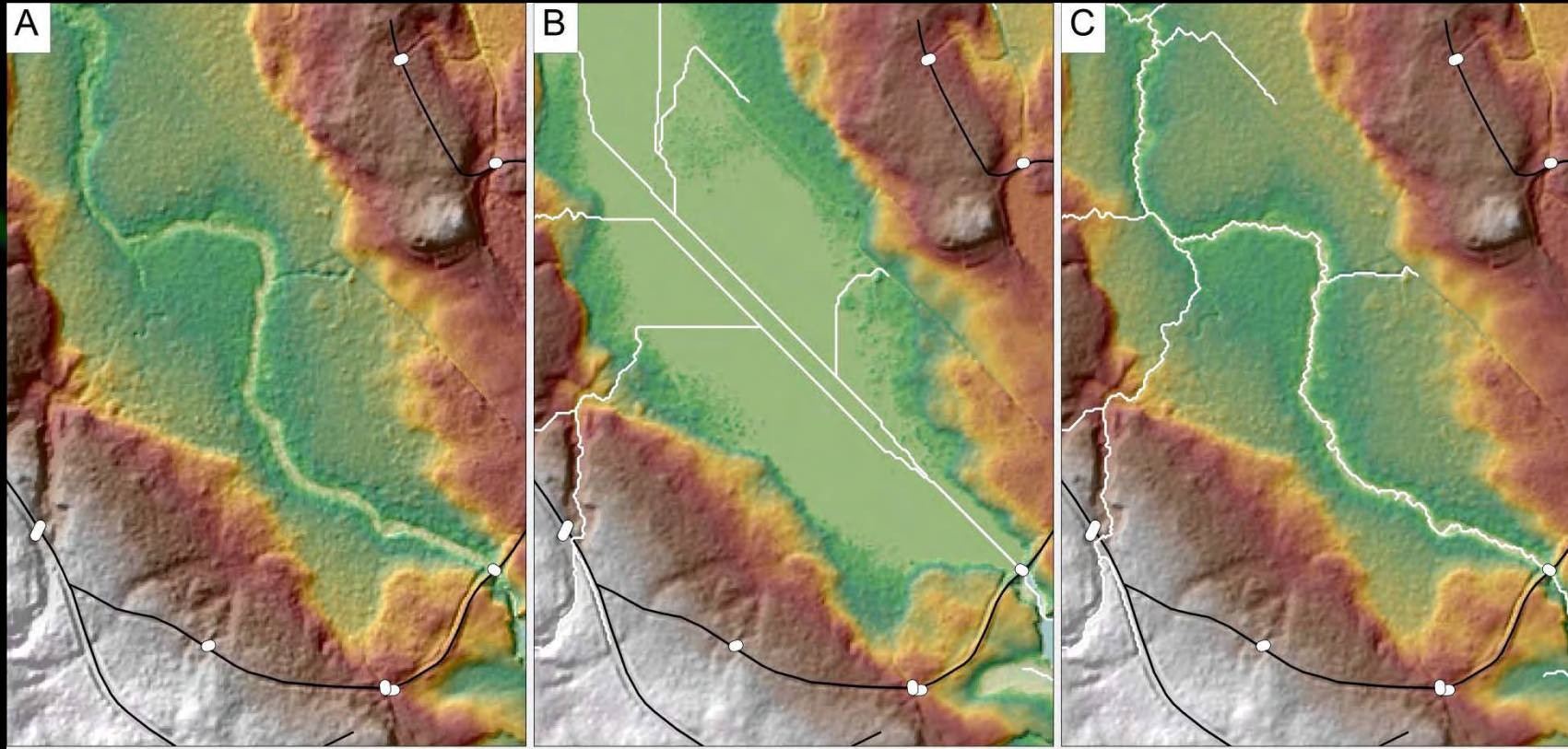
Filled DEM

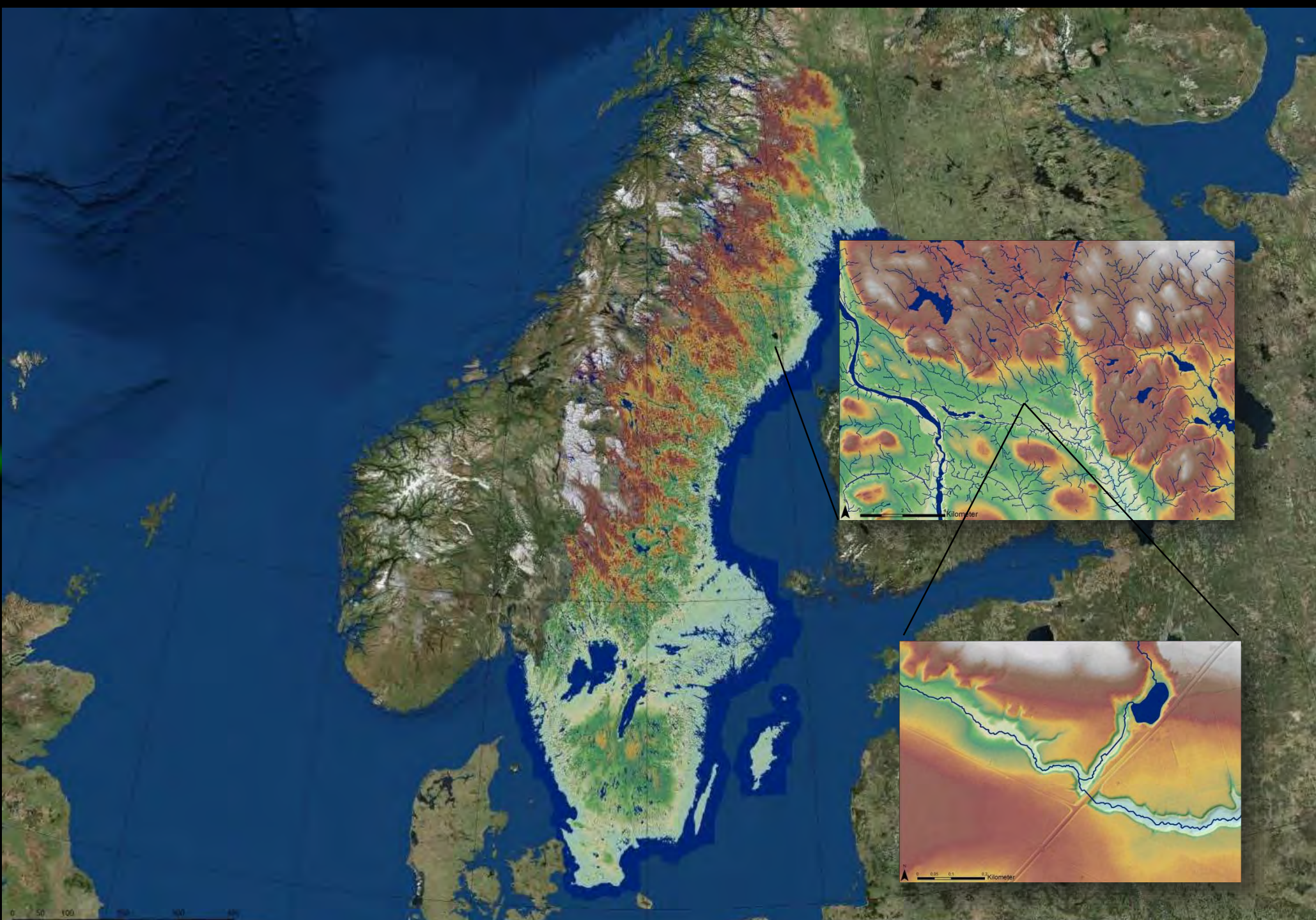


Original DEM

Filled DEM

Breached DEM



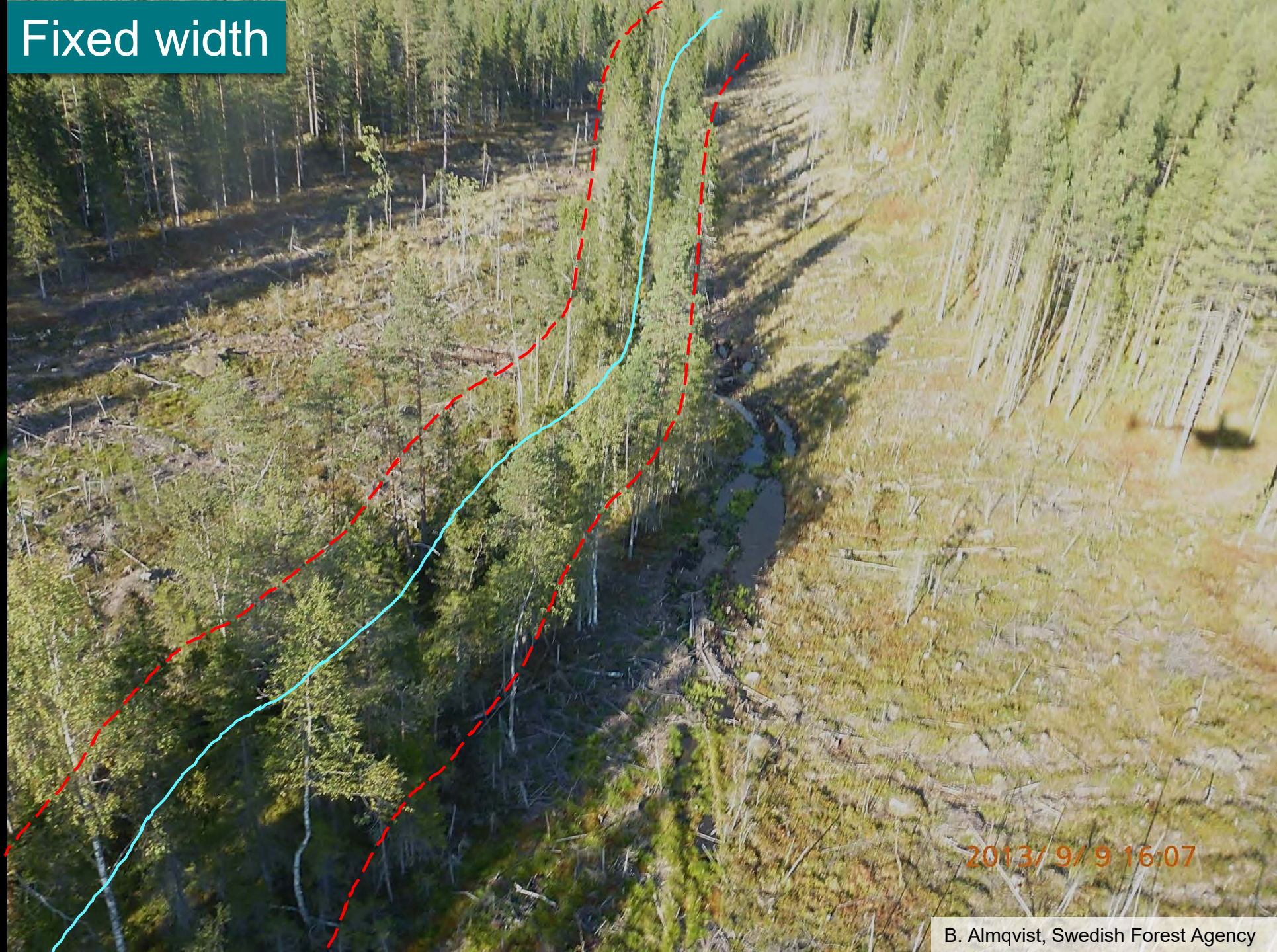


Buffer zone



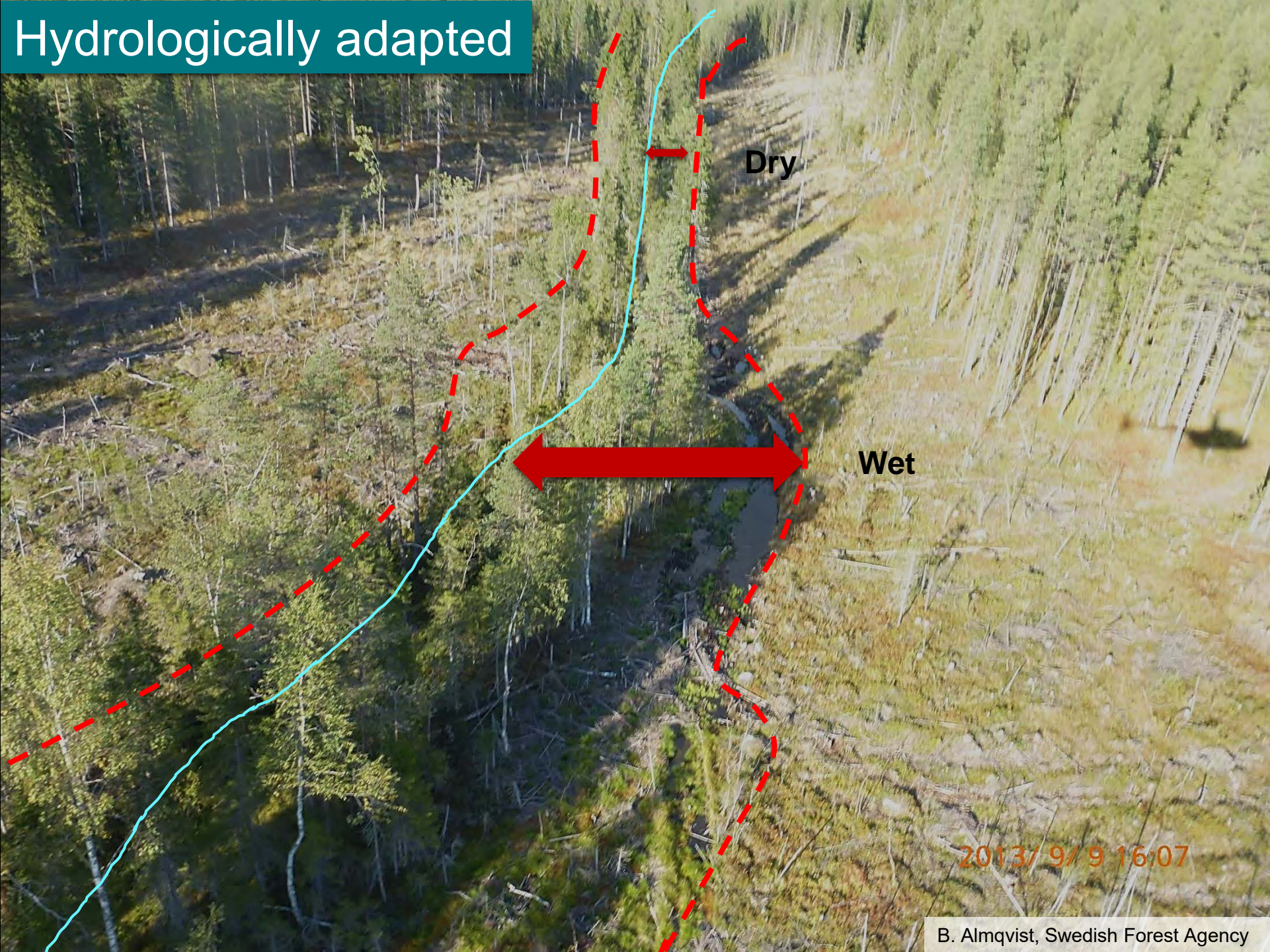
2013/ 9/ 9 16:07

Fixed width

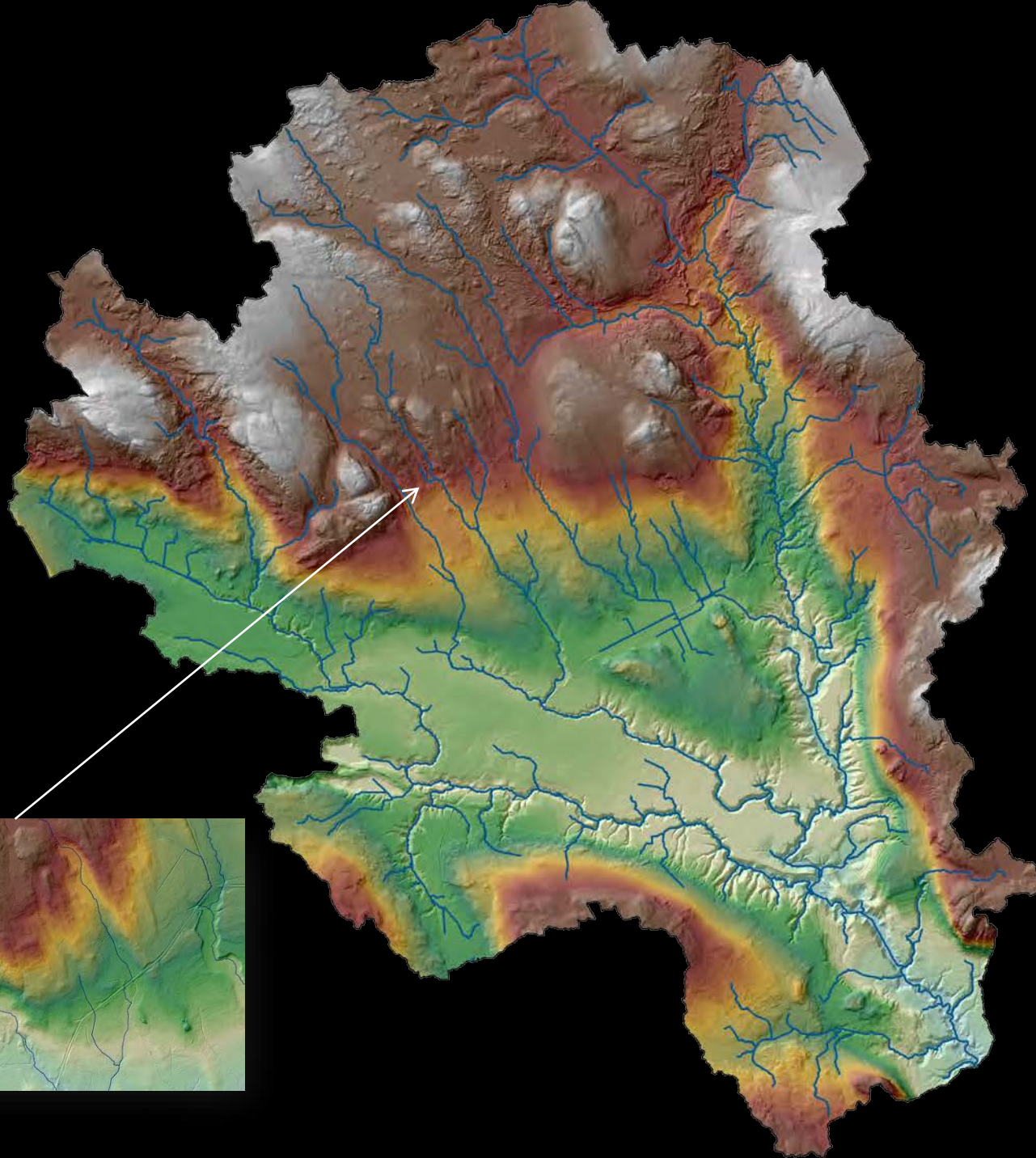


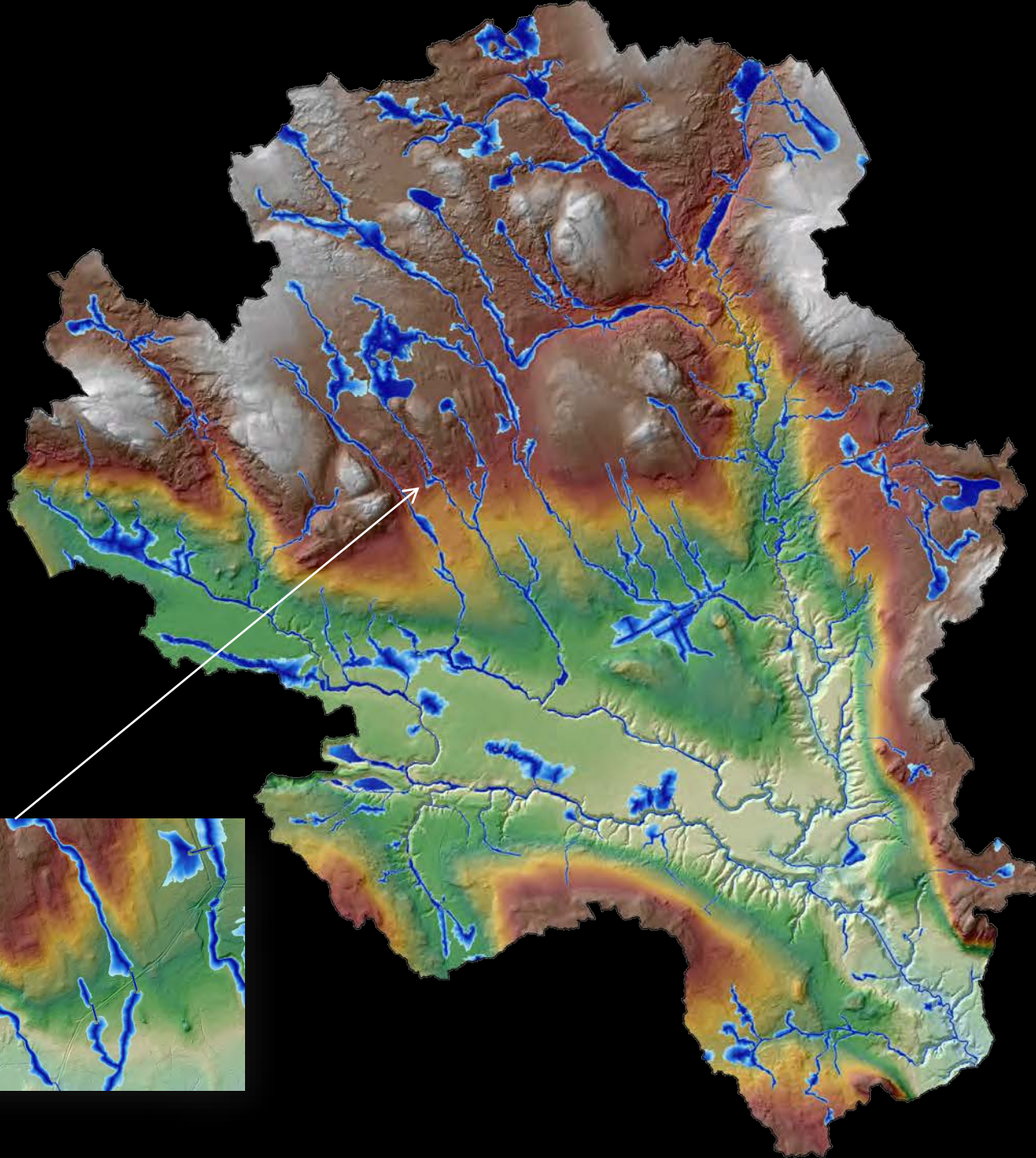
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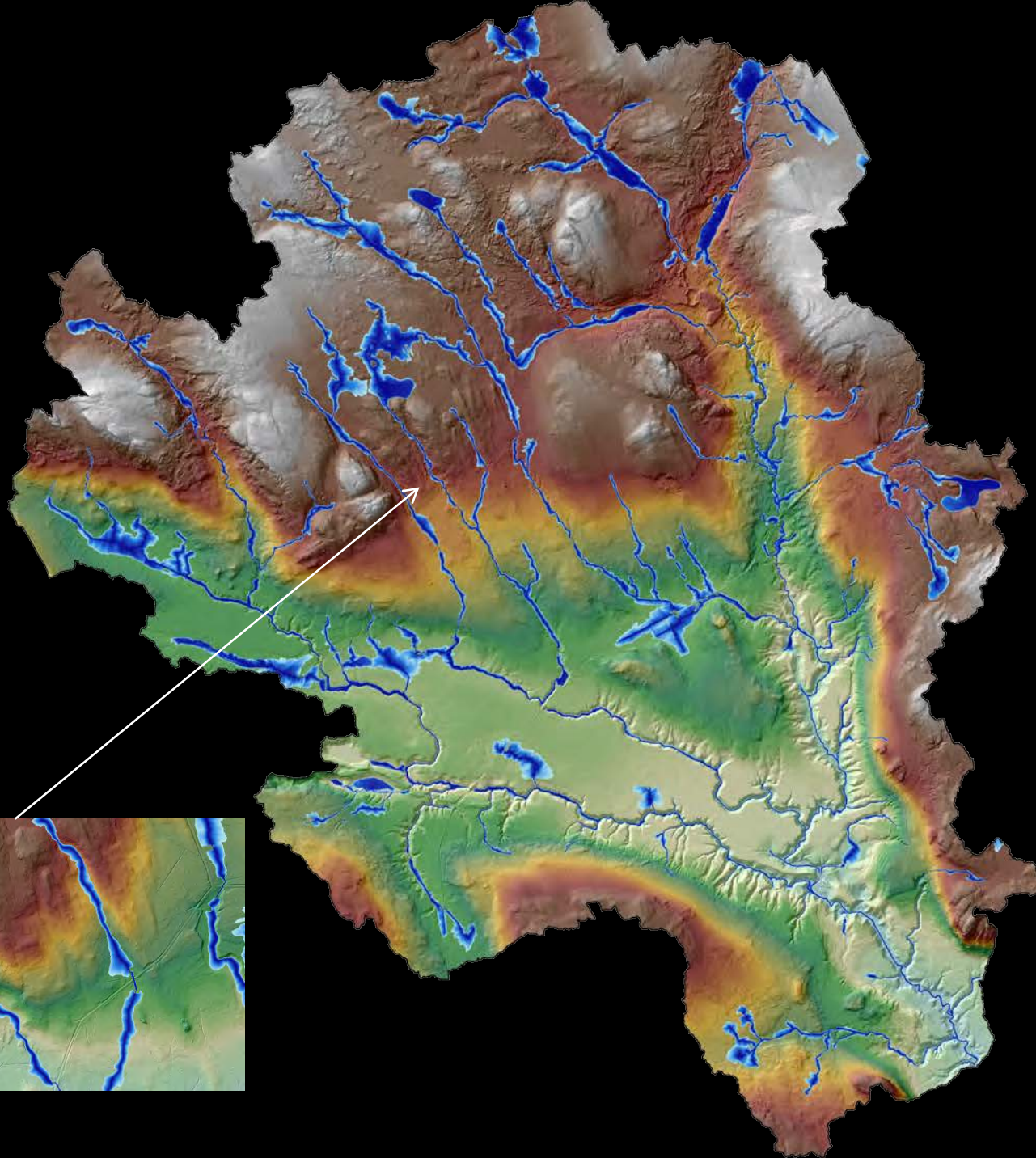
Hydrologically adapted



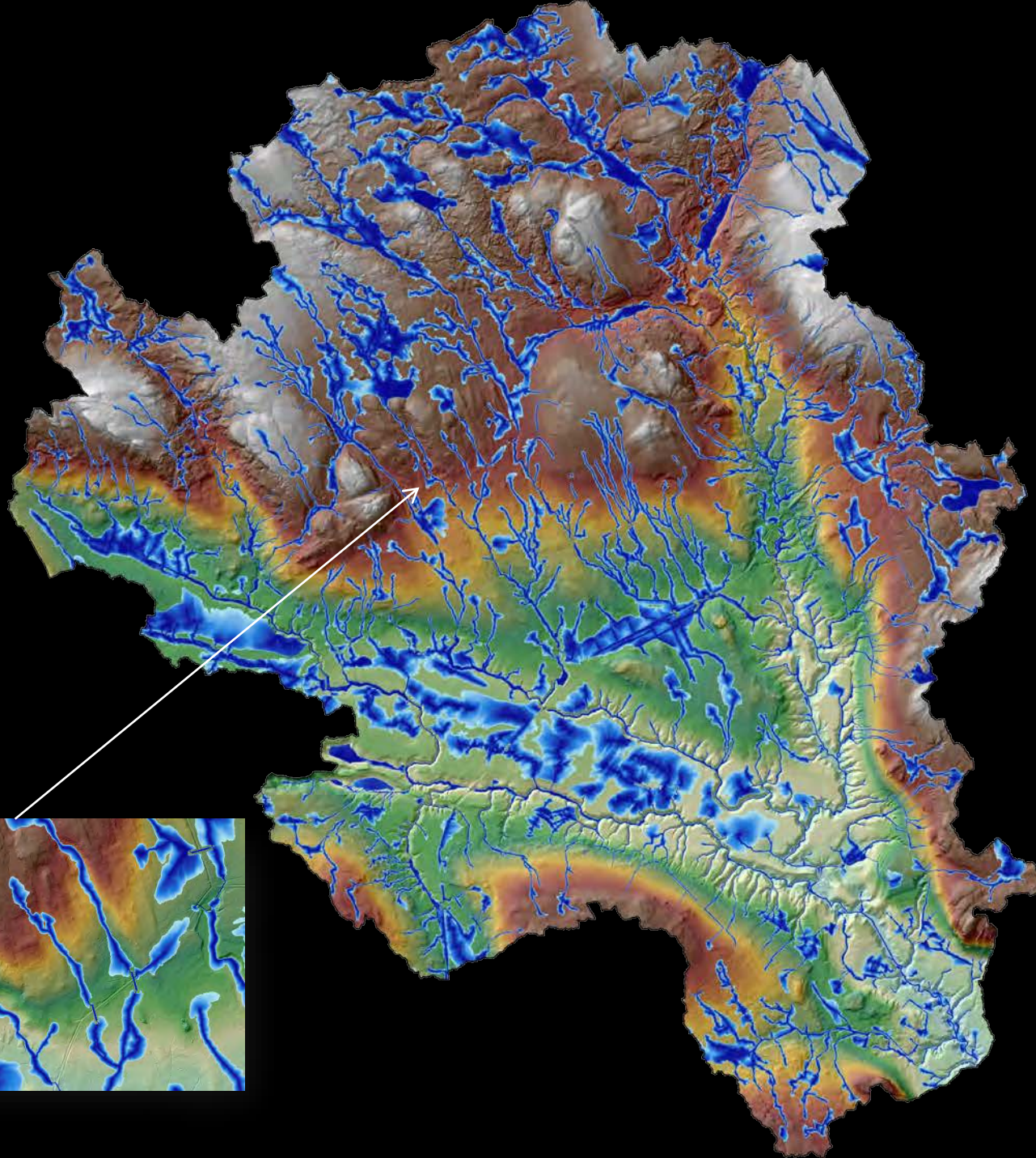
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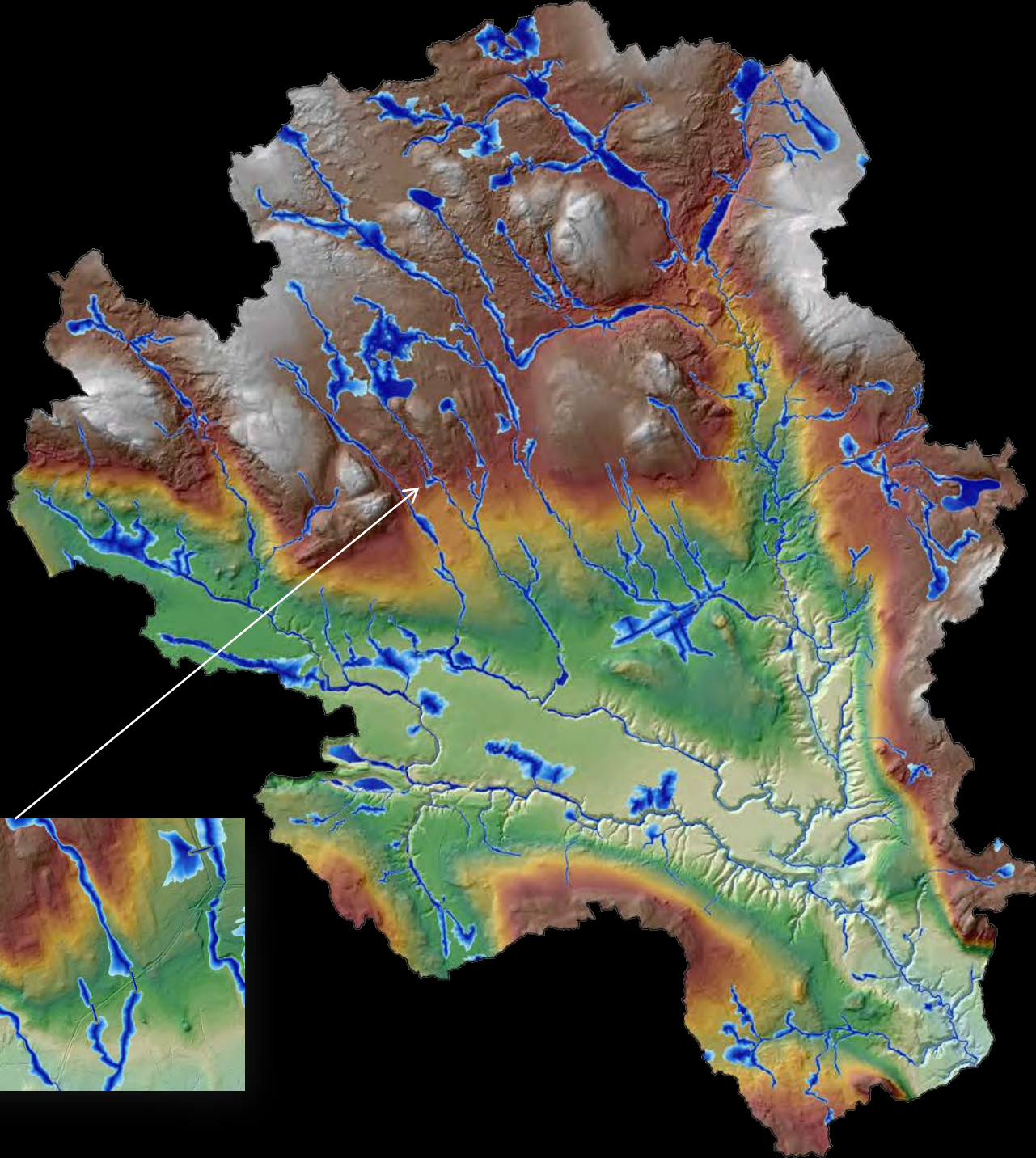




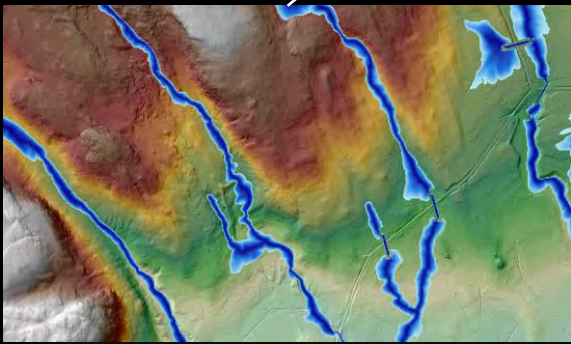
Ishi Buffam



Ishi Buffam

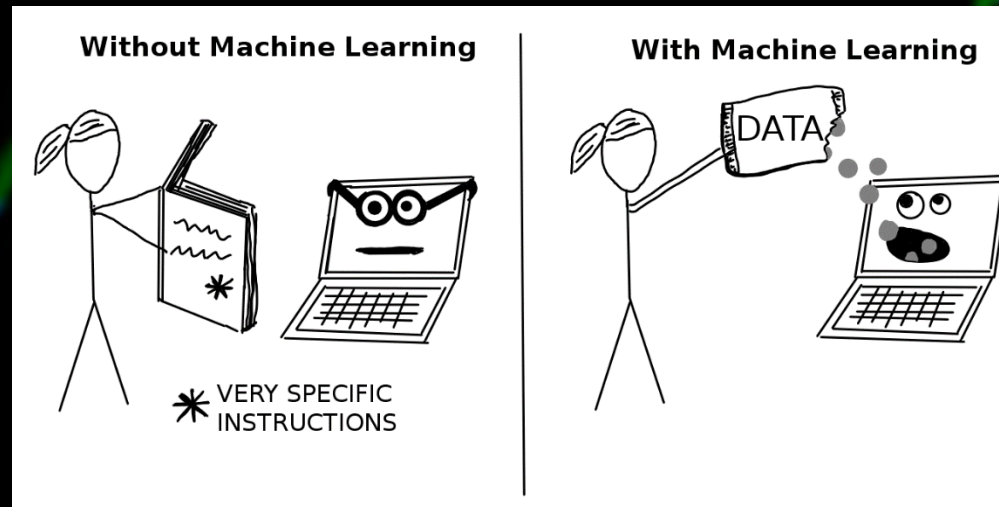


Ishi Buffam

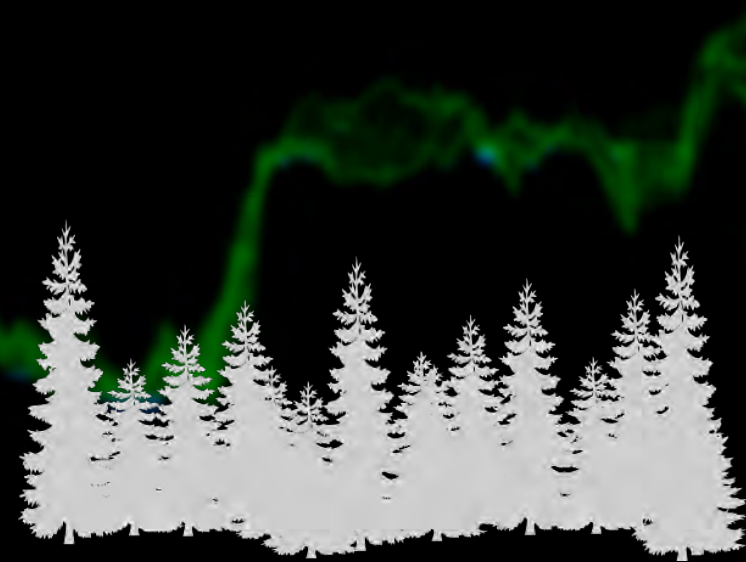
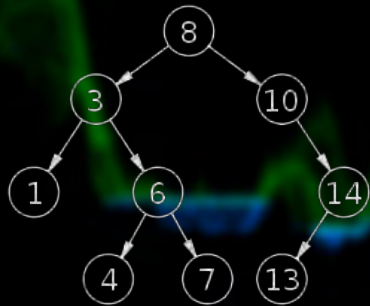




Machine learning

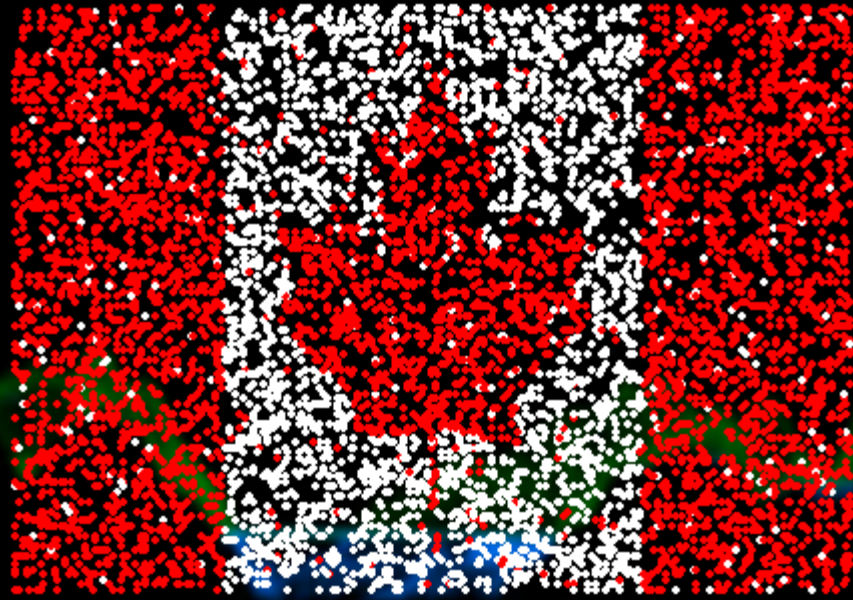


Decision trees



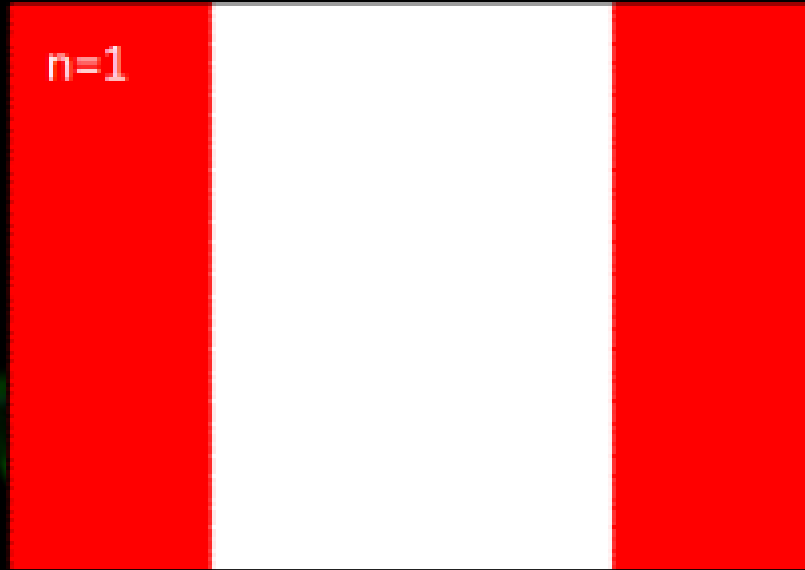
Decision forest

XGBoost



Training data of the Canadian flag

XGBoost



First tree

XGBoost



A few more trees

XGBoost



A few more trees...

XGBoost



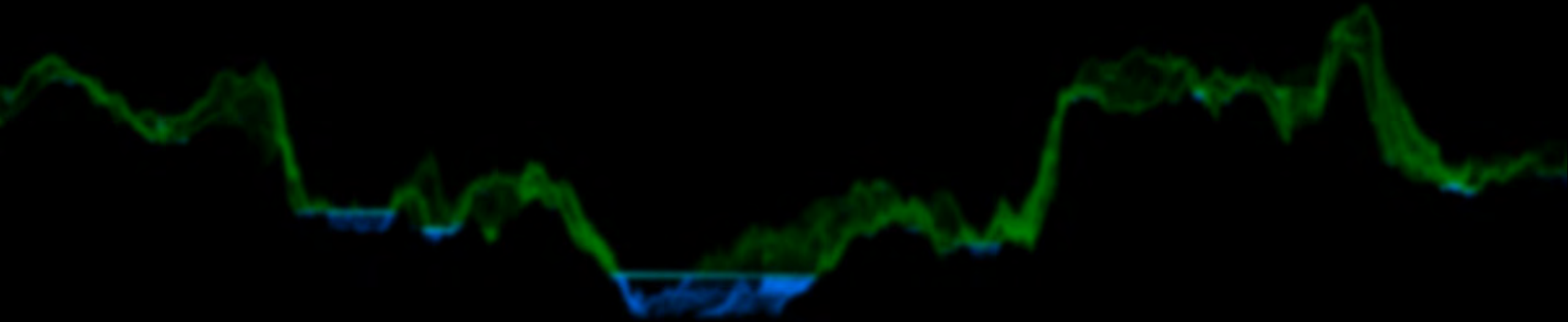
A few more trees...

XGBoost

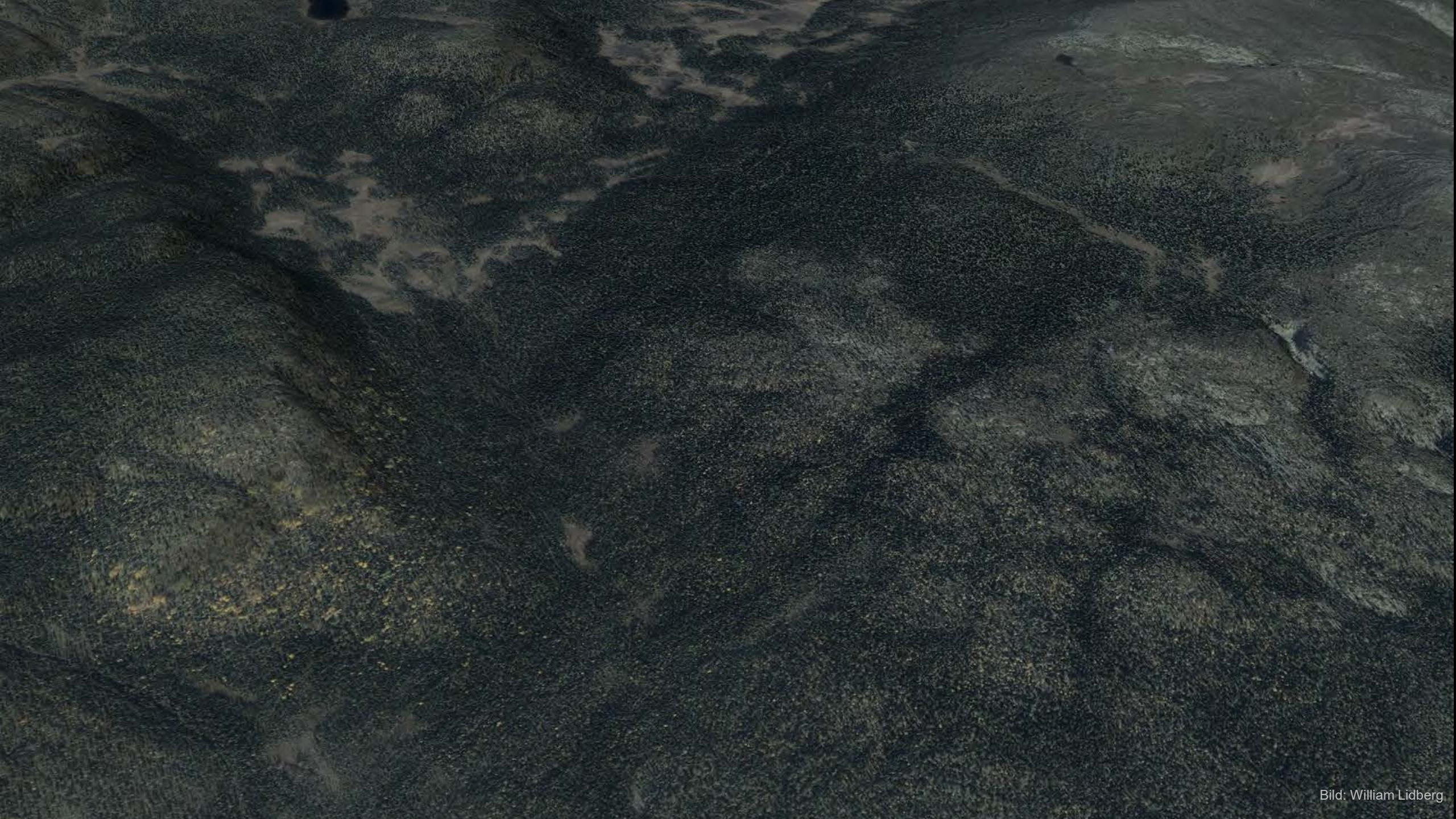


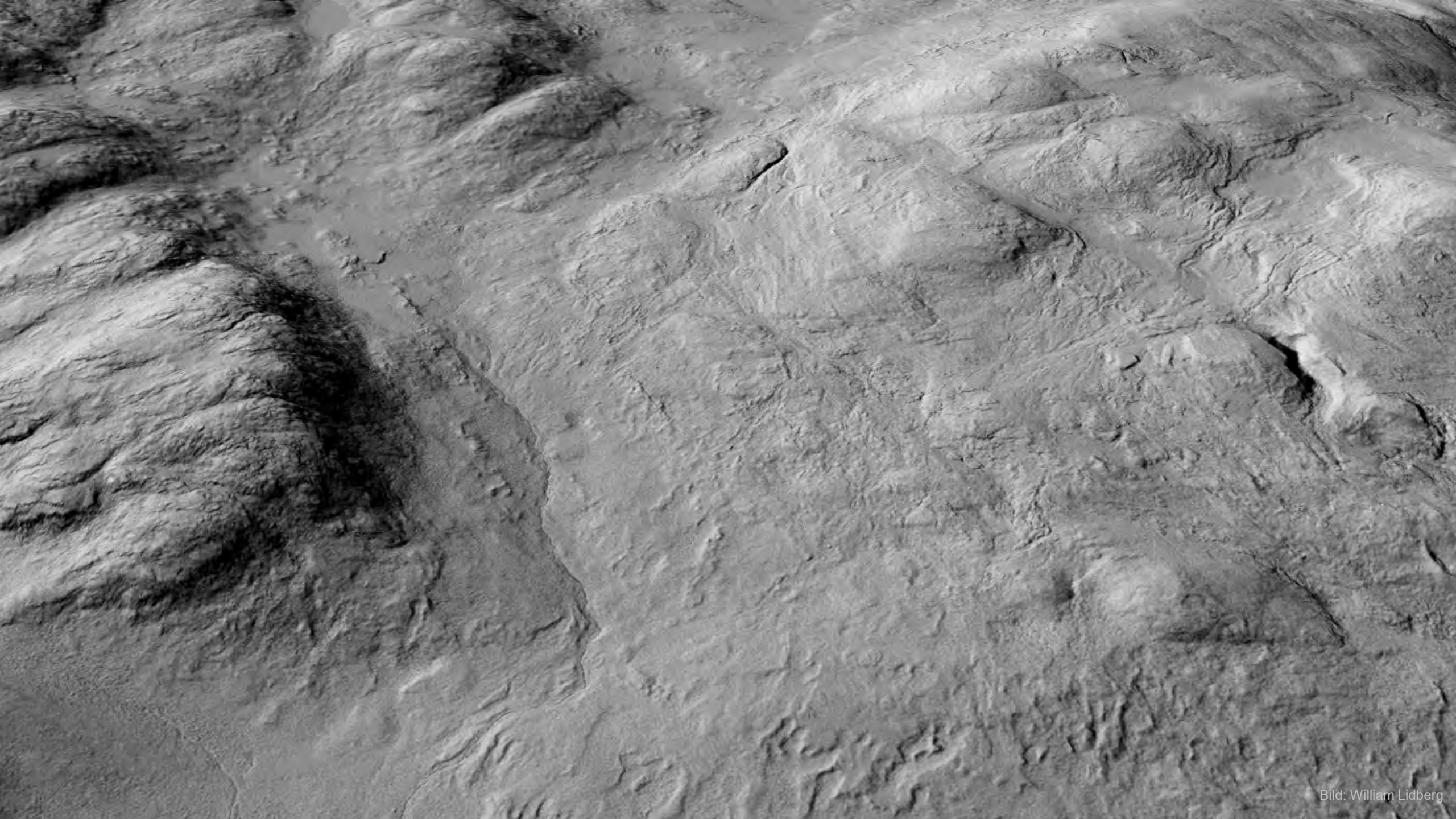
Lots of trees

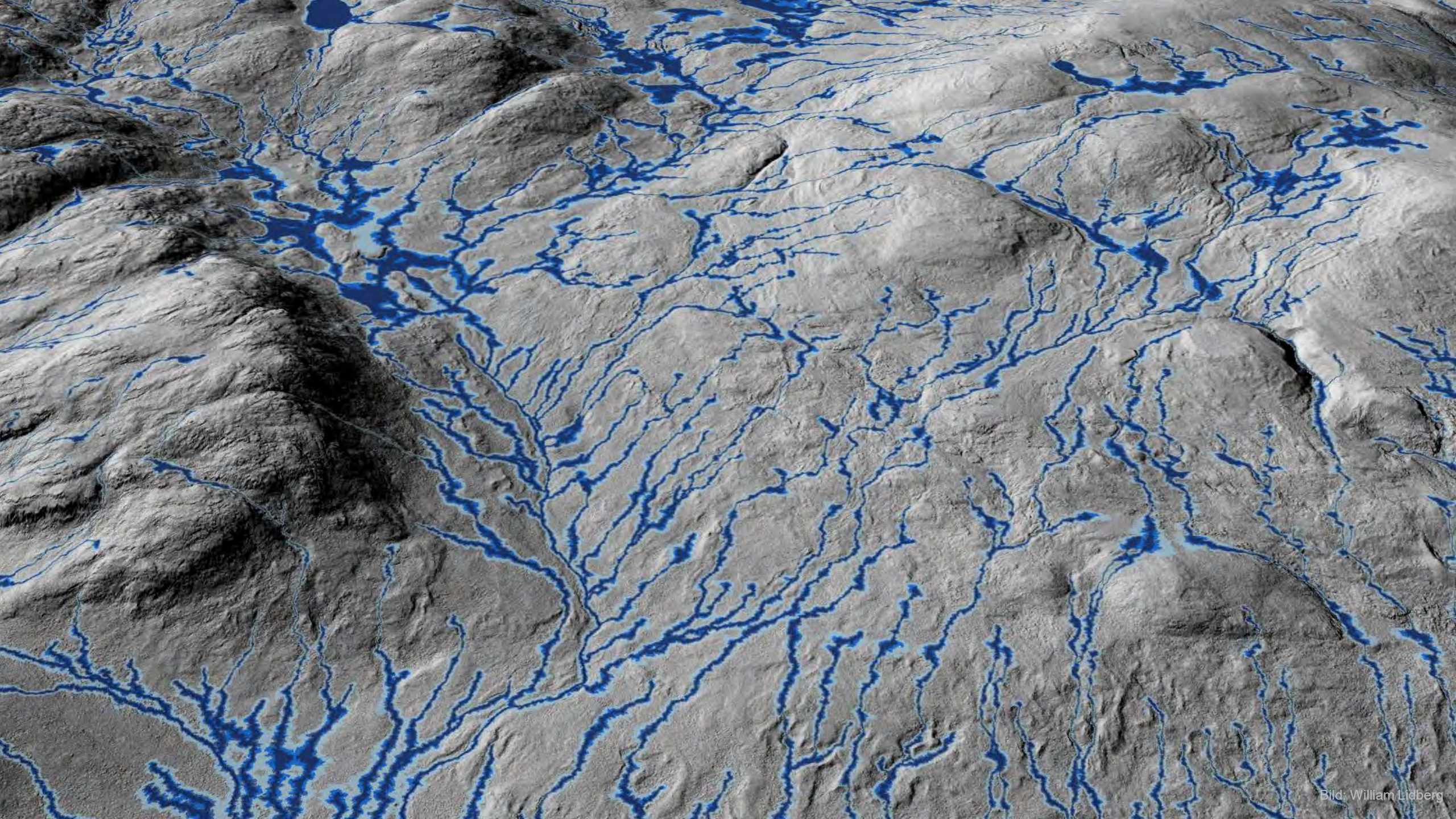
Soil moisture













Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

Winter

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

Spring

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

Summer

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

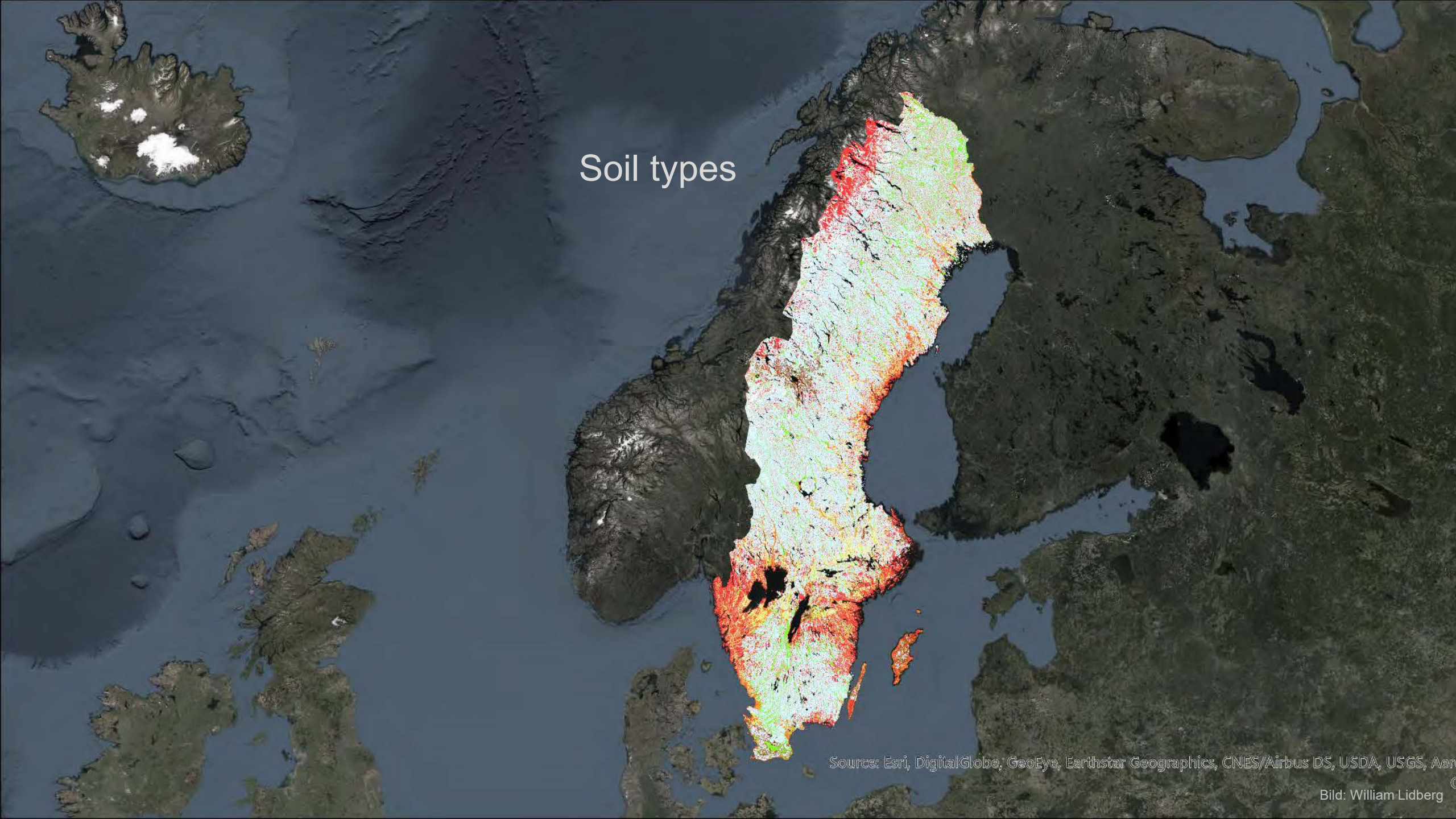
Bild: William Lidberg

Autumn

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

Soil types



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

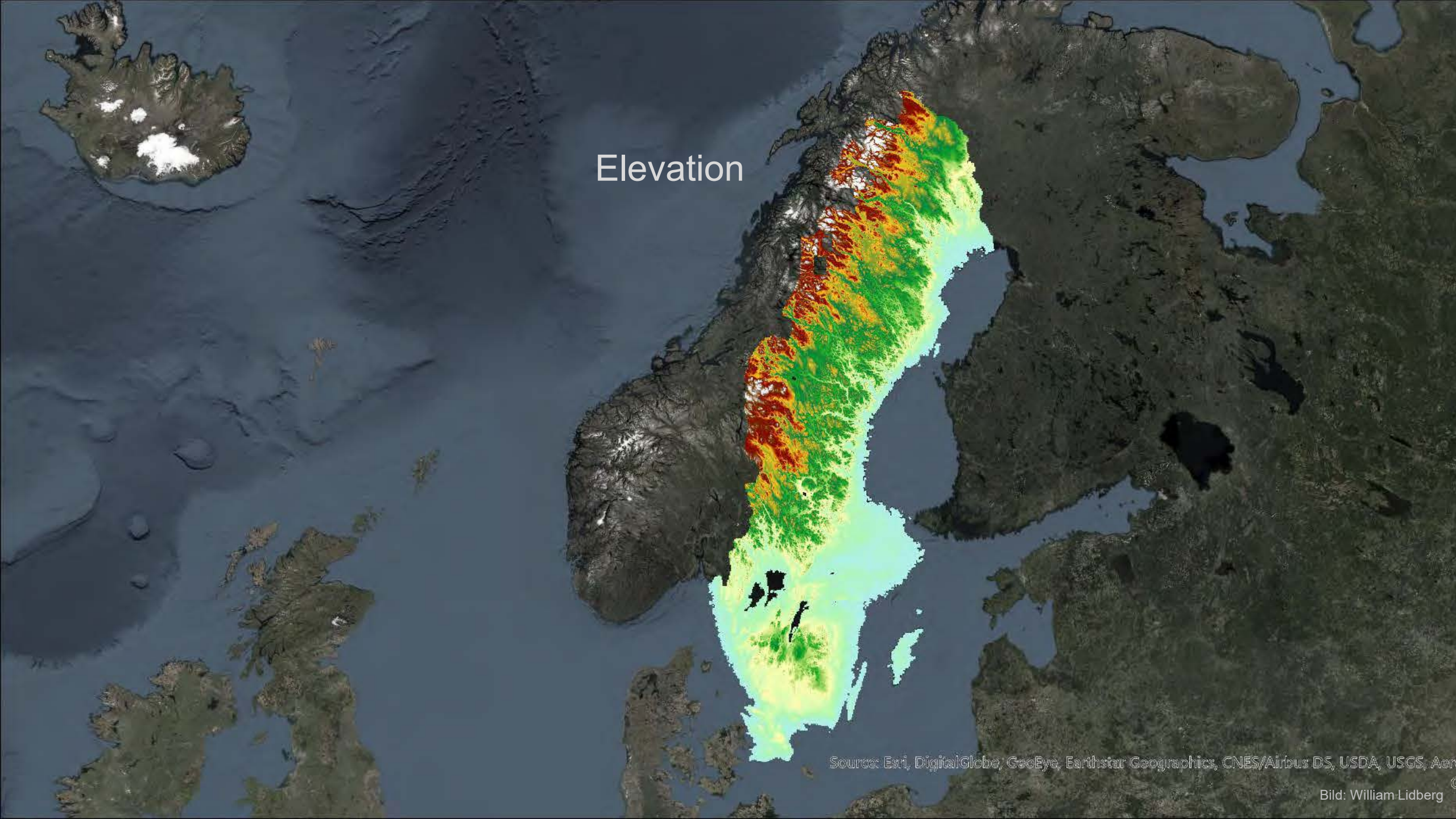
Bild: William Lidberg

Soil depth

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

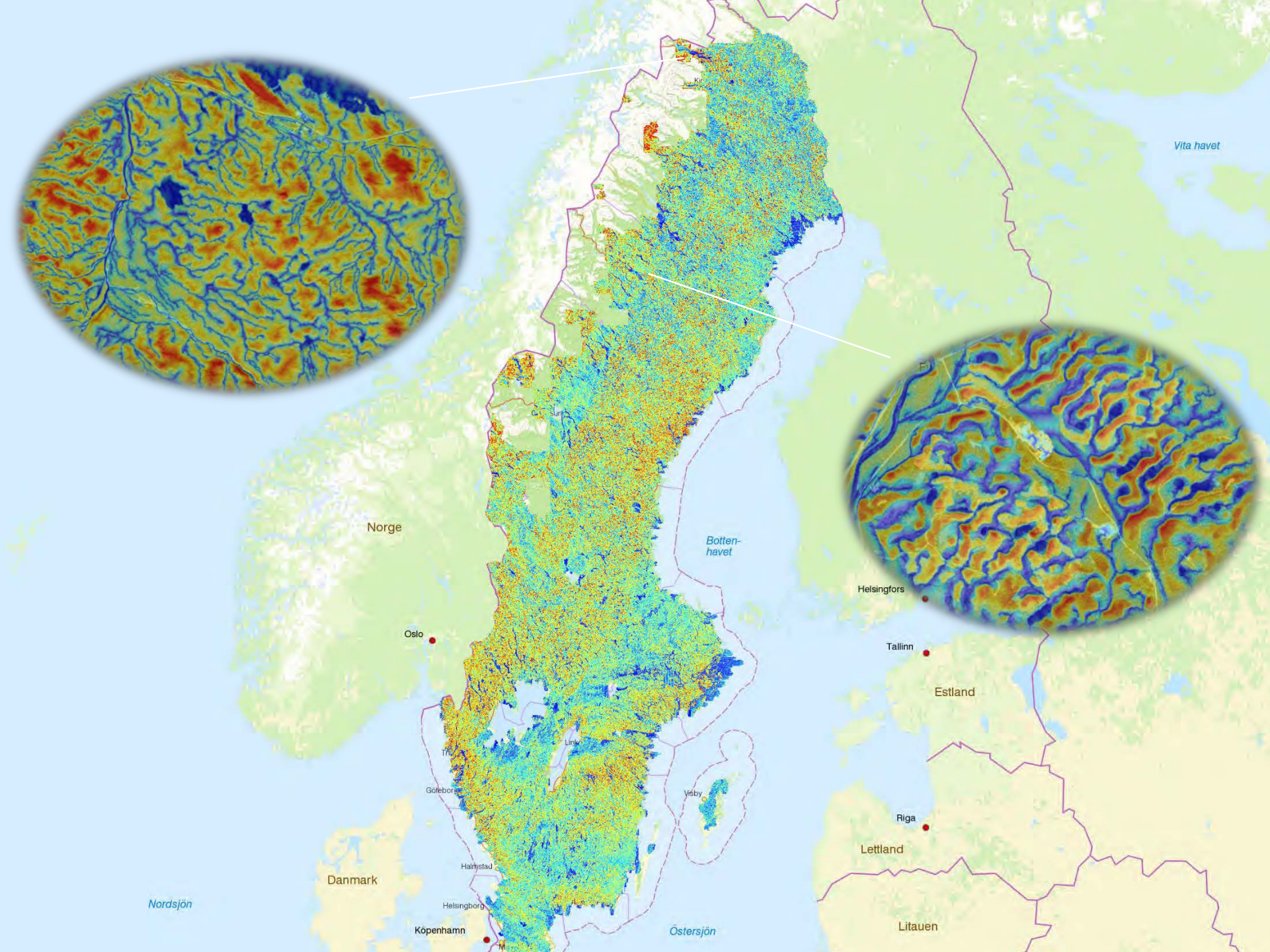
Bild: William Lidberg

Elevation



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg



Peatlands



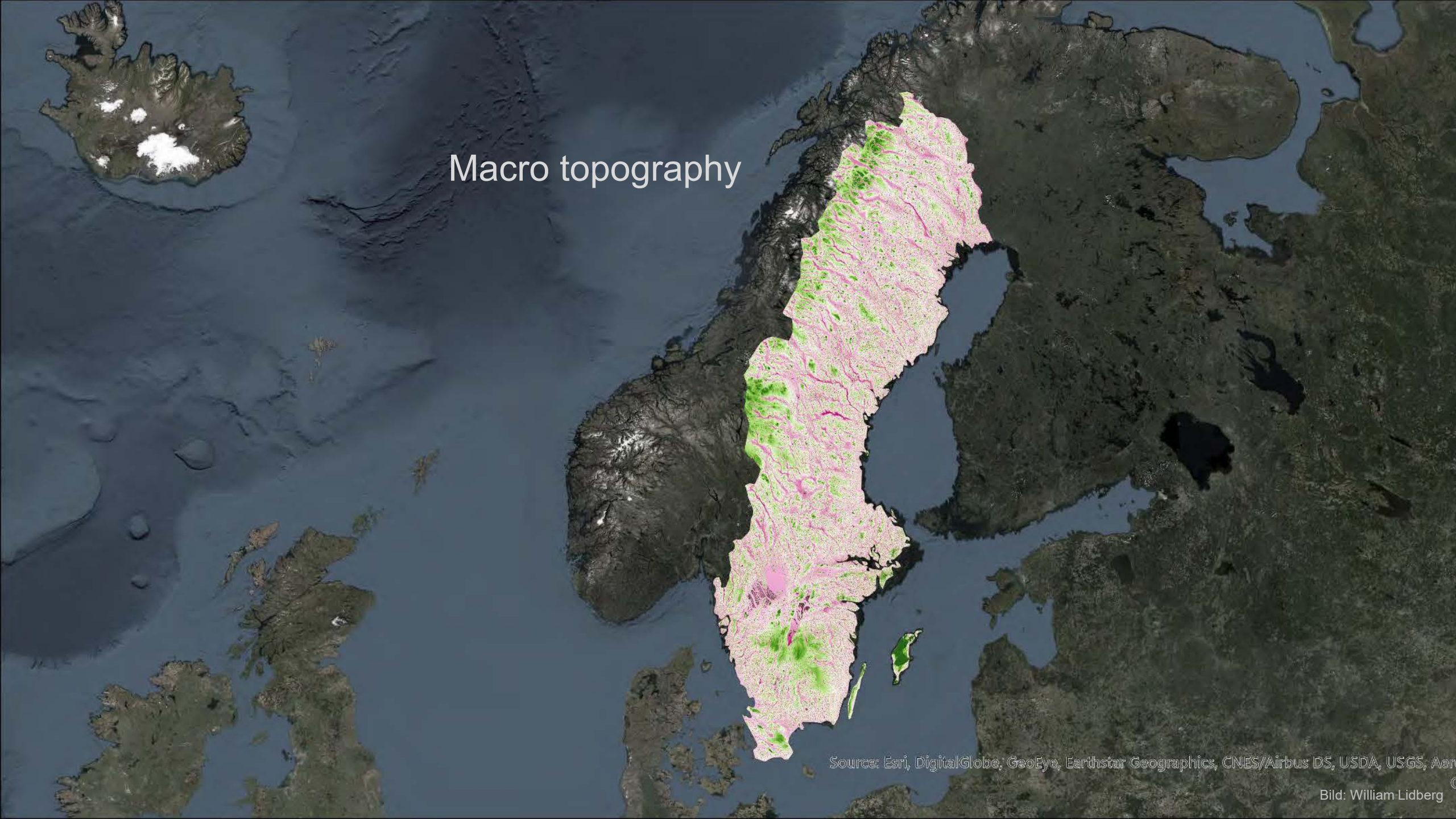


Micro topography

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

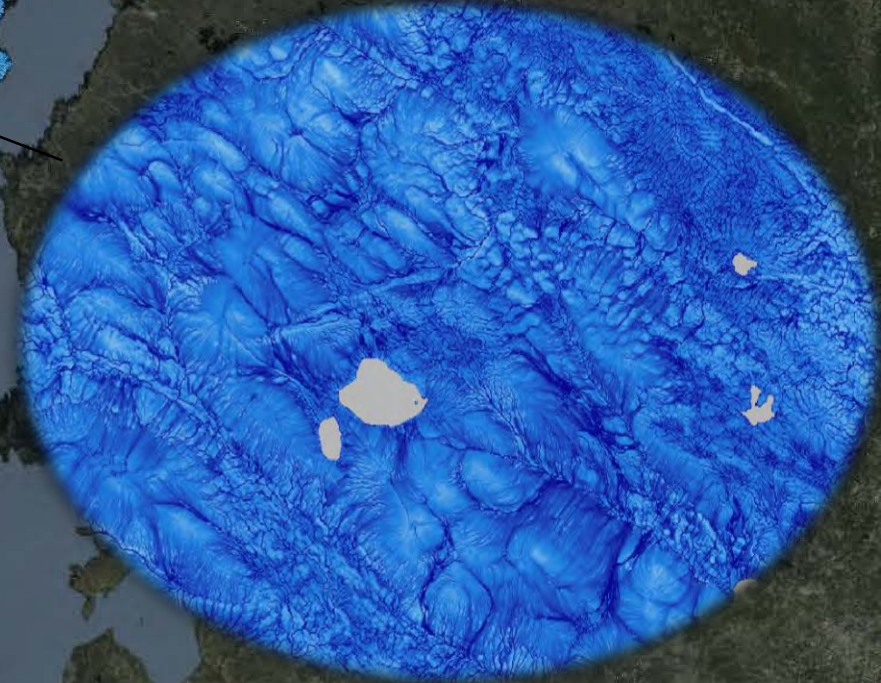
Macro topography



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

Traditional modeling



National Forest Inventory



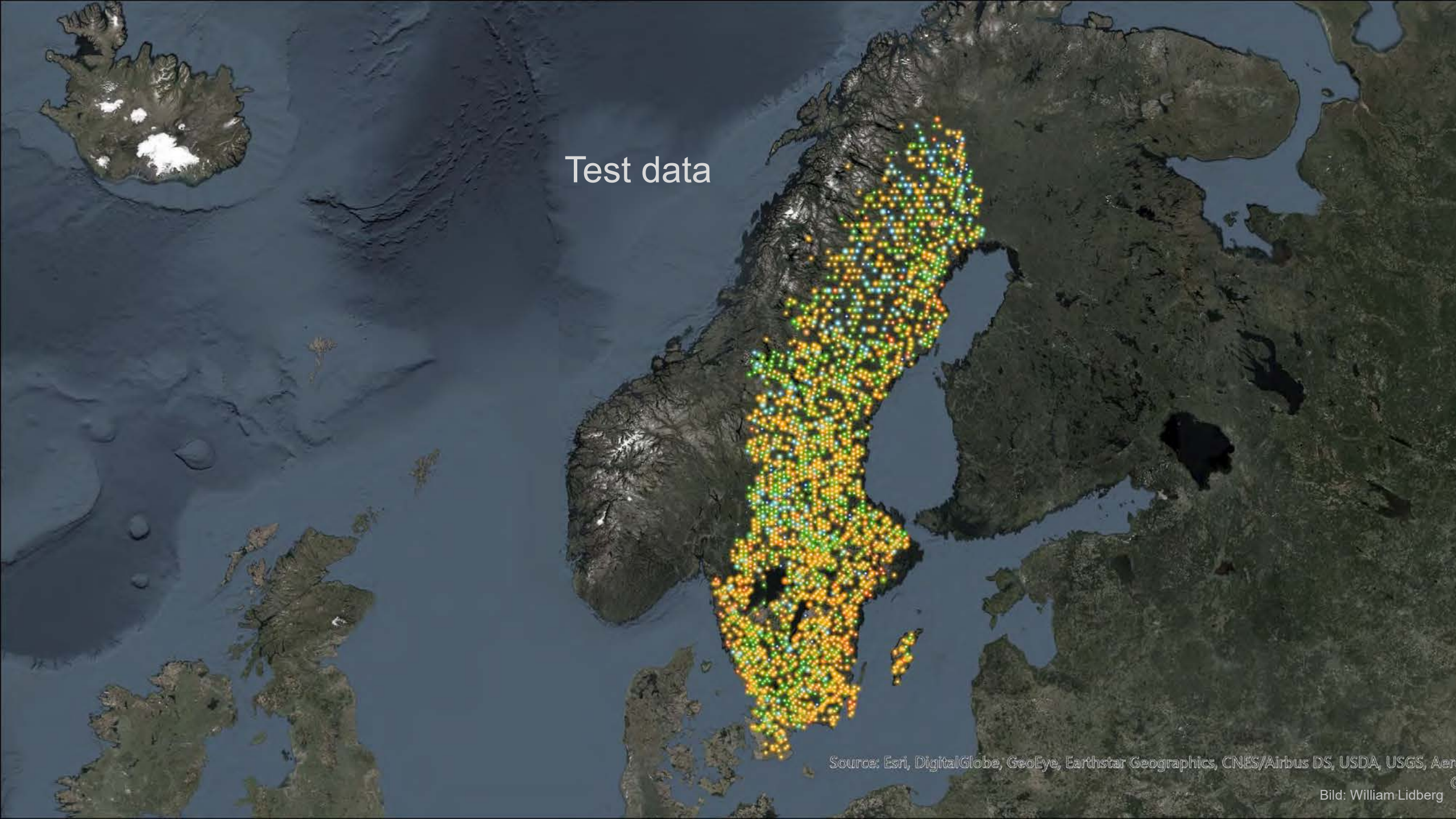
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg

Test data

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero

Bild: William Lidberg



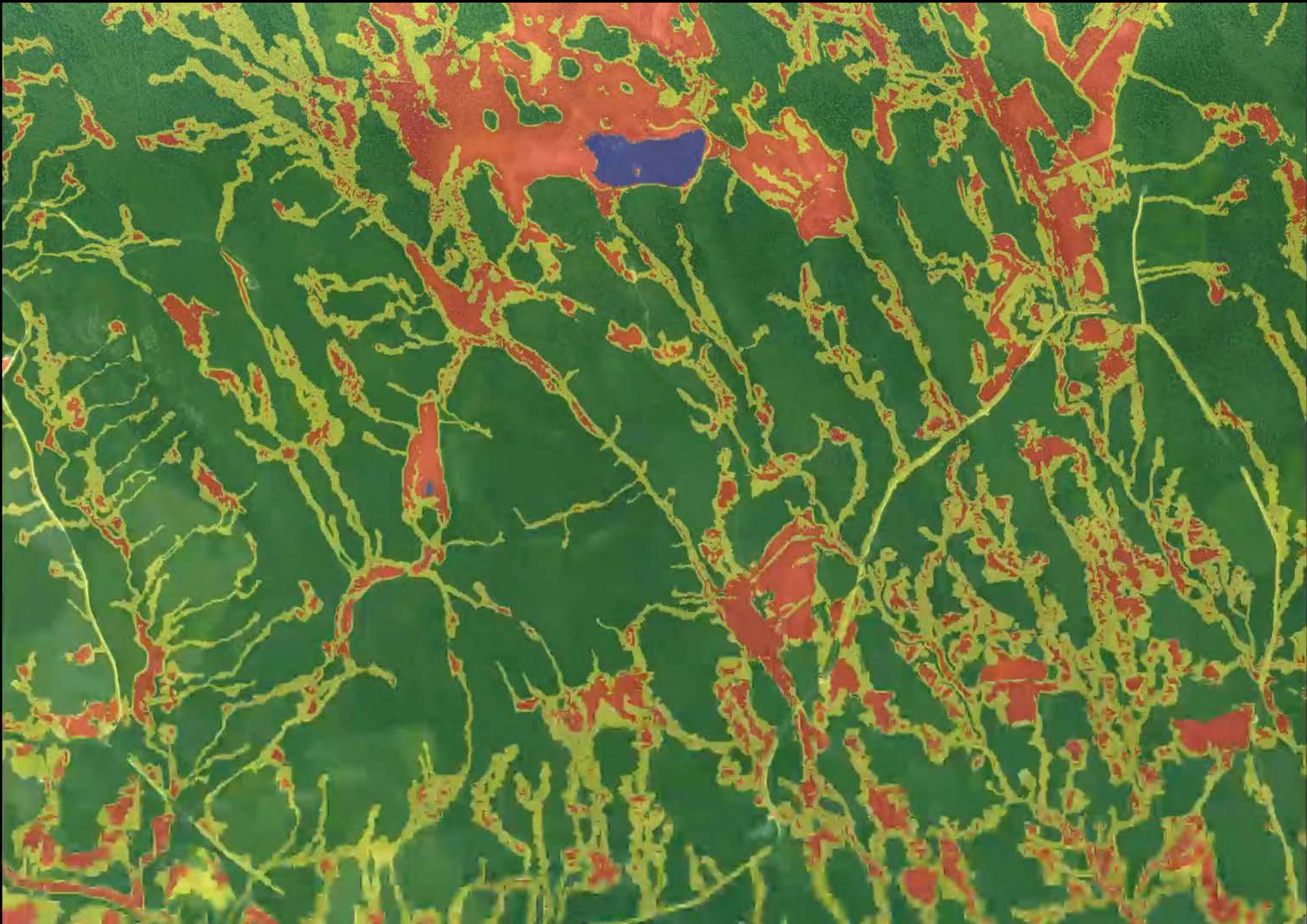
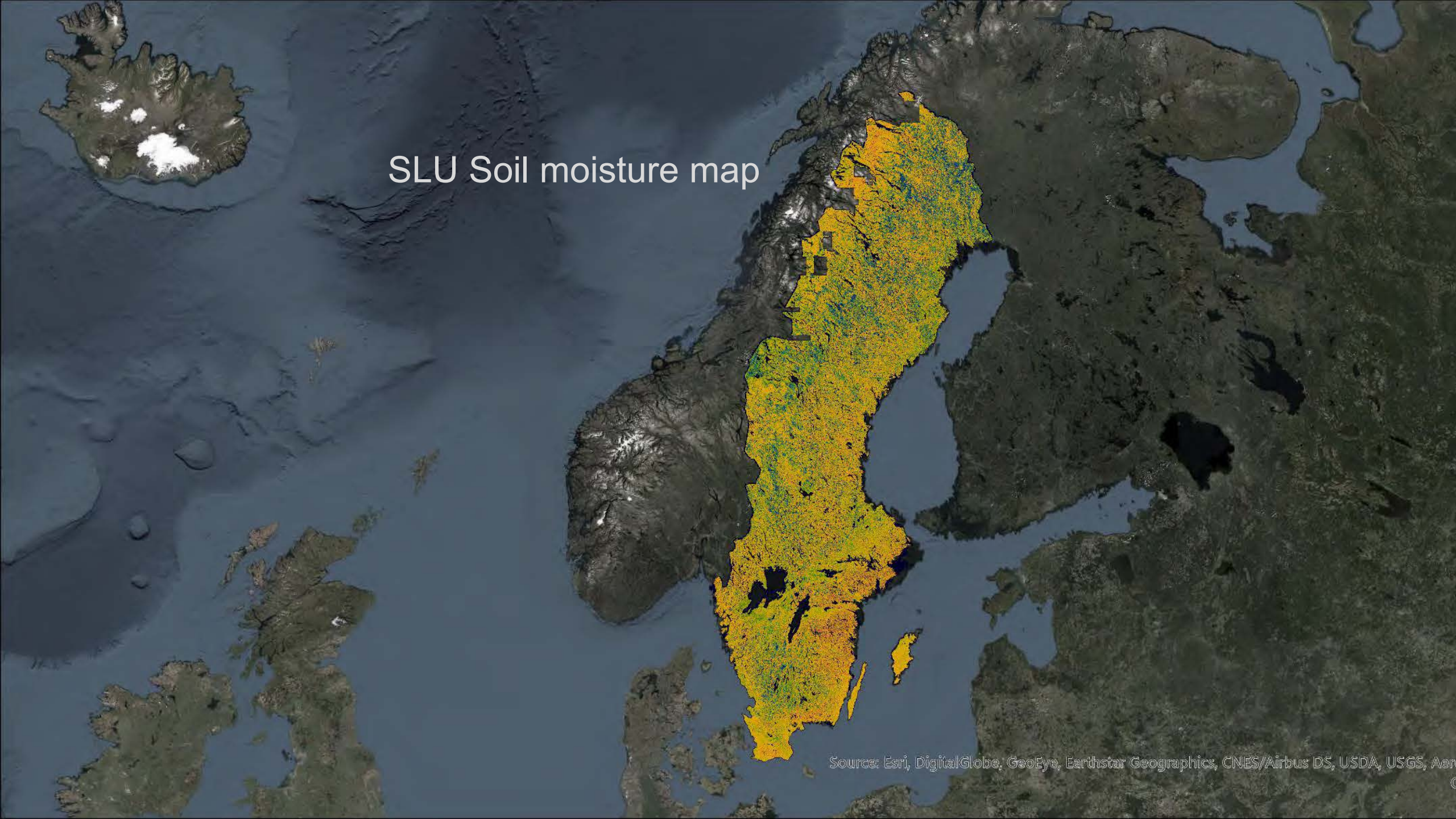
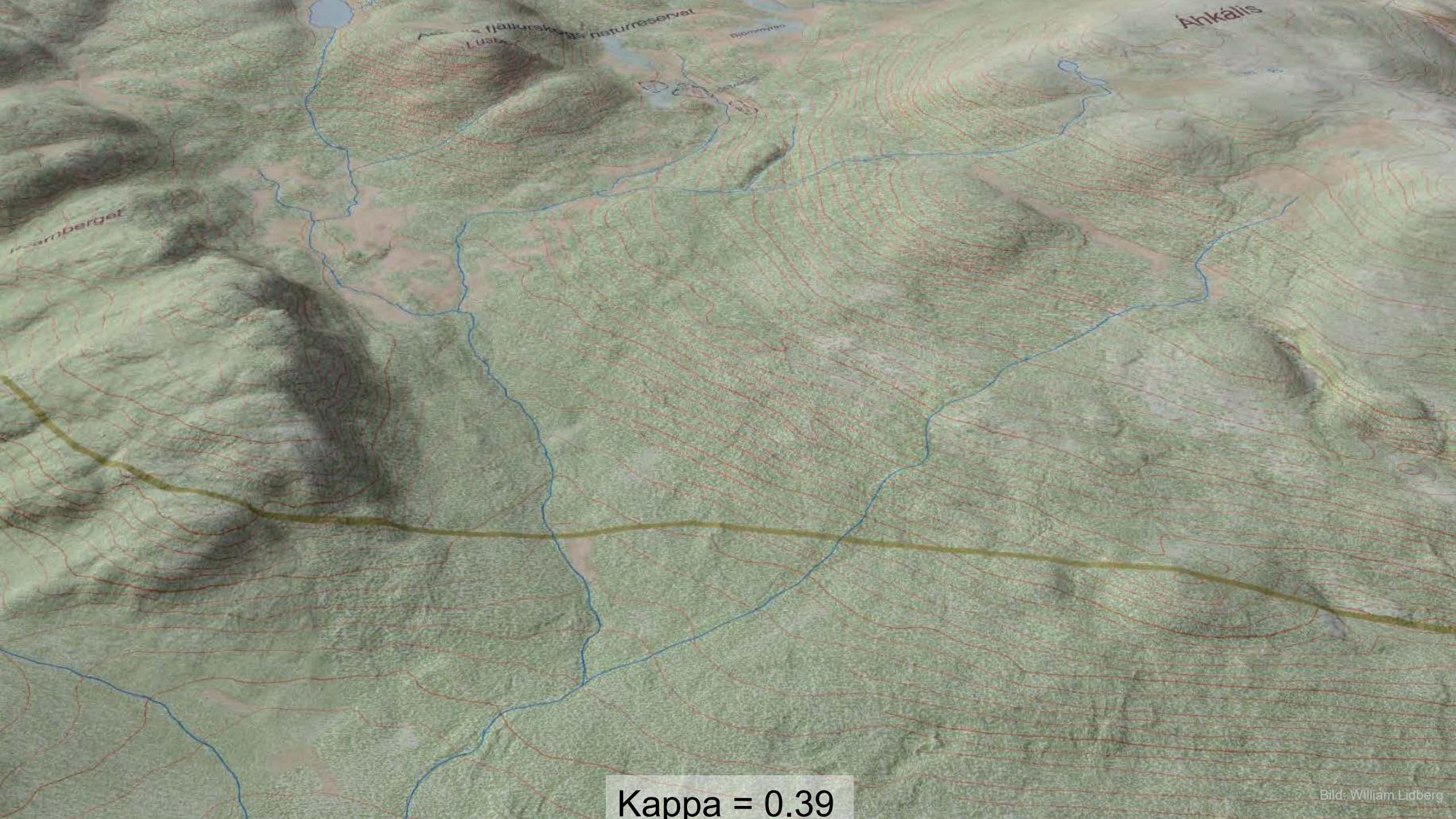


Bild: William Lidberg

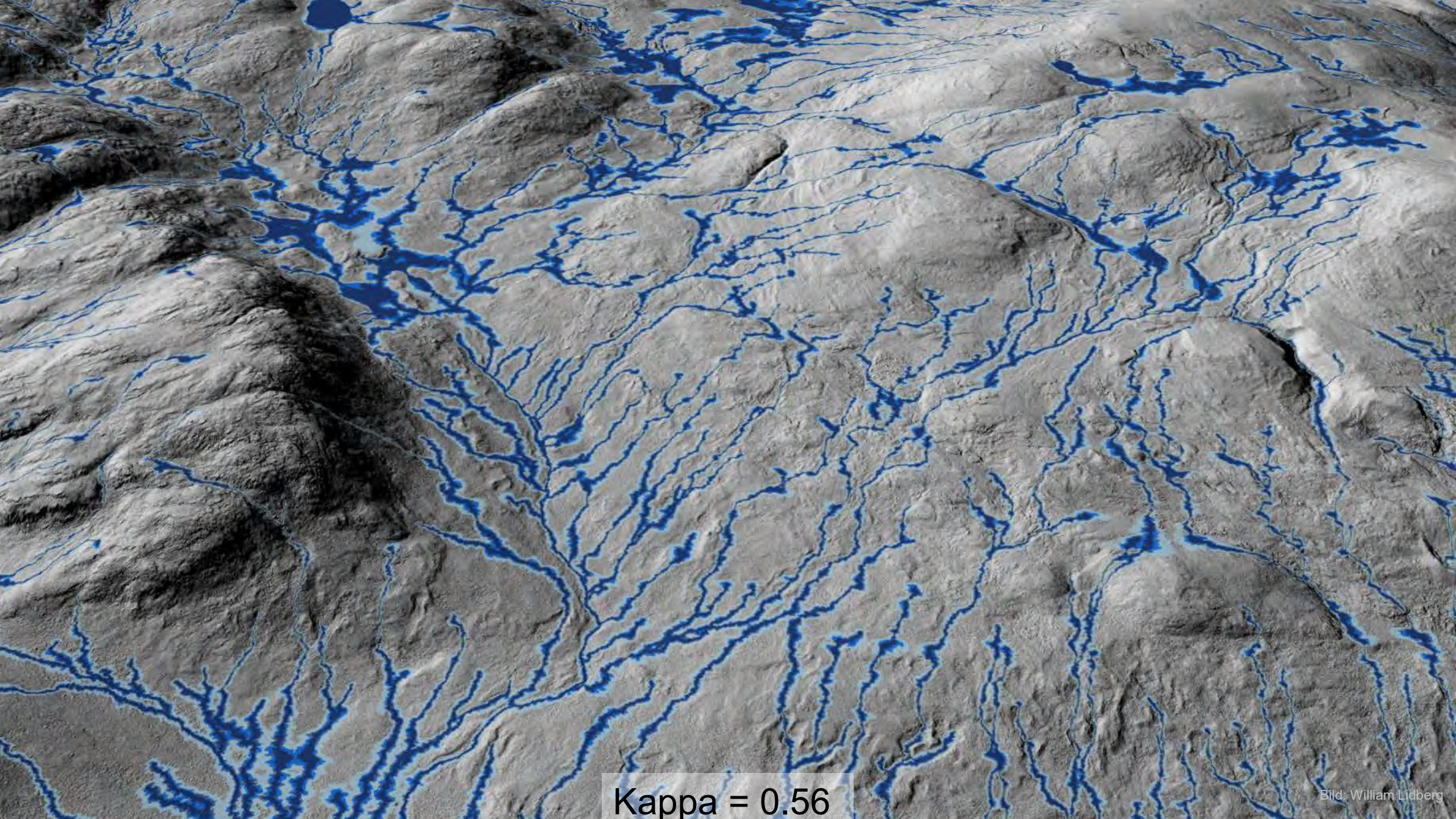
A satellite-style map of Sweden and surrounding regions, including parts of Norway, Denmark, and Iceland. The landmasses are shown in dark grey and black, representing topography. The sea is a dark blue-grey. A large, irregularly shaped area covering most of Sweden is highlighted with a vibrant, multi-colored pattern of yellow, orange, and green, representing soil moisture data. The text "SLU Soil moisture map" is overlaid in white in the upper left quadrant of the map.

SLU Soil moisture map

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero



Kappa = 0.39



Kappa = 0.56

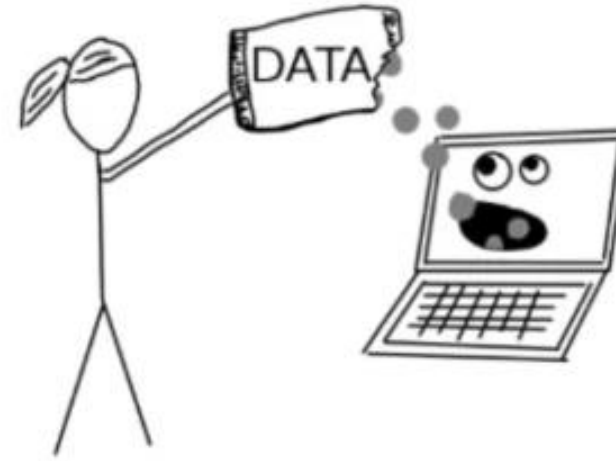


Kappa = 0.69

Without Machine Learning



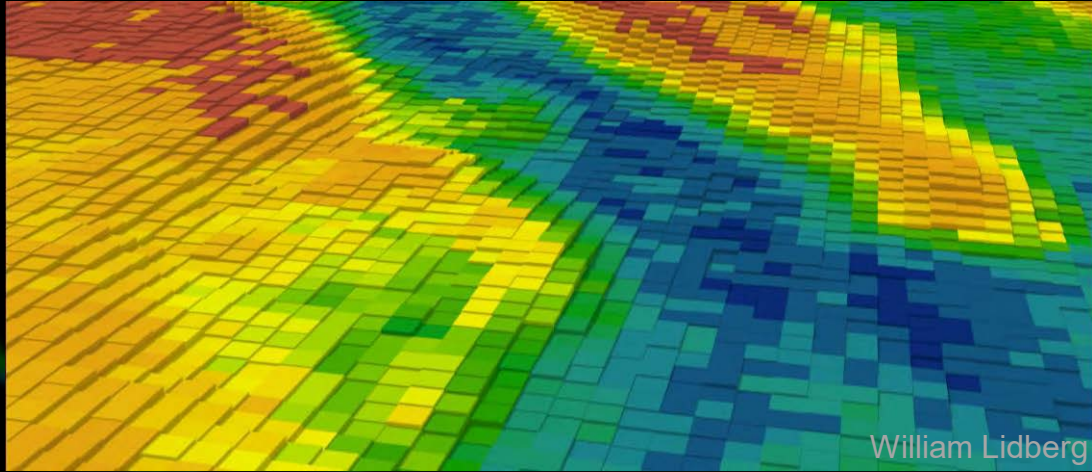
With Machine Learning



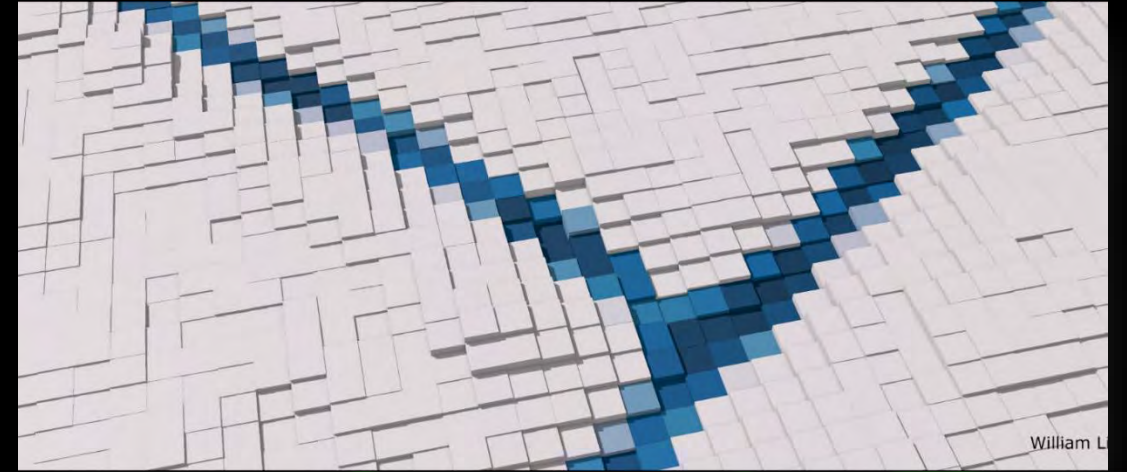
Why did you predict a bufferzone here?

(*awkward silence*)

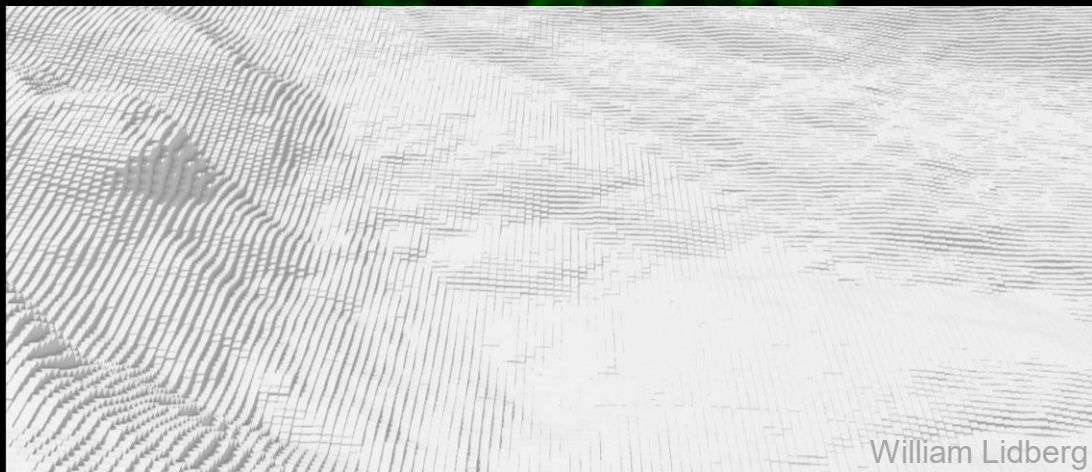




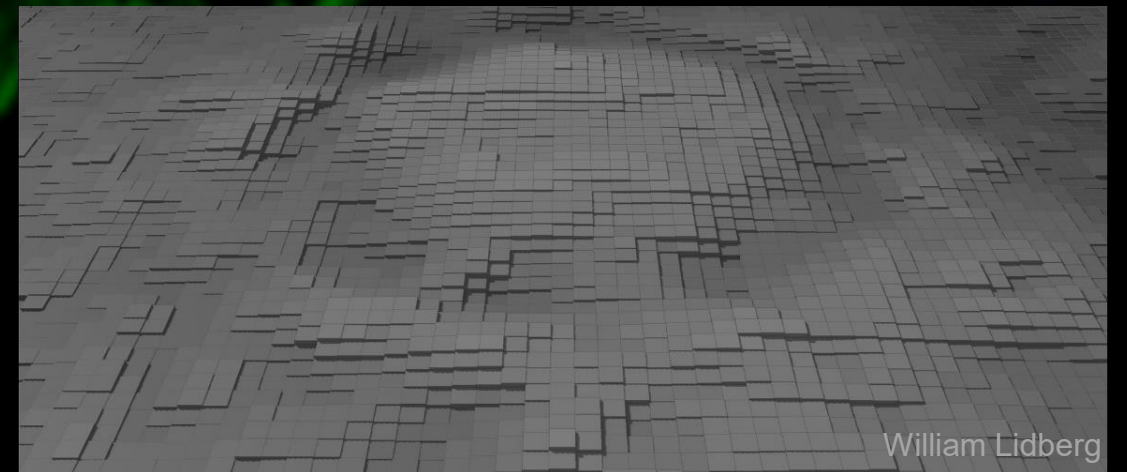
Wet areas



Channels



Soils



Cultural remains