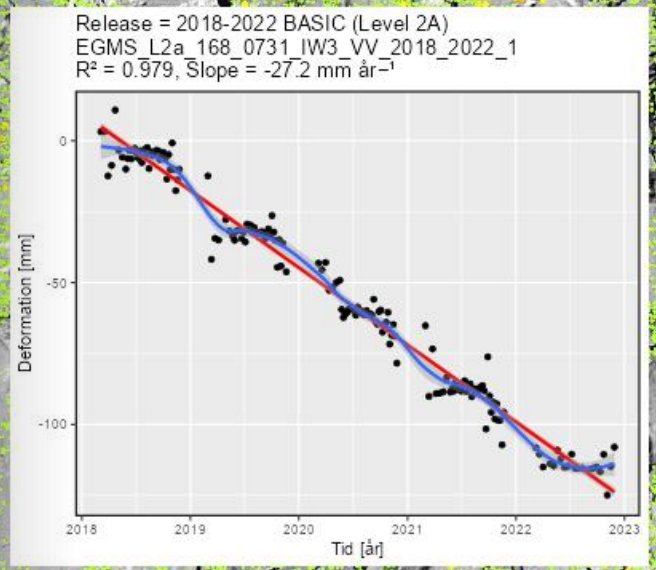
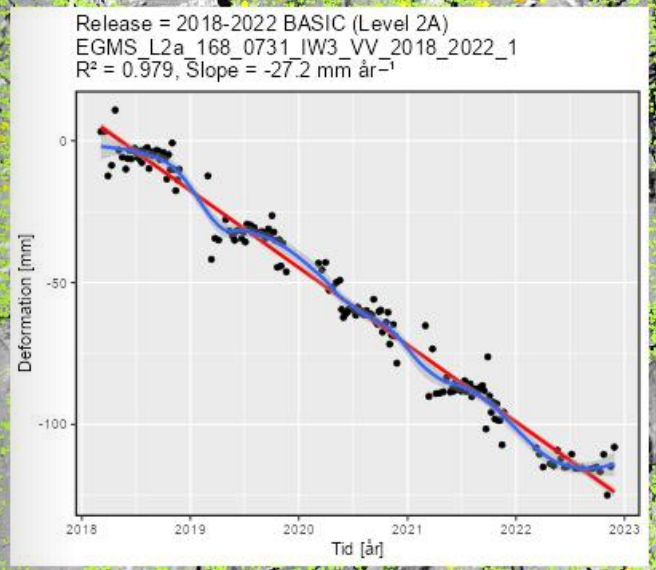
Unlocking the Power of InSAR: From EGMS and Beyond…



Godefroid Ndayikengurukiye, Mats Öberg,
Faramarz Nilfouroushan & Svetlana Serikova

STATENS GEOTEKNISKA INSTITUT
Norconsult
LANTMÄTERIET
UNIVERSITY OF GÄVLE

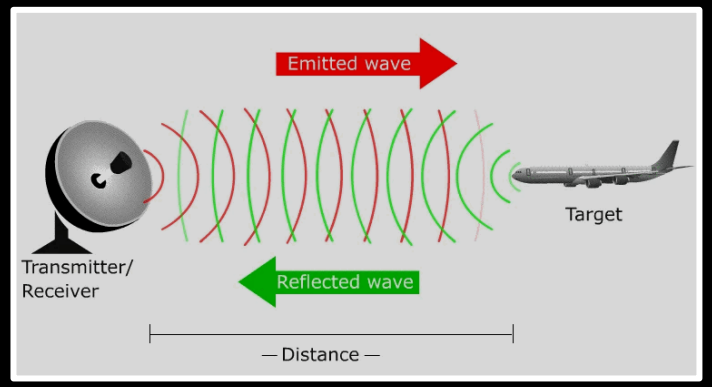
- Introduction & background
- What is EGMS ?
- The Swedish EGMS is under development
- The architecture of the national service
- Demo
- Practical exercise : Hands on R script
- Quiz



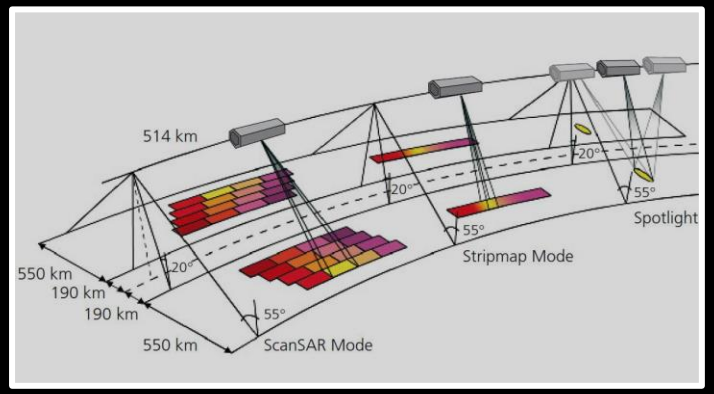
Why do SGI, National Land Survey & Norconsult work together ?

- SGI’s mission includes [...] preventing & minimizing the negative effects of landslides & coastal erosion [...]
- The government instructs SGI to work with other agencies
- The National Land Survey (hereafter Lantmäteriet), SGU, MSB, Trafikverket... are SGI’s collaborators
- SGI finds expertise from consulting firms like, among others, Norconsult Sverige AB
- For SGI monitoring ground stability & deformation is crucial
- InSAR has therefore become a collaboration framework in a form of a ”national EGMS-based” project

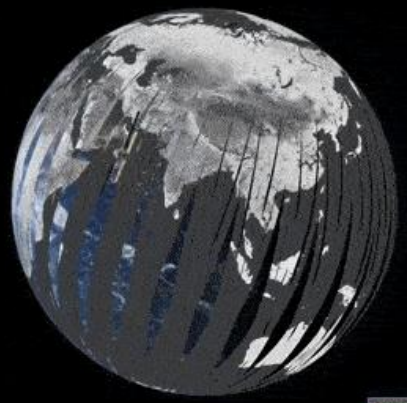
What is InSAR ?



Radar principles

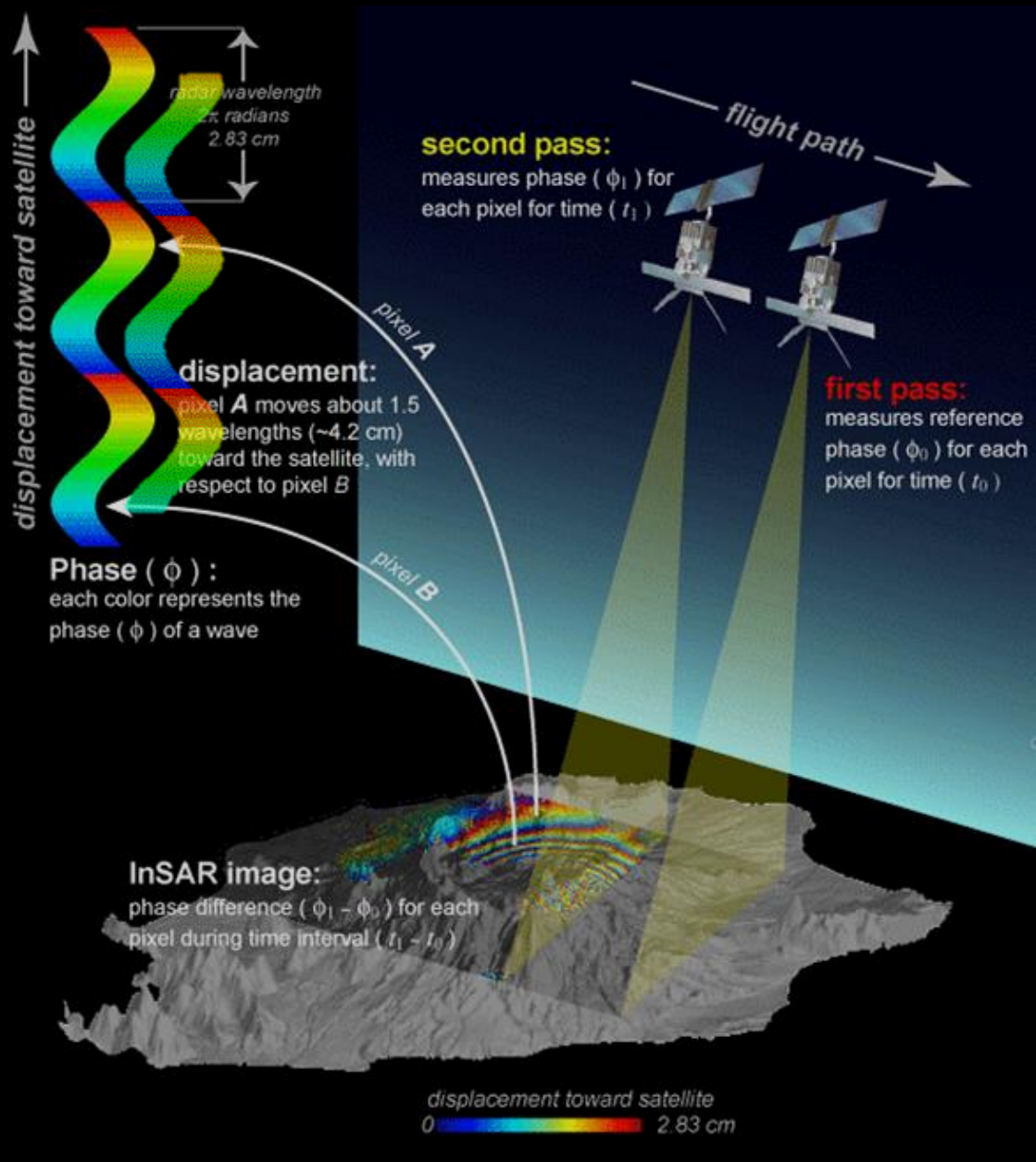


SAR principles

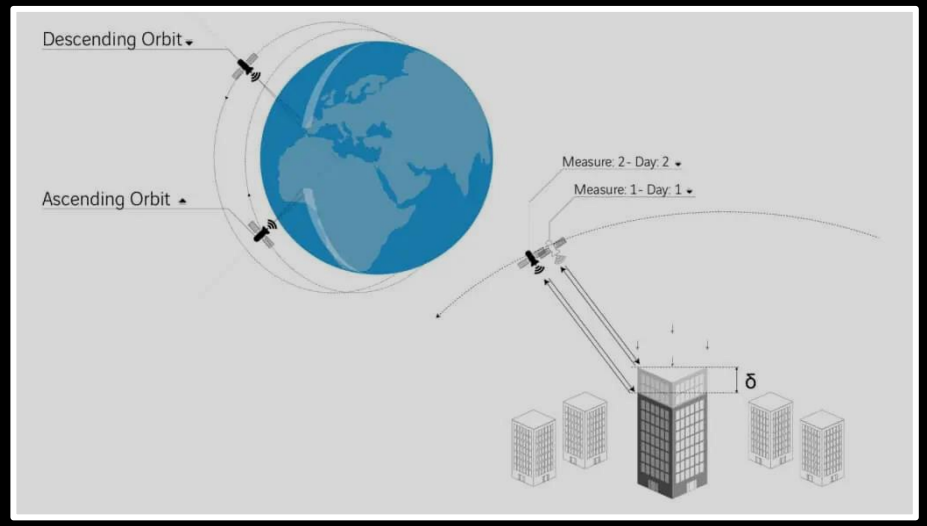


SAR system mounted
on 2 orbiting satellites

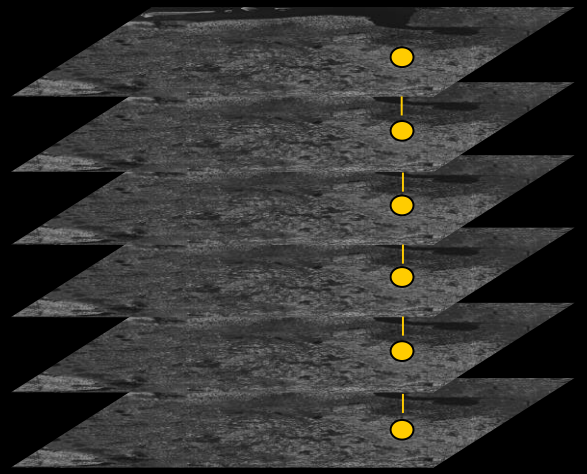
InSAR principles



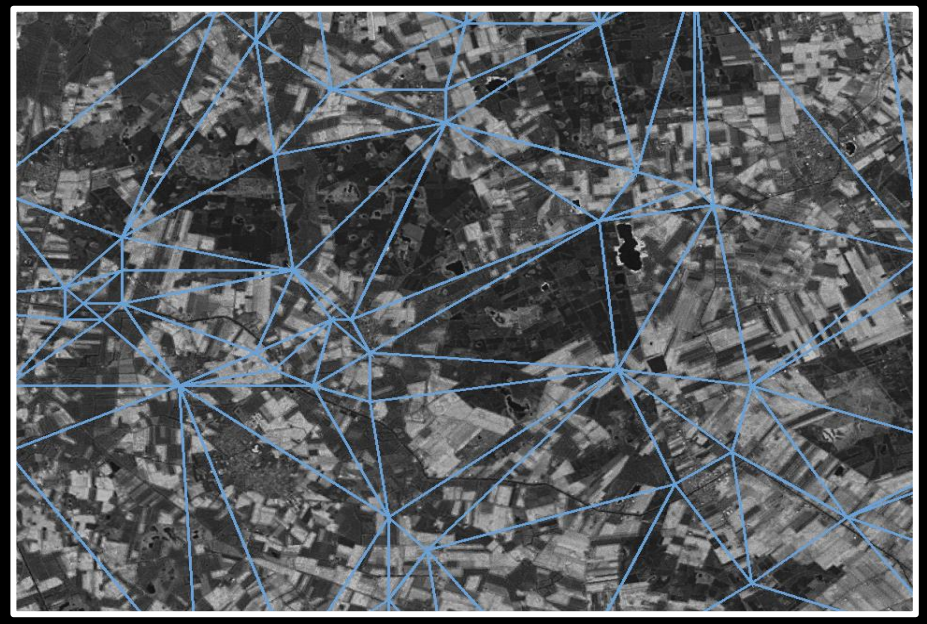
Copernicus, a treasure



With Sentinel-1 from the Copernicus Program,
2 data geometries are available :
ascending & descending



Huge amount of data are available over the same area, high acquisition frequency (Sentinel-1A, 6-12 days) making the time series analysis possible

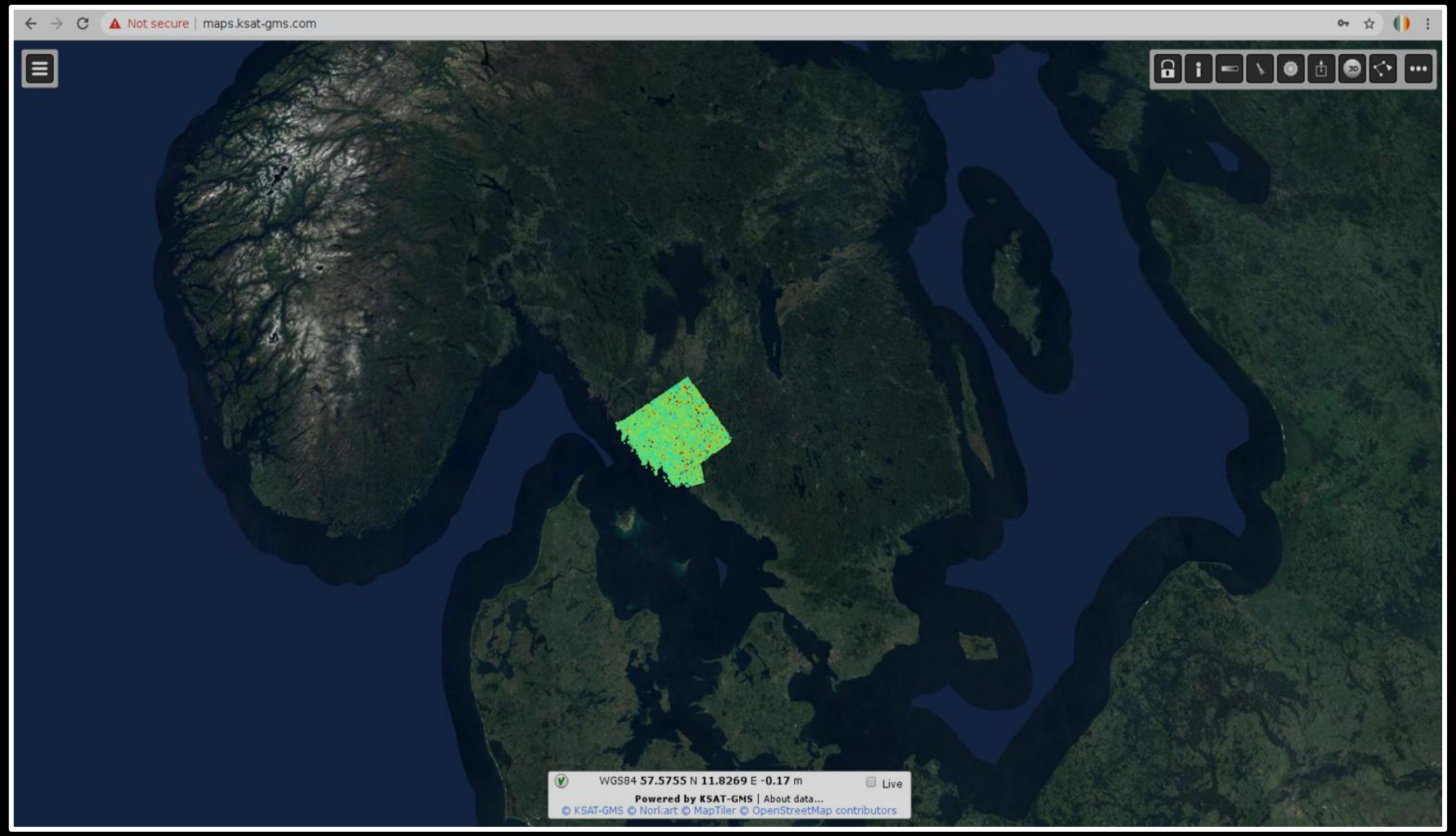


PSI (Persistent Scatterers Interferometry) uses stable radar targets that are distinguished in all images !

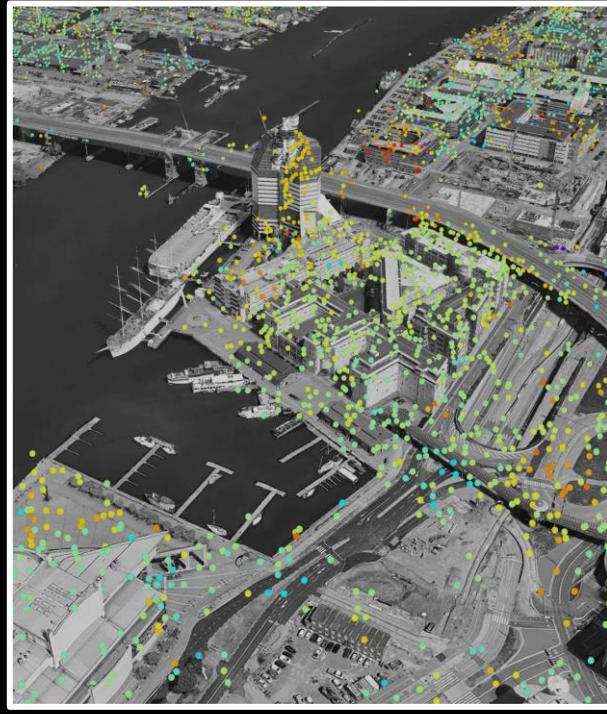
With some limitations:

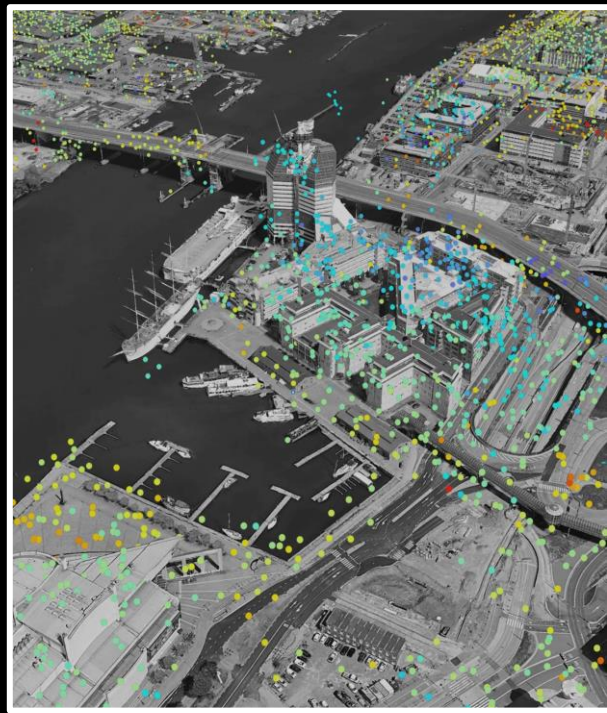
- Land cover limitations (i.e., vegetation, wetlands)
- Snow season

First test in Sweden : 2019



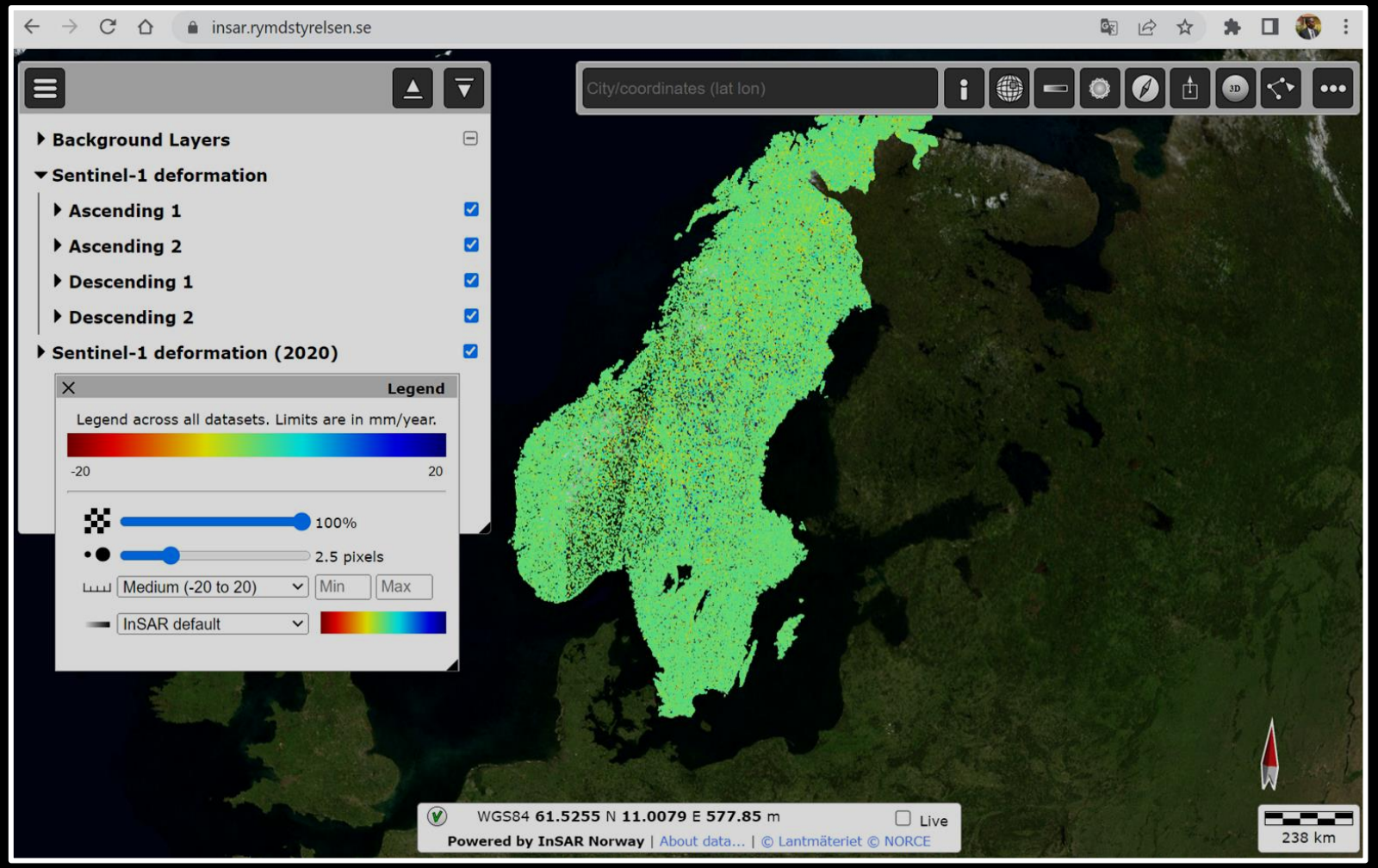
Test area in Gothenburg, SGI, NGU & PPO Labs





ASC & DES geometries
Lilla Blomen, Gothenburg,
SGI, NGU & PPO Labs

Promising research project in 2020-2022



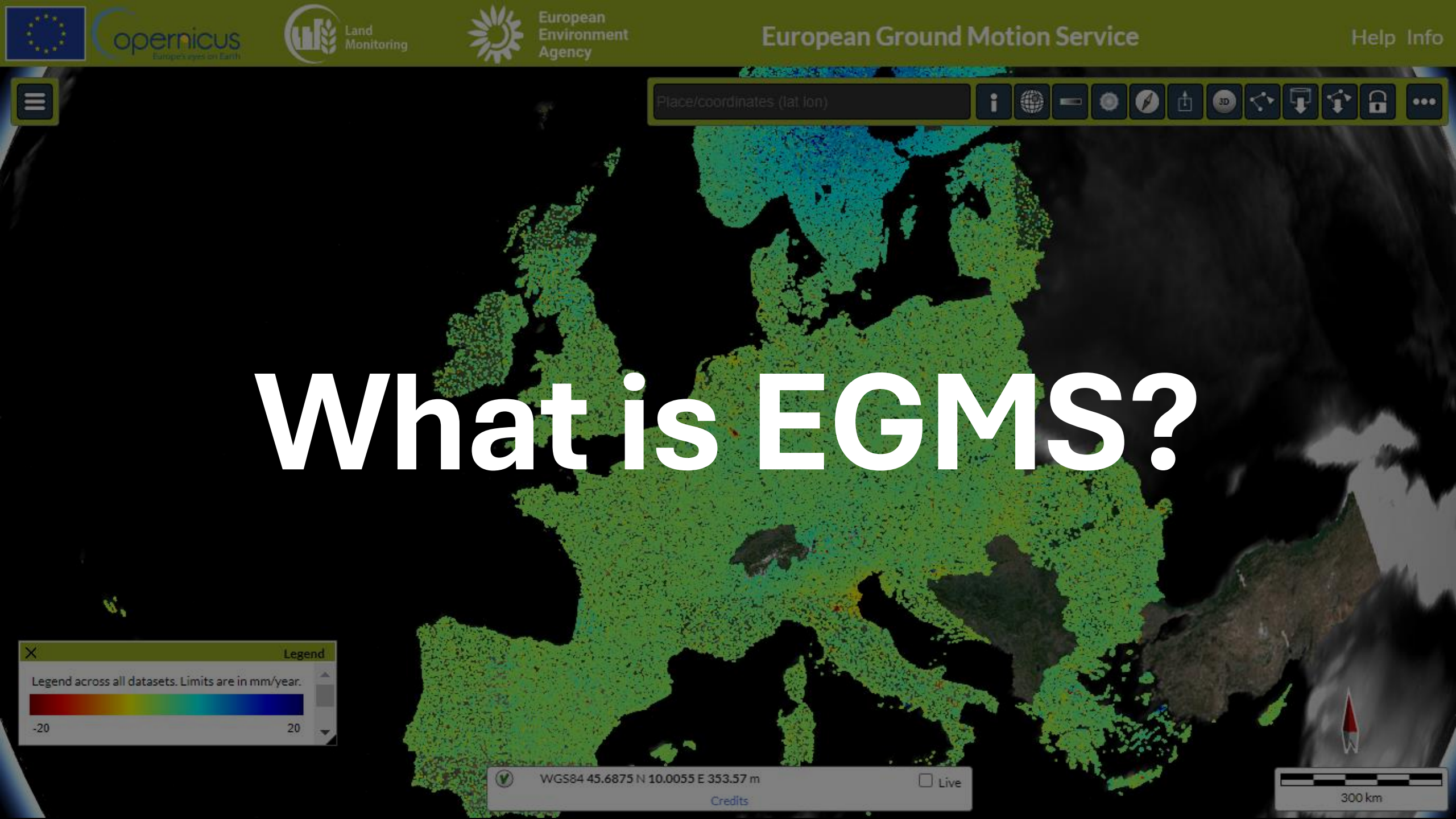
The Swedish National Space Administration's (Rymdstyrelsen) InSAR
(NGU, NORCE, NSA, NVE & PPO Labs)
https://insar.rymdstyrelsen.se

InSAR Norway
(NGU, NORCE, NSA, NVE & PPO Labs)
https://insar.ngu.no

Improvement needs & limitations:

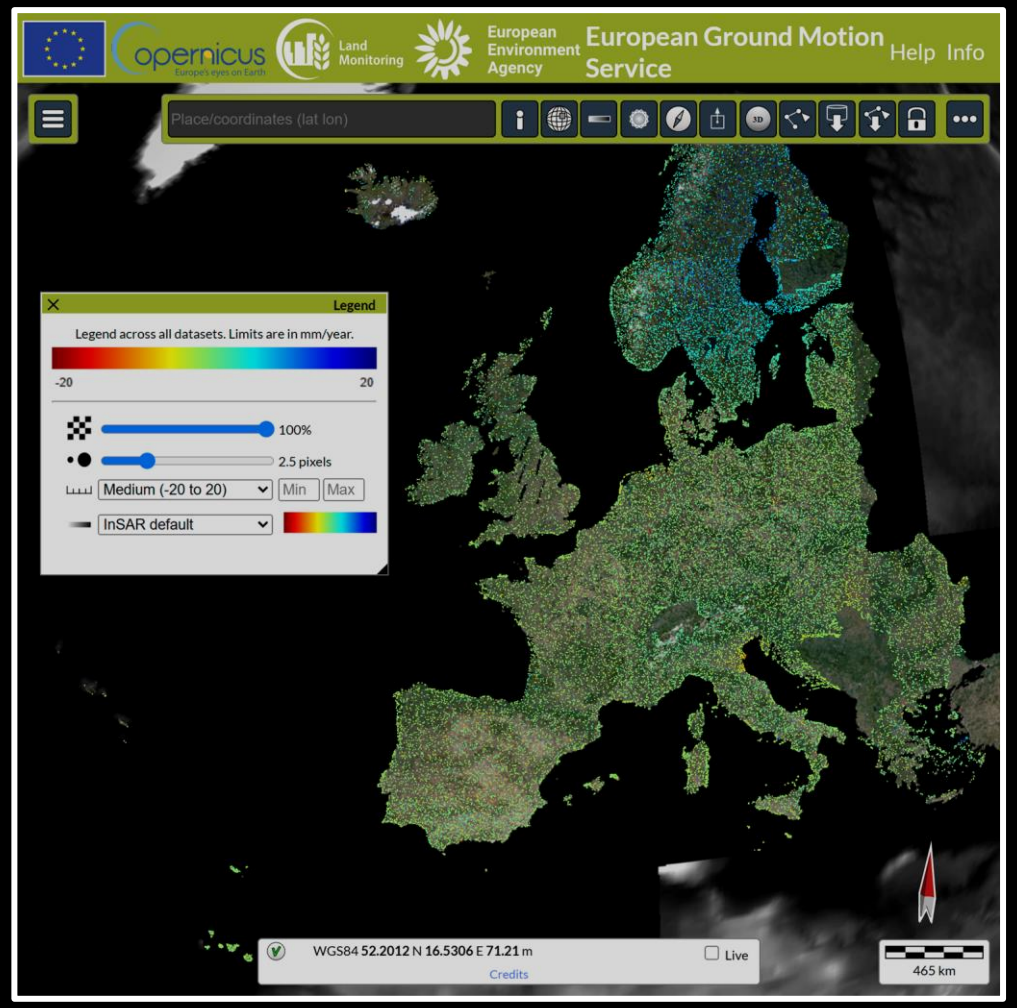
- Contract-bound & timely limited
- Search database for locations
- Background maps
- Custom functionalities
- Persistence of users' own maps…

>> have led to Swedish EGMS project


Copernicus
Land Monitoring
European Environment Agency
European Ground Motion Service
Help Info
Place/coordinates (lat lon)
What is EGMS?
Legend
Legend across all datasets. Limits are in mm/year.
-20
20
WGS84 45.6875 N 10.0055 E 353.57 m
Live
Credits
300 km

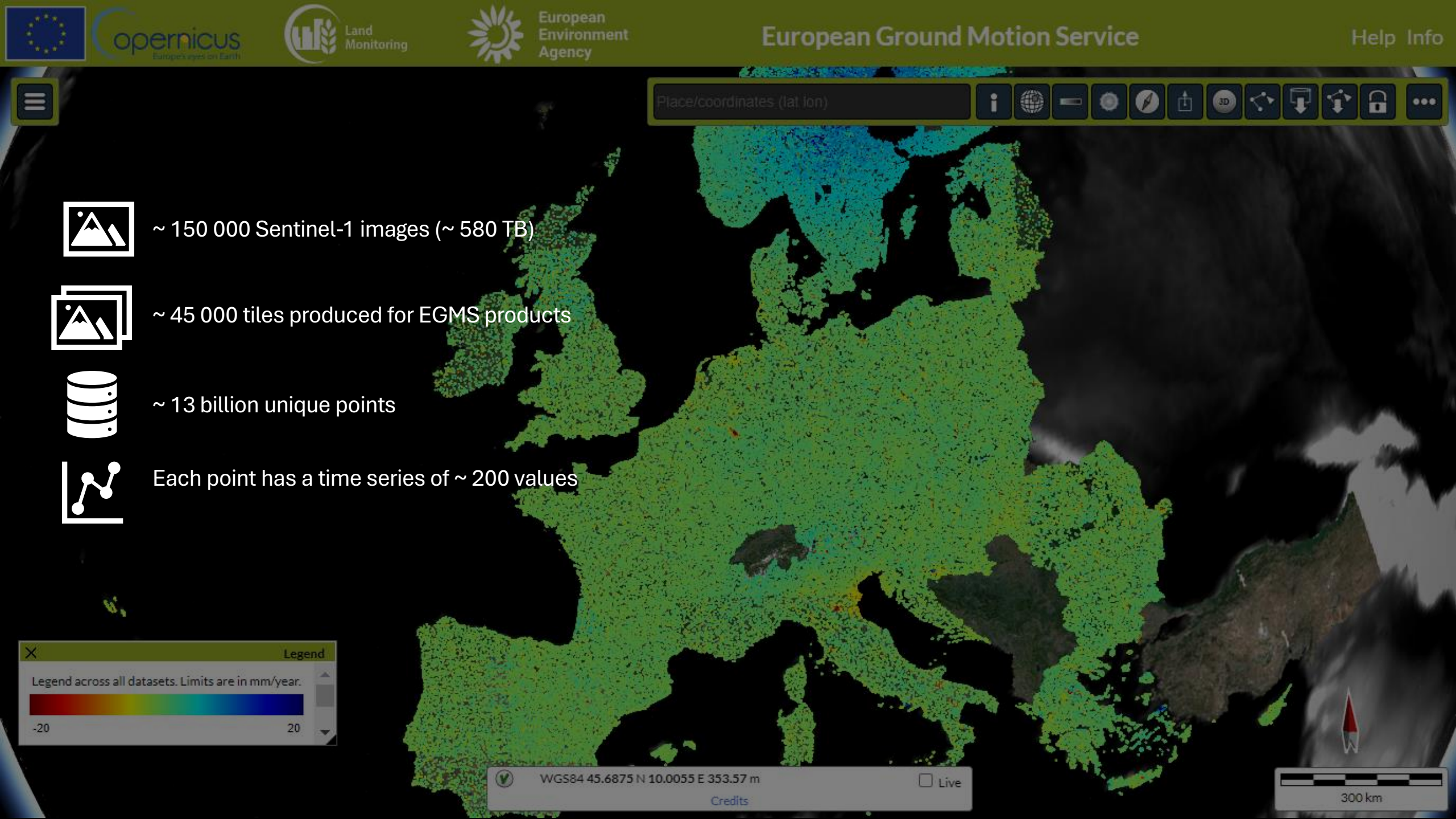
European Ground Motion Service (EGMS), based on InSAR

- WebGIS visualization of EGMS products offering opportunity to perform simple analysis
- An interface to search & download the products
- Annually updated (covering the latest 5-years period)
- An essential element of the Copernicus Land Monitoring Service (CLMS) portfolio
- Produced using data collected by the Sentinel-1 radar satellite mission
- Useful for many applications including Infrastructure monitoring : bridges, roads, railways, buildings…



[Source]

[EGMS]

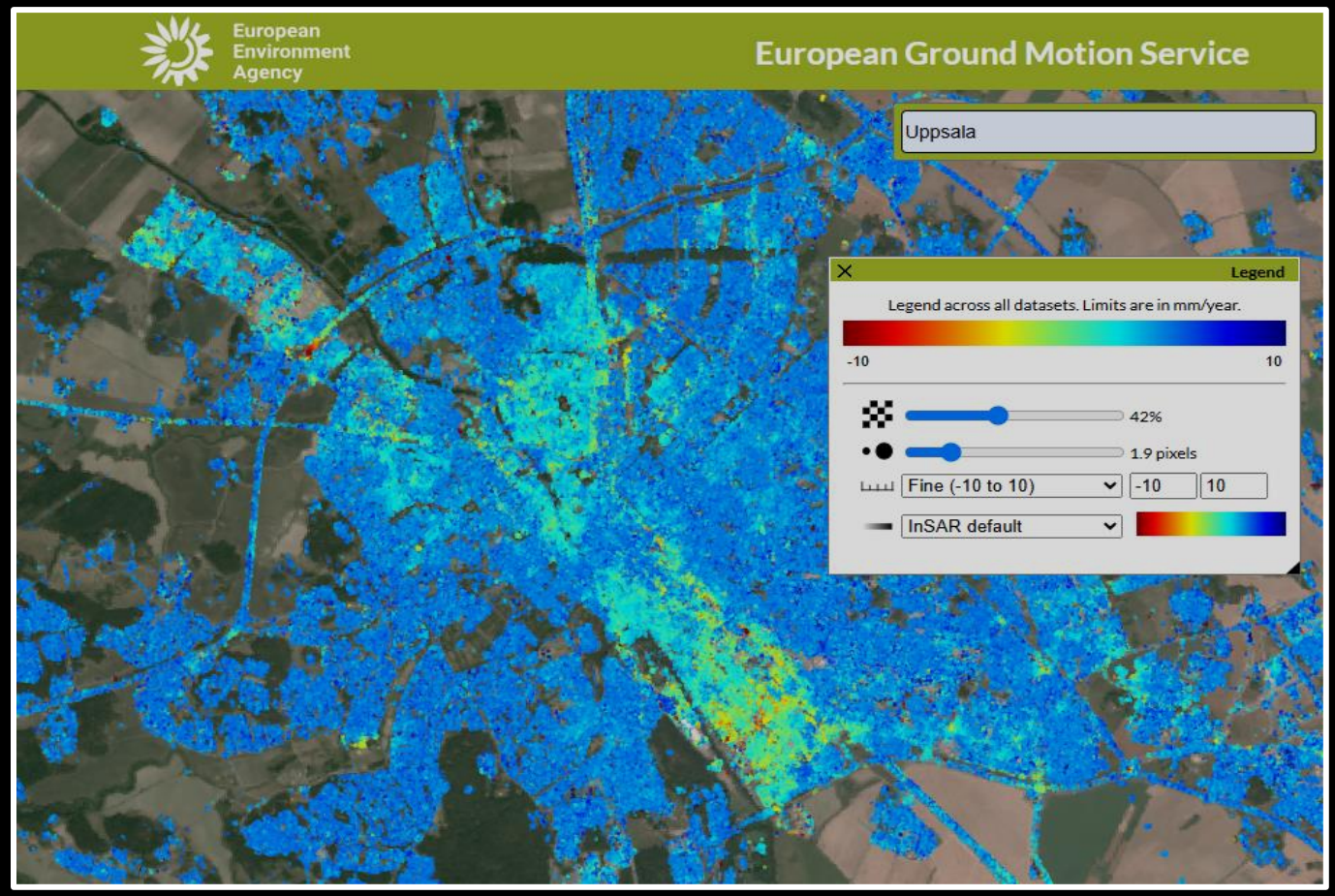

Copernicus
Land Monitoring
European Environment Agency
European Ground Motion Service
Help Info
Place/coordinates (lat lon)
~ 150 000 Sentinel-1 images (~ 580 TB)
~ 45 000 tiles produced for EGMS products
~ 13 billion unique points
Each point has a time series of ~ 200 values
Legend
Legend across all datasets. Limits are in mm/year.
-20
20
WGS84 45.6875 N 10.0055 E 353.57 m
Live
Credits
300 km

European Ground Motion Service (EGMS), based on InSAR

Ground deformation due to many processing & factors including:

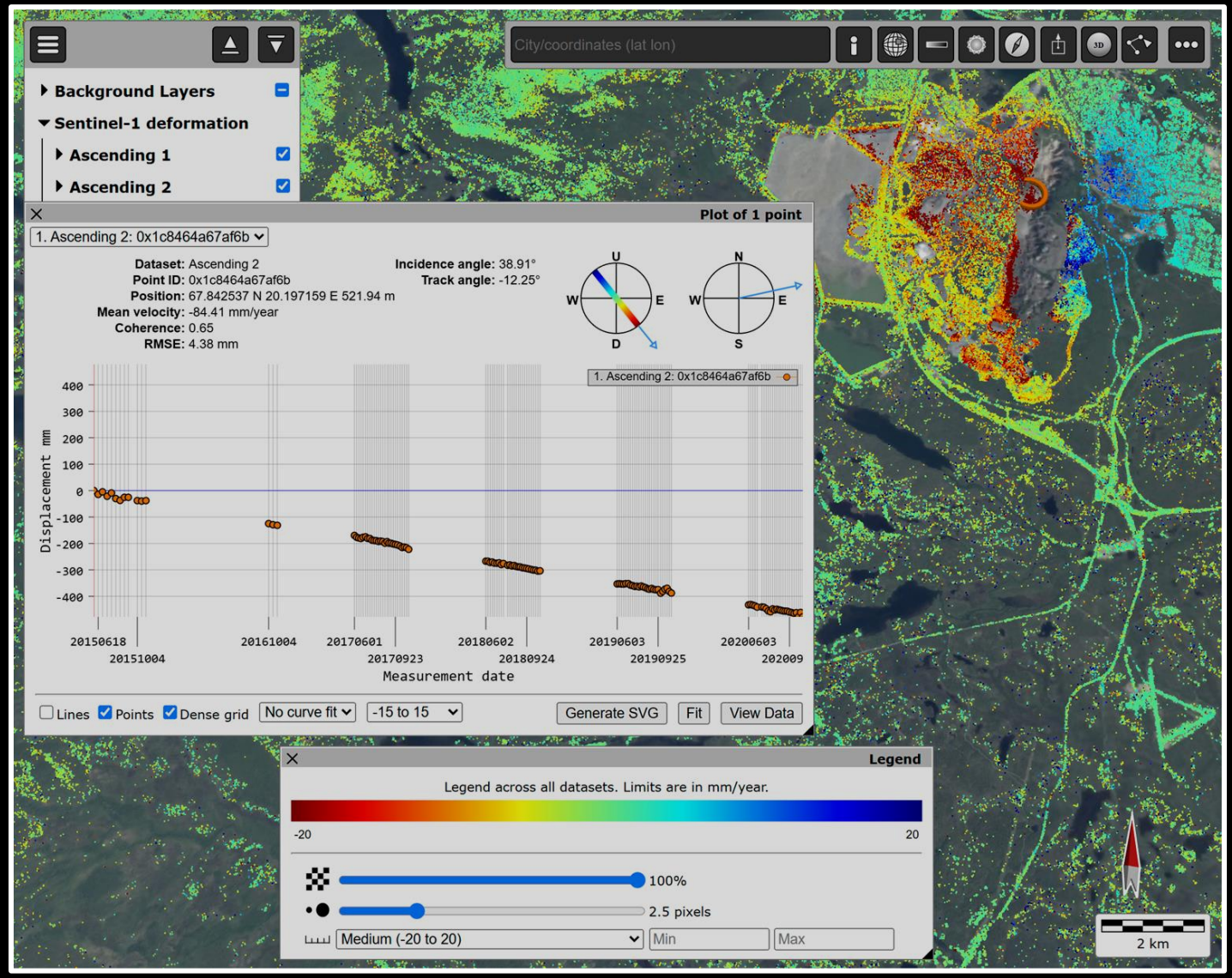
- mining effects
- subsidence & uplift
- landslides
- coastal processes
- tectonics…

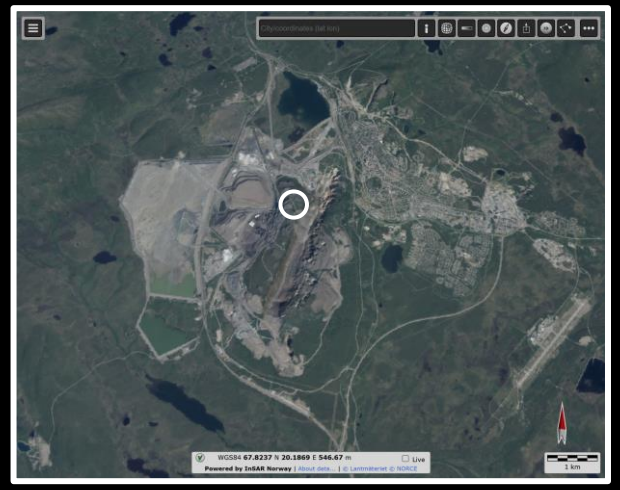
However, not the elements, that change or move quickly over time !



Clay-induced subsidence in Uppsala

Ongoing ground deformation in Kiruna





[Hyperlink]

E6 Landslide (September 23, 2023)

InSAR-based products can serve as precursors, allowing to prepare before the event happens !

>> saves $ £ € SEK and lives!

E6 vid Stenungsund är avstängd i båda riktningarna efter att ett stort slukhål har skurit av vägen. Mikael Berglund/TT

[Hyperlink]

Radio Sweden All broadcasts Contact News archive

The E6 is an important link to Sweden's west and Norway, says Infrastructure Minister Andreas Carlsson. Credit: Hanna Brunlöf Windell/TT

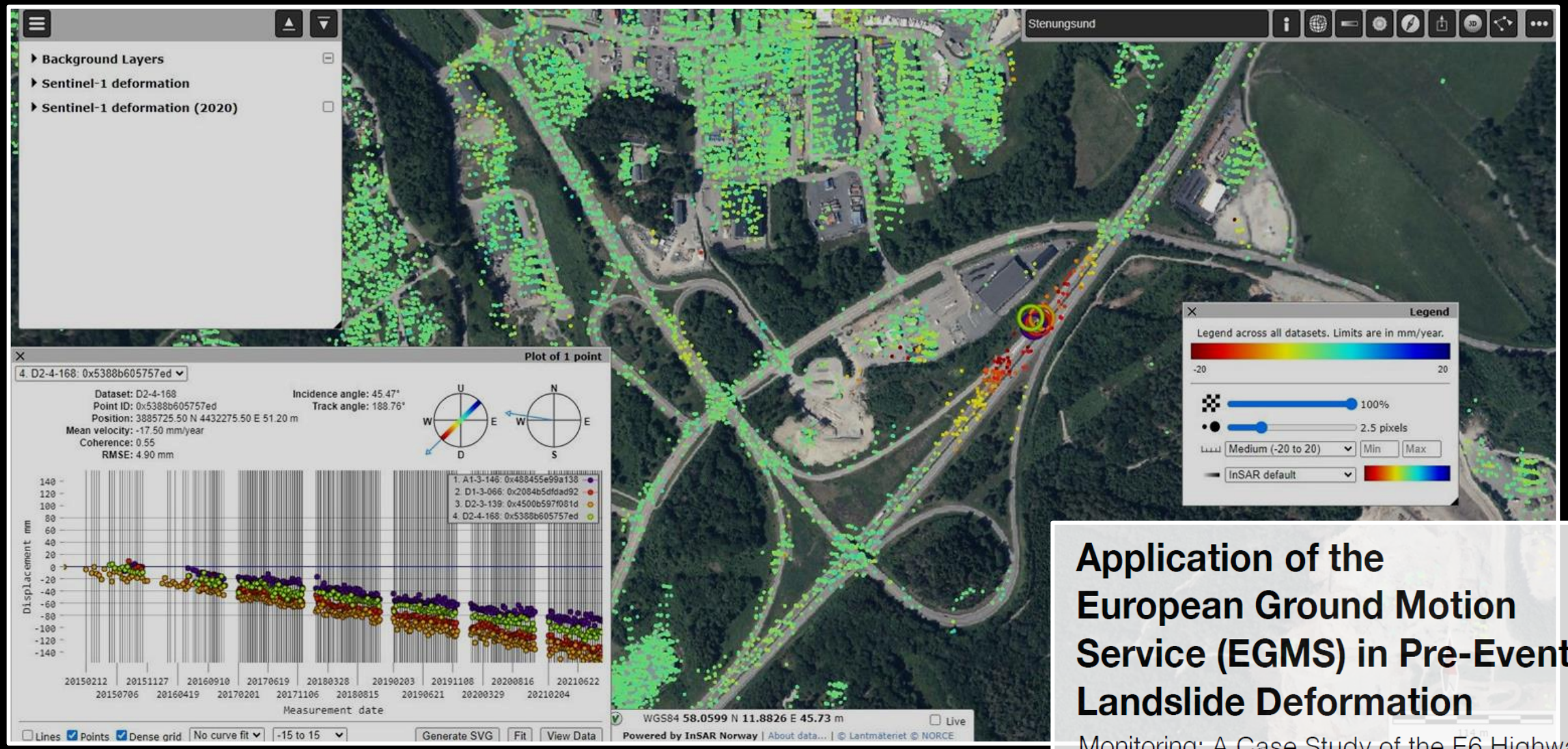
INFRASTRUCTURE

Government to spend an extra SEK 1 billion repairing the E6 motorway

0:58 min My playlist Share

Published fredag 5 april kl 12.08

Risk zone at E6 highway, highlighted by InSAR !



Application of the European Ground Motion Service (EGMS) in Pre-Event Landslide Deformation

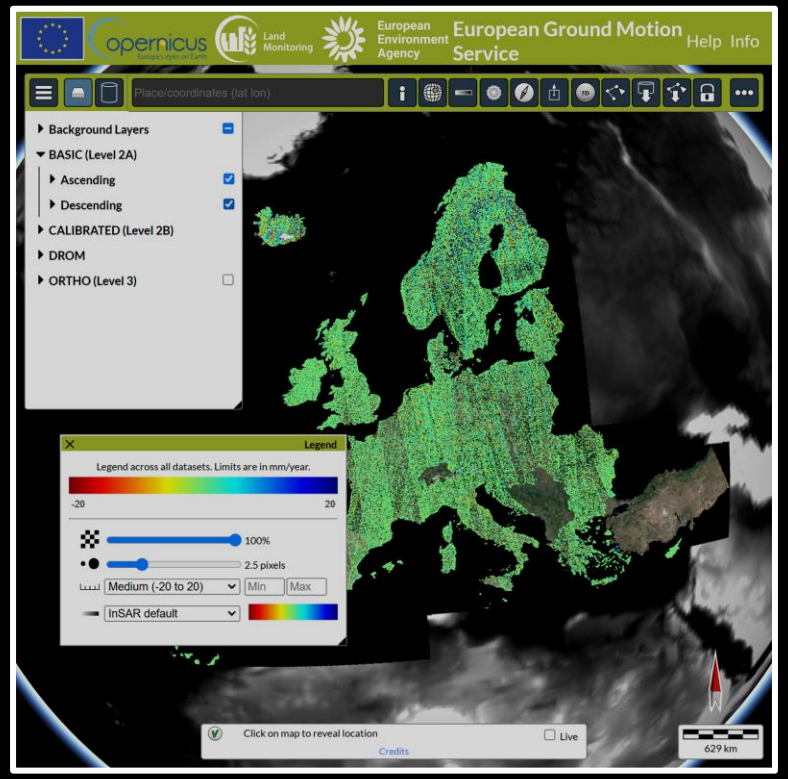
Monitoring: A Case Study of the E6 Highway at Stenungsund, Sweden

WRITTEN BY: Faramarz Nilfouroushan[1,2], Zahra Dabiri[3] and Mehdi Darvishi[4]

[Hyperlink]

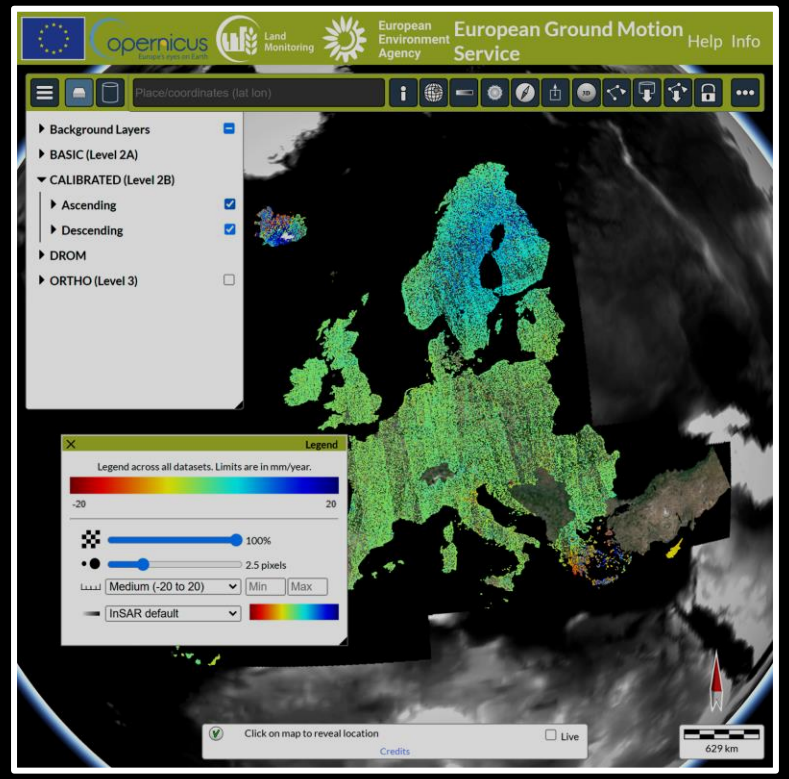
[Source]

EGMS products



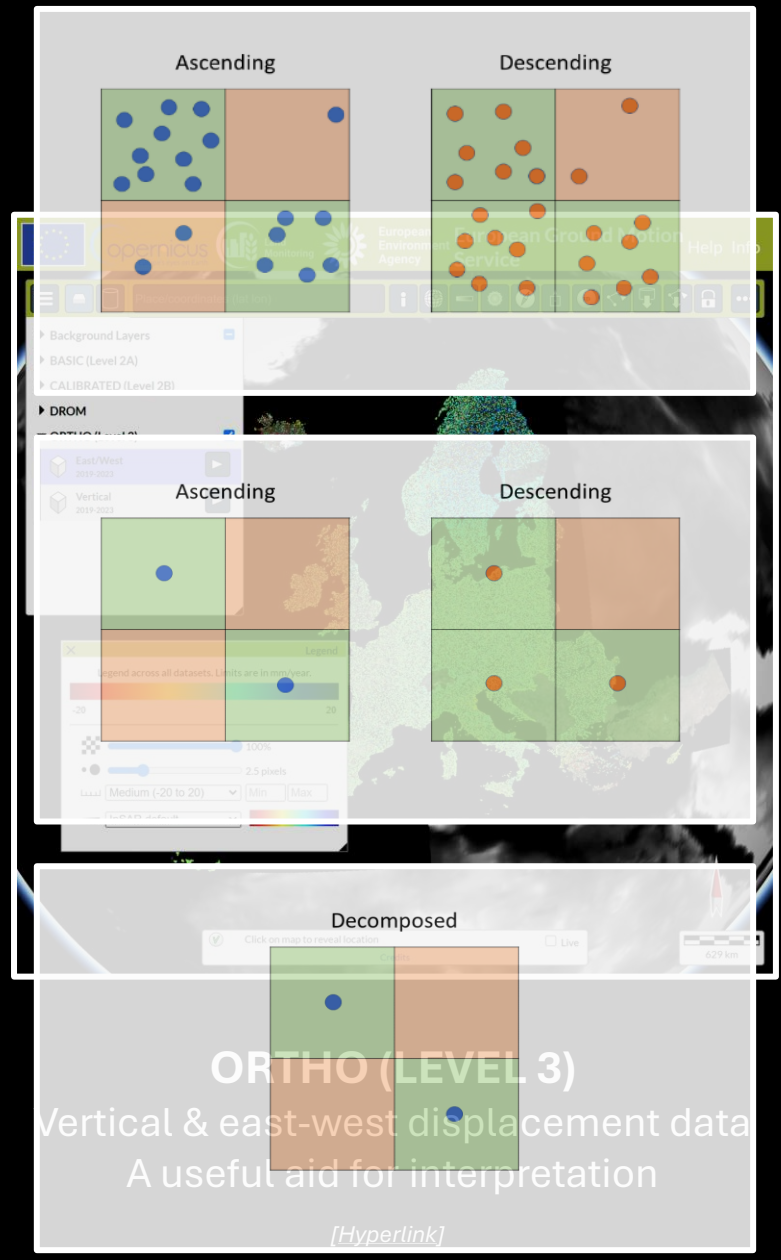
BASIC (LEVEL 2A)
Displacement data along LOS
Relative measurements

[Hyperlink]



CALIBRATED (LEVEL 2B)
Displacement data along LOS
Anchored to a GNSS reference frame

[Hyperlink]



ORTHO (LEVEL 3)
Vertical & east-west displacement data
A useful aid for interpretation

[Hyperlink]

LOS – Line of Sight

EGMS limitations

- Discontinuous coverage: technique relies on pre-existing ground-features that reflect radar signal

  >> might not be measurements where one wants them to be !

- Measurement point positioning: meter-scale uncertainty on point precise location
  >> due to radar geometry

- Spatial resolution: each measurement point is captured at a 20 x 5 m ground cell

- Motion orientation: EGMS does not provide measurements in north-south orientation
  >> due to the geometry of satellite acquisitions

- Delay in product: due to massive processing workload
  >> a delay of ~ 8-20 months between the date of the last and present processed SAR image

- Gaps in time series for some locations because of winter season

[Source]

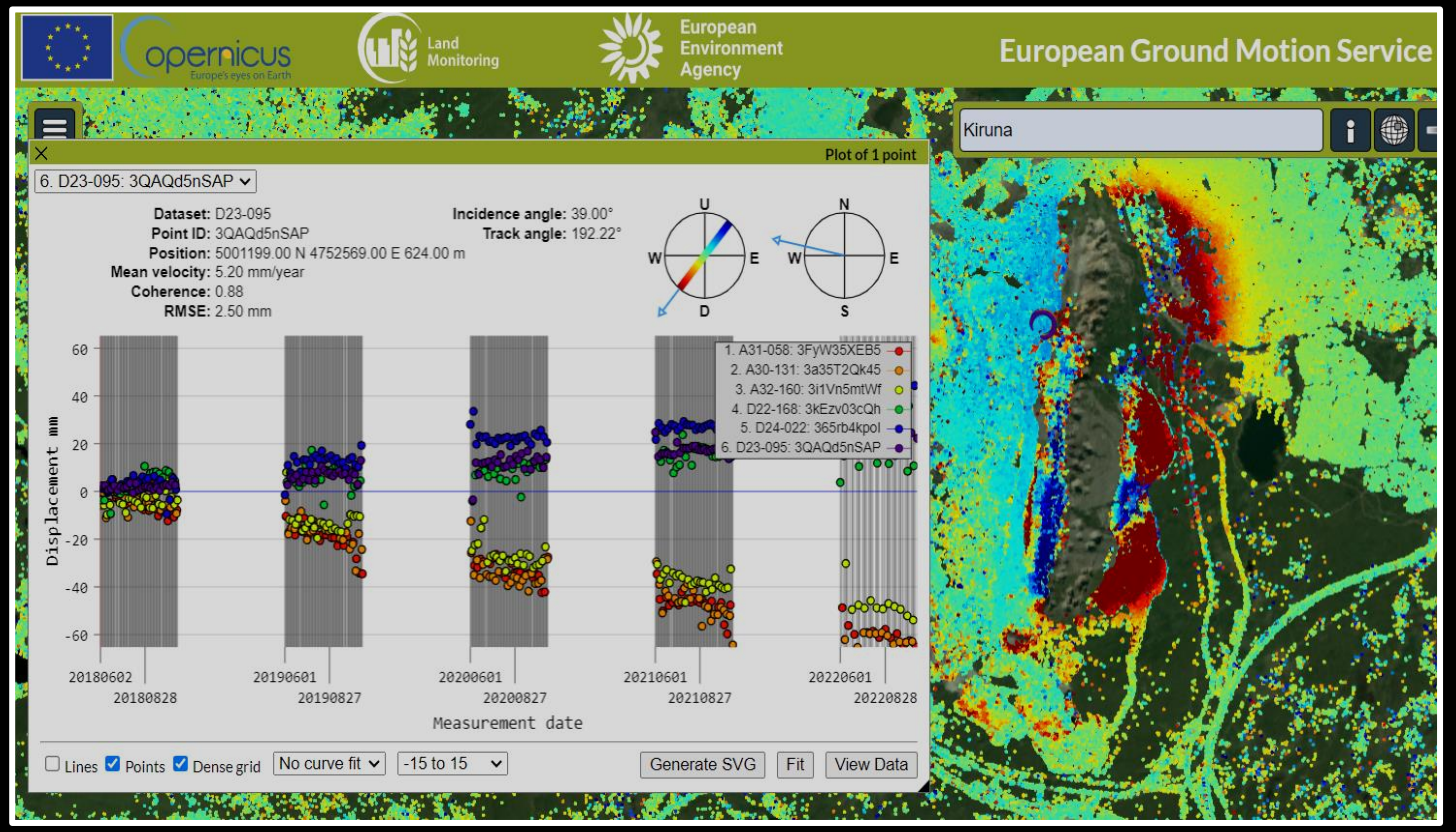
EGMS data need to be interpreted!

1. What is happening here ?
2. What is the value of velocity saying to me ?
3. Why is one slope blue and the other one is orange ?
4. …

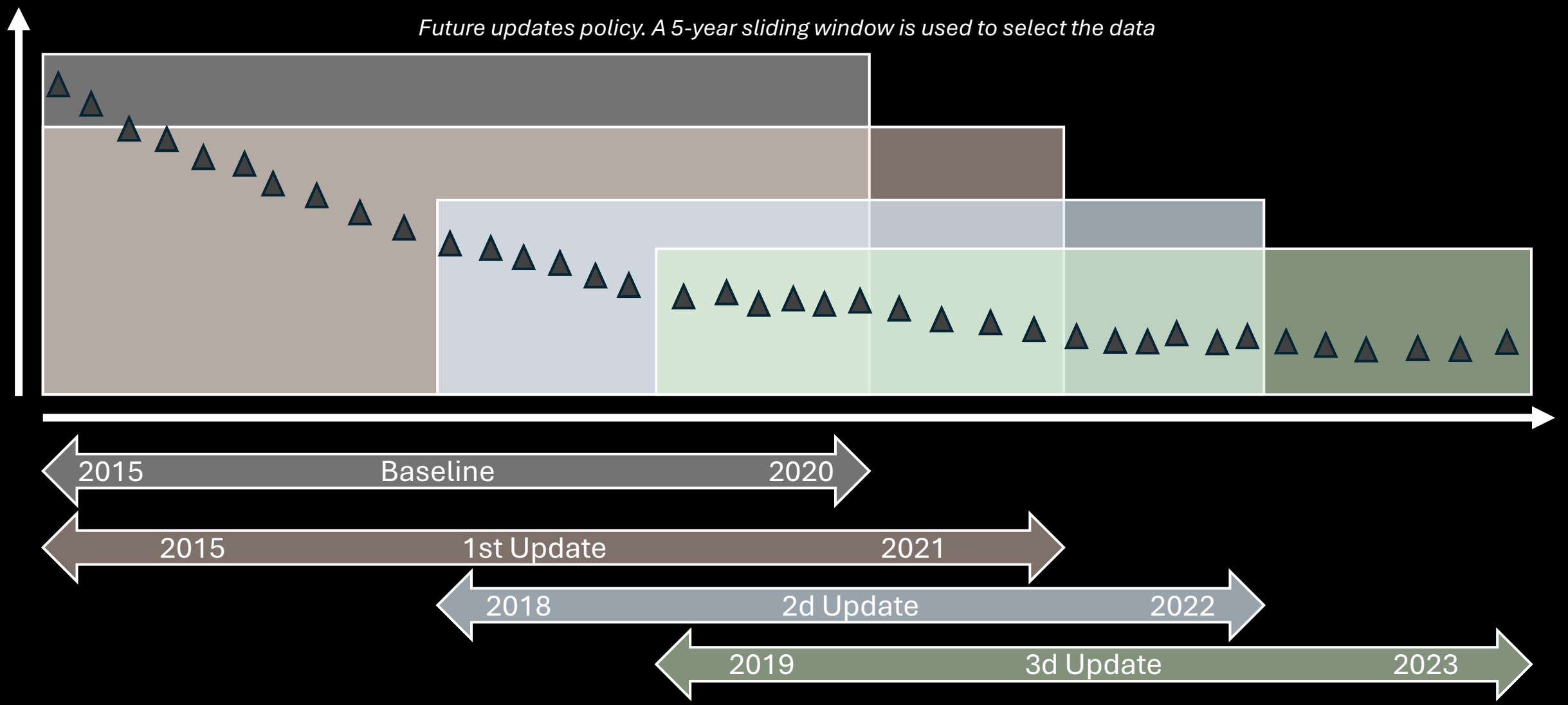
Note: Ascending and Descending LOS rates

>> not always the same trend!

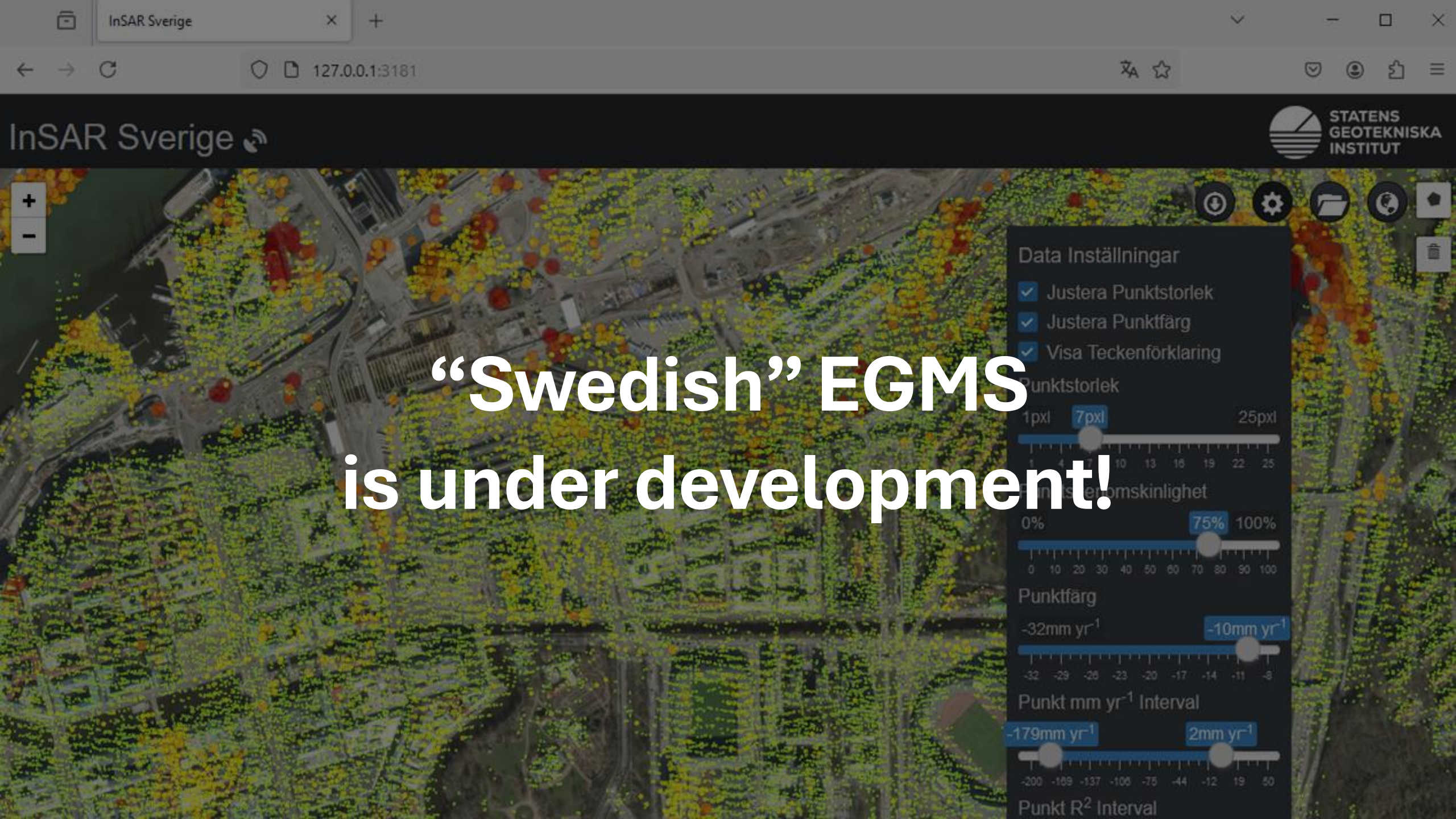
Different results for Kiruna mine, different colors, different movements, EW motions + vertical !



EGMS updates: 5-year sliding window with overlaps



Displacements can have different trends in different periods !
Linear or non-linear movements !?


InSAR Sverige
127.0.0.1:3181
InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Data Inställningar
Justera Punktstorlek
Justera Punktfärg
Visa Teckenförklaring
Punktstorlek
1pxl
7pxl
25pxl
Punktgenomskinlighet
0%
75%
100%
Punktfärg
-32mm yr-1
-10mm yr-1
Punkt mm yr-1 Interval
-179mm yr-1
2mm yr-1
Punkt R2 Interval
“Swedish” EGMS
is under development!

Swedish ground motion service based on EGMS (InSAR)

- **2024**

April: SGI **procurement** (”upphandling”) of InSAR Sweden, covering entire Sweden with EGMS release 2015-2021 (first release from Sentinel1) and release 2018-2021

>> Contract won by **Norconsult Sverige AB**

December: First **prototype** in-house SGI

>> demo later by Norconsult Sverige AB

Capabilities:
- Background maps (WMS) ”free of choice” such as Lantmäteriet (National Land Survey) orthophoto 0.16m, LM topowebb, SGU soil map, LM GNSS corner reflectors, etc.
- Additional functionality compared to EGMS

Financing: **Trafikverket** (Swedish Transport Administration), **MNKA/SMHI** (Government Network for Climate Adaptation) & **SGI**

STATENS GEOTEKNISKA INSTITUT

SMHI

TRAFIKVERKET

Swedish ground motion service based on EGMS (InSAR)

- **2025**

February: Brief presentation at EUSPA workshop – European Union Agency for the Space Program

Q3 Aim: **Multi-user optimized public website**

Autumn:

1. Analysis, screening/identification of areas with stability issues. Possibly AI & ML.
2. Release 2019-2023 loaded.

Reference group:
- Trafikverket (Swedish Transport Administration)
- Lantmäteriet (Swedish mapping, cadastral and land registration authority)
- SGU (Swedish Geological Survey)
- Göteborg stad (City of Gothenburg, land management department)

Financing: SGI + **Rymdstyrelsen** (Swedish National Space Agency)

Future 2025 and onwards

>> operation and management by **SGI**

STATENS GEOTEKNISKA INSTITUT

Rymdstyrelsen
Swedish National Space Agency

Swedish EGMS: architecture

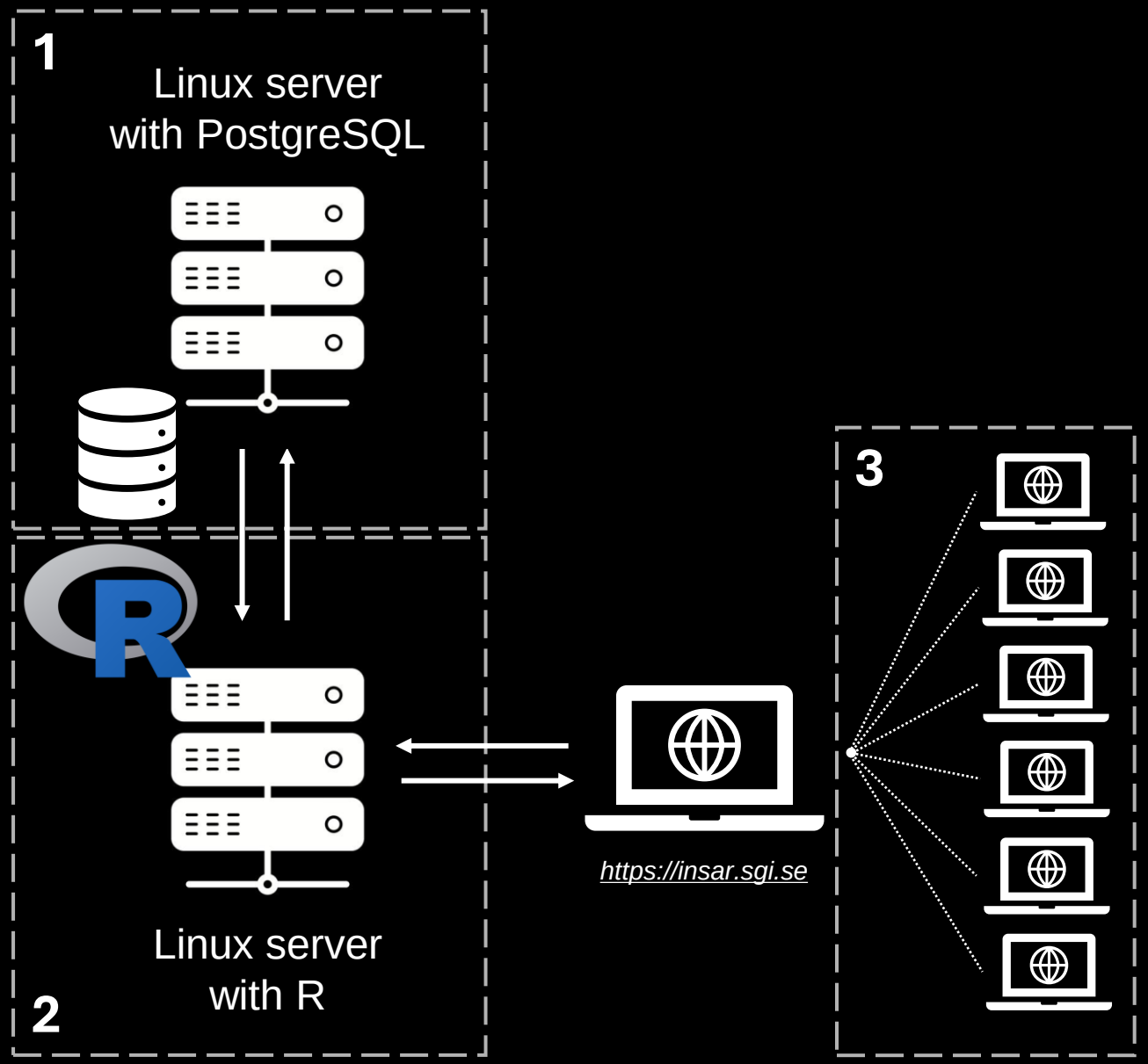
2 Linux servers:

>> Backend – PostgreSQL database

>> Frontend – Shiny R application

3 main steps:

1. Database setup & data migration
2. Development of frontend
3. Application scaling



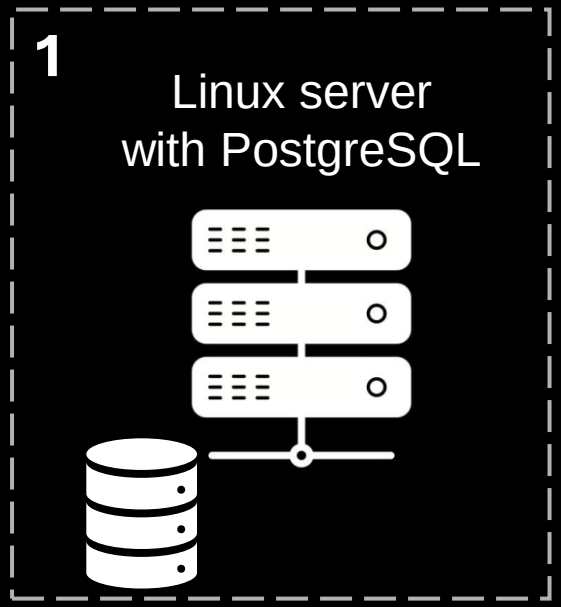
Database setup & data migration

Large dataset

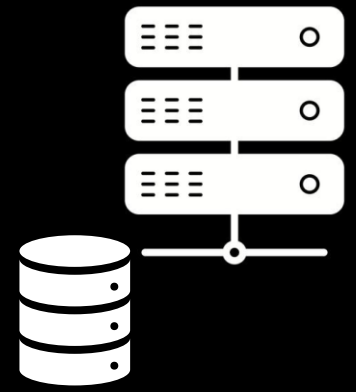
>> compressed size on disk ~ 800 GB

Requires:

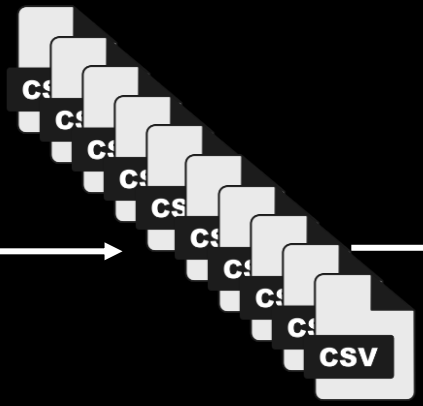
- Structured database schema
- Seamless multi-step data download process
- Efficient data migration



Linux server
with PostgreSQL



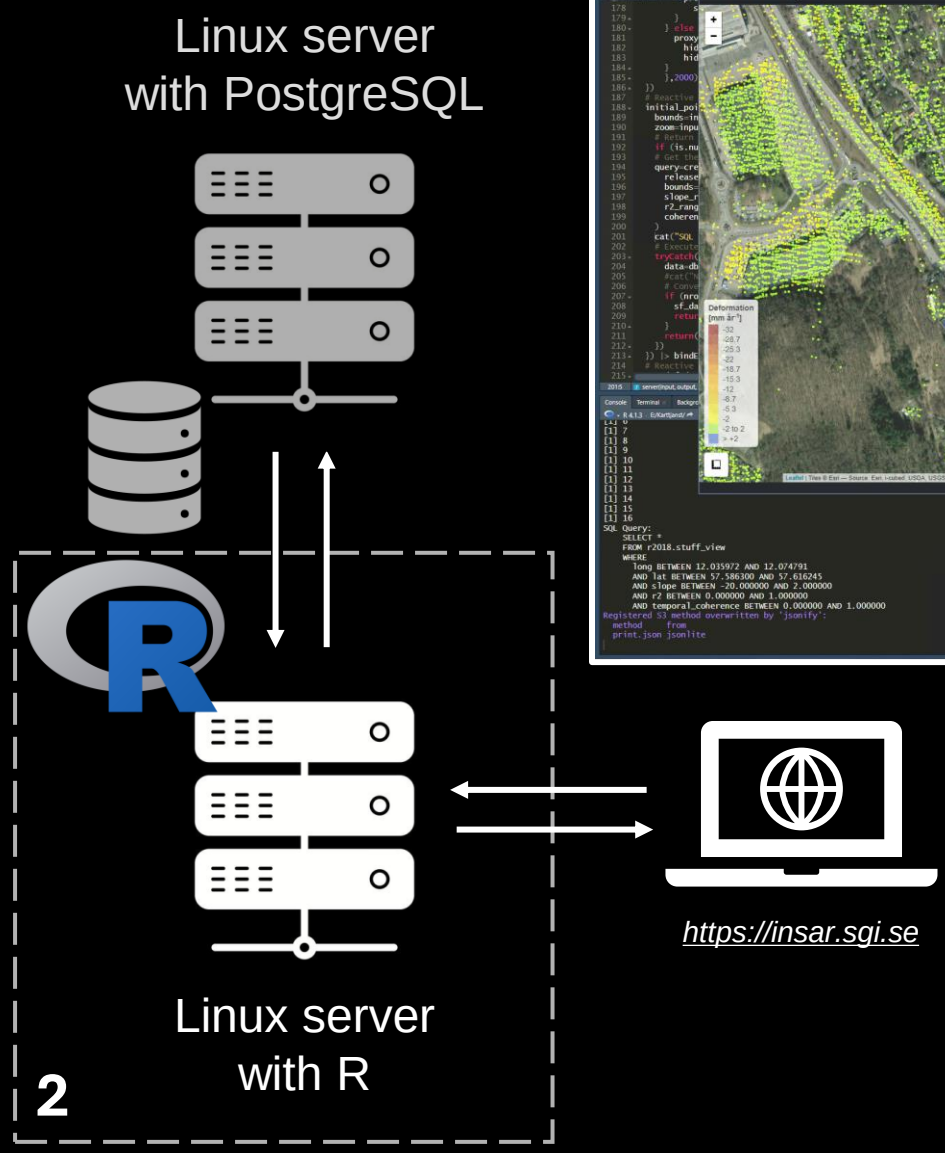
EGMS data → FME script → CSV → FME script

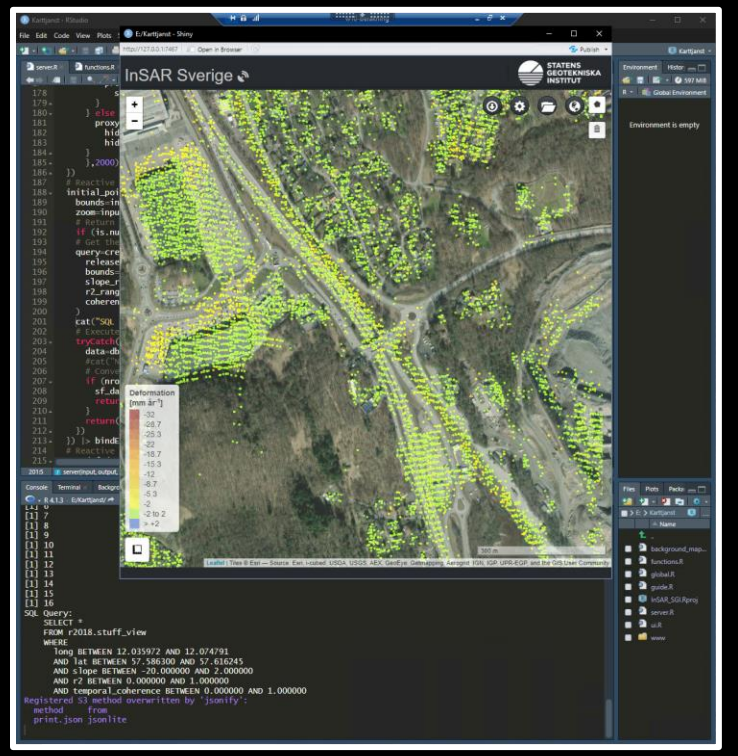


Development of frontend

Shiny R application
>> server.R
>> ui.R
...

- Extended functionality
  >> filtering, point graphics, trends
- “On-the-fly” data analysis
  >> interactivity
- Background layers
  >> integration of additional layers...





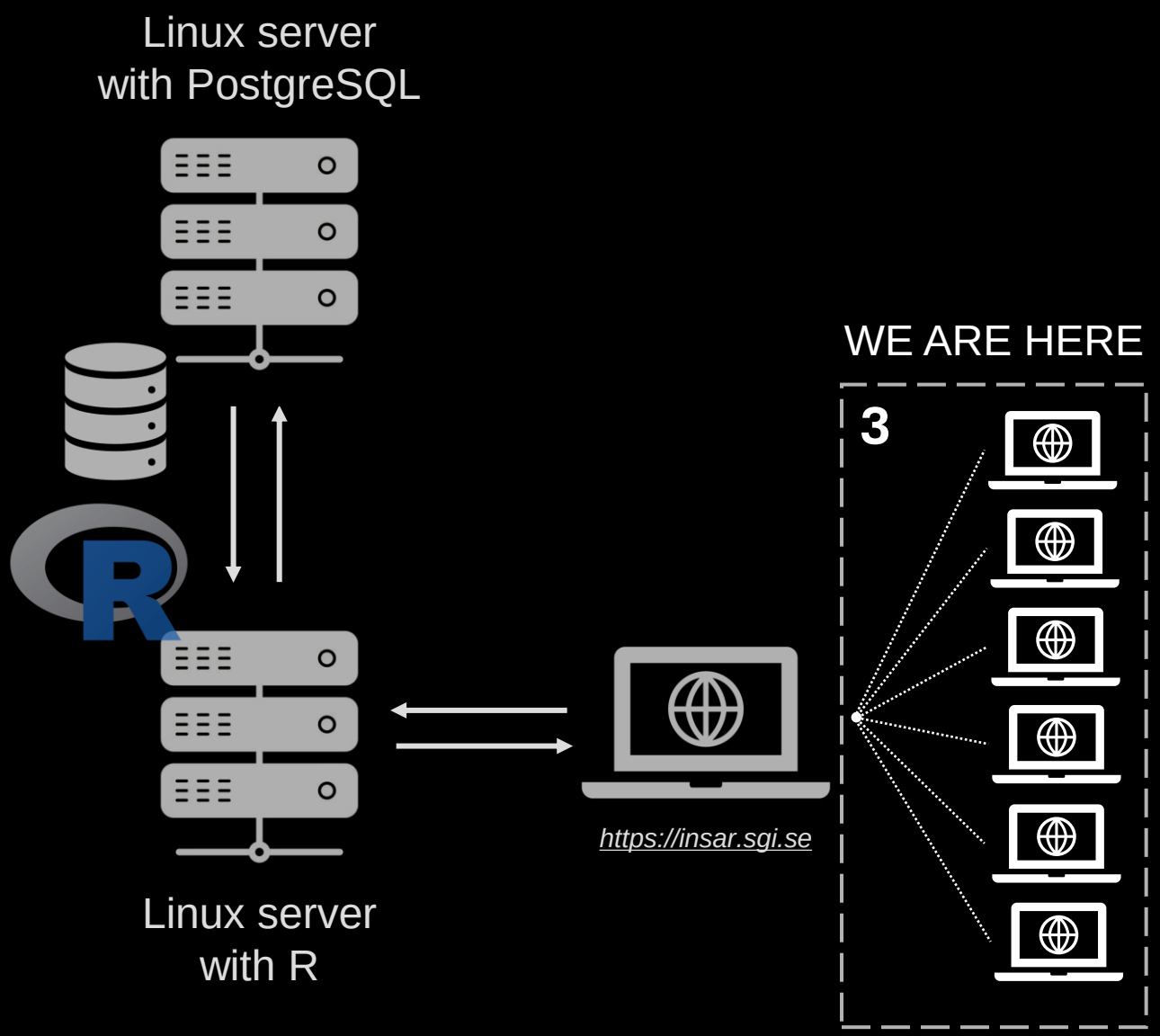
Application scaling

Shiny R is single-threaded

>> scaling for multiple users is needed
>> load balancing
>> optimization

Work in progress

>> different strategies are being evaluated to select the best approach

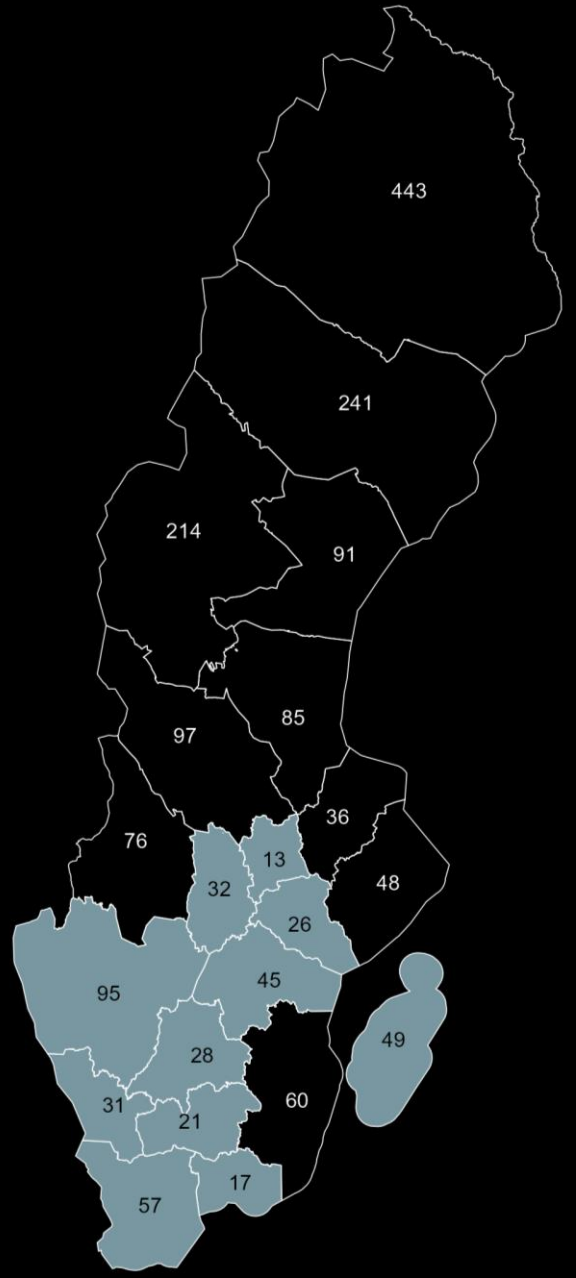


Status

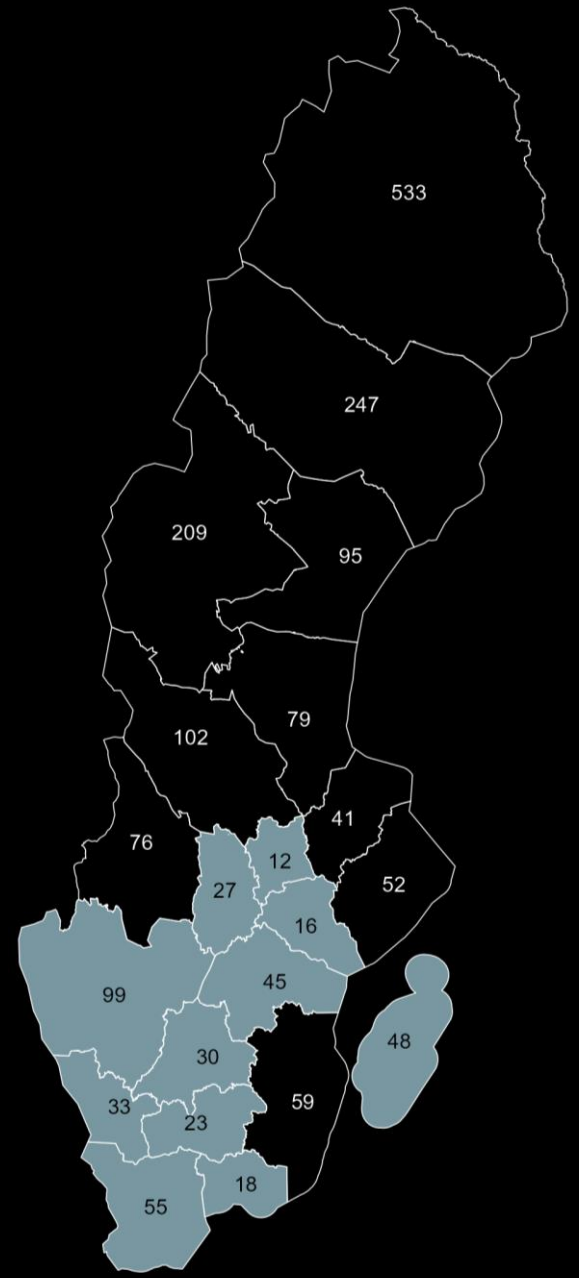
11 counties have been written to the database

>> 10 counties left

Release 2015-2021



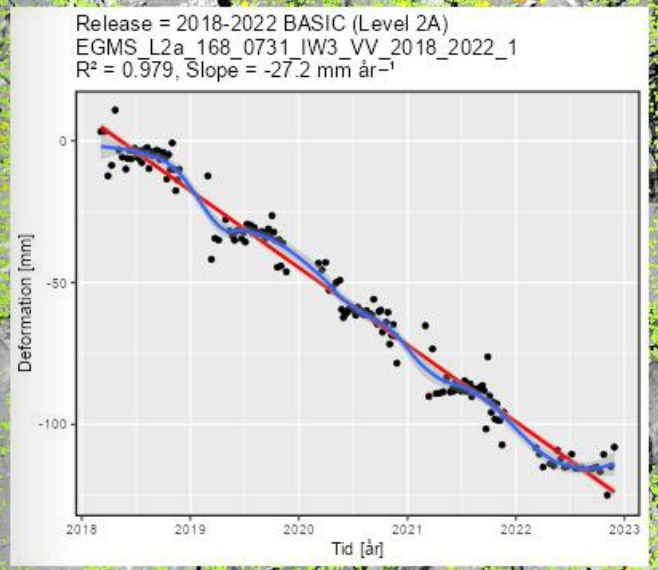
Release 2018-2022

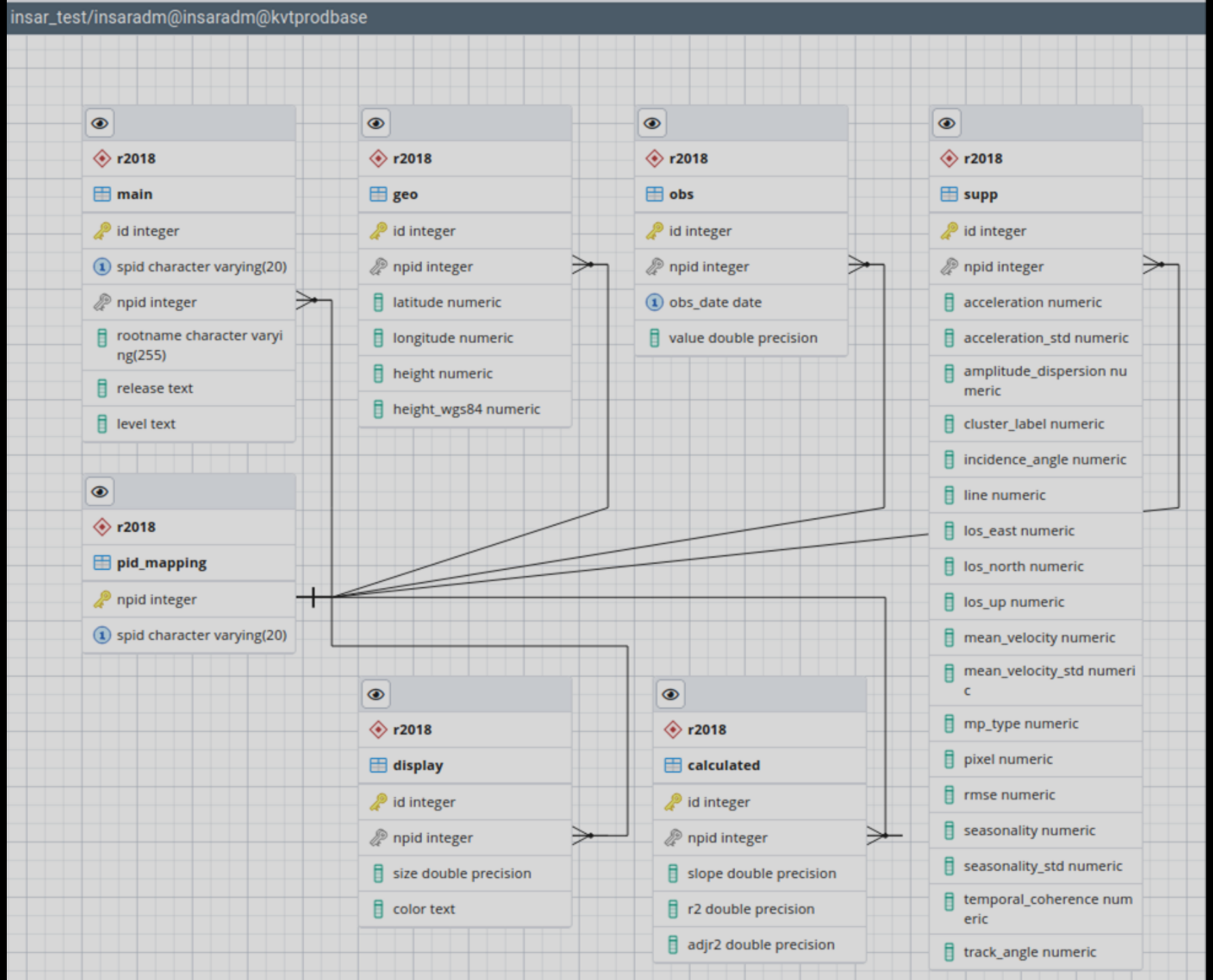


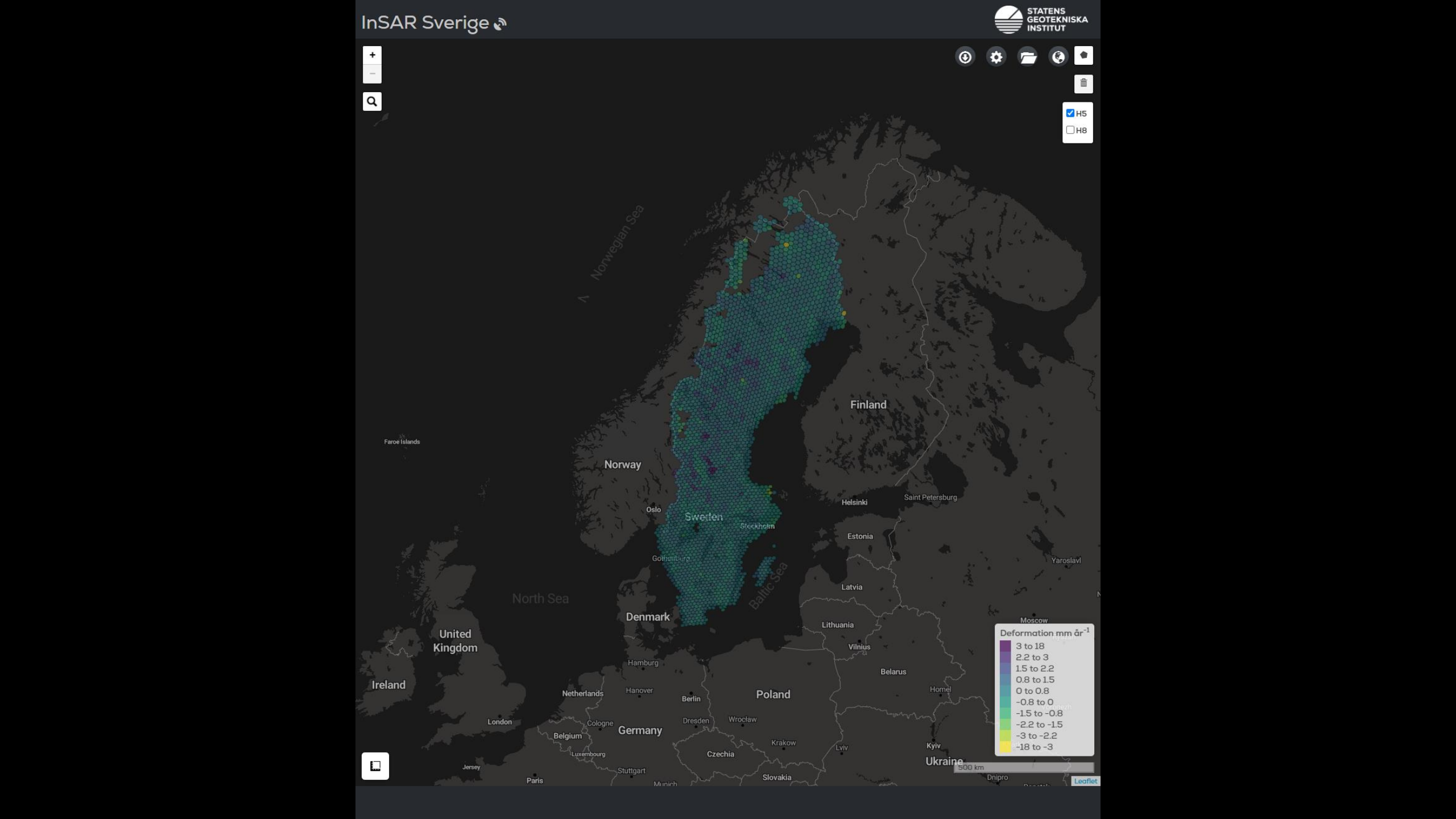
**Numbers indicate total number of csv files covering the county*

Demo

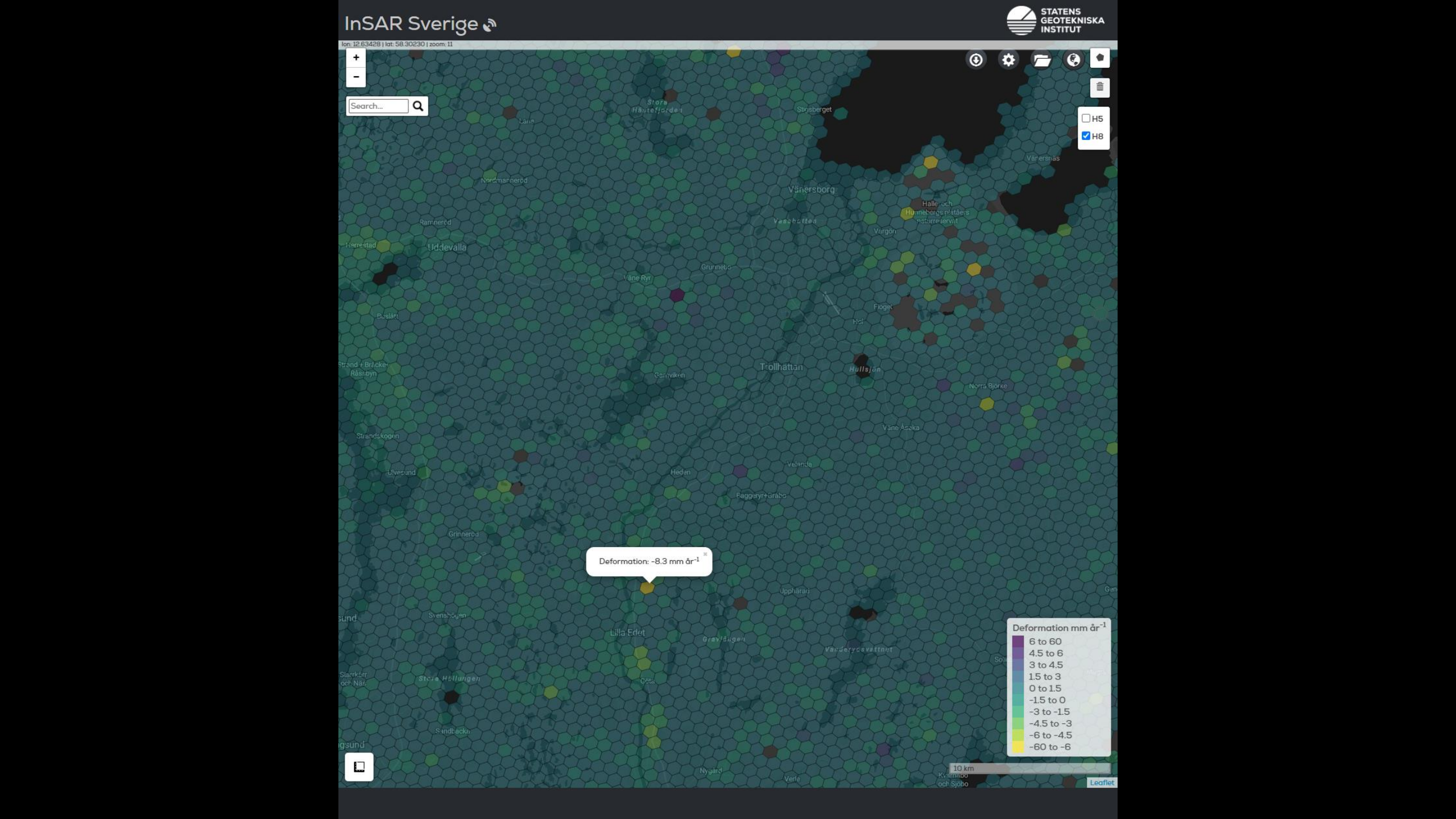
QUESTIONS?

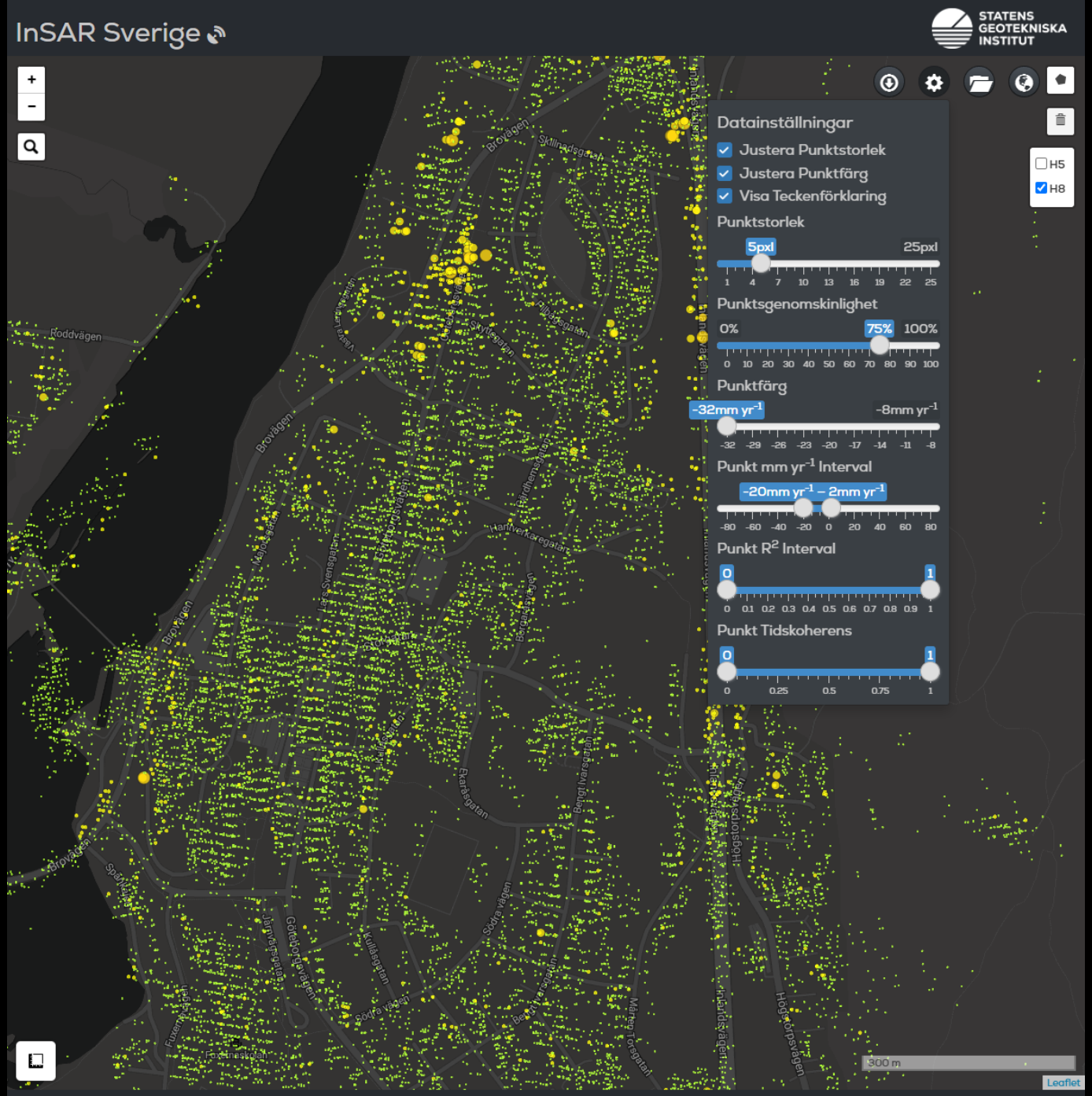

Release = 2018-2022 BASIC (Level 2A)
EGMS_L2a_168_0731_IW3_VV_2018_2022_1
R² = 0.979, Slope = -27.2 mm år⁻¹
Deformation [mm]
0
-50
-100
2018
2019
2020
2021
2022
2023
Tid [år]

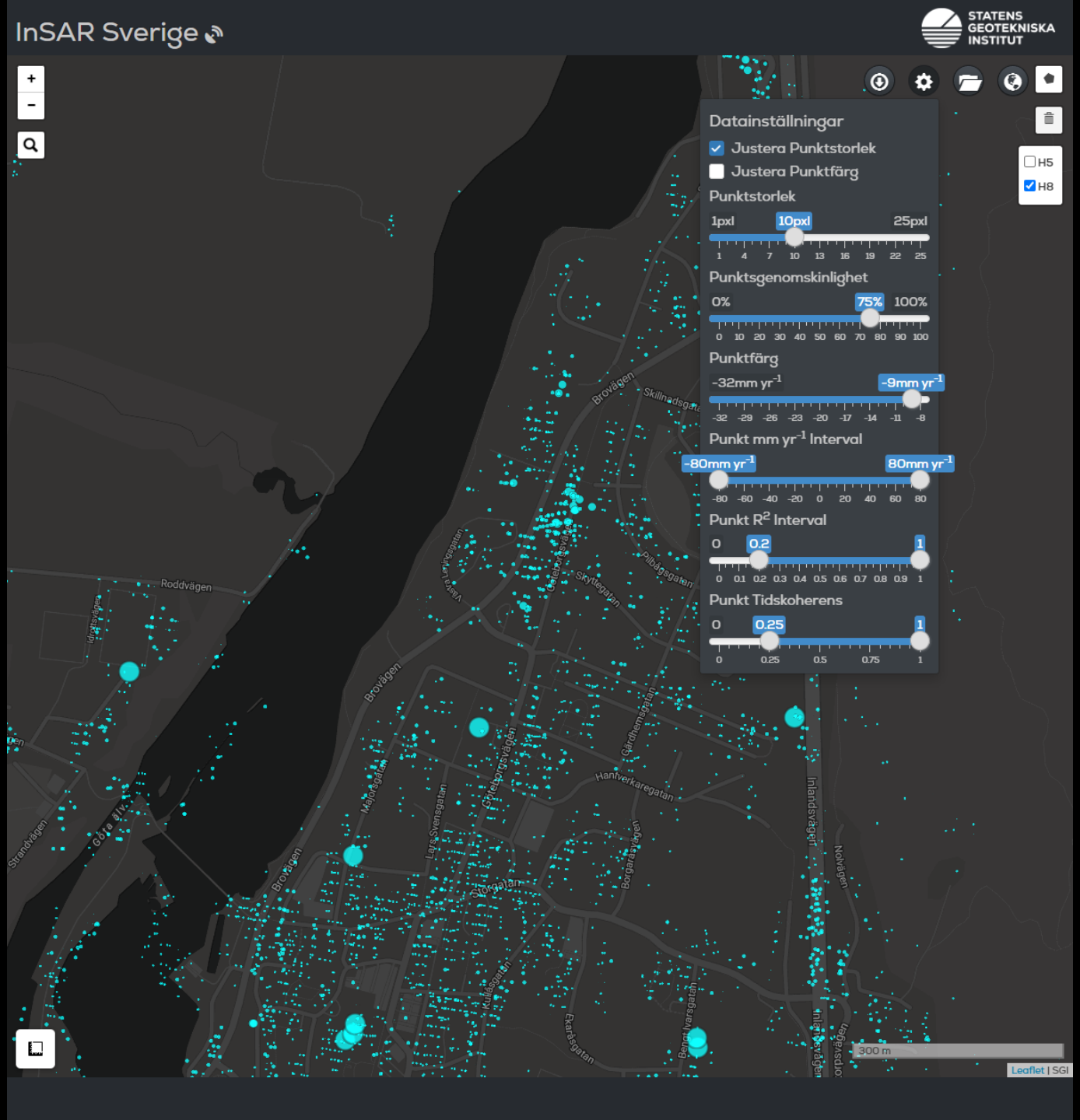

insar_test/insaradm@insaradm@kvtprodbase
r2018
main
id integer
spid character varying(20)
npid integer
rootname character varying(255)
release text
level text
r2018
geo
id integer
npid integer
latitude numeric
longitude numeric
height numeric
height_wgs84 numeric
r2018
obs
id integer
npid integer
obs_date date
value double precision
r2018
supp
id integer
npid integer
acceleration numeric
acceleration_std numeric
amplitude_dispersion numeric
cluster_label numeric
incidence_angle numeric
line numeric
los_east numeric
los_north numeric
los_up numeric
mean_velocity numeric
mean_velocity_std numeric
mp_type numeric
pixel numeric
rmse numeric
seasonality numeric
seasonality_std numeric
temporal_coherence numeric
track_angle numeric
r2018
pid_mapping
npid integer
spid character varying(20)
r2018
display
id integer
npid integer
size double precision
color text
r2018
calculated
id integer
npid integer
slope double precision
r2 double precision
adjr2 double precision

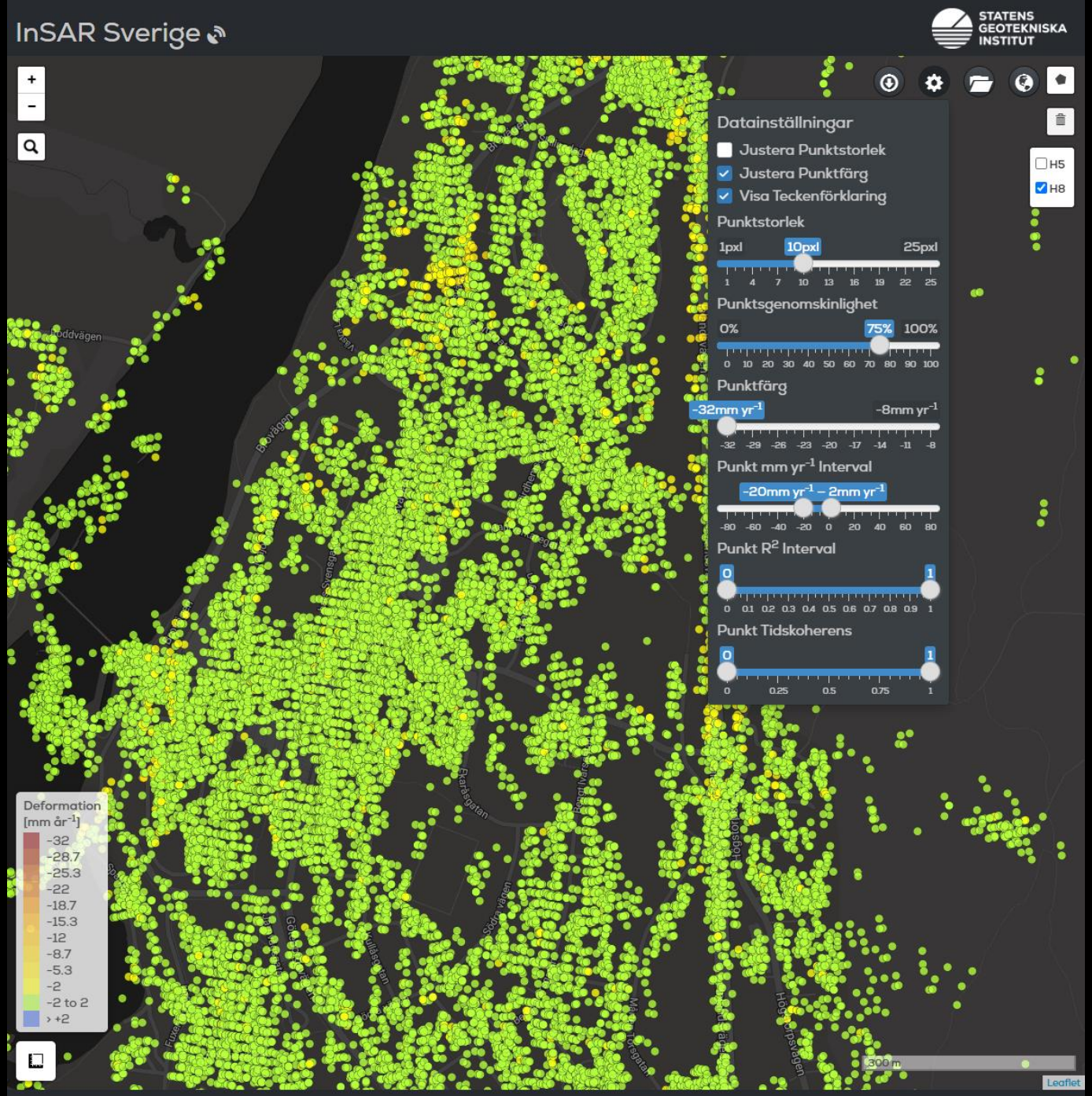

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
H5
H8
Deformation mm år-1
3 to 18
2.2 to 3
1.5 to 2.2
0.8 to 1.5
0 to 0.8
-0.8 to 0
-1.5 to -0.8
-2.2 to -1.5
-3 to -2.2
-18 to -3
Norwegian Sea
Finland
Faroe Islands
Norway
Oslo
Sweden
Stockholm
Helsinki
Saint Petersburg
Estonia
Gothenburg
Yaroslavl
Latvia
North Sea
Baltic Sea
Denmark
Lithuania
Moscow
United Kingdom
Vilnius
Hamburg
Belarus
Ireland
Netherlands
Hanover
Berlin
Poland
Homel
London
Cologne
Dresden
Wrocław
Germany
Belgium
Krakow
Lviv
Kyiv
Luxembourg
Czechia
Ukraine
Jersey
Stuttgart
Slovakia
Paris
Munich
Dnipro
500 km
Leaflet

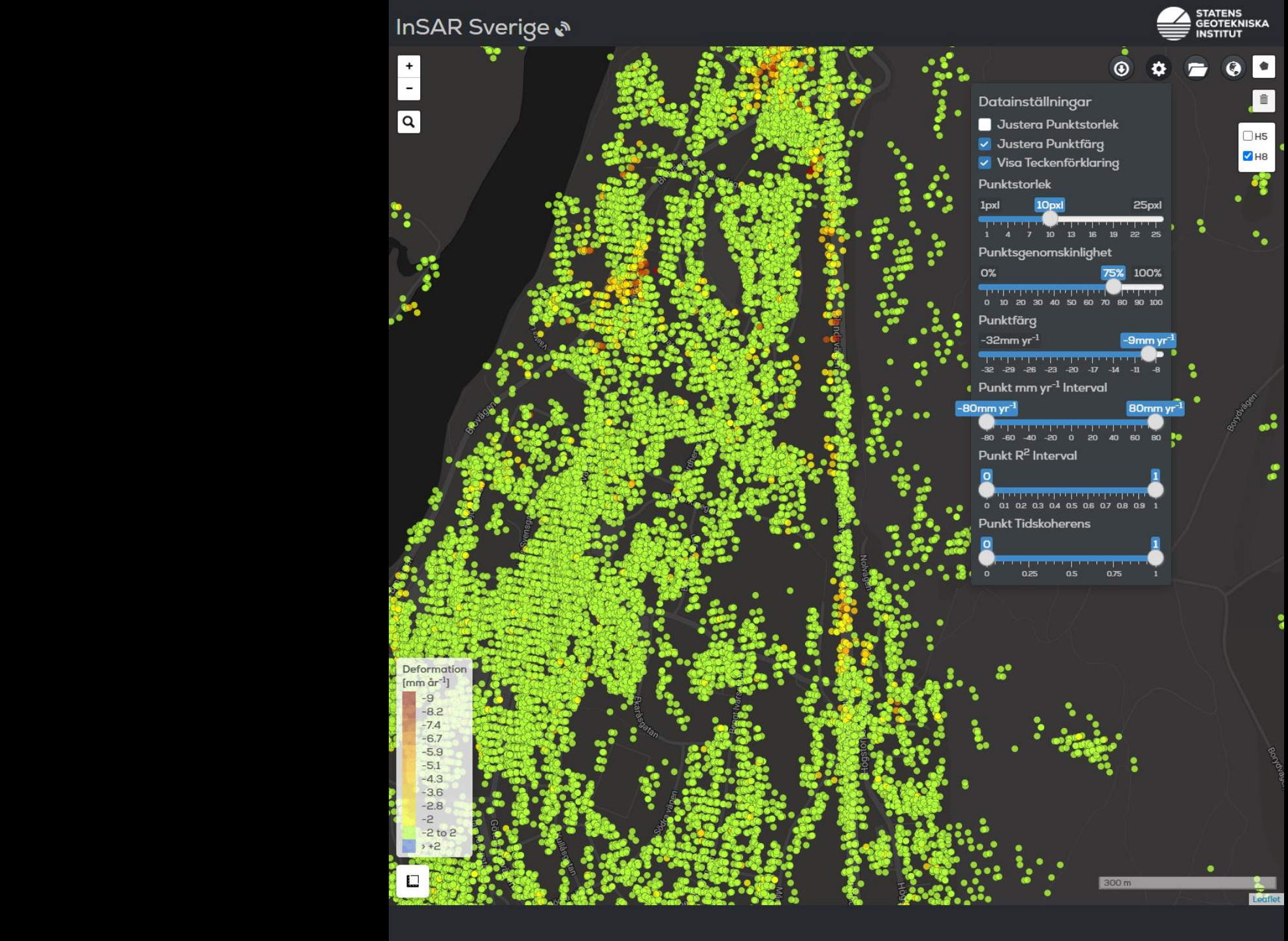
InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
lon: 13.85925 | lat: 58.83514 | zoom: 9
Sarpsborg
Fredrikstad
Search...
Halden
H5
H8
Mariestad
Lidköping
Vänersborg
Uddevalla
Skara
Skövde
Trollhättan
Deformation: 0.5 mm år-1
Falköping
Stenungsund
Skärhamn
Alingsås
Kungälv
Lerum
Gothenburg
Borås
Deformation mm år-1
0.8 to 1.5
0 to 0.8
-0.8 to 0
-1.5 to -0.8
30 km
Leaflet

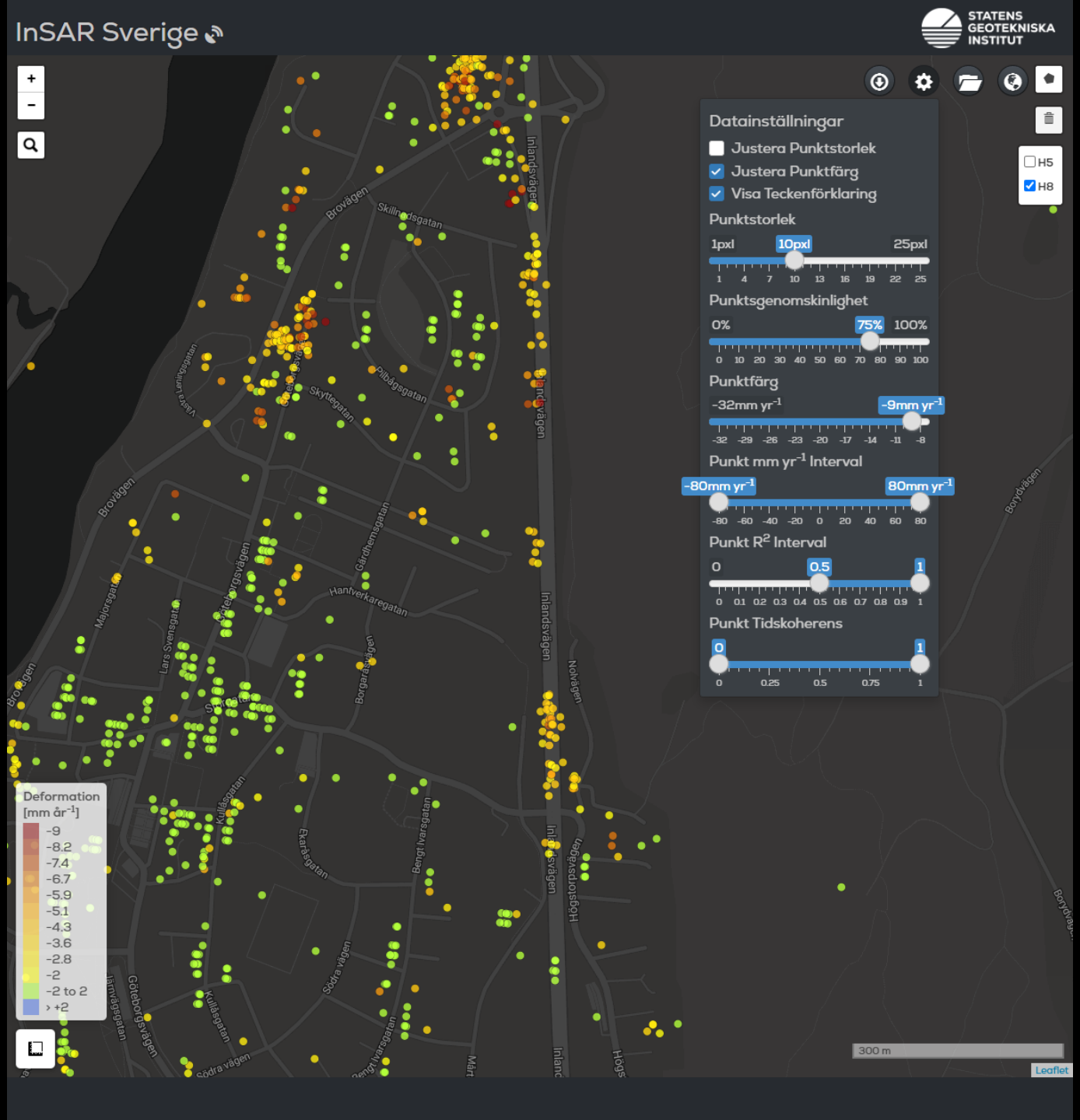

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
lon: 12.63428 | lat: 58.30230 | zoom: 11
Search...
H5
H8
Deformation: -8.3 mm år-1
Deformation mm år-1
6 to 60
4.5 to 6
3 to 4.5
1.5 to 3
0 to 1.5
-1.5 to 0
-3 to -1.5
-4.5 to -3
-6 to -4.5
-60 to -6
10 km
Leaflet
Vänersborg
Trollhättan
Uddevalla
Lilla Edet

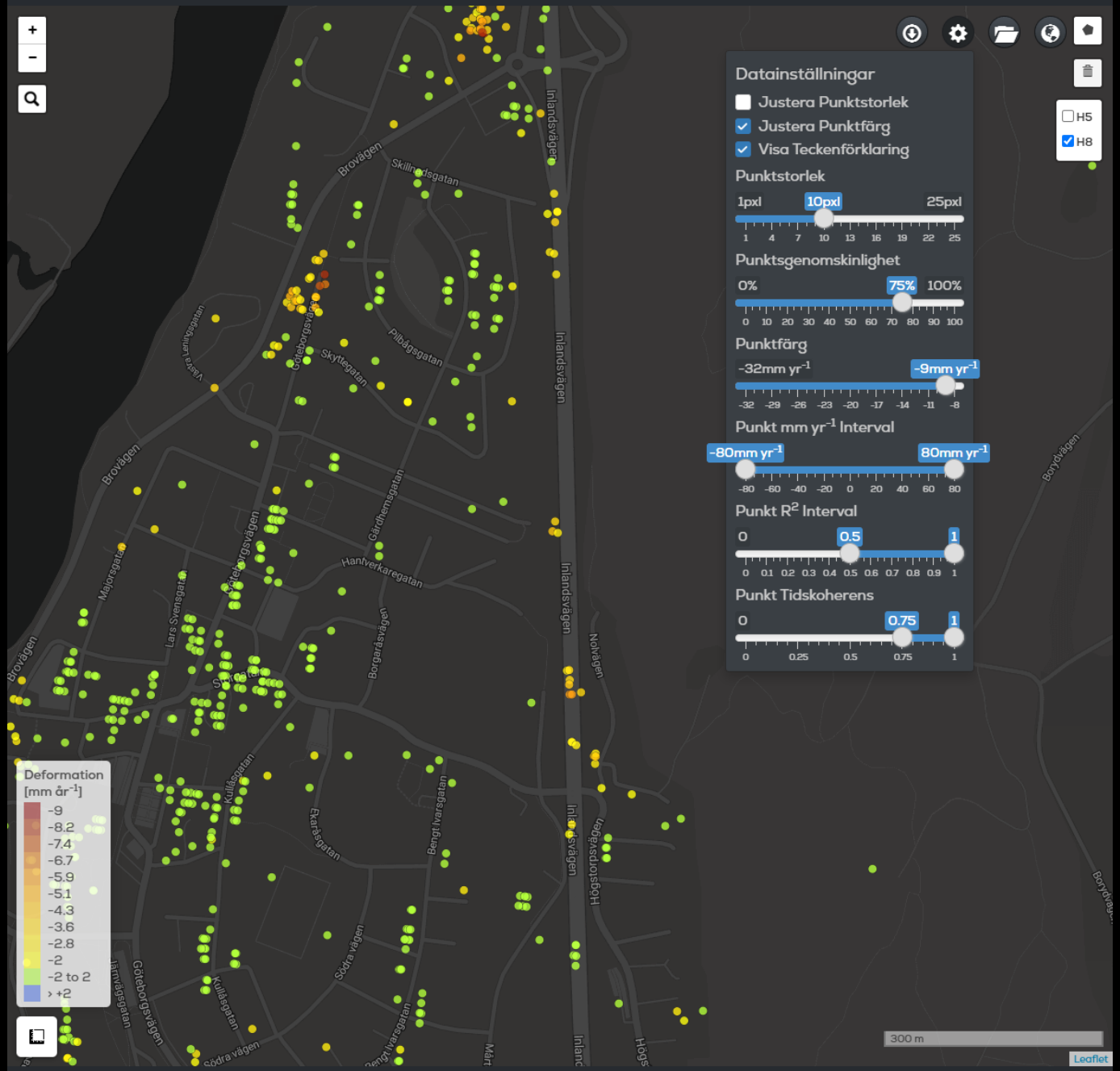

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Datainställningar
Justera Punktstorlek
Justera Punktfärg
Visa Teckenförklaring
Punktstorlek
5pxl
25pxl
1 4 7 10 13 16 19 22 25
Punktsgenomskinlighet
0%
75%
100%
0 10 20 30 40 50 60 70 80 90 100
Punktfärg
-32mm yr-1
-8mm yr-1
-32 -29 -26 -23 -20 -17 -14 -11 -8
Punkt mm yr-1 Interval
-20mm yr-1 – 2mm yr-1
-80 -60 -40 -20 0 20 40 60 80
Punkt R2 Interval
0
1
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Punkt Tidskoherens
0
1
0 0.25 0.5 0.75 1
H5
H8
Roddvägen
Brovägen
Skillnadsgatan
Skyttegatan
Hantverkaregatan
Ekarasgatan
Bengt Ivarsgatan
Högstorpsvägen
Inlandsvägen
Södra vägen
Kullåsgatan
Göteborgsvägen
Järnvägsgatan
Fuxenvägen
Fuxemaskolan
Spårvägen
300 m
Leaflet


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Datainställningar
Justera Punktstorlek
Justera Punktfärg
Punktstorlek
1pxl
10pxl
25pxl
Punktsgenomskinlighet
0%
75%
100%
Punktfärg
-32mm yr-1
-9mm yr-1
Punkt mm yr-1 Interval
-80mm yr-1
80mm yr-1
Punkt R2 Interval
0
0.2
1
Punkt Tidskoherens
0
0.25
1
H5
H8
Roddvägen
Brovägen
Skyttegatan
Pilbågsgatan
Gärdhemsgatan
Hantverkaregatan
Inlandsvägen
Nolvägen
Strandvägen
Mejerigatan
Lars Svensgatan
Ekarasgatan
300 m
Leaflet | SGI


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Datainställningar
Justera Punktstorlek
Justera Punktfärg
Visa Teckenförklaring
Punktstorlek
1pxl
10pxl
25pxl
Punktsgenomskinlighet
0%
75%
100%
Punktfärg
-32mm yr-1
-8mm yr-1
Punkt mm yr-1 Interval
-20mm yr-1 – 2mm yr-1
Punkt R2 Interval
Punkt Tidskoherens
H5
H8
Deformation [mm år-1]
-32
-28.7
-25.3
-22
-18.7
-15.3
-12
-8.7
-5.3
-2
-2 to 2
› +2
300 m
Leaflet


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Datainställningar
Justera Punktstorlek
Justera Punktfärg
Visa Teckenförklaring
Punktstorlek
1pxl
10pxl
25pxl
Punktsgenomskinlighet
0%
75%
100%
Punktfärg
-32mm yr-1
-9mm yr-1
Punkt mm yr-1 Interval
-80mm yr-1
80mm yr-1
Punkt R2 Interval
Punkt Tidskoherens
H5
H8
Deformation [mm år-1]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
300 m
Leaflet

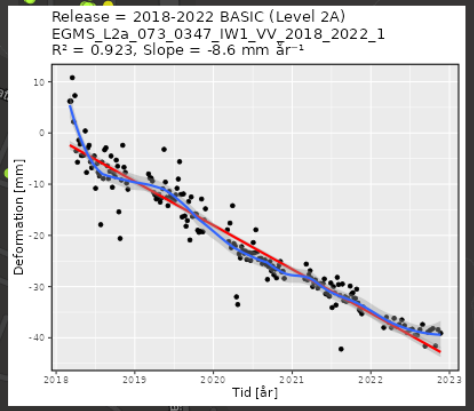

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Datainställningar
Justera Punktstorlek
Justera Punktfärg
Visa Teckenförklaring
Punktstorlek
1pxl
10pxl
25pxl
1 4 7 10 13 16 19 22 25
Punktsgenomskinlighet
0%
75%
100%
0 10 20 30 40 50 60 70 80 90 100
Punktfärg
-32mm yr-1
-9mm yr-1
-32 -29 -26 -23 -20 -17 -14 -11 -8
Punkt mm yr-1 Interval
-80mm yr-1
80mm yr-1
-80 -60 -40 -20 0 20 40 60 80
Punkt R2 Interval
0
0.5
1
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Punkt Tidskoherens
0
1
0 0.25 0.5 0.75 1
H5
H8
Deformation [mm år-1]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
Brovägen
Skillnadsgatan
Inlandsvägen
Pilbågsgatan
Skyttegatan
Gärdhemsgatan
Hantverkaregatan
Majorsgatan
Lars Svensgatan
Borgaråsvägen
Nolvägen
Kullåsgatan
Ekaråsgatan
Bengt Ivarsgatan
Högstorpsvägen
Södra vägen
Göteborgsvägen
Borydvägen
300 m
Leaflet


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Datainställningar
Justera Punktstorlek
Justera Punktfärg
Visa Teckenförklaring
Punktstorlek
1pxl
10pxl
25pxl
1 4 7 10 13 16 19 22 25
Punktsgenomskinlighet
0%
75%
100%
0 10 20 30 40 50 60 70 80 90 100
Punktfärg
-32mm yr-1
-9mm yr-1
-32 -29 -26 -23 -20 -17 -14 -11 -8
Punkt mm yr-1 Interval
-80mm yr-1
80mm yr-1
-80 -60 -40 -20 0 20 40 60 80
Punkt R2 Interval
0
0.5
1
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Punkt Tidskoherens
0
0.75
1
0 0.25 0.5 0.75 1
H5
H8
Deformation [mm år-1]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
Brovägen
Skillnadsgatan
Inlandsvägen
Pilbågsgatan
Skyttegatan
Göteborgsvägen
Gärdhemsgatan
Hantverkaregatan
Majorsgatan
Lars Svensgatan
Borgaråsvägen
Nolvägen
Borydvägen
Kullåsgatan
Ekaråsgatan
Bengt Ivarsgatan
Högstorpsvägen
Södra vägen
Järnvägsgatan
300 m
Leaflet

InSAR Sverige

STATENS GEOTEKNISKA INSTITUT

-8.6 mm år^{-1}

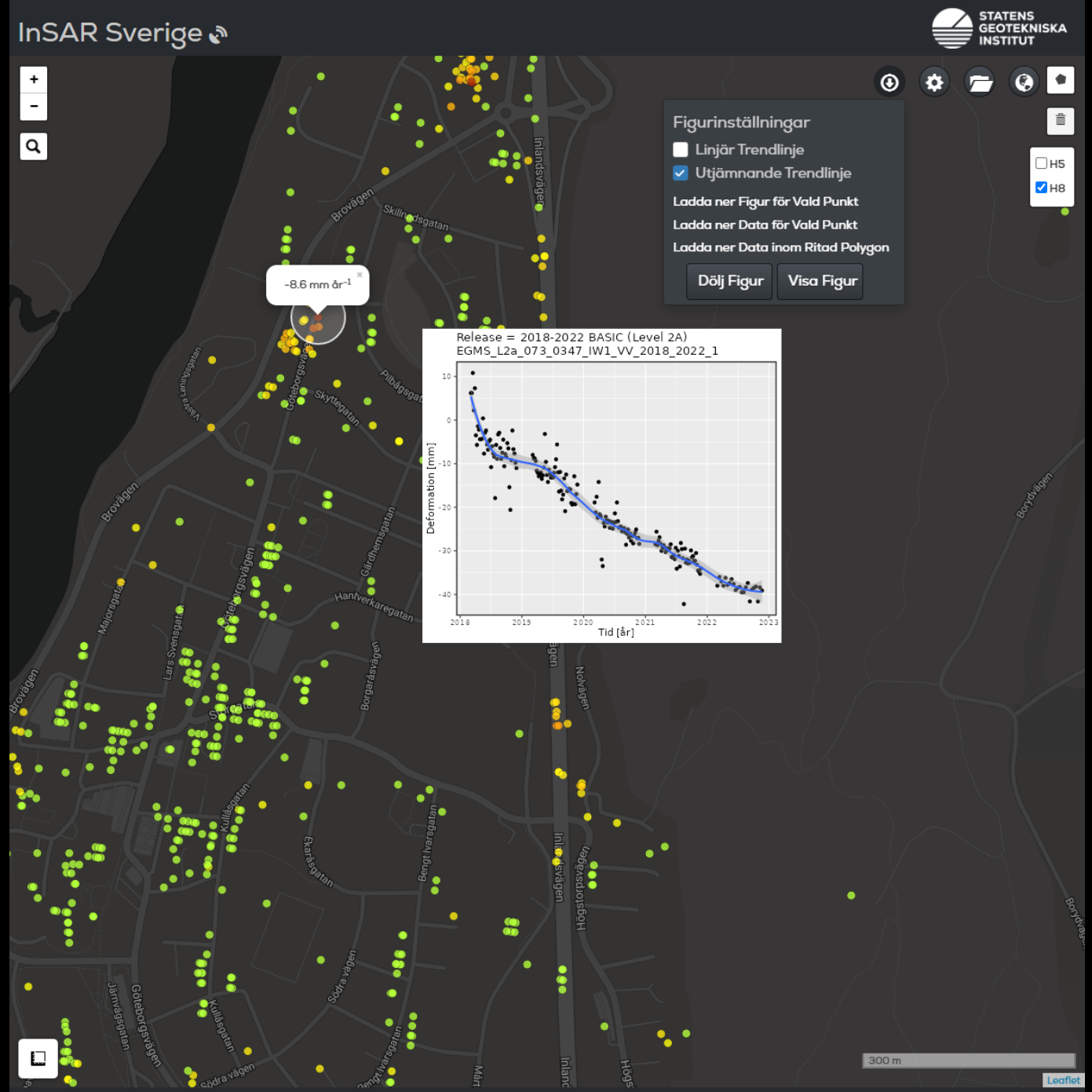


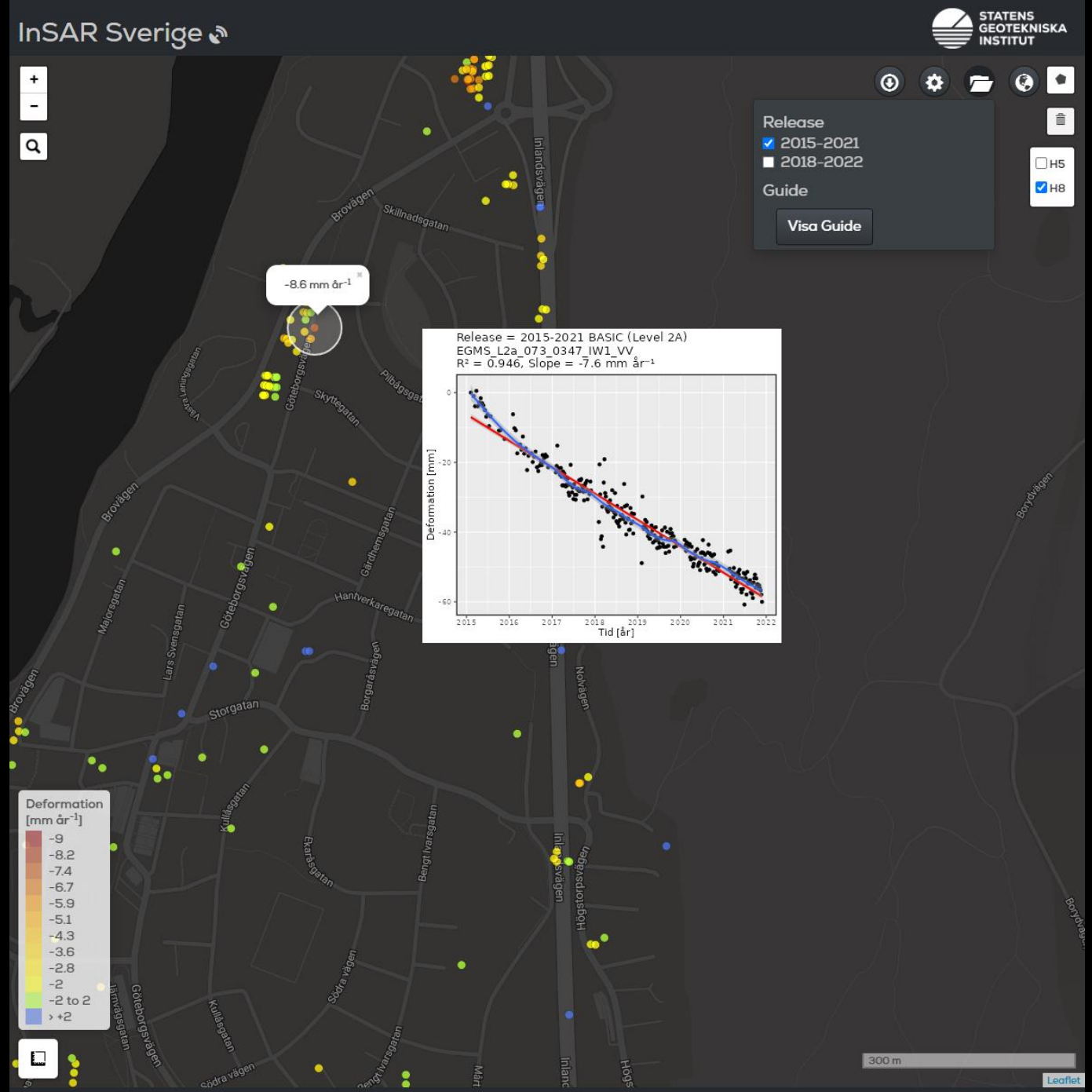
H5
H8

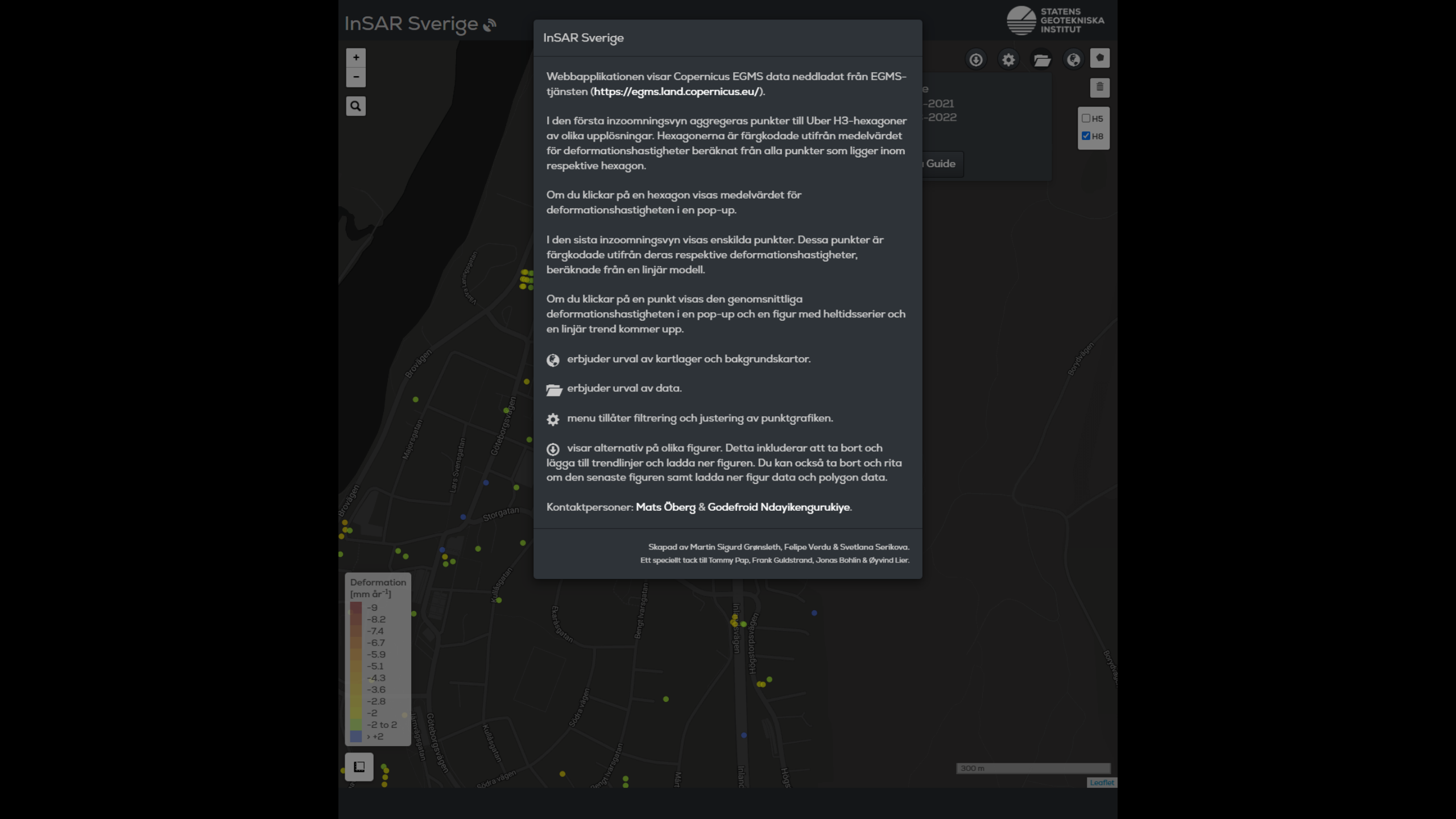
Brovägen
Skillingsgatan
Inlandsvägen
Skyttegatan
Pilbågsgatan
Västra Larmgatan
Göteborgsvägen
Gärdhemsgatan
Hantverkaregatan
Majorsgatan
Lars Svensgatan
Borgarsvägen
Nolvägen
Kullåsgatan
Ekarasgatan
Bengt Ivarsgatan
Högstorpsvägen
Södra vägen
Järnvägsgatan
Borgvärdsvägen

300 m

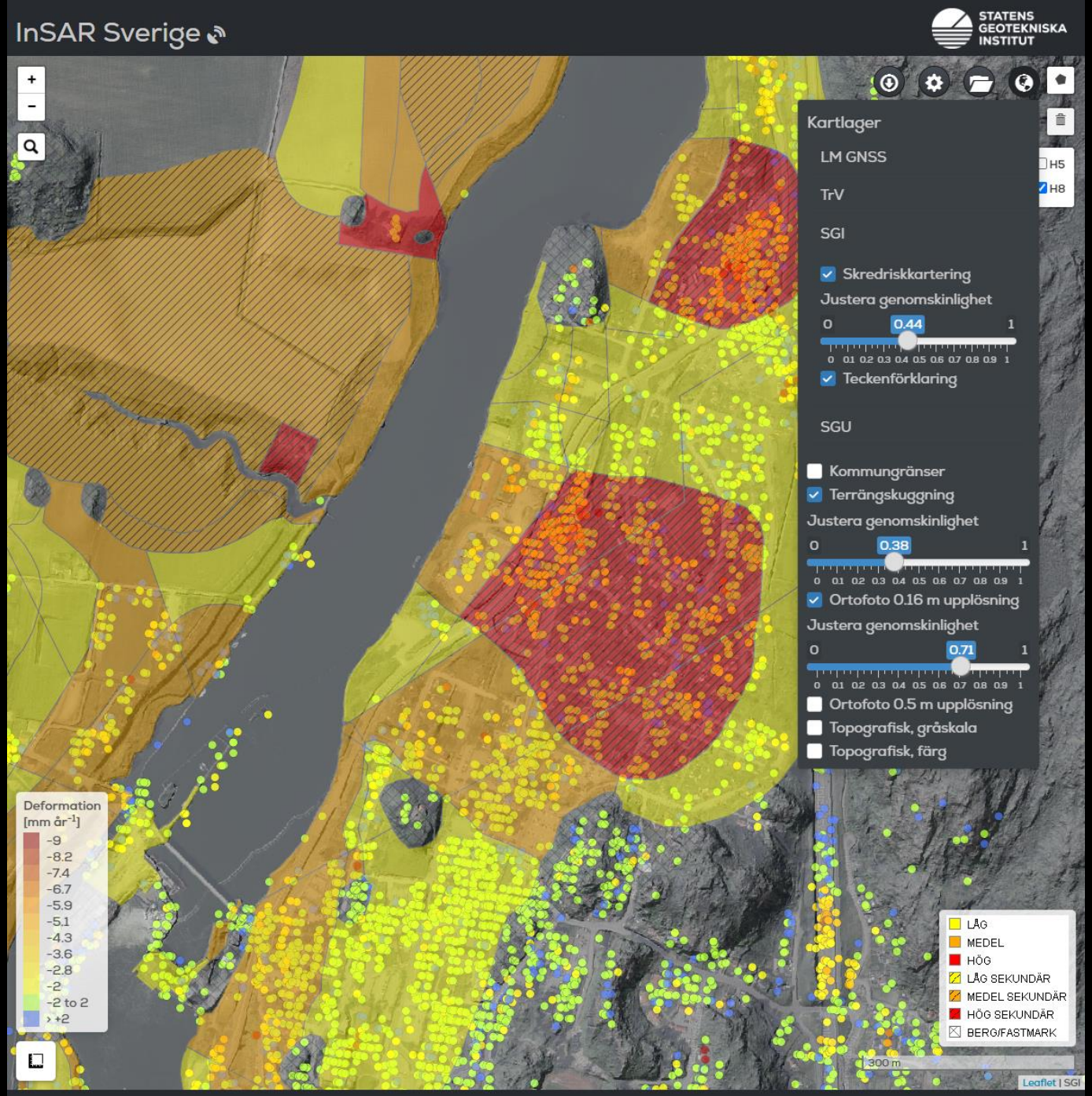
Leaflet

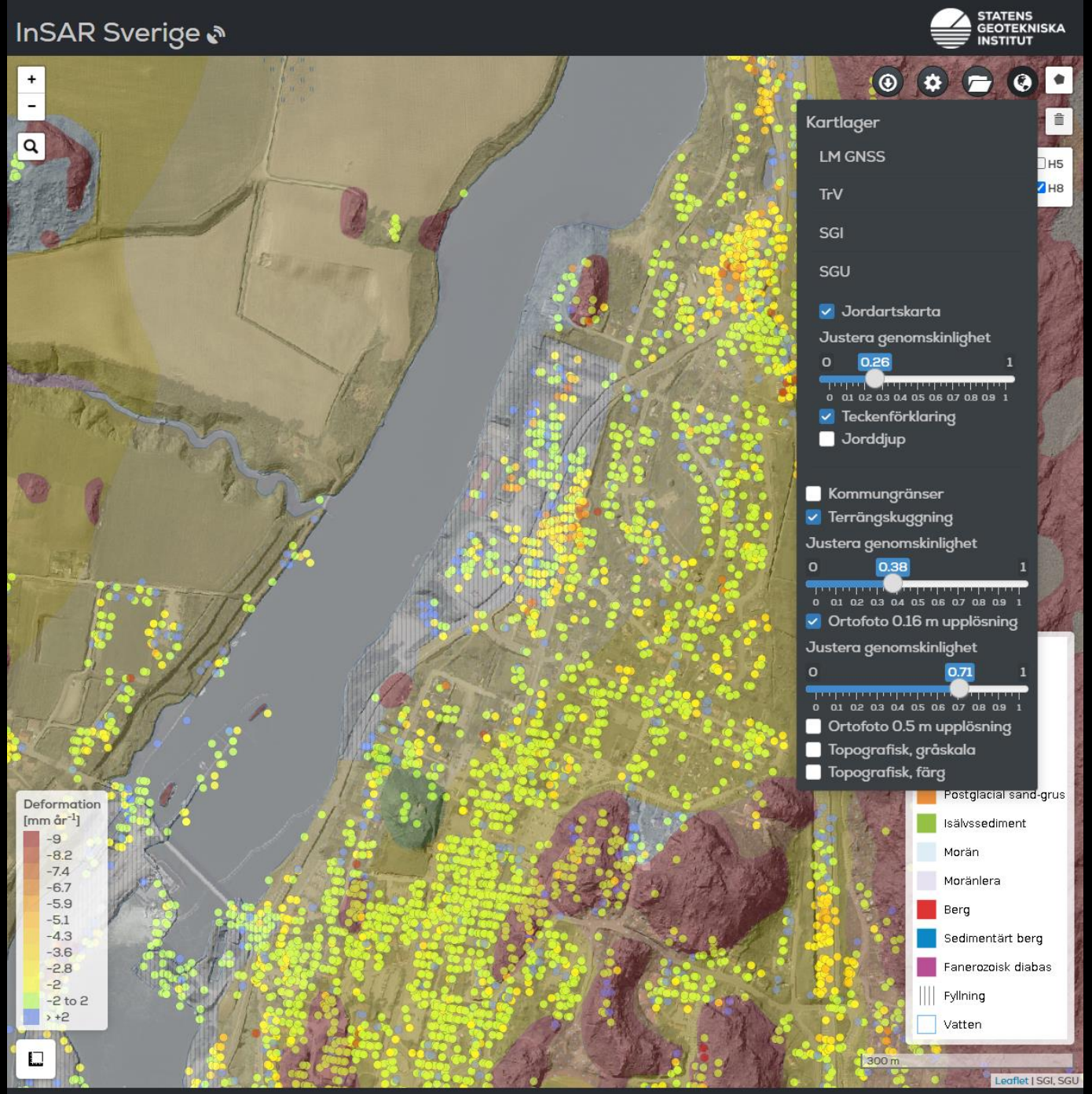

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Figurinställningar
Linjär Trendlinje
Utjämnande Trendlinje
Ladda ner Figur för Vald Punkt
Ladda ner Data för Vald Punkt
Ladda ner Data inom Ritad Polygon
Dölj Figur
Visa Figur
H5
H8
-8.6 mm år-1
Release = 2018-2022 BASIC (Level 2A)
EGMS_L2a_073_0347_IW1_VV_2018_2022_1
Deformation [mm]
Tid [år]
300 m
Leaflet

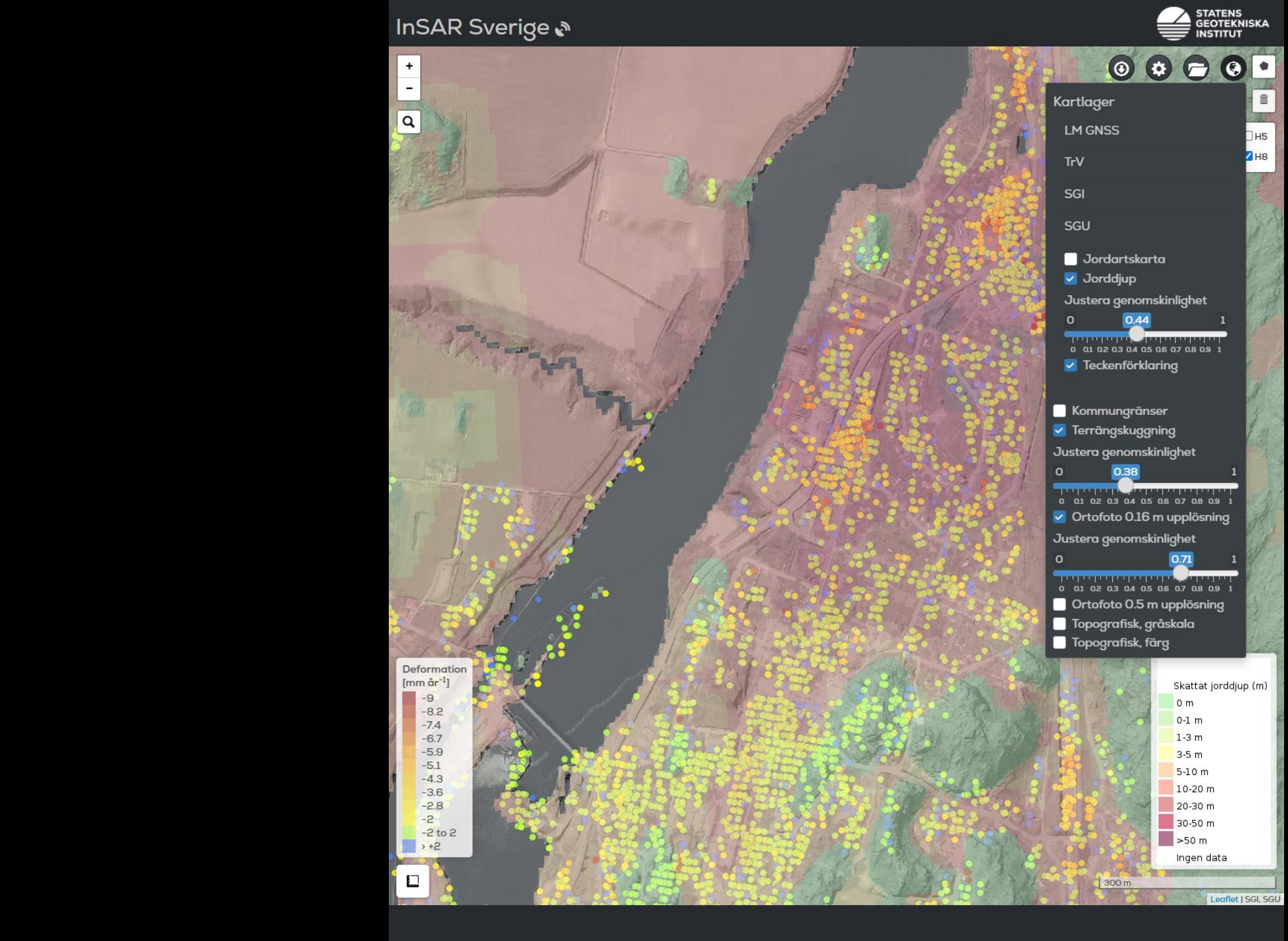

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Release
2015-2021
2018-2022
Guide
Visa Guide
H5
H8
-8.6 mm år⁻¹
Release = 2015-2021 BASIC (Level 2A)
EGMS_L2a_073_0347_IW1_VV
R² = 0.946, Slope = -7.6 mm år⁻¹
Deformation [mm]
Tid [år]
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
300 m
Leaflet

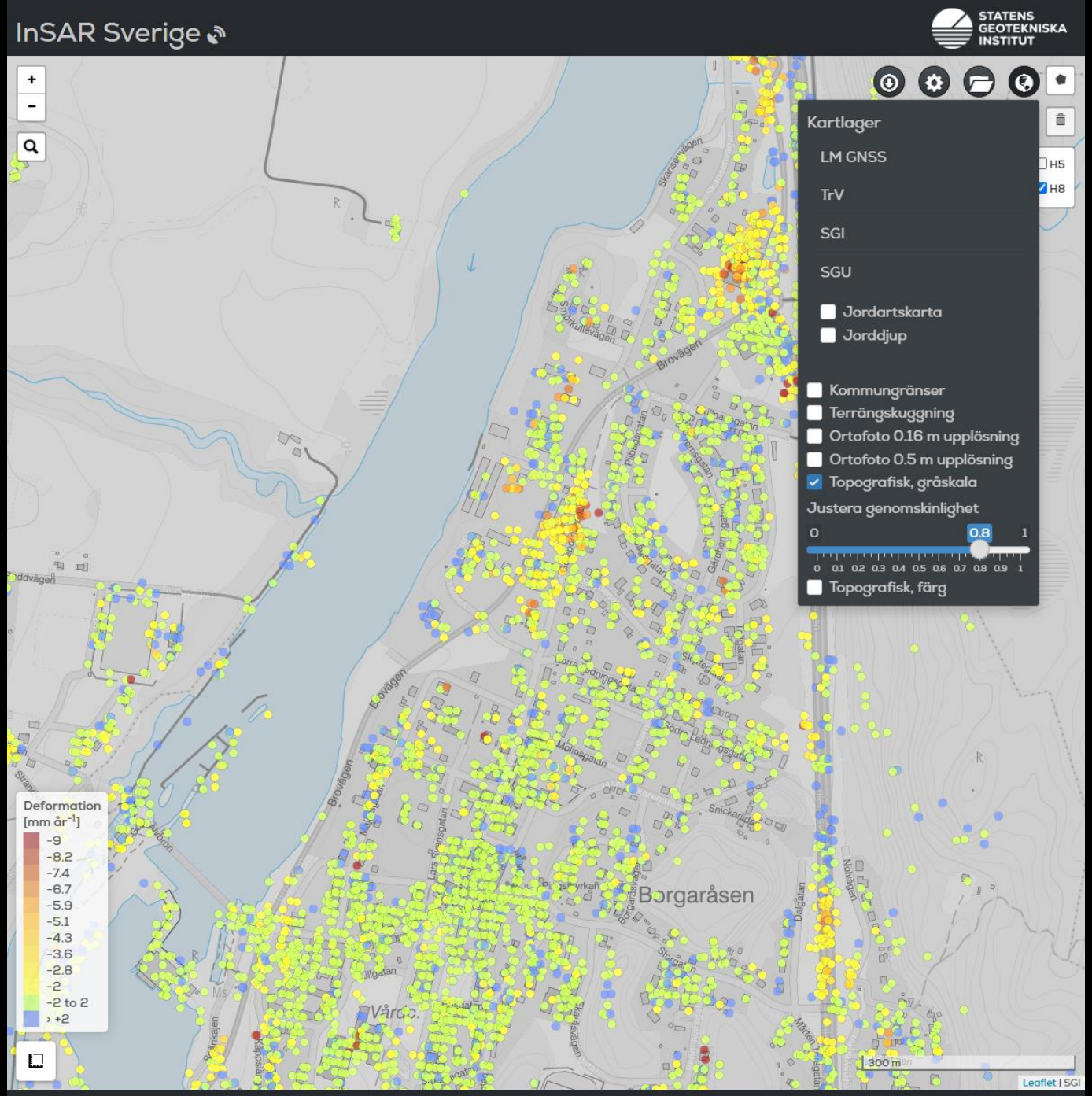

InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
InSAR Sverige
Webbapplikationen visar Copernicus EGMS data neddladat från EGMS-tjänsten (https://egms.land.copernicus.eu/).
I den första inzoomningsvyn aggregeras punkter till Uber H3-hexagoner av olika upplösningar. Hexagonerna är färgkodade utifrån medelvärdet för deformationshastigheter beräknat från alla punkter som ligger inom respektive hexagon.
Om du klickar på en hexagon visas medelvärdet för deformationshastigheten i en pop-up.
I den sista inzoomningsvyn visas enskilda punkter. Dessa punkter är färgkodade utifrån deras respektive deformationshastigheter, beräknade från en linjär modell.
Om du klickar på en punkt visas den genomsnittliga deformationshastigheten i en pop-up och en figur med heltidsserier och en linjär trend kommer upp.
erbjuder urval av kartlager och bakgrundskartor.
erbjuder urval av data.
menu tillåter filtrering och justering av punktgrafiken.
visar alternativ på olika figurer. Detta inkluderar att ta bort och lägga till trendlinjer och ladda ner figuren. Du kan också ta bort och rita om den senaste figuren samt ladda ner figur data och polygon data.
Kontaktpersoner: Mats Öberg & Godefroid Ndayikengurukiye.
Skapad av Martin Sigurd Grønsleth, Felipe Verdu & Svetlana Serikova.
Ett speciellt tack till Tommy Pap, Frank Guldstrand, Jonas Bohlin & Øyvind Lier.
H5
H8
Guide
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
Brovägen
Majorsgatan
Lars Svensgatan
Göteborgsvägen
Storgatan
Kullagatan
Ekarasgatan
Bergi Ivarsgatan
Södra vägen
Järnvägsgatan
Högstorpsvägen
Borgvägen
300 m
Leaflet

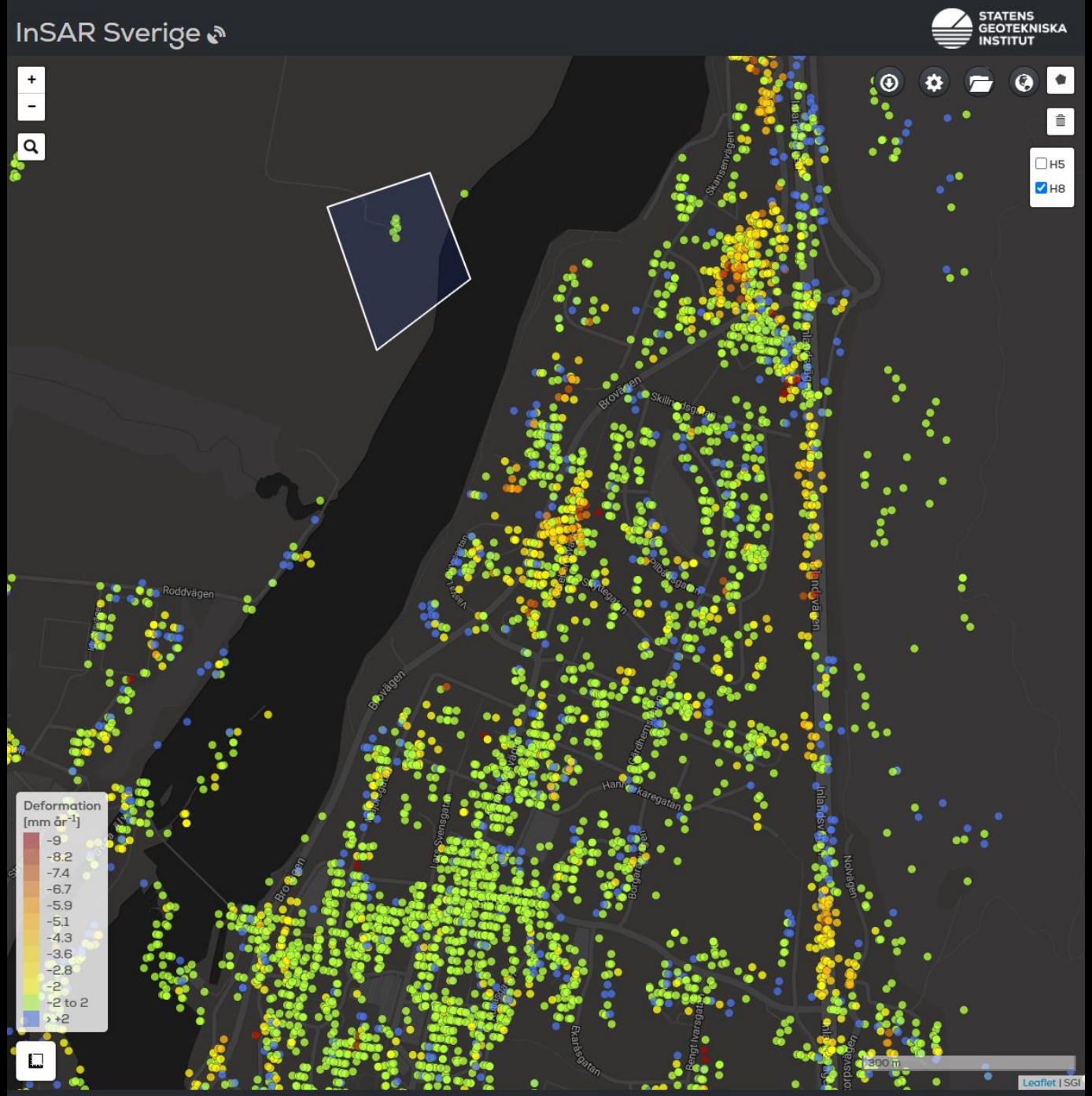
InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Kartlager
LM GNSS
TrV
SGI
SGU
Kommungränser
Terrängskuggning
Justera genomskinlighet
0
0.38
1
Ortofoto 0.16 m upplösning
Justera genomskinlighet
0
0.71
1
Ortofoto 0.5 m upplösning
Topografisk, gråskala
Topografisk, färg
H5
H8
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
300 m
Leaflet


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Kartlager
LM GNSS
TrV
SGI
Skredriskkartering
Justera genomskinlighet
0 0.44 1
Teckenförklaring
SGU
Kommungränser
Terrängskuggning
Justera genomskinlighet
0 0.38 1
Ortofoto 0.16 m upplösning
Justera genomskinlighet
0 0.71 1
Ortofoto 0.5 m upplösning
Topografisk, gråskala
Topografisk, färg
H5
H8
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
LÅG
MEDEL
HÖG
LÅG SEKUNDÄR
MEDEL SEKUNDÄR
HÖG SEKUNDÄR
BERG/FASTMARK
300 m
Leaflet | SGI


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Kartlager
LM GNSS
TrV
SGI
SGU
Jordartskarta
Justera genomskinlighet
0 0.26 1
Teckenförklaring
Jorddjup
Kommungränser
Terrängskuggning
Justera genomskinlighet
0 0.38 1
Ortofoto 0.16 m upplösning
Justera genomskinlighet
0 0.71 1
Ortofoto 0.5 m upplösning
Topografisk, gråskala
Topografisk, färg
H5
H8
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
Postglacial sand-grus
Isälvssediment
Morän
Moränlera
Berg
Sedimentärt berg
Fanerozoisk diabas
Fyllning
Vatten
300 m
Leaflet | SGI, SGU


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Kartlager
LM GNSS
TrV
SGI
SGU
Jordartskarta
Jorddjup
Justera genomskinlighet
0.44
Teckenförklaring
Kommungränser
Terrängskuggning
Justera genomskinlighet
0.38
Ortofoto 0.16 m upplösning
Justera genomskinlighet
0.71
Ortofoto 0.5 m upplösning
Topografisk, gråskala
Topografisk, färg
H5
H8
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
Skattat jorddjup (m)
0 m
0-1 m
1-3 m
3-5 m
5-10 m
10-20 m
20-30 m
30-50 m
>50 m
Ingen data
300 m
Leaflet | SGI, SGU


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
Kartlager
LM GNSS
TrV
SGI
SGU
Jordartskarta
Jorddjup
Kommungränser
Terrängskuggning
Ortofoto 0.16 m upplösning
Ortofoto 0.5 m upplösning
Topografisk, gråskala
Justera genomskinlighet
0
0.8
1
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Topografisk, färg
H5
H8
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
› +2
Borgaråsen
Brovägen
Skanservägen
Molinsgatan
Snickarlida
Dalgatan
Nolvägen
300 m
Leaflet | SGI


InSAR Sverige
STATENS GEOTEKNISKA INSTITUT
H5
H8
Deformation [mm år⁻¹]
-9
-8.2
-7.4
-6.7
-5.9
-5.1
-4.3
-3.6
-2.8
-2
-2 to 2
> +2
Roddvägen
Brovägen
Skansenvägen
Inlandsvägen
Nolvägen
Ekaräsgatan
300 m
Leaflet | SGI