trädkontoret.

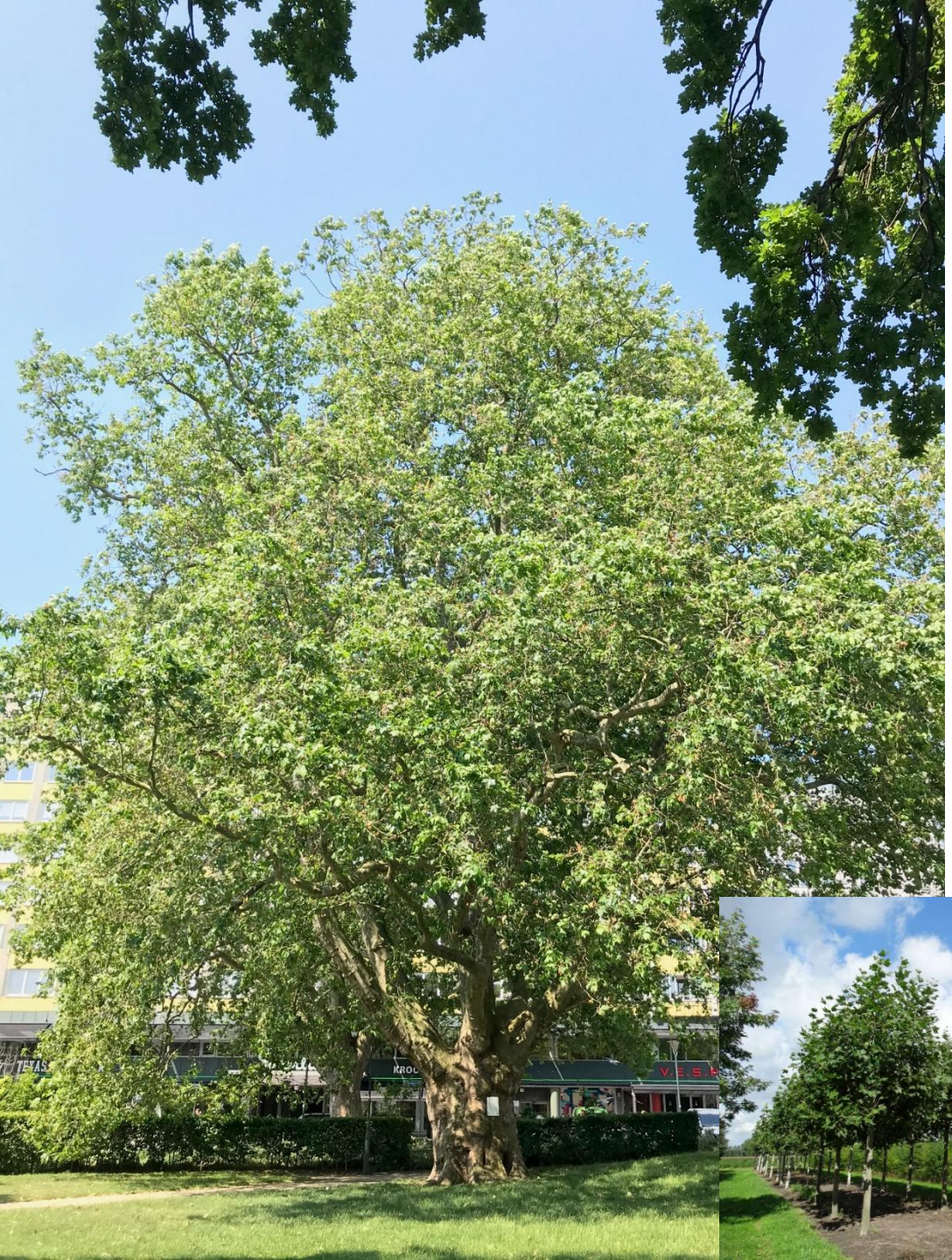
Climate forecasting for tree species

Boominfodag

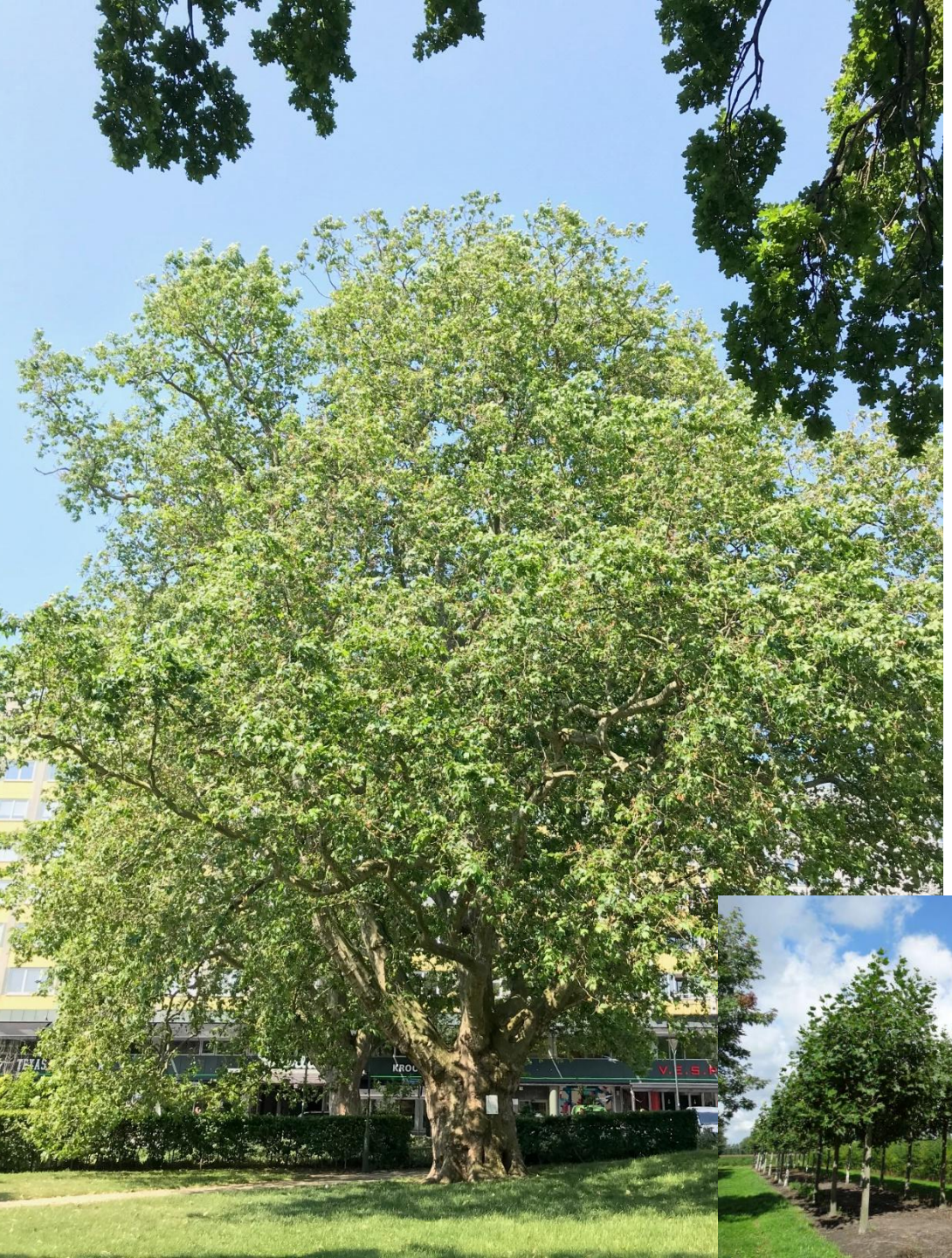
Gustav Nässlander, The Tree Office

CLIMATE ADAPTATION

i-Tree®

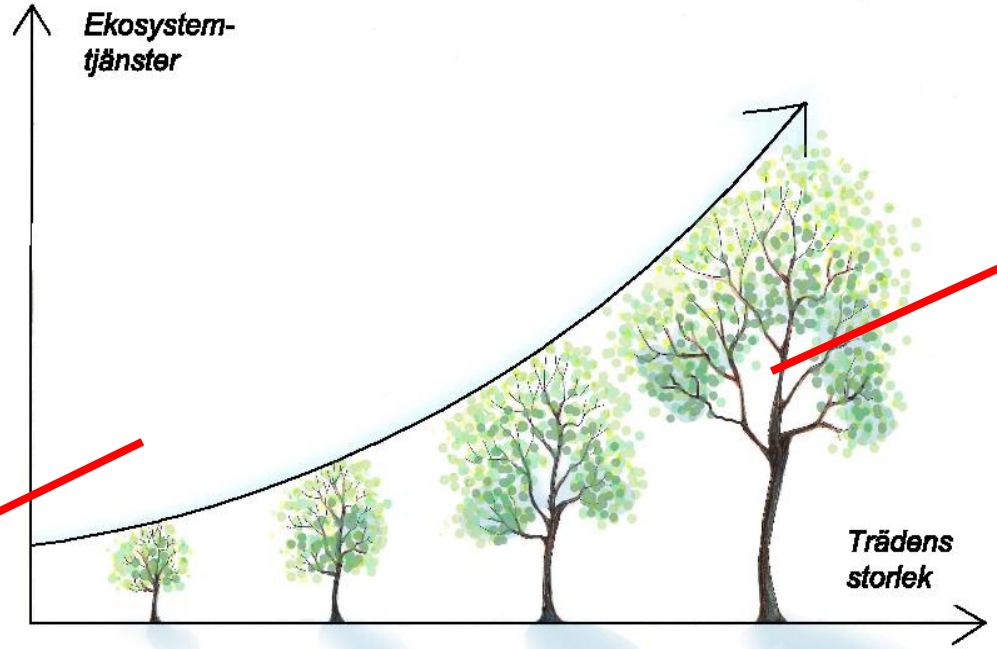


- Big plane tree in Malmö
- DBH **188** cm
- Leaf area **3291** m2
- If we saw this tree to the ground, to compensate we would need to plant **265** new trees.

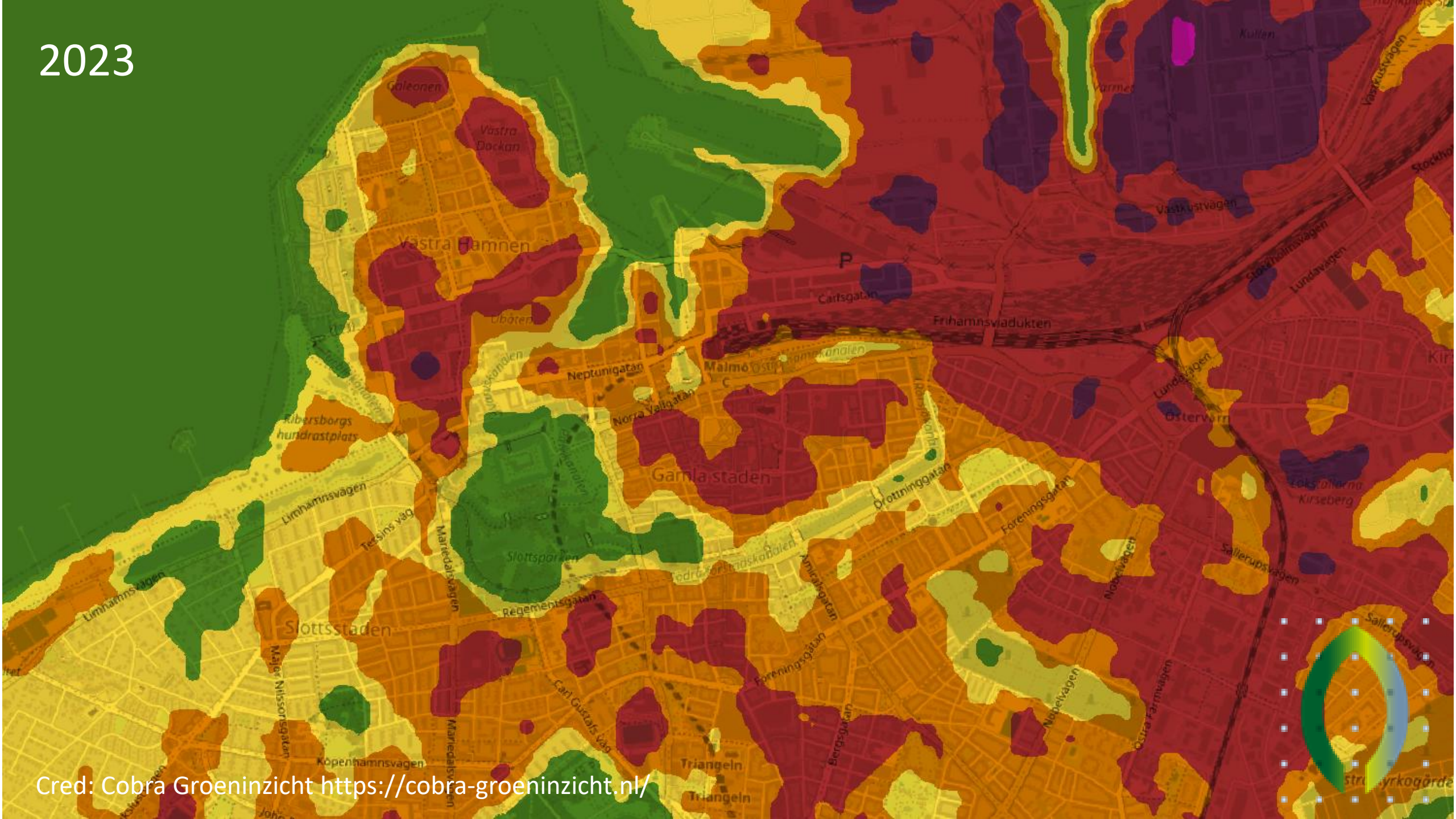


Or plant 1 tree and wait 170 years

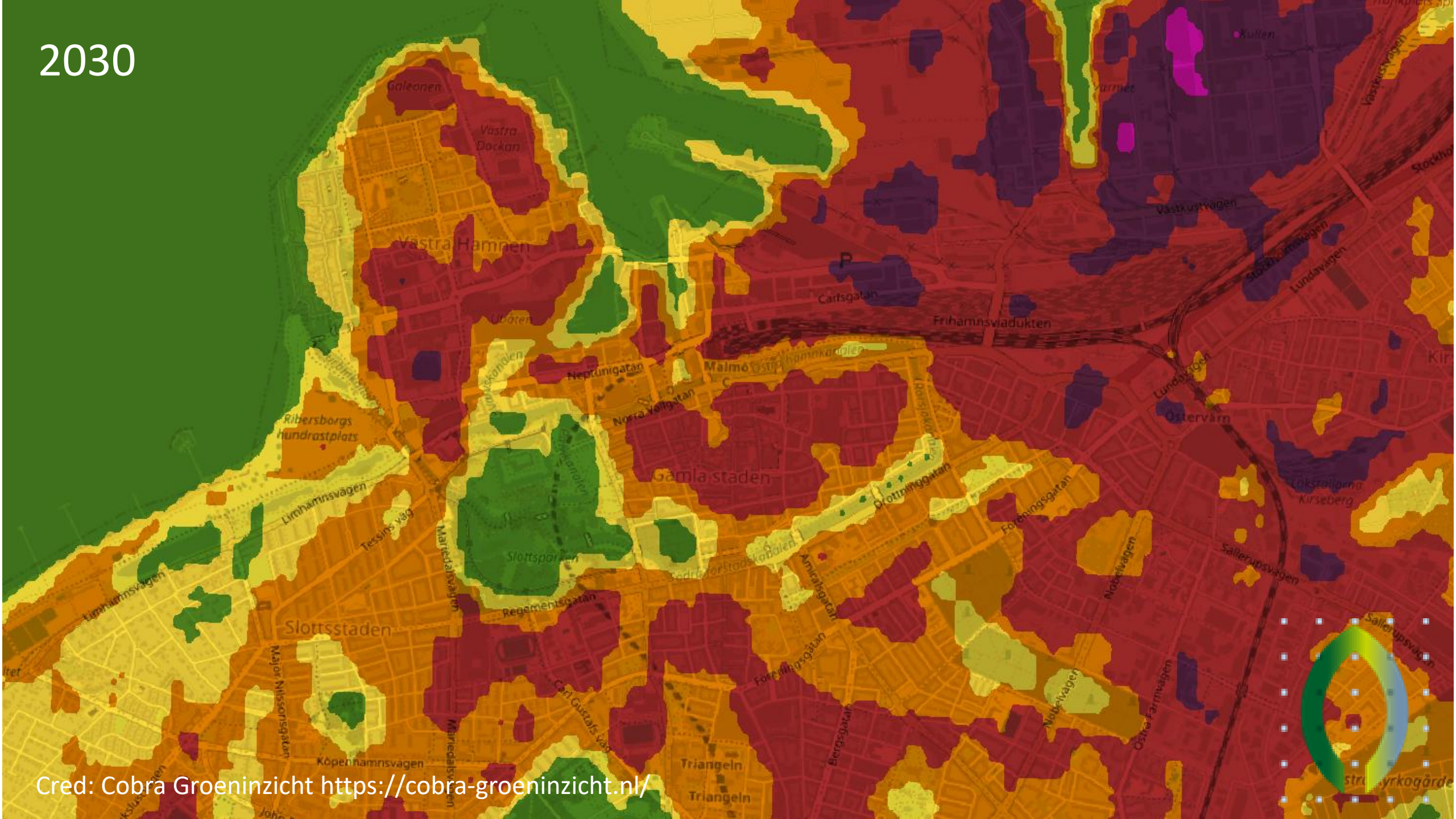
Big trees contribute more and...
Big urban trees take time

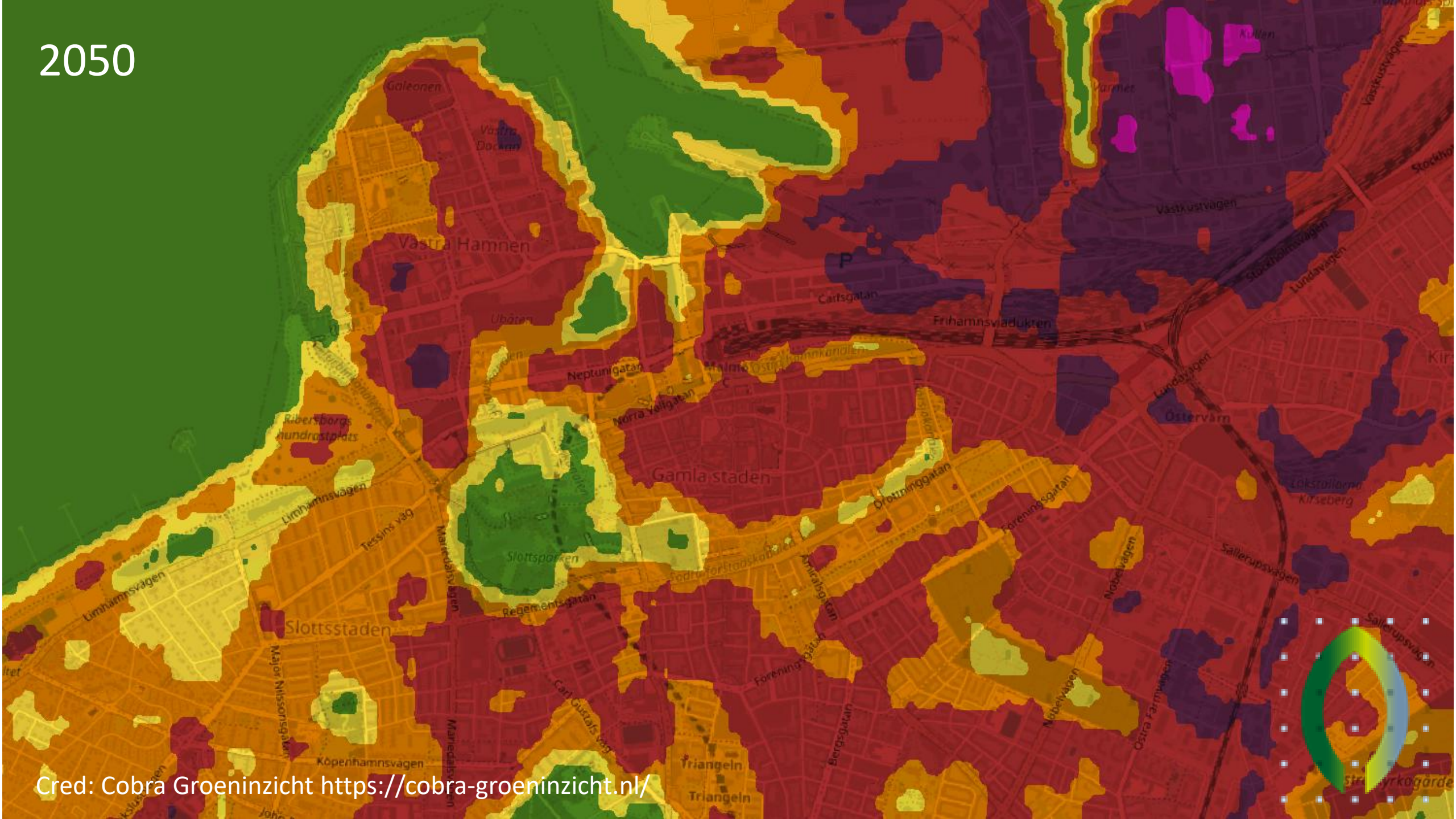


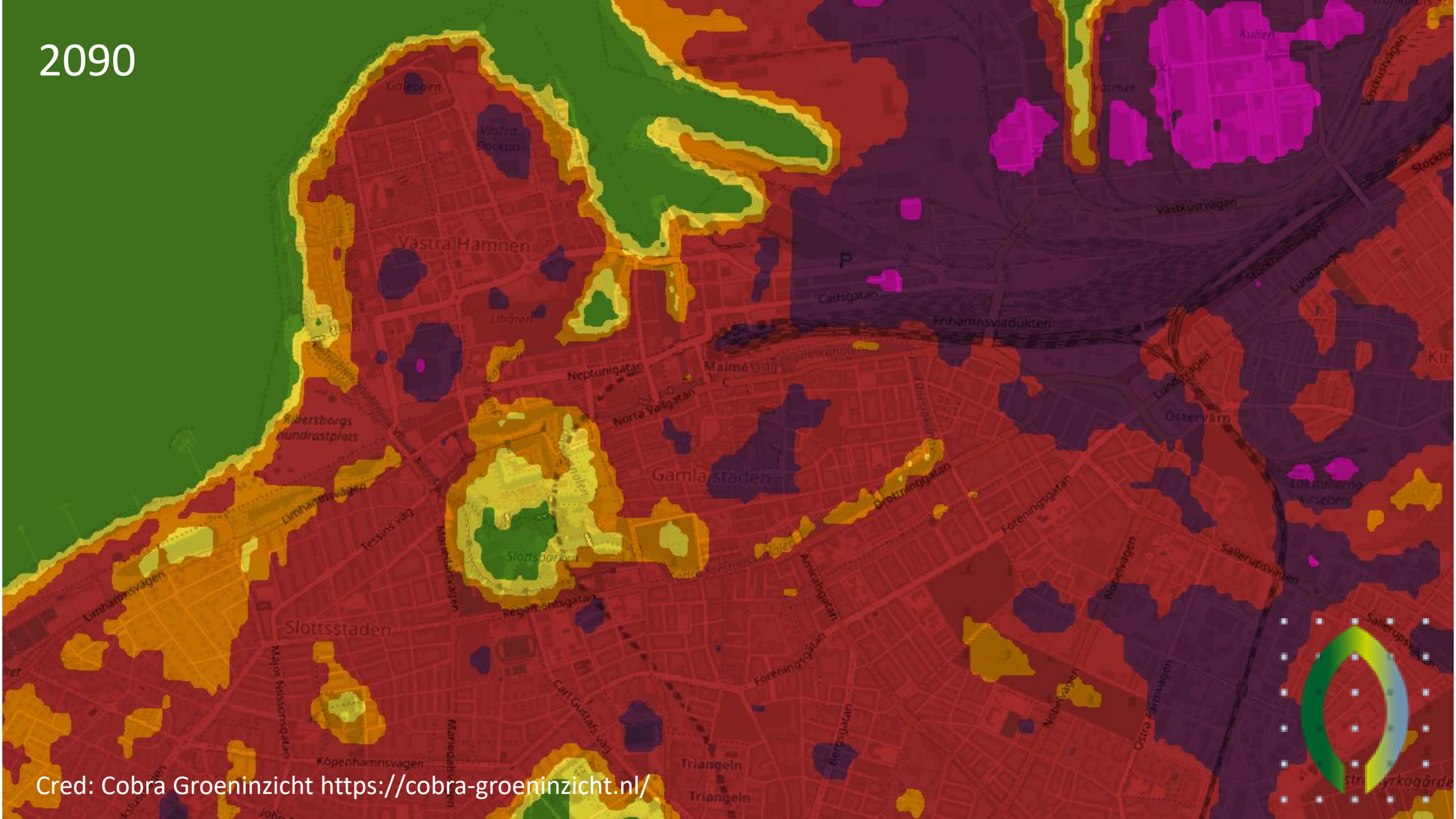
TREES ARE CLIMATE ADAPTATION AGENTS
But.....



Cred: Cobra Groeninzicht https://cobra-groeninzicht.nl/


2030
Västra Hamnen
Gamla staden
Slottsstaden
Triangeln
Triangeln
Malmö Östra hamnkanalen
Carlsgatan
Frihamnsviadukten
Neptunigatan
Norra Vallgatan
Ribersborgs hundrastplats
Limhamnsvägen
Tessins väg
Mariedalsvägen
Regementsgatan
Amiralsgatan
Föreningsgatan
Nobelvägen
Östra Farmvägen
Lundavägen
Västkustvägen
Köpenhamnsvägen
Carl Gustafs väg
Major Nilssonsgatan
Bergsgatan
Ostervärn
Kirseberg
Cred: Cobra Groeninzicht https://cobra-groeninzicht.nl/

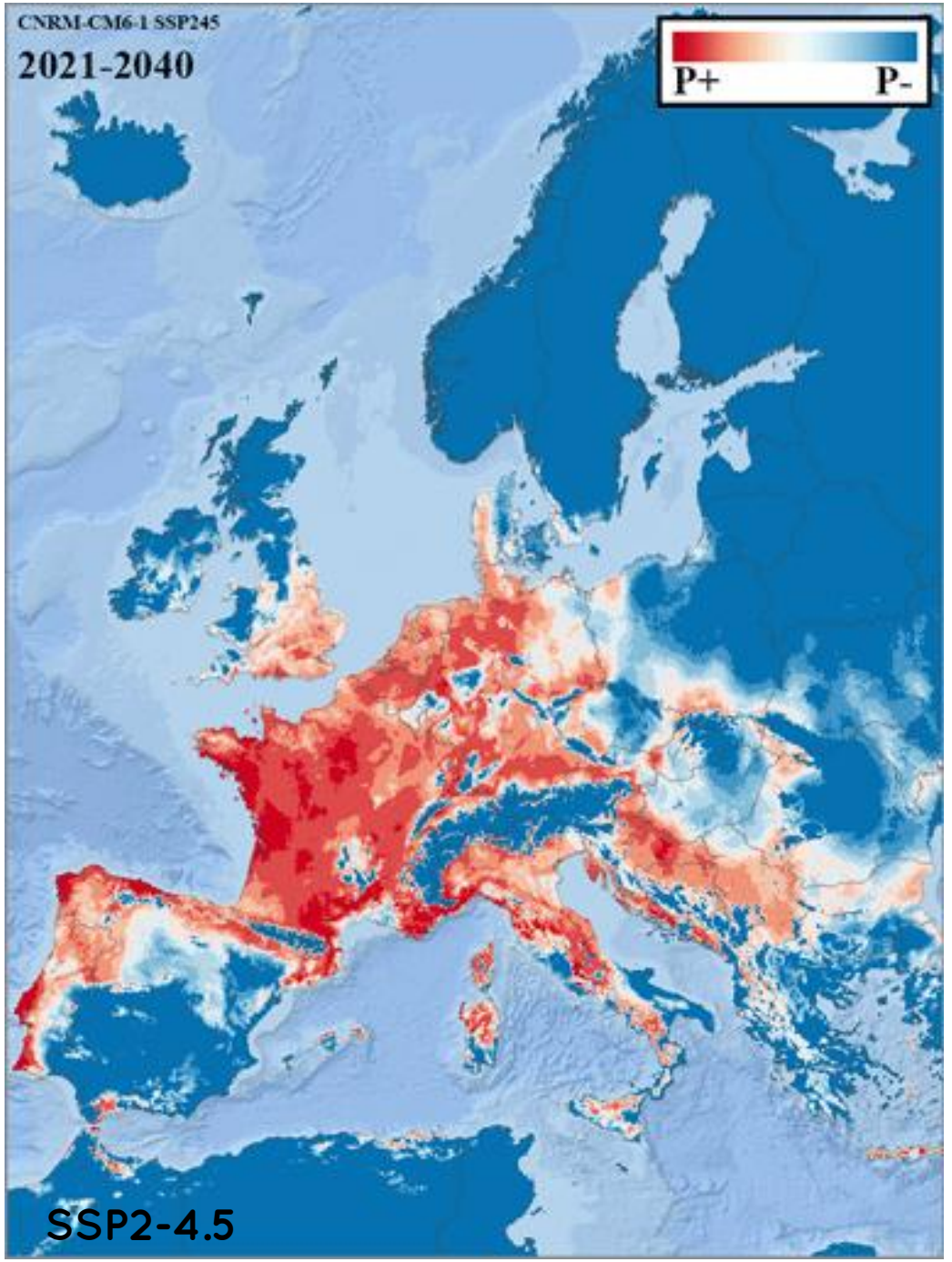

2050
Västra Hamnen
Gamla staden
Slottsstaden
Triangeln
Triangeln
Cred: Cobra Groeninzicht https://cobra-groeninzicht.nl/


2090
Västra Hamnen
Gamla Staden
Slottsstaden
Triangeln
Triangeln
Malmö C
Cred: Cobra Groeninzicht https://cobra-groeninzicht.nl/

trädkontoret.

First prognosis

Simulating the potential spreading of *Ailanthus altissima* in the Nordics.



Cred: Simon Hannus

https://se.linkedin.com/pulse/ailanthus-i-sverige-%C3%A4r-allt-bara-gudars-skymning-en-analys-hannus

Funded by the Nordic Council of Ministers with the objectives of:

Create a network of Nordic cities that can share solutions and ideas between them.

Evaluate how well Nordic cities meet the 3+30+300 rule.

Evaluate the species distribution, with a focus on indigenous/non-native species within the Nordic cities.

YGGDRASIL
The Living Nordic City

FULL REPORT HERE:

https://tradkontoret.se/yggdrasil/

YGGDRASIL

The Living Nordic City

Current species distribution

- Tree species diversity is important!

- Analysis based on tree data from the cities: Malmö, Bergen, Umeå, Stavanger and Kolding
- A variety in data quality
- Santamour model (10-20-30)

Current species distribution

Table 9. *Tree species distribution in the partnering cities, scores marked in red surpass the threshold.*

City	Santamour-ratio (10-20-30)	Most common species (%)	Most common genus (%)	Most common family (%)	Number of trees in database	Ratio native/ exotic trees	Population*	Trees in database per capita
Malmö	6-10-26	Swedish whitebeam (*Sorbus intermedia*) 6%	maple (*Acer*) 10%	Rose family (*Rosaceae*) 27%	91,079	51/49%	362,133	0.25
Bergen	55-55-55	linden (*Tilia sp.*) 55%	linden (*Tilia sp.*) 55%	Mallows (*Malvaceae*) 55%	1,779	56/44%	291,940	0.006
Umeå	56-60-62	silver birch (*Betula pendula*) 56%	birch (*Betula*) 60%	Birch family (*Betulaceae*) 62%	30,915	92/8%	130,224	0.24
Stavanger	16-23-24	sycamore maple (*Acer pseudo-platanus*) 16%	maple (*Acer*) 23 %	Soapberry family (*Sapin-daceae*) 24%	6,563	60/40%	237,369	0.027
Kolding	12-23-23	Norway maple (*Acer platanoides*) 12%	linden (*Tilia*) 23%	Mallows (*Malvaceae*) 23%	11,873	75/25%	62,444	0.19

** From Wlkipedia "City" or "Urban"*

Current species distribution

https://www.umea.se/byggaboochmiljo/naturvardparker/stadstradochskog/bjorkarnasstad.4.19a41f3a17567e789ef11aa.html

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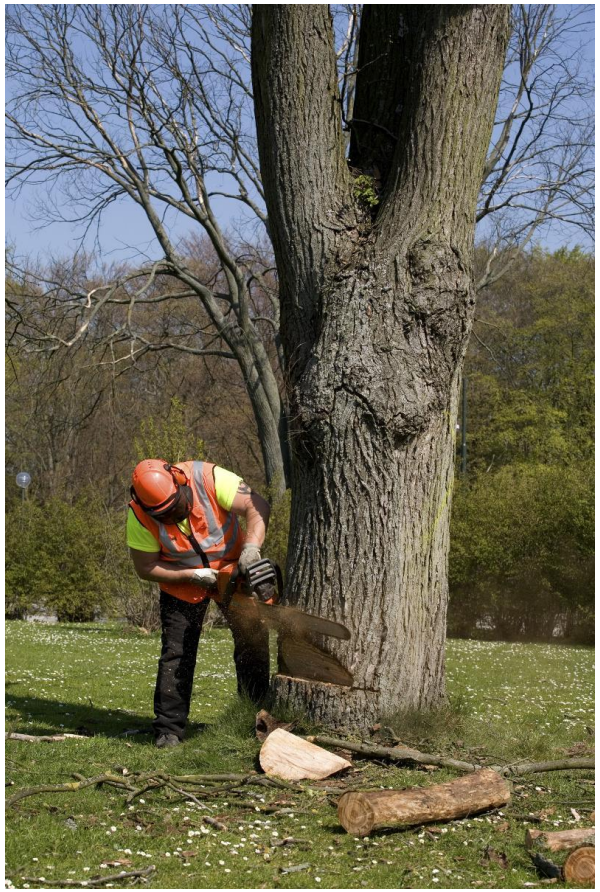
Current species distribution

- Malmö: More than 40 000 elm trees felled due to dutch elm disease



Current species distribution

- Malmö: More than 40 000 elm trees felled due to dutch elm disease
- Strategical planting aiming at very high tree species diversity

Future species distribution

- Investigating current planting practices
- Swedish tree nursery data, from the four largest nurseries
- Analysis of 29 707 sold single stem trees

Future species distribution

Summary	Amount	Percentage
Total amount of trees sold	29,707	100%
Number of exotic trees sold	11,653	39%
Number of native trees sold	15,658	53%
Number of "unknown"* trees sold	2,396	8%
Number of "unknown" and native trees sold together	18,054	61%

*Trees that could not be categorised as native nor exotic due to insufficient data, for example "oaks" (Quercus sp.) that could be any oak, both native or exotic species of oaks.

Table 10. *The species composition of the Swedish nurseries sales of trees during 2023.*

Future species distribution

Place	Species	Number of sold trees	Percentage of total
1	Silver birch (*Betula pendula*)	2,819	9.4%
2	Norway maple (*Acer platanoides*)	2,334	7.8%
3	Sargent cherry (*Prunus sargentii*)	1,520	5.1%
4	Small-leaved linden (*Tilia cordata*)	1,239	4.1%
5	English oak (*Quercus robur*)	1,076	3.6%

Table 12. *The five most commonly sold species in Sweden in 2023 based on the result from the study.*

Future species distribution

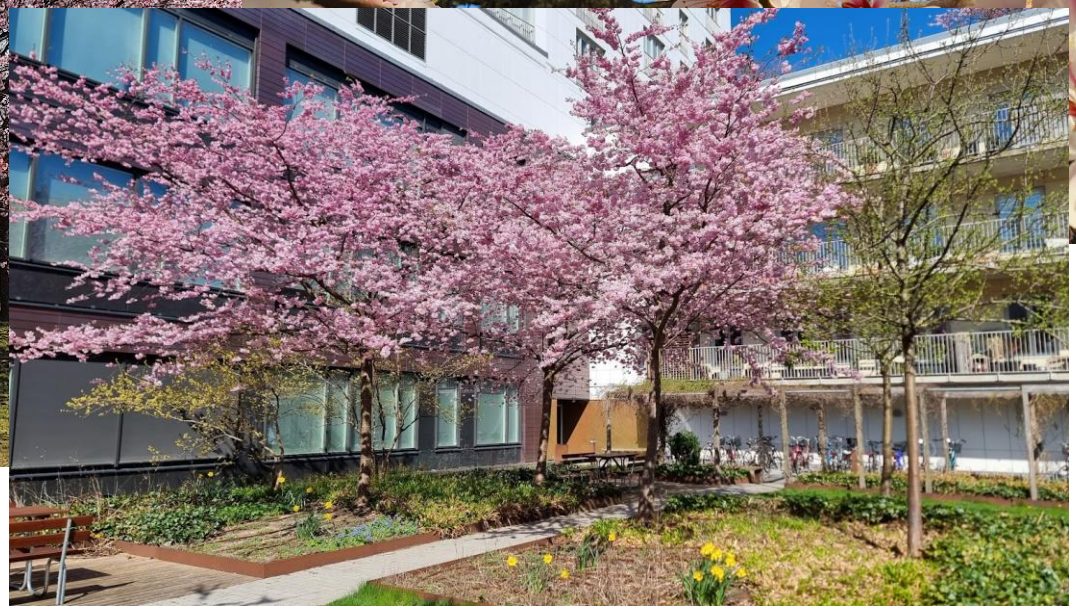
Acer

Santamour (10-20-30): 9-16-41

Guess which family….

Betula pendula

Future species distribution



Climate forecasts

- The future Nordic climate will see an increase in both annual temperature and uneven precipitation patterns.
- How will this change impact our current urban forests?
- **Method**: Climate "forecasts" by combining high resolution climate data and tree species used in the Nordic region

The shift in annual mean temperature from 1981-2010 to 2071-2100
Climate model based on SSP370 scenario for mean annual temp for GFDL-esm4

Climate forecasts

- SSP370 scenario
- 19 variables:
  - Maximum temperature for hottest month
  - Minimum temperature for coldest month
  - Annual precipitation
  - Annual average temperature
  - And many more…

The shift in annual mean temperature from 1981-2010 to 2071-2100
Climate model based on SSP370 scenario for mean annual temp for GFDL-esm4

Results

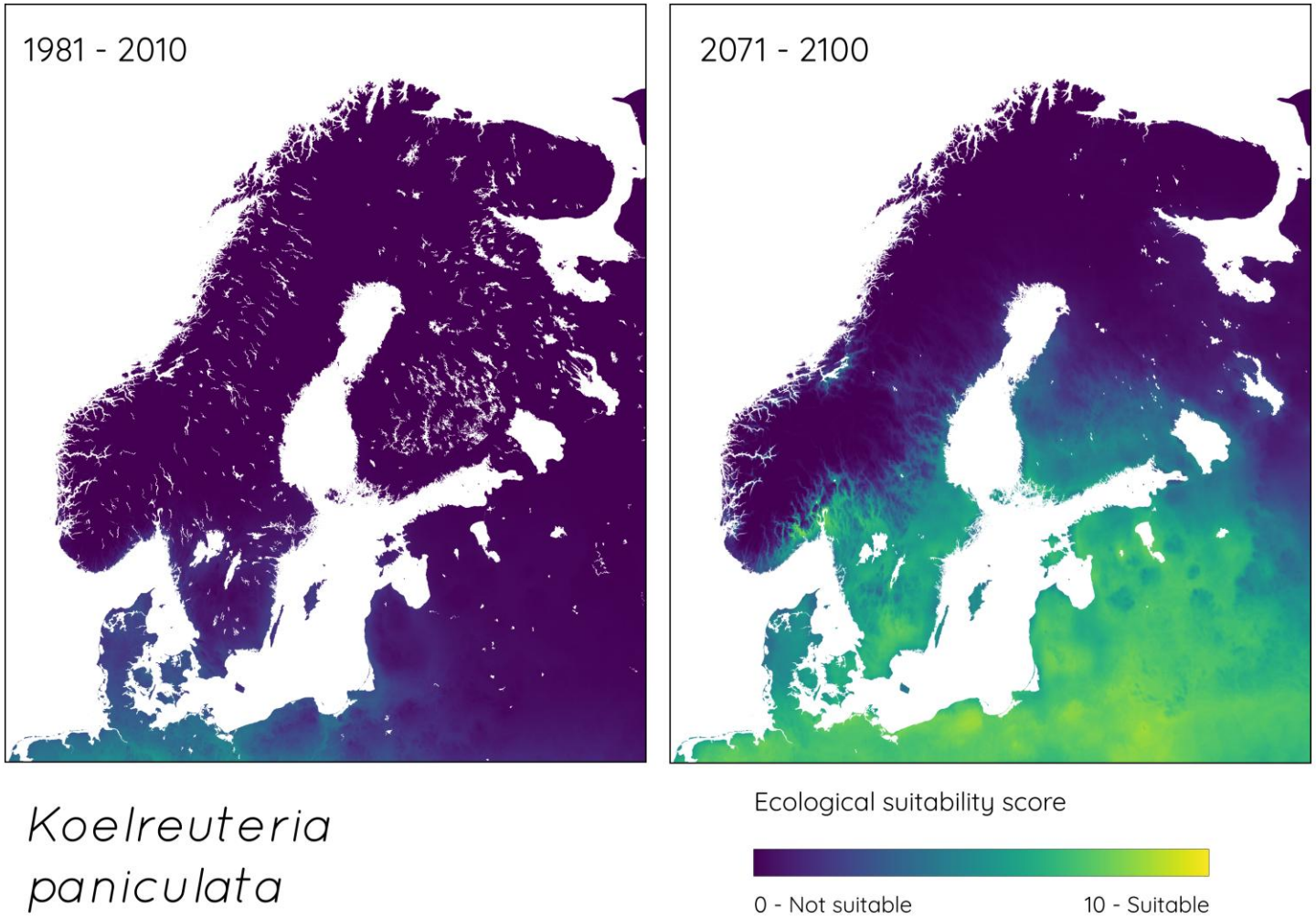
- Rising temperatures will drive environmental boundaries further north
- Species adapted to dryer and warmer climate will meet improved conditions
- Species with poor resistance to drought will meet lesser conditions

Especially in urban areas!

Estimated movement of Betula pubescens from 1981-2010 to 2071-2100

Results

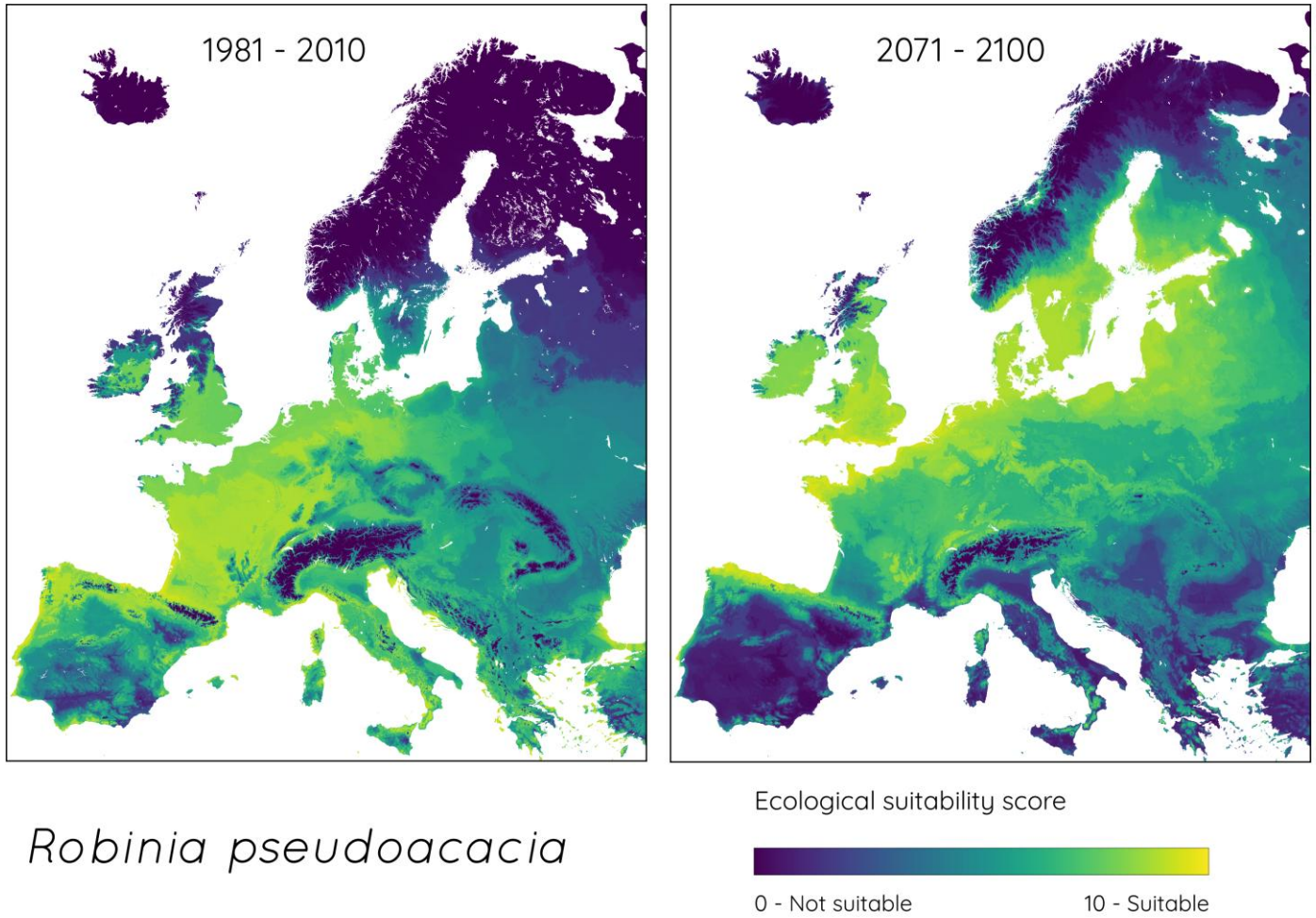
- Increased temperatures will extend the growing season, benefiting both native and exotic species.
- Potential for new tree selections
- Risks of new invasive species
- Risks of new pests and diseases



Koelreuteria paniculata

Results

- Increased temperatures will extend the growing season, benefiting both native and exotic species.
- Potential for new tree selections
- Risks of new invasive species
- Risks of new pests and diseases
- Eg: Species with a high risk of invasiveness (*Robinia pseudoacacia*) are likely to become invasive.



Robinia pseudoacacia

Species	1981–2010 score	2071–2100 score
Prunus maackii	9	2
*Sorbus intermedia**	8	1
Populus balsamifera	9	6
*Picea abies**	6	4
Populus simonii	8	7
*Populus tremula**	6	5
*Sorbus aucuparia**	7	6

Table 14. *Table showing the species with the most negative predicted development for the Stockholm region in 2071–2100 compared to 1981–2010. The score is based on the raster values for each species from the climate forecast with Stockholm as a geographical reference point. Species native to Sweden are marked with an asterisk (*)*

Species	1981–2010 score	2071–2100 score
Pterocarya fraxinifolia	1	8
Acer saccharinum	2	8
Corylus colurna	1	7
Quercus palustris	1	7
*Acer campestre**	2	7
Fraxinus ornus	1	6
Platanus x hispanica	0	4
Robinia pseudoacacia	3	7
*Ulmus minor**	2	6
Gleditsia triacanthos	1	4
Koelreuteria paniculata	2	5
Metasequoia glyptostroboides	2	5
Pinus nigra	3	6
Pyrus communis	6	9
Quercus rubra	5	8
Tilia x euchlora	4	7

Table 13. *Table showing the species with the best predicted development for the Stockholm region in 2071–2100 compared to 1981–2010. Higher scores indicate better ecological conditions, and lower scores indicate less suitable conditions for each species. The score is derived from the suitability score (see Figure 57 and 58) for each species from the climate forecast, with Stockholm as the reference point. Species native to Sweden are marked with an asterisk (*).*

Betula pubescens

Tidsperiod: 1981 - 2010

METODIK

Preparering arter
Information om en trädarts observerade förekomst hämtas från portalen Gbif.org. Först filtreras med målet att preparera och gallra dessa data för användning, inklusive att ta bort observationer med hög osäkerhet och duplicerade koordinater, samt att partitionera data i block för vidare analys
Preparering klimat
Data laddas ner från https://chelsa-climate.org/. Den innehåller högupplöst globala klimatdata. Klimatdatan bearbetas genom olika paket i programspråket R och beskärs sedan för att passa upptagningsområdet, i detta fall Europa
Prognosmodell
Artförekomst tillsammans med klimatdata bearbetas sedan genom ett Maxent-script i programspråket R där varje arts potentiella habitat modelleras efter förekomst- och klimatdata. Scriptet genererar, för valt årsintervall, ett rasterlager artens förväntade utbredningsområde.

Betula pubescens

Tidsperiod: 2071-2100

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Quercus petraea

Tidsperiod: 1981 - 2010

METODIK

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Quercus petraea

Tidsperiod: 2071 - 2100

METODIK

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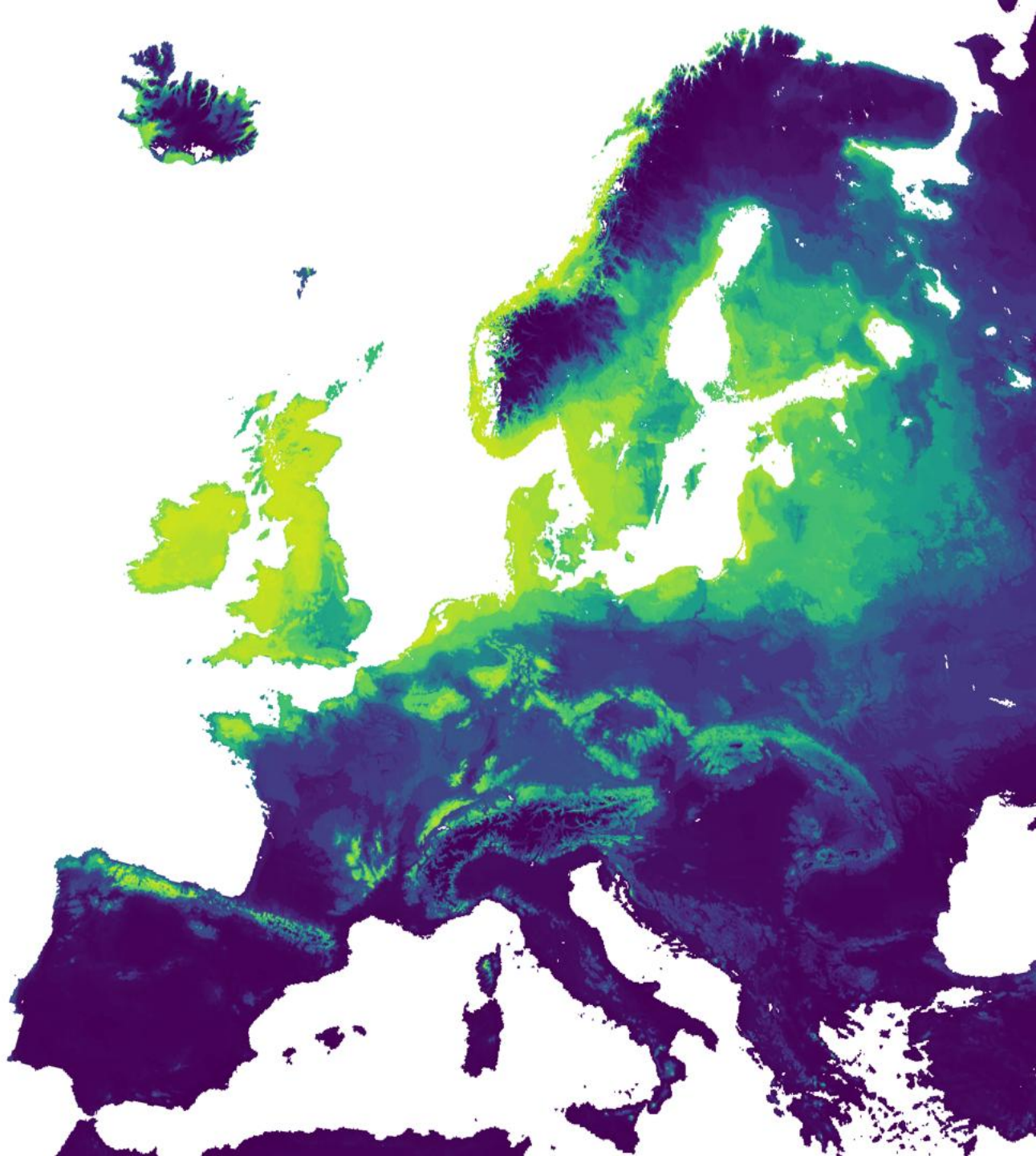


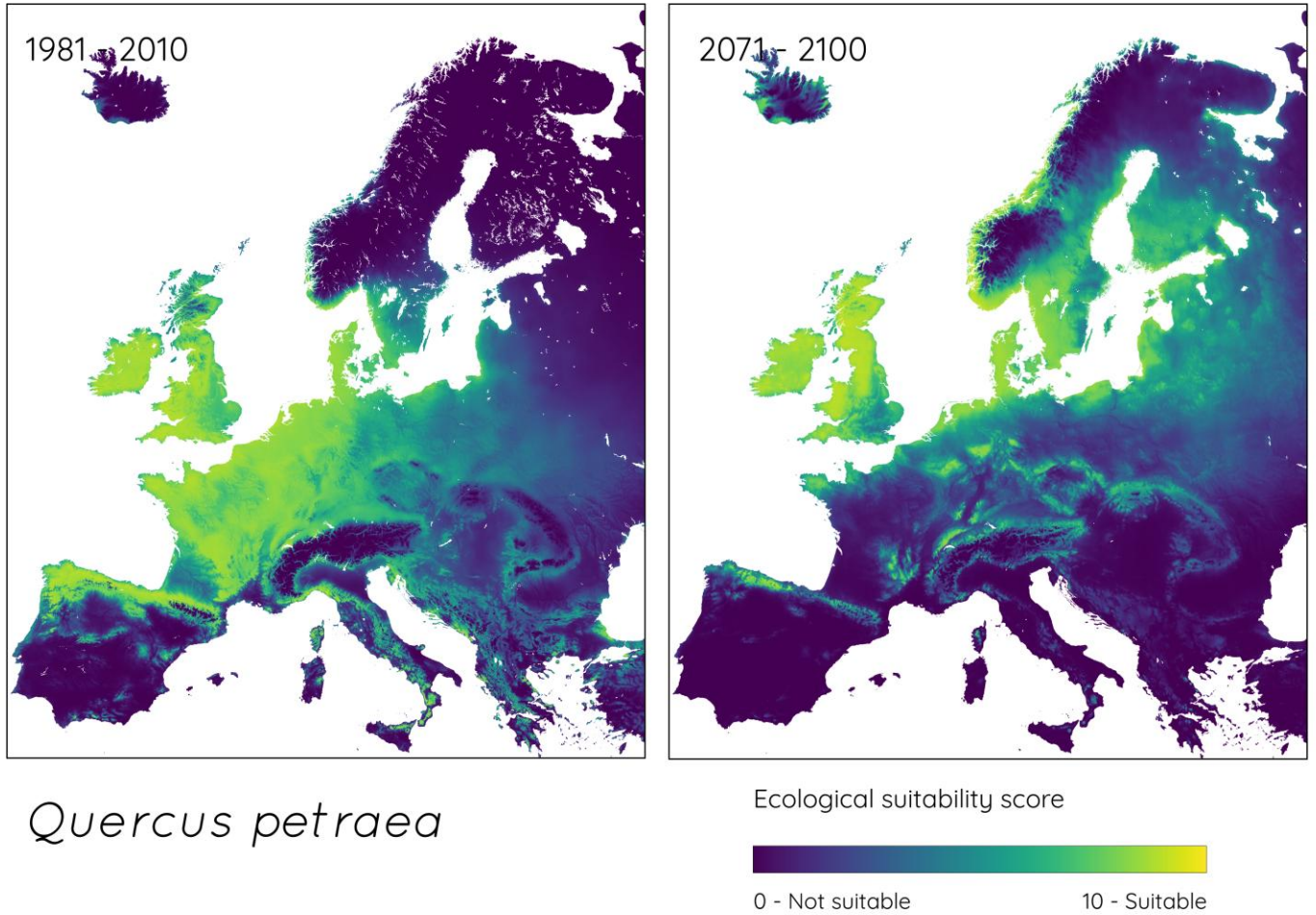
Impact on 3-30-300

- Street trees are often subjected to a range of stressors.
  - Limited root space
  - Compacted soil
  - Lack of nutrients and water
  - Pollution from traffic and construction
- Trees already struggling in these environments will be more vulnerable
- Trees adapted to harsh growing circumstances will better be able to grow into mature trees

Dry summer conditions with drought stressed trees in central Malmö. Photographer: Johan Östberg

Conclusions

- An increase in annual mean temperature will drive ecological boundaries further north.
- Future tree selection should prioritize species that can withstand heat, drought, and urban stressors.
- Climate adapted trees are crucial for maintaining tree canopy coverage and ecosystem services



Quercus petraea

Thanks for listening!

trädkontoret.

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