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INRAE

IPM Popillia
Integrated Pest Management of Japanese Beetle

How reachable is Europe for the Japanese beetle ?

Tracking planes, trains and trucks to inform surveillance strategies

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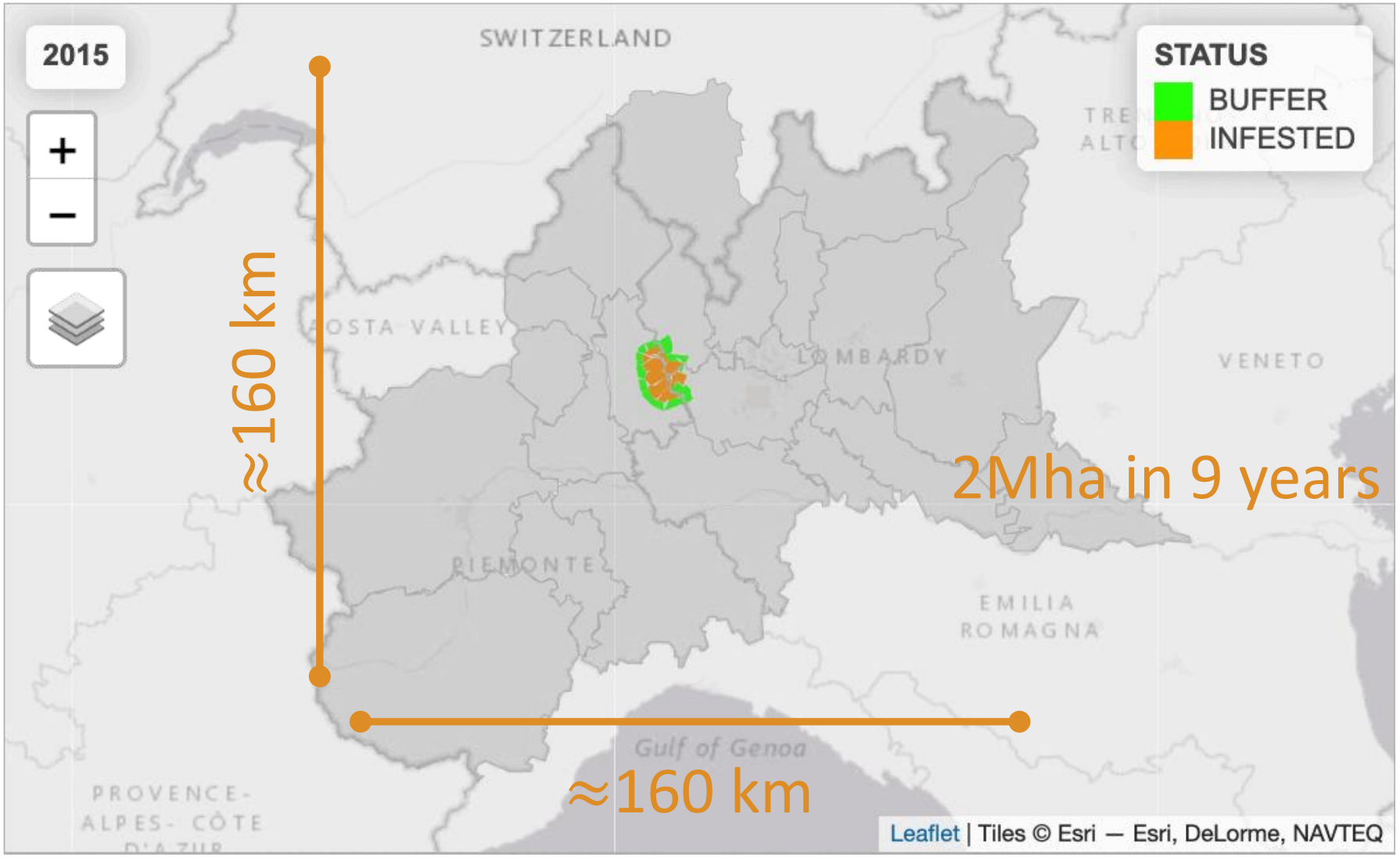
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861852

Active dispersal



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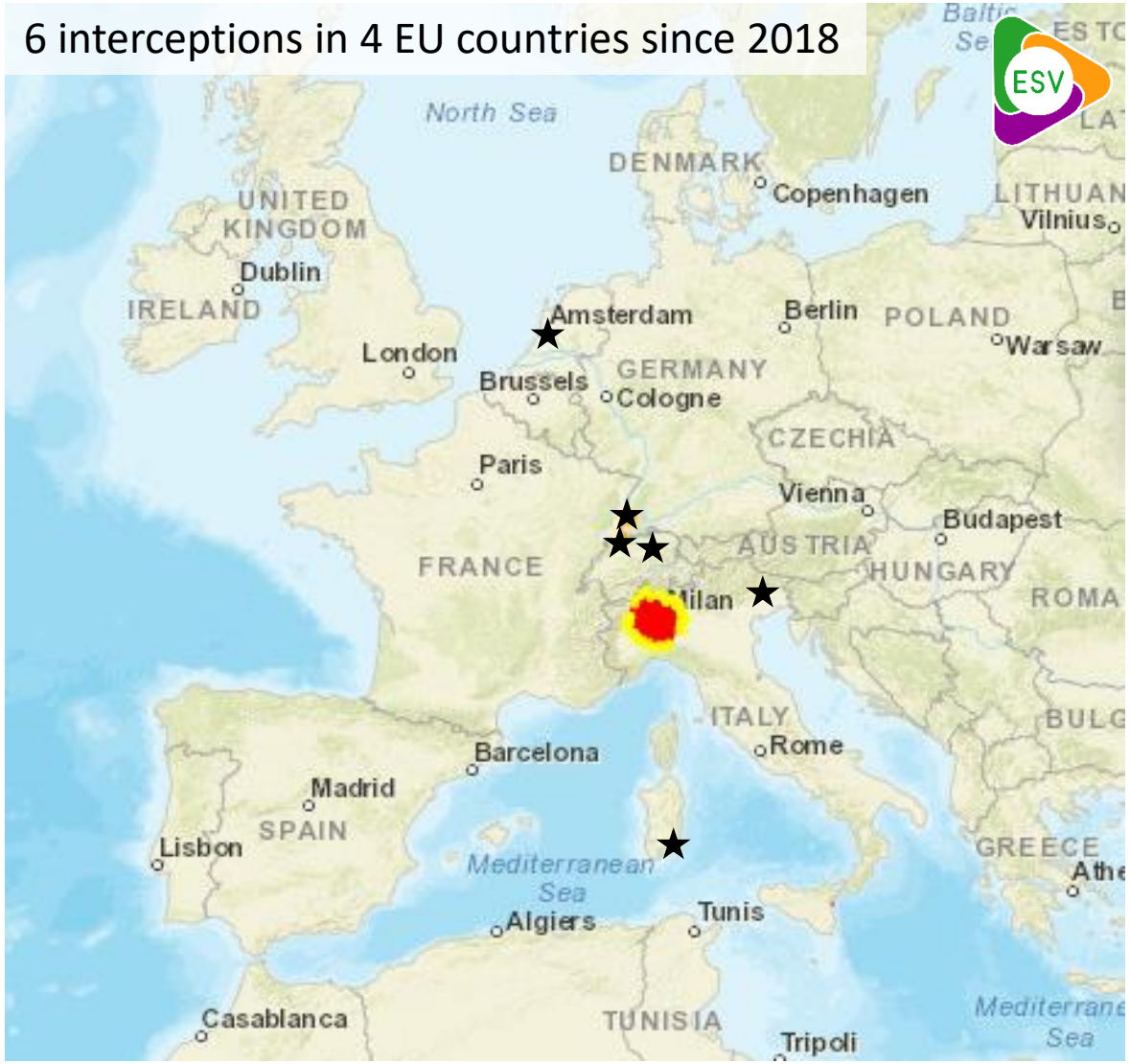
Hitchhiker pest - human-facilitated dispersal



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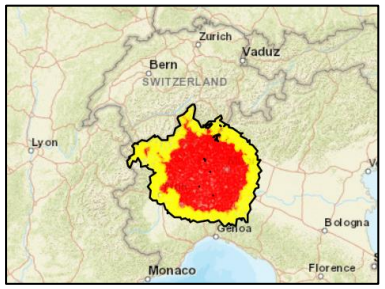
How is the infested area connected to the rest of Europe by transport networks?

1. **Select transport mode** relevant to the Japanese beetle's dispersal: planes, trains and trucks
2. **Compile data** on directional flows in EU, during adult emergence (summer)
3. **Assess** transport network **connectivity from the infested area**
4. **Rank** sites from most reachable to least reachable



Infested area = cities in (infested + buffer) zone in 2022

3 databases

SCAN ME!

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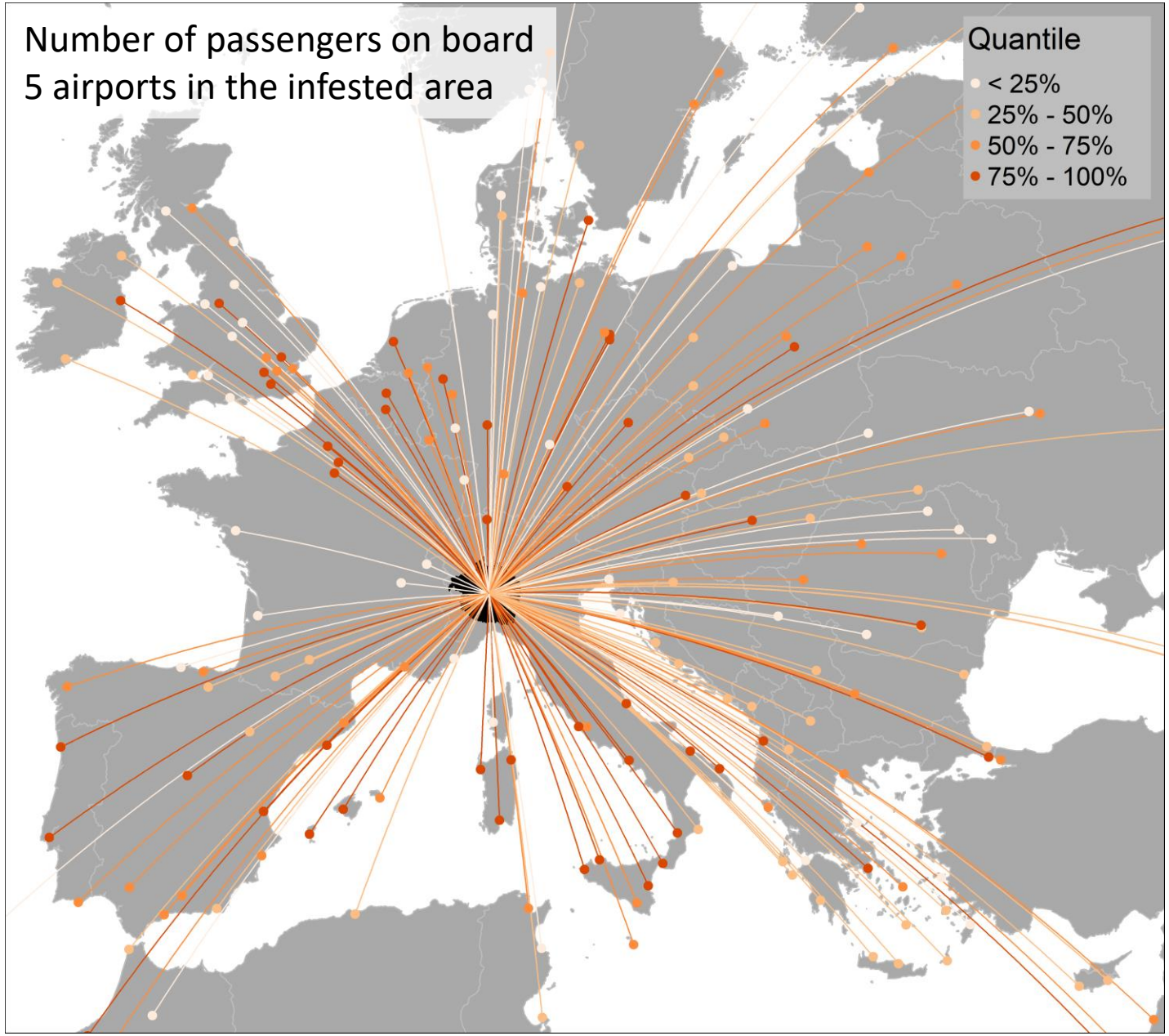

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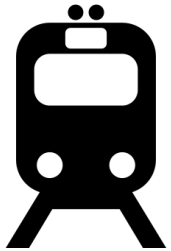

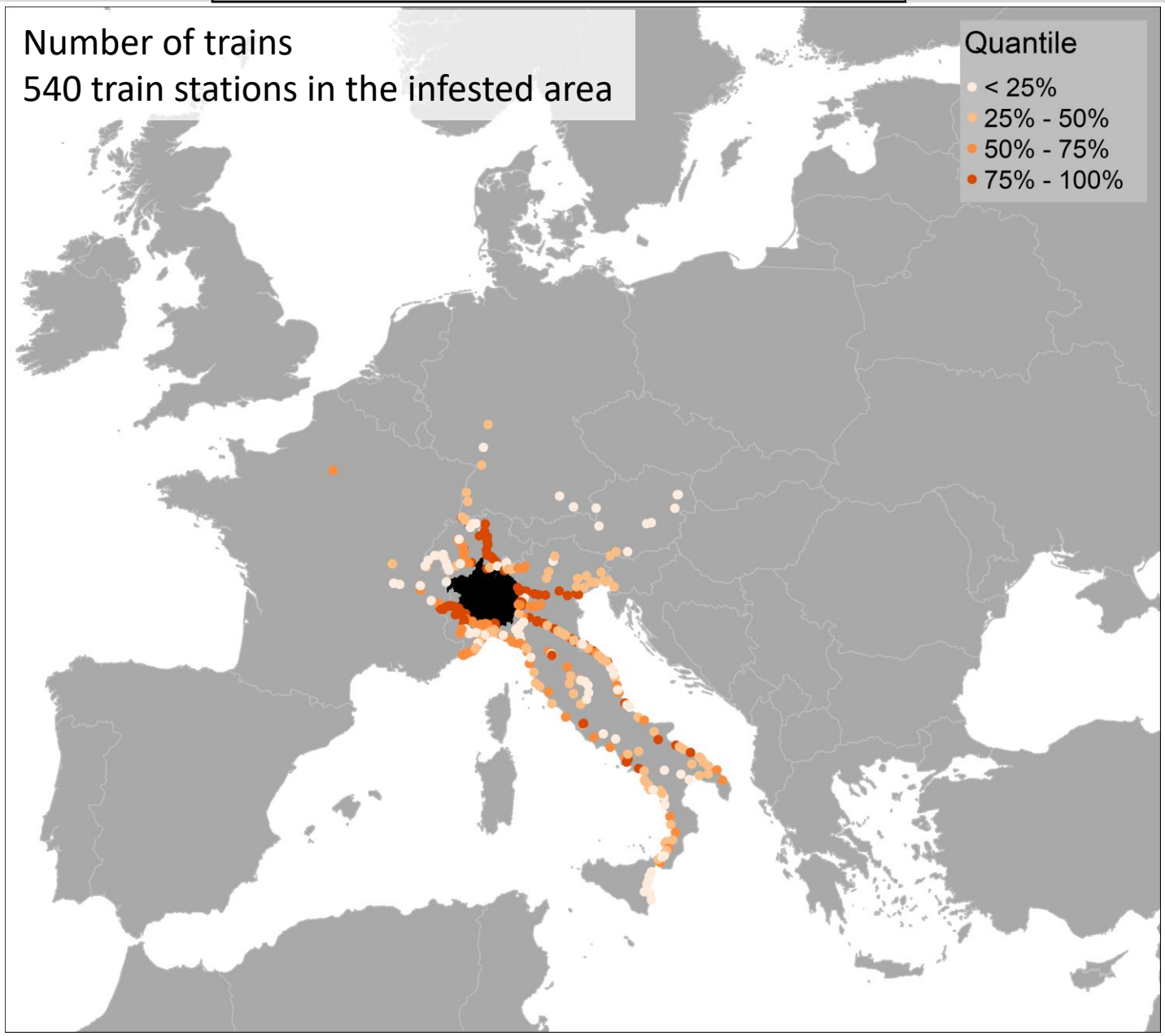

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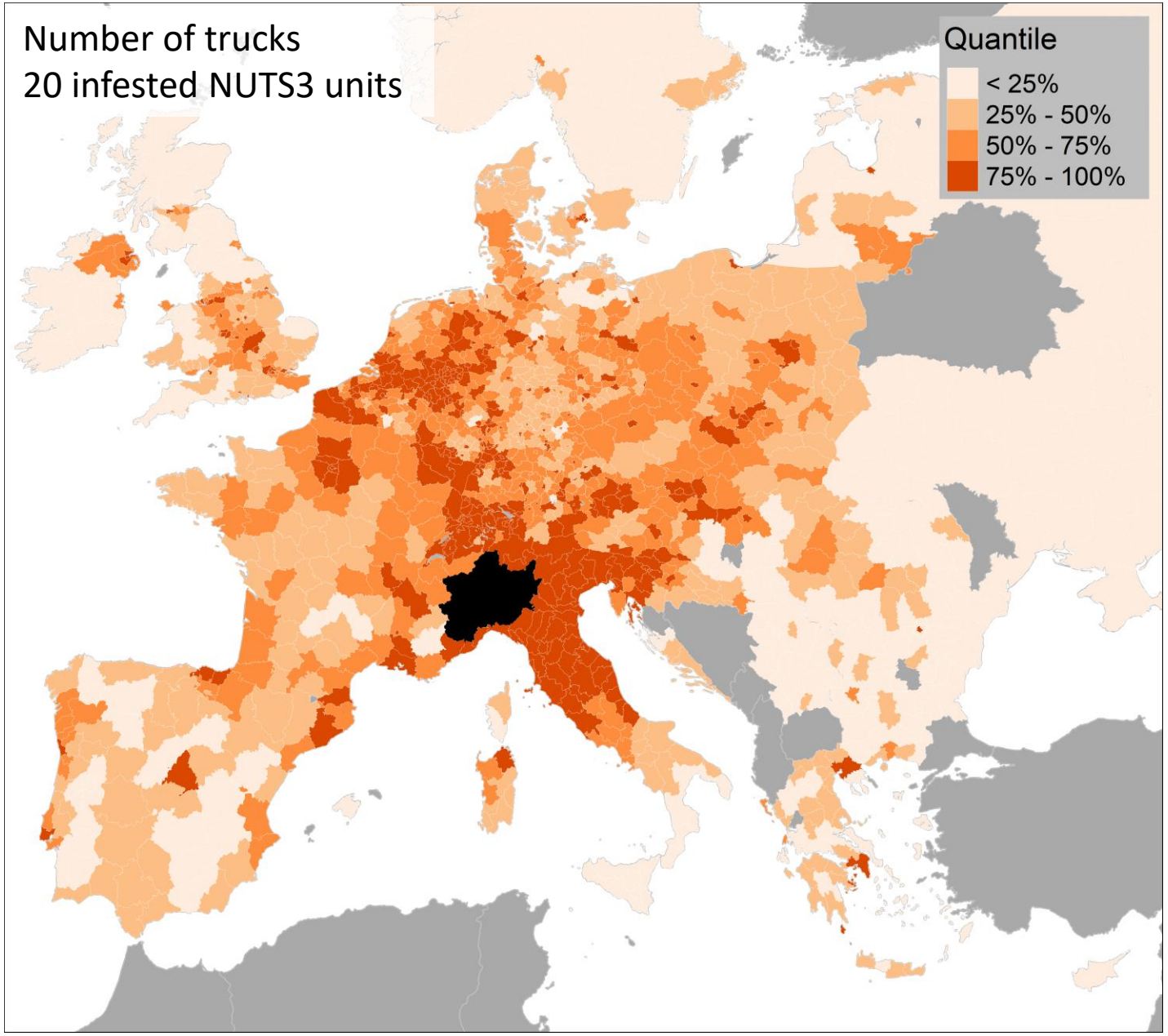

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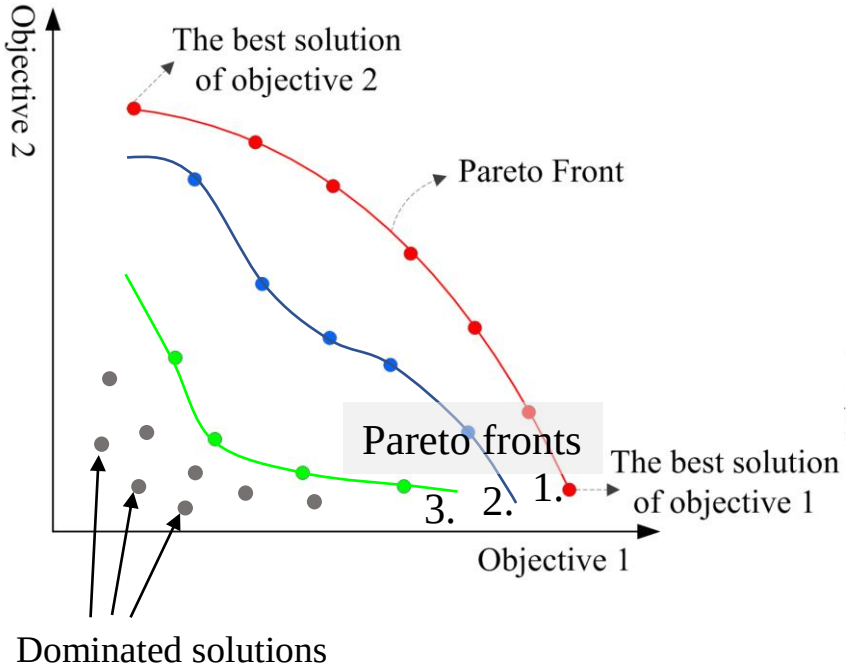
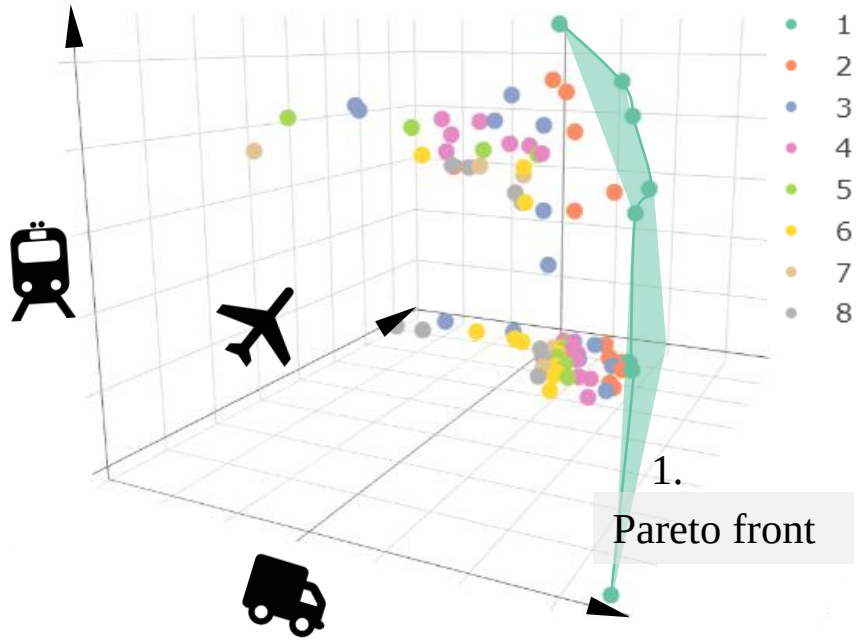
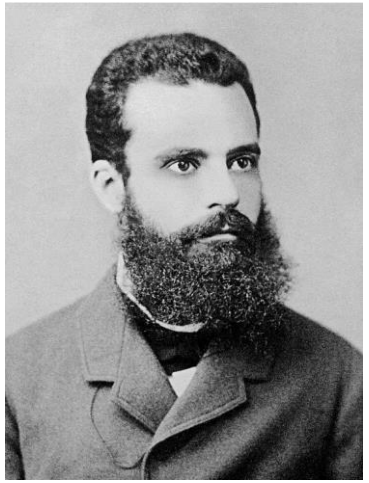
Combining planes, trains & trucks using Pareto front

Multi-objective optimization method, the **Pareto front** (also called **Pareto frontier** or **Pareto curve**) is the set of all Pareto-efficient situations







Vilfredo Pareto (1848–1923), Italian civil engineer and economist

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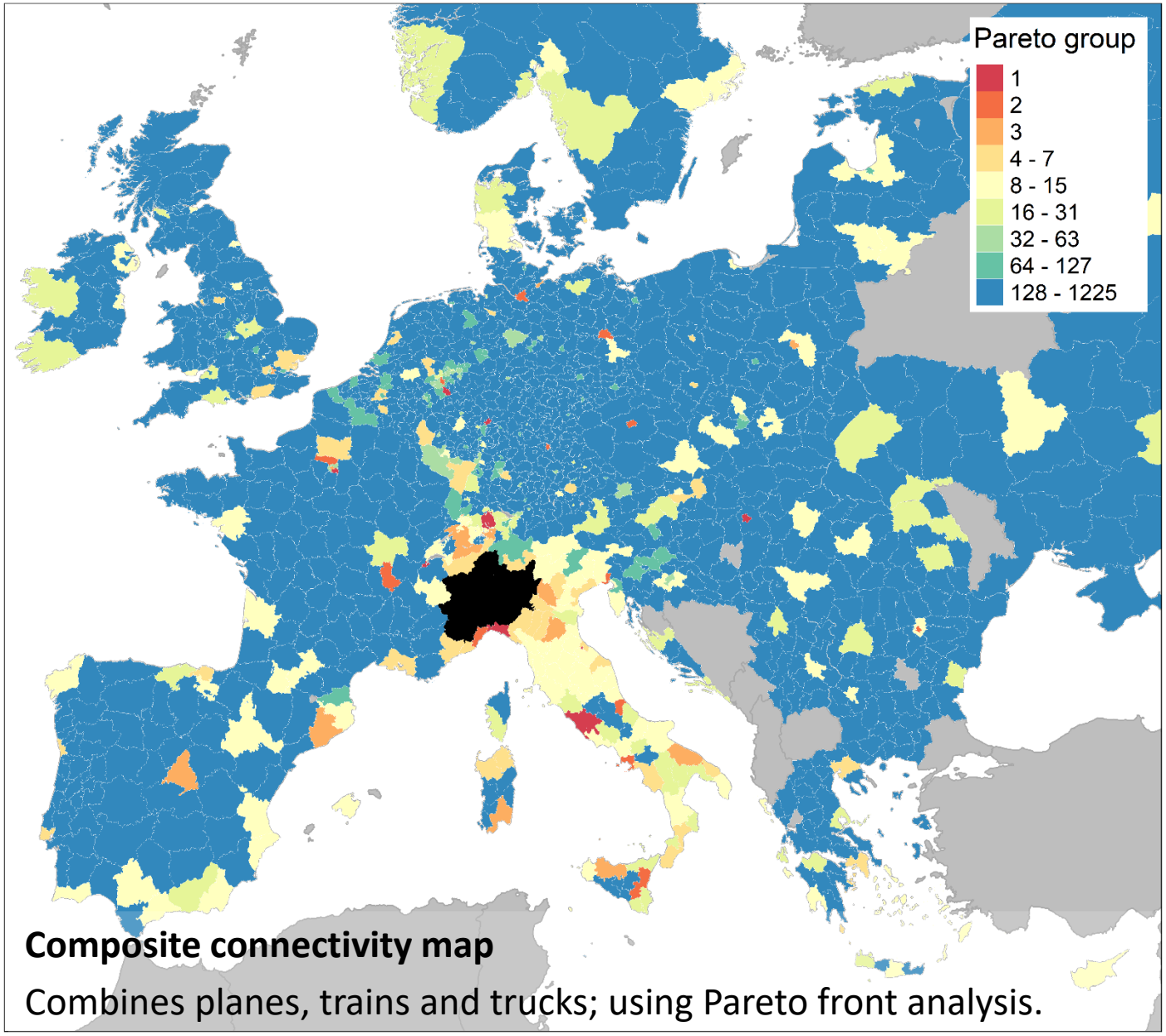

Composite connectivity map

Combines planes, trains and trucks; using Pareto front analysis.

1st Pareto front

Geneve	CH
Zurich	CH
Frankfurt am Main, Kreisfreie Stadt	DE
Koln, Kreisfreie Stadt	DE
Val-de-Marne	FR
Budapest	HU
Genova	IT
Roma	IT
San Marino	SM

2nd Pareto front

Hlavni mesto Praha	CZ
Berlin	DE
Dusseldorf, Kreisfreie Stadt	DE
Hamburg	DE
Nurnberg, Kreisfreie Stadt	DE
Rhone	FR
Val-d'Oise	FR
Catania	IT
Gorizia	IT
Napoli	IT
Pescara	IT
Savona	IT
Bucuresti	RO

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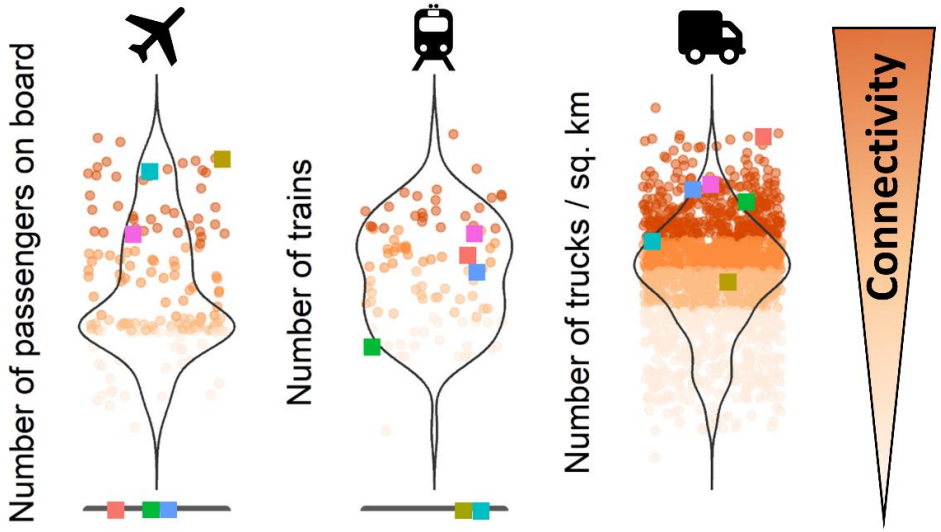
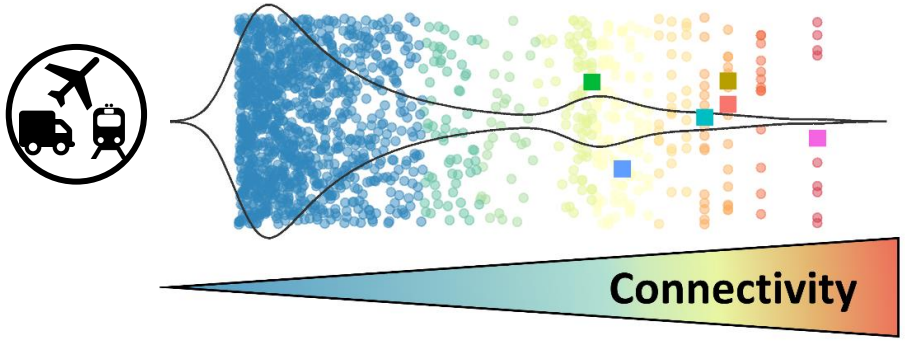


Composite index of connectivity - Pareto front:



P. japonica interceptions

- Basel-Stadt, 2021
- Cagliari, 2021
- Freiburg im Breisgau, 2022
- Groot-Amsterdam, 2018
- Udine, 2022
- Zurich, 2023

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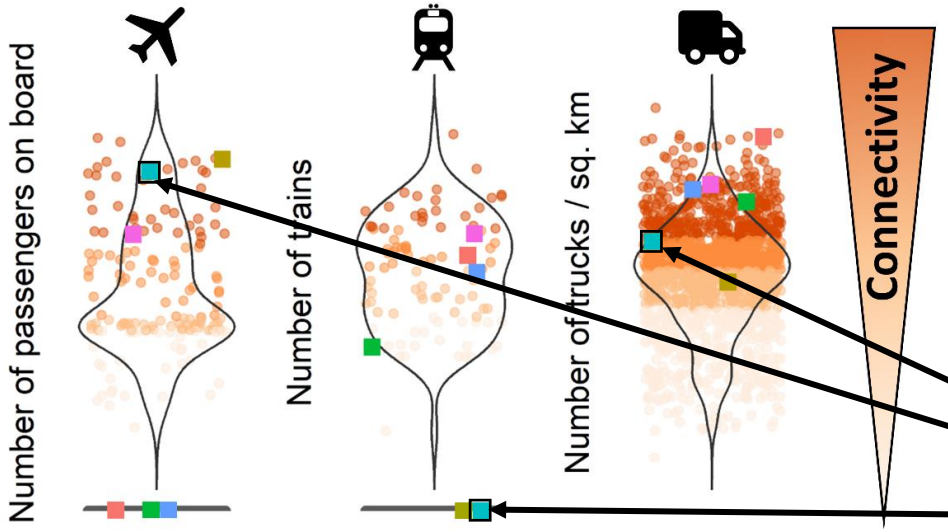
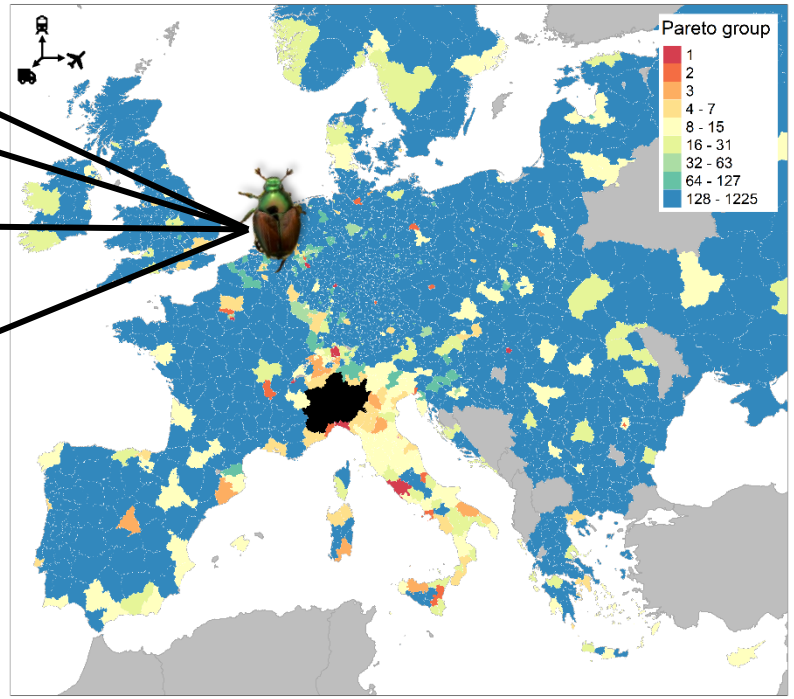
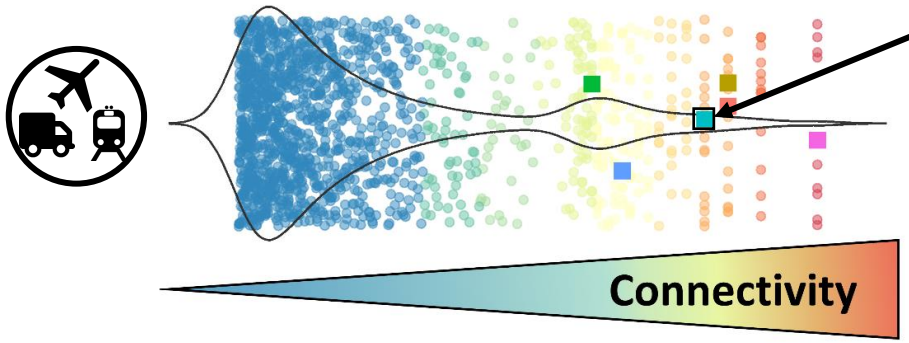


Amsterdam



Composite index of connectivity - Pareto front:



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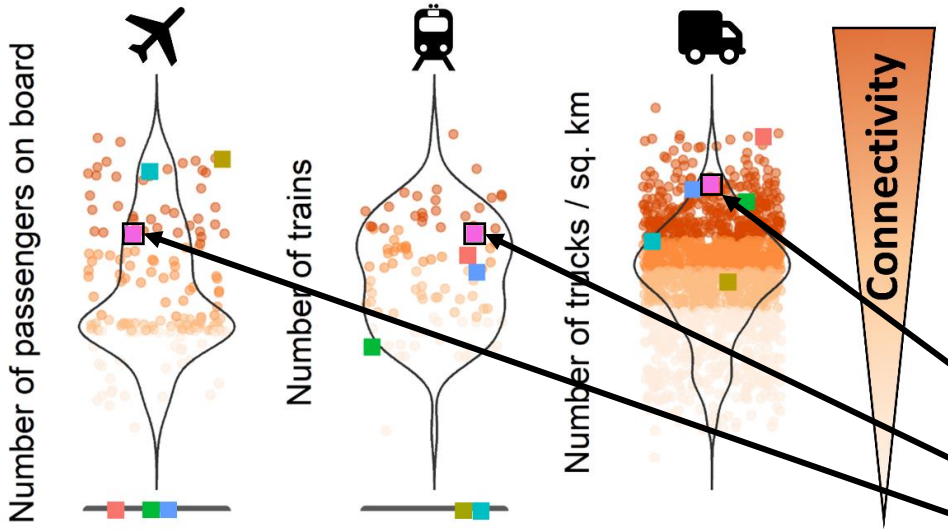

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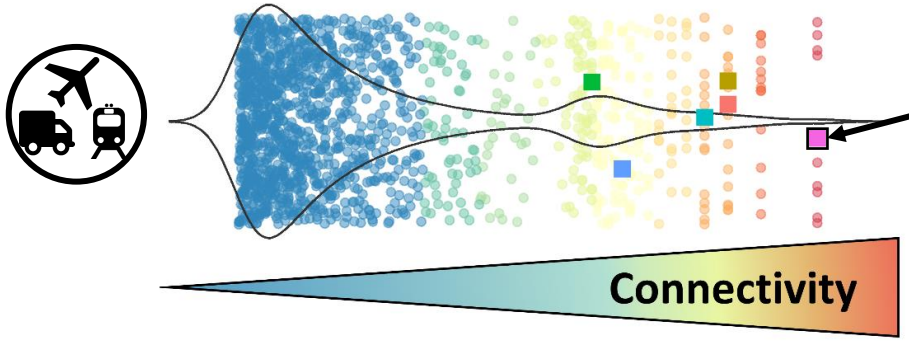
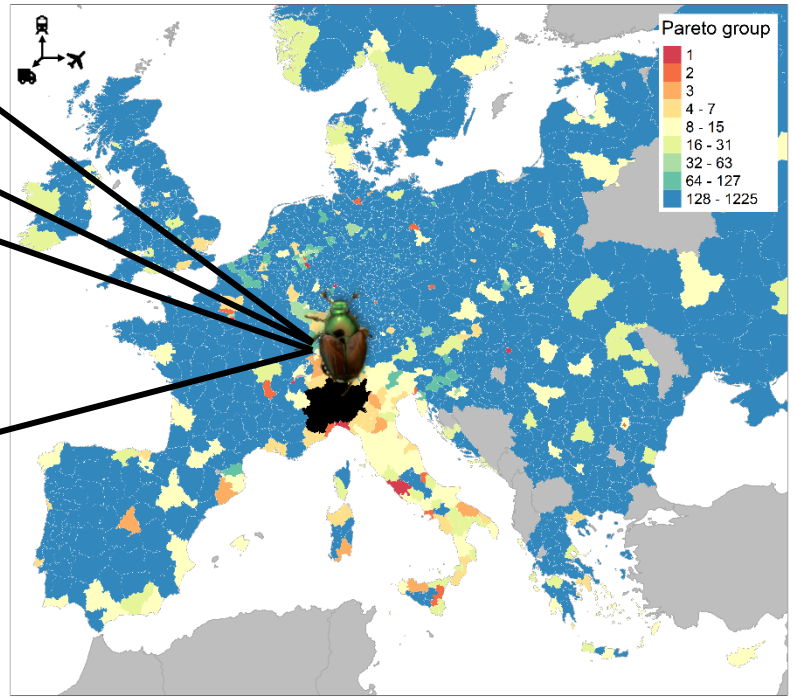


P. japonica interceptions

- Basel-Stadt, 2021
- Cagliari, 2021
- Freiburg im Breisgau, 2022
- Groot-Amsterdam, 2018
- Udine, 2022
- Zurich, 2023

Zurich

One of the nine European sites most connected to the area infested by the Japanese beetle.



New outbreak reported in July 2023.

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What could this framework be used for?

- Tool to model hitchhiker pests' spread
- Design surveillance at **continental** level
- Improve **risk assessment**

Publication and dataset

OPEN ACCESS

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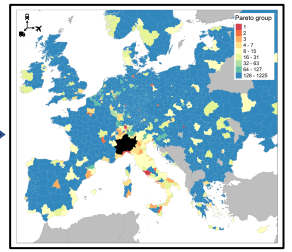
Is this site reachable ?

Yes

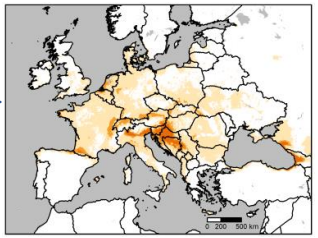


No

No priority for surveillance

Is this site suitable?

Yes



No

No priority for surveillance

Would pest impact be high?

Yes

No

No priority for surveillance

Priority for surveillance

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Thank you all for your attention

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H2020 IPM Popillia project

www.popillia.eu

IPM Popillia
Integrated Pest Management of Japanese Beetle

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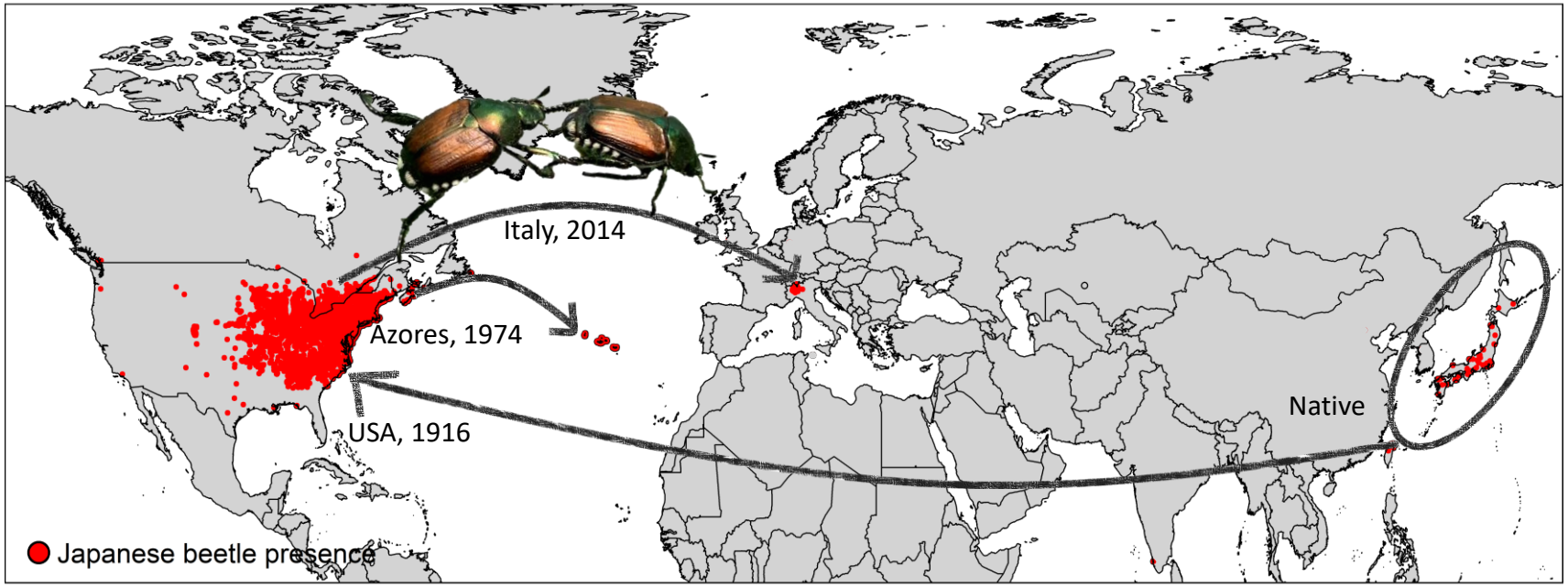
Popillia japonica - Coleoptera

- Native to Japan
- Successfully introduced and established in the USA, and the Azores archipelago
- First detected in continental Europe in Italy in 2014

A biological invasion in progress



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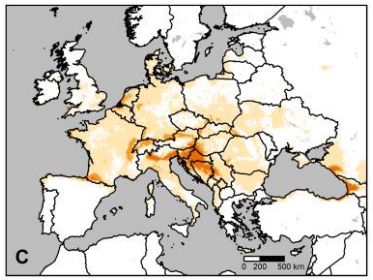
Combining suitability, dispersal, and pest impact to build a surveillance strategy

Risk-based surveillance strategy

Suitability

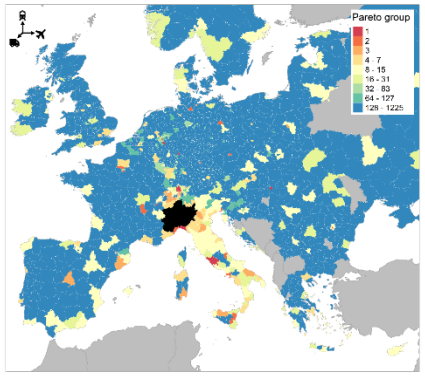


Borner, Leyli, Davide Martinetti, and Sylvain Poggi. « A new chapter of the Japanese beetle invasion saga: predicting suitability from long-infested areas to inform surveillance strategies in Europe ». *bioRxiv*, 2022. https://doi.org/10.1101/2022.11.14.515960.

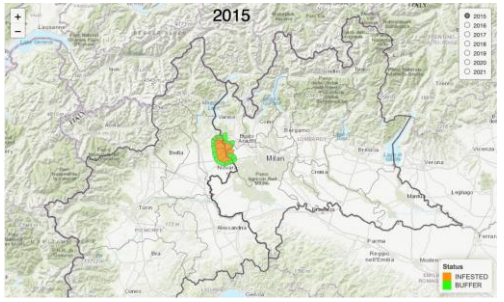
Dispersal

How reachable is a place from the infested zone ?

Passive dispersal



Active dispersal



Pest Impact

How much (€) could a place be affected ?
- depending on yield loss and control/surveillance costs -
(Straubinger *et al.*, 2022)

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For human-transported pests and pathogens with a European range, the framework presented here allows for the identification of entry points within Europe.

Improvements:

- More precise trade data, for example using movements of goods specifically identified as carrying pests (soil, plants, etc.) (Fenn-Moltu et al. 2023),
- entry points identified may be refined by cross-referencing with the presence of sensitive host plants or favourable ecological conditions.
- Local connectivity can also be used to refine field efforts: distribution of airports, train stations, truck stops, etc (Plötz and Speth 2021).

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Biology and behavior of the Japanese beetle

Piedmont region, Italy - July 2021
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adult stage larval stages

Life cycle

- Life cycle: 1-year (sometimes 2-years)
- Emergence: between May and July
- Life span: ~ 4-6 weeks
- Egg-laying in grasslands (late summer): 40-60 eggs/female
- Three larval stages, buried >15cm deep: December

Damages in larval and adult stages

- Grass roots (grass, lawns, pastures)
- Fruits, flowers and foliage of host plants (> 400 plant species)

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References

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