

Finding the busiest European air routes that can be travelled by train

(with coordinates of locations, unique identifiers, and
labels in multiple languages)

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Hi, I'm Giorgio Comai

- researcher and data analyst working for OBCT/CCI
- we coordinate the [European Data Journalism Network](#)



- I process data and create tools for data journalists
- I code in the R programming language
- I am the author of the R package [tidywikidatar](#) - an R package that facilitates exploring 'Wikidata' through tidy data frames

A report: Train alternatives to short-haul flights in Europe

- my colleagues Lorenzo Ferrari and Gianluca De Feo produced a report for Greenpeace



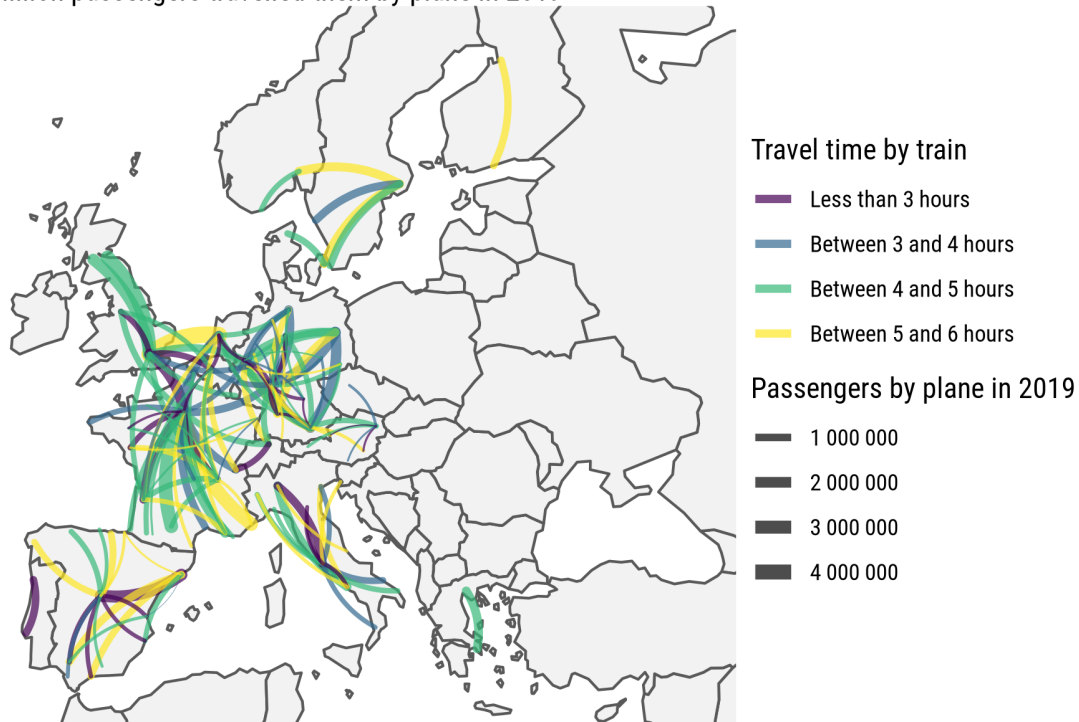
<https://www.balcanicaucaso.org/eng/Occasional-papers/Train-alternatives-to-short-haul-flights-in-Europe>

- I pre-processed data, created datasets, and did some quality checks on the data
https://edjnet.github.io/european_routes/

In this presentation:

- key steps of the data processing
- data issues
- solutions

All these routes take less than 6 hours by train
96 million passengers travelled them by plane in 2019



Main steps for finding main air routes that can be travelled by train

- take a dataset with the number of passengers across all main flight routes in Europe -> Eurostat's [avia_par_](#) datasets
 - deal with inconsistencies in the original datasets (missing data, non-standard codes, flights to “unknown airports”, to oil rigs, etc.)
- exclude routes with no land/plausible train connection between them
- exclude those routes that cannot be reasonably travelled by land or that would take huge amounts of time
- merge routes serving different airports associated to the same city
- find coordinates of airports and their relative city hubs for visualisation and getting data about distance
- match the result with the train datasets (generated separately)
- get labels of cities and airports in different languages (and alphabets)

avia_par_datasets

In principle, standardised, but with considerable data issues, including:

- there are slightly different stats, not all of them available for all countries
 - We opted for "passengers carried (departures)", which is mostly available
 - but e.g. not for Turkey, for which we had to rely on "passengers carried" (PAS_CRD)
 - Czechia has only data for the country of destination, not specific airport
 - we derived the data from other countries, using "passengers carried (arrivals)" (and with the same approach, also data for Bosnia, Albania, Moldova)
 - airports in Serbia, Montenegro or Pristina airport occasionally have inconsistent ICAO codes (e.g. RS_ME instead of the two-letter country code); Basel airport is reported with different country codes
- missing data, non-standard airport codes, flights to "unknown airports", to oil rigs, etc.
 - e.g. hundreds of thousands of passengers who, according to official data, flew into the unknown taking off from major European airports, mostly from either Brussels or Turkish airports
 - some airports that appear only as the destination, and some only as points of departure (mostly small airports)

Finding coordinates of airports, and of the city hub they serve

- Eurostat's dataset does not include coordinates of airports (we need them to exclude excessively long routes, and find which of them is on islands)
- to compare with train routes, we need to merge data for multiple airports serving the same city
 - we care e.g. about the traffic volumes between London and Paris, not between each of the London airports and each of the Paris airports
- finding city hubs is not obvious, as mostly airports are located in local administrative units that are not very telling (airports often are located in very small towns, next to very big cities)

We relied on Wikidata for most of these things. Why is Wikidata useful?

- all data are in the public domain, no licensing restrictions
- one single identifier - ideal for deduplication and consistent matching
- labels in many languages

Heathrow Airport (Q8691)

major international airport serving London, England, United Kingdom



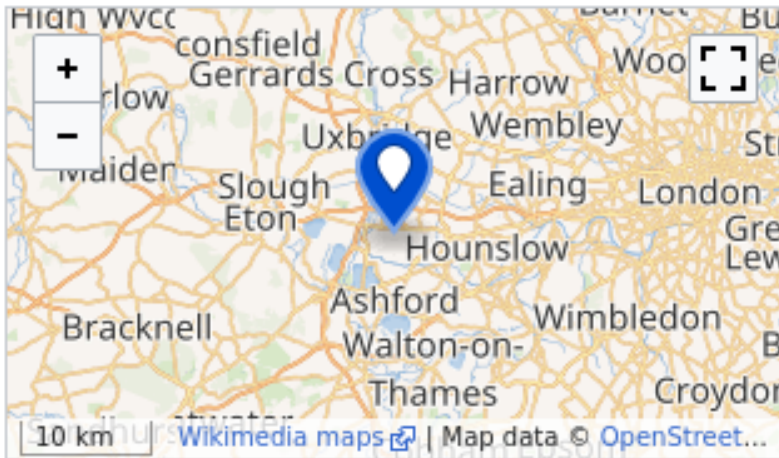
Heathrow | London Heathrow Airport | London Heathrow | LHR | EGLL | London's Heathrow Airport

▼ In more languages

Language	Label	Description	Also known as
English	Heathrow Airport	major international airport serving London, England, United Kingdom	Heathrow London Heathrow Airport London Heathrow LHR EGLL London's Heathrow Airport
German	Flughafen London Heathrow	größter der sechs internationalen Verkehrsflughäfen von London	EGLL LHR Heathrow
Italian	Aeroporto di Londra-Heathrow	aeroporto internazionale inglese	Aeroporto di Heathrow Heathrow LHR EGLL
Polish	Port lotniczy Londyn-Heathrow	No description defined	
Romanian	Aeroportul Londra Heathrow	No description defined	
Russian	Хитроу	крупнейший международный аэропорт Лондона	
Afrikaans	Lughawe Londen-Heathrow	No description defined	
Arabic	مطار لندن هيثرو	No description defined	مطار هيثرو مطار لندن هيثرو مطار لندن هيثرو الدولي مطار هيثرواد

It includes coordinates for all airports

coordinate location



51°28'39.000"N, 0°27'41.000"W

The image shows a map interface with a grey sidebar on the left containing the text 'coordinate location'. To the right is a map of the London area with a blue location pin placed over Hounslow. The map includes zoom in (+) and zoom out (-) buttons, a 10 km scale bar, and a 'Wikimedia maps' logo. The map data is attributed to OpenStreetMap. Below the map, the coordinates '51°28'39.000"N, 0°27'41.000"W' are displayed in blue text.

Has a field for "transport hub served"

place served by transport hub

London

The image shows a grey sidebar on the left containing the text 'place served by transport hub'. To the right is a dropdown menu with a location pin icon and the text 'London'.

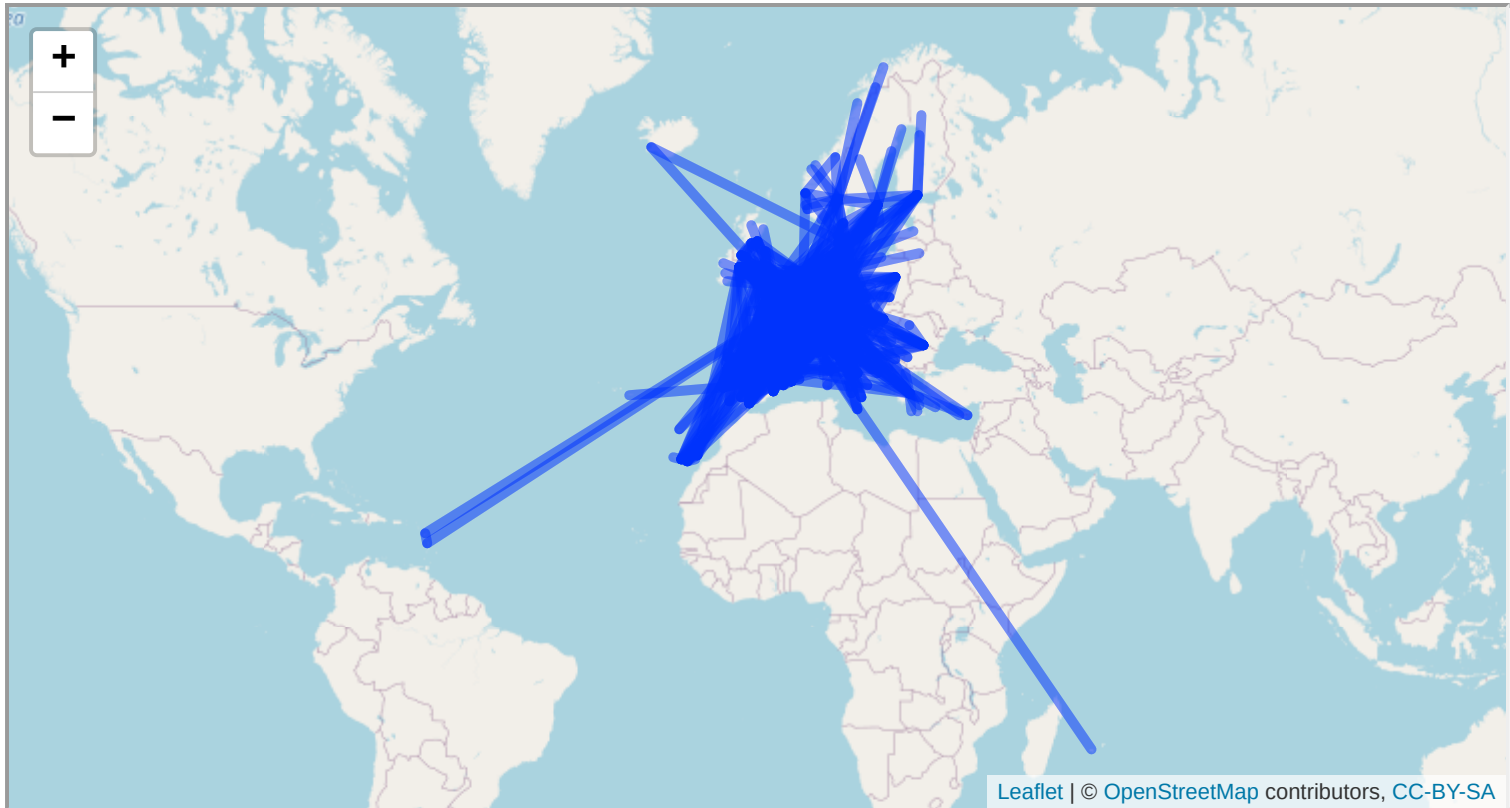
And again, coordinates and multilingual label for the hub cities

- data can be retrieved systematically, via API
- query for coordinates of the city
- get different labels e.g. London, Londyn, Londra, Лондон, ლონდონი (for big cities, very complete)
- cities can then have a single identifier, in our case useful for matching and deduplication with train dataset
- having name of the city in the local language has been useful for better matching with the train dataset
- we can also use the Wikidata identifier to retrieve a picture of the city or the airport systematically from Wikimedia commons, which can be useful in some interactive visualisations

Back to the routes

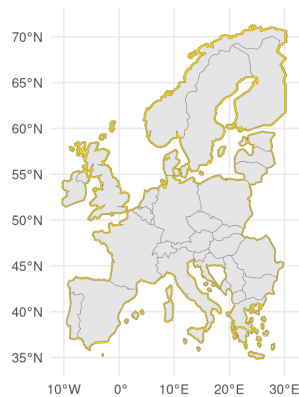
- we now have cleaned the original `avia_par_` dataset
- we have associated airports to the main cities they serve
- we have merged passengers from different airport travelling between the same cities (e.g. all Paris-London passengers, no matter their airport of departure)
- we have unique and consistent identifiers for airports and cities
- we have coordinates for all airports and cities

Time to exclude overseas routes that cannot possibly be travelled by train

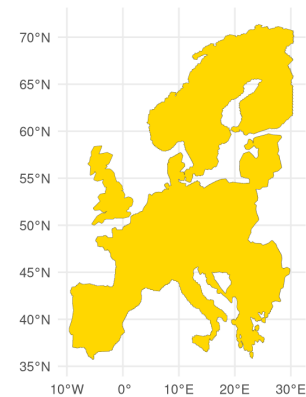


We do this, by adding a buffer to merge e.g. Sicily and Scandinavia, and then include Great Britain

Buffer area added in yellow



Europe's "trainland"



Airports to be excluded



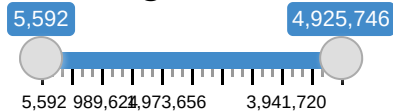
Main routes that can be travelled by train

ranking	route	passengers	distance_km
1	London - Amsterdam	4,925,746	358
2	London - Barcelona	3,387,482	1139
3	London - Edinburgh	3,374,774	534
4	Paris - Toulouse	3,216,294	588
5	Paris - Nice	3,178,806	686
6	London - Madrid	3,147,547	1263

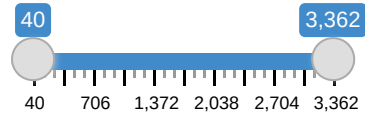
1-6 of 2345 rows

Previous **1** 2 3 4 5 ... 391 Next

Passengers



Distance



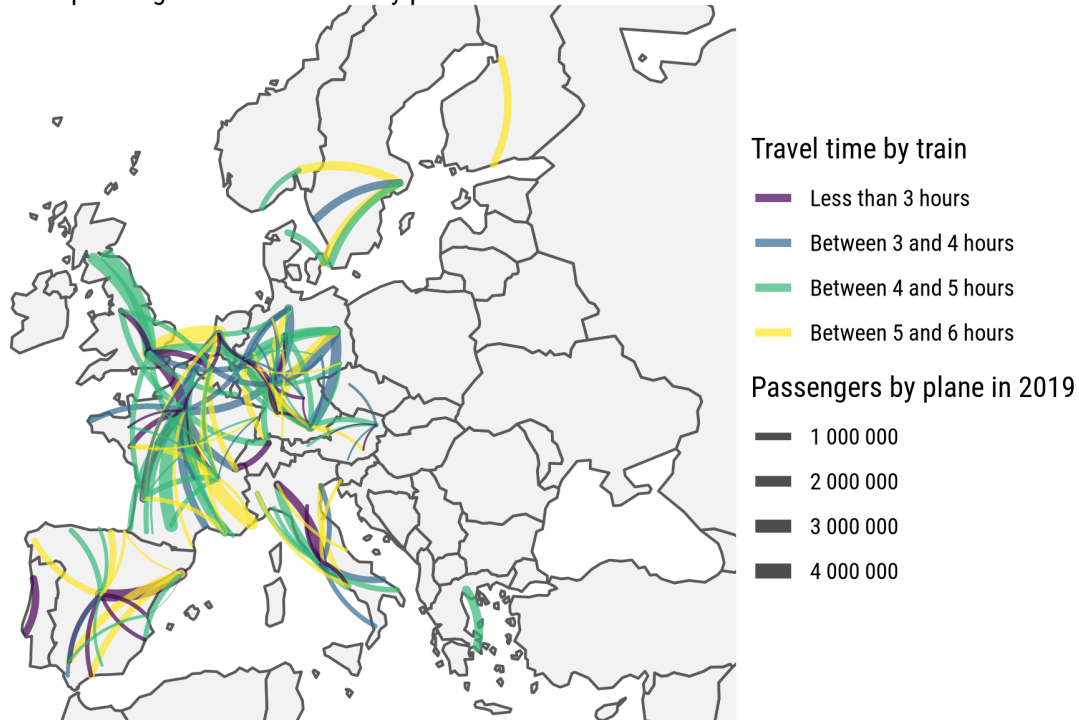
ranking	route	passengers	distance_km
1	London - Amsterdam	4925746	358
2	London - Barcelona	3387482	1139
3	London - Edinburgh	3374774	534
4	Paris - Toulouse	3216294	588
5	Paris - Nice	3178806	686
6	London - Madrid	3147547	1263
7	London - Milan	3031104	959
8	Paris - Barcelona	2690832	831

1-8 of 2345 rows

Previous **1** 2 3 4 5 ... 294 Next

Back to maps, for all...

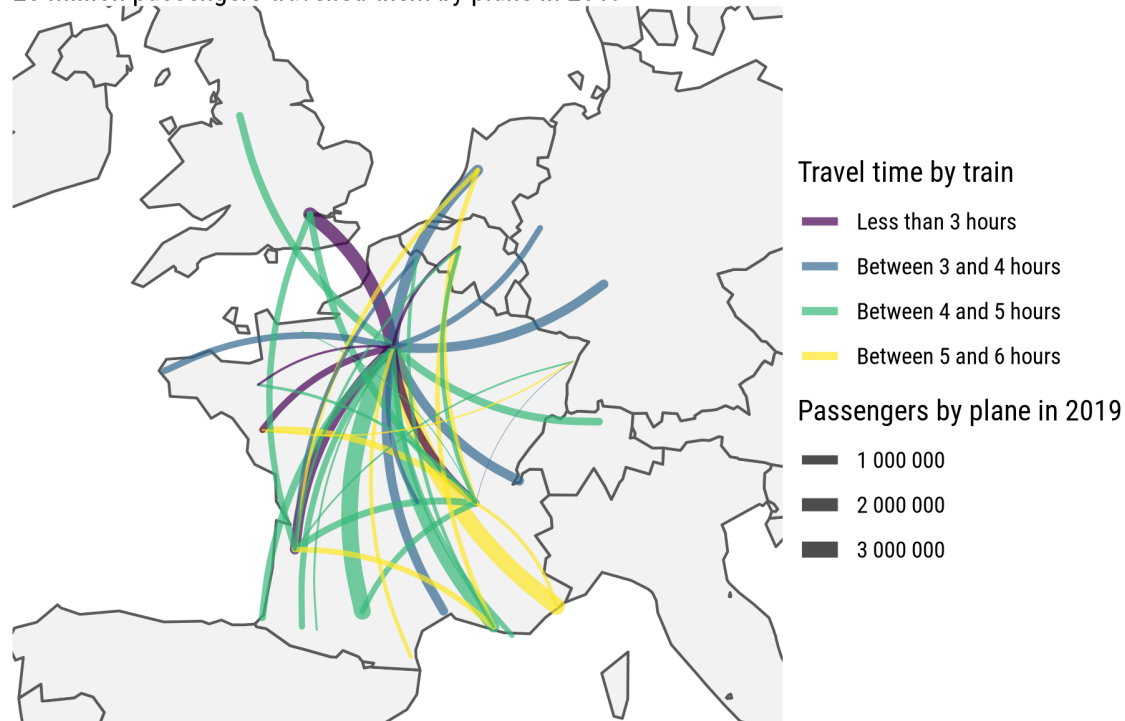
All these routes take less than 6 hours by train
96 million passengers travelled them by plane in 2019



Giorgio Comai / @EdjNet | Source: Eurostat `avia_par_`, OBCT for Greenpeace

Or only specific countries, e.g. here France

All these routes involving France take less than 6 hours by train
28 million passengers travelled them by plane in 2019



Giorgio Comai / @EdjNet | Source: Eurostat `avia_par_`, OBCT for Greenpeace

Summary of issues and solutions

- Eurostat's `avia_par_` datasets are a great starting point, but they still requires many hours of work to be actually useful
 - flights to "unknown airport", in particular from Czechia
 - inconsistent airport codes
 - no coordinates for airports included
- Wikidata is very useful
 - to get unique identifiers that be can used across datasets
 - get labels of airport and cities in many languages
 - get coordinates, hubs, pictures, potentially other information

Links

- this presentation: https://giorgiocomai.eu/slides/2022-06-16-european_routes_un_slides/2022-06-16-european_routes_un_slides.html
 - in pdf: https://giorgiocomai.eu/slides/2022-06-16-european_routes_un_slides/2022-06-16-european_routes_un_slides.pdf
- extended version of the data analysis, including code and intermediate datasets available for download:
 - https://edjnet.github.io/european_routes/
 - https://github.com/EDJNet/european_routes
- Full report: **Train alternatives to short-haul flights in Europe**
<https://www.balcanicaucaso.org/eng/Occasional-papers/Train-alternatives-to-short-haul-flights-in-Europe>
- brief article for the wider public:
<https://www.europeandatajournalism.eu/eng/News/Data-news/More-trains-fewer-emissions>