



On the move

AN EXPLORATION OF POPULATION MOVEMENT
IN A DYNAMIC WORLD AND ITS CITIES

Our agenda

Today, we will take you through the following |

1. Who we are
2. How we interpreted the assignment theme
3. What our research questions are
4. What we aimed to do
5. What we did it with
6. What we prepared



- i. What data we found to do it
- ii. What you can see

7. What we will do next
-

8. Bibliography

MAKING IT ALL HAPPEN

Our team



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Living cities

Understanding living | “life is dynamic”

- **Movement** of people is (and will be) one of the key traits of modern states and cities
- However, cities are not isolated, they interact with each other creating vast networks
- We focus on this **interconnectedness** that defines the places people inhabit

Quantifying movement | one metric to rule them all?

- Our measure will be **population flows** – counting the number of people leaving their point of origin to reach a destination
- Aiming for consistent metrics where possible (depending on availability)

Spatial scale | from the macro to the micro

- To provide a complete picture we will focus on population flows across **two spatial scales**
- **Global** - inter-country permanent population flows (international migration)
- **Local** - intra-country population flows (internal migration)

Our reading and questions

In the literature | research, on migration and its visualization, too big to summarise here

- **Research and visualisation |** both characterised by complexity and politicisation (see bibliography)
 - Study of migration, irrespective of level of analysis, is often split into **8 dimensions** (Allen, see appendix)
 - We focus on **temporal and spatial** dimensions for simplicity, but we must recognise that we are obscuring the many nuances involved – these need to be highlighted verbally
- **Visualisation works of note |** inspired to **update** and **fill** in space-time **gaps**
 - Sander et al. (2014) **inspired us to explore this topic at global scale** (see Project 2) Although not without its critics, **we aim to update data within from 2015 to 2019** and address shortcomings in commentary where possible (Allen, 2018; Fakir and Abedin, 2020; Kennedy et al., 2016; Vannini et al., 2018)
 - **Question 1 |** Do we see trends shown by Sander et al continuing in recent years?
 - **Second inspiration,** comes from mobile data availability for China, studies of migration are typically done on annual datasets examining **systemic shifts**, with data available on a daily level, we explore whether the **trends from the theory can be observed**, as well as **seasonality** that other studies allude to but cannot elaborate on (Chan, 2013; Ma and Tang, 2020; Zhang, 2017)
 - **Question 2 |** Do population movements measured by mobile data reflect the volumes/direction expected by theory developed by other means? What seasonality can be observed?

Our modular approach...

Introduction and contextual information for the user

Global level

Country case study (China)

Set the scene with population counts

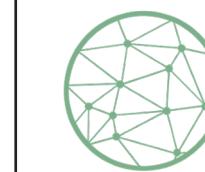
Country-country flow

Intensity of internal migration

Flows between key cities



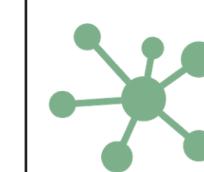
Project 1



Project 2



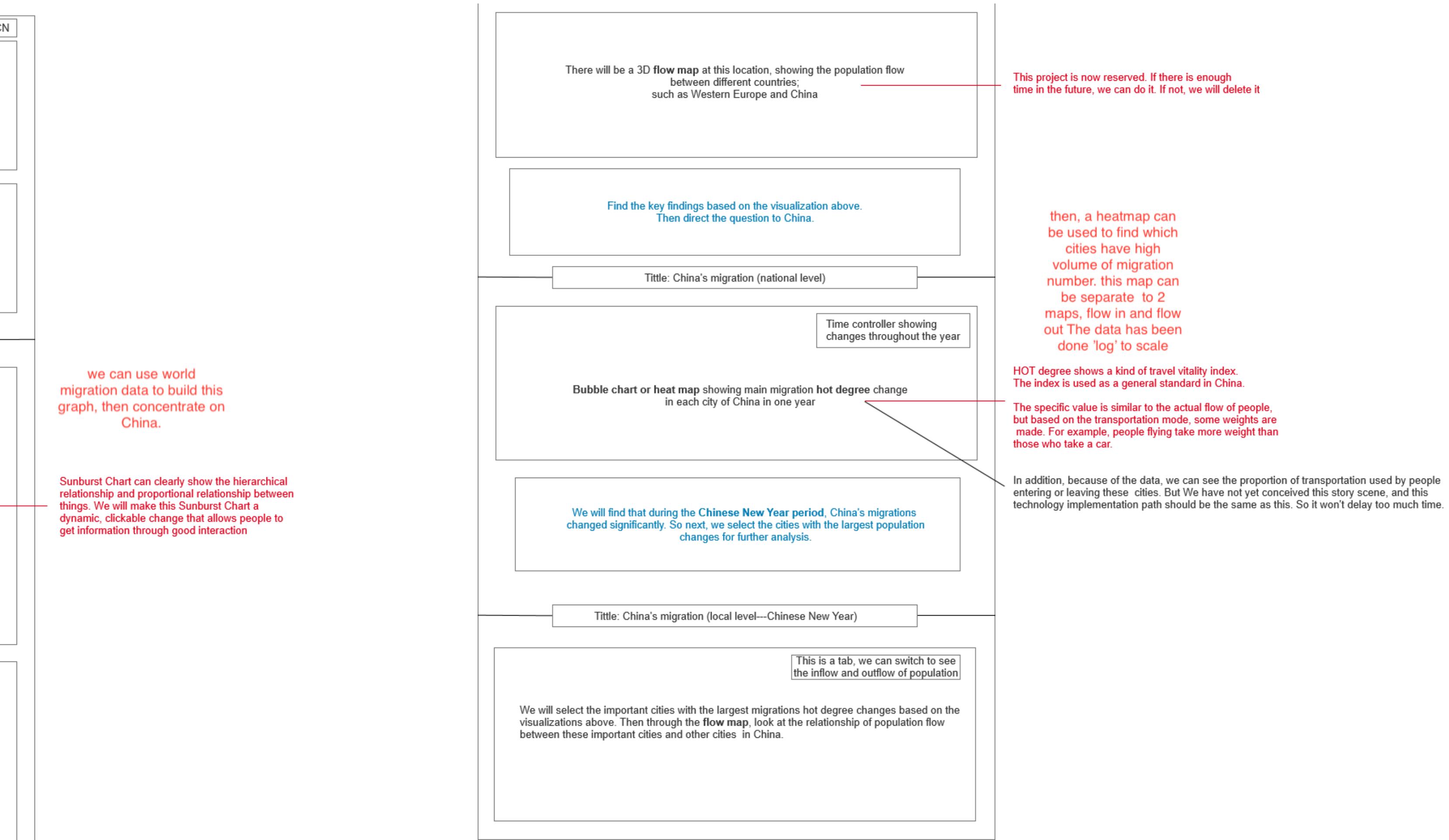
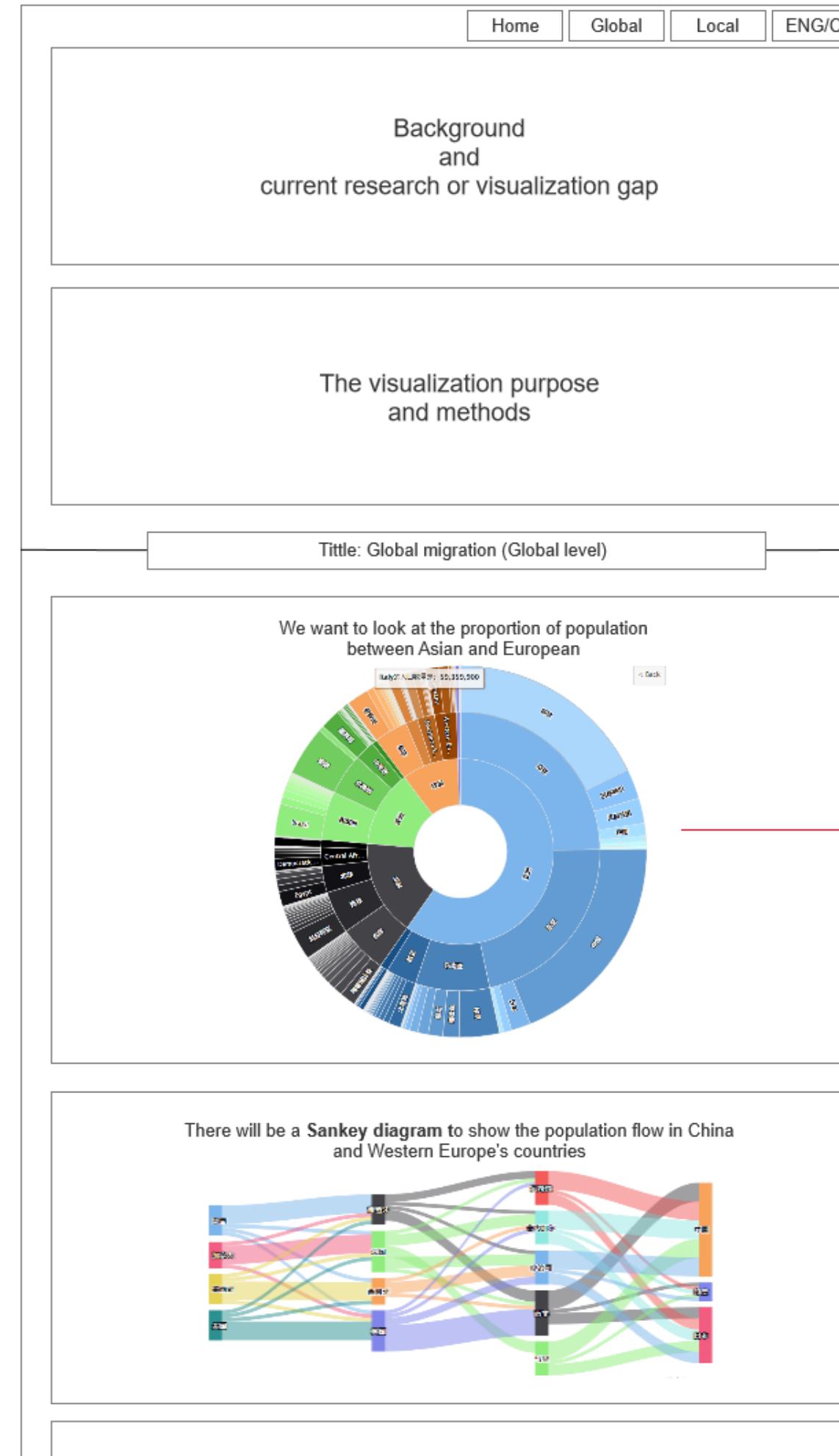
Project 3



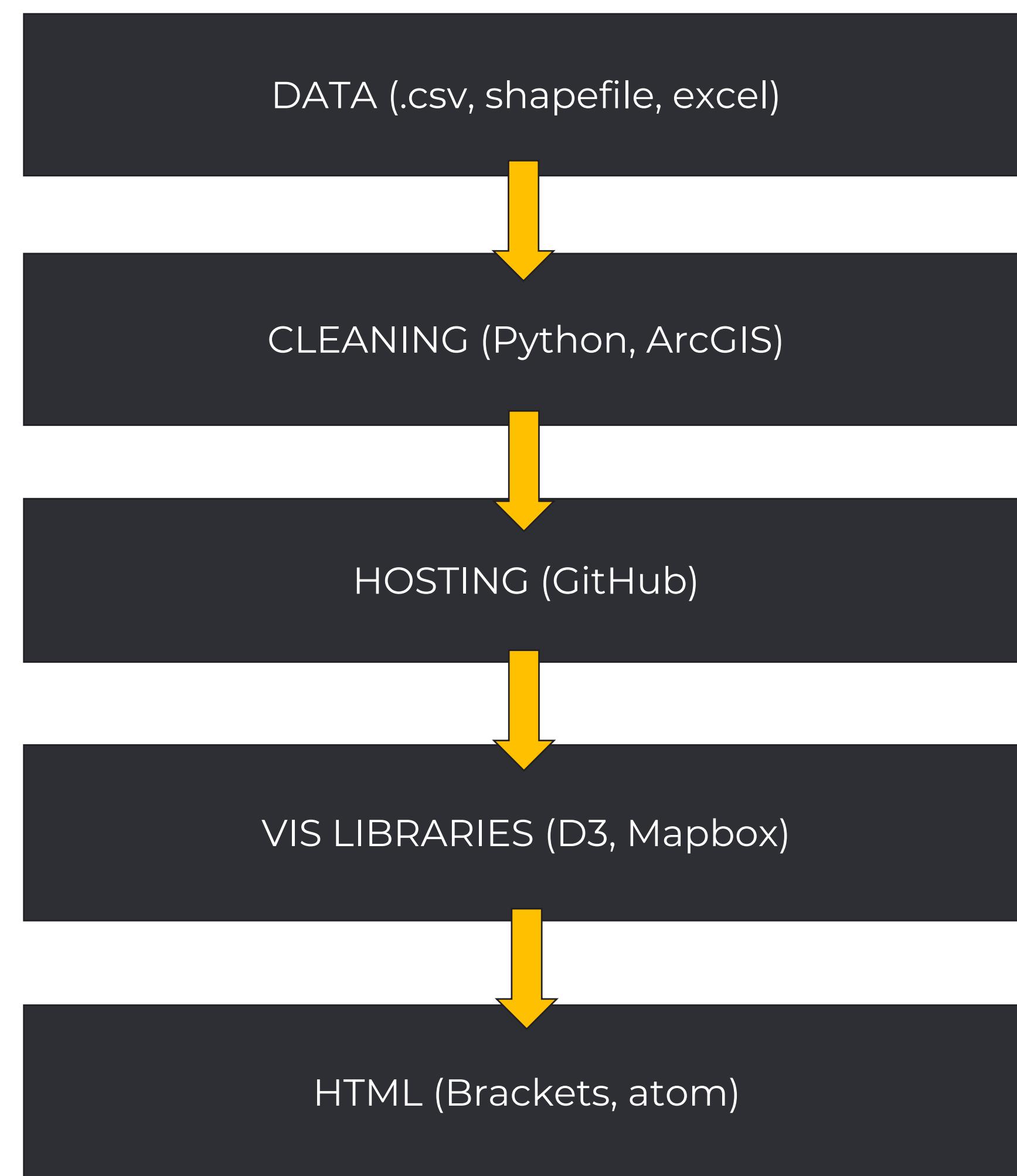
Project 4

PLANNING OUR STORY

... and our wireframes



Our technology stack





SHOWCASING EXAMPLES

Our global work

Project 1



This visualization shows the proportion of migrants in various countries in Asia and Europe



Project 2

This visualization shows the relationship between the migration of people in Asia and Europe

Our global data

Inter-country data |

- **Source** | United Nations----Population Division
- **Date range** | 2019
- **Detail** | Annual
- **Volume** | 300 columns of data

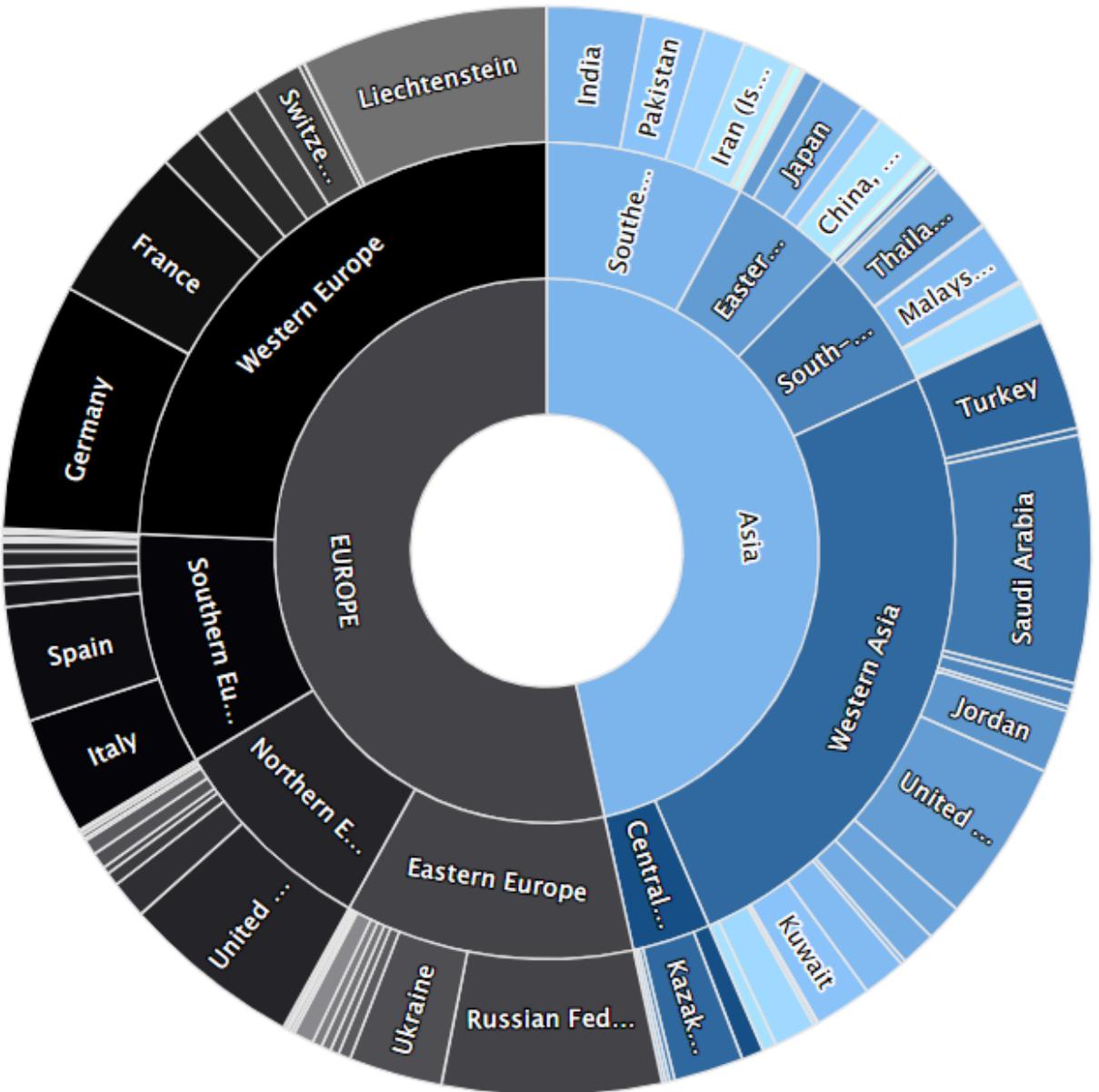
Basic description

Population flow	Western Asia	Central Asia	Southern Asia	Eastern Asia	Eastern Europe	Northern Europe	Southern Europe	Western Europe
Western Asia	13808956	95089	18402429	32939	1326557	179540	331077	596121
Central Asia	166412	482760	16363	102415	4395501	11502	0	11699
Southern Asia	161692	11811	11176671	312886	1473	54939	5670	5030
Eastern Asia	235	28041	210013	5201972	21384	60989	11016	35205
Eastern Europe	2097067	5603254	1666384	830016	10339711	489026	389687	426144
Northern Europe	1135485	41672	2550790	580099	2472166	2050704	960103	957178
Southern Europe	332769	50007	693595	439295	3260825	582720	3112718	1593817
Western Europe	3840848	1107365	1103989	542957	6024633	741588	5488083	2974052

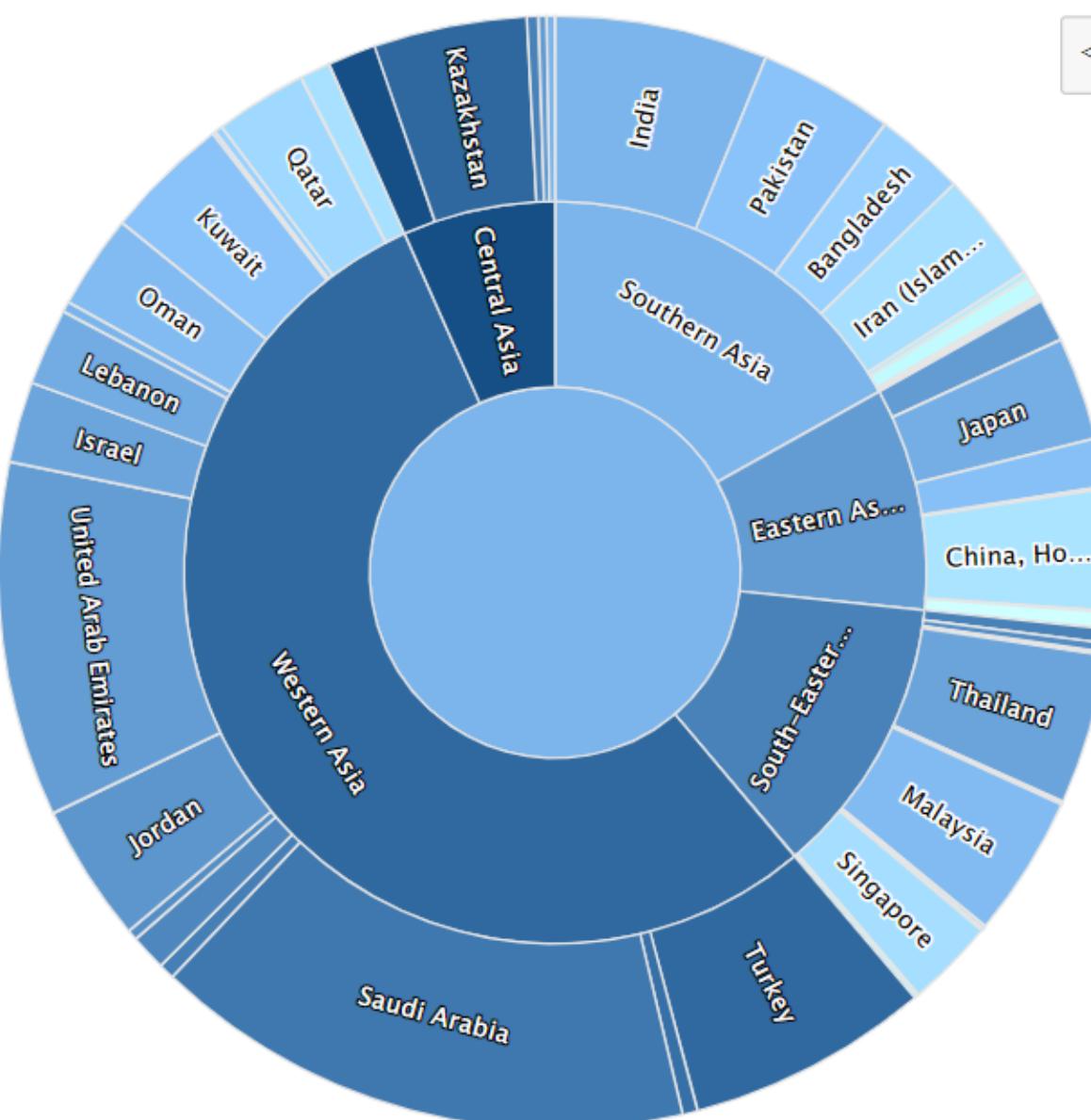
BUILDING

Project 1

2019 Population migration in Asia and Europe



2019 Population migration in Asia and Europe



2019 Population migration in Asia and Europe

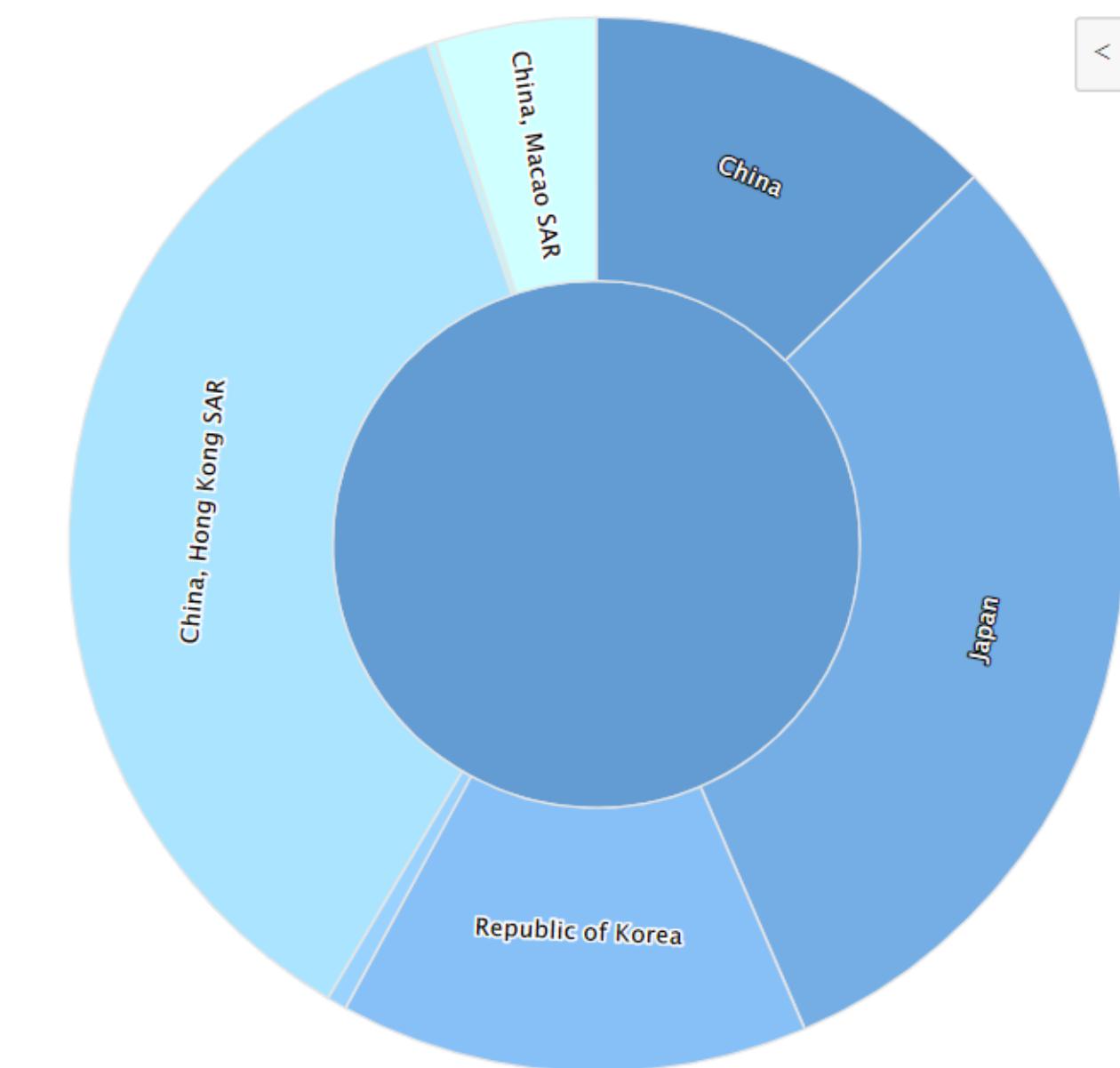


Chart: Sunburst diagram

Description: The reason for choosing this graph is that the pie chart has a good interactive experience. It can classify various countries and continents, and then can clearly show the corresponding proportion and quantity. At the same time, this graph allows the user to further view the required data by clicking. Thereby improving the efficiency of data visualization, allowing users to understand various relationships such as proportion, quantity, level, etc. in a short time.

Project 2



Chart: Sankey diagram (easily to see the data flow)

Description: The aim of this diagram is to look the migration data between Asia and Europe in details. It is obvious that there are huge volume of people migrate between two regions, especially connections southern Asia to western Asia.

It is based on the work of Sander et al. (2014)

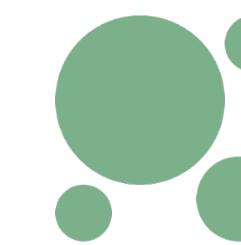


SHOWCASING EXAMPLES

Our China work

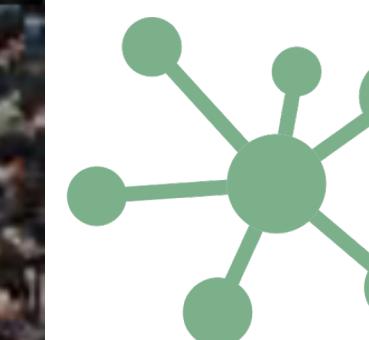
Project 3

Exploring intensity of population migration
in China across different temporal
resolutions



Project 4

Exploring the origins and destinations of
movement between core movement hubs



Our data part 2

Intra-country data | Showing degree of ‘heat’ of population movement by type of transport

Main observation | High degree of variation in ‘hot’ value

- **Source** | Tencent Data Platform
- **Date range** | January 2018 – June 2019
- **Detail** | Daily
- **Volume** | 2,003,080 inflow; 1,929,673 outflow

Inflow

	hot	car	train	flight
count	2003080.000	2003080.000	2003080.000	2003080.000
mean	8579.018	0.359	0.469	0.172
std	15461.317	0.273	0.233	0.272
min	4.000	0.000	0.000	0.000
25%	1843.000	0.120	0.290	0.000
50%	3922.000	0.340	0.470	0.000
75%	8764.000	0.560	0.650	0.360
max	1038282.000	1.000	1.000	1.000

Outflow

	hot	car	train	flight
count	1929673.000	1929673.000	1929673.000	1929673.000
mean	8889.710	0.336	0.467	0.197
std	15454.971	0.277	0.237	0.290
min	2.000	0.000	0.000	0.000
25%	2054.000	0.090	0.280	0.000
50%	4250.000	0.300	0.470	0.000
75%	9172.000	0.540	0.650	0.440
max	1038282.000	1.000	1.000	1.000

Basic description

- The travel hot degree among most cities in China and the proportion of travel modes.

$$\begin{aligned}
 \text{hot degree} = & \text{weight} \times \text{passenger}_{\text{count}} \times \text{Air}_{\text{ratio}} \\
 & + \text{weight} \times \text{traveller}_{\text{count}} \times \text{Train}_{\text{ratio}} \\
 & + \text{weight} \times \text{trips}_{\text{count}} \times \text{Car}_{\text{ratio}}
 \end{aligned}$$

Our challenge

Task | In order to visualize we needed to combine different datasets and make the basic flow data.

Challenge description |

- Geocoding city names proved difficult to do on scale because of different naming conventions
 - i.e. the addition of '*shi*' (市), '*dao*' (道) and '*zhou*' (州) suffix meaning 'city'
- We do not have ready-made flow map in shp.

Solutions |

- In order to match the data in the two files, we **manually paired** all Chinese cities in sequence. Although time-consuming, once completed, we could **easily join additional data** frames
- **We do not have flow data line segments.** To generate these, we used the XY To Line function in **ArcGIS** to establish the flow of population flow between different cities based on the relationship of the city data flow in CSV. Then, after the file name is matched, the data is imported into the line segment, so that Mapbox is used for visual display

Project 3

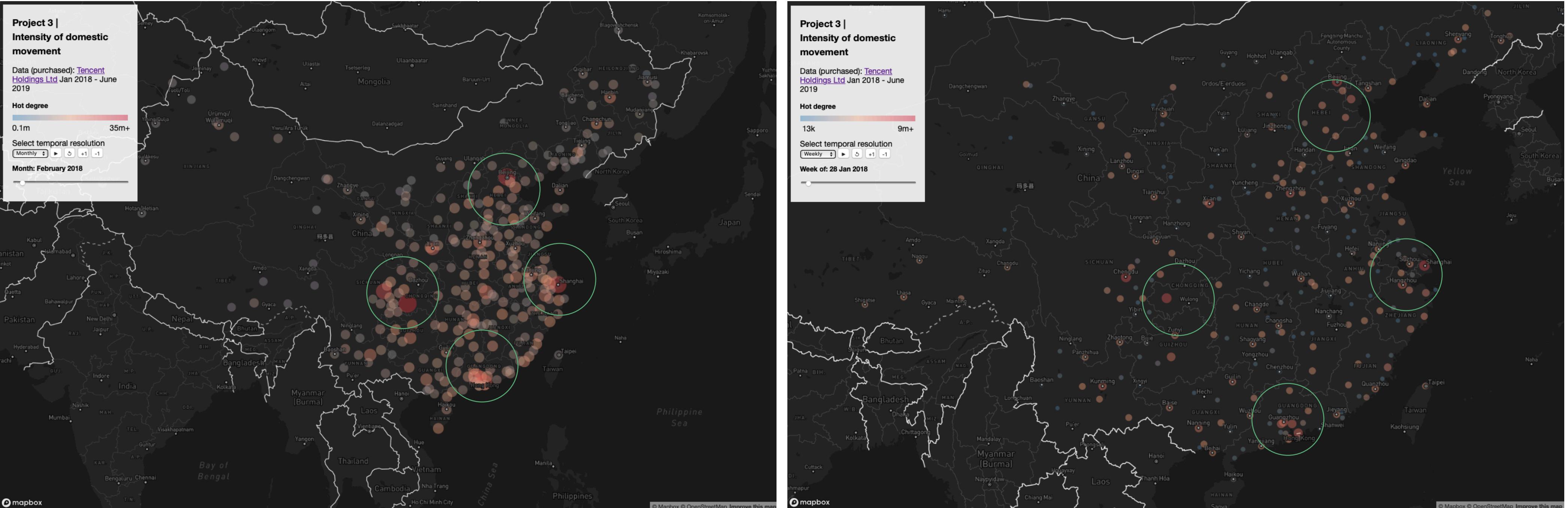


Chart | Bubble / intensity map over time

Description |

Interactive elements to explore the change over time at a chosen **temporal resolution** (month, week, day). **Technical challenges remain** with the daily layer. We can observe intense concentration of movement in key metropolitan areas and **seasonal drops** ~ Chinese New Year. Given high intensity around Beijing, Shanghai, Shenzhen, Chengdu and Chongqing. Then followed by Wuhan, Zhengzhou and Xi'an. We note they are **province capitals** under central gov. jurisdiction and will be central to Project 4.

Project 4

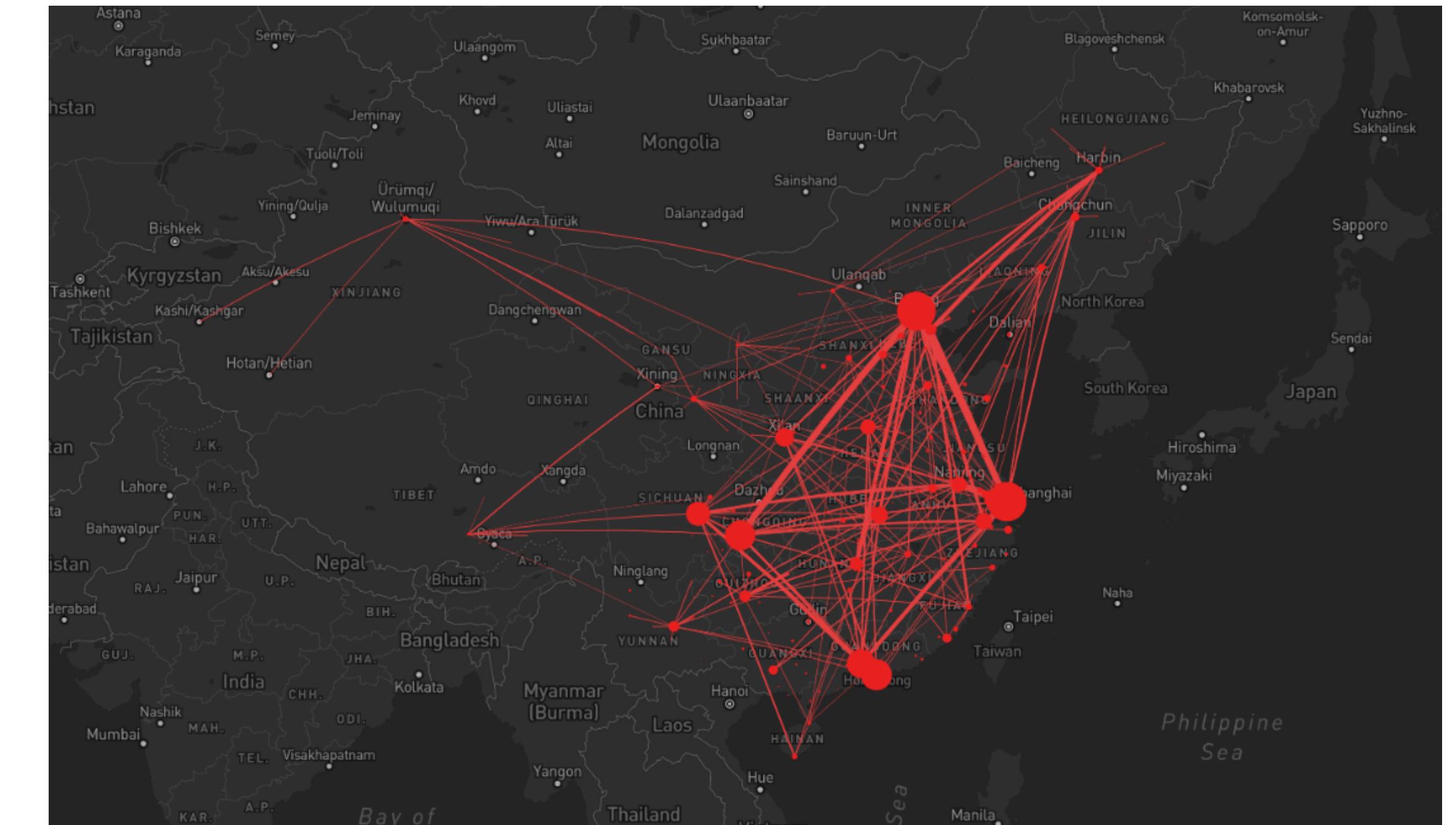
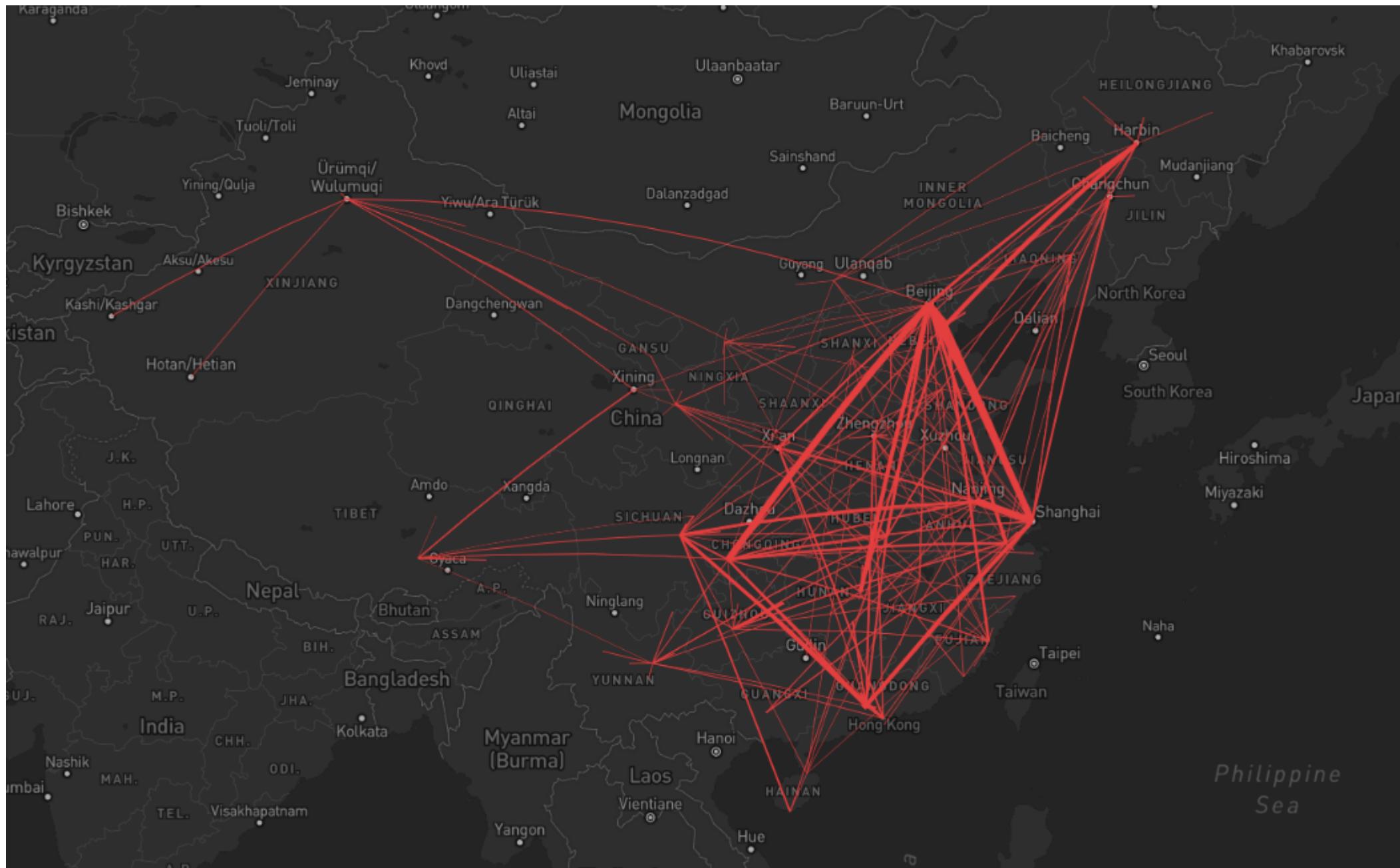


Chart: Flow / connection map

Description: Focus on **provincial capitals** and their respective connections. We show flows between all key **32 cities** to their top 10 destinations showing a total of 320 flows. The **thickness of the line** represents the heat intensity. Our challenges include identifying a **suitable colour pallet**, and a means to include the category of transport prevalent (flight, train, car)

Our next steps

Task 1 | Combine our four projects into a single continuous website

Focus | Our focus will be on simplicity and on the user being able to explore their preferred aspect of migration at the desired spatial and temporal scale

Task 2 | For Projects 3 and 4, we focused on population outflow, using the existing structure we can introduce the inflow and perhaps a ‘net change’ dataset

Task 3 | The color and size of bubbles in Project 3 need to be further changed, so that users can quickly distinguish information and obtain useful information.

Task 4 | Project 4 requires the addition of interactive elements in order to meet the user requirements set out in task 1

Focus | These include letting the user know the number of line segments between the two cities through the mouse hover. In addition, in the content of data display, we can also show the ratio of people choosing different modes of transportation, which is no longer simply the movement of people between cities. Therefore, several layers may be added.

Task 5 | Multi-lingual support for **English** and **Mandarin**



T h a n k y o u

谢 谢

P L E A S E S H A R E Q U E S T I O N S A N D F E E D B A C K

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Appendix 1

Table 1. Dimensions of migration and corresponding features

Dimension	Description	Example Features
Quantitative	Numerical data showing quantities of migrants	<ul style="list-style-type: none"> migrant stocks migrant flows
Type	Different reasons or main motivations for migrating	<ul style="list-style-type: none"> labour/economic forced study family
Spatial	Geographic origins, destinations, or transiting areas	<ul style="list-style-type: none"> direction locations internal movement international movement
Temporal	Changes in characteristics relating to individuals or migration processes over time	<ul style="list-style-type: none"> dynamics/trends histories shocks
Political	Governance of migration or migrants via expressions of power	<ul style="list-style-type: none"> public opinion state activities differences in policies
Social	Interpersonal and cultural aspects	<ul style="list-style-type: none"> lived experiences community impacts
Economic	Impacts and drivers of migration relating to labour markets or fiscal performance	<ul style="list-style-type: none"> access to employment impacts on public services
Ethical	Trade-offs, norms, values, or moral dilemmas	<ul style="list-style-type: none"> availability of rights available freedoms

Source | (Allen, 2018, p. 6)

Appendix 2 | Sharing the work

Component	Component owner(s)	Additional support
Presentation	Diqui Yang, Xin Zhao, Antonios Fiala, Xiang Zhou	
Idea dev.	Diqui Yang, Xin Zhao, Antonios Fiala, Xiang Zhou	
Lit. review	Antonios	-
Data cleaning	Data cleaned by project owners	
Project 1	Xiang Zhou	-
Project 2	Diqui Yang, Xin Zhao	-
Project 3	Antonios and Xiang	-
Project 4	Antonios and Xiang	-
Website design	TBC (Antonios & Xiang)	Diqui Yang, Xin Zhao