Domestic Migration in Germany

Adian Dawuda, Felix Schachtschneider

30.01.2024

Recap project idea

Topic and Stakeholders

- **Definition and Scope:** Internal migration in Germany- relocation of residence within the country
- **Key trends:** movements between northern and southern Germany as well as between eastern and western states
- **Factors:** economic conditions, employment opportunities, and regional development disparities

Policy Makers and Government Officials at BAMF

Bundesamt für Migration und Flüchtlinge

Source: Binnenwanderung in Deutschland (2023) Deutscher Bundestag - WD 1 - 3000 - 040/22

Stakeholders

Mr. Martin Migration

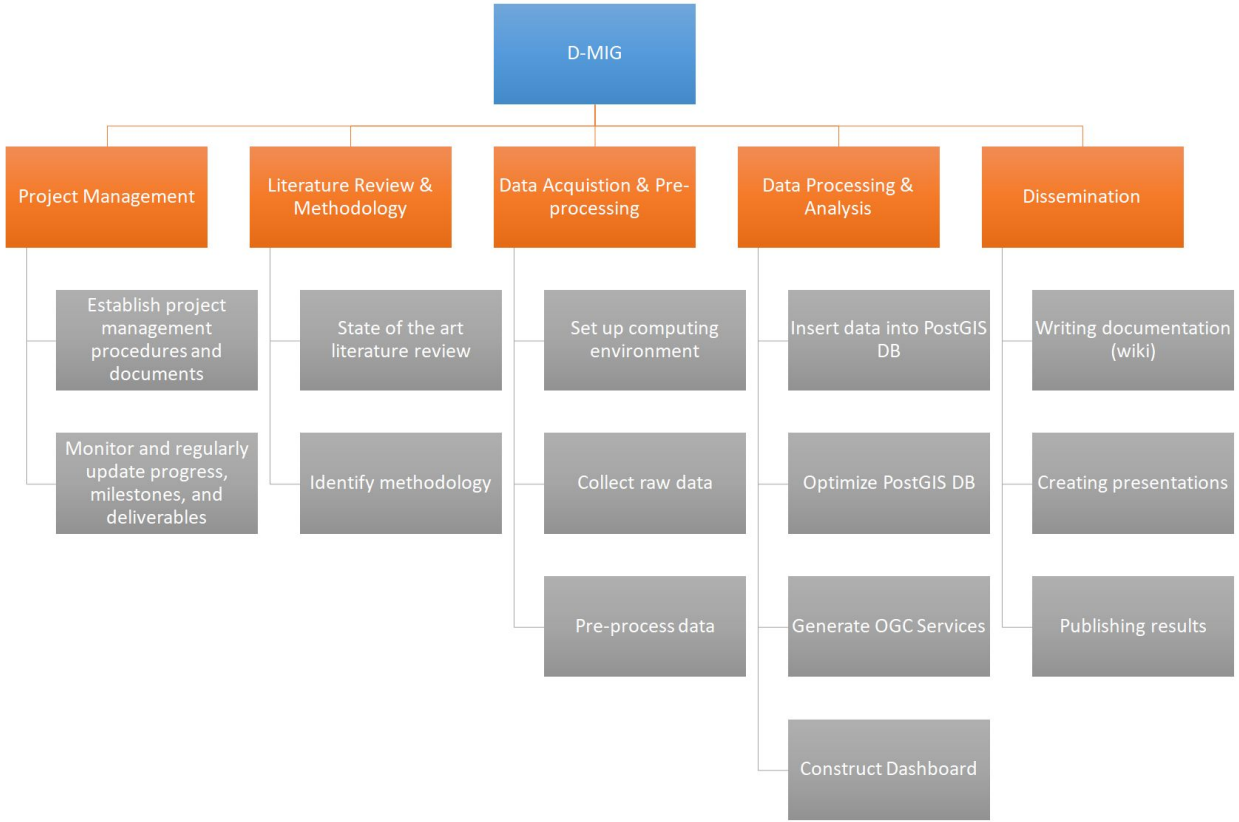
Job: Assistant Migration Officer
Interested in: Exploring the inner-country migration of Germany
Needs/Goals: Monitor migration movements

Ms. Berta Bamf

Job: Official in charge
Interested in: Investigating Internal Migration within Germany
Needs/Goals: Control Migration movements /Understanding migration patterns

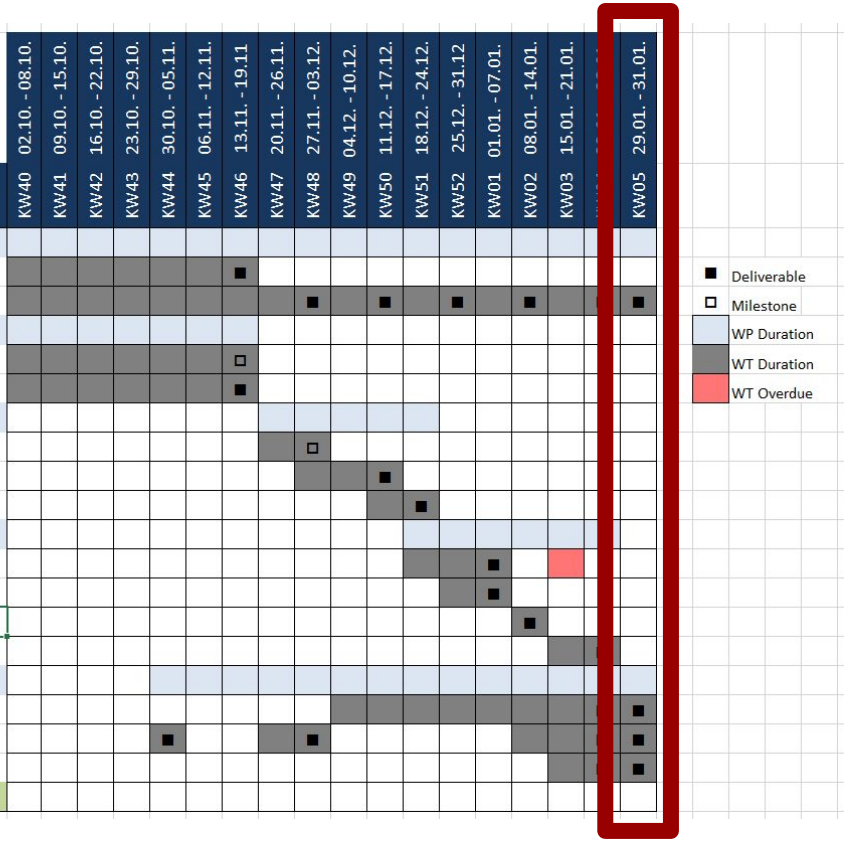
Project Overview

DMIG Work Package Breakdown



Current status

Time Estimate (hours)	Tasks	Responsible	Start	End	Status
20 (10%)	**Project Management**				
10	Establish project management procedures and documents	Adian, Felix	KW40	KW46	Complete
10	Monitor and regularly update progress, milestones, and deliverables	Adian, Felix	KW40	KW05	Open
30 (15%)	**Literature Review & Methodology**				
20	State of the art literature review	Adian, Felix	KW40	KW46	Complete
10	Identify methodology	Adian, Felix	KW40	KW46	Complete
50 (30%)	**Data Acquisition & Pre-Processing**				
10	Set up computing environment	Adian, Felix	KW47	KW48	Complete
20	Collect raw data	Adian, Felix	KW48	KW50	Complete
20	Pre-process data	Adian, Felix	KW50	KW51	Complete
60 (25%)	**Data Processing & Analysis**				
20	Insert data into PostGIS DB	Adian, Felix	KW51	KW01	Complete
10	Optimize PostGIS DB	Adian, Felix	KW52	KW01	Complete
10	Generate OGC services	Adian, Felix	KW02	KW02	Complete
20	Construct Dashboard	Adian, Felix	KW03	KW04	Complete
40 (20%)	**Dissemination**				
15	Writing documentation (wiki)	Adian, Felix	KW46	KW05	Open
15	Creating presentations	Adian, Felix	KW44	KW05	Open
10	Publishing results	Adian, Felix	KW02	KW05	Open
	Completion			KW05	



Approach & SDI methods

standards: JSON/REST, GeoJSON, Simple Feature Standard ISO 19125
Metadata ISO 19115/19139, OGC compliant Web-services

used technologies:

open source: Python (GeoPandas/GeoAlchemy2), PostgreSQL/PostGIS, GeoServer

proprietary: ArcGIS Insights

SDI Architecture

DE states spatial Data

- NUTSL1 = Bundesländer in DE
- Year: 2021
- Data type: Polygons
- Scale: 1:10 million
- CRS: EPSG 4326

Domestic Migration data

- Domestic migration data available as table without spatial attributes
- Years: 2000-2022

EUROSTAT API

GENESIS-Online API

JSON/REST-based APIs

Download

- Download via HTTP GET requests
- GeoJSON and CSV files

Preprocess & Combine

- Combine necessary attributes from migration dataset with NUTSL1 spatial attributes using the GeoPandas library
- Calculate Bundesland centroids

Store

Insert data into PostGIS enabled Postgres DB using the GeoAlchemy 2 library

PostGIS database

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- 1NF & 2NF
- 3NF not needed as rows/columns not intended to be edited after creation

Access using Simple Feature queries

GeoServer

@ geoserver22s.zgis.at

Web Feature Service

Publish using OGC WFS standard

ArcGIS Insights dashboard

- Visualize data via interactive Chord diagram and map
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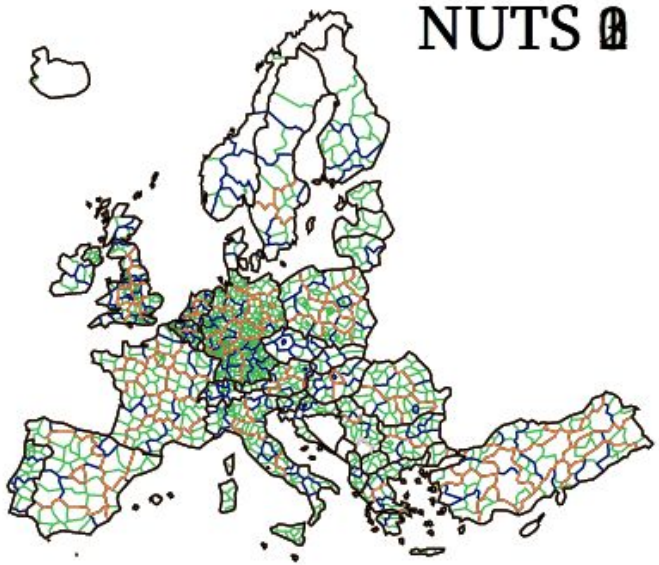

https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts#nuts21

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EUROSTAT API

JSON/RI

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Tabellenaufbau

Position	Code	Inhalt	Ausprägungen
	12711	Wanderungsstatistik	
	DINSG	Deutschland insgesamt	
	BEV010	Binnenwanderung	
	JAHR	Jahr (1)	ZEIT AUSWÄHLEN
	NAT	Nationalität (2)	AUSWÄHLEN
	GES	└ Geschlecht (2)	AUSWÄHLEN
	BLDHK1	Herkunfts-Bundesland (16)	AUSWÄHLEN
	BLDZL1	└ Ziel-Bundesland (16)	AUSWÄHLEN

https://www-genesis.destatis.de/genesis//online?operation=table&code=12711-0022

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```
abspath = os.path.abspath(__file__)
dir_name = os.path.dirname(abspath)
os.chdir(dir_name)

# Define list of scripts in the order to be executed in
scripts = ['eurostat.py', 'genesis.py', 'process.py']

# Execute each script in the list
for script in scripts:
    print(f'executing {script}')
    try:
        script_code = open(script, 'r', encoding='utf-8').read()
        exec(script_code)
        print(f'{script} successfully executed')
    except FileNotFoundError:
        print(f'{script} not found.')
    except Exception as error:
```

queries

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# Execute e
for script
    print(f
    try:
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    except
        pri
    except
```

`main.py`

Description:

This script is responsible for the high level automation of the entire workflow. It executes the three scripts eurostat.py, genesis.py, and process.py consecutively. If any execution errors occur, the exception output is printed.

Note: The script assumes that the eurostat.py, genesis.py, and process.py scripts are located in the same directory.

`eurostat.py`

Description:

This script makes use of the Eurostat GISCO (Geographical Information System of the Commission) REST-based API to download NUTS (Nomenclature of Territorial Units for Statistics) Level 1 regions for 2021 (latest at the time of writing). In Germany, these regions are equivalent to the Bundesländer. The regions are requested using an HTTP GET request and received as polygon features in the EPSG:3857 coordinate reference system. These features are then written to a GeoJSON file in the same directory. The default filename is set to `NUTS_L1.geojson`.

Third party dependencies:

- `requests`

`genesis.py`

Description:

This script makes use of the GENESIS-Online REST-based API to download German domestic migration data for a specified year. The data is represented at state level. To access the API a GENESIS-Online account is needed. An account can be registered free of charge at https://www-genesis.destatis.de/genesis/online?Menu=RegistrierungForm. The data is requested by defining the dataset and the required features and sending an HTTP GET request. The data is received in tabular format and saved as a CSV file in the same directory as the script. The default filename is set to dmig[year].csv (e.g., dmig2022.csv).

Third party dependencies:

- `requests`

`process.py`

Description:

This script is responsible for processing the data. This includes loading the migration data CSV file and NUTS GeoJson file, merging both datasets, and exporting the resulting dataset to a PostGIS enabled Postgres database.

more...

Third party dependencies:

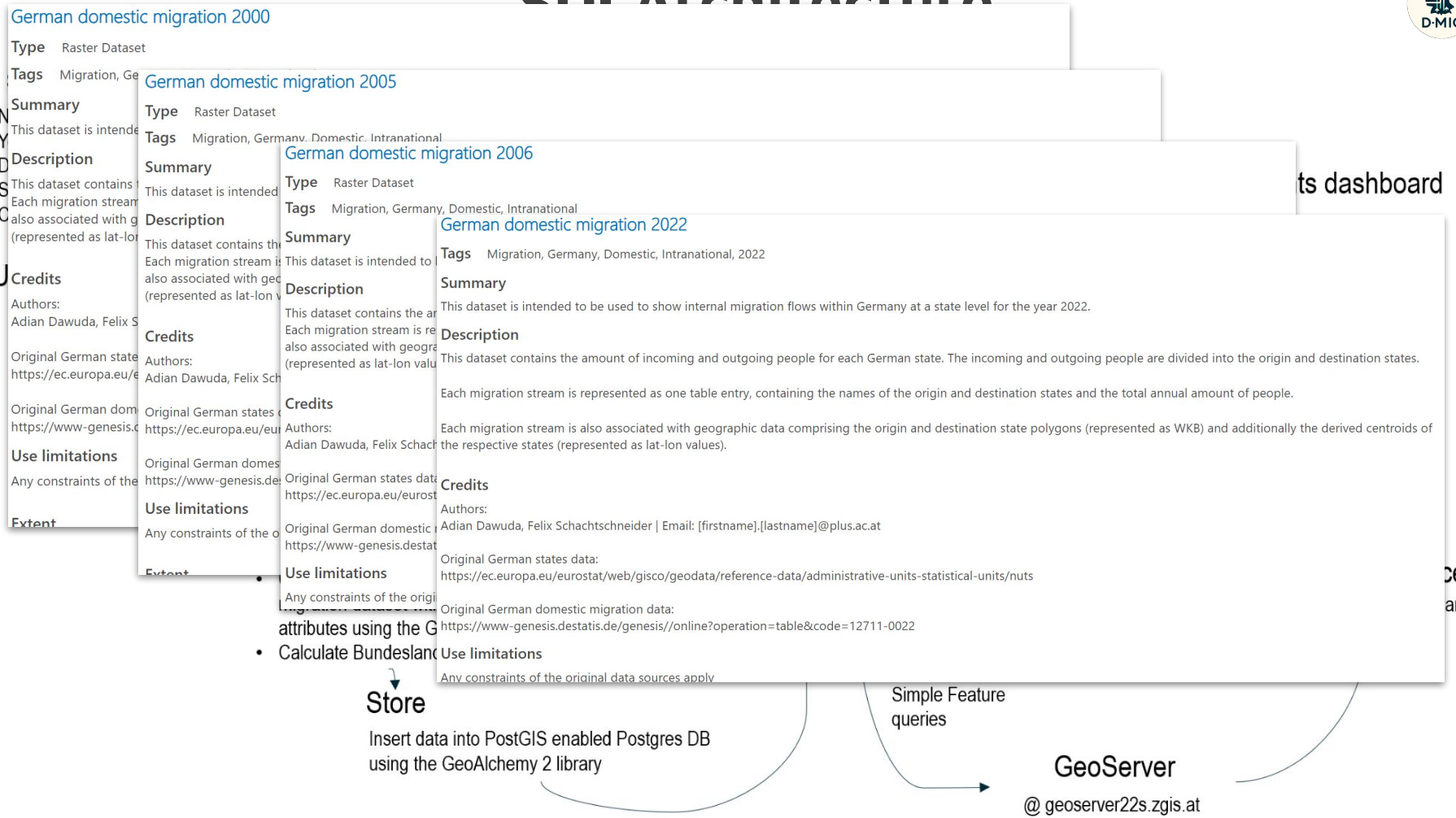
- `geopandas`
- `pandas`
- `geoalchemy2`
- `shapely`
- `sqlalchemy`

`parameters.py`

Description:

This Python file serves as a location to store all user defined parameters needed to execute the workflow. This includes the year for which the domestic migration data is to be used and the connection parameters needed to insert the data into a PostGIS database.

SDL Architecture



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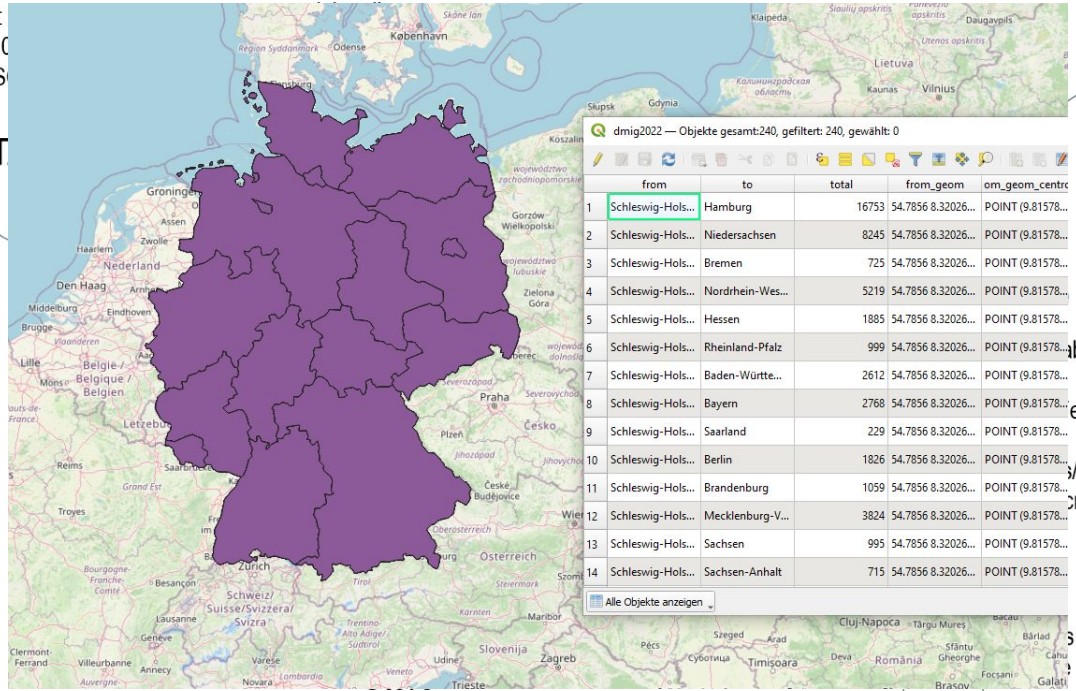

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2	Schleswig-Hols...	Niedersachsen	8245	54.7856 8.32026...	POINT (9.81578...
3	Schleswig-Hols...	Bremen	725	54.7856 8.32026...	POINT (9.81578...
4	Schleswig-Hols...	Nordrhein-Wes...	5219	54.7856 8.32026...	POINT (9.81578...
5	Schleswig-Hols...	Hessen	1885	54.7856 8.32026...	POINT (9.81578...
6	Schleswig-Hols...	Rheinland-Pfalz	999	54.7856 8.32026...	POINT (9.81578...
7	Schleswig-Hols...	Baden-Württe...	2612	54.7856 8.32026...	POINT (9.81578...
8	Schleswig-Hols...	Bayern	2768	54.7856 8.32026...	POINT (9.81578...
9	Schleswig-Hols...	Saarland	229	54.7856 8.32026...	POINT (9.81578...
10	Schleswig-Hols...	Berlin	1826	54.7856 8.32026...	POINT (9.81578...
11	Schleswig-Hols...	Brandenburg	1059	54.7856 8.32026...	POINT (9.81578...
12	Schleswig-Hols...	Mecklenburg-V...	3824	54.7856 8.32026...	POINT (9.81578...
13	Schleswig-Hols...	Sachsen	995	54.7856 8.32026...	POINT (9.81578...
14	Schleswig-Hols...	Sachsen-Anhalt	715	54.7856 8.32026...	POINT (9.81578...

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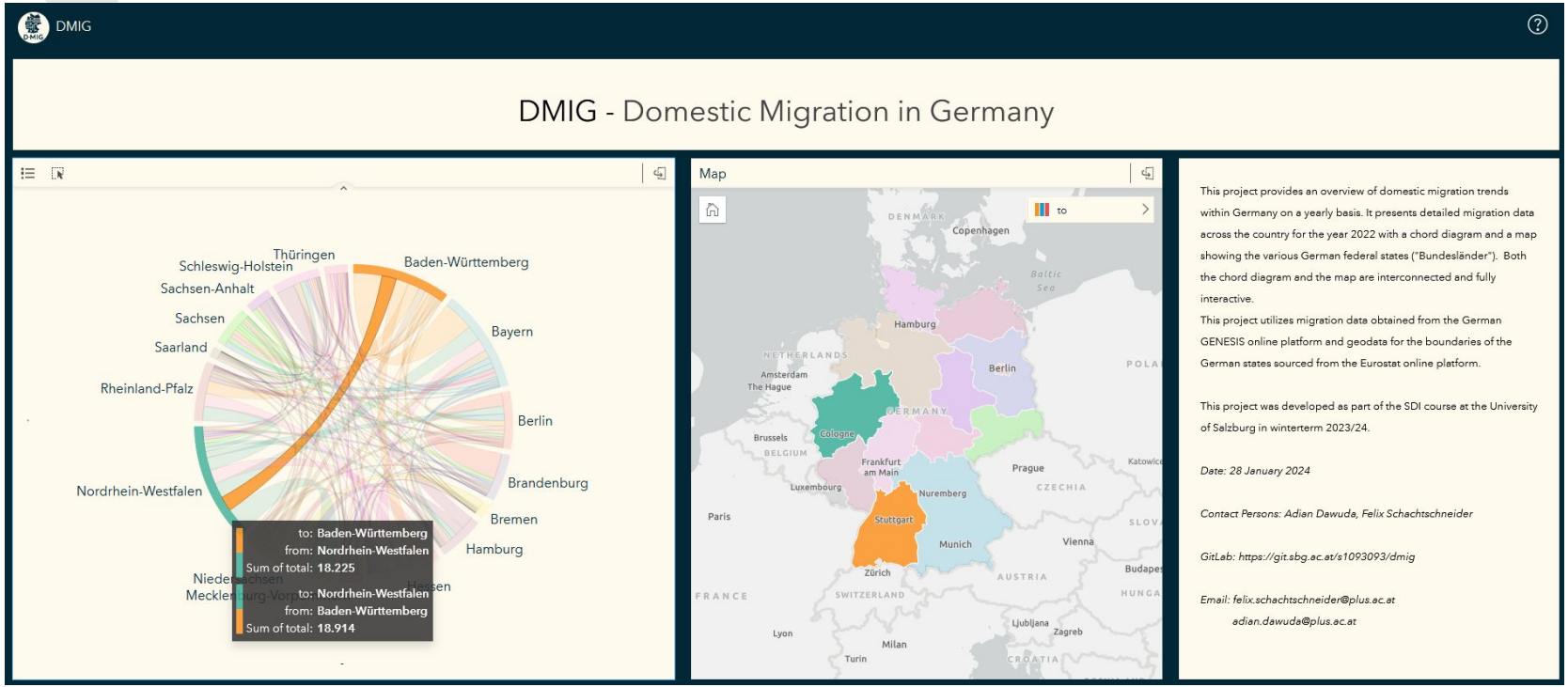
Dashboard Result



https://geoportal22s.zgis.at/portal/apps/insights/index.html#/view/0c4b817ad5fd4917ad724a40b23251d8

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