Urban Tree Health Analysis

Course: Urban Technologies

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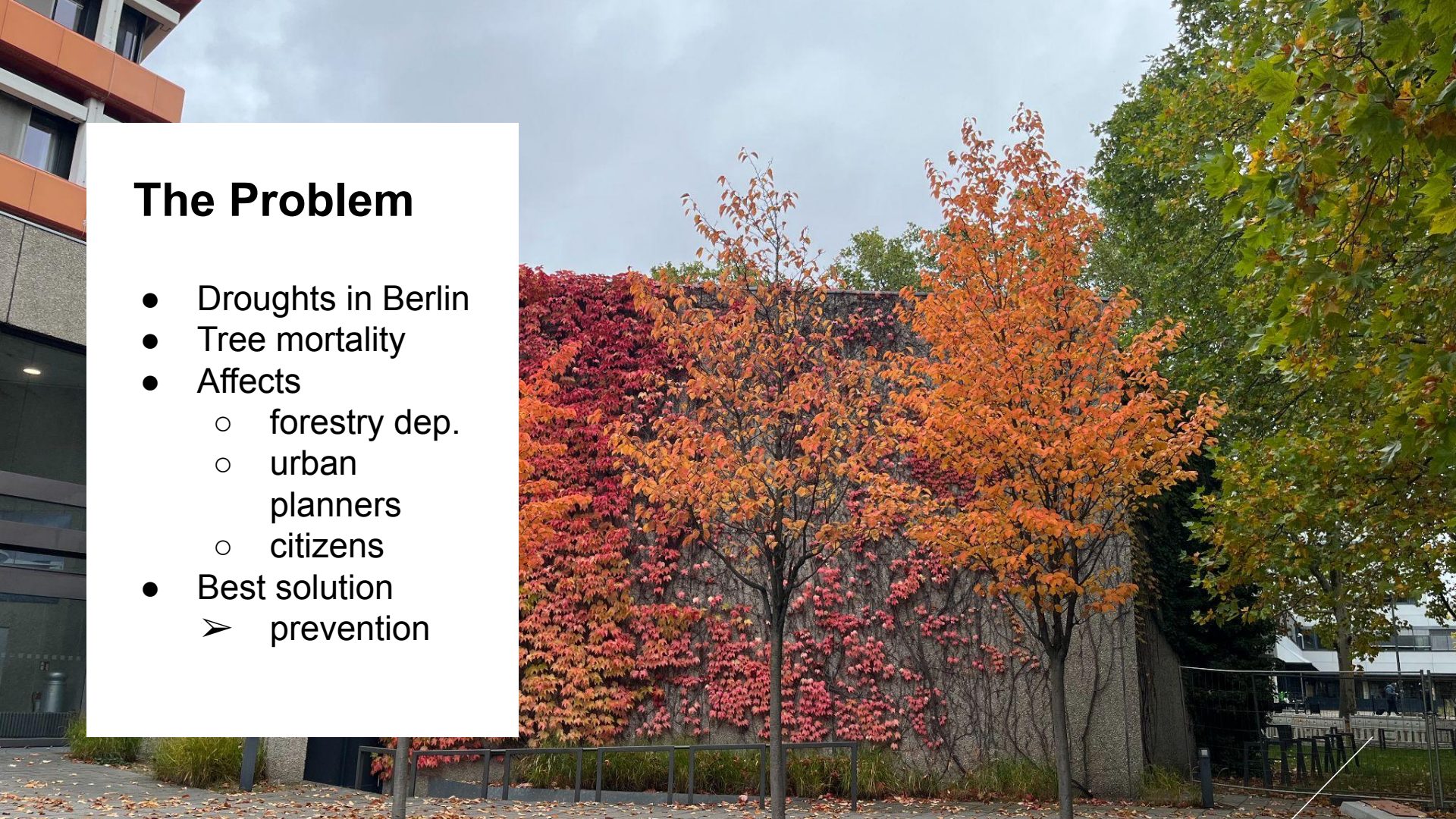
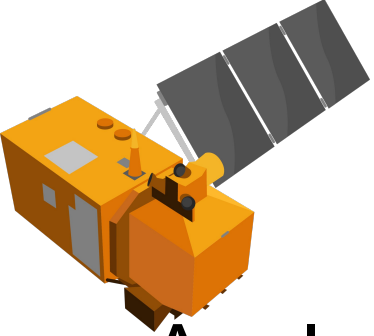


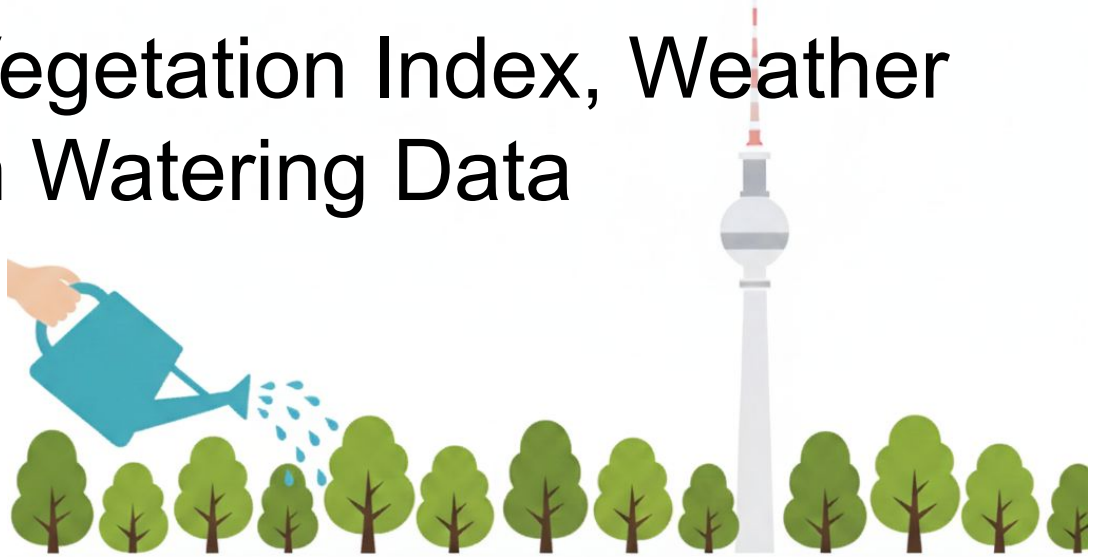
The Problem

- Droughts in Berlin
- Tree mortality
- Affects
  - forestry dep.
  - urban planners
  - citizens
- Best solution
  - ➢ prevention



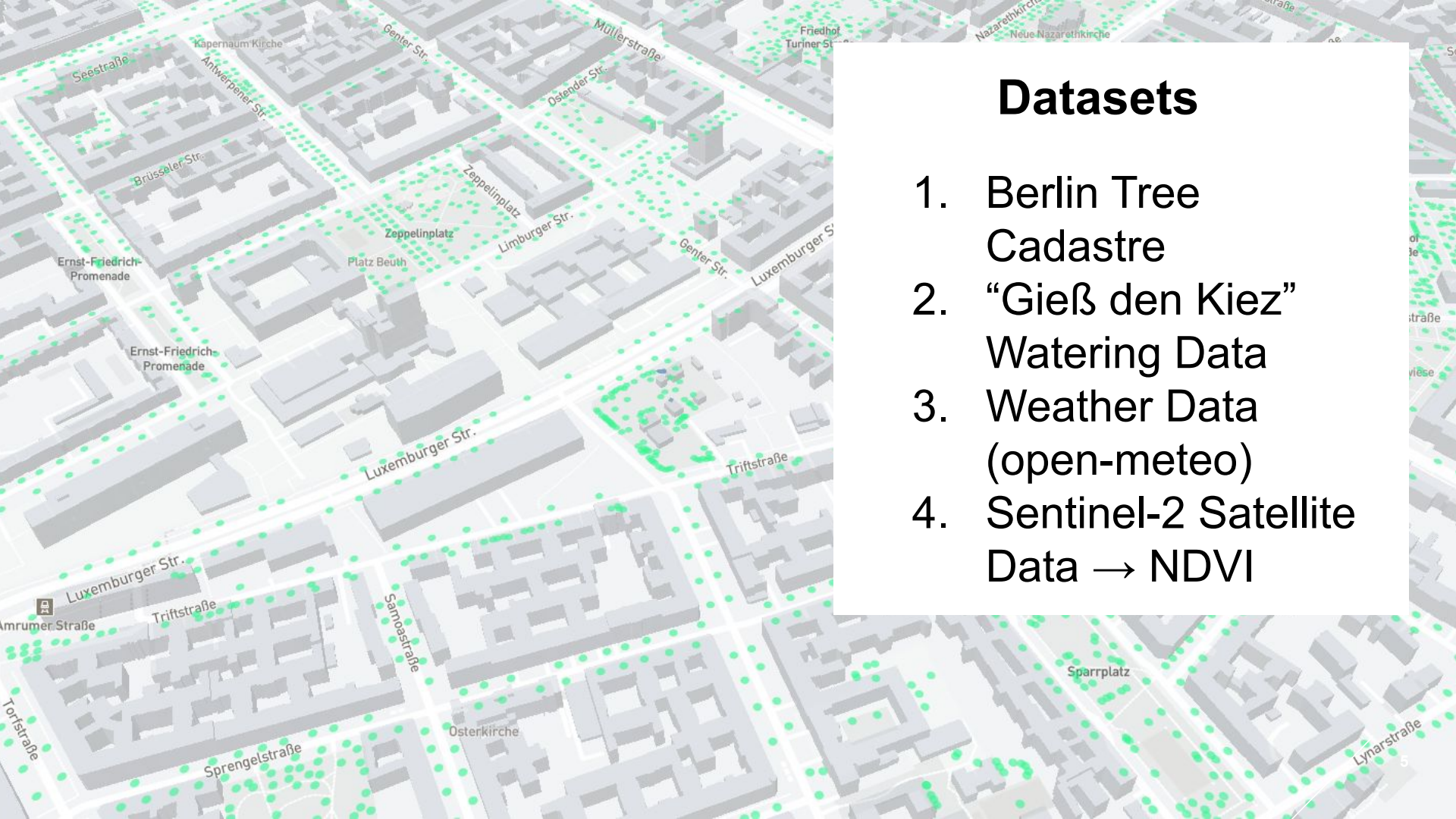
The Idea

Analysis of Street Tree Health in Berlin Using Satellite Vegetation Index, Weather Data and Citizen Watering Data



Background

- Monitoring drought impacts on street trees using remote sensing - Disentangling temporal and species-specific response patterns with Sentinel-2 imagery. (2024)
- Prediction of vegetation dynamics using NDVI time series data and LSTM. (2018)
- And many more…



Datasets

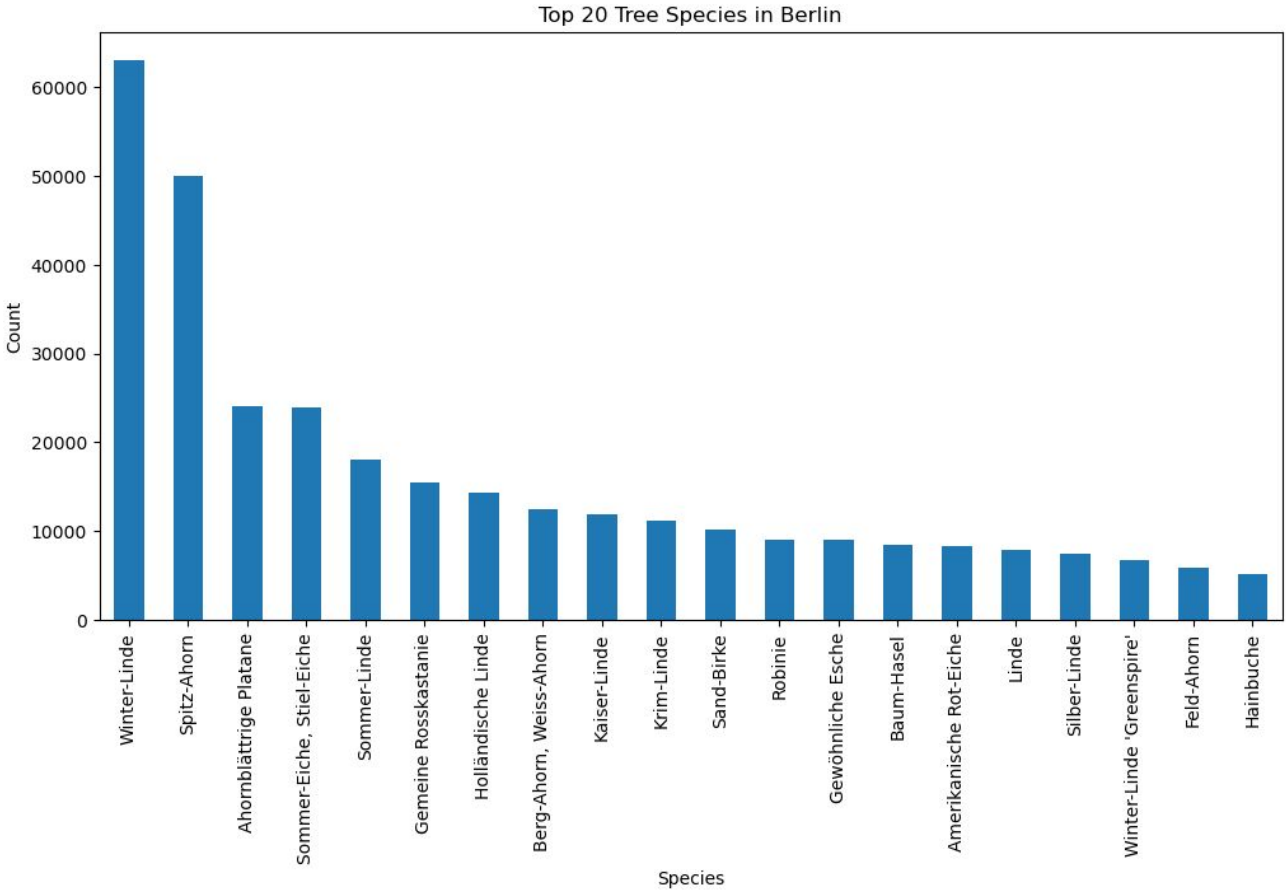
1. Berlin Tree Cadastre
2. “Gieß den Kiez” Watering Data
3. Weather Data (open-meteo)
4. Sentinel-2 Satellite Data → NDVI

Datasets and EDA - **Tree Cadastre Data**

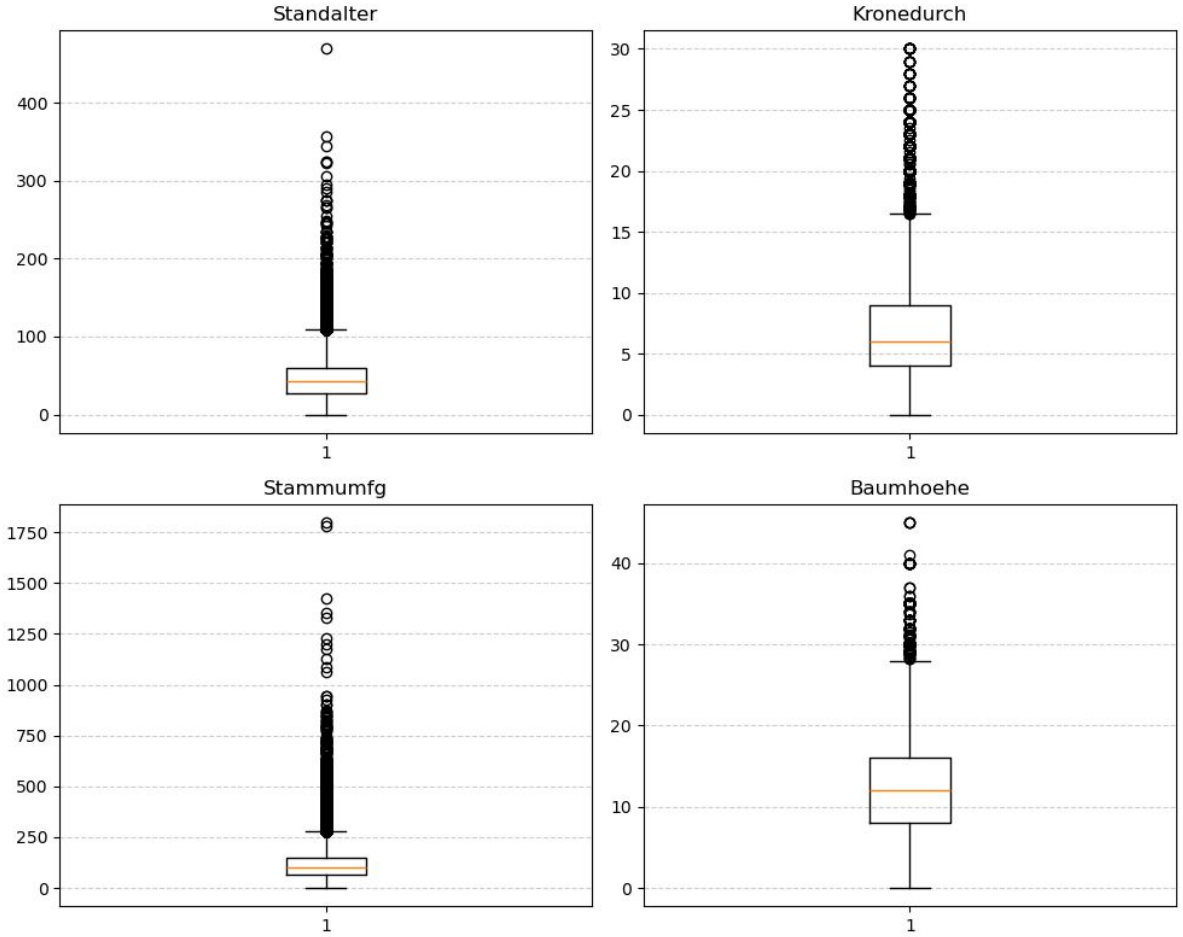
- loaded via Geoportal Berlin API
- 434035 entries
- 22 features

```
                                id                gisid              pitid  \
0  strassenbaeume.00008100_000bbafb  00008100_000bbafb  00008100:000bbafb
1  strassenbaeume.00008100_000bbafd  00008100_000bbafd  00008100:000bbafd
2  strassenbaeume.00008100_000bbafe  00008100_000bbafe  00008100:000bbafe
3  strassenbaeume.00008100_000bbaff  00008100_000bbaff  00008100:000bbaff
4  strassenbaeume.00008100_000bbb00  00008100_000bbb00  00008100:000bbb00

   standortnr kennzeich              namenr               art_dtsch  \
0          93     01414  Fritz-Reuter-Allee      Pyramiden-Hainbuche
1          91     01414  Fritz-Reuter-Allee  Berg-Ahorn, Weiss-Ahorn
2          90     01414  Fritz-Reuter-Allee  Berg-Ahorn, Weiss-Ahorn
3          89     01414  Fritz-Reuter-Allee  Berg-Ahorn, Weiss-Ahorn
4          88     01414  Fritz-Reuter-Allee  Berg-Ahorn, Weiss-Ahorn

                       art_bot gattung_deutsch   gattung  ...      hausnr
0  Carpinus betulus 'Fastigiata'       HAINBUCHE  CARPINUS  ...  gü.111/113
1            Acer pseudoplatanus           AHORN      ACER  ...      gü.111
2            Acer pseudoplatanus           AHORN      ACER  ...      gü.109
3            Acer pseudoplatanus           AHORN      ACER  ...      gü.105
4            Acer pseudoplatanus           AHORN      ACER  ...      gü.103

   zusatz pflanzjahr standalter kronedurch  stammumfg  baumhoehe  eigentuemer
0    None       1975       50.0        NaN      109.0       15.0  Land Berlin
1    None       1975       50.0        NaN      382.0        NaN  Land Berlin
2    None       1980       45.0        NaN       98.0       14.0  Land Berlin
3    None       1935       90.0        NaN      189.0       15.0  Land Berlin
4    None       1975       50.0        NaN      145.0       15.0  Land Berlin

     bezirk                    geometry
0  Neukölln  POINT (13.44828 52.44315)
```

Datasets and EDA - **Tree Cadastre Data**



Datasets and EDA - **Tree Cadastre Data**



Datasets and EDA - **Tree Cadastre Data**

Highest tree:

- Black poplar
- 45m
- 175 years old
- Lichtenberg

Oldest tree:

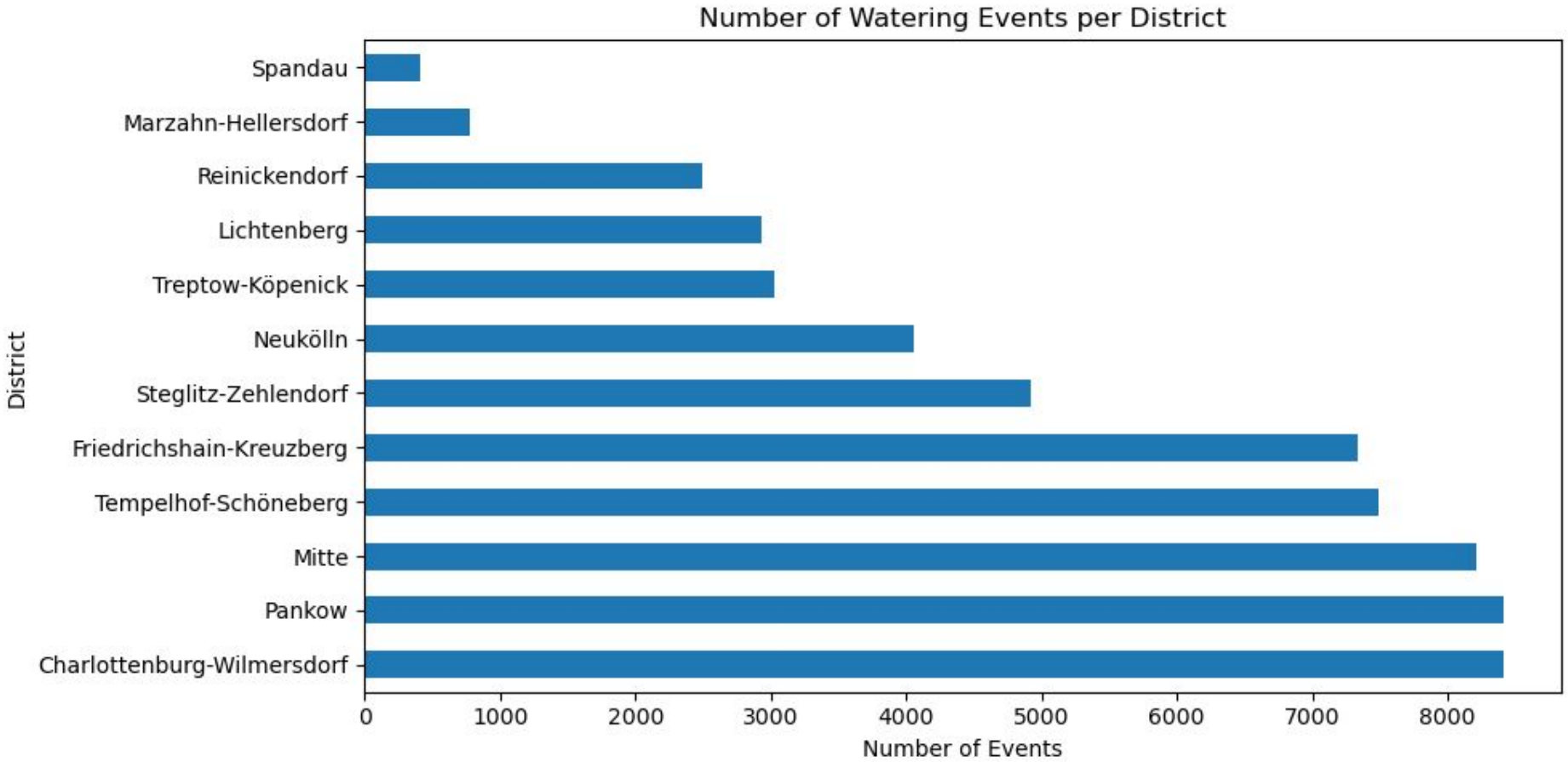
- Black locust
- 17m
- 469 years old
- Marzahn-Hellersdorf

Datasets and EDA - **Watering Data**

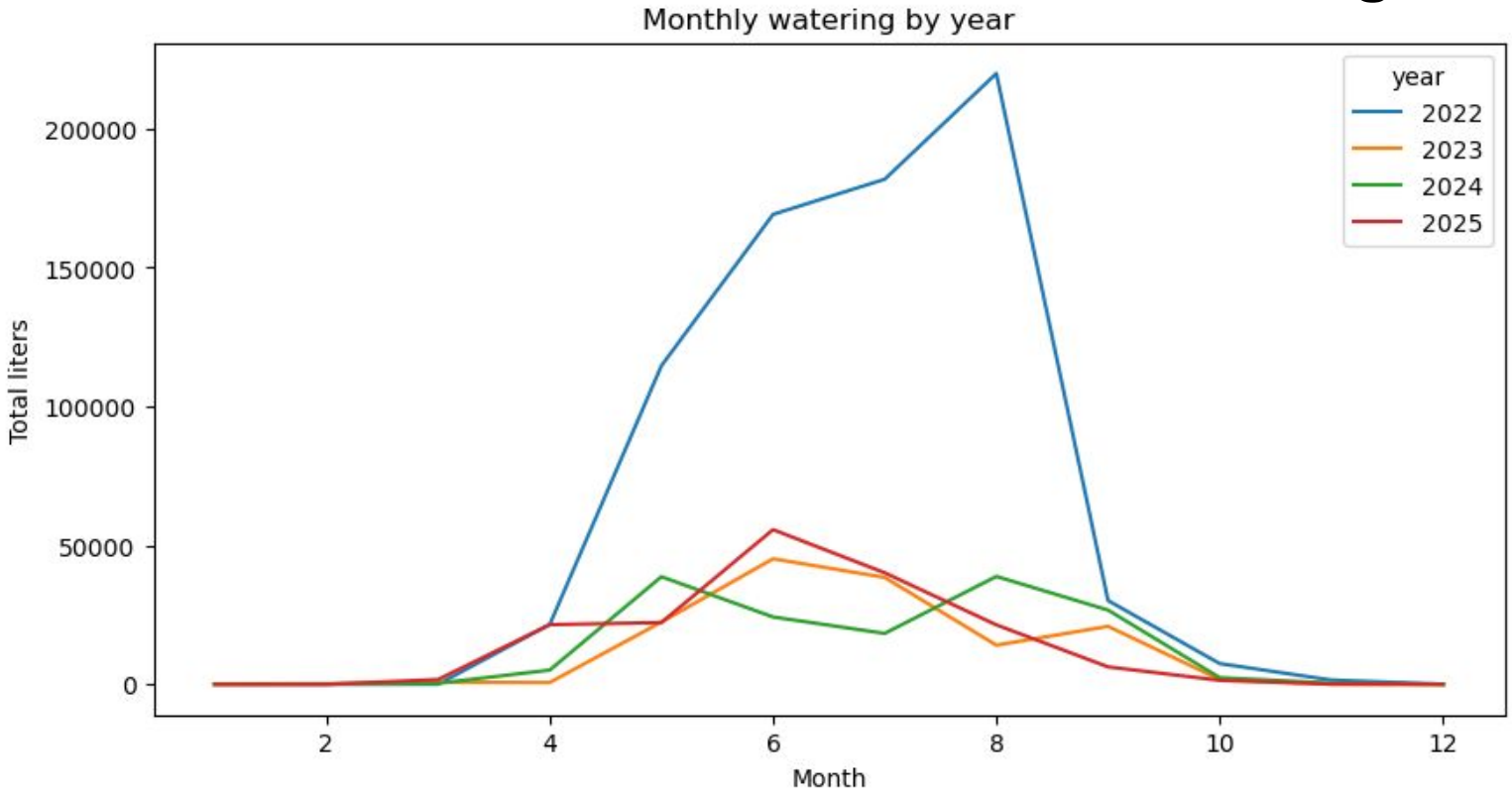
	id	lng	lat	bezirk	art_dtsch	gattung_deutsch	strname	pflanzjahr	timestamp	bewaesserungsmenge_in_liter
0	00008100:00224e5d	13.30562	52.46547	Steglitz-Zehlendorf	Spitz-Ahorn	AHORN	Englerallee	2017.0	2025-10-22 00:00:00+00:00	7.0
1	00008100:001417f0	13.36017	52.48880	Tempelhof-Schöneberg	Silber-Linde 'Szeleste'	LINDE	Erdmannstraße	2020.0	2025-10-21 00:00:00+00:00	100.0
2	00008100:001f5836	13.49687	52.57073	Lichtenberg	Holländische Linde	LINDE	Zingster Straße	1989.0	2025-10-17 00:00:00+00:00	30.0
3	00008100:0017d340	13.43520	52.55603	Pankow	Holländische Linde	LINDE	Jacobsohnstraße	1994.0	2025-10-17 00:00:00+00:00	20.0
4	00008100:001abc75	13.59403	52.51573	Marzahn-Hellersdorf	Spitz-Ahorn	AHORN	Zanderstraße	1996.0	2025-10-16 00:00:00+00:00	20.0

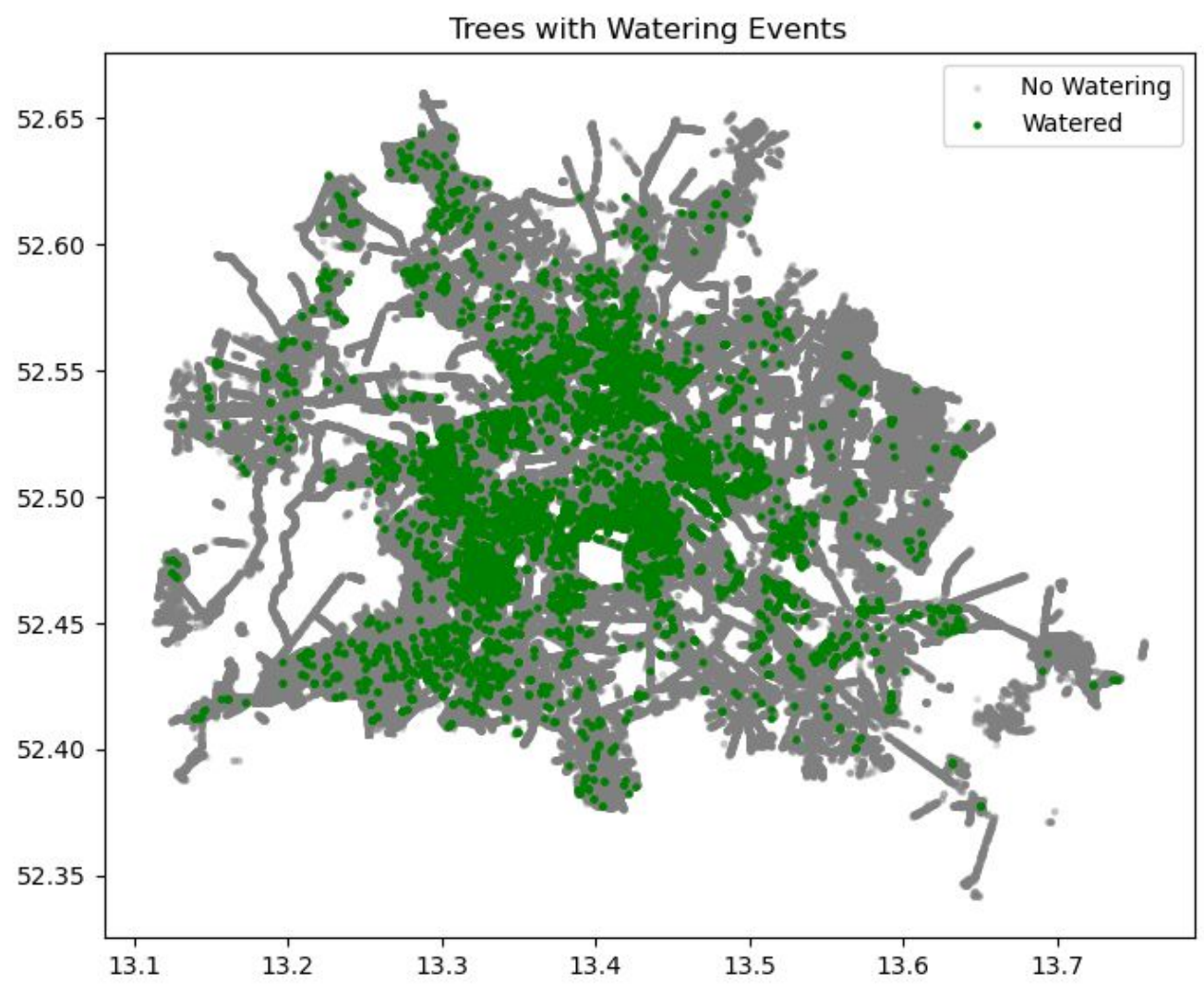
- loaded from Berlin OpenData portal
- 58601 entries for 11242 trees
- 10 features

Datasets and EDA - **Watering Data**



Datasets and EDA - **Watering Data**

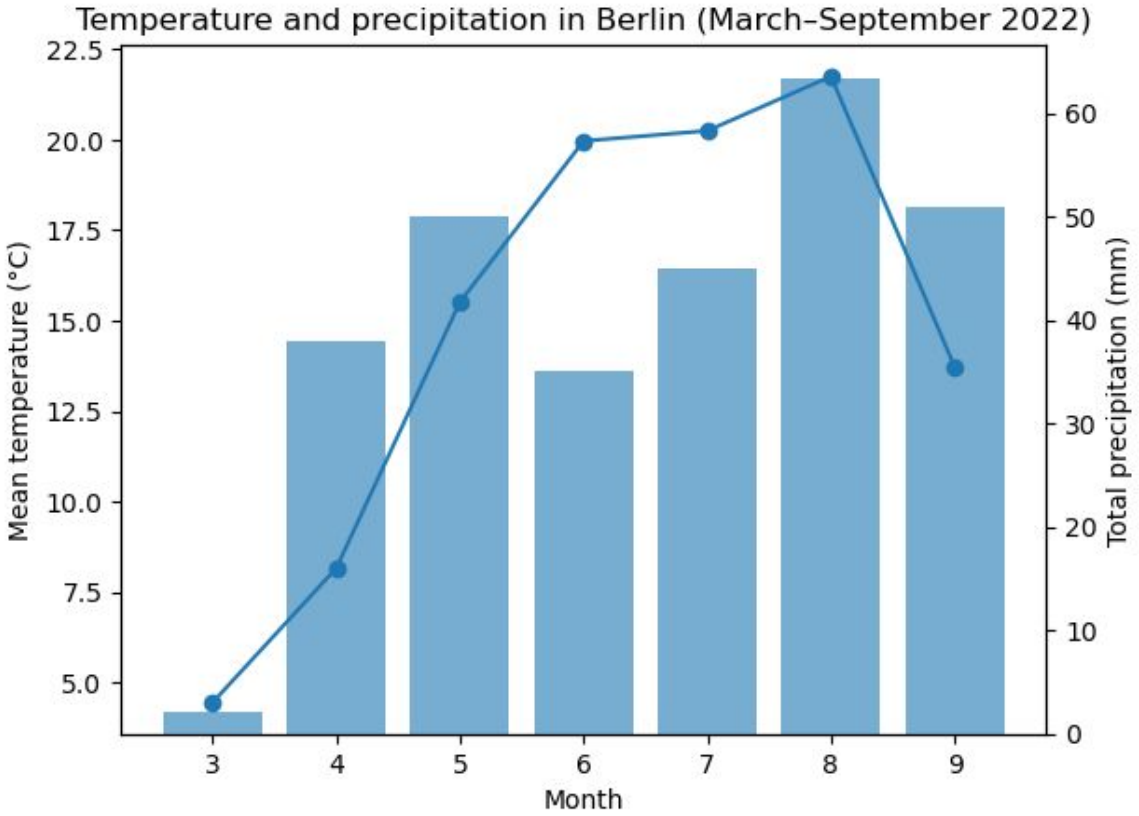




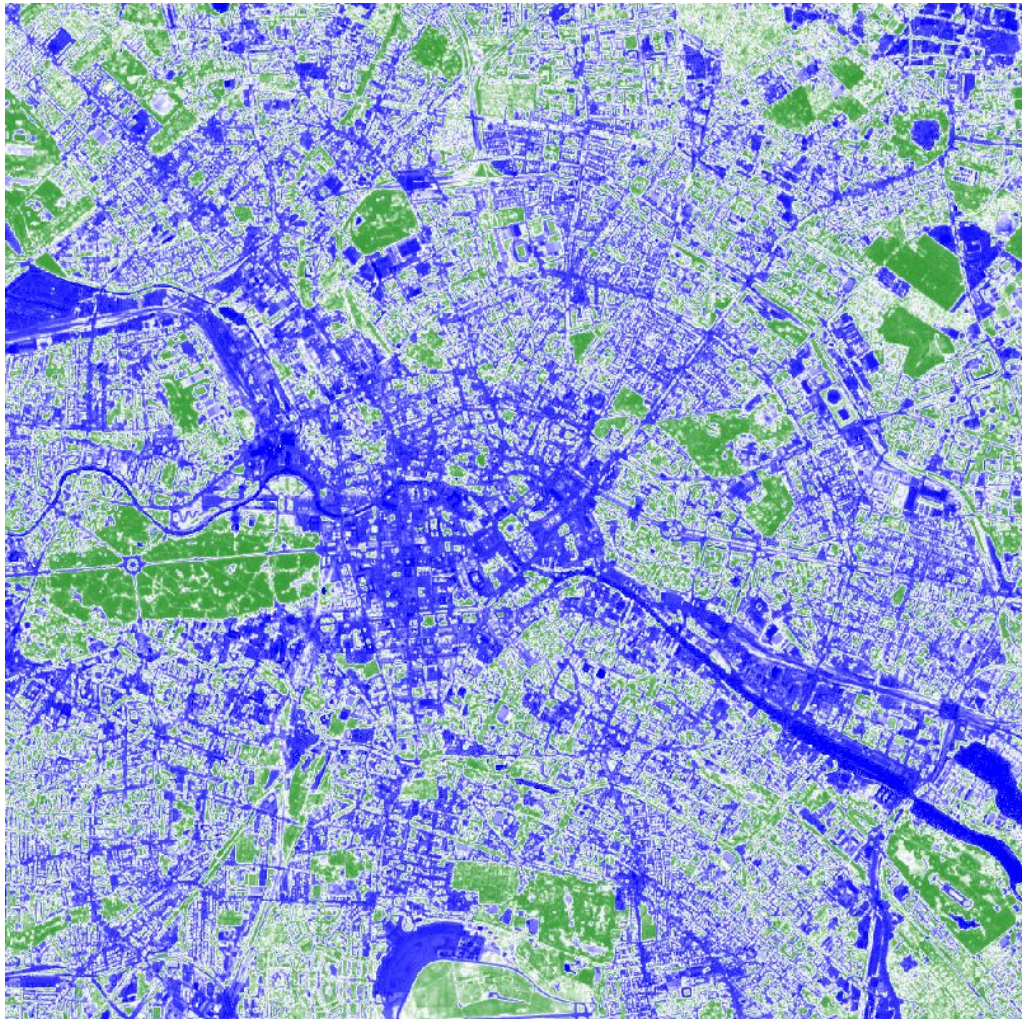
Datasets and EDA - **Watering Data**

- 11242 trees watered over 4 years
  → ~2.6% of all trees

Datasets and EDA - **Weather Data**



- loaded via open-meteo API
- average temperature and precipitation per month in 2022 for Berlin

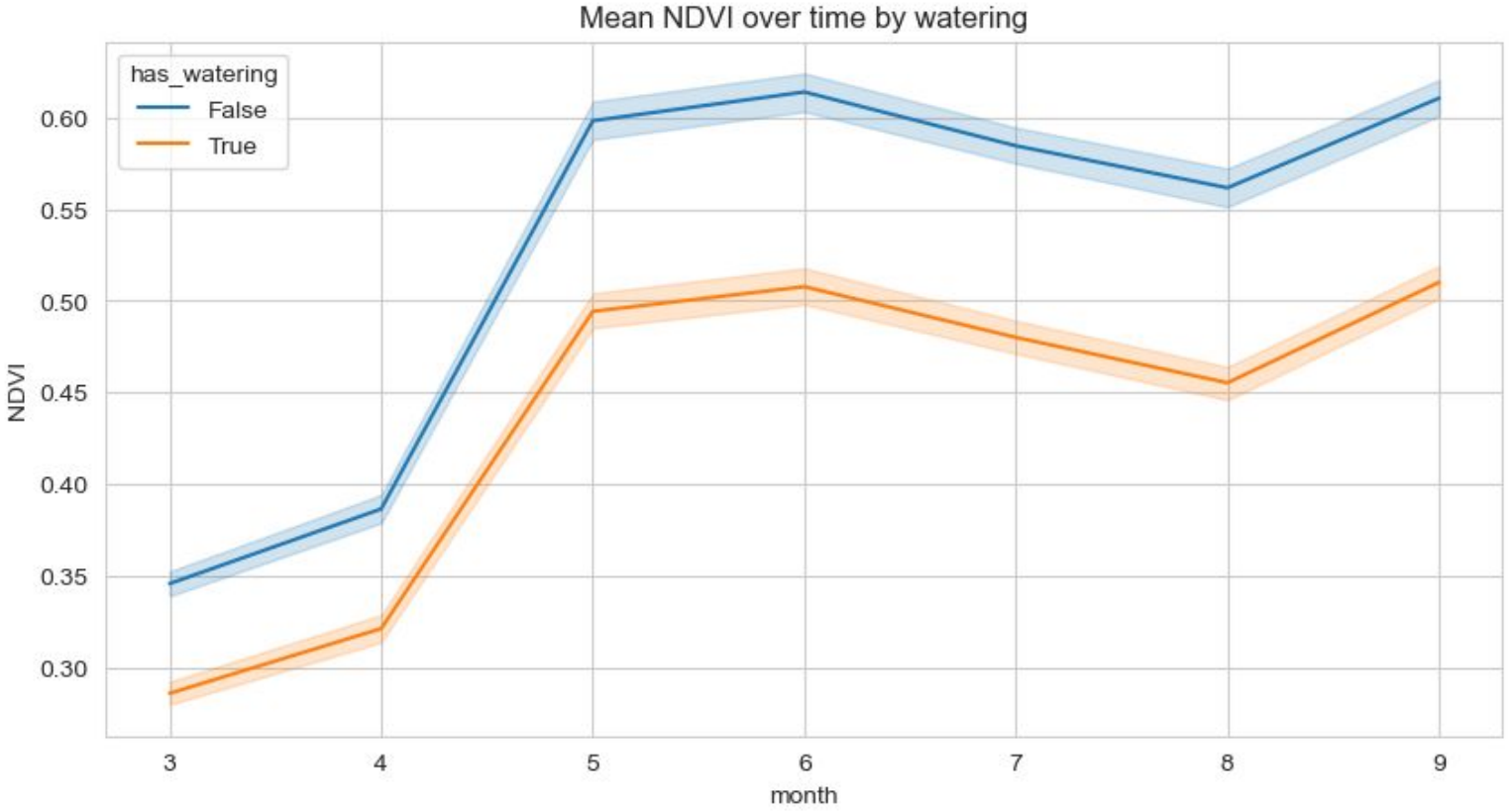


Datasets and EDA - **NDVI Data**

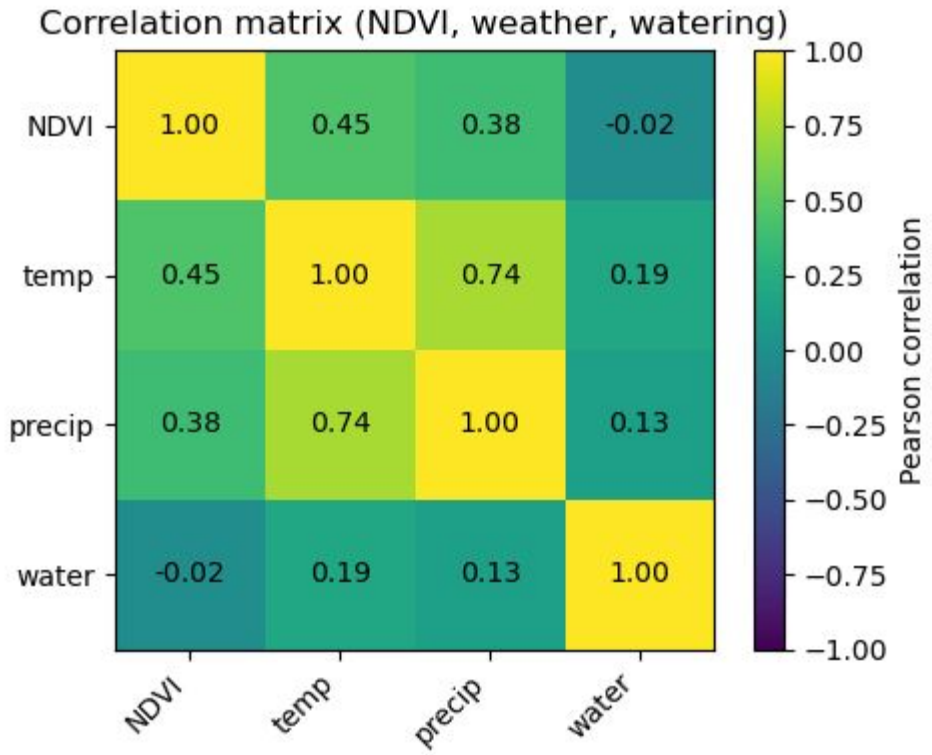
- loaded via Google Earth Engine API
- NDVI (Normalized Difference Vegetation Index)

  → proxy for vegetation vitality
- Charlottenburg-Wilmersdorf and Pankow trees in 2022
- 974 trees with watering
- 974 random trees without watering

Datasets and EDA - **NDVI Data**

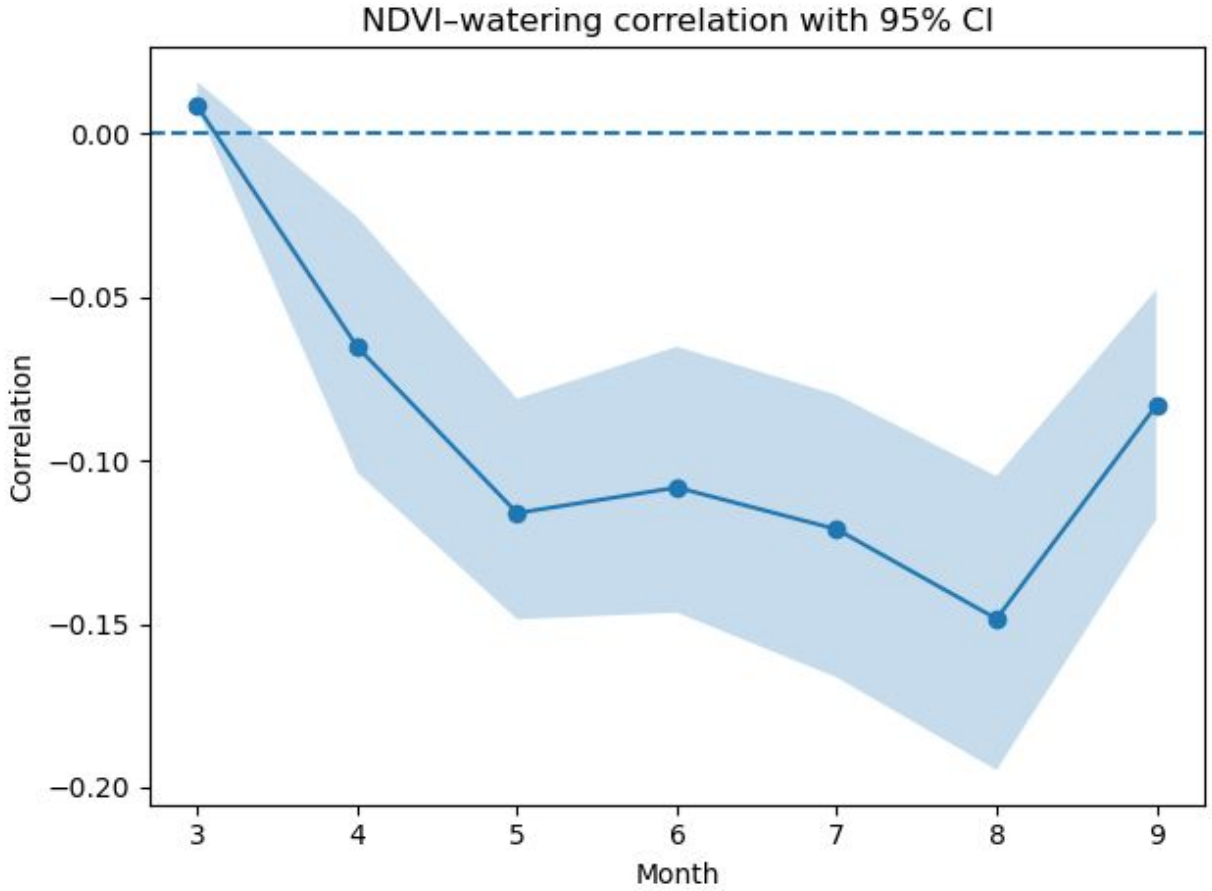


Datasets and EDA



But: time aspect not considered!

Datasets and EDA



Data Problems

1. NDVI noise/small tree crowns
2. Too many cloudy days → solved with mosaic function
3. Potentially incomplete/wrong watering data
4. Weather data has no variance over trees → no correlation calculation

Results / Discussion

- higher temperature → higher NDVI
- higher precipitation → slightly higher NDVI
- lower NDVI → a bit more watering in the same month

- next steps:
  - more data
  - more local weather data

Sources

- Daten Berlin. Baumbestand Berlin WFS. Retrieved December 2, 2025, from https://daten.berlin.de/datensaetze/baumbestand-berlin-wfs-48ad3a23
- Giess den Kiez. About. Retrieved December 2, 2025, from https://www.giessdenkiez.de/about?lang=en
- Google Earth Engine. COPERNICUS/S2_SR_HARMONIZED. Retrieved December 2, 2025, from https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR_HARMONIZED?hl=de
- Open Meteo. Retrieved January 10th, 2026, from https://open-meteo.com/
- https://www.vdberk.fr/arbres/populus-nigra-italica/. Retrieved January 20th, 2026.
- https://www.giardinaggio.it/giardino/alberi/robinia/robinia.asp. Retrieved January 20th, 2026.
- Leisenheimer, L., Wellmann, T., Jänicke, C., & Haase, D. (2024). Monitoring drought impacts on street trees using remote sensing—Disentangling temporal and species-specific response patterns with Sentinel-2 imagery. Ecological Informatics, 82, 102659. https://doi.org/10.1016/j.ecoinf.2024.102659
- Reddy, D. S., & Prasad, P. R. C. (2018). Prediction of vegetation dynamics using NDVI time series data and LSTM. Modeling Earth Systems and Environment, 4, 409–419. https://doi.org/10.1007/s40808-018-0431-3

Any Questions?

https://github.com/ninaimmenroth/urban-tech-berlin-trees