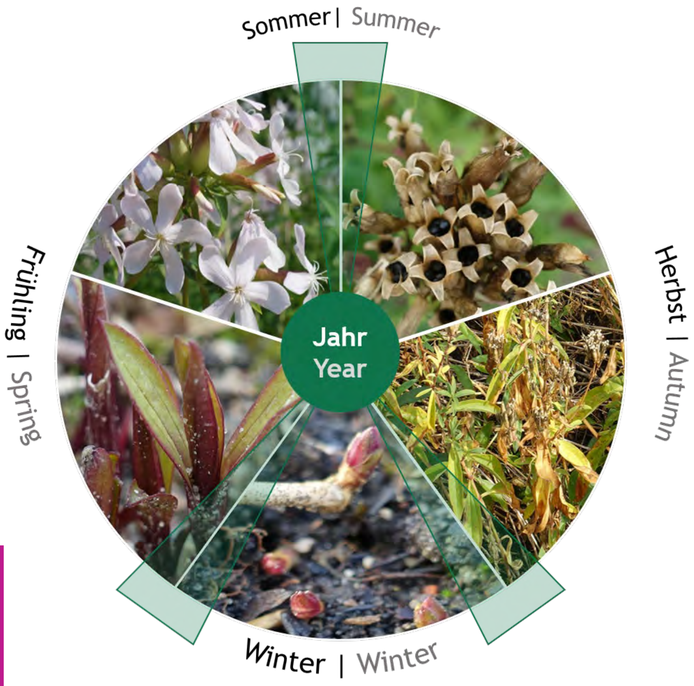
Pflanze KlimaKultur! - A citizen science approach to studying the effects of urbanization on the phenology of herbaceous plants

Wayne Schmitt[1], Tim Kortekamp[1], Birgit Nordt[1], Rolf A. Engelmann[2], Isabell Hensen[3,4], Luise Ohmann[3,5,6], Marco Patrzek[7], Robert Rauschkolb[3,7], Christine Römermann[3,7], Sebastian Schmidt[2], Sabrina Träger[3,4], Aletta Bonn[3,5,6], Gerald Parolly[1]

[1] Freie Universität Berlin, Botanic Garden and Botanical Museum, Königin-Luise-Str. 6-8, 14195 Berlin, Germany
[2] Leipzig University, Botanical Garden, Linnéstr. 1, 04103 Leipzig, Germany
[3] German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Puschstr. 4, 04103 Leipzig, Germany
[4] Martin Luther University Halle-Wittenberg, Institute of Biology/Geobotany and Botanical Garden, Große Steinstr. 79/80, 06108 Halle (Saale), Germany
[5] Helmholtz Centre for Environmental Research - UFZ, Department Ecosystem Services, Permoserstr. 15, 04318 Leipzig, Germany
[6] Friedrich Schiller University Jena, Institute of Biodiversity, Dornburgerstr. 159, 07743 Jena, Germany
[7] Friedrich Schiller University Jena, Institute of Ecology and Evolution with Herbarium Haussknecht and Botanical Garden, Philosophenweg 16, 07743 Jena, Germany



Phenological Stages of *Saponaria officinalis*

Weekly Observations by Participants with the *Flora Incognita* App or Web Interface

Climate Data is Recorded by Logger Every 15 Min.

Data Gathering, Cleaning and Analysis

Background

- The development of herbaceous plant species is tightly linked to environmental factors such as temperature and water availability
  - The phenology of selected species can be an indicator for changes in climate
  - Urban environments act as heat islands and exhibit effects of climate extremes more strongly
- Citizen science approach since March 2022
  - Ca. 200 participants in four cities (Berlin, Halle, Jena, Leipzig) planted project species in their own gardens and observe the phenological stages
  - Model “climate-beds” are established at botanical gardens and associated partners
- Parallel social study to analyze participants’ incentives to take part in citizen science, their experiences within the project, and the potential of citizen science to answer fundamental ecological questions

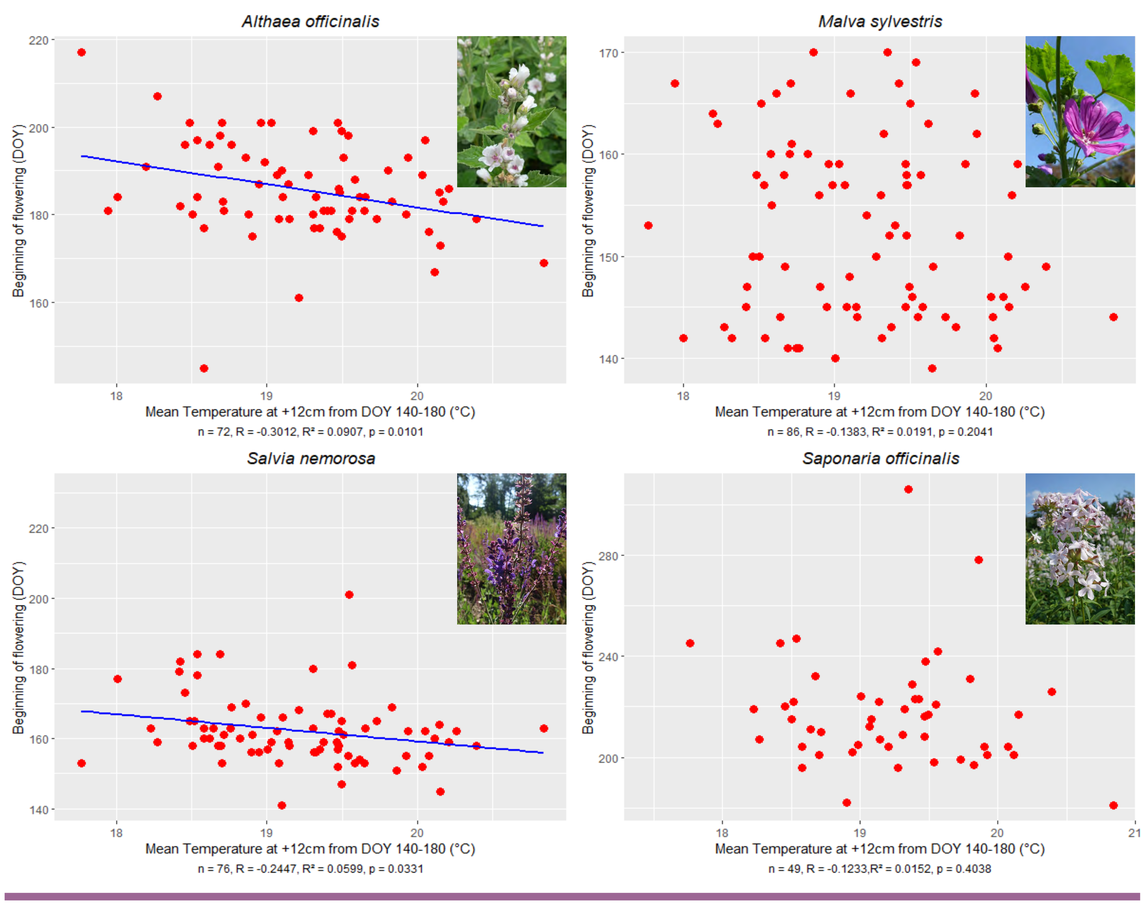
The Model Bed at Berlin Botanic Garden in Summer 2022

Project Setup

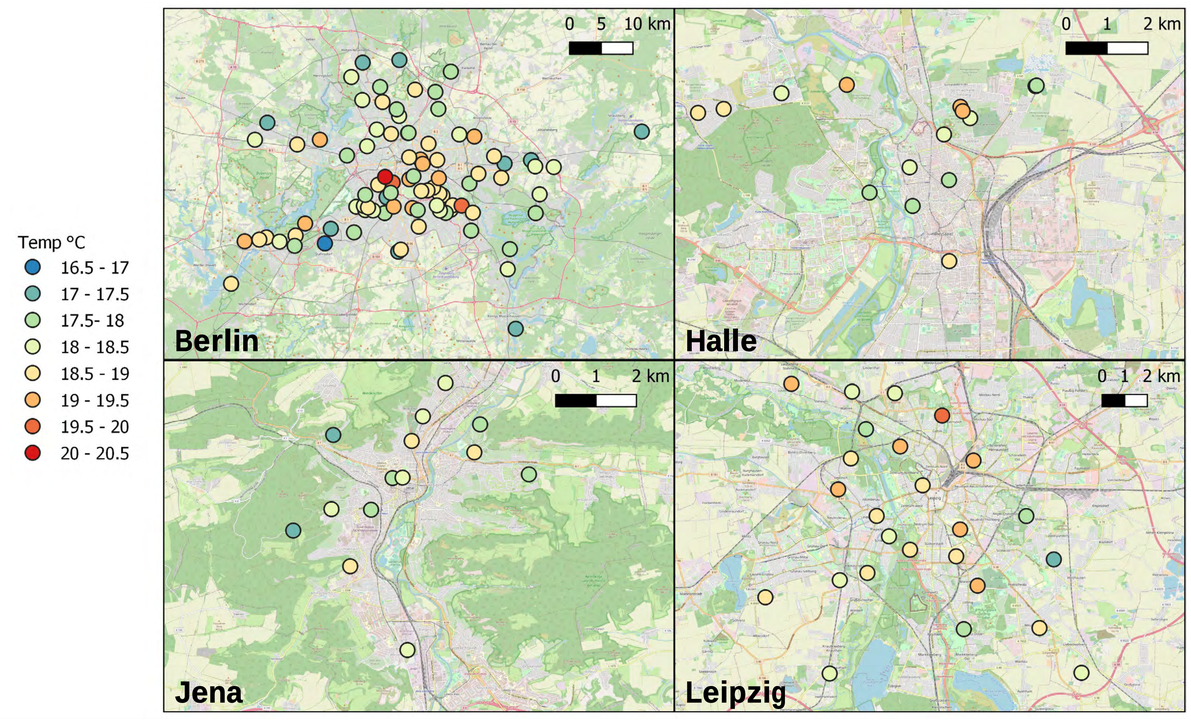
- 11 plant species (native or naturalized, easy to care for, insect friendly):
  - *Althaea officinalis*, *Clematis recta*, *Eranthis hyemalis*, *Filipendula vulgaris*, *Malva sylvestris*, *Salvia nemorosa*, *Saponaria officinalis*, *Scabiosa canescens*, *Securigera varia*, *Solidago virgaurea*, *Tulipa sylvestris*
  - A set of plants was given to every participant for planting in their own “climate-beds”
- Almost 200 study sites/“climate-beds” evenly distributed throughout each city
- Observed phenological stages (weekly):
  - First shoot, new leaf development, 50% senescence, flower, ripe fruits
- Citizen Scientist training:
  - Workshops given to all participants on how to observe the five developmental stages as well as an informational pamphlet
  - Monthly meetings both online and in-person were arranged to answer questions
- Phenological data collection:
  - Either using the Flora Incognita app (special feature developed for project data collection by TU Illmenau, AG P. Mäder) or our web interface created through ESRI ArcGIS® Survey123
- Climate data logger:
  - TOMST® (Czechia) TMS-4 data logger: Measures in 15-minute intervals the soil (6 cm belowground), surface, and air (12 cm aboveground) temperature as well as soil moisture

Analysis and Preliminary Results

- Visible temperature gradient from cooler surrounding countryside to warmer urbanized core of the cities, but potential effects from microclimate are also reflected
- First data analysis: Pearson’s R correlations between mean temperature data for DOY 140 to DOY 180 and start of flowering
  - Negative correlations between begin of flowering (DOY) and air temperature (°C) in two species for 2022: *Althaea officinalis* and *Salvia nemorosa*
  - No significant correlation found in the analysis of *Malva sylvestris* and *Saponaria officinalis*



Correlations of Air Temperature vs. Start of Flowering

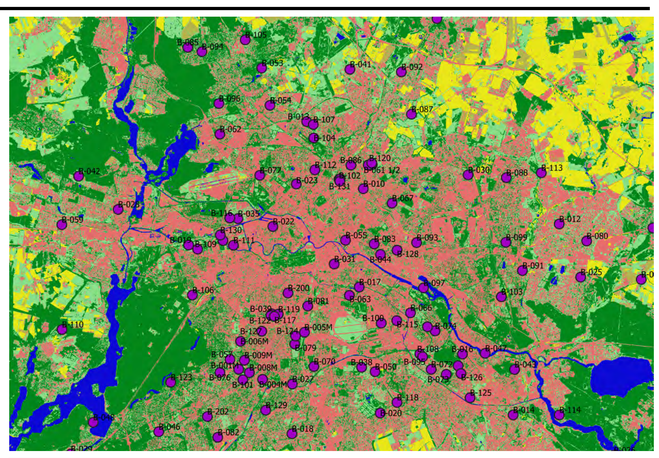


Mean Air Temperature (+12 cm) of all Four Cities for May-June

Outlook

- 2023 first shoot data will be analyzed in the context of weather data gathered in the winter
- Land cover analysis around each “climate-bed” site with remote sensing data for correlating phenology with factors such as amount of green space, water or built up area

Forest	Low Vegetation	Water
Built-Up	Bare Soil	Agriculture



Land Cover Around Participants’ “Climate-Beds” in Berlin

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References

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Birgit Nordt & Wayne Schmitt
Botanic Garden and Botanical Museum Berlin
pflanzeklimakultur@bo.berlin
www.pflanzeklimakultur.de