**Introduction**

* What is the scope of the problem?
  + Improving the modeling of the walkable environment / service connecting area for urban green spaces (UGS) in European cities based on a proximity approach
  + Provide solutions for easy-to-handle / understandable indicators based on publicly available data and software
  + Develop an approach to combine high-resolution data with a comparative approach
* What do we know about the problem?

ES = Important

* + Ecosystems supply ecosystem services (ES) which are critical to human wellbeing (Syrbe & Grunewald, 2017).
  + Living in proximity of urban green spaces (UGS) was found to have positive effects on mental health and physical activity as well as reduce mortality (Kabisch 2017?).
  + In the Sustainable Development Goal (SDG) 11, the United Nations have agreed to provide universal access to public green spaces by 2030.

(Global) urban pop growing = relevance of ES in cities

* + Urban population is growing worldwide. 55% of the global population were living in cities by 2018 and 68% are projected to do so in 2050 (UN, 2019).
  + In Europe, 74% of the population are living in cities (UN, 2019).

European challenges = narrowing down

* + In Europe: Growing and shrinking cities (Kabisch, Haase & Haase 2012).
  + Varying challenges and opportunities for the development of green spaces (Kabisch, Haase 2012).

State of the art in European comparison:

* + Accessibility and availability of UGS in Europe have been analyzed and compared in multiple studies e.g.:
  + Kabisch et al. 2016 green spaces Europe
  + JRC accessibility study
  + …

Use intensity =

* + Use intensity can influence ES, creating a mismatch between supply and demand (Syrbe & Grunewald, 2017).
  + Compact city paradox: The more compact a city, the more people benefit from UGS, the higher the pressure on the ecological functions of the UGS (Quelle?).

SCA = modeling space between SPA and SBA important

* In their 2017 work, Syrbe and Grunewald make a case for not only assessing ES in consideration of their underlying ecosystem types.
* They propose to spatially distinguish the demand and supply sides of ES as well as the area that connects both sides (Syrbe & Grunewald 2017):
* Service providing areas (SPA) represent the supplying side, the spatial unit where the ES are generated (e.g. UGS).
* Service benefiting areas (SBA) embody the demand side, the target of an ES flow (e.g. the residents of a city).
* Service connecting areas (SCA) are the space connecting provision and demand (e.g. an urban street network).

Proximity = Modeling green space proximity in cities important (SCA for green space and population in cities)

* + Accessibility of UGS vs availability of UGS:
  + Three perspectives have been used in past studies to tackle the problem:
  + Provision (area / person): Flow from green area to buildings (providing green space)
  + Pressure (person / area): Flow from residential buildings (population) to green spaces (pressure on / demand of green areas)
  + Proximity (min. or avg. distance): Space between supply and demand (proximity)

State of the art in green space proximity:

* + …
  + Approach from Wolff 2021: Coupling the perspectives via network characteristics.
    - Network analysis
  + Wolff found two promising indicators: Detour Index (DI) and Local Significance (LS)
    - DI: measure of the efficiency of the paths people take to their next UGS / modeling barriers.
    - LS: measure of use intensity of UGS that might serve as a spatial indicator for overuse of UGS.
  + Modeling the *walkable environment* of a city by including the three perspectives mentioned above + network characteristics approach.
* What do we not know about the problem?

Research gaps (of previously mentioned studies):

* + Mostly using fixed distances
    - ‘To have or not to have access to green spaces’
  + Mostly using only one perspective
    - Not accounting for mutual dependencies of supply and demand
    - No focus on service connecting areas / walkable environment
    - A proximity perspective is necessary to account for barriers and network characteristics
  + Mostly using coarse resolution on a larger scale
    - Fine resolution can reveal spatial patterns at a finer scale enabling targeted intervention
    - A finer resolution will also reduce the uncertainty that is introduced if e.g. a grid or a district aggregation is used

Building based approach:

No comparable studies using e.g. a building-based approach on a European scale

Conclusion:

* + Knowledge about UGS is important for planning and decision making to remove uncertainties in UGS provision.
  + Detect mismatch between provision and demand
  + Need for a method that models service connecting areas to combine supply and demand aspects of green space accessibility / availability with a high spatial resolution that is comparable on a European scale
* What is the purpose of this paper?
  + Research questions

What does a modeling approach look like that estimates the walkability between green space supply and demand in cities?

How to incorporate publicly accessible data and open source software in order to allow i.) a reproduction over time (e.g. with more recent data), ii.) assessments in data-scare regions, and iii.) comparative approaches covering a larger sample of cities

* + - How can easy understandable and applicable indicators be used in order to support urban planning in detecting mismatches between demand and supply

* + Objective 1: From concept to workflow (based on service-connecting area/proximity approach)

What does a modeling approach look like that estimates the walkability between green space supply and demand in cities?

Modeling service connecting areas:

Description of indices

* + - * + Combine buffer distance and network distance (Detour index)
        + Combine population, GBS size network distance (Local significance)

local significance for streets / detour index for buildings

Objective 2: Develop and apply indicators, display/interpret/compare them

* + - How can easily understandable and applicable indicators be used in order to support urban planning in detecting mismatches between demand and supply
      * Create Network characteristics for European cities
      * Comparison across Europe
        + Clustering / aggregation
      * City scenarios
        + Three scenarios

1. Applying walkability indices
   1. Develop modeling approach
2. Comparing walkability indices
   1. Compare results across Europe
3. Implementing walkability indices
   1. Show possible use cases for city planners