Appendix 2: Table of data inputs/outputs. This serves as a quick qualitative overview of the scope and complexity of the tools and a basis for the planning tool performance table (Table 5). The sources for this table are listed in Table 4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tool** | **Data base / methodology**  | **User Input** | **Data processing** | **Output** |
| GREENPASS | * 10 years of research
* 5 international case studies
* Geodata
* Measurements
* Simulations
* Urban Standard Typologies (UST)
 | * Geodata (Open Source)
* CAD data
* GPS data
* Edited planning project (e.g. material allocation & insert green infrastructure).
 | * Combination of ENVI-met simulations with area analysis, evapotranspiration models, cost analysis, and qualitative indicators.
* by experts with optimization for new planning and existing buildings
 | * Maps of PET distribution at different times (including at night) on a hot summer day with and without the application of measures, and in 3 standard scenarios (100% sealed, moderately vegetated, maximally vegetated).
* Values and scores for (up to) 28 indicators
 |
| CLARITY Advanced Screening Tool | Geodata:* Euro-Cordex simulations (21 climate indices)
* Copernicus dataset (Urban Atlas, European Settlement Map, European Street Tree Layers, Digital elevation model, Basins)
* Rivers from USGS HydroSHEDS
* EUROSTAT population data
* CORINE land use data
* Vulnerablity functions
 | * Data package for one of > 400 European cities
* Selection of temporal horizons
* Selection of RCP scenarios
* Selection of adaptation measures and application coefficient
* Optional insertion of local data by developers
 | * via EMIKAT calculation of hazard indices in finer resolution, data on population distribution and heat influence on population and economy, influence of adaptation measures (still under development)
 | * Maps and tables with values for 4 time horizons (1971-2000, 2011-2040, 2041-2070, and 2071-2100), and 3 RCP scenarios (RCP2.6, RCP4.5, RCP8.5) on a hot summer day for UTCI, GT; and for population distribution, population density, number of people exposed, outdoor discomfort level, heat wave impact.
* Values on direct and indirect economic impact due to changes in mortality, work absenteeism, and hospital admissions, as well as increase in mortality rates
* Theoretical maps and values of the above indicators changed by adaptation strategies (still under development).
 |
| INKAS-NRW/INKAS | Geodata:* ATKIS Basis-DLM
* official house coordinates
* official house perimeters
* 3D building model in LoD1
* Copernicus Imperviousness Layer
* Measurements
* Simulations
* Land use and building types
 | INKAS NRW:* Selection of a map area in the specialized information system climate adaptation
* Impact analysis selection adaptation category, parameters, number of experiments (scenarios), development type, development environment, adaptation measure(s).

 INKAS:* Impact analysis, selection of measure category, parameters, number of experiments (scenarios), development type, development environment, measure
* Area analysis selection development type, parameters
 | * In the case of the map “Heat-adapted neighborhood planning” in the specialist information system Climate Adaptation, the development type and the development environment are automatically determined and inserted in INKAS NRW
* Data on measure effectiveness and area analysis were generated in advance through measurements and simulations
 | INKAS NRW:* Map of development types in the specialized information system for climate change adaptation

INKAS NRW & INKAS Wirkungsanalyse:* Diagrams of the expected local change at ground-level Tair (daily minimum and maximum) on a low-wind hot summer day due to various urban development measures (with and without the application of measures).
* Diagram of the effectiveness of the measure in the selected development type during the day and at night.

INKAS Flächenanalyse:* Graphs/charts and tables of summer heat stress vulnerability of development types based on Tair and GT of the ground level air layer during the day and night (reference environment open space).
 |
| Future Cities Adaptation Compass | * Practical experience of the project partners
* Literature
* No comprehensive scientific elaboration
 | Vulnerability check:* Previous events (text)
* Spatial meaning (text)
* Adaptability and vulnerability class of receptors to extreme weather events (categories).

Learn about climate change:* Selection of land or adaptation, trend of climate changes

Explore adaptation measures:* The preset effects can be changed if necessary (categories)
 | * Summary of inputs and clear presentation by arranging them in categories
* Offsetting the derived risk categories against the measure efficiencies for the output of measure recommendations.
 | * Future risk of receptors for summer and winter in categories (very high, high, medium, low).
* Scores for the effectiveness of the measures in relation to the risks, identified as high and very high
 |
| Betroffenheitswizard | * Literature
 | * Assignment of the expression of the climate signal and the sensitivity respectively at the present time (t0) and a future time (t1) by categories (low, medium, high) for 10 topics
 | * Accounting of the estimation of exposure and sensitivity
 | * Categorization of climate monitoring (actual situation t0) and climate impact assessment (expected future situation t1) into low, medium, high for assessment of potential need for action.
* List of appropriate measures based on the assessment of impact areas.
 |
| C40 Heat Resilient Cities Benefits Tool | * Comprehensive literature study
* Temperature data
* Simulations
* Extrapolations
* Multiplier functions
 | * Selection of measure type
* Selection of one of over 90 cities (assignment of climate zone)
* Starting & ending year analysis
* Details of measures (e.g. area size of the measure, crown cover, area share of the measure in the project area, albedo)
* Recommended coverage level (minimum share of city covered by measure, city size)
* Minimum temperature threshold for mortality
* RCP scenarios
* Demographic data (population density, proportions of age groups, population increase per year, number of hospital admissions for various medical conditions)
* Economic data (⌀ hospital costs of a heat-related illness, statistical value of a human life)
 | * Calculations in the tool on the input and/or default data combined with adjustment and health multiplier functions for the selected time period.
 | Heat effect of the measure:* Estimated number of days (⌀ per year) above threshold with and without measure for selected RCP scenarios, and difference
* reduced Tair

Health effects of the measure:* Estimated number of lives saved (annual ⌀) and hospital admissions reduced (for total analysis period as well as annual ⌀) for each of the selected RCP scenarios.

Economic effects of the measure:* Estimated hospital costs saved and value of lives saved in annual ⌀ for selected RCP scenarios.
 |
| Adaptation Support Tool (AST)*\* only available in V2* | * *\* for PET map: empirical PET model based on Rayman model simulations*
* Literature
* Hydrologic model (Urban Water Balance Model)
* *\** *Reduction factors for heat stress*
 | * City structure type
* Goal of climate change adaptation
* Multifunctional land use
* Scale level
* Existing spatial types
* Subsoil availability
* Roof type
* Soil type
* Position of the landscape
* Optional data: climate, cost, and water quality targets such as evapotranspiration (mm/year), heat reduction (°C), number of cooling surfaces, construction costs (€), maintenance costs (€/year).
* Selecting measures and locating them on the map by area, line or point
* Measure details (e.g. water storage depth and inflow area), if applicable.
 | * Calculation of scores for ranking of measures by selected area characteristics and adaptation targets.
* Calculation in the tool of the expected measure effectiveness based on information on area size of the measure, water storage depth and inflow area.
* *\** *Calculation of the reduction of the heat load via reduction factors*
 | * Scores and ranking for effectiveness of adaptation measures in relation to input data.
* Values and tables on water storage capacity (m³), groundwater recharge (mm/year), evapotranspiration (mm/year), heat reduction (°C), cooling surfaces (number), construction costs (€), maintenance costs (€/year), water quality in % (pathogen reduction, nutrient reduction, adsorbents).
* *\** *Co-benefits for active action through urban green: Carbon storage (kg CO2/dam²/year), Reduced health costs due to particulate removal from air (€/year), Reduced medical visit costs (€/year), Avoided lost work time (€/year), Prevented premature deaths due to commuting (€/year), Increased physical activity (€/year), Added value of homes (€).*
* *\** *detailed heat stress effect for active measure: new PET temperature (°C), PET temperature difference (°C), map display of current and new PET situation, and PET difference*
 |
| Microclimate and Urban Heat Island Mitigation Decision-Support Tool (UHI-DS) | Among others:* Thermal images
* Measures
* Geodata
* Building Information Models
* CAD data
* Development master plans
* Computer modeling
* Simulations
* Literature (Urban Heat Island, Mitigation Performance Index)
 | Public space:* Streets and pedestrian walkways: Low/high solar reflectance index (SRI)
* Public squares (squares and parking lots): Low/high SRI
* Vegetation: No/Street trees
* Shadow: No/public square
* Evaporative cooling: No/extensive
* Water bodies: no/given

Building Form/Building:* Building height: medium or high
* Roofs: Low/high SRI or green
* Soil coverage of the building plot: Low/high SRI

Filter selection Urban Heat Island Mitigation Performance Index:* Goals, climate region, urban structure context, category (building, public space, community).
 | * Calculation in the tool of the expected effect on Tair and UTCI by the selected measures.
* Ranking in the Urban Heat Island Mitigation Performance Index by selecting different filters.
 | Actual state (Existing):* 3D video of the thermal surrounding
* 2D Heat map
* Climate zone
* Max/Min yearly Tair
* ⌀ yearly precipitation
* Water bodies
* Wind
* Vegetation and land use

Planning state (Planned):* Air temperature distribution over map, as well as ⌀, min. and max. Tair in the district.
* Tair at random site
* UTCI through stress categories (strong, very strong, extremely)
* max. reduction Tair (⌀ and local)
* Information about objects (e.g. address, object type, roof type, facade), data on the district (shares of different urban structures)
* Forwarding to Urban Heat Island Mitigation Performance Index (adaptation measures inventory) --> Ranking for measures depending on filter selection.
 |