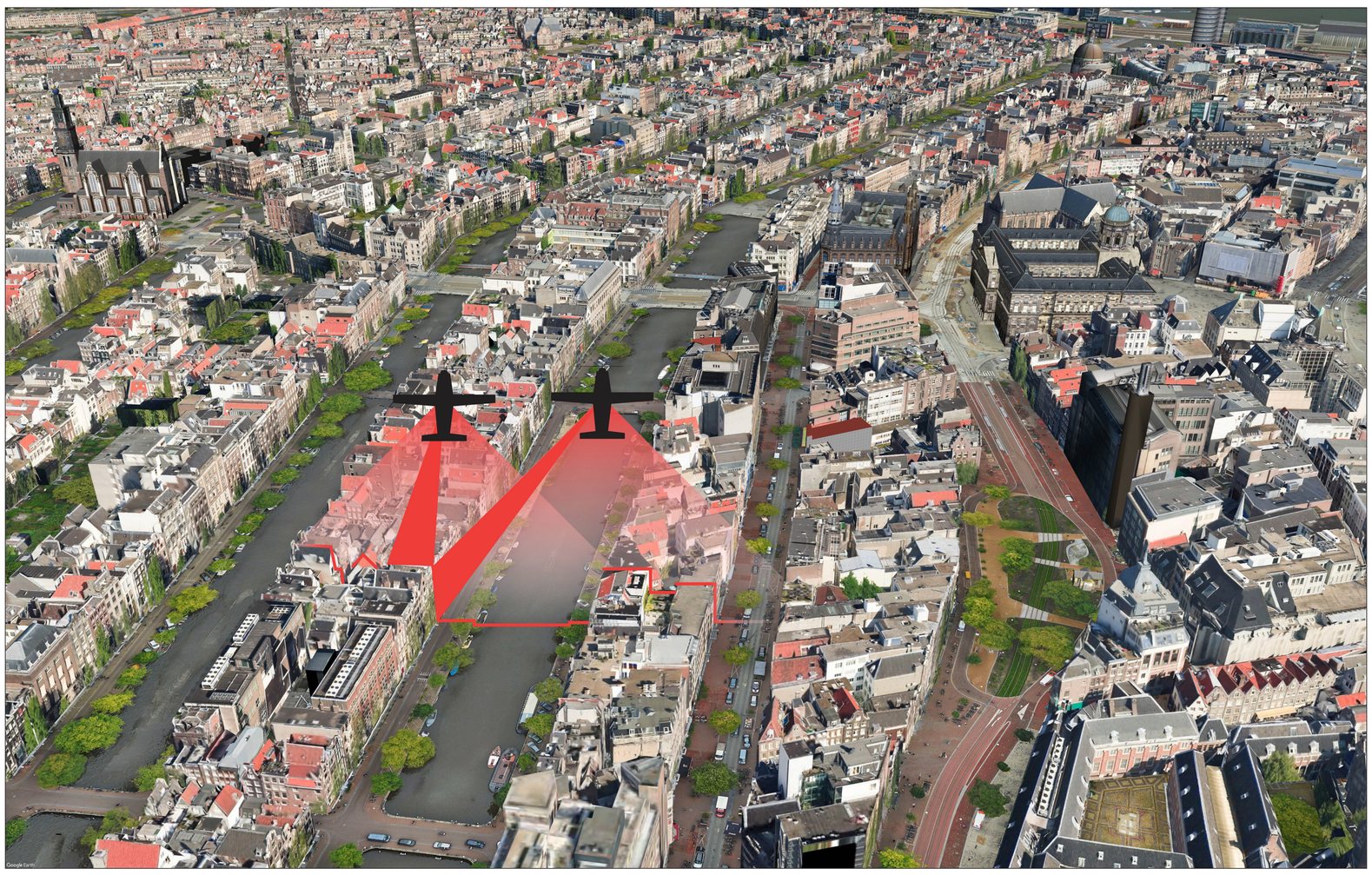
HEat Robustness In relation To AGEing cities (HERITAGE) Programme

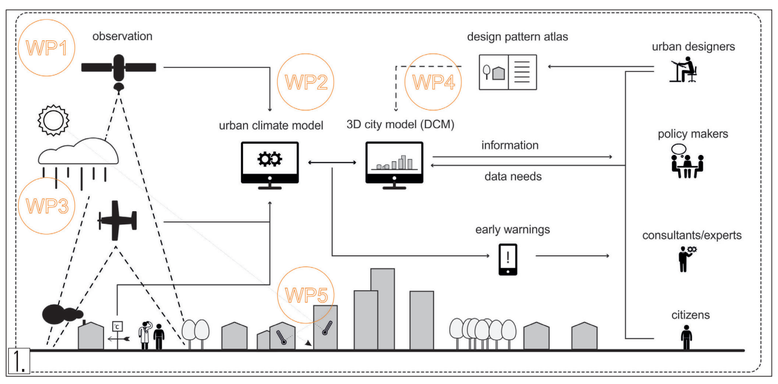
Due to ongoing climate change and urbanization, societies face challenges concerning environmental quality, energy management and citizens' health. While many past observational and modelling studies concentrated on understanding urban microclimate and how humans experience this, focus has been on relatively modern infrastructure ("street canyons") regarding modelling and observational efforts which showed less success over historical districts. Many cities have a significant share of aged and historical buildings with unique and different street profiles from modern infrastructure, which raises additional challenges in the energy transition due to low energy-efficiency and restrictions to required interventions.

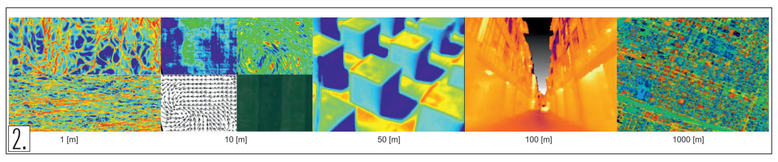
Our research programme will develop a high-tech sensing and design system (Fig1) aiming at detection, reduction and prevention (by monitoring and design) of heat-stress occurring due to ageing of built environmental settings and buildings in cities, through socio-technical solutions. This integral system will detect and forecast spatiotemporal patterns of heat stress at unprecedented resolutions (down to 1m scale, Fig2), aiming at technological solutions to reduce and mitigate indoor and outdoor heat stress through developing urban design guidelines and connecting the energy transition, housing demands, repurposing areas, climate adaptation and digitalisation.

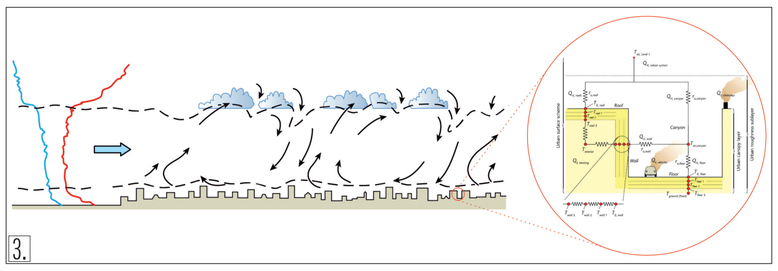
The HERITAGE high-tech sensing and design system necessitates a multi-disciplinary research ecosystem approach involving earth observation, urban hydro-meteorology and climatology, urban design and sustainable infrastructural energy systems; i.e. expertise-fields well represented by the consortium. Therefore, parallel to the sensing, long-term research lines are rolled out on robust hydro-meteorological, design and energy solutions, both (sensing and technological solutions) at multiple spatiotemporal scales (Fig2) and forms. Concretely, these research lines fill knowledge gaps in climate policies through innovative techniques for analysis, simulation, development and experimental testing of newly designed multiscale urban heritage canopy layer schemes for climate models (Fig3), multiscale form-microclimatic relationships (Fig4) and new sustainable energy systems (Fig5), all ideally suited for application in aged neighborhoods and buildings.

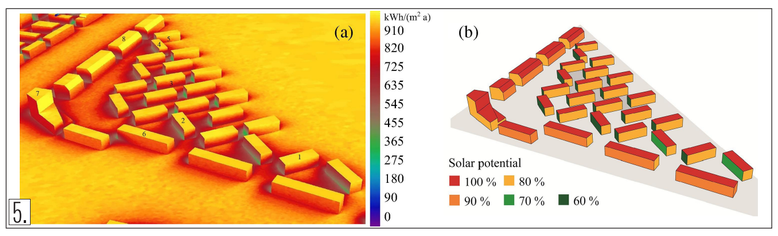
Specifically with respect to thermal remote sensing, the programme will focus on the derivation of turbulent and radiative energy fluxes from remote sensing observations. These activities encompass three sub-approaches; LST assimilation into developed urban heritage canopy layer schemes, 3D radiative flux estimation from high resolution thermal drone and airborne observations (Fig6) and development of new turbulent flux schemes better adjusted to turbulence characteristics (Fig7). The HERITAGE programme will start in July 2023.

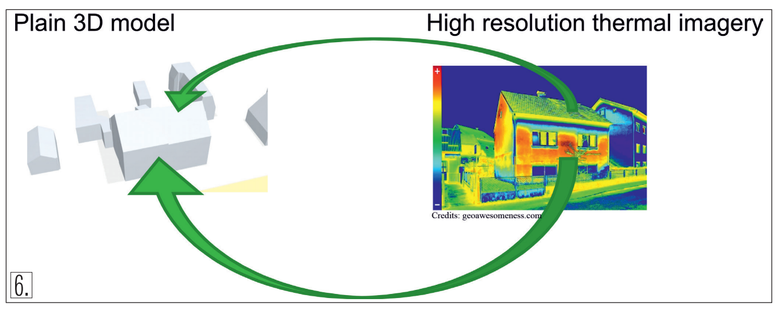


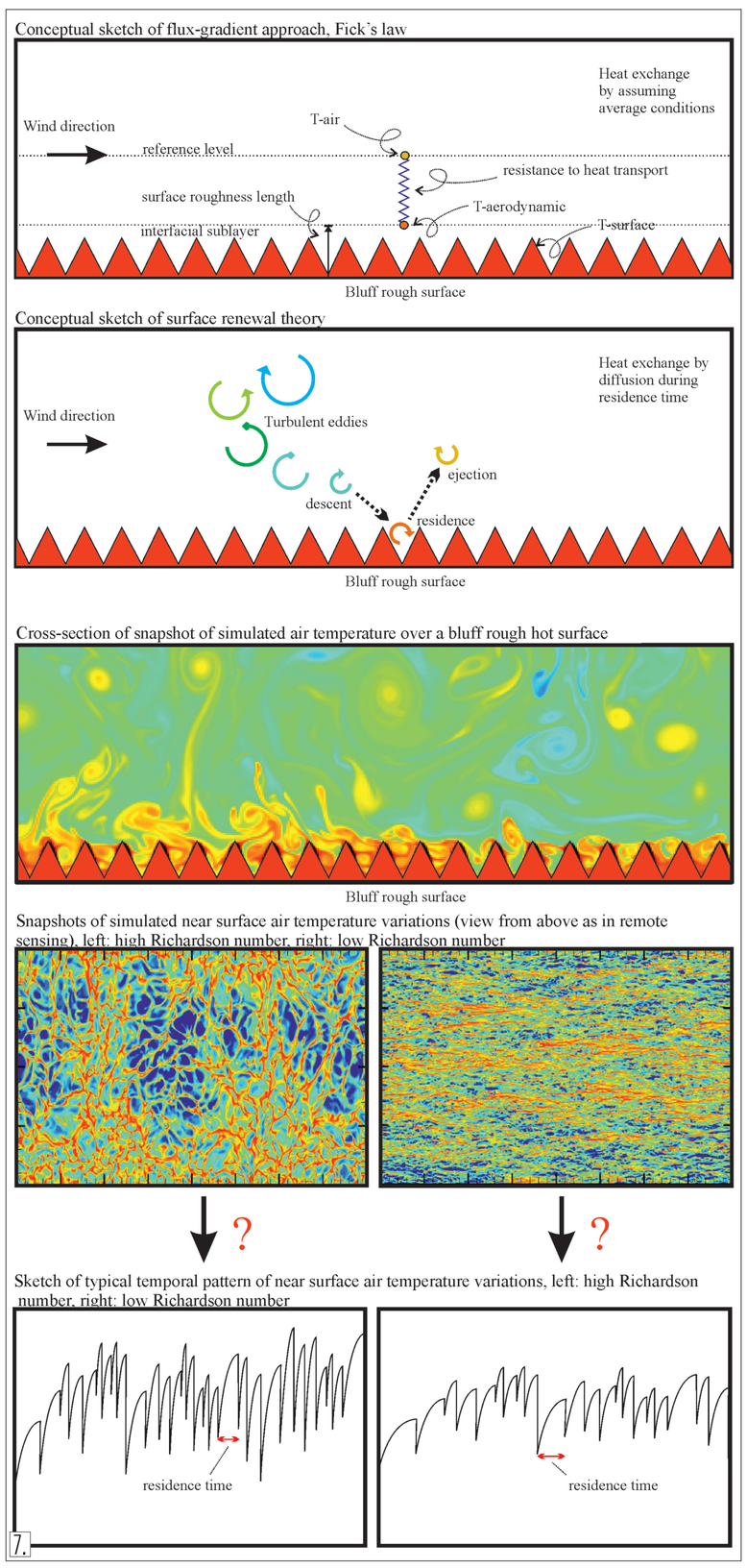












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