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Orientation 1: Climate risks and climate service needs in Sub-Saharan urban Africa

Niina Käyhkö, Venla Aaltonen
kadi-project.eu

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5. Key requirements for a research infrastructure(s) to support CSs in cities

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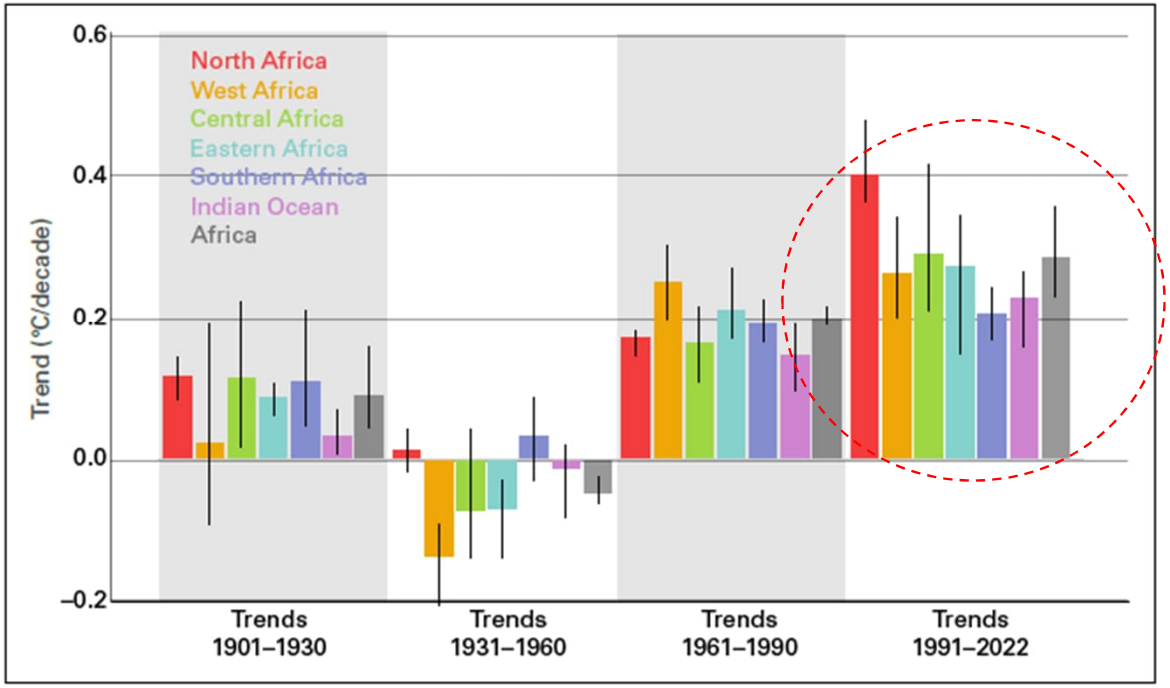
Climate related hazards in the cities of Sub-Saharan Africa



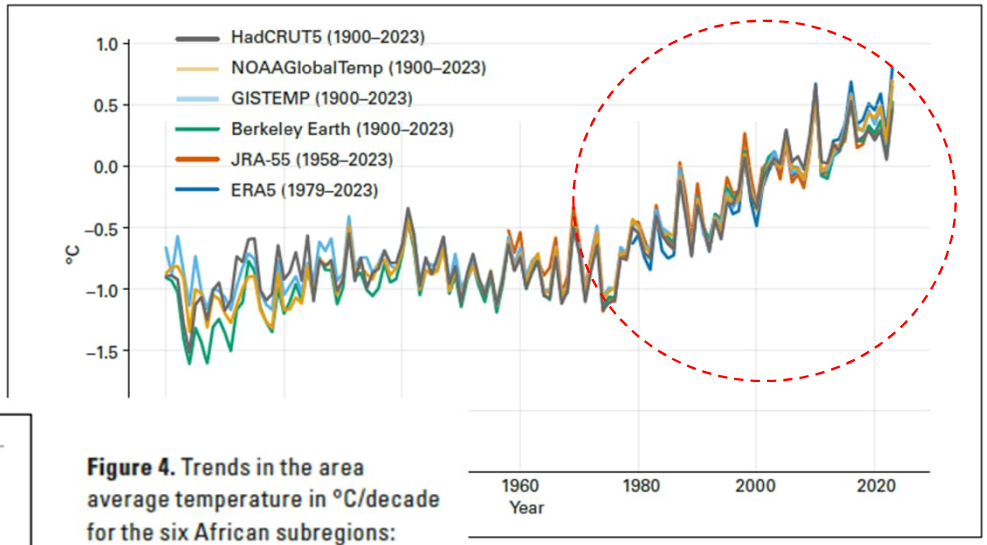
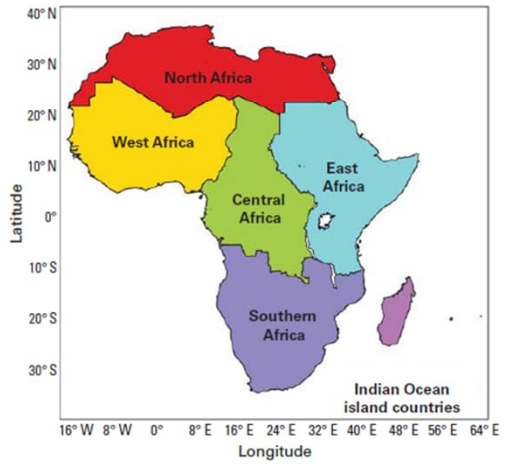


Figure 4. Trends in the area average temperature in °C/decade for the six African subregions: North Africa (red), West Africa (yellow), Central Africa (green), East Africa (light blue), Southern Africa (dark blue), the Indian Ocean island countries (purple), and the whole of Africa (grey) over four 30-year sub-periods: 1901–1930, 1931–1960, 1961–1990, and 1991–2023. The trends were calculated using different datasets, including observational datasets (HadCRUT5, NOAAGlobalTemp, GISTEMP, and Berkeley Earth) and reanalyses (JRA-55 and ERA5). The black vertical lines indicate the range of the six estimates.

1–2020 climatological period for Africa (WMO Regional ing observational datasets.



WMO (2024). State of the Climate in Africa 2023. https://library.wmo.int/idurl/4/69000

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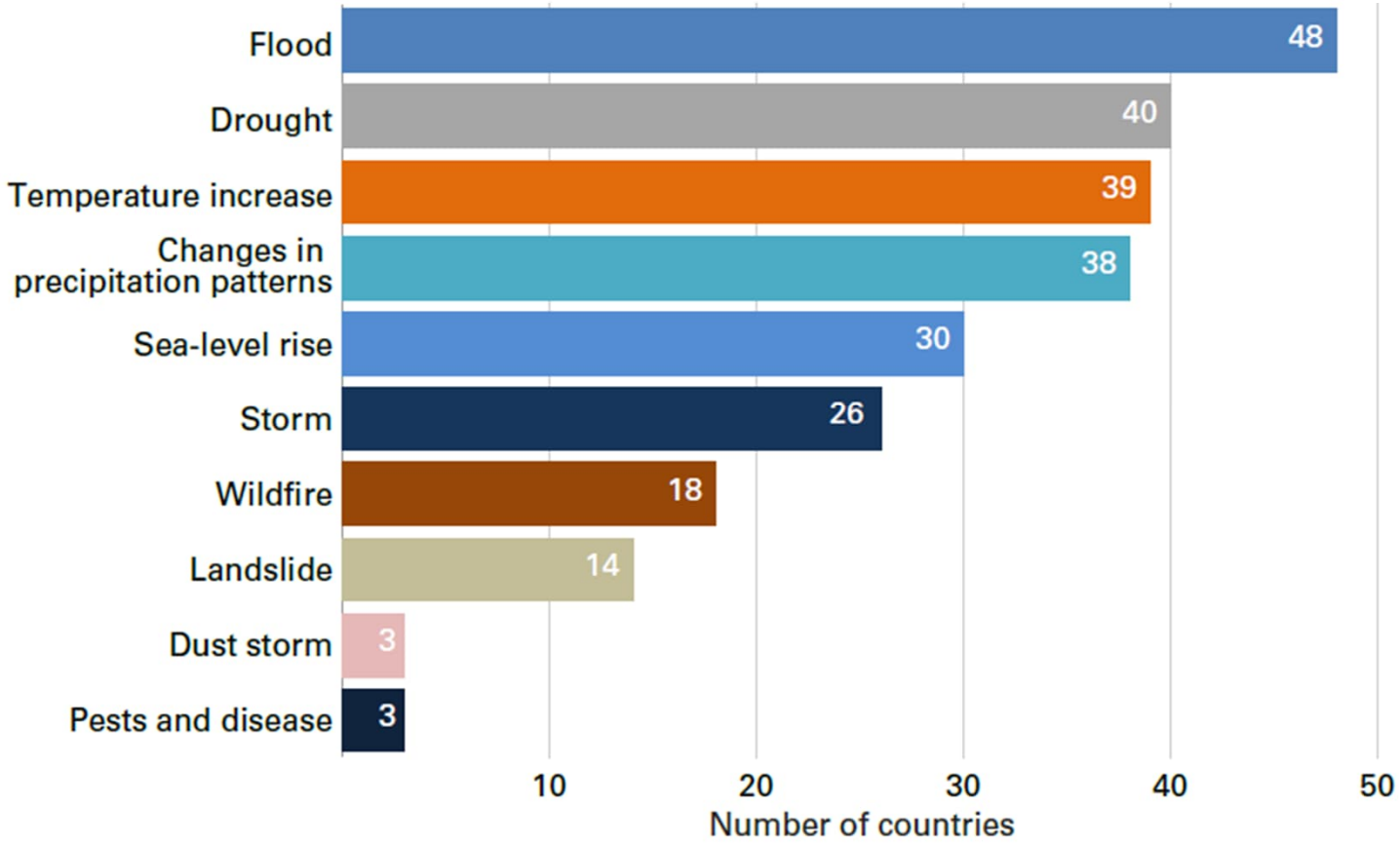
Climate related hazards in the cities of Sub-Saharan Africa



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Climate related hazards in the cities of Sub-Saharan Africa

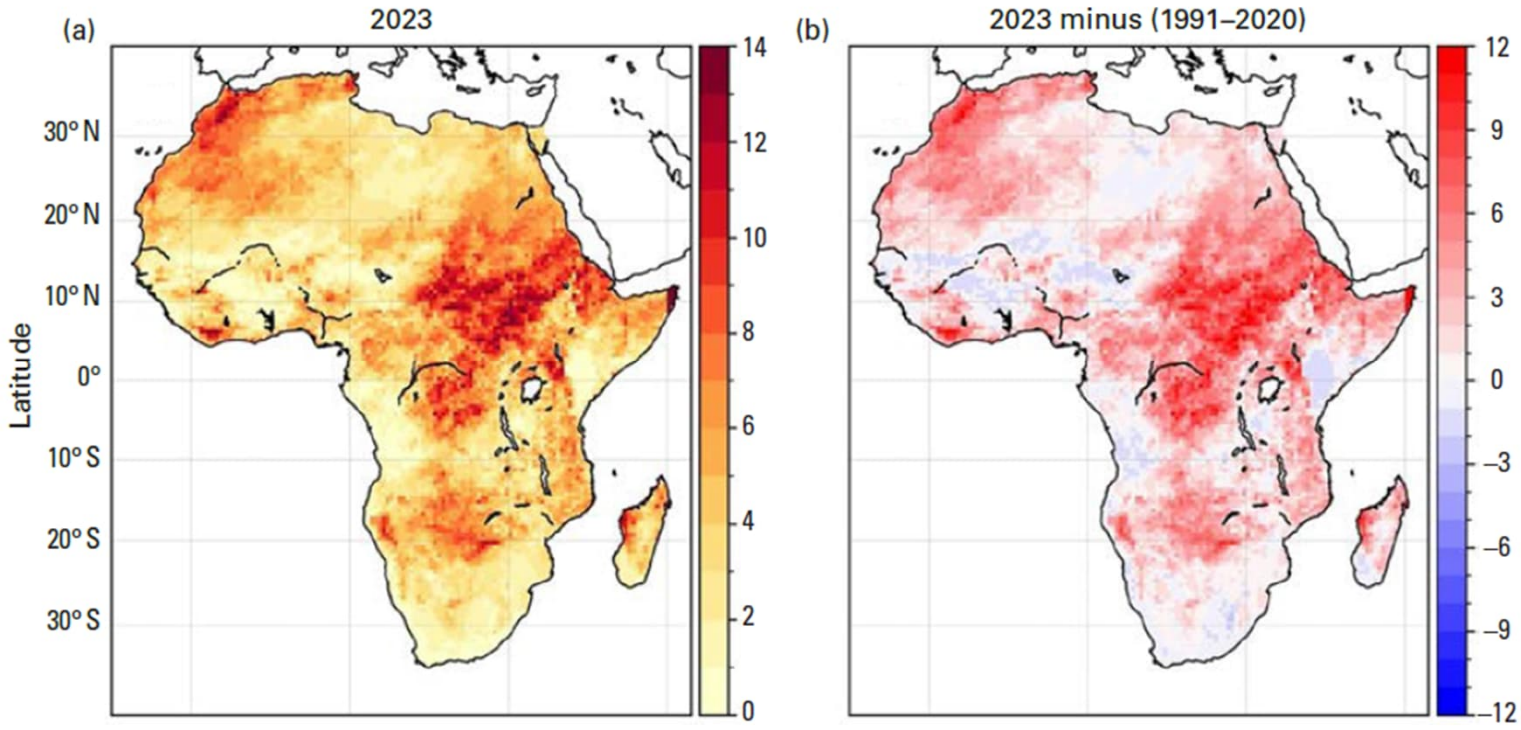

Figure 13. Spatial distribution of
(a) the heatwave number (HWN) for 2023
(b) the anomalies of the HWN for 2023 with respect to the climatology of the reference period 1991–2020

WMO (2024). State of the Climate in Africa 2023. https://library.wmo.int/idurl/4/69000

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Climate related hazards in the cities of Sub-Saharan Africa

- **Heat Stress:** Higher temperatures can lead to heat-related health issues, with urban heat islands exacerbating the effects.
- **Flooding (tidal, seasonal):** Coastal cities are particularly susceptible to tidal influences and flooding, exacerbated by rising sea levels. Heavy rains can lead to waterlogging, impacting infrastructure and livelihoods.
- **Air Pollution: U**rban areas often face ongoing air quality issues, which can be worsened by rising temperatures and increased vehicular emissions.
- **Multi-hazard Risks:** Cities are challenged by multiple hazards occurring simultaneously, which can compound vulnerabilities and impact recovery.

These hazards create significant challenges for urban planning and climate risk management, highlighting needs for effective adaptation strategies

Pelling et al. (2018). Africa's urban adaptation transition under a 1.5° climate. Current Opinion in Environmental Sustainability. https://doi.org/10.1016/j.cosust.2017.11.005

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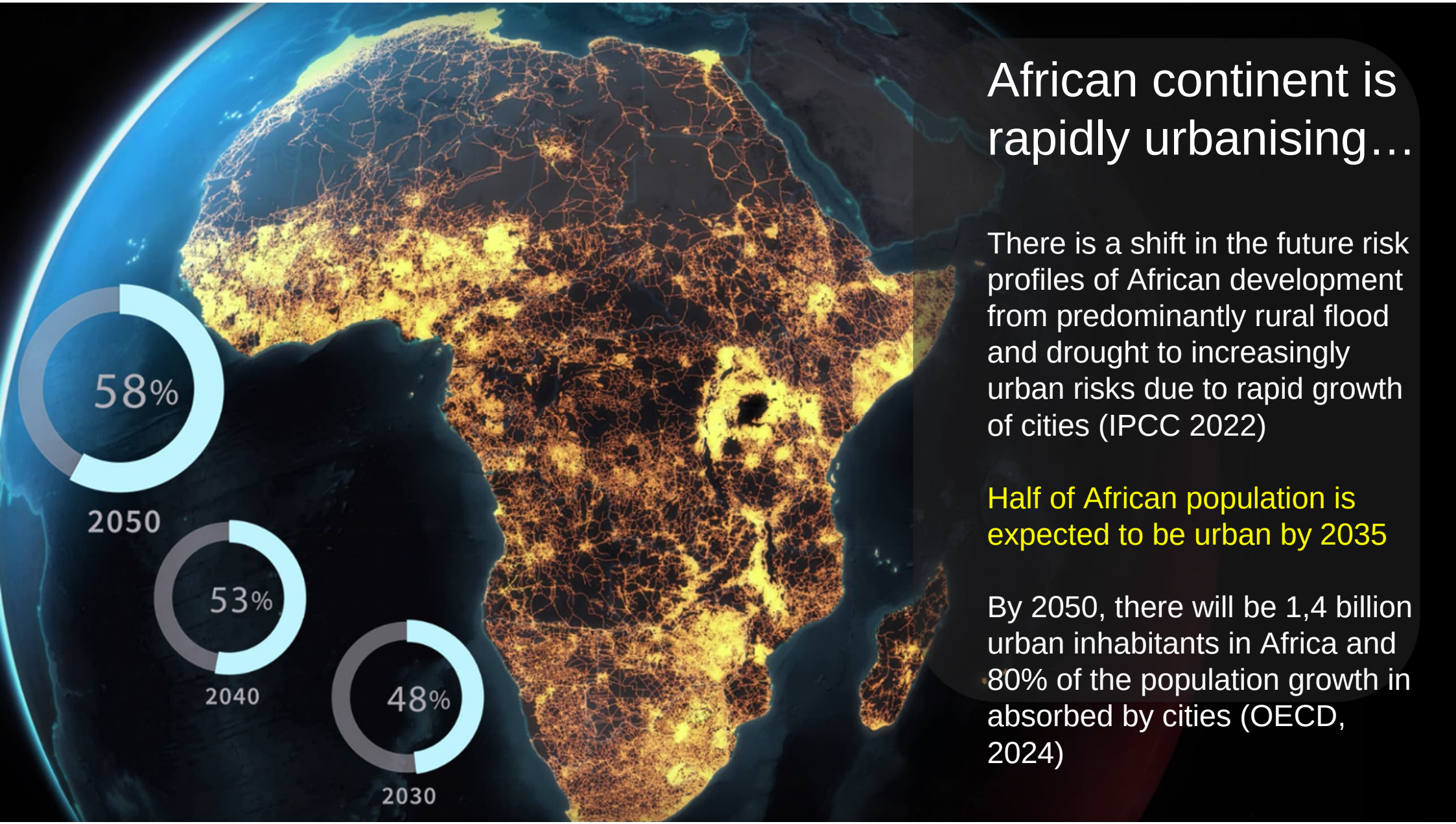
Open Street Map Africa – putting African cities on a map

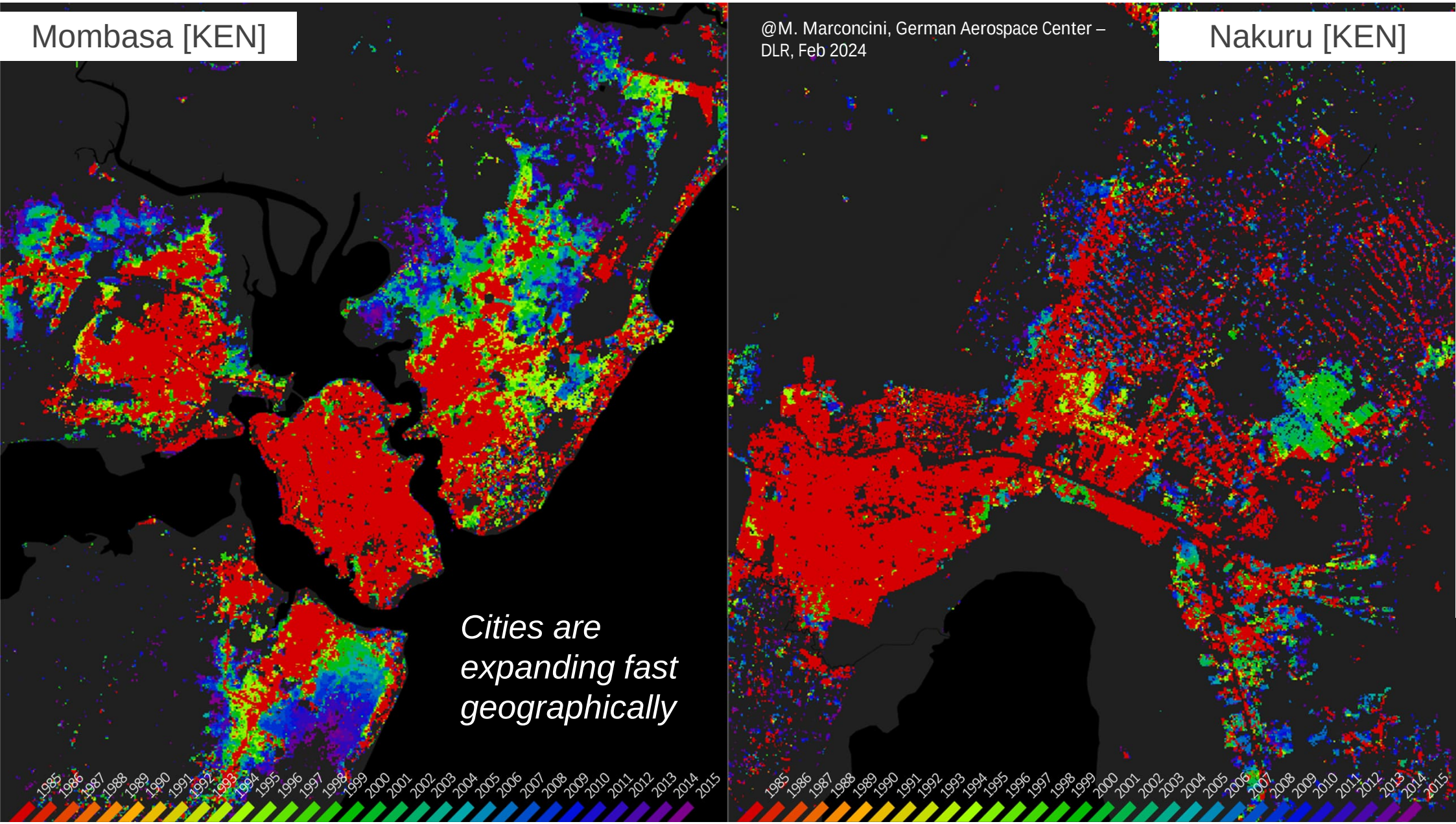


African continent is rapidly urbanising…

There is a shift in the future risk profiles of African development from predominantly rural flood and drought to increasingly urban risks due to rapid growth of cities (IPCC 2022)

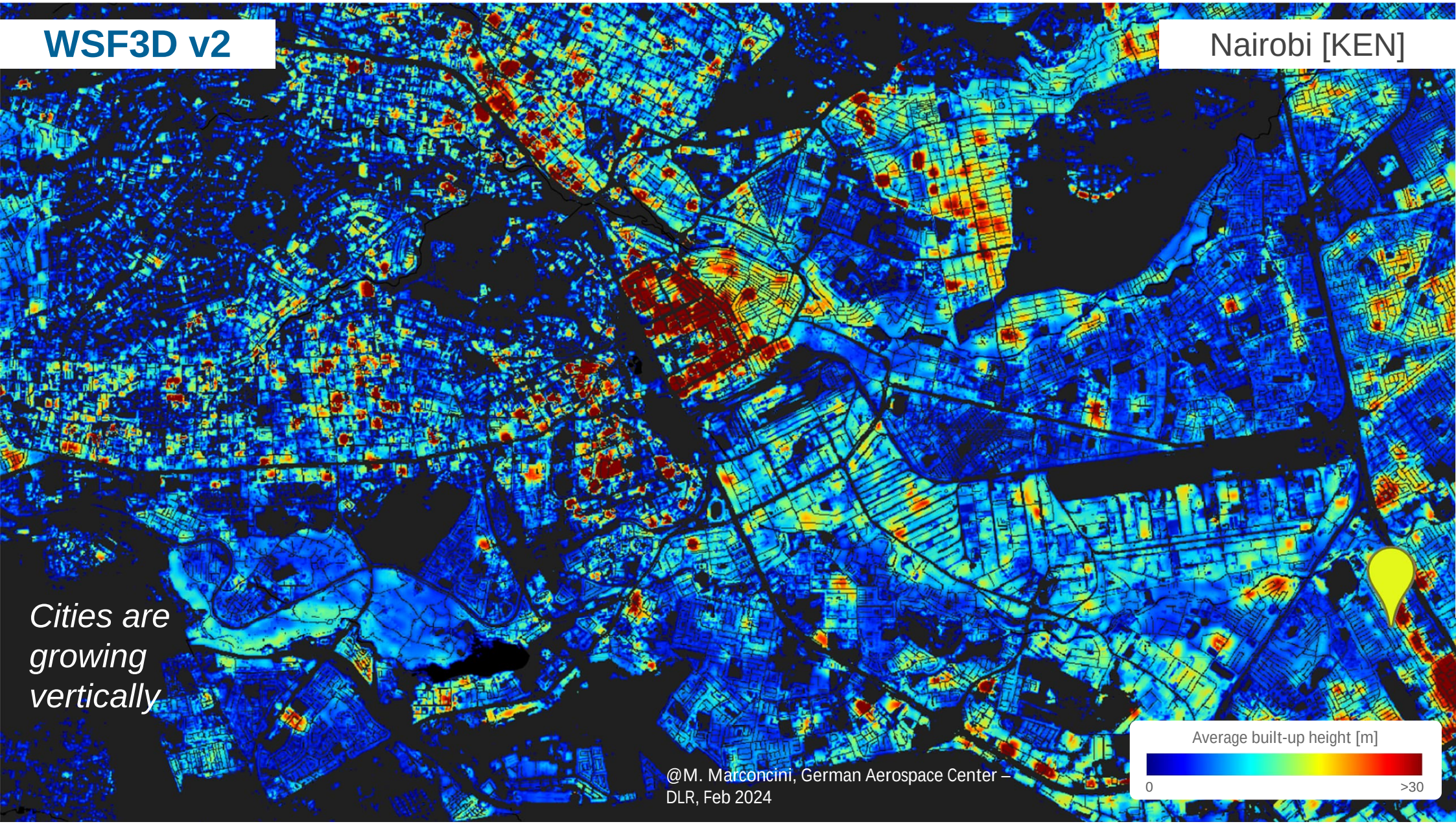
Half of African population is expected to be urban by 2035

By 2050, there will be 1,4 billion urban inhabitants in Africa and 80% of the population growth in absorbed by cities (OECD, 2024)


Mombasa [KEN]
@M. Marconcini, German Aerospace Center – DLR, Feb 2024
Nakuru [KEN]
Cities are expanding fast geographically
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

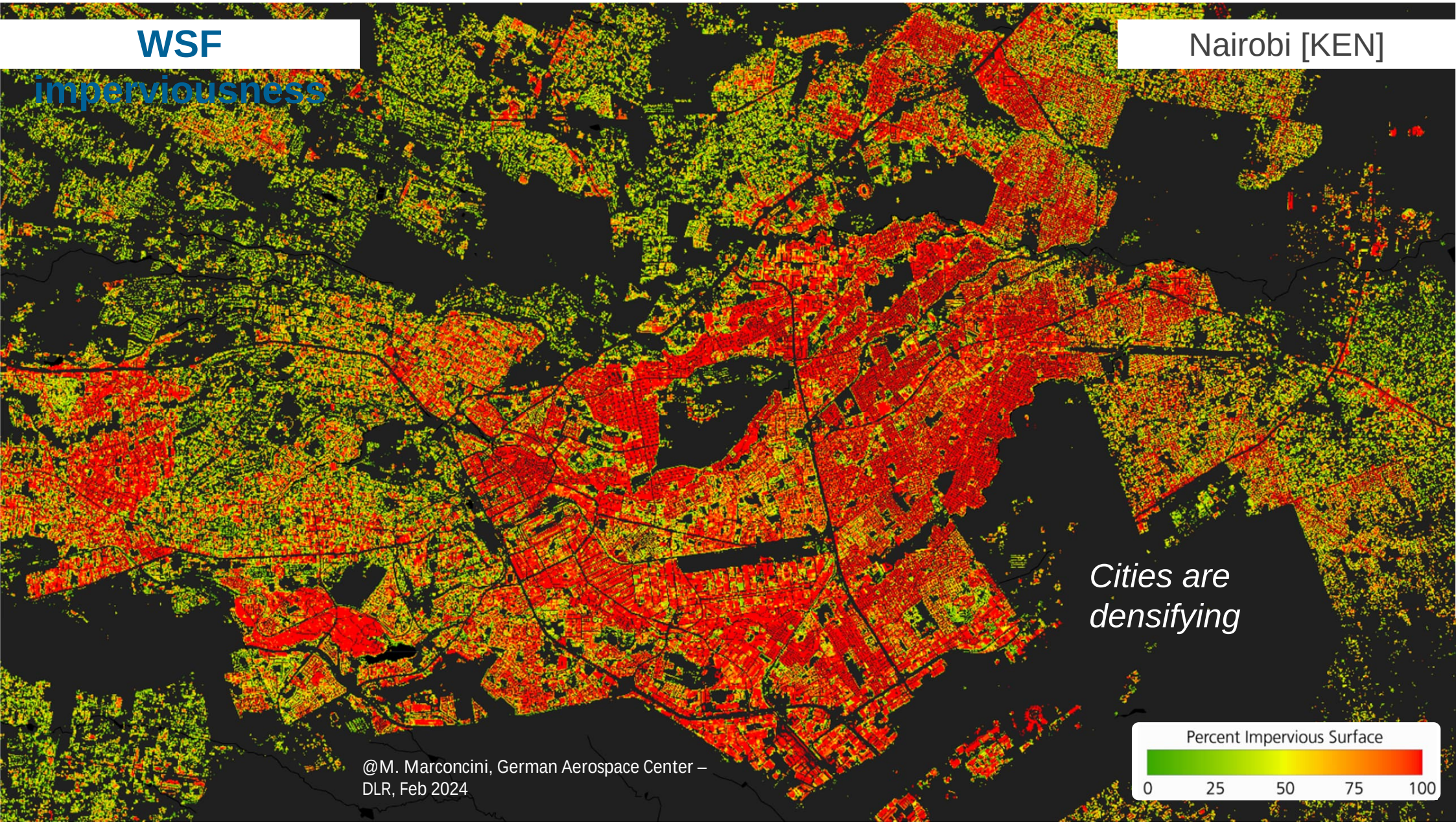
WSF3D v2

Nairobi [KEN]



WSF imperviousness

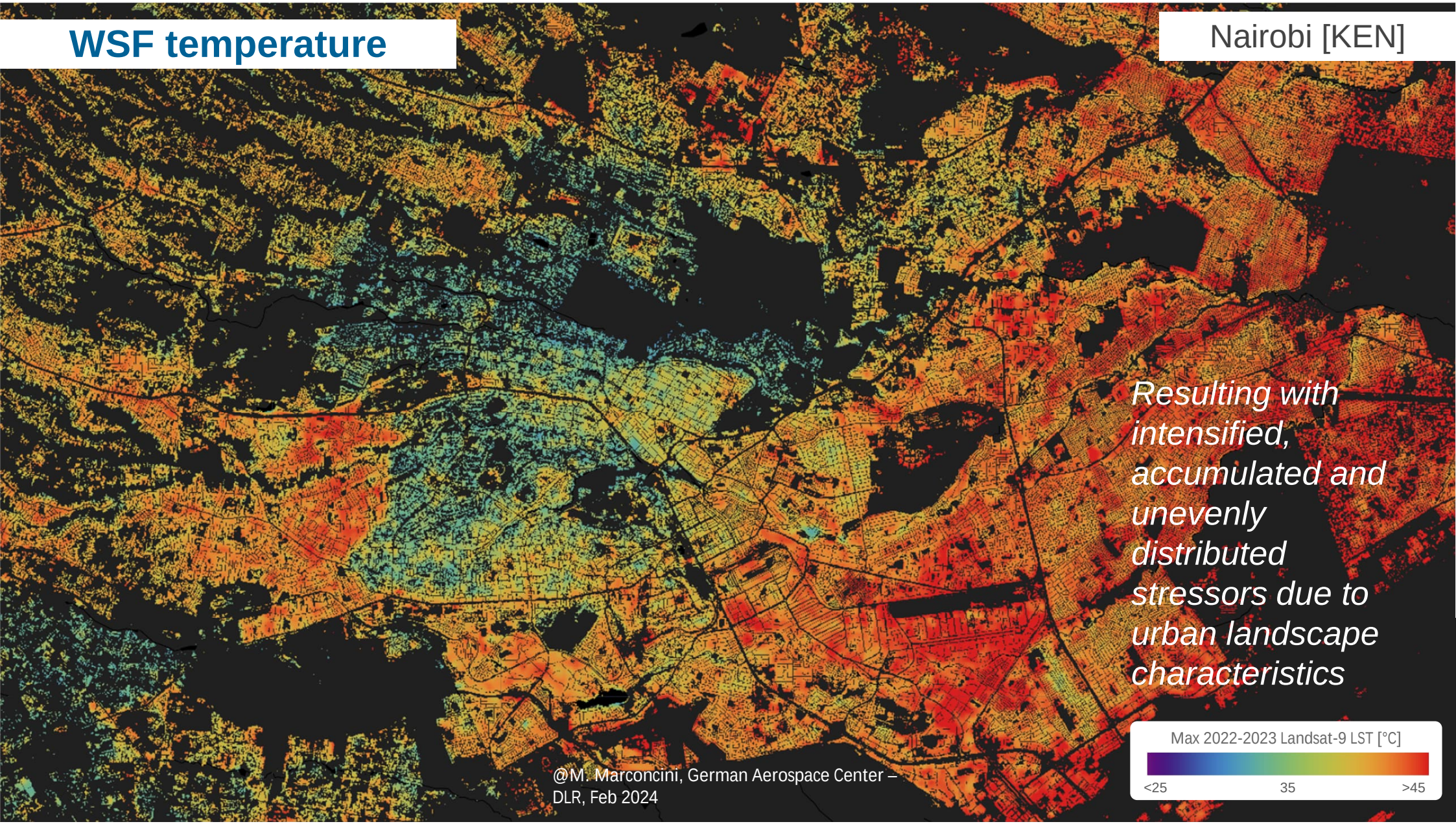
Nairobi [KEN]



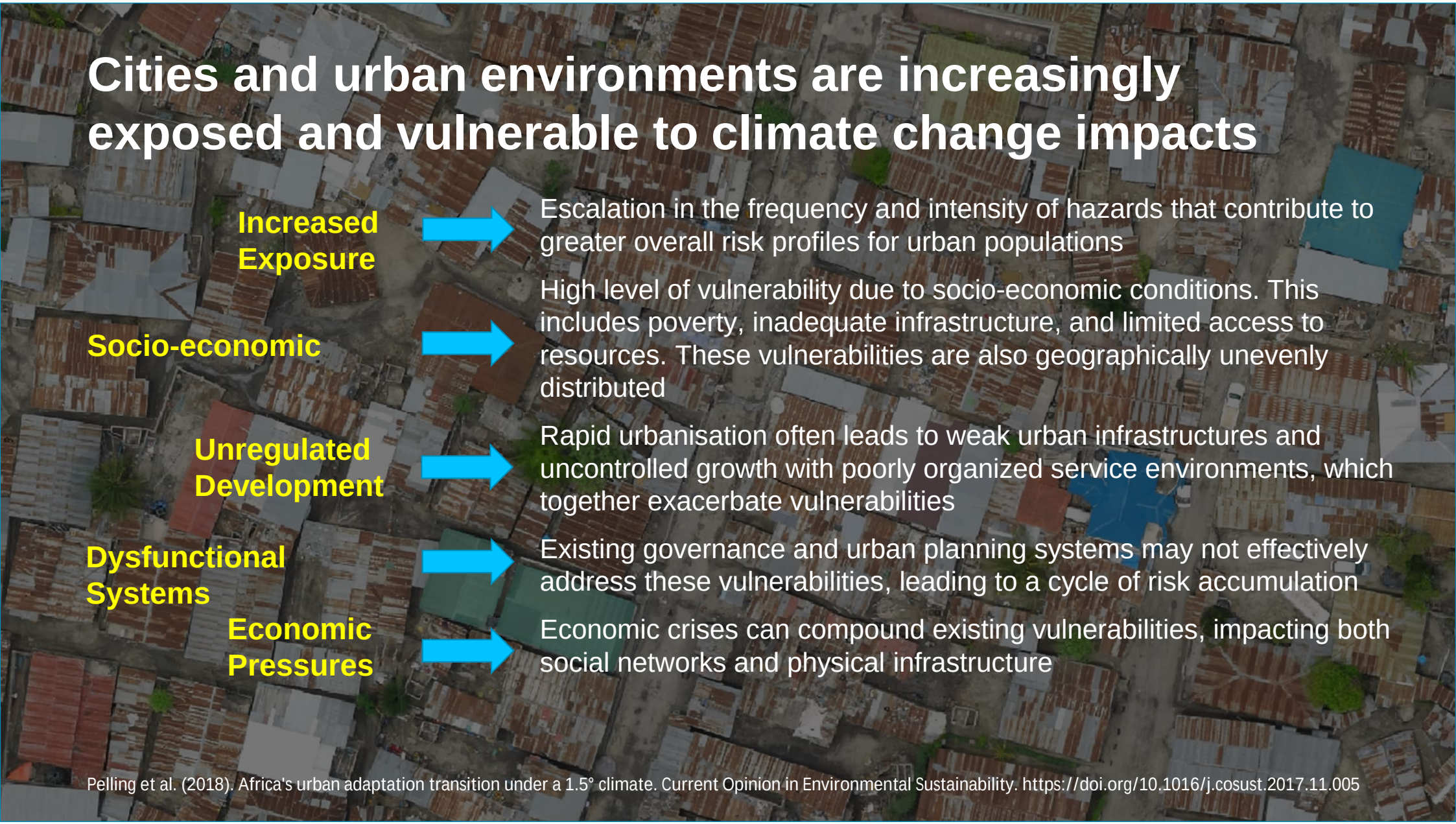
@M. Marconcini, German Aerospace Center – DLR, Feb 2024

WSF temperature

Nairobi [KEN]



Cities and urban environments are increasingly exposed and vulnerable to climate change impacts



Increased Exposure → Escalation in the frequency and intensity of hazards that contribute to greater overall risk profiles for urban populations

Socio-economic → High level of vulnerability due to socio-economic conditions. This includes poverty, inadequate infrastructure, and limited access to resources. These vulnerabilities are also geographically unevenly distributed

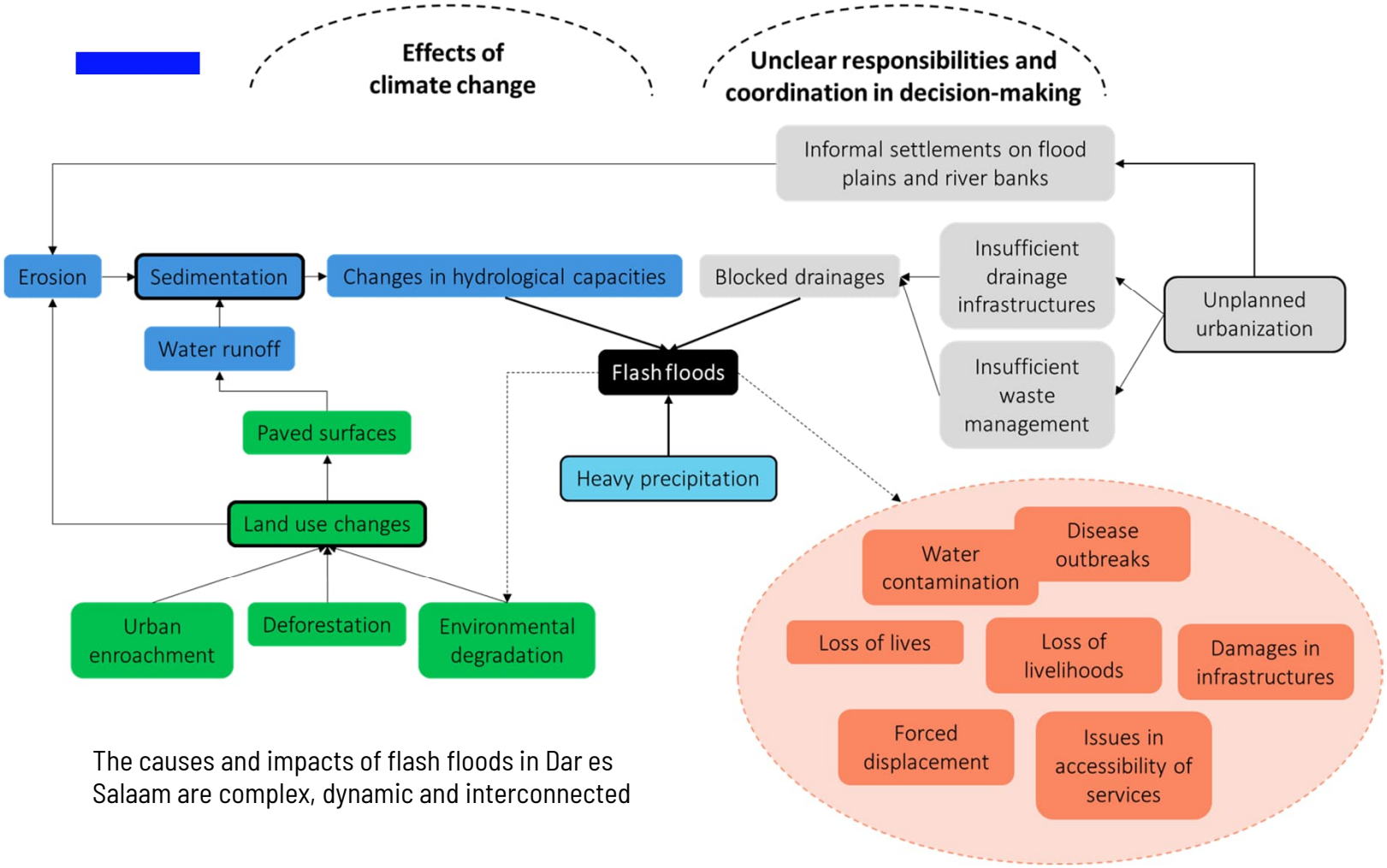
Unregulated Development → Rapid urbanisation often leads to weak urban infrastructures and uncontrolled growth with poorly organized service environments, which together exacerbate vulnerabilities

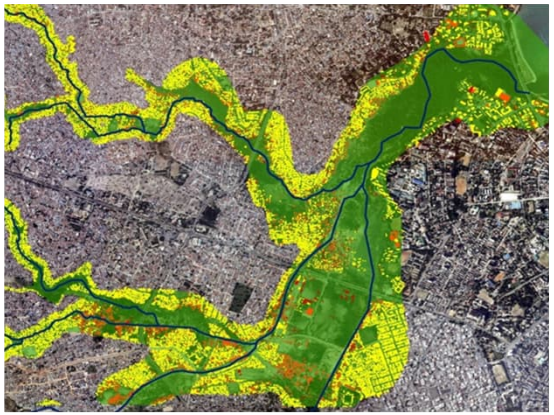
Dysfunctional Systems → Existing governance and urban planning systems may not effectively address these vulnerabilities, leading to a cycle of risk accumulation

Economic Pressures → Economic crises can compound existing vulnerabilities, impacting both social networks and physical infrastructure

Pelling et al. (2018). Africa's urban adaptation transition under a 1.5° climate. Current Opinion in Environmental Sustainability. https://doi.org/10.1016/j.cosust.2017.11.005

Risks establish in a complex and dynamic urban environment





The causes and impacts of flash floods in Dar es Salaam are complex, dynamic and interconnected

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Climate Services

“Provision of climate information to help users make climate smart decisions and adapt to climate challenges” Climate-adapt

- Seasonal forecasts (e.g., forest fire outlooks)
- Long-term projections (e.g., sea-level rise)

“Climate Services enable **better management of the risks of climate variability and change and adaptation** to climate change, through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scale” (GFCS)

https://wmo.int/activities/global-framework-climate-services-gfcs
https://climate-adapt.eea.europa.eu/en/knowledge/adaptation-information/climate-services

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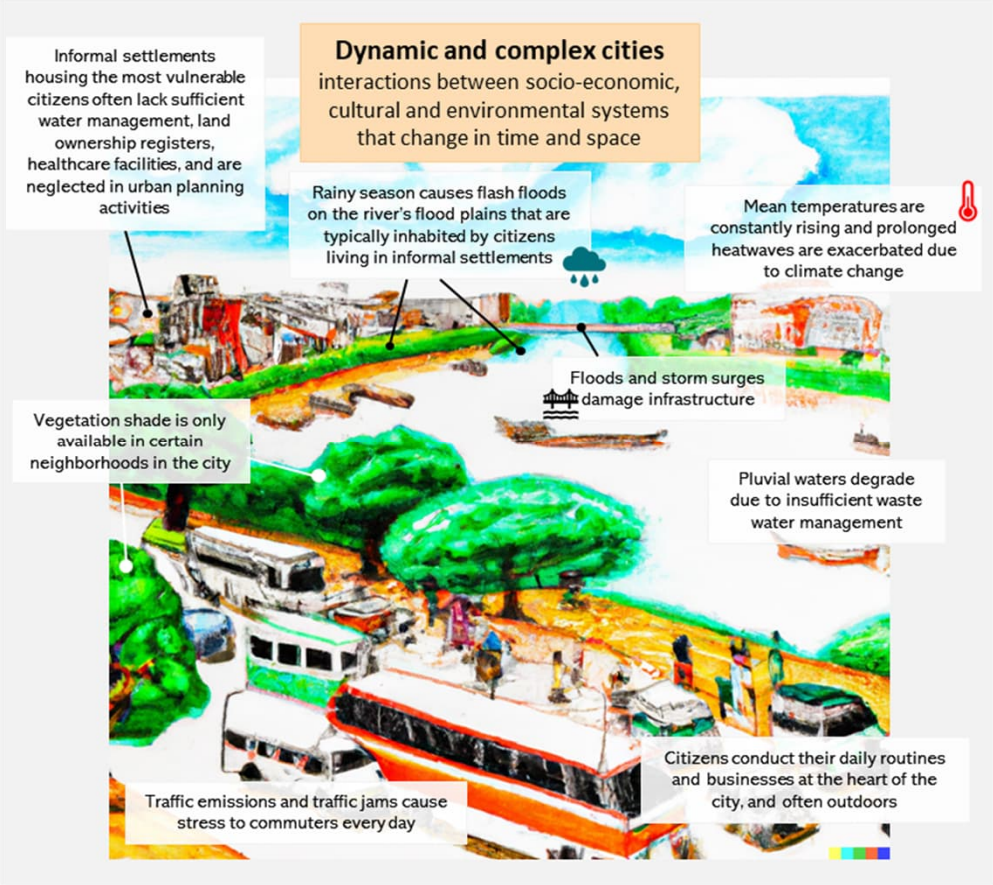
Challenge statement for urban climate services

Climate-related risks arise in urban areas through the **interplay of interconnected hazards, exposure, vulnerability, and capacity within the nature-human system**, significantly affecting the **daily lives** of urban communities and individuals.

Numerous **simultaneous risks often cascade into greater cumulative impacts** in specific locations within the city, leading to **disproportionate effects** on urban communities.

Current **climate adaptation needs are not adequately met** with existing climate services in cities, resulting in a gap between necessary adaptation strategies and those actually implemented. As a consequence, many urban areas struggle to cope with the escalating pressures of climate change.



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Challenges related to climate change adaptation in cities

Social Inequality: Marginalized communities may face heightened vulnerabilities, necessitating inclusive adaptation strategies that address these disparities

Governance: Fragmented governance structures can hinder effective coordination and implementation of adaptation strategies

Public Awareness and Engagement: Low community participation in adaptation efforts and co-creation of CSs

Resource Constraints: Limited financial resources and funding for adaptation projects often impede progress

Inadequate Infrastructure: Many cities lack the essential infrastructure to cope with climate stresses, exacerbating vulnerabilities

Economic Pressures: Competing economic priorities may limit resources available for climate adaptation initiatives

Data Gaps: A lack of reliable data on hazards and vulnerabilities can affect the planning and execution of adaptation measures

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Pelling et al. (2018). Africa's urban adaptation transition under a 1.5° climate. Current Opinion in Environmental Sustainability. https://doi.org/10.1016/j.cosust.2017.11.005

Its not enough to know the hazards and climate….

- Many climate services in Africa have **overlooked local needs and local knowledge** is often overlooked as "non-scientific" even though it is often crucial for the local residents in their adaptation actions (Daly & Dilling 2019)
- Existing services **are too strongly relying on scientific, expert-driven data and knowledge (top-down)**, which have failed to operate in local decision-making systems (e.g Vincent et al. 2018, Vogel et al 2019)

→ "*Nearly every case of successful use of climate knowledge involved some kind of iteration between knowledge producers and users*" (Dilling & Lemos 2011).

→ **Bottom-up and co-approaches** and strong stakeholder engagement in the whole process is a key to sustainable results

→ In cities, it is necessary to **combine climate information with other relevant urban system information, including human experiences related to climate stressors**

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Where can we find improved opportunities for urban climate services?

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Bridging the data availability gap

Climate risk information in the context of rapid urbanisation demands **greater spatial resolution, timeliness, and update frequency as well as capturing the interactions** of the nature-human system of the cities every day

There is room for innovative and complementary ways of collecting climate-related data and information

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21st century socio-technological landscape

- Mobile tools
- Digital data repositories and platforms
- Earth observation and global data
- Internet of Things, automation and GeoAI
- Open Data – Open tools
- Local knowledge
- Citizen Science
- Youths and learning
- Digital public goods

Disruption supported by open data, digital technologies and volunteered community engagement

https://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/10783?wbdisable=true

Image by Gerd Altmann from Pixabay

Harnessing the collective power of the crowd

Climate service co-creation requires **stronger concentration on stakeholder engagement and participatory, bottom-up and co-approaches because…**

People-centric climate services can transform climate data and knowledge into action

Urban climate services from combined use of multisensory geospatial data

- Active and passive instruments and sensors (in situ observations, airborne, space-borne..)
- Measurement of multitude of environmental parameters of the urban system (climate, infrastructures, experienced stress due to climate change etc.)
- Crowdsourcing and human experiences through participatory mapping…
- AI and automation supporting updating, scaling and transfer

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Providing new skills and competence opportunities for young people

Participation and engagement of youths and deployment of low-cost tools are critical enablers for **co-creation of new work opportunities for young people** and strengthening CS localization, ownership and sustainability

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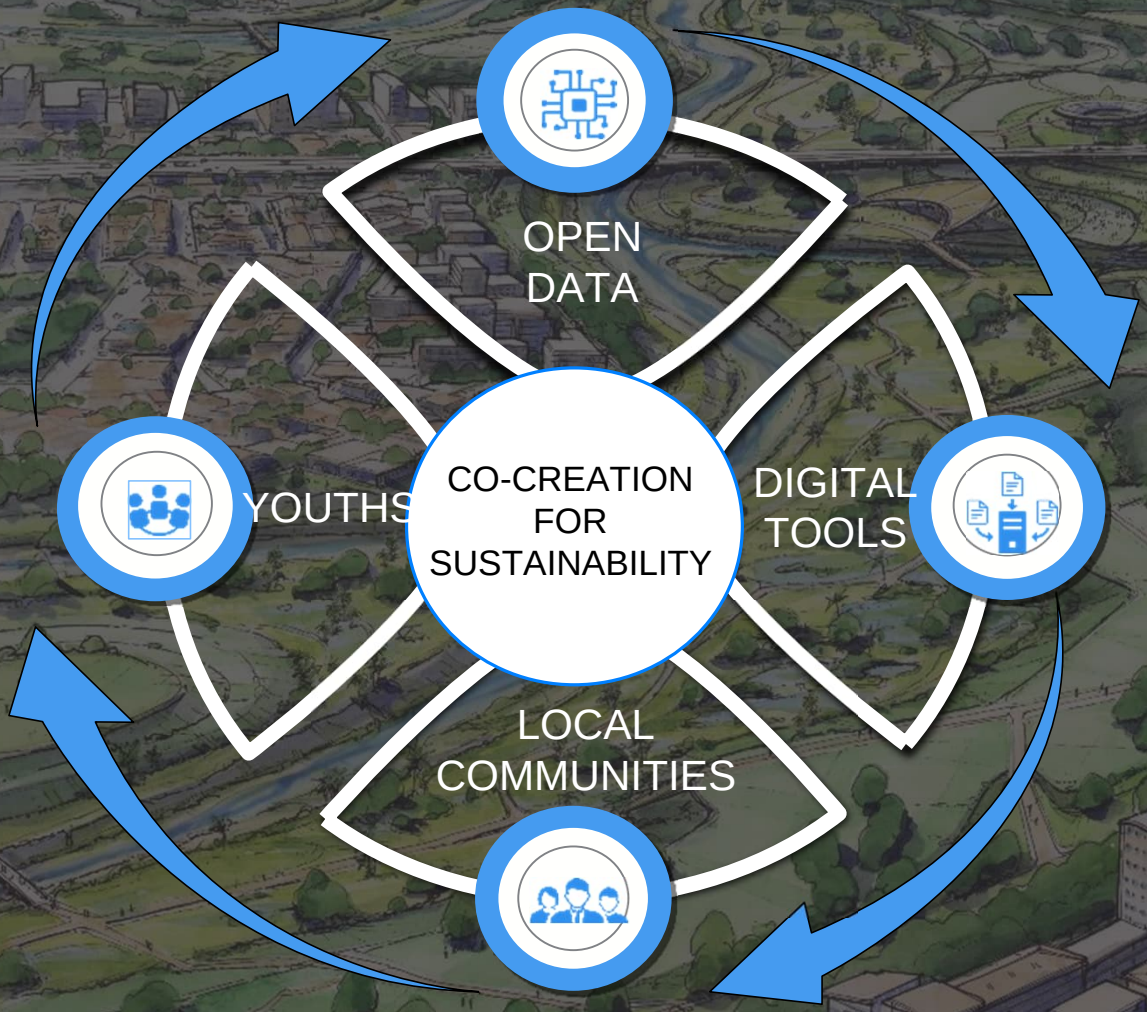
THE MISSION

Resilience Academy

"Future climate services and data production models need to be more locally driven, low complexity, fit the purpose and context and engage local talent so that decisions are reliable, owned locally and made actionable over time"

Resilience Academy is a partnership and service delivery program of the universities aiming to improve digital skills, competences and employment of the African youth for more effective climate risk management and resilience in cities

CO-CREATION OF CLIMATE SERVICES FOR CITIES



Open data – digital data of urban systems - availability, access & ACTION

Participatory - local knowledge & beneficiary feedback – co-creation and adaptation process

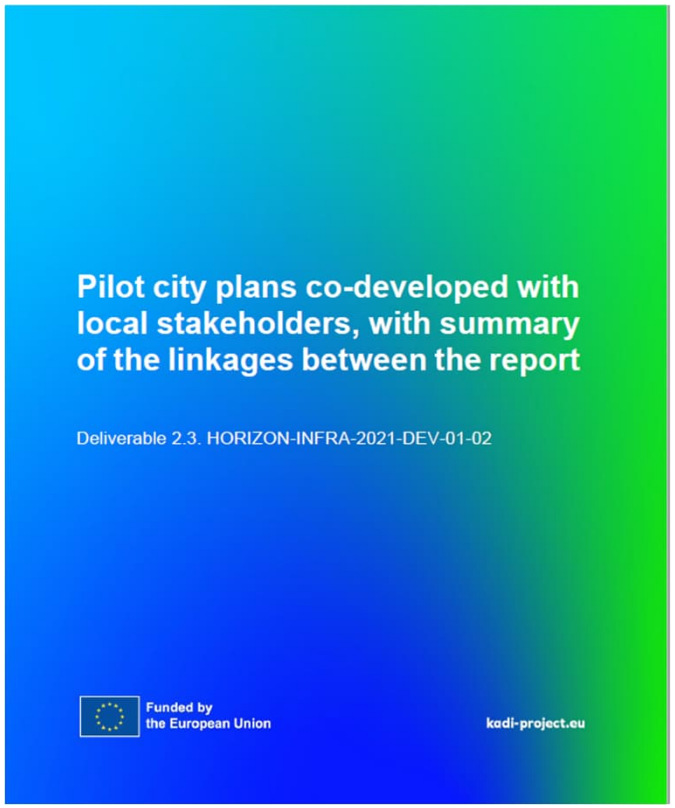
Mobilises global and local assets via localized co-production of climate risk data for action

Youths - digital skills & human capital

Localised - responsive to demand, adaptive, context-smart

Tools and methodologies are transferable and scalable digital assets

KADI City Pilots' approach towards holistic, bottom-up co-creation of urban climate services



Pilot 1: Abidjan

Concept of a particulate pollution monitoring and warning system with experimental approach that combines reference and low-cost equipment for real time integrated pollutant measurements of particulate concentration in the city.

Pilot 2: Nairobi

Piloting climate services to tackle heat stress and experienced heat of vulnerable communities by utilising citizen science approaches, historical meteorological data and analysis, and with exploring possibilities of using low-cost temperature sensors.

Pilot 3: Dar es Salaam

University students and local communities co-produce digital climate risk data with low-cost tools and participatory mapping methods for improved community-based management and adaptation to floods, heat and air pollution.

Funded by the European Union

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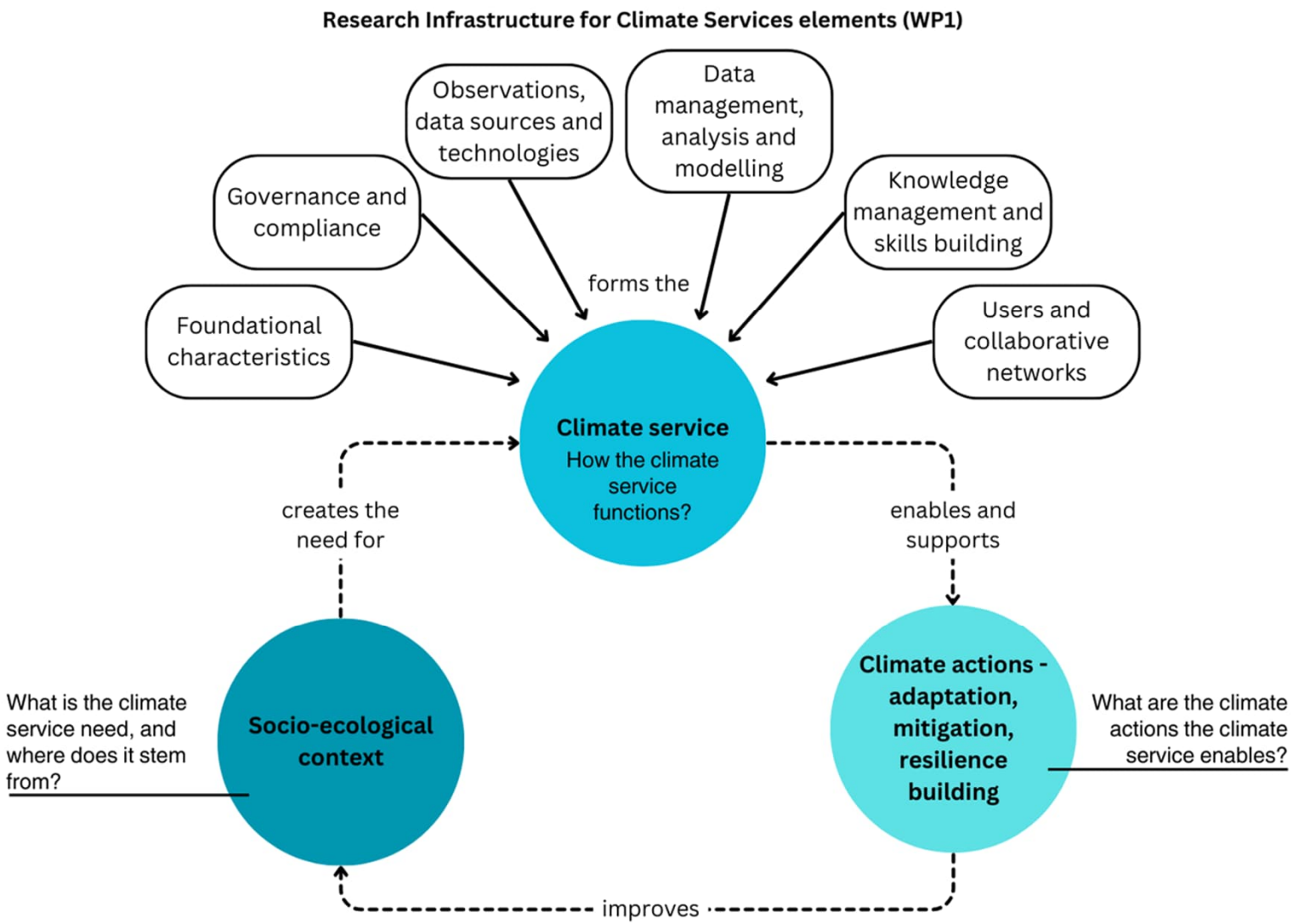
Knowledge and climate services from an African observation and Data research Infrastructure

Research infrastructures supporting co-creation of fit-for-purpose climate services



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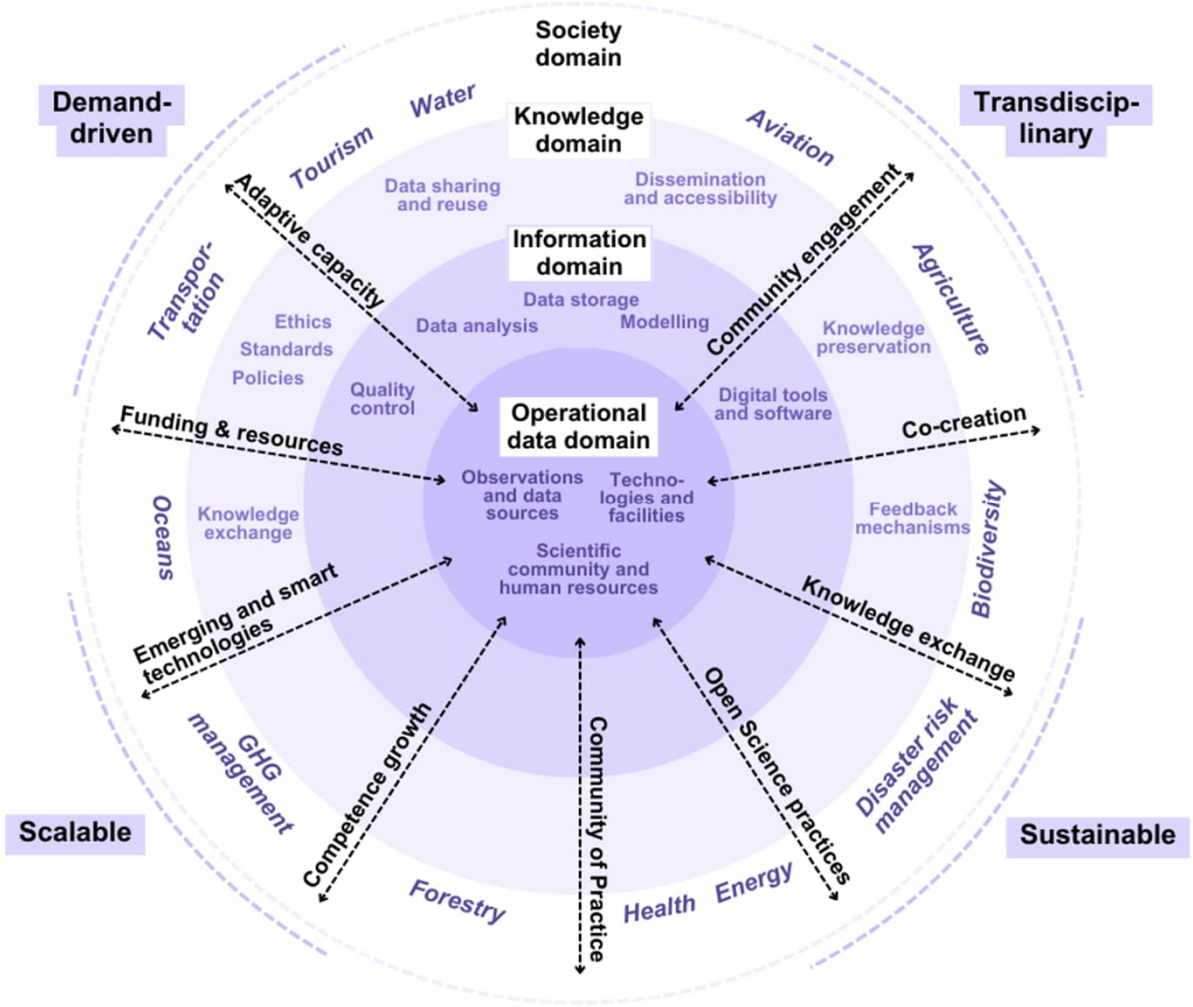
Transformative elements accelerating action

- Community engagement
- Co-creation
- Knowledge exchange
- Open Science
- Community of Practice
- Competence Growth
- Emerging and smart tech
- Adaptive capacities
- Funding and resources



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Literature and links

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Let’s share some experiences!

Let’s sit in groups of 3-4 persons and share our experiences of:

1) What kind of climate change related risks are forming in the cities/town where you come from or are currently living? Share some practical experiences?

1) Are there some climate services supporting adaptation to these risks in these cities? If yes, what kind of solutions are they?

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Funded by
the European Union

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ICOS Integrated Carbon Observation System

Resilience Academy

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UNIVERSITY OF TURKU

Eidgenössisches Departement für Wirtschaft, Bildung und Forschung

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