

Smarter Ways to Innovate: Innovative Applications of Technology

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& Chair of Environmental Technology & Design TU Delft dept. Urbanism

Canadian Water Network, Toronto, 2 May 2018

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AMS Institute [eɪ - εm – εs] is a young scientific institute located in Amsterdam. In this institute science, education, government, business partners and societal organizations are working tightly together to create solutions for the complex challenges a metropolitan region like Amsterdam is facing. Now and in the future.



ORIGINAL MISSION STATEMENT

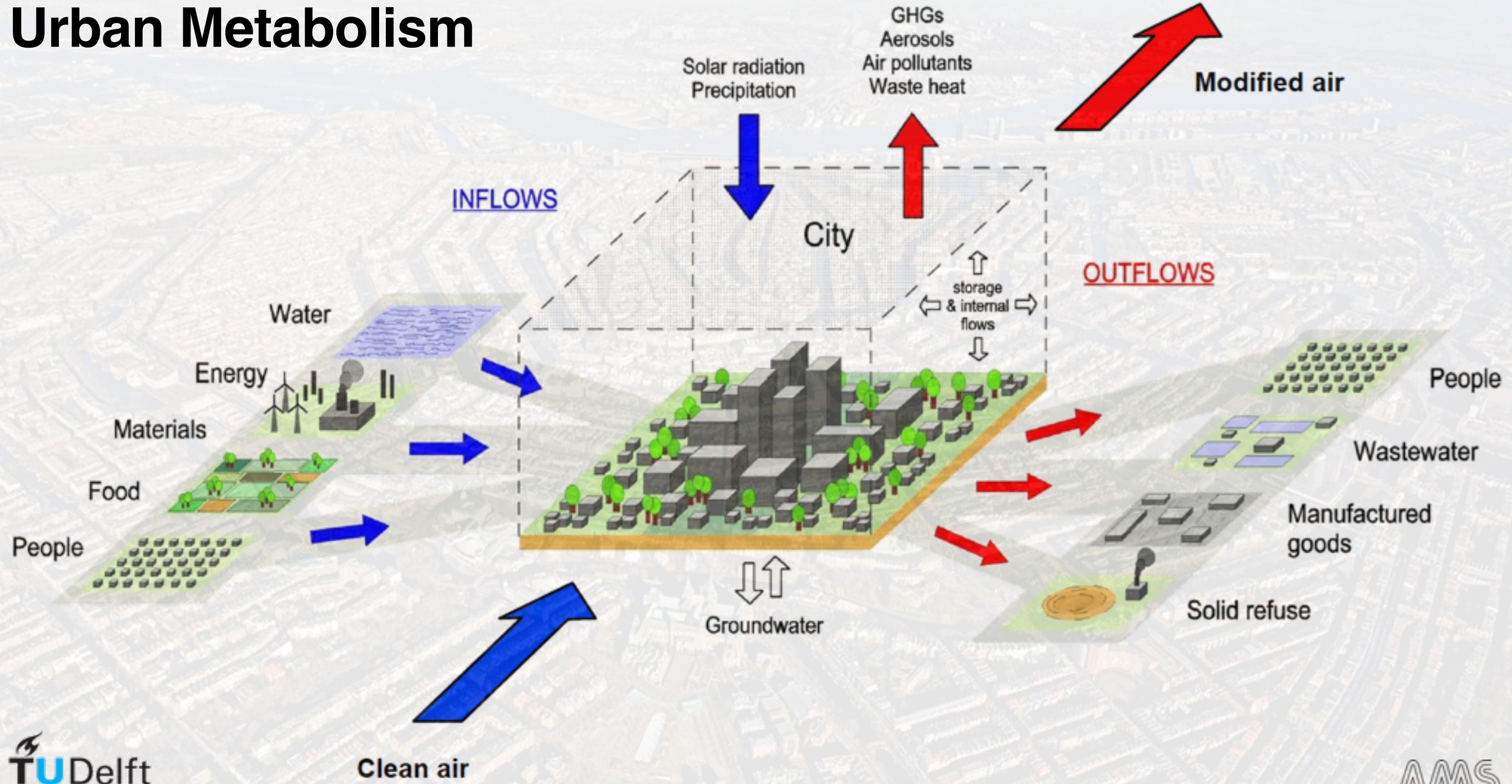


AMS' ambition is to ensure that the greater Amsterdam Region is one of the leading Metropolitan areas in **exploring and testing such innovative solutions.**

This is not just by reconsidering and **redesign of the urban metabolism** and its **infrastructural, logistical, participatory and co-creative components**. It is also about the simultaneous integration of **ICT, data generation and data handling**.



Urban Metabolism

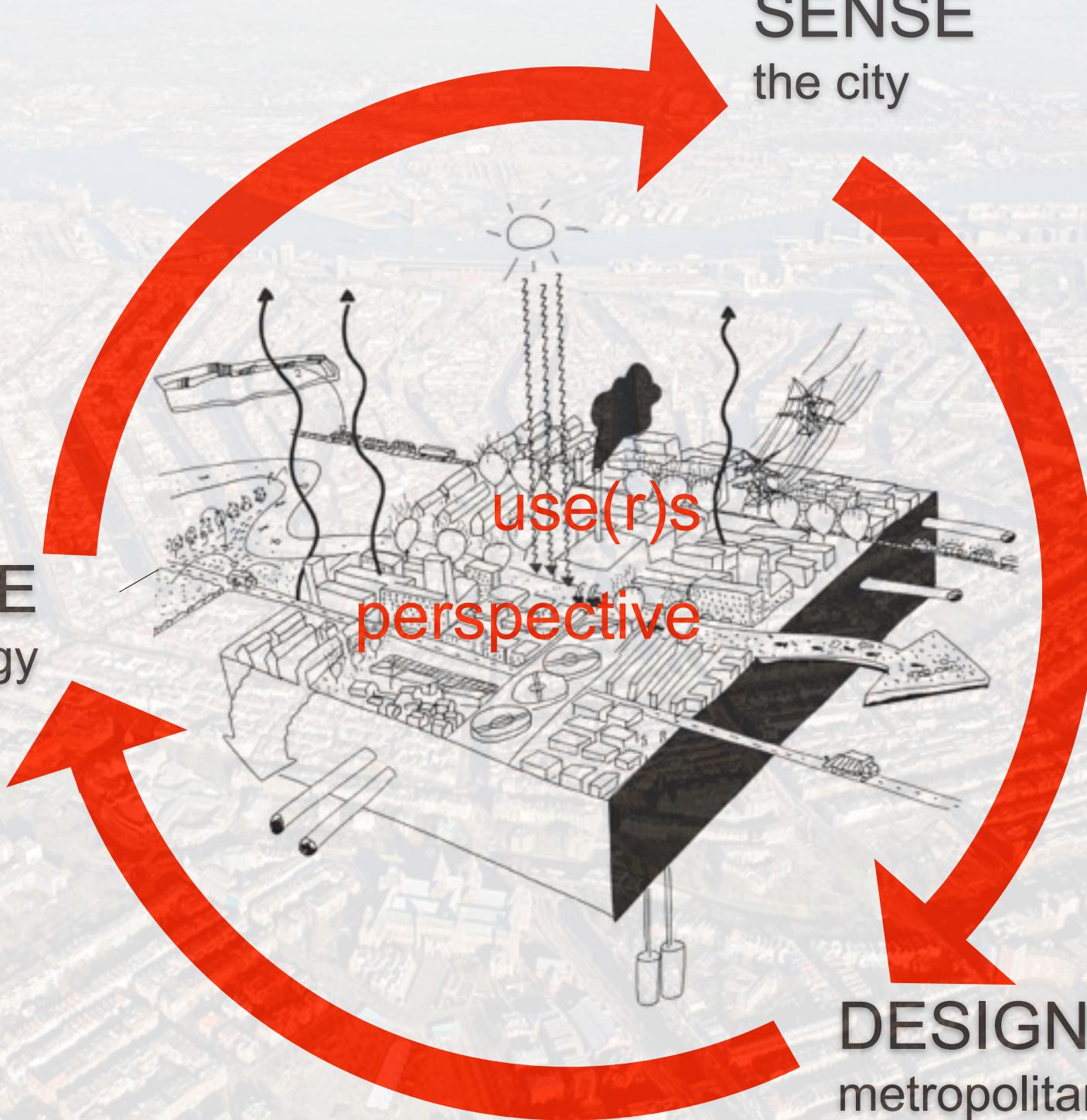


INTEGRATE
technology

SENSE
the city

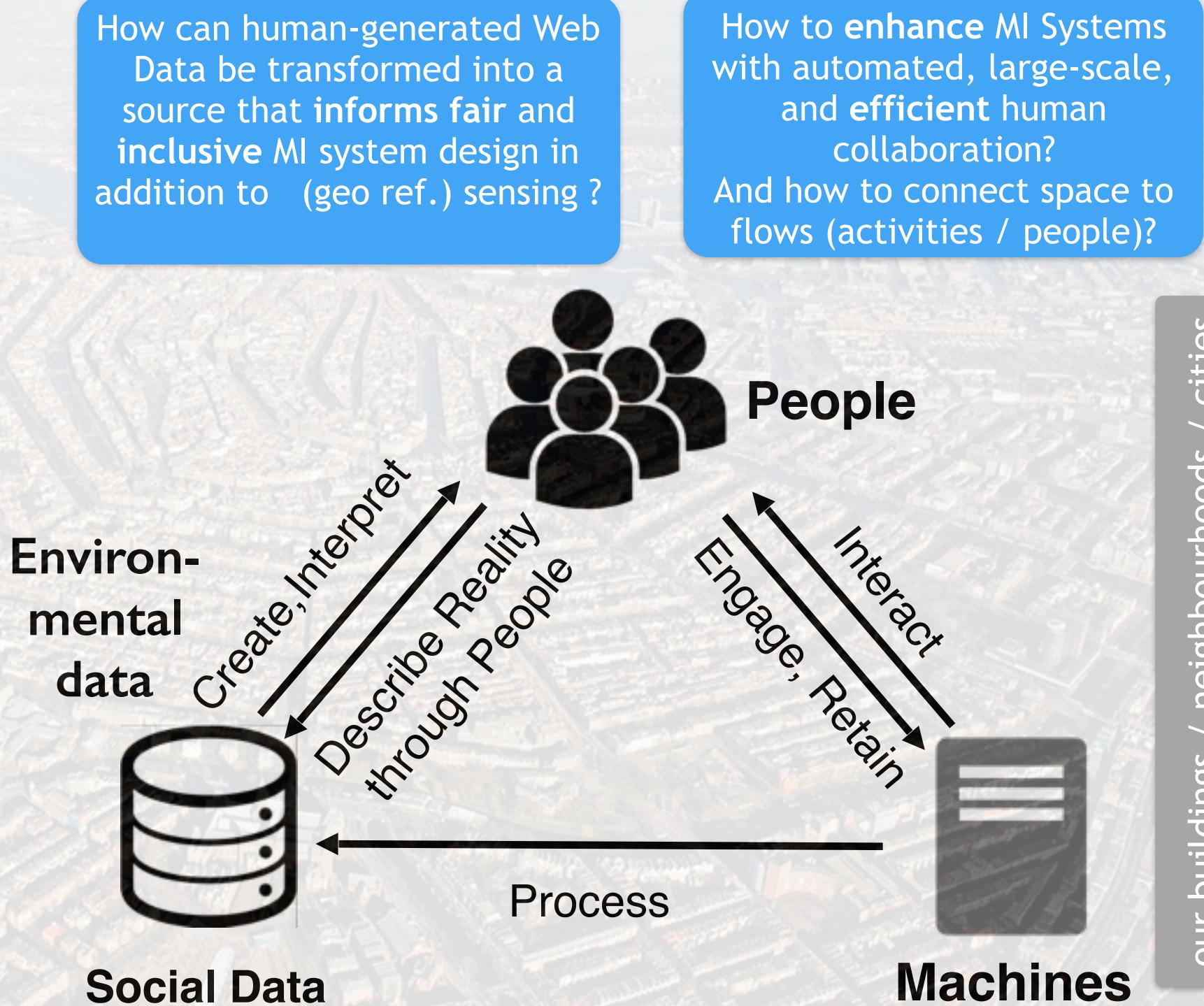
DESIGN
metropolitan solutions

use(r)s
perspective





A Socio-technical System

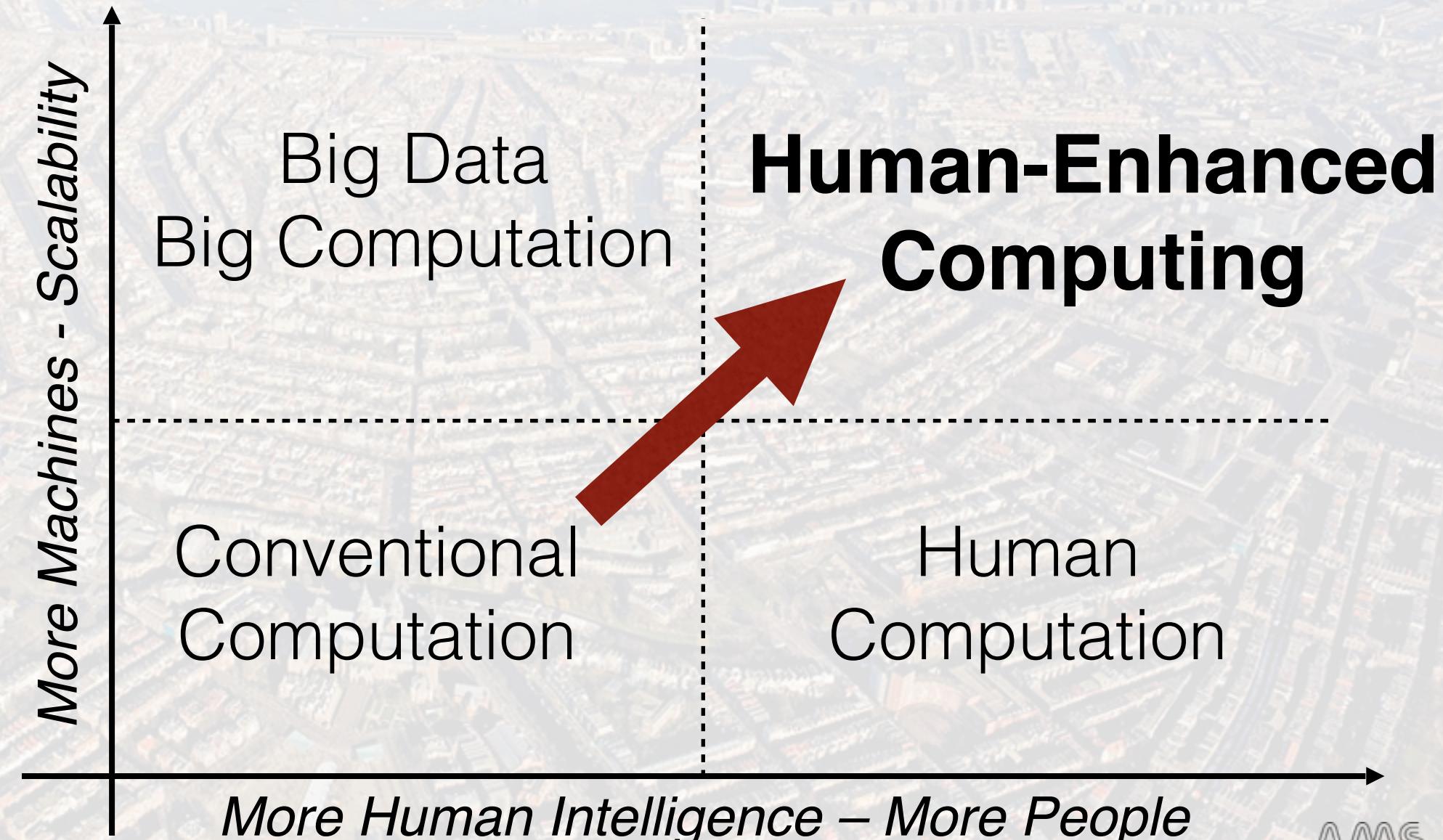


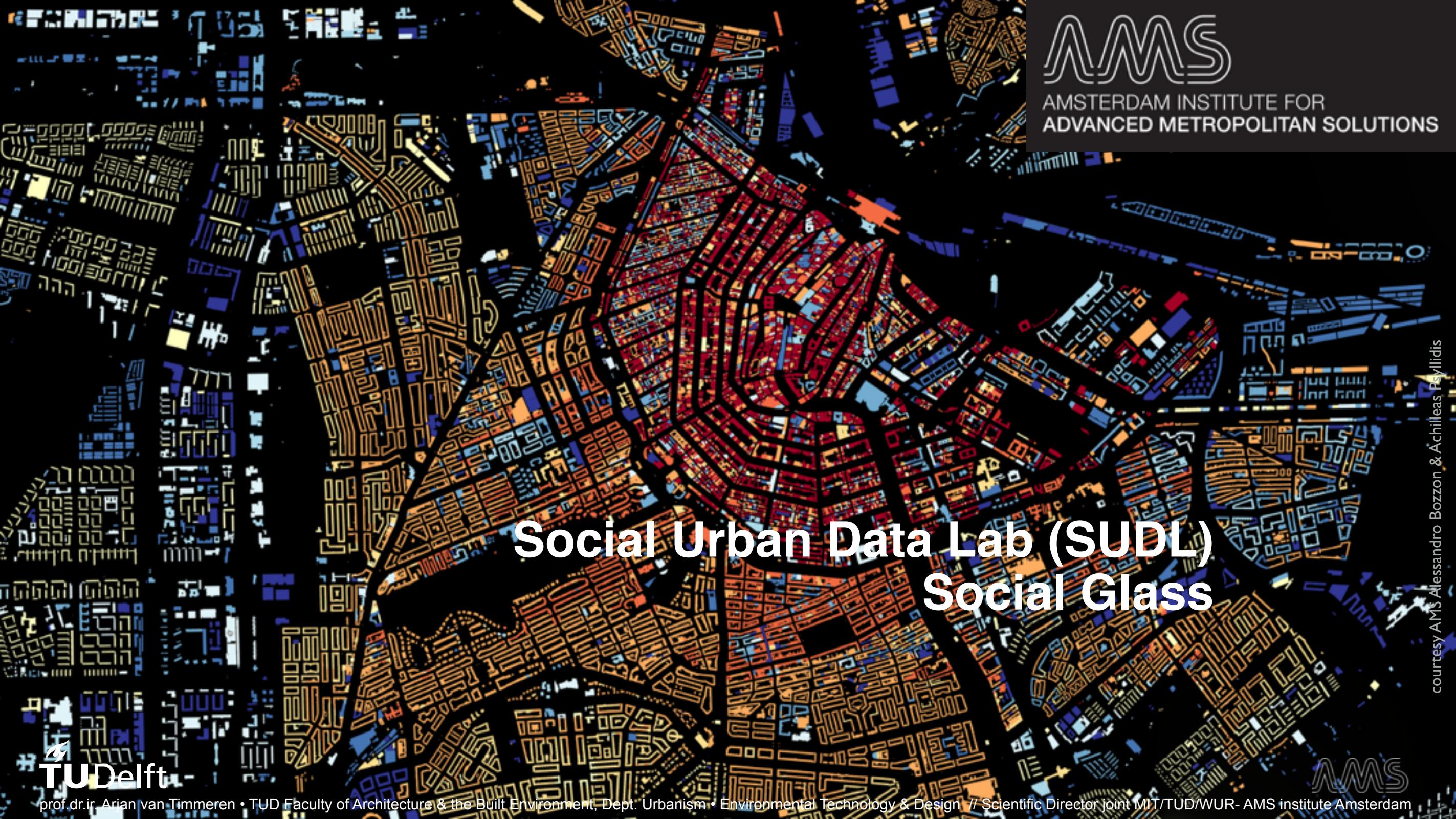
our buildings / neighbourhoods / cities

courtesy AMS Institute | Alessandro Bozzon

Challenge: People as 1st class citizens in big data pipelines

For data creation, analysis, interpretation, and sense-making





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Social Urban Data Lab (SUDL) Social Glass



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courtesy AMS Alessandro Bozzon & Achilleas Psyllidis



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A grayscale aerial map of a city with a dense pattern of small orange dots scattered across it, representing urban big data. The map shows a grid-like street pattern and various buildings.

Urban big data is a goldmine of knowledge about cities that we cannot afford ignoring.

It is imperative that we update the methodological toolbox of urban analytics and policy making.

courtesy AMS Alessandro Bozzon & Achilleas Psyllidis



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Social Urban Data

Census Records, Demographics, Spatial Statistics, Economic Data, Real-Estate Data etc.

- High data quality
- High levels of accuracy, completeness, and validity
- Generally truthful
- Semantic-by-design

- Low refresh rate
- Costly & laborious collection methods
- Non-scalable
- Limited or no temporal variability (static, semi-static)

Sensor & Mobile Phone Data

Physical Sensor Data, Mobile Phone Logs (CDRs), Transport Data, Energy Data etc.

- High levels of accuracy
- High spatio-temporal resolution
- High technology penetration
- Generally truthful
- Scalable & dynamic

- Mostly proprietary
- Very expensive to acquire (CDRs)
- Very expensive to deploy at the city-scale
- No semantics

Social Web Data

Geo-localized Social Media Data from web platforms (e.g. Twitter, Instagram, Sina Weiboo 4SQ etc.)

- High speed & refresh rate
- Created by people
- Enriched with annotations about places and human activities
- Scalable

- Mismatch between the platform's scope and the application domain
- "Noisy"
- Biased (tech, social)
- Generally untrustworthy



courtesy AMS Alessandro Bozzon & Achilleas Psyllidis

How to systematically and reliably exploit environmental & social data in urban analytics?

A Platform for Urban Analytics and Decision-making Through Heterogeneous Social Data



Urban Data Integration

Real-time analysis of multiple social & environmental data sources

Spatio/temporal Environmental Demographic and topic profiling

Crowdsourcing & Human Computation



courtesy AMS Alessandro Bozzon



RAIN SENSE

Sensing urban weather for rainproof Amsterdam





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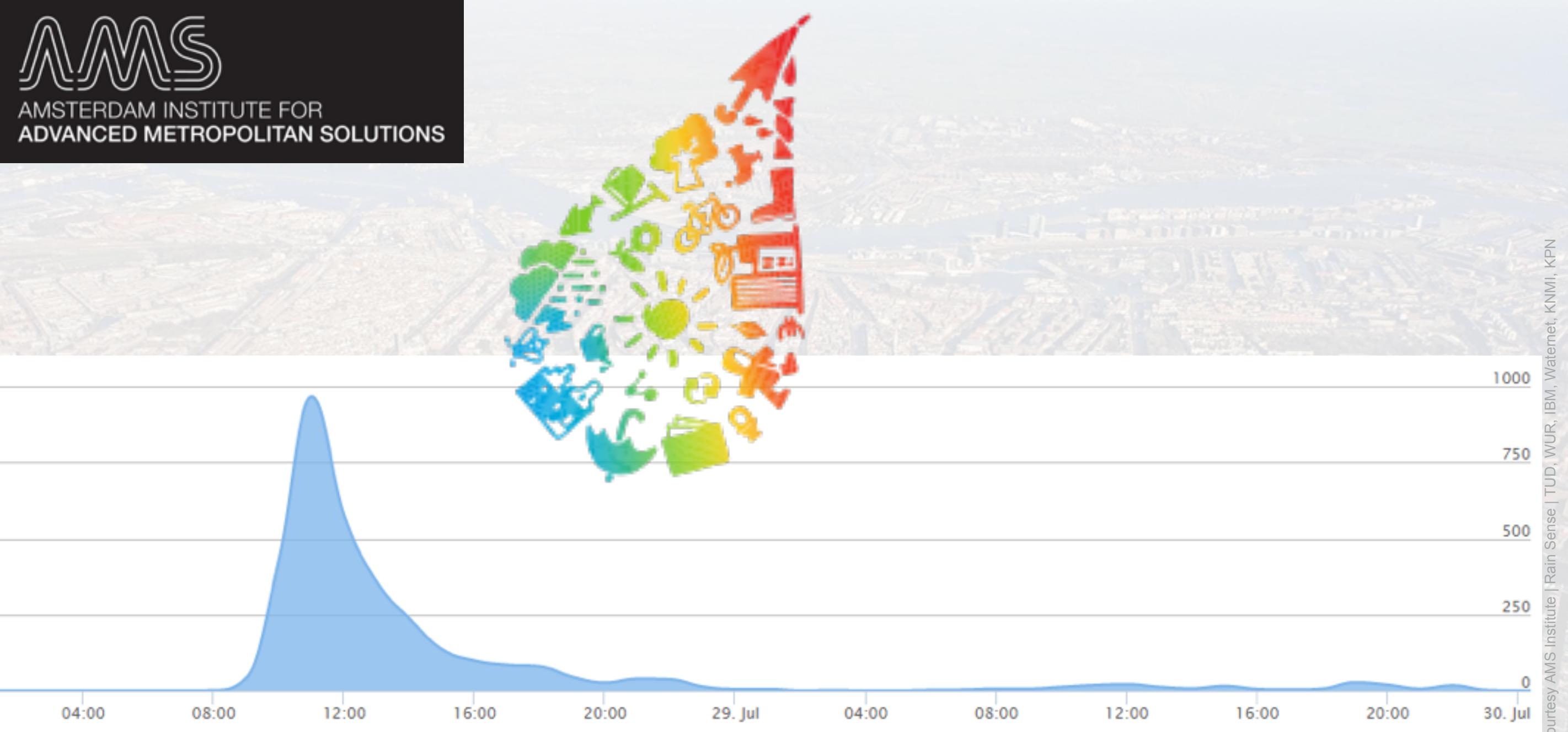
Courtesy AMS Institute | Rain Sense | TUD, WUR, IBM, Waternet, KNMI, KPN



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Amsterdam, 28 July





Courtesy AMS Institute | Rain Sense | TUD, WUR, IBM, Waternet, KNMI, KPN



Amsterdam, 28 July



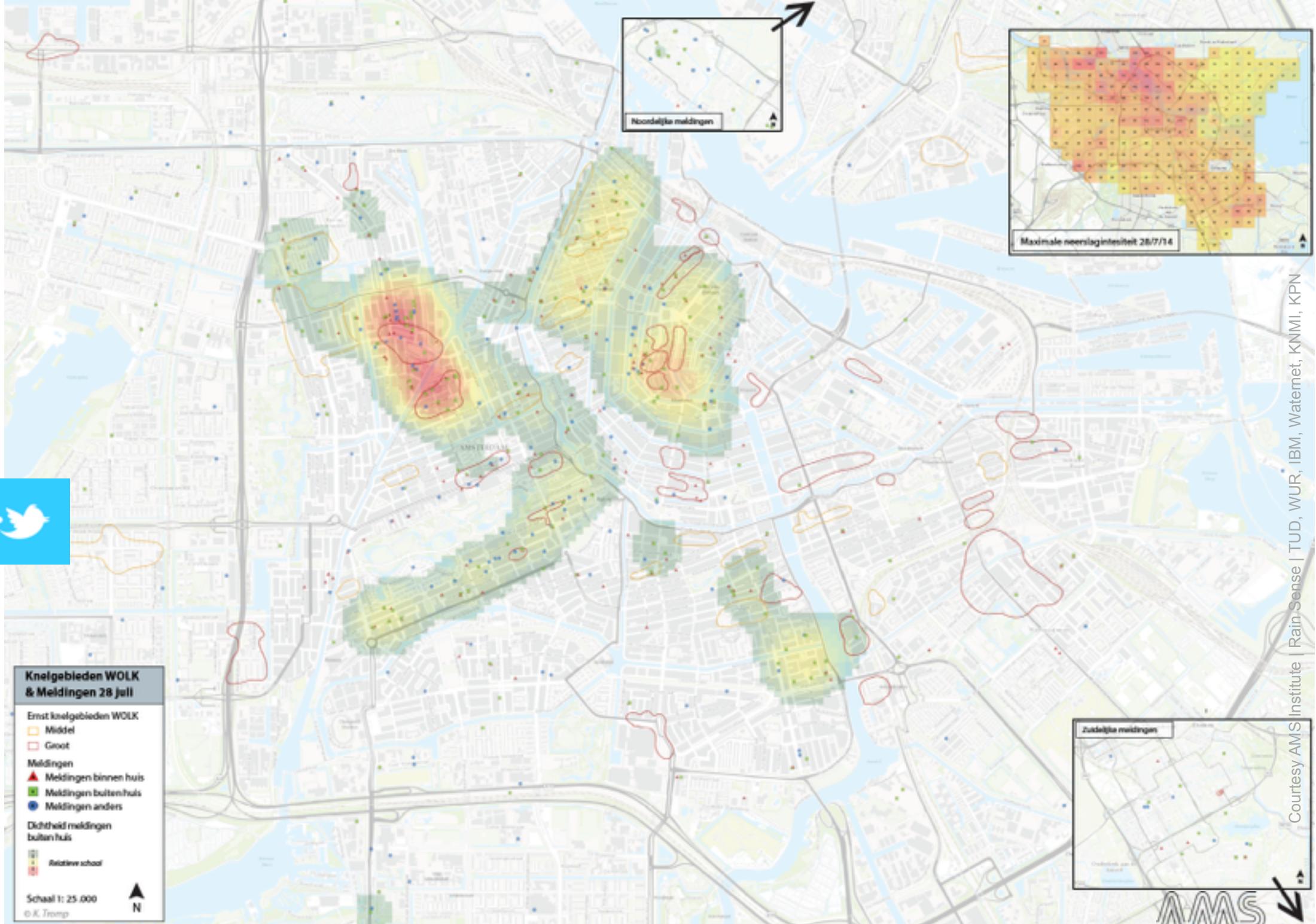


Nederland Trends @trendinahh - Jul 28
2 verified accounts helped to turn #wateroverlast into a Trending Topic.
These accounts were: @omroepbrabant & @omroepzeeland — #tmdnl
Amsterdam, North Holland

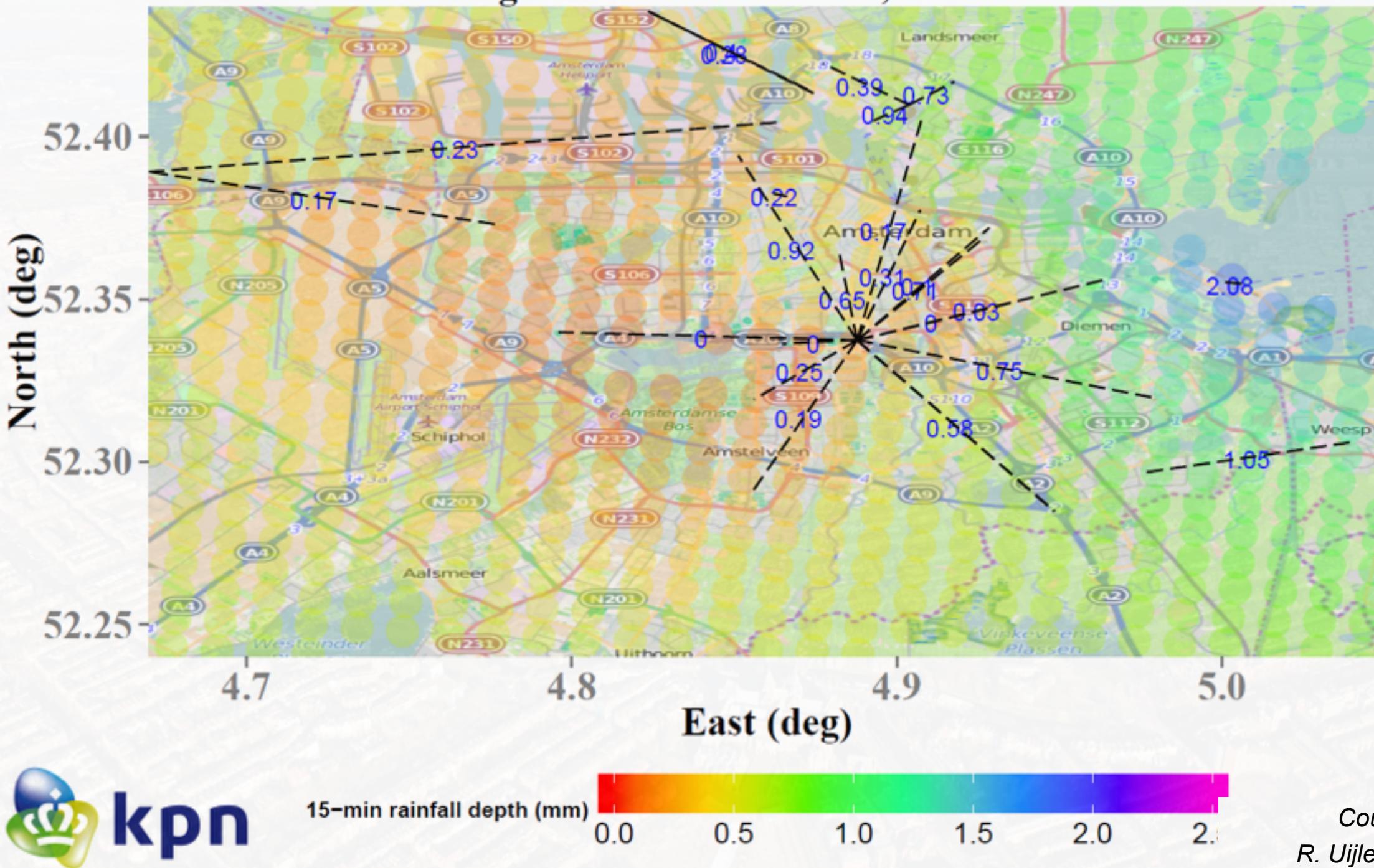
Nederland Trends @trendinahh - Jul 28
The tweet with the most impact of the #wateroverlast Trend, was published by
@RuSt . Twitter.com/RuSt/status/49... (199 RTs) #tmdnl
Amsterdam, North Holland

Nederland Trends @trendinahh - Jul 28
#TopApps for #wateroverlast
Twitter for iPhone 25%
Twitter Web Client 19%
Twitter for Android 15%
Amsterdam, North Holland

RuSt @RuSt - Jul 28
Er neemt hier iemand de naam Rivierenbuurt wel heel serieus #wateroverlast.
Amsterdam #huchtbed pic.twitter.com/unDzUEYORv



Regenkaart: 20-07-2015, interval 16



Rainfall map
derived from
GSM antenna
links.

15 min rainfall
intensities over
Amsterdam, 20
July 2015

Select range: 23/10/2015 12:00 AM - 23/10/2015 11:59 PM



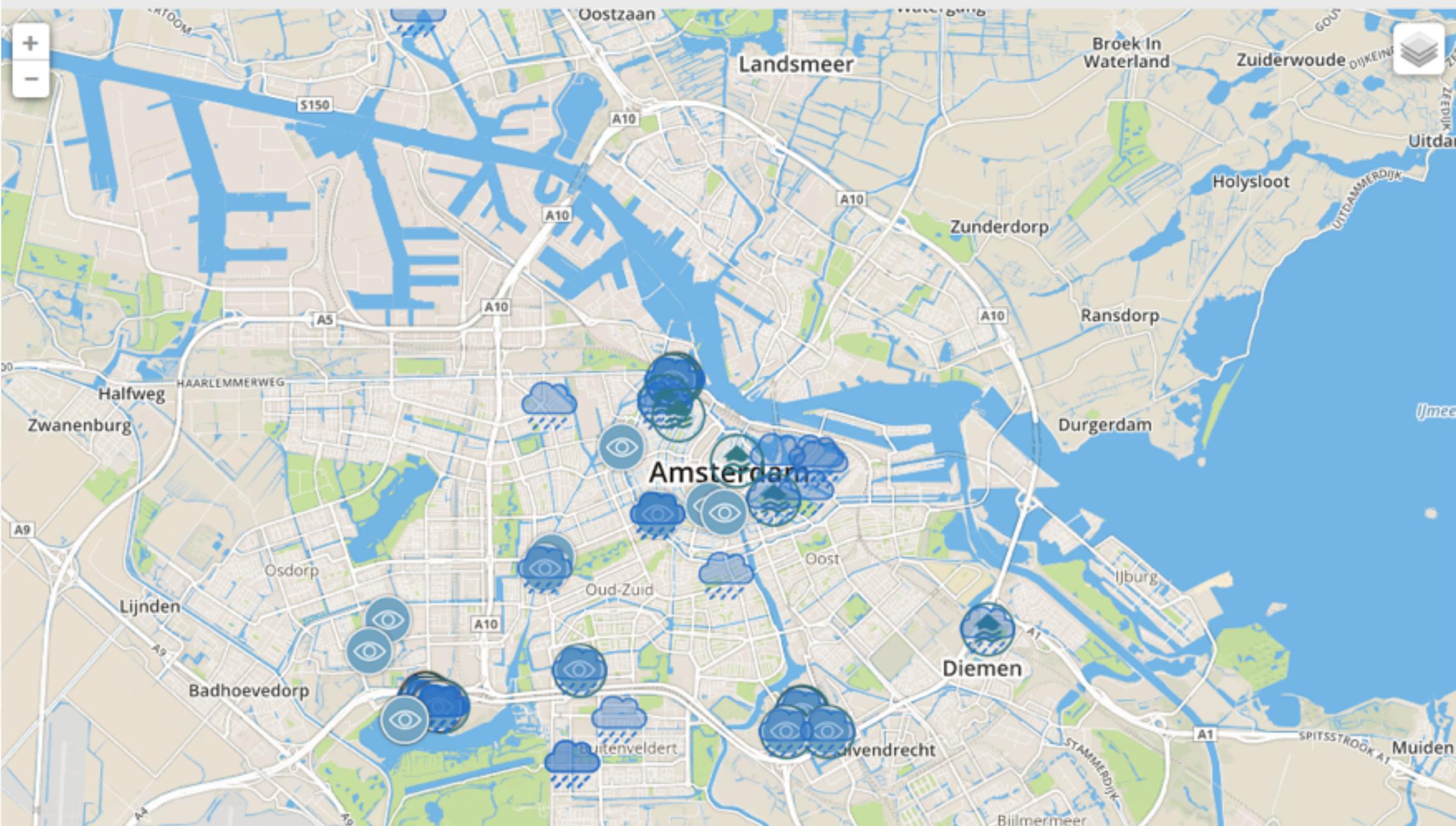
Rain



Flood



Atmosphere



Social Weather
App inputs
summer
experiment
Amsterdam:
Reported rainfall
and flooding



PUMA
Prospecting the Urban Mines
of Amsterdam.



| REsource Management in Peri-urban Areas: Going Beyond Urban Metabolism

Grant Agreement No.: 688920

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688920





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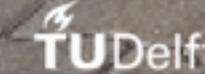


Courtesy AMS Institute | 3D Printing for the Circular City | PhD candidate Fotini Setaki



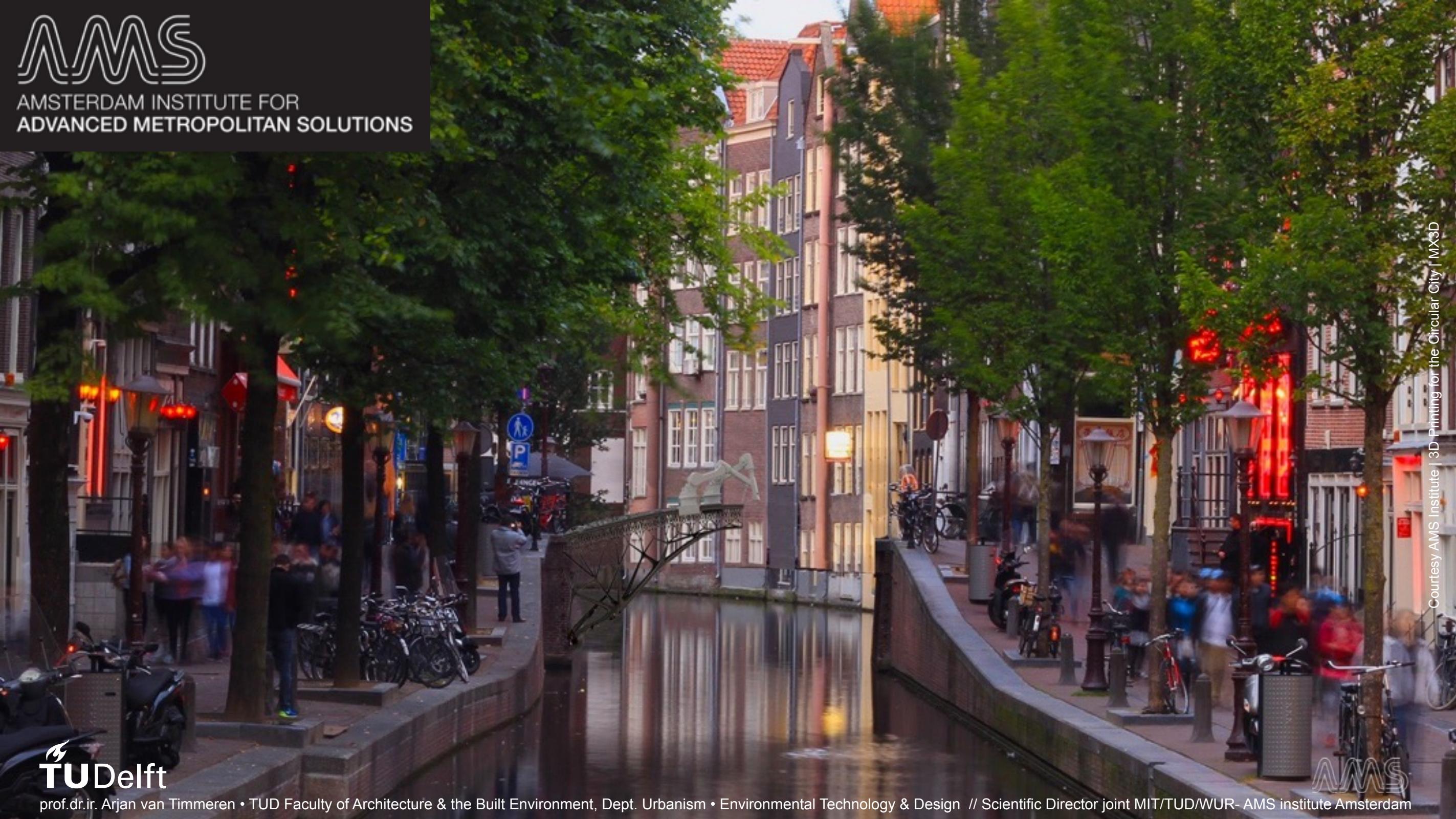
THE
NEW
RAW

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Consortium and Peri-urban Living Labs :

Participant (Acronym)	Country
Delft University of Technology (TUD)	NL
Ghent University (UG)	BE
DiARC UNINA - University of Naples Federico II (UNINA)	I
HafenCity Universität Hamburg (HCU)	D
Institute for Regional Studies, CERS of HAS, MTA KRTK (RKI)	H
Institute of Geography and Spatial Organization Polish Academy of Sciences (IGiPZ)	PL
Joint Research Centre (JRC)	I
Geo-Col GIS and Collaborative Planning (Geo-Col)	NL
Delta Development Group (DELTA)	NL
BIOKOM Nonprofit Ltd (BIOKOM)	H
Gertz Gutsche Rümenapp Stadtentwicklung und Mobilität GbR (GGR)	D
OVAM - Public Waste Agency of Flanders (OVAM)	BE
Municipality of Haarlemmermeer (GHM)	NL
Campania Regional Authority (CRA)	I
Pheno horizon (PHH)	PL
Bauer Umwelt GmbH (BMU)	D/I
IVAGO (IVAGO)	BE
Stadtrenigung Hamburg (SRH)	D





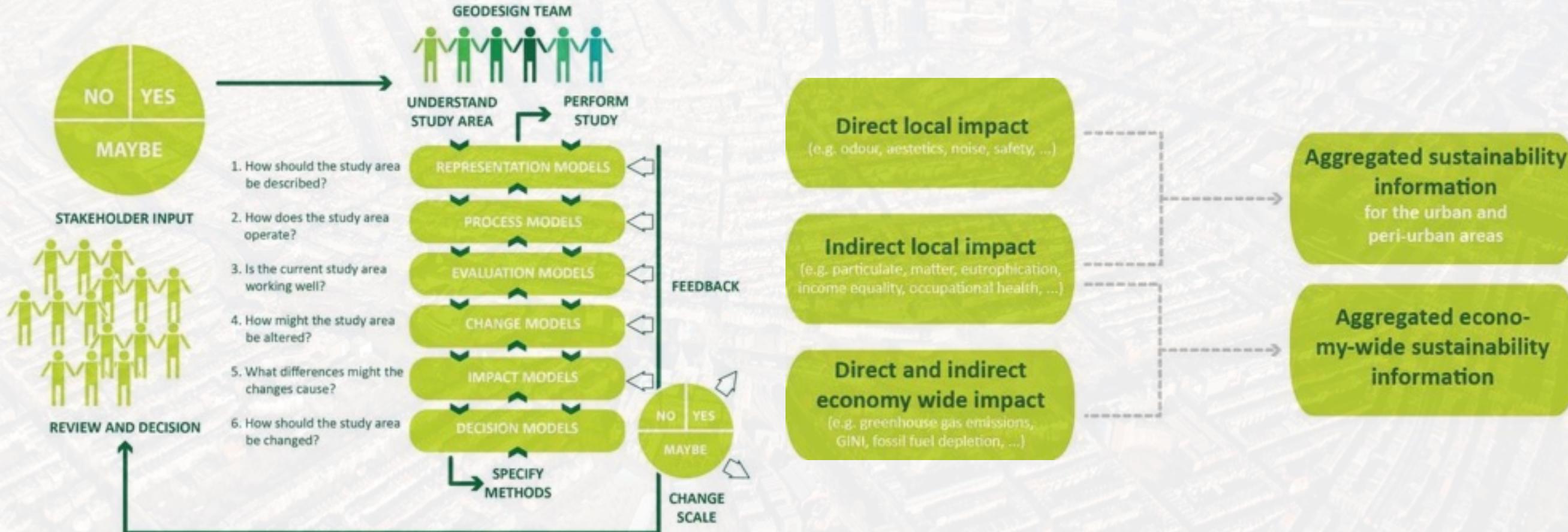
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Approach:

- REPAiR integrates life cycle thinking and geodesign connected to activities and thus locations, to operationalise urban metabolism!





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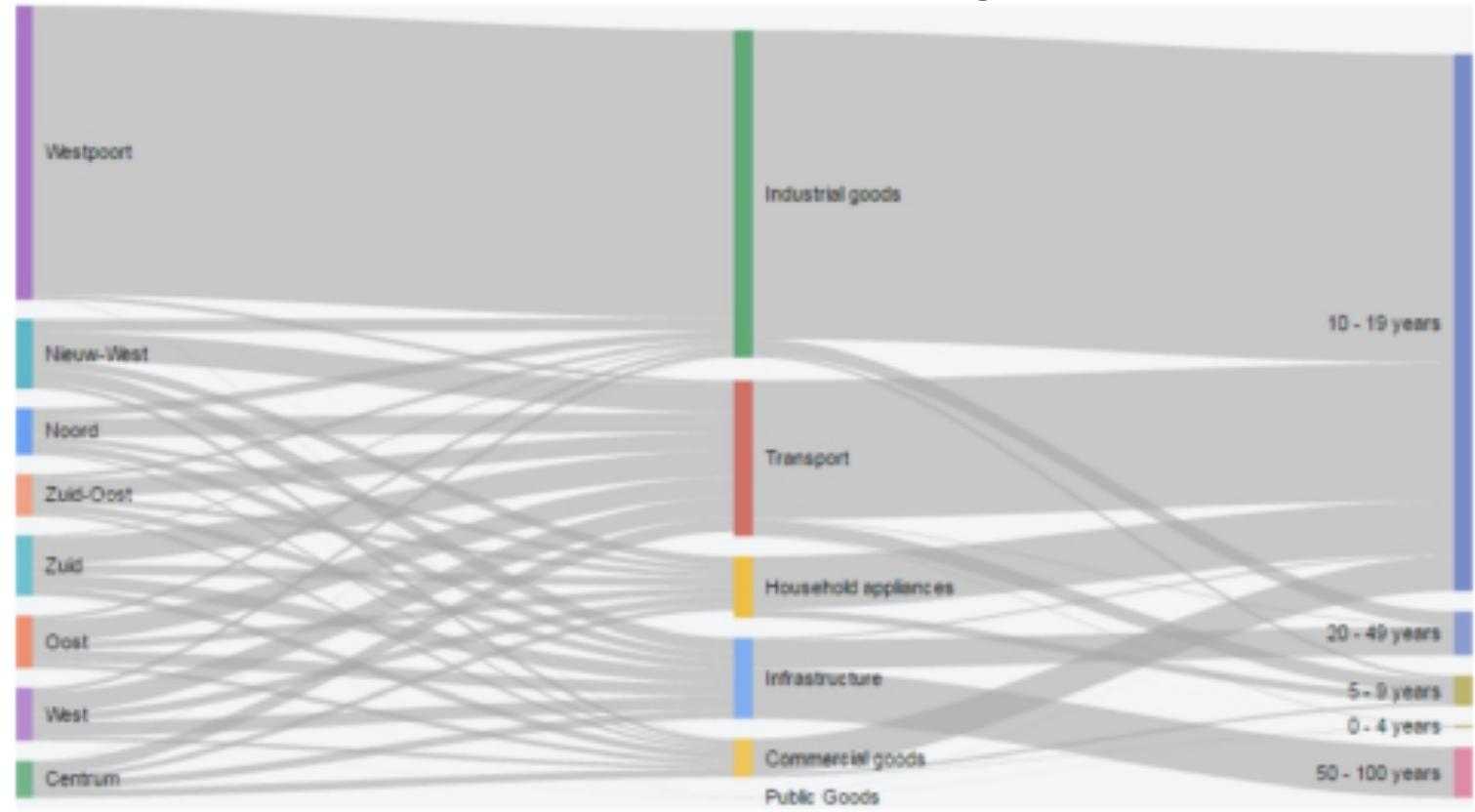
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Stock outflow



Urban mining map - example



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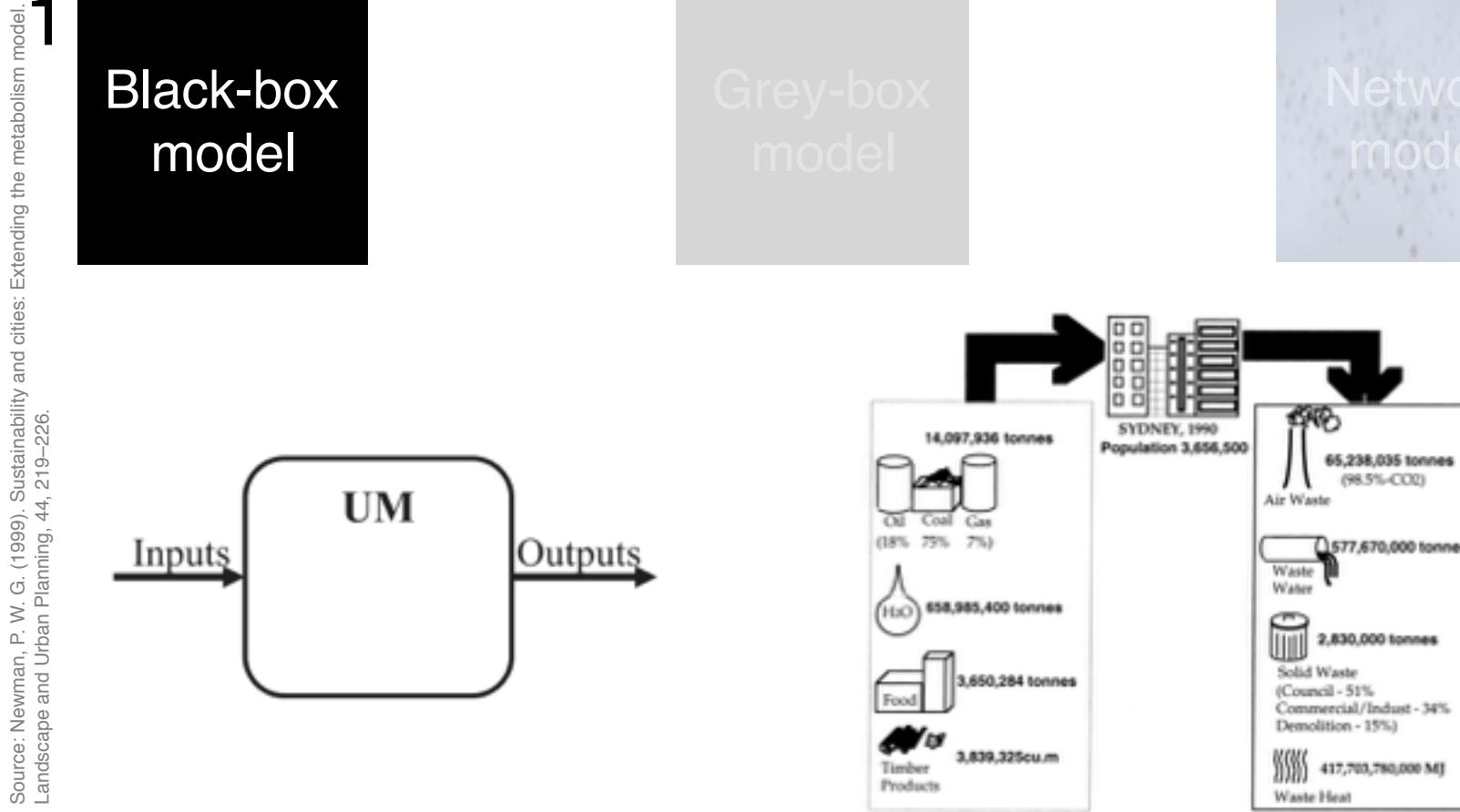
Three models of Urban Metabolism Analysis

1

Black-box
model

Grey-box
model

Network
model



An example of Black-box model: Resource inputs consumed and waste outputs discharged from Sydney, 1990 (Newman, 1999)



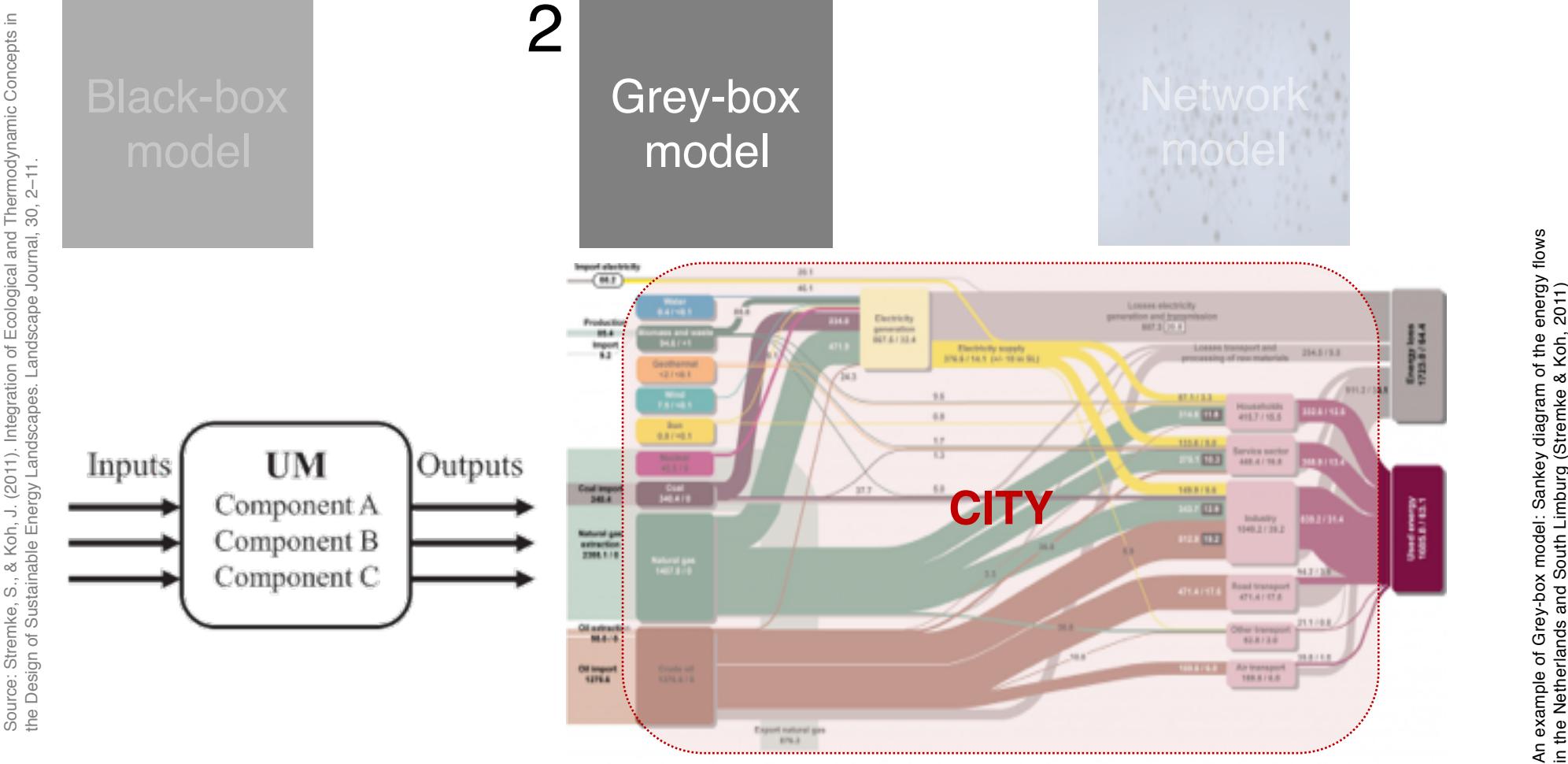
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Three models of Urban Metabolism Analysis





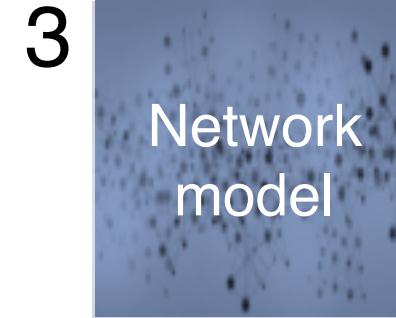
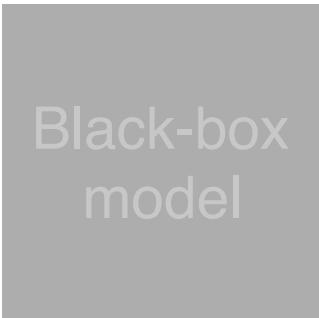
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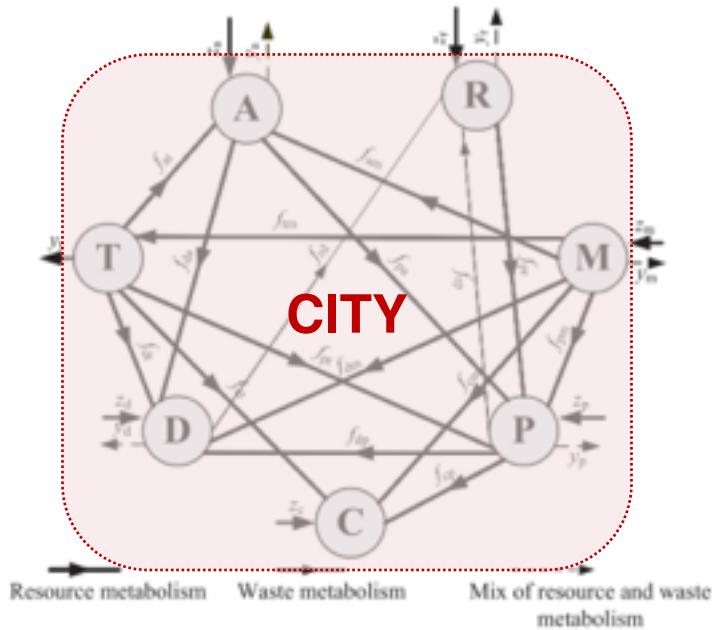
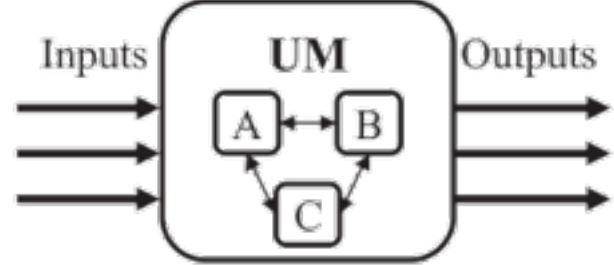
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Three models of Urban Metabolism Analysis



Source: Zhang, Y., Liu, H., & Chen, B. (2013). Comprehensive evaluation of the structural characteristics of an urban metabolic system: Model development and a case study of Beijing. Ecological Modelling, 252, 106–113.



An example of Network model: Model of Beijing's urban metabolism with two metabolic mainlines (Zhang et al., 2013)

**“ Civilization advances by extending
the number of important operations
which we can perform without
thinking about them. ”**

Alfred Whitehead

NETWORKED ENVIRONMENTS



Congregation Market square, Pittsburgh (Michael Henninger, 2014)

Networked Environments



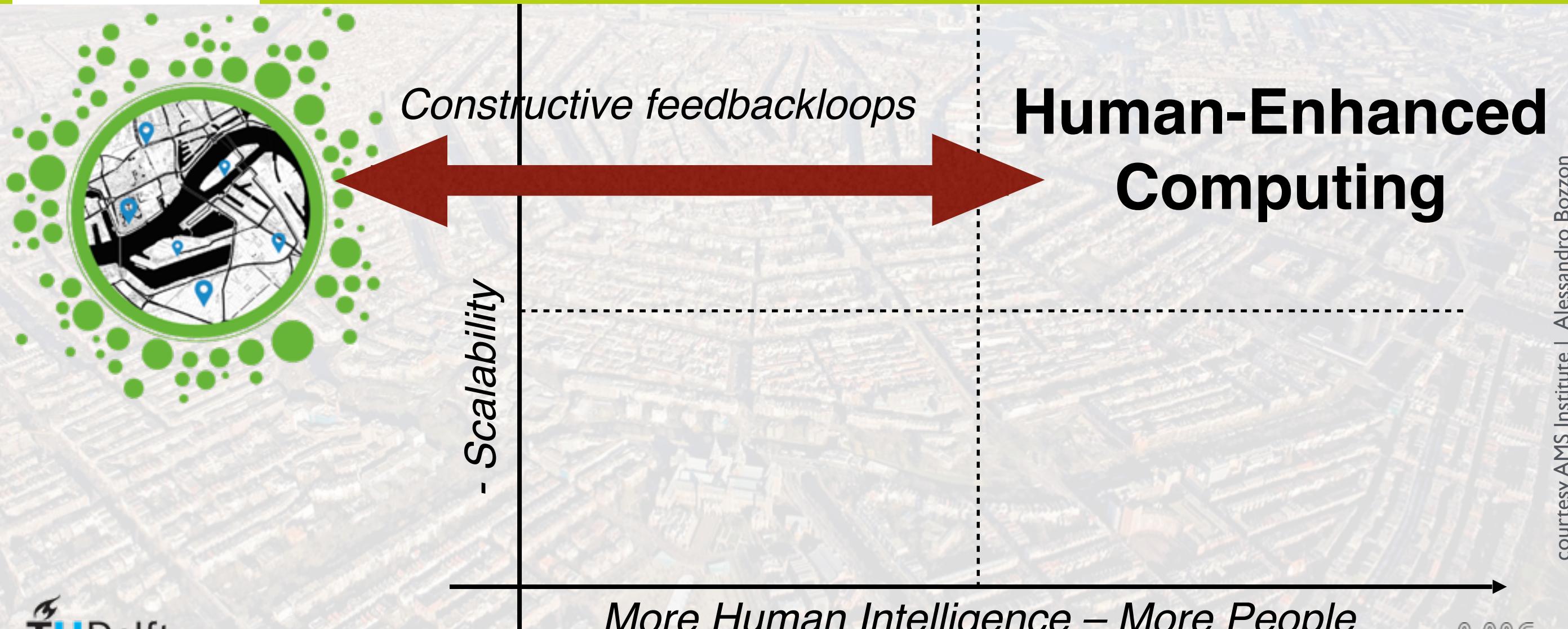
Congregation Market square, Pittsburgh (Michael Henninger, 2014)



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Roboat * Amsterdam

Imagine dozens of smart Roboats navigating Amsterdam's canals

Researchers at MIT and AMS, the Amsterdam Institute for Advanced Metropolitan Solutions, have started a project that aims to design and deploy the world's first fleet of autonomous boats in the city of Amsterdam. Called Roboats, these water-based vehicles could transport goods and people and could also be used for the creation of temporary floating infrastructure — such as self-assembled bridges and concert stages. Roboats will also monitor the city's waters, using new environmental sensing methods, providing vital insights on the urban ecosystem and human health. Amsterdam is an ideal place for developing this project. About one fourth of the area of the city is covered by water, and it has more than one thousand kilometers of canals and 1,500 bridges. Besides, Amsterdam has a long-standing focus on urban innovation. Amsterdam's waters, including bridges, canals, the IJ and its docks offer plenty of opportunity to further develop the city's functionality and quality of life. Roboat project could become a reference for many urban areas around the globe (from São Paulo to London, from New York City to São Paulo). Furthermore, outcomes from Roboat could lead to international entrepreneurial initiatives (start-ups) ushering the way to an era where the economy enters the 4th industrial revolution.

Team

MIT Principal Investigators

Dennis Frenchman, *DUSP*

Carlo Ratti, *DUSP Senseable City Lab*

Danieal Rus, *CSAIL*

Andrew Whittle, *CEE*

Amsterdam AMS

Arjan van Timmeren *Director*

Press

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(MIT SCL / AMS, 2016)



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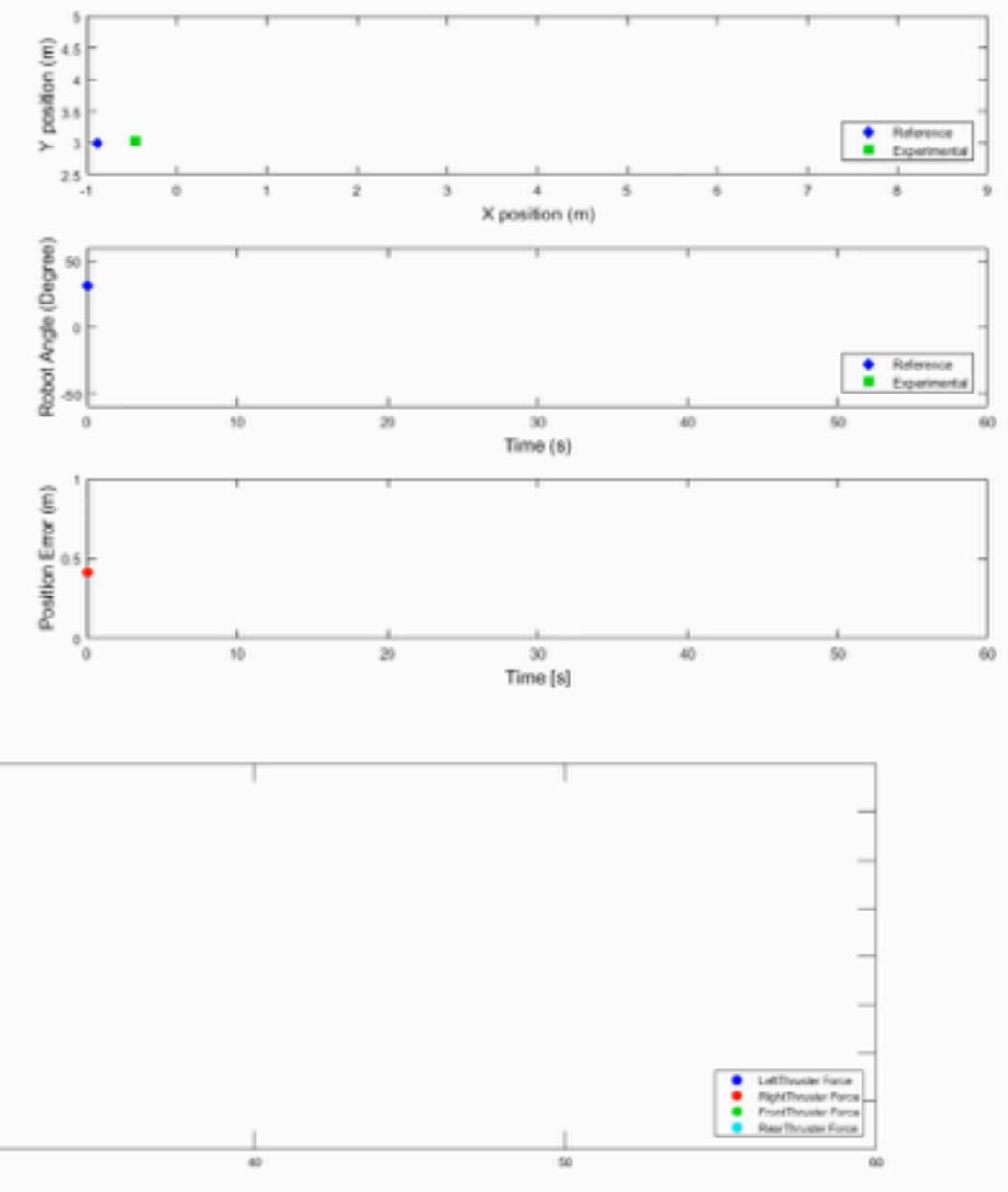
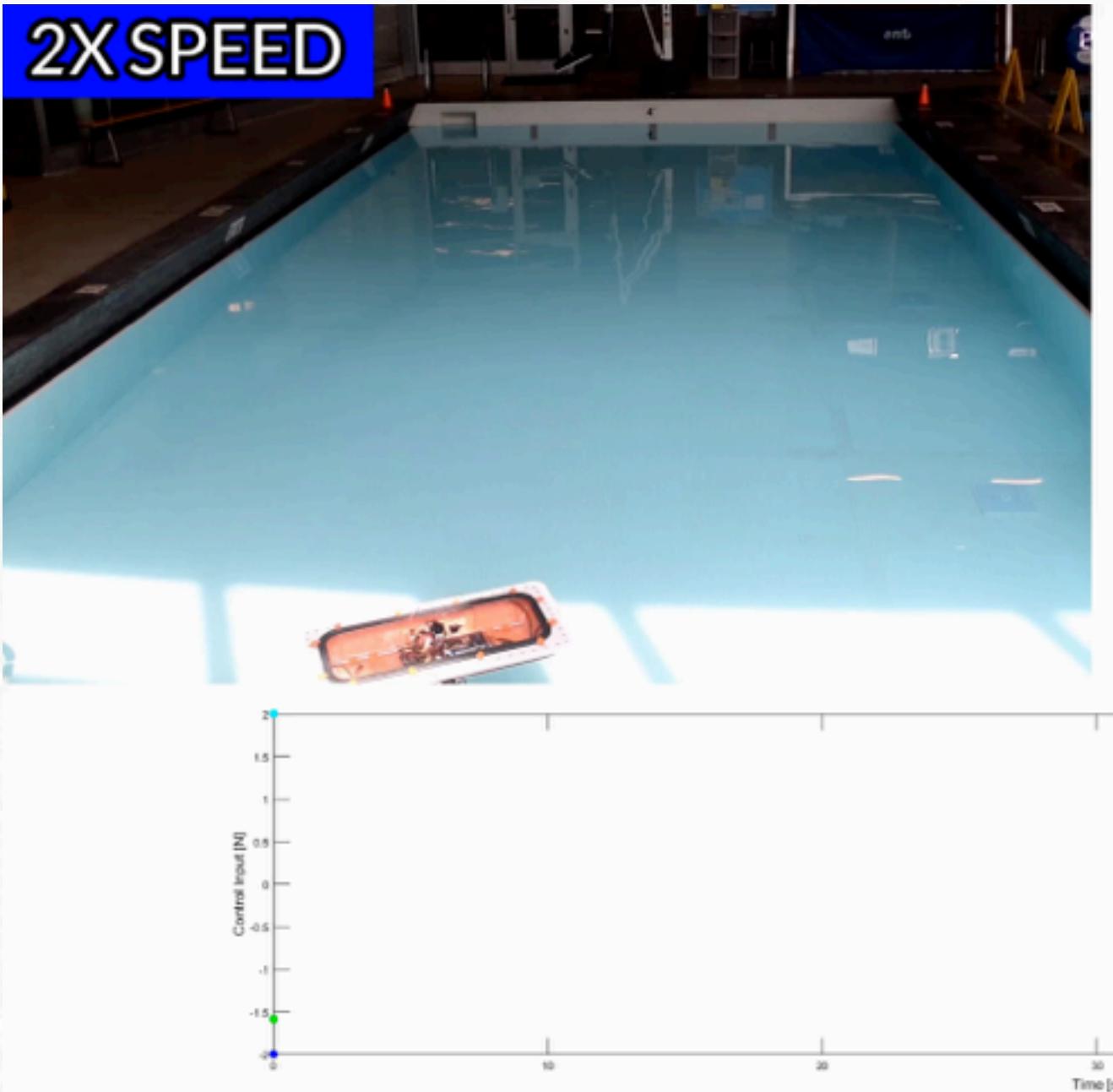


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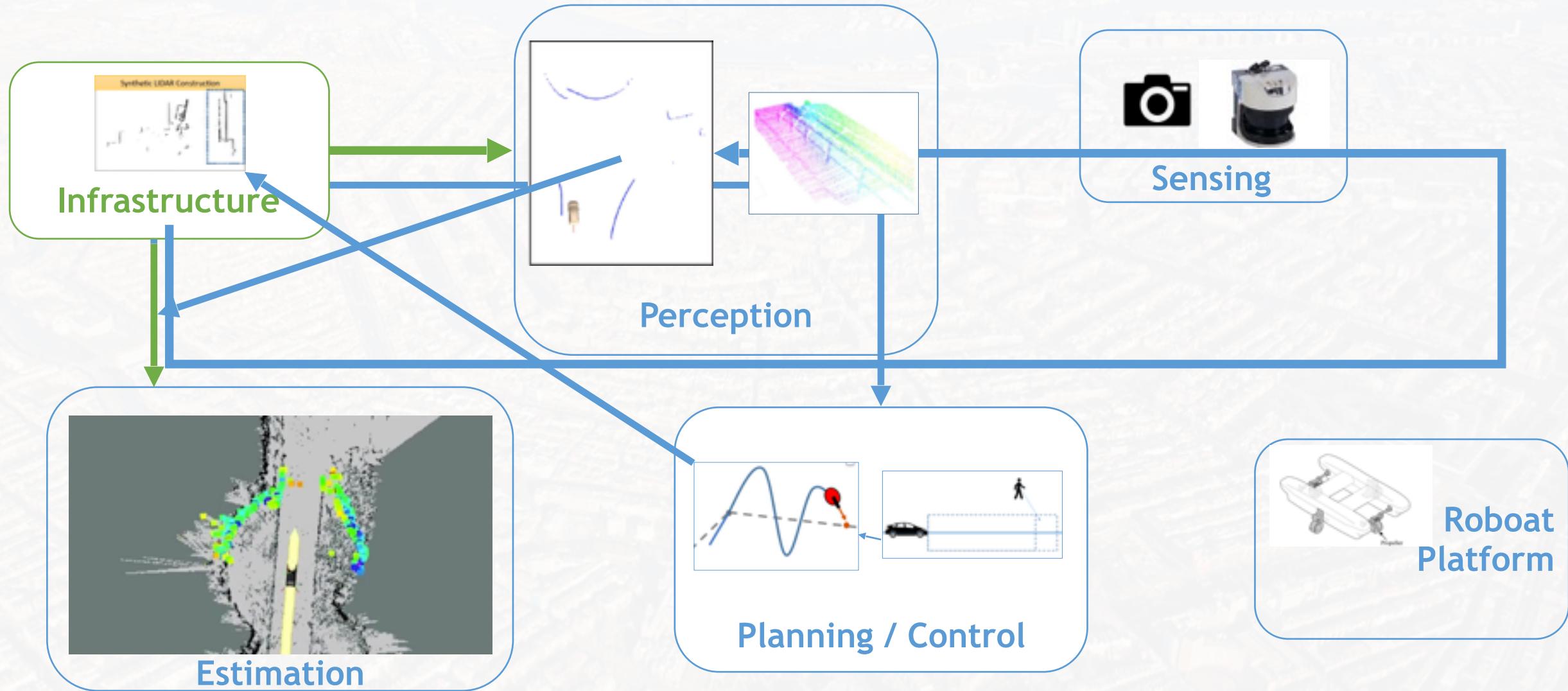




First experiments



Autonomy Recipe





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SENSING



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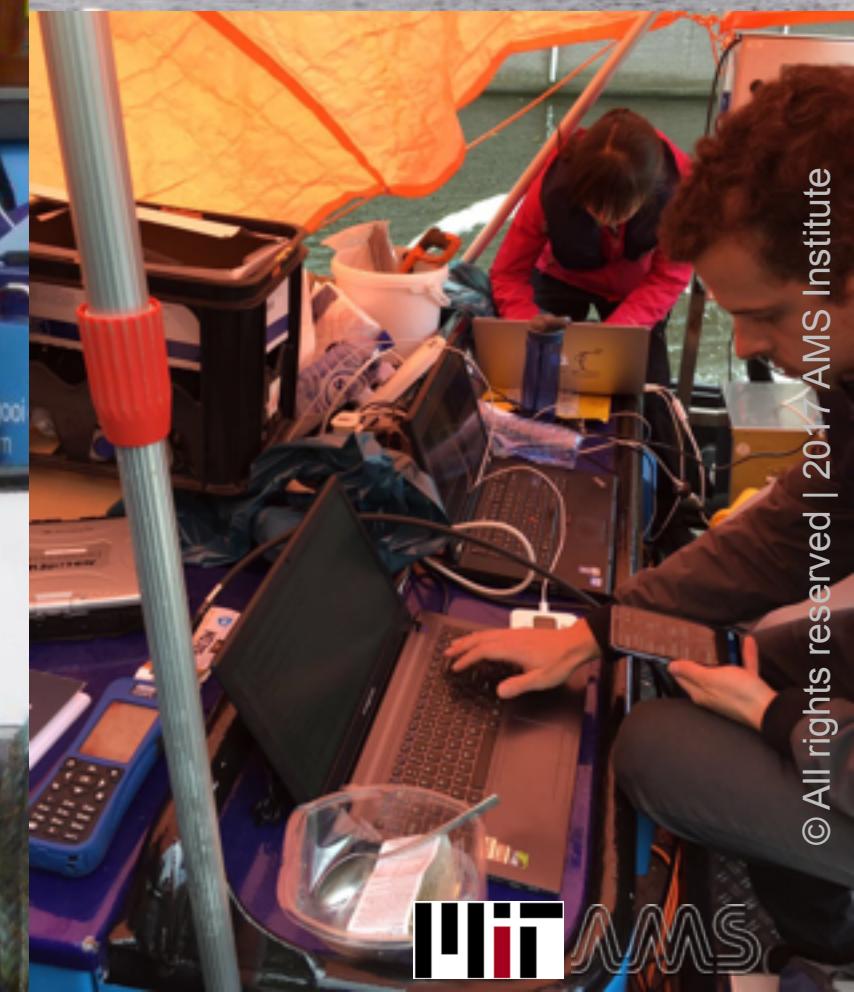


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ENVIRONMENTAL SENSING

Andrew Whittle et al.



Autonomous sensing in marine environments

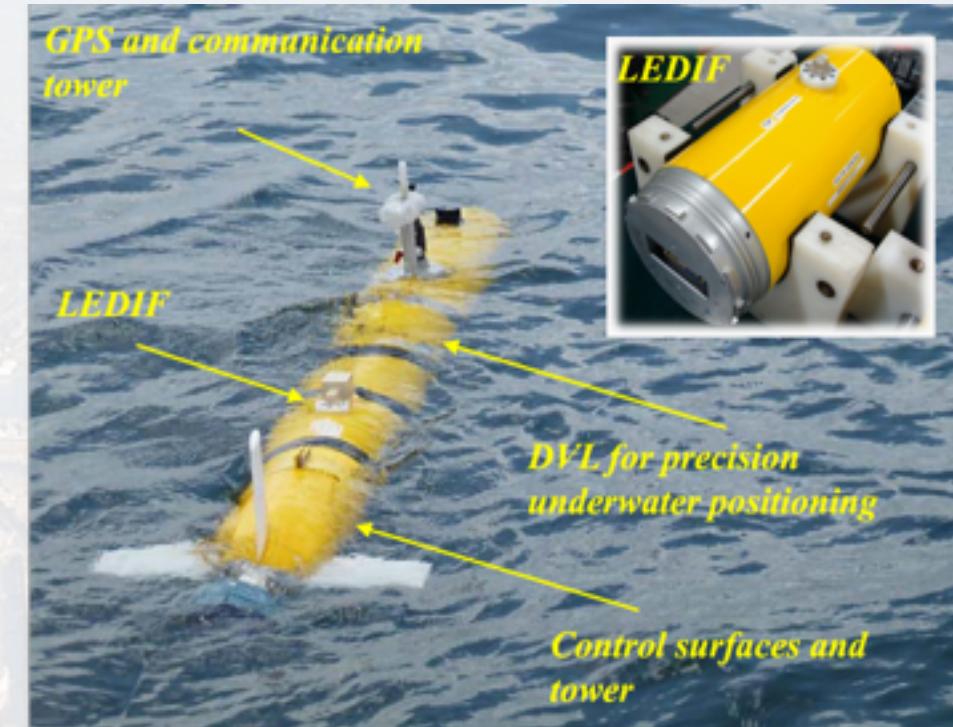


AUV



ASV

Online water quality measurements deployed on autonomous vessels in marine environment:
Singapore (Profs. Patrikalakis, Hemond)

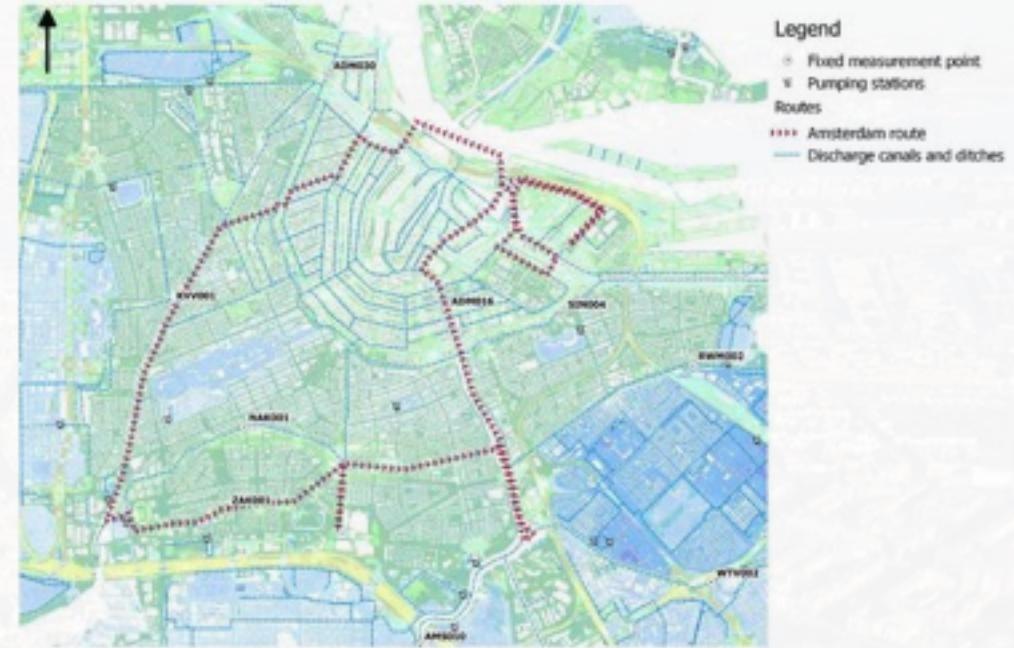


Submersible holographic imaging

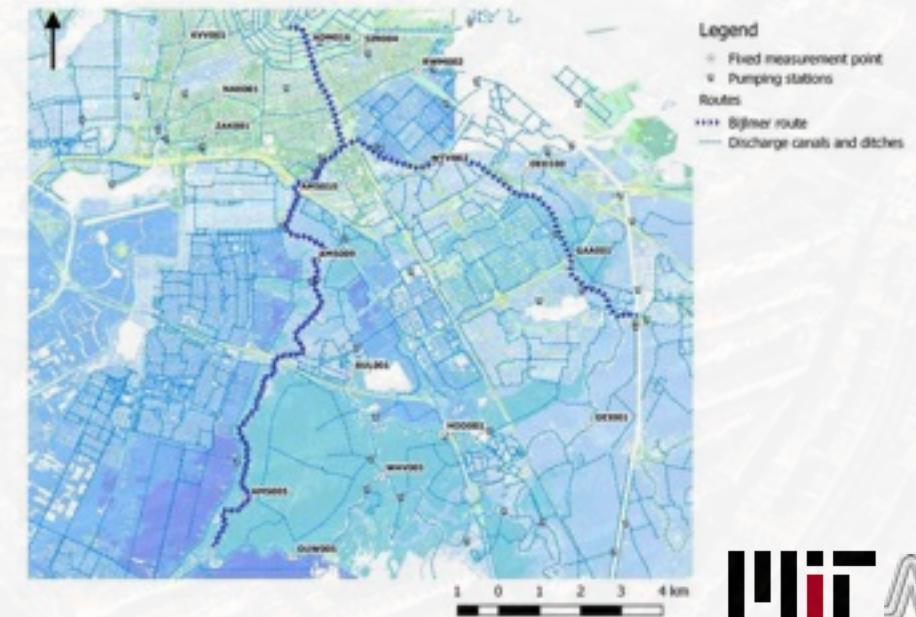
© wave

Applications:
Harmful algal blooms, oil spills

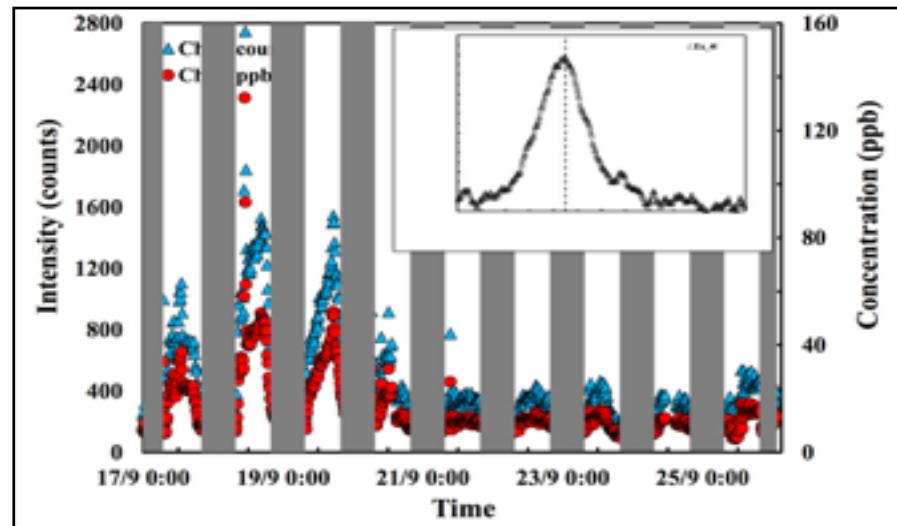
routes and objectives: September 5-8, 2017



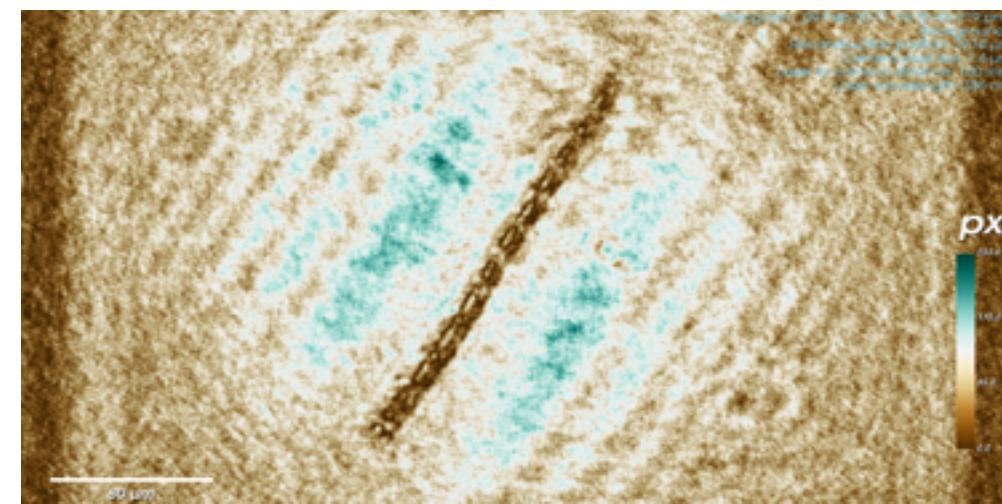
- * Canals:
 - Spatial gradients (N-S)
 - Local emissions
- * SW Amsterdam:
 - Isolated parts of system
- * Bijlmer:
 - Brackish water discharges from deep polders
 - Discharge from sewage treatment plant



key measurements for initial studies with WaterNet

**Portable LEDIF technology:**

- 3D spatiotemporal water quality
Chlorophyll
- High MW organics (oil spills)
- Ng et al., (2014)

**SHI system:**

- Diatom – skeletonema
- Leong et al. (2016)



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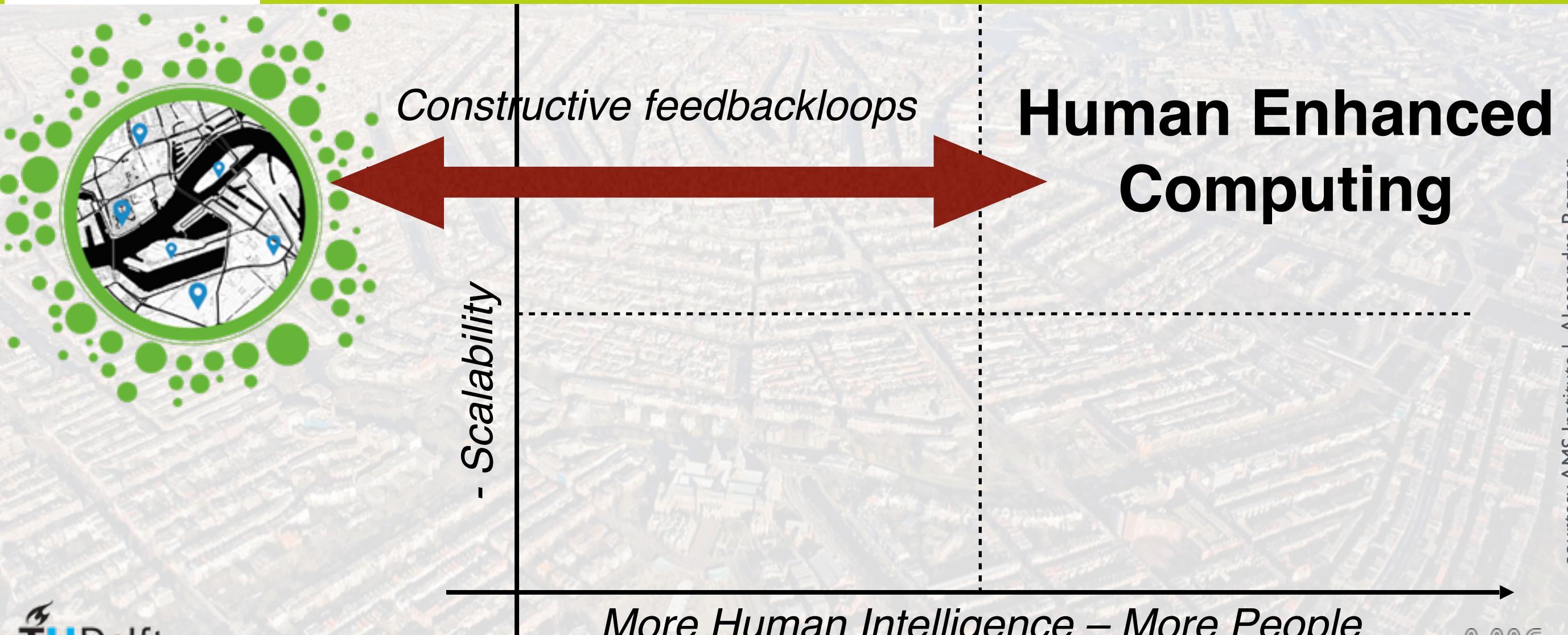
(MIT SCL / AMS, 2016)

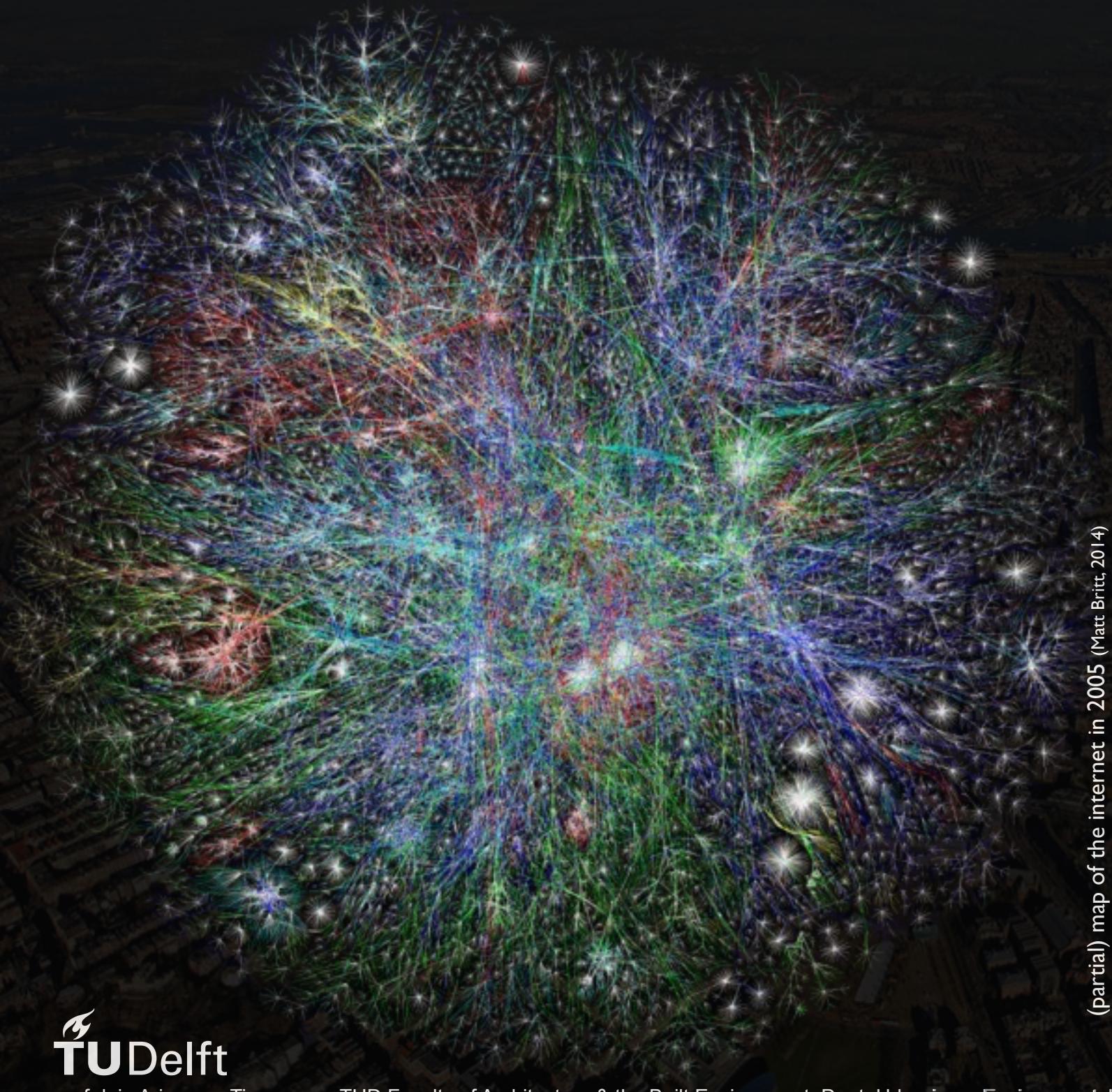


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Scientific Director

Joint initiative MIT-TUD-WUR

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תודה
Dankie Gracias
Спасибо شکرًا
Merci Takk
Köszönjük Terima kasih
Grazie Dziękujemy Dekojame
Ďakujeme Vielen Dank Paldies
Kiitos Täname teid 谢谢
Thank You Tak
感謝您 Obrigado Teşekkür Ederiz
Σας ευχαριστούμε 감사합니다
Bedankt Děkujeme vám
ありがとうございます Tack



It is self-evident we live in the wealthiest and most scientifically advanced era of human history. Our world has become increasingly urbanized and dominated by the city, the technologically sophisticated, highly resource dependent cradles of civilization that simultaneously concentrate financial, technological, cultural and creative capital while propagating poverty, economic inequality, criminality and pollution. Yet, our demands on the biosphere are growing at such an exponential pace we have disrupted the dynamic equilibrium of the compound most integral to life: water (H_2O).

H_2O propels the climate, lubricates continental drift and shapes our geographies. Its abundance demarcates international boundaries while its scarcity sparks civil conflict. You can read this book comfortably because water vapour in the atmosphere absorbs incoming solar radiation and the oceans act as a massive heat sink that stabilizes earth's ambient temperature. This very same effect is exacerbated by the prodigious amounts of greenhouse gases we emit, resulting in a precipitous warming that threatens our long-term prospects.

Presently, cities are confronted with a number of increasingly unmanageable crises, from the triple threat of climate change, water scarcity, and environmental degradation to the deterioration of water supply and sanitation networks which will soon require radical retrofitting and/or complete replacement. This is most apparent in the countries of the Global South, where billions living in slums still lack easy access to clean water.

What can be done? Is water actually becoming scarcer? Will it be a simple matter of installing water efficient toilets and faucets? Is it something best left to the free market? Or, can our problems be disrupted by ubiquitous IT and Smart Cities?

UNDER PRESSURE: WATER AND THE CITY

Laurence Henriquez
Arjan van Timmeren

UNDER PRESSURE:
WATER AND THE CITY



UNDERPRESSURE.ONLINE

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