Deutsche Gesellschaft für Geographie | DGfG

KlimNet Stadt und Land im Fluss

WIR SIND DABEI! KlimaExpo.NRW Motor für den Fortschritt

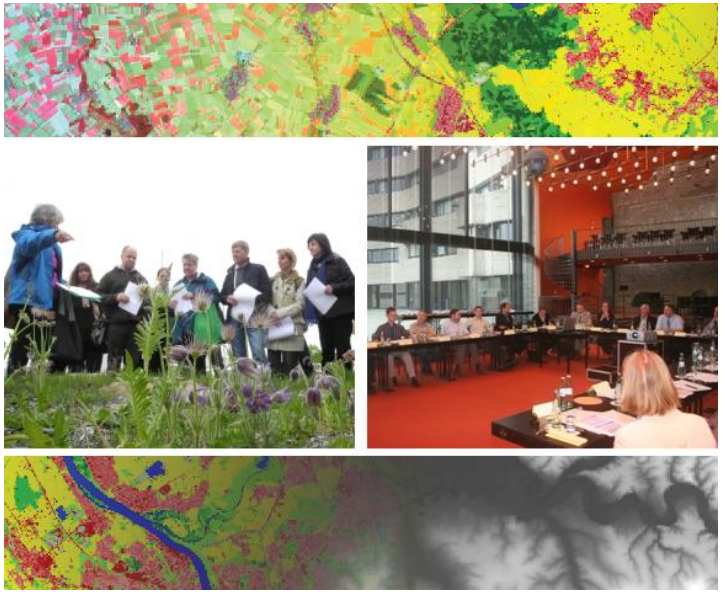
Geographisches Institut GEOmatik Ruhr-Universität Bochum

Simulating Impacts of Regional Planning on Land Consumption Patterns

using an Automated Retrospective Classification Approach and a Scenario-based Urban Growth Simulation Model in Western Germany from 1985-2030

Andreas Rienow, Lakshmi N. Kantakumar, Gohar Ghazaryan, Arne Dröge-Rothaar, Sarah Sticksel, Birte Trampnau, Frank Thonfeld
Geographisches Institut, Ruhr-Universität Bochum
andreas.rienow@rub.de

1. Monitoring of land consumption 1985-2020 based on automated retrospective classification
2. **Provision of data for local authority stakeholders**
3. Propaedeutic training of action taking for climate adaptation (young adults)
4. **Scenario-based, spatially explicit simulation of urban growth 2030**



Study area

- North Rhine-Wes

Data preprocessin

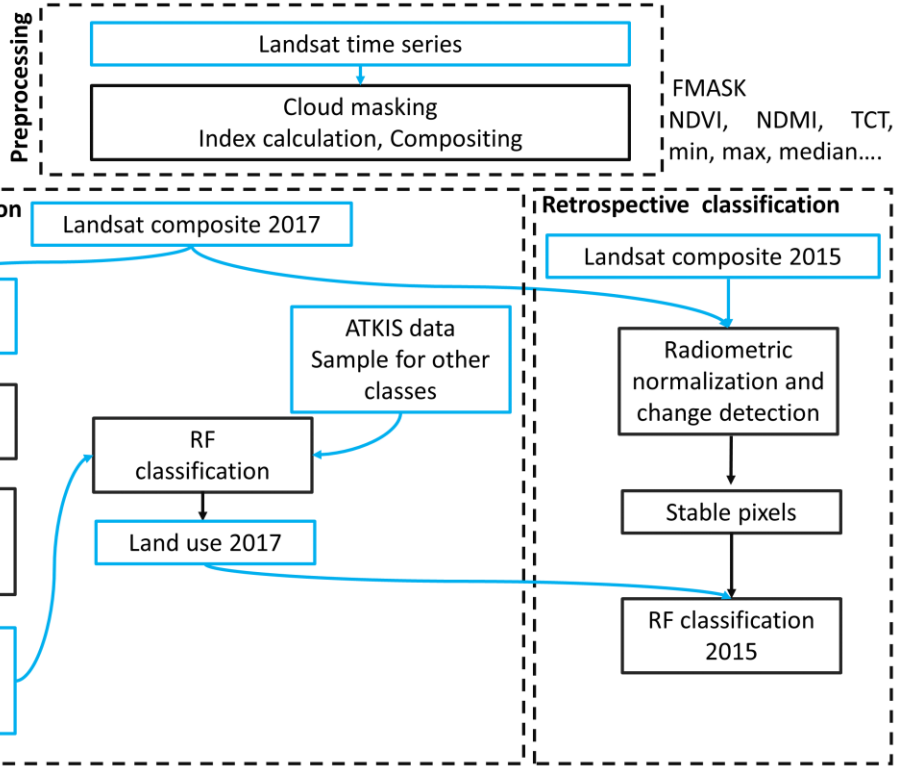
- Landsat cloud ma
- mosaicking
- index calculation
- calculation of ten

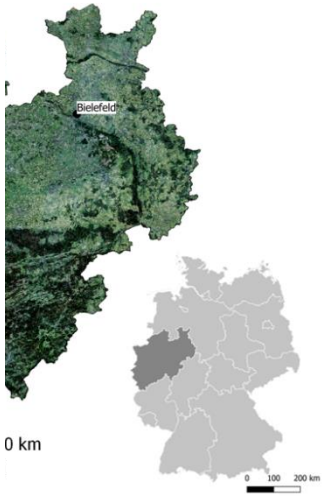
Estimation of impe

- random forest (R
  Topographic-Car

Land use classifica

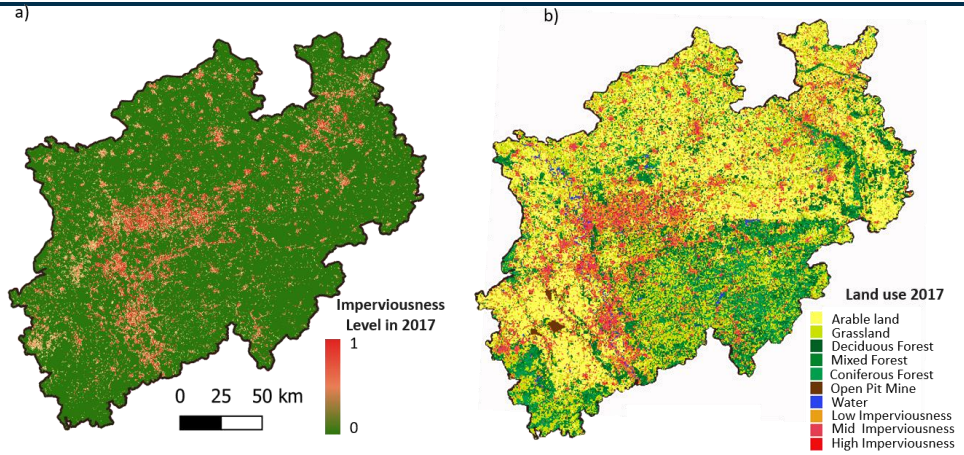
- RF classification (5
  composites
- Input for 2017 – S
- Input for former y





Ghazaryan et al. (2021)

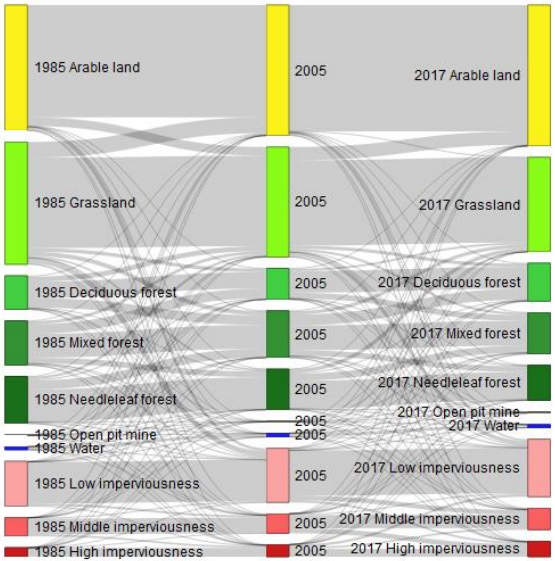
Classification Results 2017



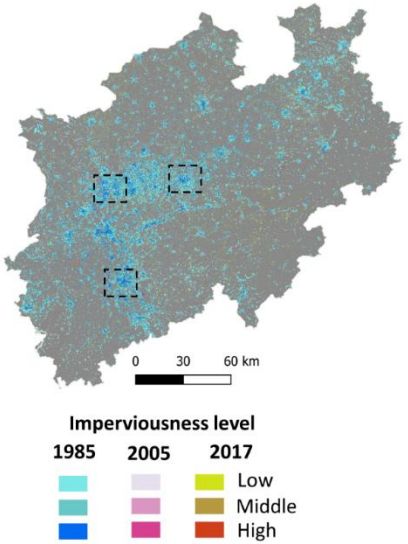
Year	OA	PA for Low, Middle, and High Imperviousness Class	UA for Low, Middle, and High Imperviousness Class	Accuracies for Aggregated Urban Area		Accuracies for Aggregated Non-Urban Areas	
				PA	UA	PA	UA
2017	89.0%	89.3 90.5 94.4	89.4 90.5 94.4	96.3	93.04	92.7	96.2
2015	87.0%	77.9 93.9 90.1	81.5 90.7 90.1	94.6	91.3	90.9	94.7
2010	80.0%	62.9 77.9 90.5	69.3 83.2 87.5	93.1	90.7	91.2	92.3
2005	79.1%	82.9 76.2 89.9	78.2 92.4 82.6	94.8	92.1	94.6	96.7
2000	80.2%	63.1 78.1 90.2	69.1 83.5 87.8	93.1	96	96.2	93.3
1990	75.3%	54.9 67.6 90.1	65.1 79.7 80.8	91.3	95.8	95.8	91.4
1985	77.3%	61.1 69.8 87.4	74.5 75.7 82.9	87.7	95.9	96.1	88.3

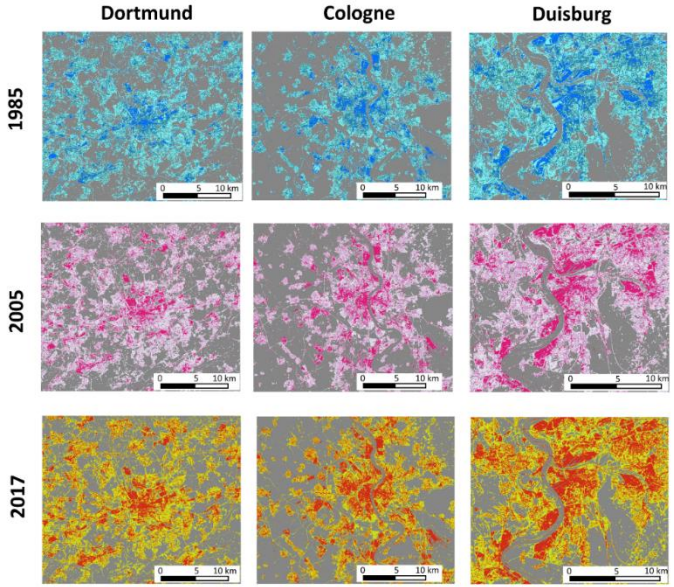
Ghazaryan et al. (2021)

Ghazaryan et al. (2021)



Sankey plot for land-use changes observed

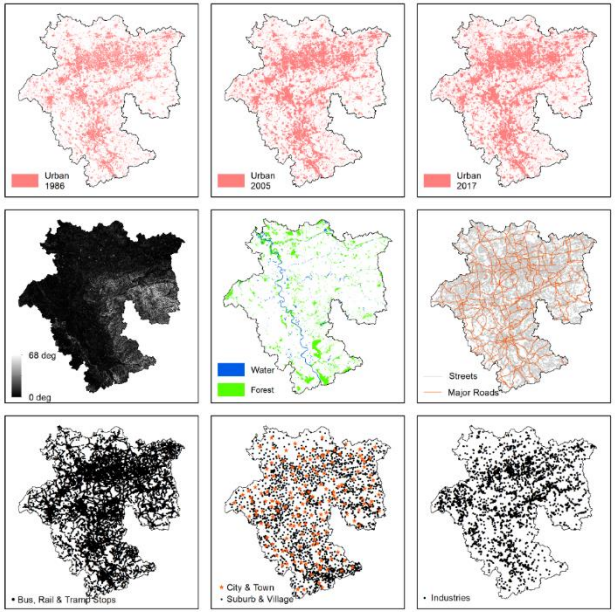




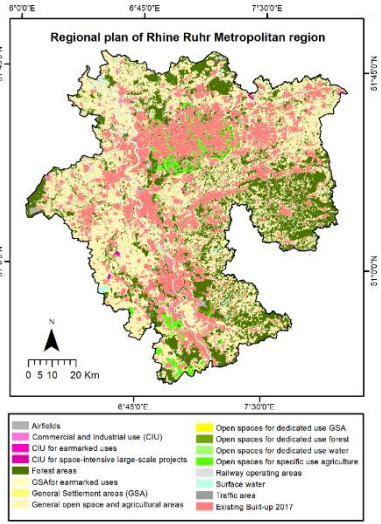
Changes in imperviousness level

SUSM: a scenario-based urban growth simulation model using remote sensing data

1. **Input data module** processes the user-supplied data, urban extent maps, digital elevation maps and transportation networks
2. **Scenario development module** facilitates the development of future urban development scenarios
3. **Transition potential module** estimates the suitability of non-urban pixel to be transformed into urban by weigthing the site-specific urban growth driving factors
4. **Allocation module** is responsible for estimating area of future urban growth and simulating the urban growth
5. **Validation module** assesses the simulation capability of SUSM



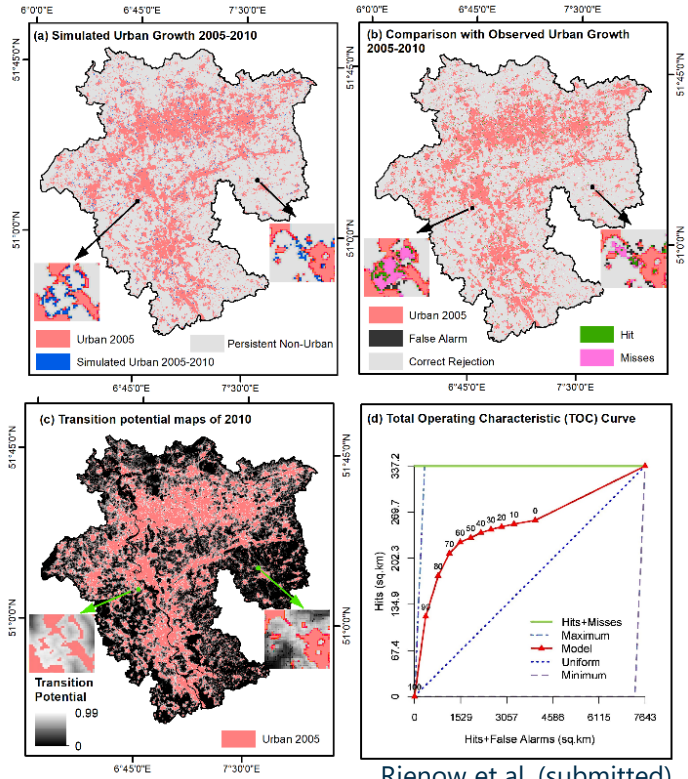
Kantakumar et al. (2019)



Rienow et al. (submitted)

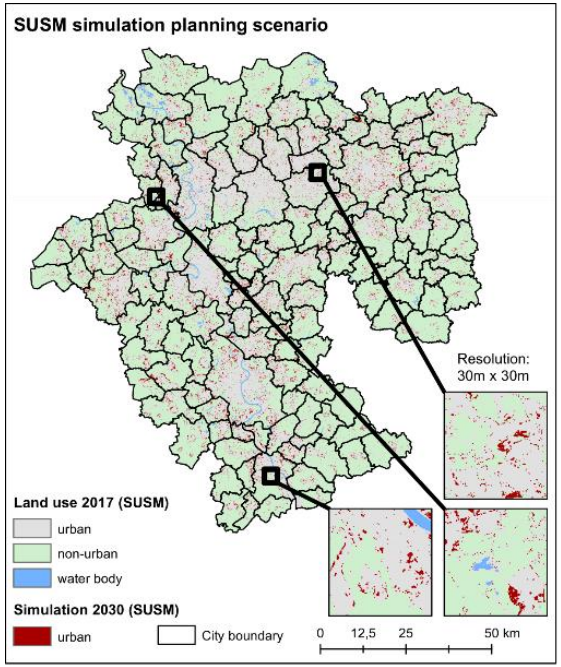
Validation

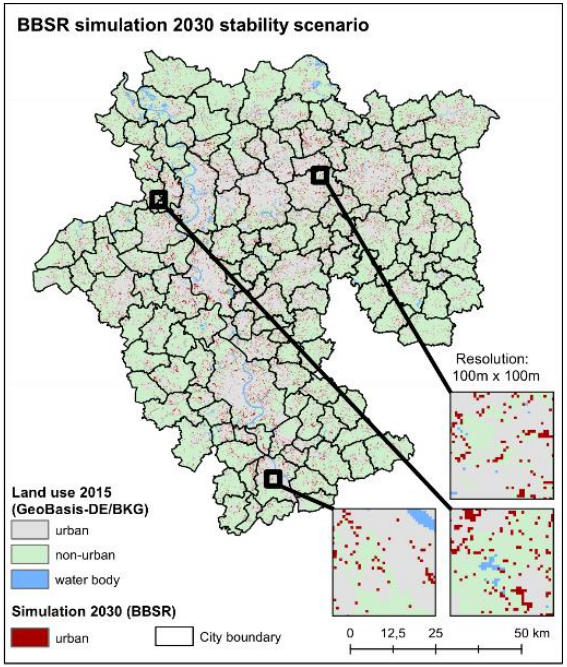
Simulated Urban growth	Observed Urban growth			
	2005-2010		2005-2017	
	Urban	Non-Urban	Urban	Non-Urban
Urban	H = 77.89 km²	FA = 86.31 km²	H = 229.46 km²	FA = 110.08 km²
Non-Urban	M = 86.80 km²	CR = 7392.15 km²	M = 107.70 km²	CR = 7195.91 km²
Validation Metric	**Score**	**95% C.I.**	**Score**	**95% C.I.**
Producer's accuracy (Sensitivity)	47.30%	[36.61%, 57.99%]	68.06%	[59.30%, 76.82%]
User's accuracy (Precision)	47.44%	[39.50%, 55.39%]	67.58%	[62.46%, 72.71%]
Overall accuracy	97.74%	[97.4%, 98.08%]	97.15%	[96.78%, 97.54%]
Specificity (True negative rate)	98.85%	[98.6%, 99.10%]	98.49%	[98.21%, 98.78%]
Matthews correlation coefficient	0.46	--	0.66	--
Figure of fit	0.31	--	0.51	--
AUC	0.76		0.84	

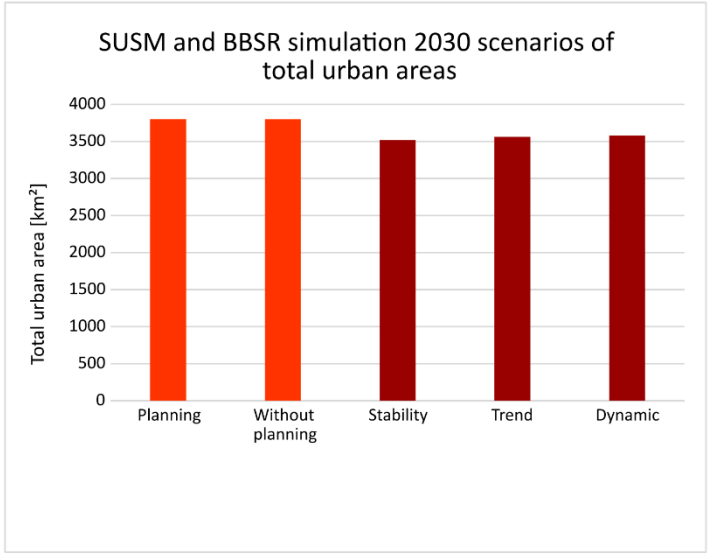


Rienow et al. (submitted)

SUSM and BBSR comparison





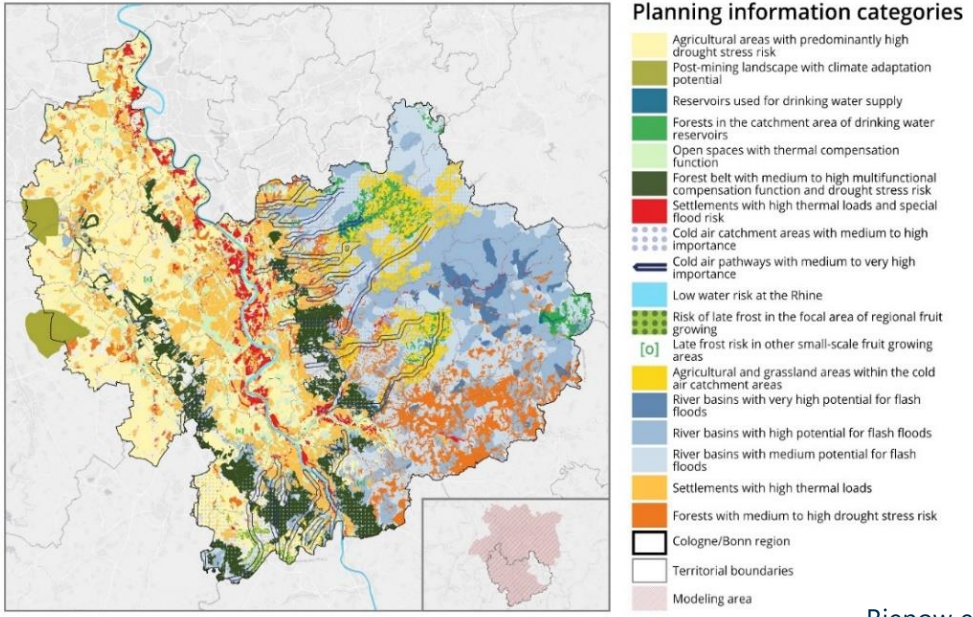


Rienow et al. (submitted)

Climate Change Prevention Strategy

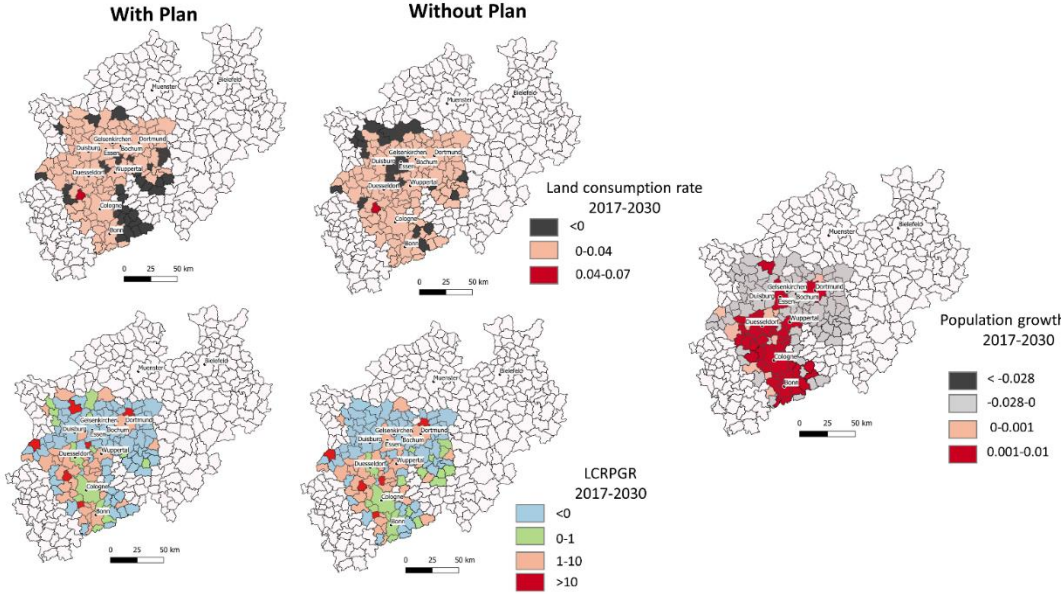
Planning Information map: Climate change prevention strategy

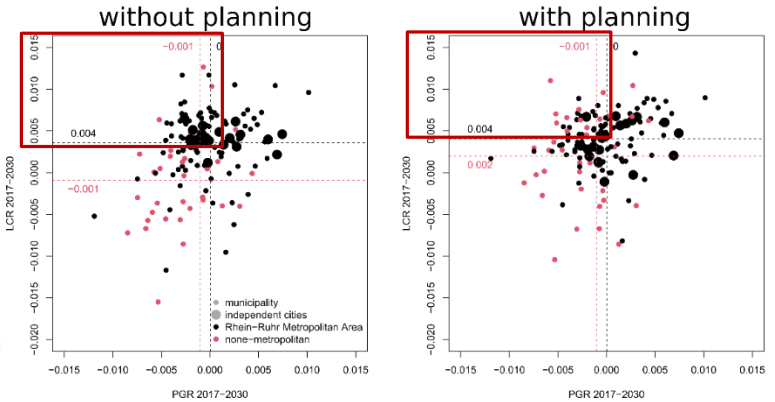
Rhine-Ruhr metropolitan region: Rhine Area



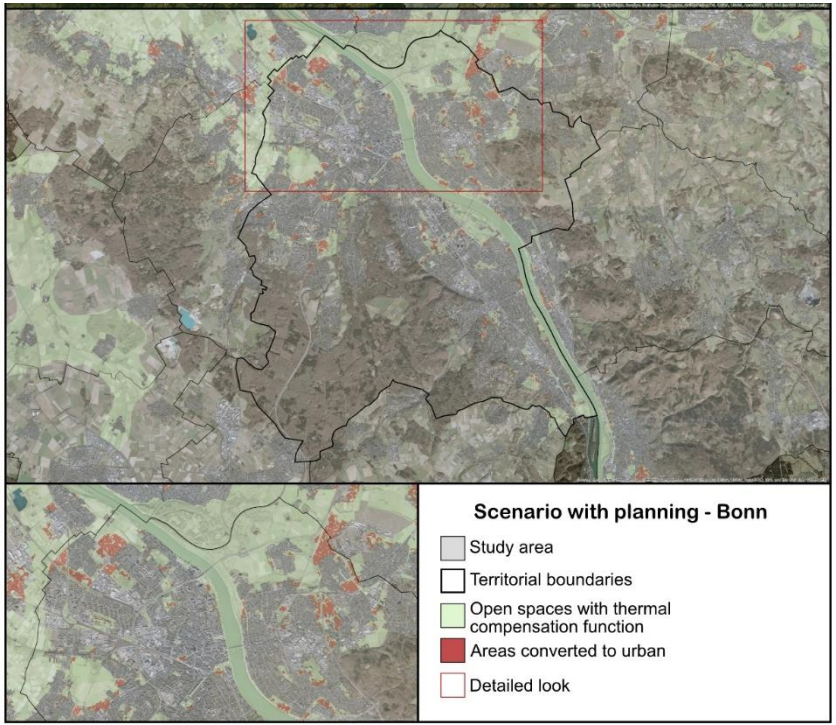
Rienow et al. (submitted)

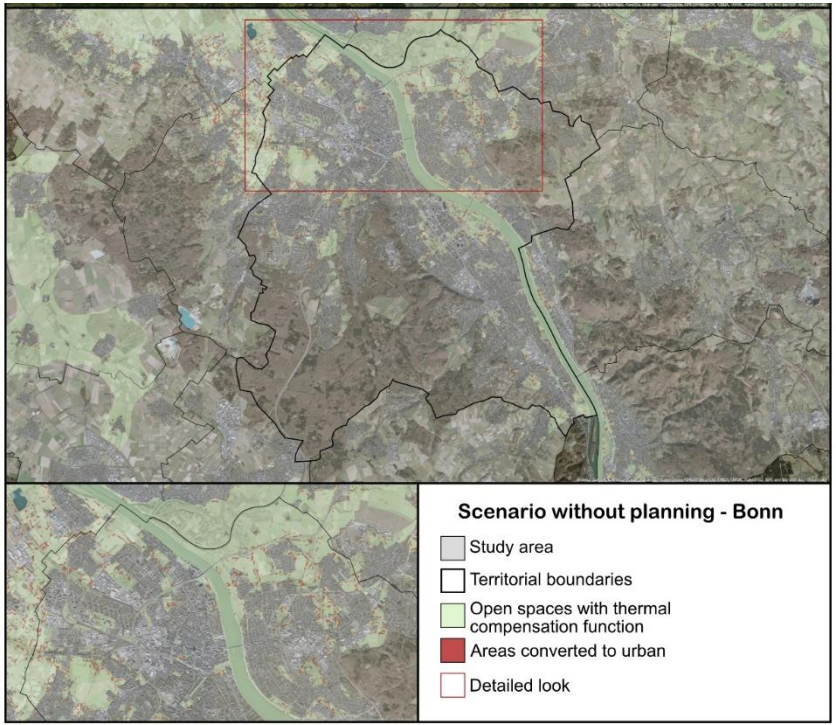
Future land consumption compared to population growth





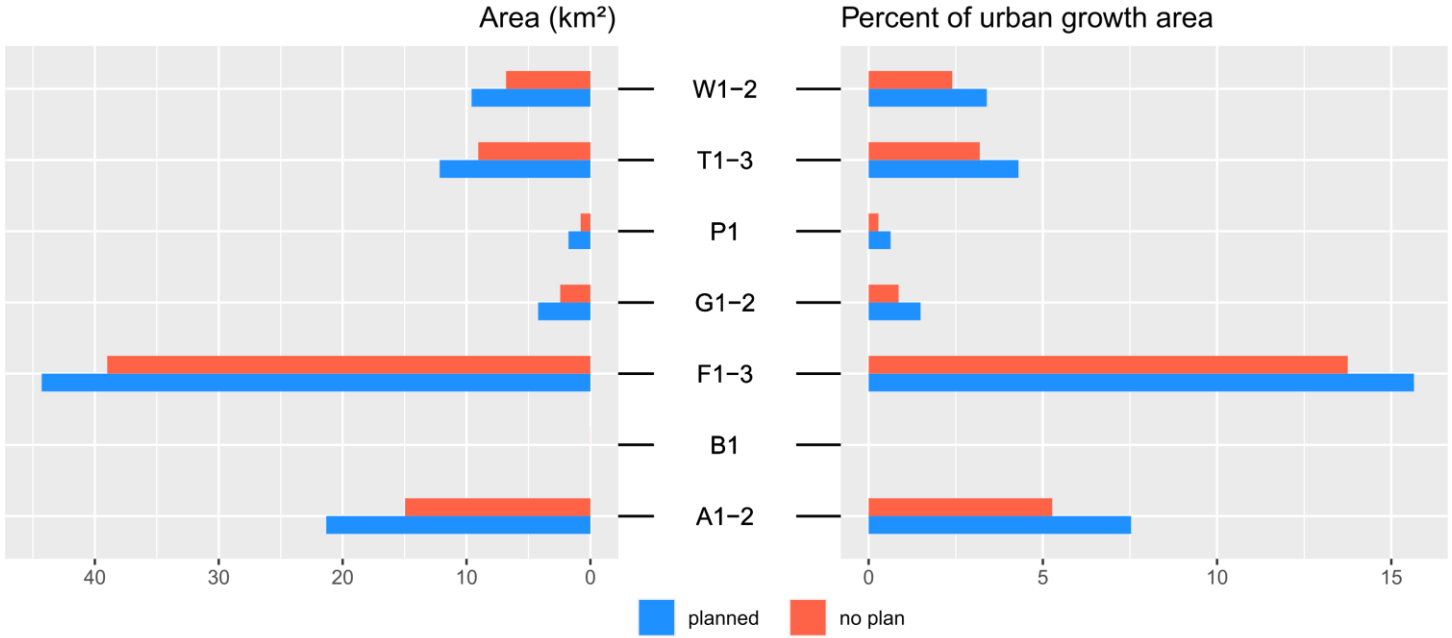
Rienow, A., Kantakumar, L.N.,Ghazaryan, G., Dröge-Rothaar, A., Sticksel, S., Trampnau, B., Thonfeld, F. (submitted): Modelling the spatial impact of regional planning and climate change prevention strategies on land consumption in the Rhine-Ruhr Metropolitan Area 2017-2030. Landscape and Urban Planning.





Rienow et al. (submitted)

Urban growth in climate change prevention strategy categories 2030

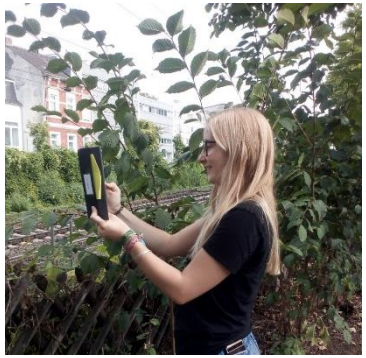


Rienow et al. (submitted)

Crowd mapping of climate change adaptation

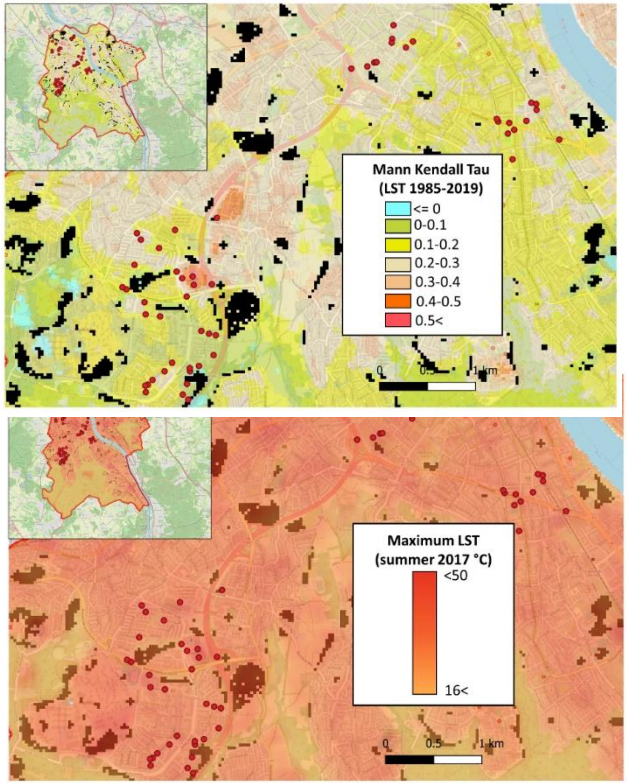
Rienow (submitted)

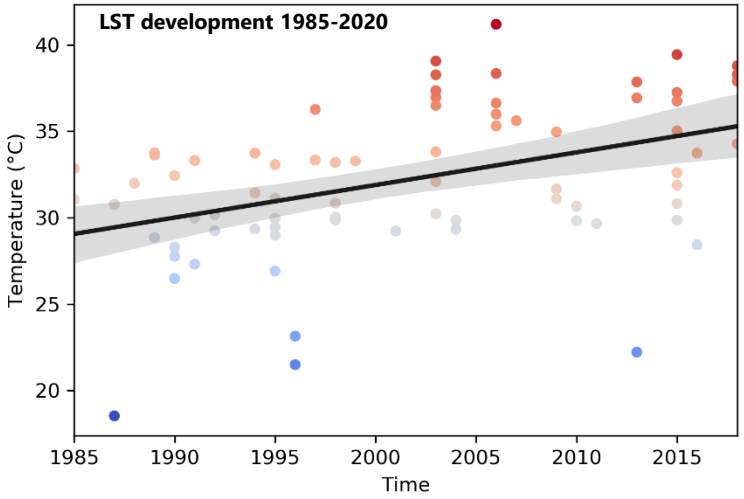
Type	Count
Good Practice Examples	
Water bodies	6
Trees	72
Meadows	40
Vertical green	32
Reduced traffic	3
Green island	19
Other	27
Need for Action	
Too hot	61
Too sunny	26
Too dry	33
Too wet	4
Too stuffy	6
Other	19
Ideas	
Suggestions	42



} e.g. solar panels, green roof, „Grüne Insel“, trees, wild flower meadow

Urban growth 2030, LST development and crowd mapped thermal stress

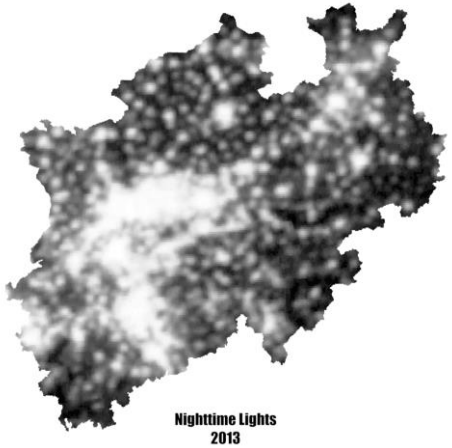




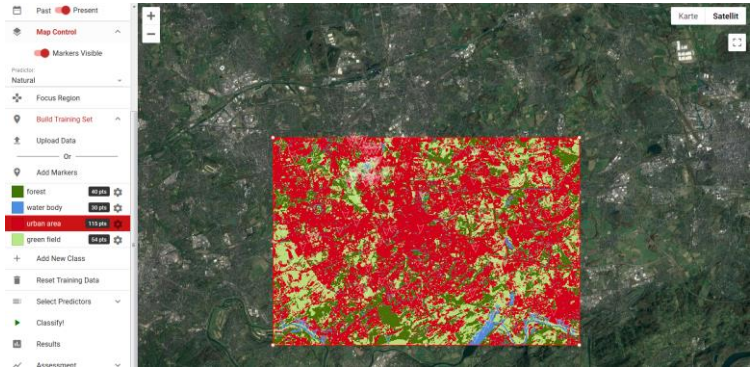
Rienow et al. (submitted)

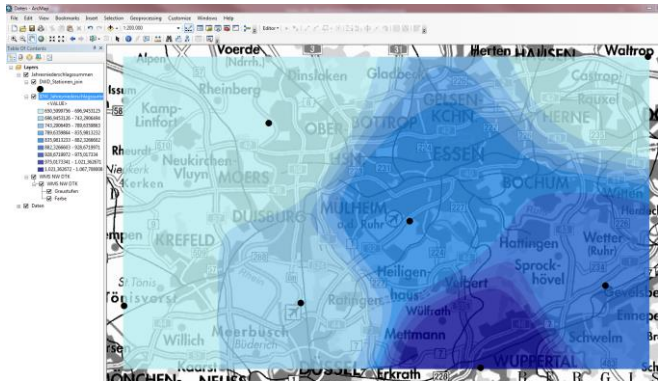
What's next?

- Organisation of exchange events between authorities and citizens
- Implementation of the full framework in GEE
- Model optimisation & integration of additional datasets (e.g. Nighttime Lights)
- Combine with socio-economic data in regard to investigate climate justice



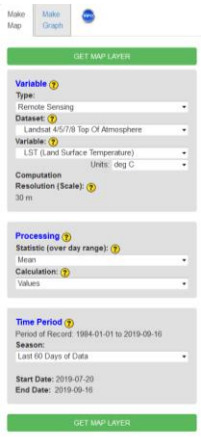
Thank you very much!

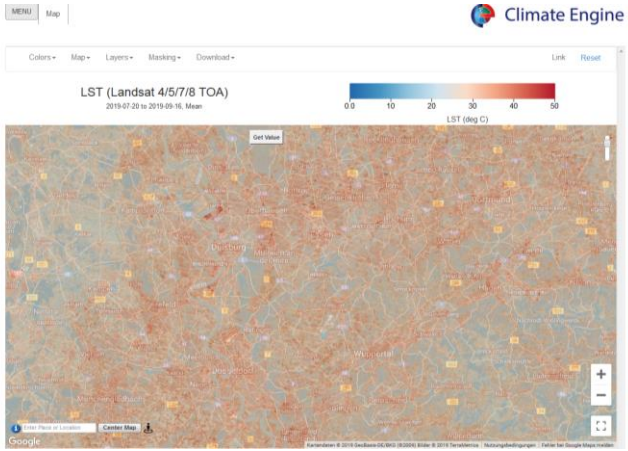




Mobilization of Cit(ies)zens – Educating "In-Betweeners"

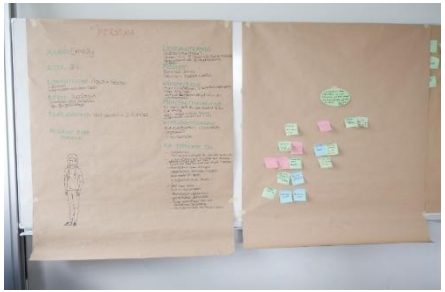
Classification (Remap), Interpolation of precipitation (ArcGIS), surface temperature measurement (Climate Engine), Urban LUCC Modeling (XULU/ SLEUTH)



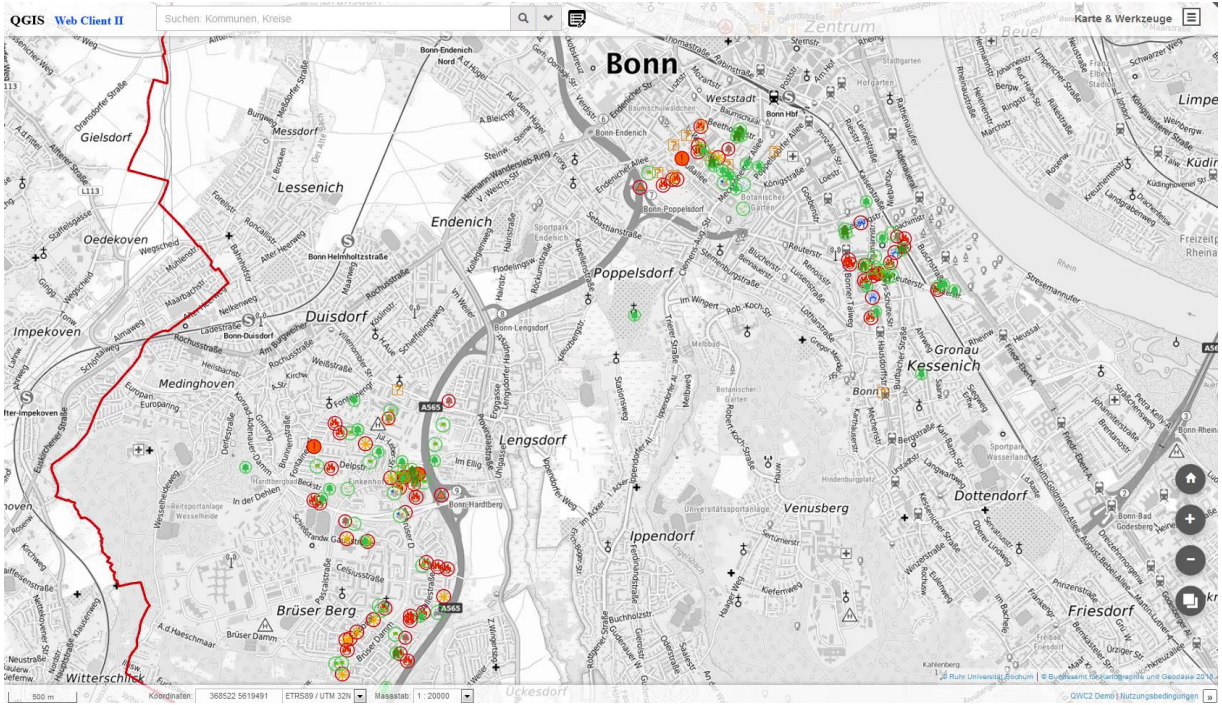


Mobilization of Cit(ies)zens – Educating “In-Betweeners”

Field trip, design-thinking-method, creating a sustainable city



WILA Bonn e.V., (Eds.) (2020): Handlungsleitfaden. Bonn. http://klimalandschaften-nrw.de/images/Leitfaden_Gute_Ideen_gegen_den_Klimawandel_KLIMNET_web.pdf


QGIS Web Client II
Suchen: Kommunen, Kreise
Karte & Werkzeuge
Bonn
Zentrum
Beuel
Gielsdorf
Messdorf
Lessenich
Endenich
Oedekoven
Impekoven
Duisdorf
Medinghoven
Poppelsdorf
Weststadt
Lengsdorf
Gronau
Kessenich
Venusberg
Dottendorf
Ippendorf
Friesdorf
Brüser Berg
Witterschlick
Uckesdorf
500 m
Koordinaten: 368522 5619491
ETRS89 / UTM 32N
Massstab: 1 : 20000
QWC2 Demo | Nutzungsbedingungen