Stadtklima und Stadtvegetation

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Klimaschutz

lokale Emittenten

↓ (Treibhauseffekt)

globale Wirkung

↓

Klimatologie

⟷

Klimaanpassung

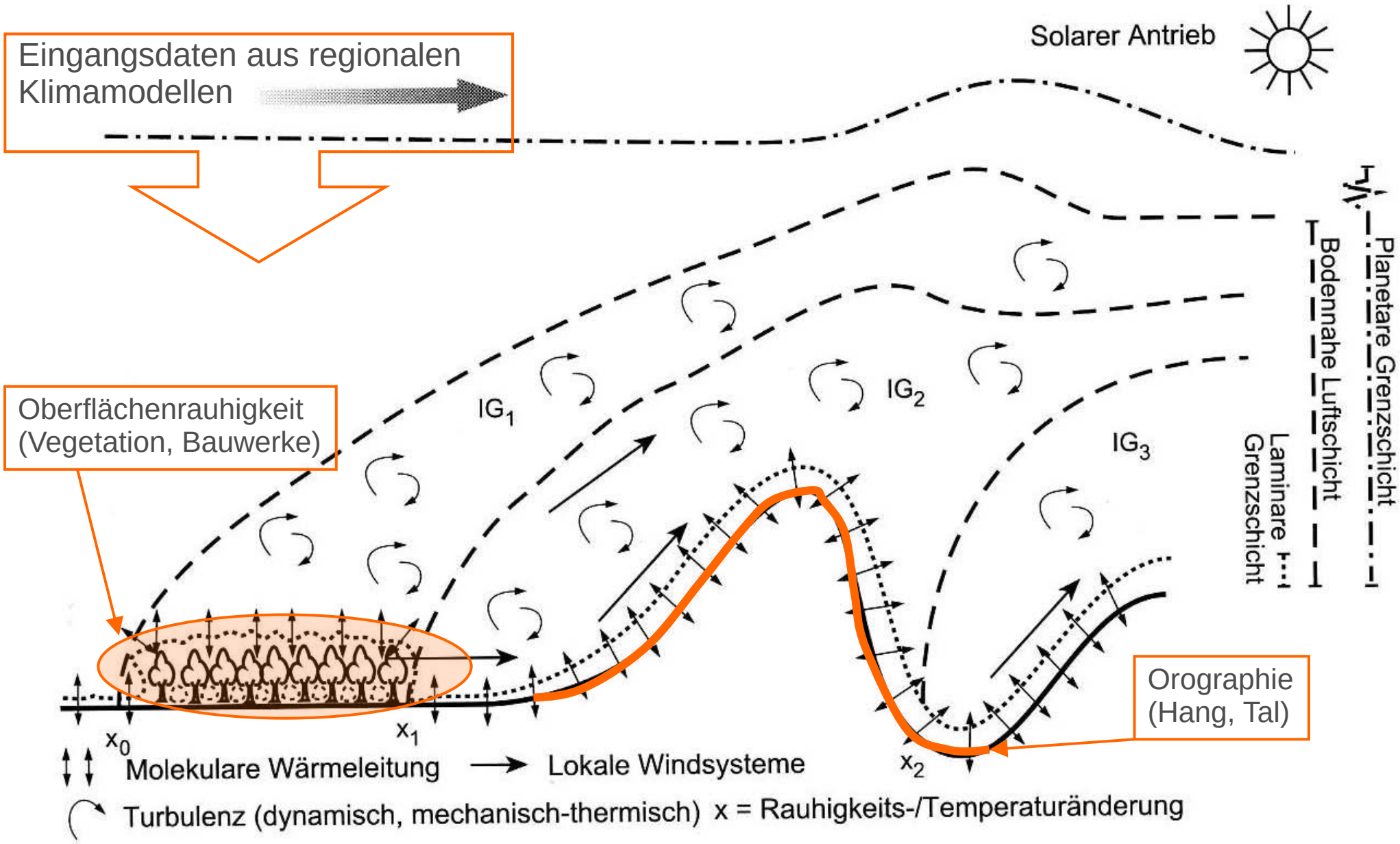
globaler Wandel

↓

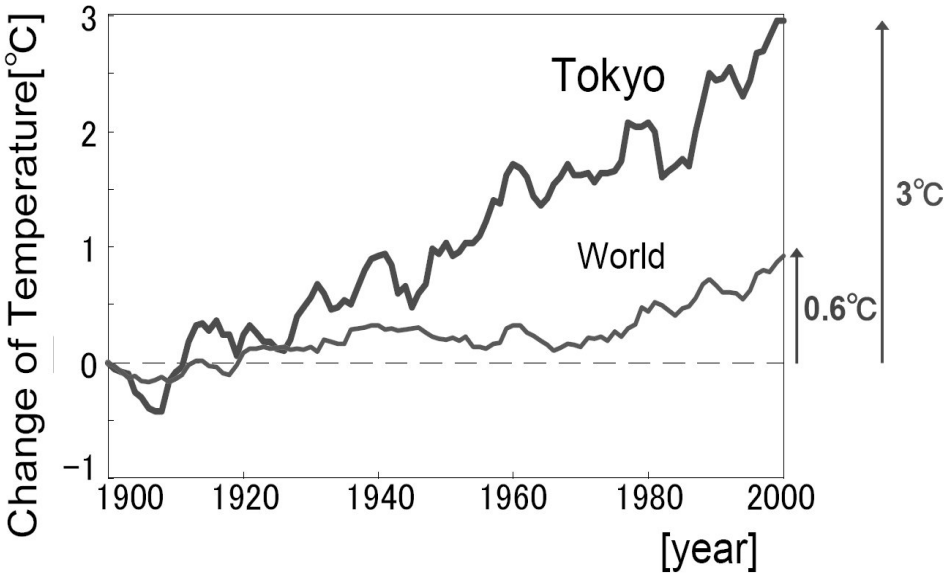
regionale Wirkung

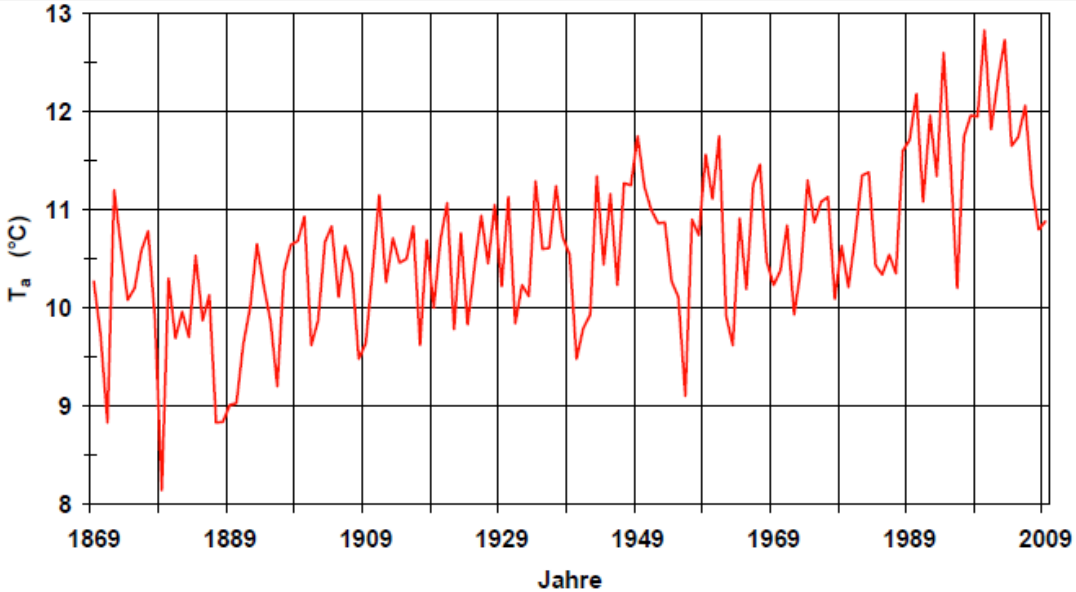
↓

Klimafunktionen
Stadtklima

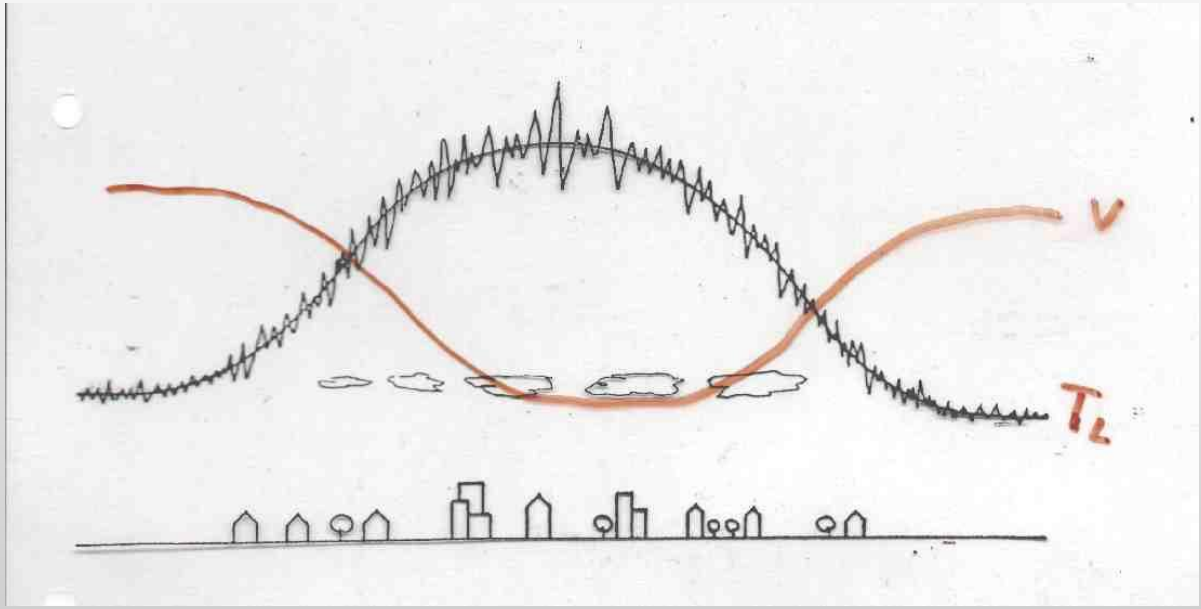

Eingangsdaten aus regionalen Klimamodellen
Solarer Antrieb
Planetare Grenzschicht
Bodennahe Luftschicht
Laminare Grenzschicht
IG1
IG2
IG3
Oberflächenrauhigkeit (Vegetation, Bauwerke)
Orographie (Hang, Tal)
x0
x1
x2
Molekulare Wärmeleitung
Lokale Windsysteme
Turbulenz (dynamisch, mechanisch-thermisch)
x = Rauhigkeits-/Temperaturänderung

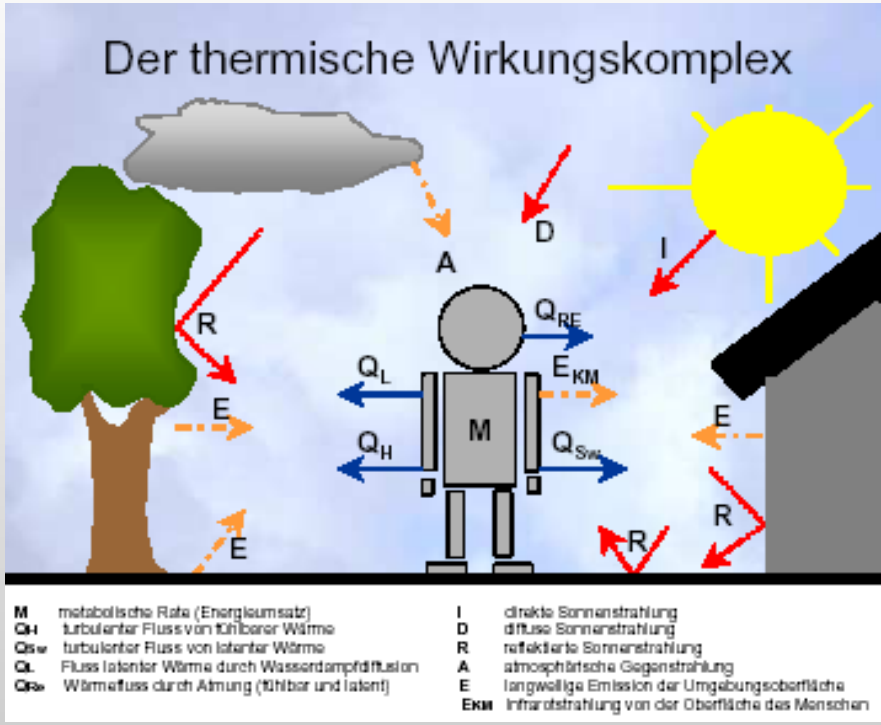
Stadteinfluss und Klimawandel (Lufttemperaturen) Tokyo; Freiburg



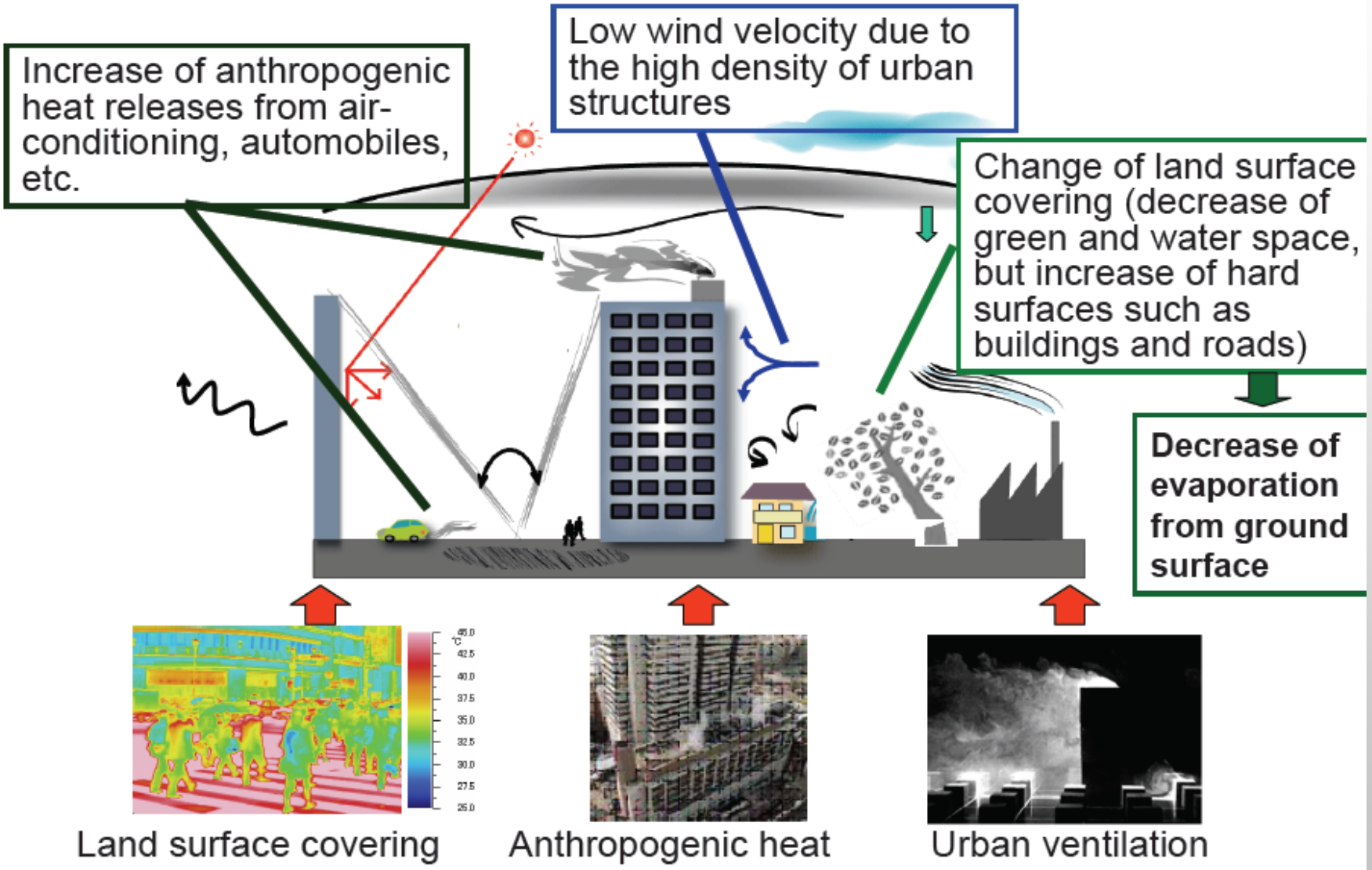


Stadtklima und Mensch

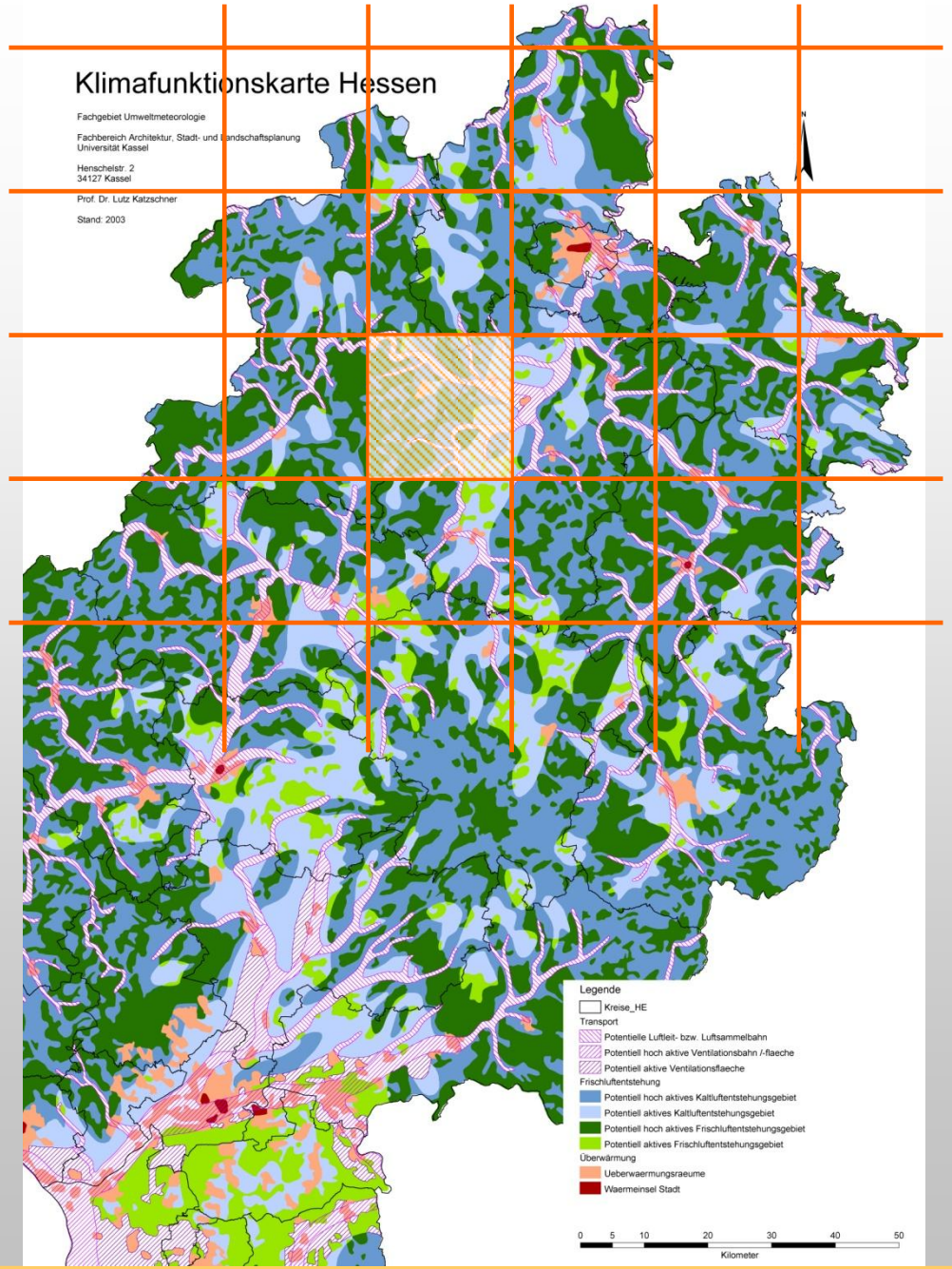




Causes of the urban heat island (Ashie)



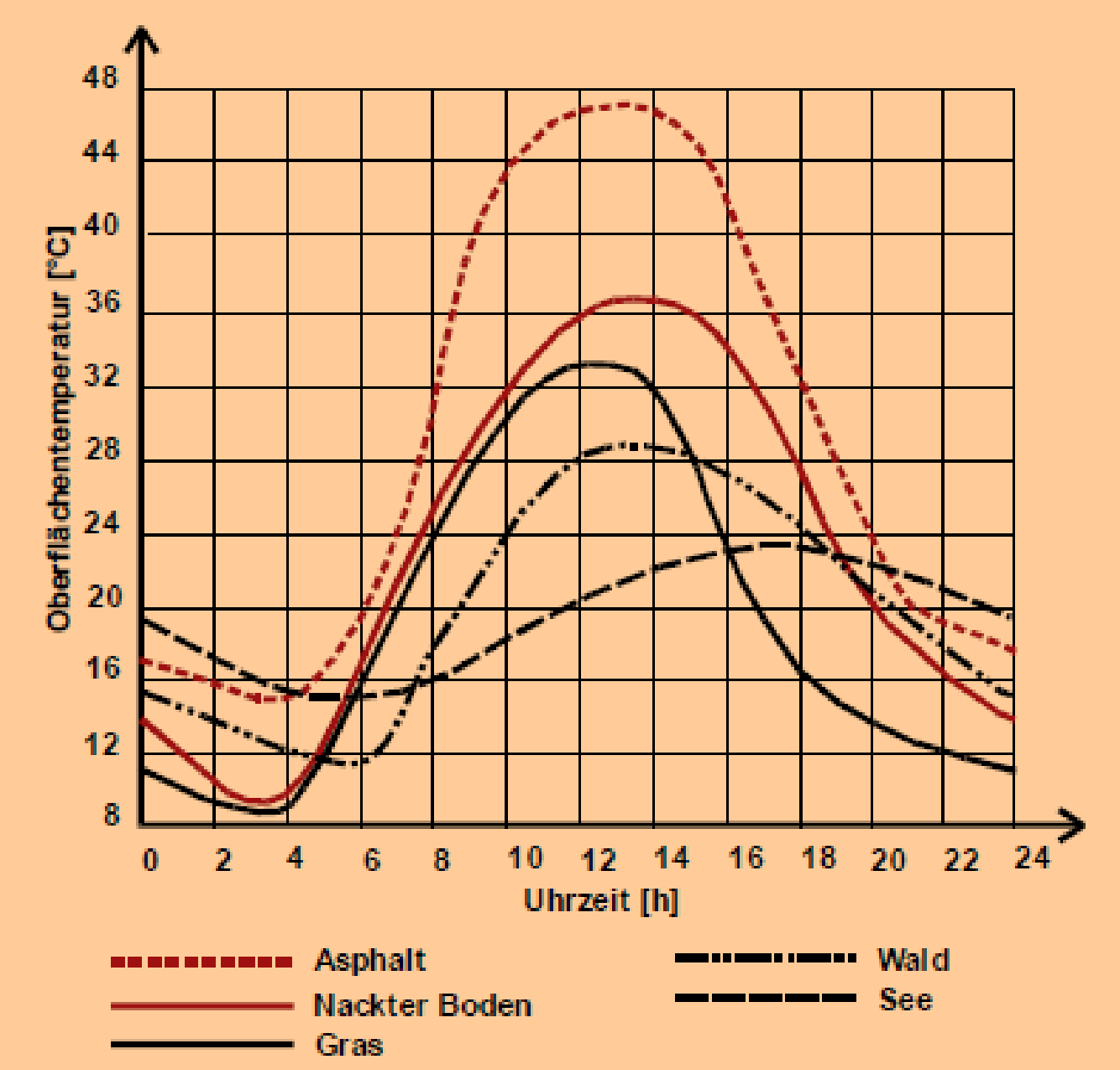
Detaillierte Darstellung



1 Zelle = 20km x 20km

Benötigten Informationen:

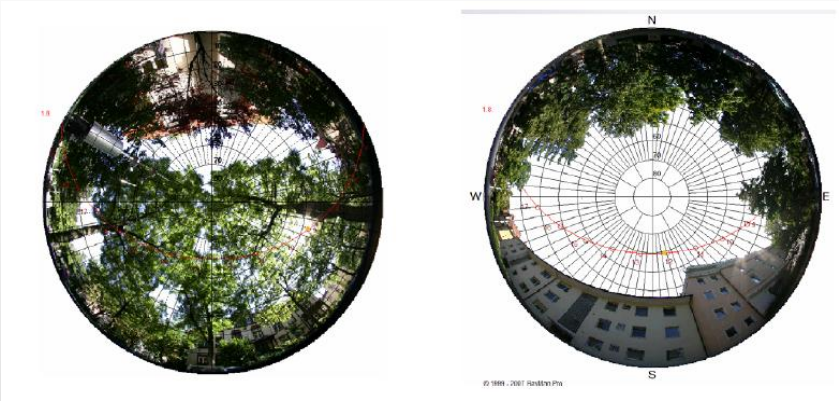
- Topographie
- Hangneigung
- Flächennutzung
- Vegetation
- Albedo
- etc…

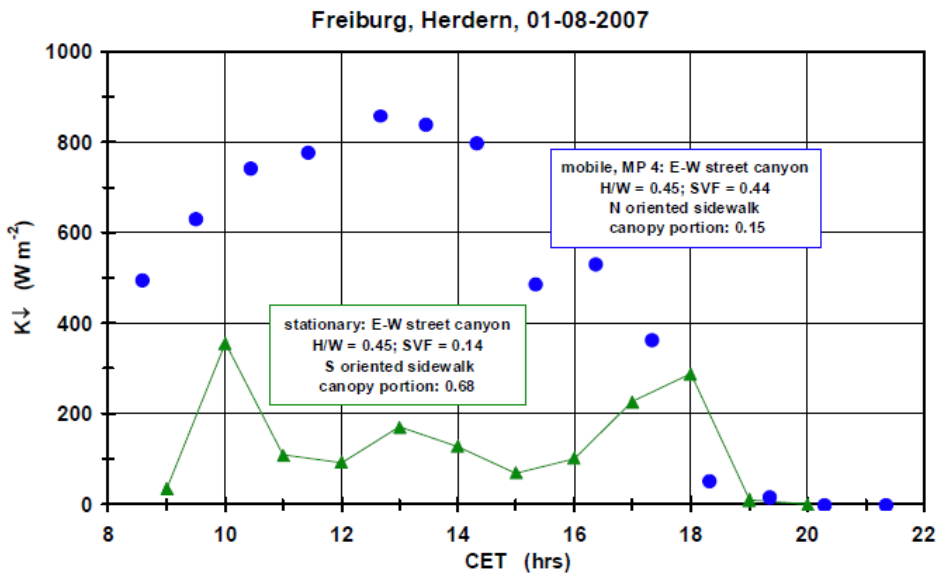

Oberflächentemperatur [°C]
48
44
40
36
32
28
24
20
16
12
8
0
2
4
6
8
10
12
14
16
18
20
22
24
Uhrzeit [h]
Asphalt
Nackter Boden
Gras
Wald
See

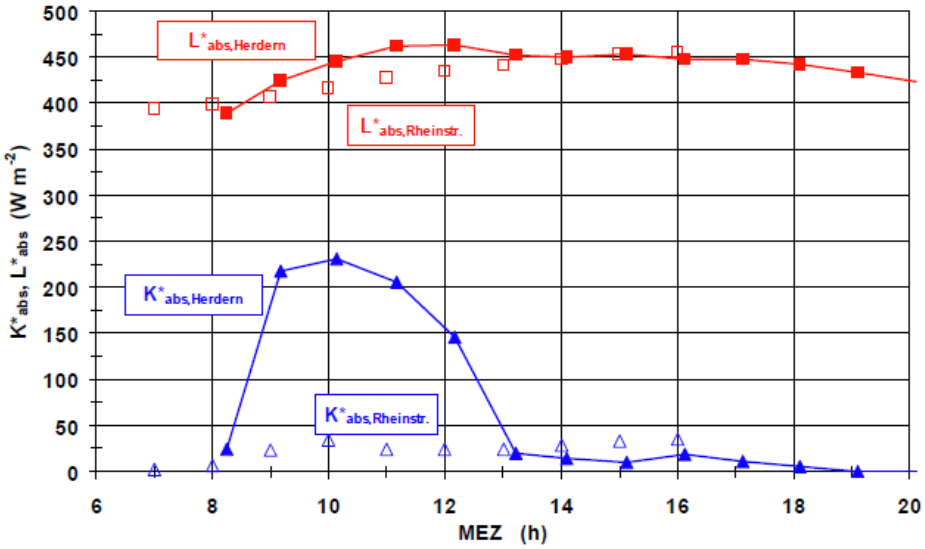
nvestigation area

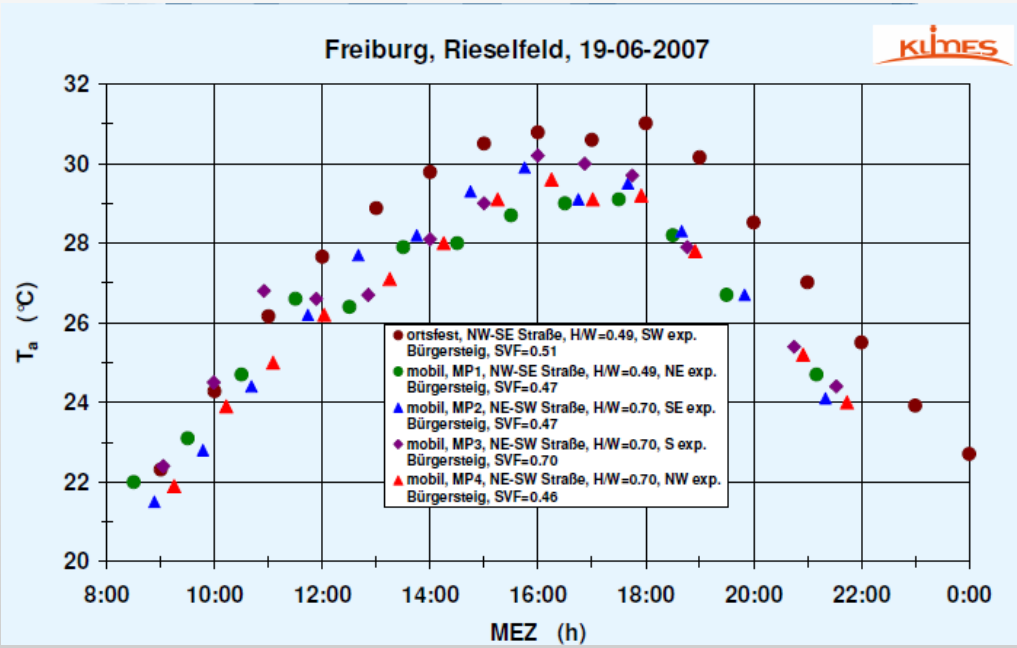
Messung von Strahlungsflüssen und thermischer Behaglichkeit

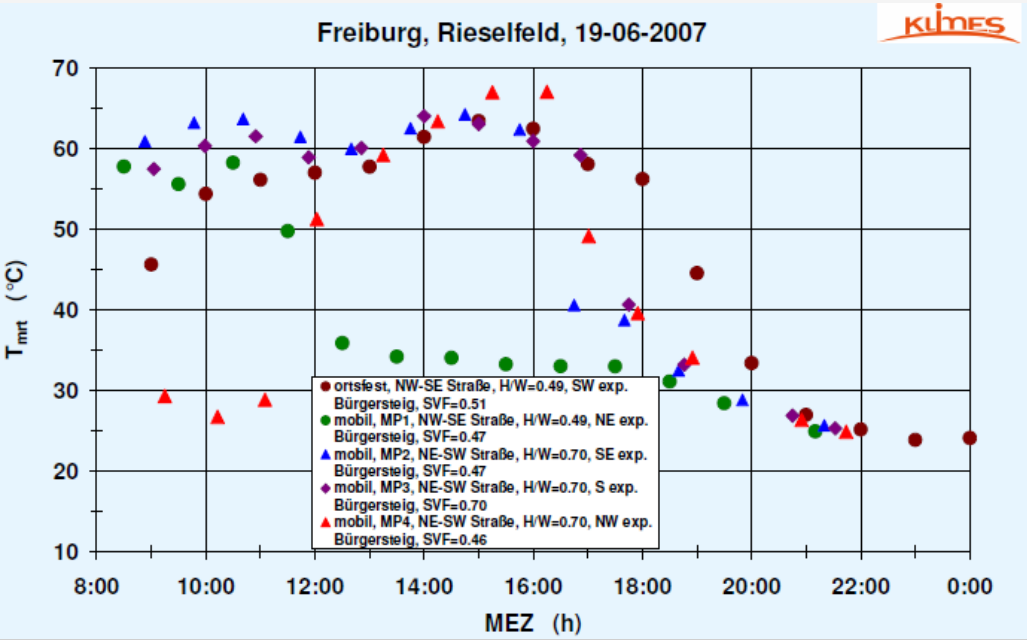
Horizonteinengung durch Baumvegetation und deren Beeinflussung auf Strahlungsflüsse

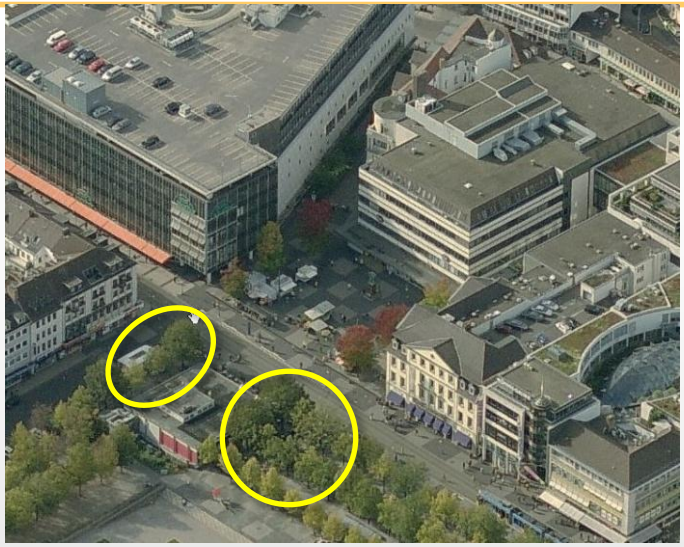


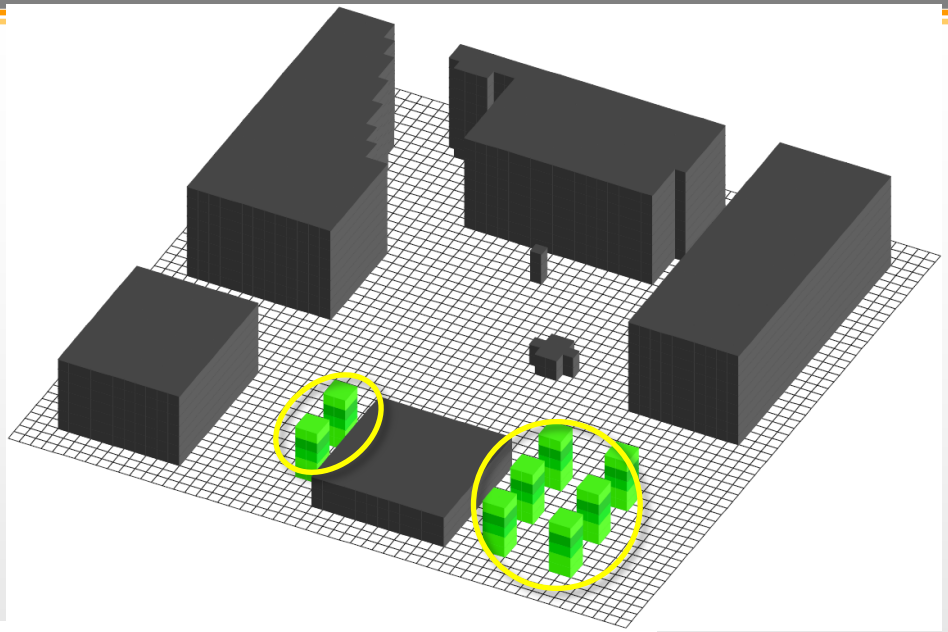


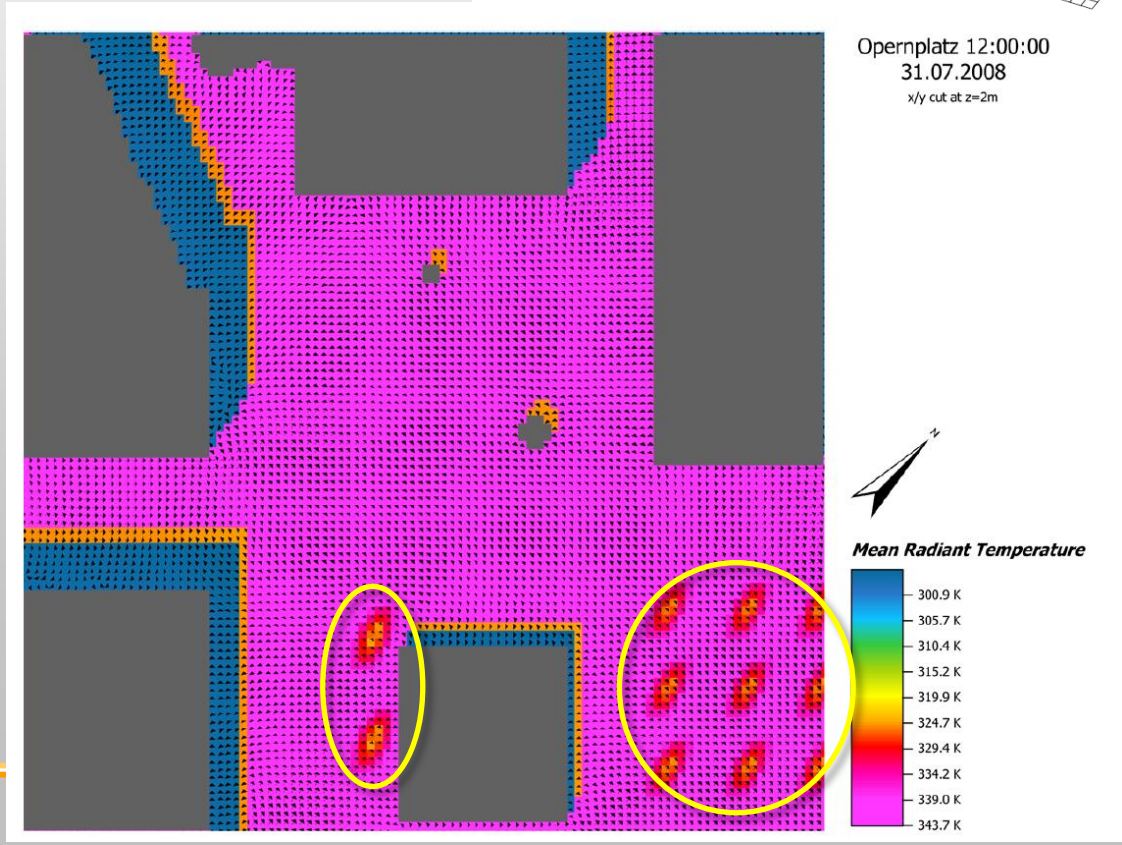


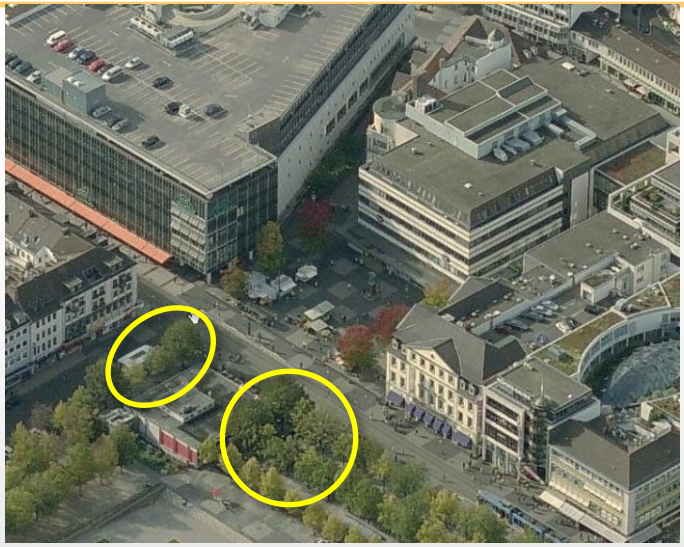

Freiburg, Rieselfeld, 19-06-2007
KLIMES
T_a (°C)
MEZ (h)
ortsfest, NW-SE Straße, H/W=0.49, SW exp. Bürgersteig, SVF=0.51
mobil, MP1, NW-SE Straße, H/W=0.49, NE exp. Bürgersteig, SVF=0.47
mobil, MP2, NE-SW Straße, H/W=0.70, SE exp. Bürgersteig, SVF=0.47
mobil, MP3, NE-SW Straße, H/W=0.70, S exp. Bürgersteig, SVF=0.70
mobil, MP4, NE-SW Straße, H/W=0.70, NW exp. Bürgersteig, SVF=0.46

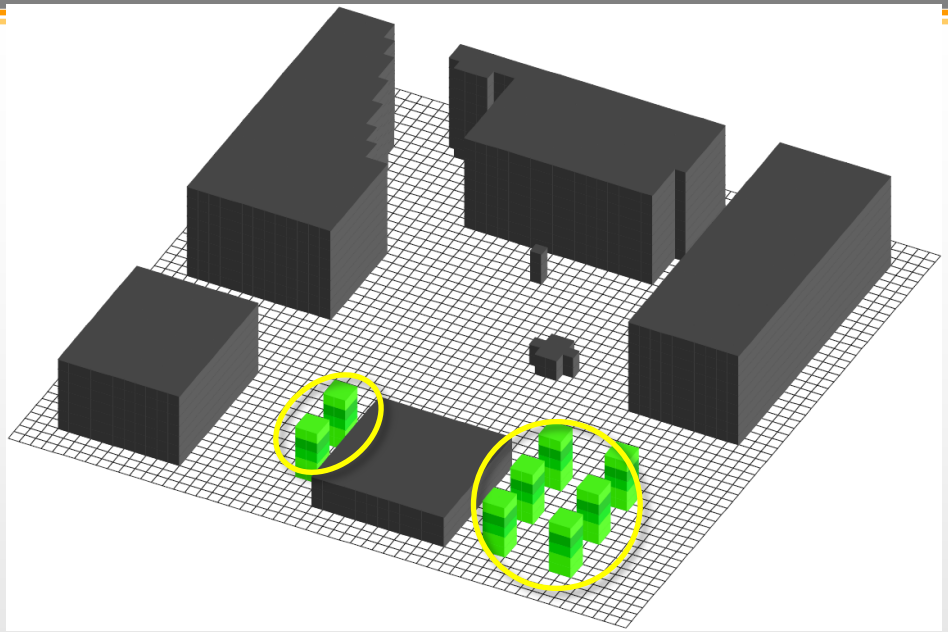

Freiburg, Rieselfeld, 19-06-2007
KLIMES
T_{mrt} (°C)
MEZ (h)
ortsfest, NW-SE Straße, H/W=0.49, SW exp. Bürgersteig, SVF=0.51
mobil, MP1, NW-SE Straße, H/W=0.49, NE exp. Bürgersteig, SVF=0.47
mobil, MP2, NE-SW Straße, H/W=0.70, SE exp. Bürgersteig, SVF=0.47
mobil, MP3, NE-SW Straße, H/W=0.70, S exp. Bürgersteig, SVF=0.70
mobil, MP4, NE-SW Straße, H/W=0.70, NW exp. Bürgersteig, SVF=0.46

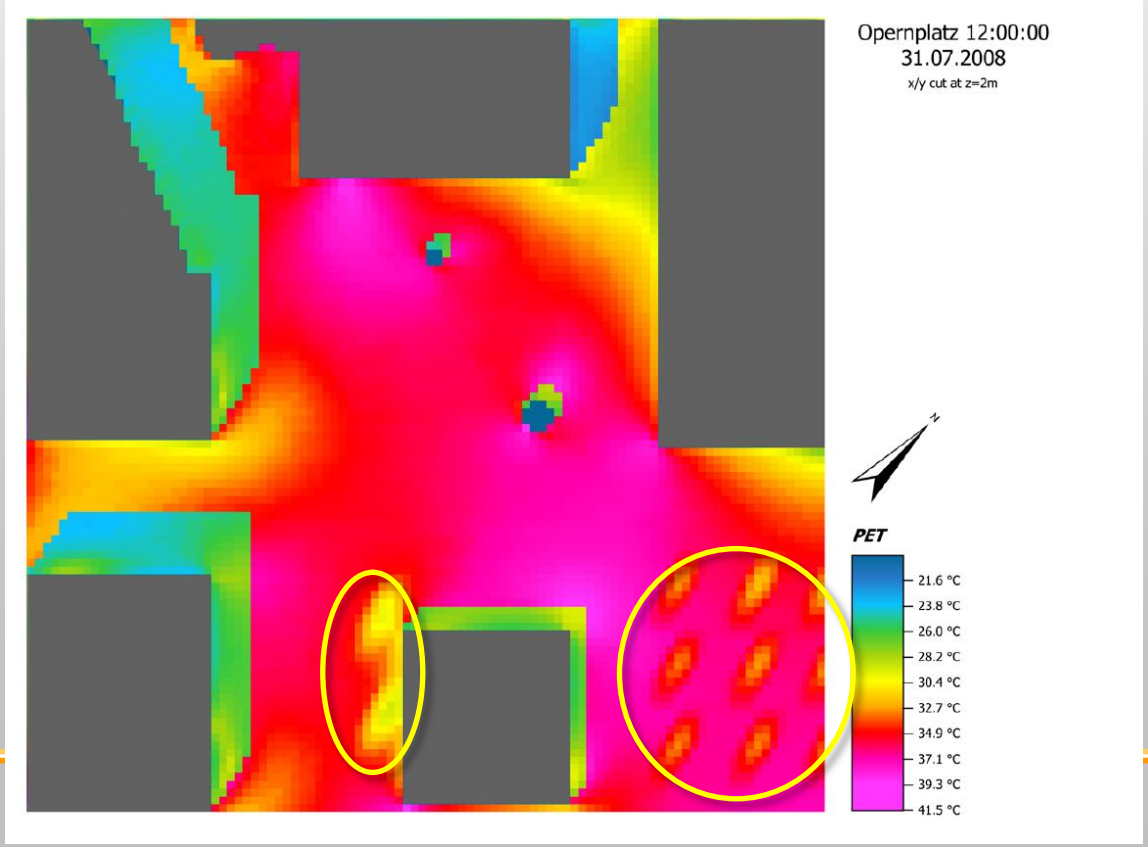


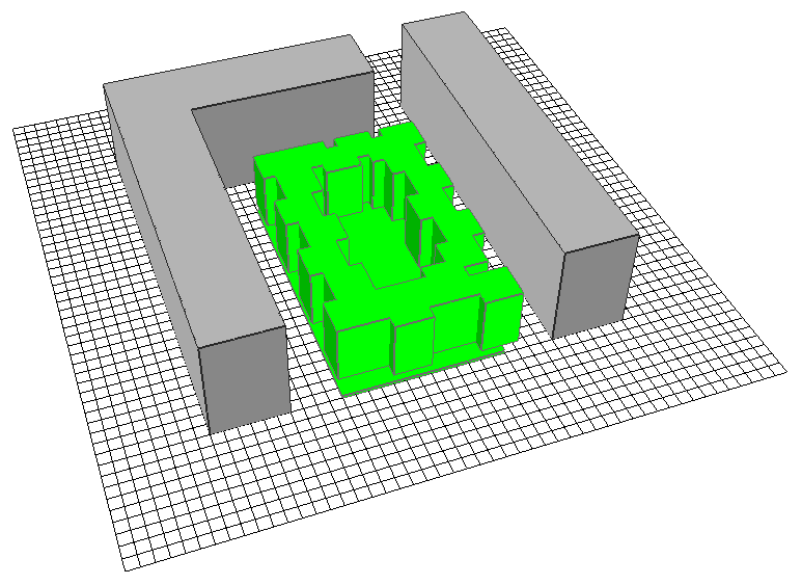


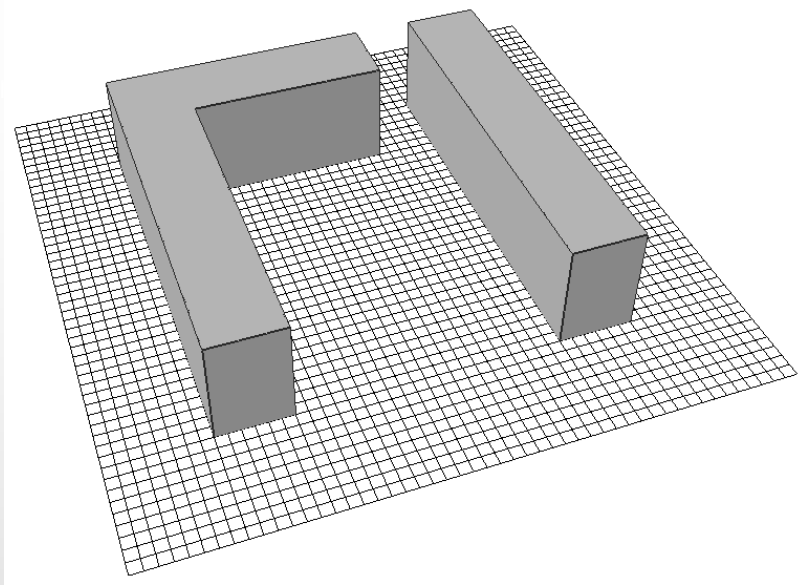

Opernplatz 12:00:00
31.07.2008
x/y cut at z=2m
N
Mean Radiant Temperature
300.9 K
305.7 K
310.4 K
315.2 K
319.9 K
324.7 K
329.4 K
334.2 K
339.0 K
343.7 K

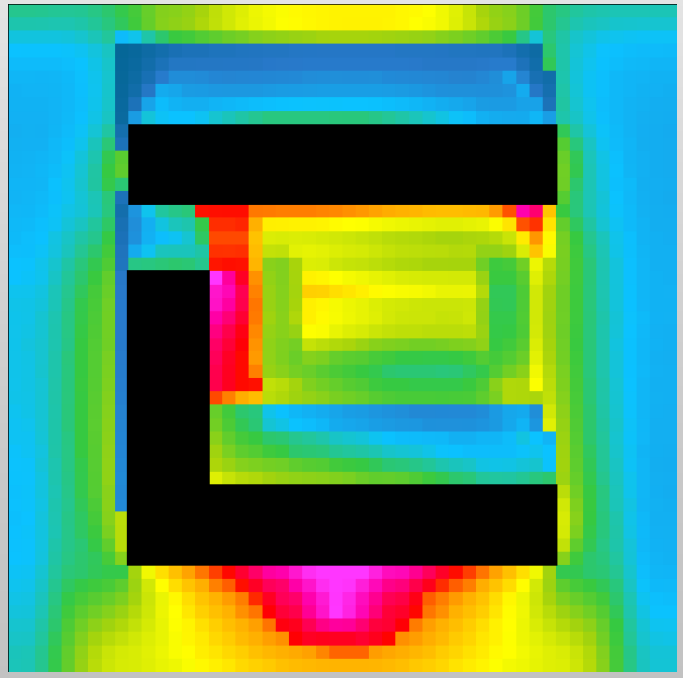


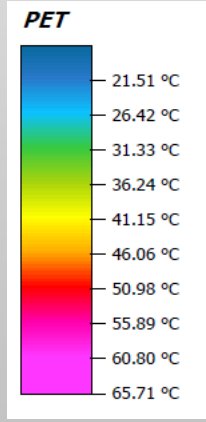


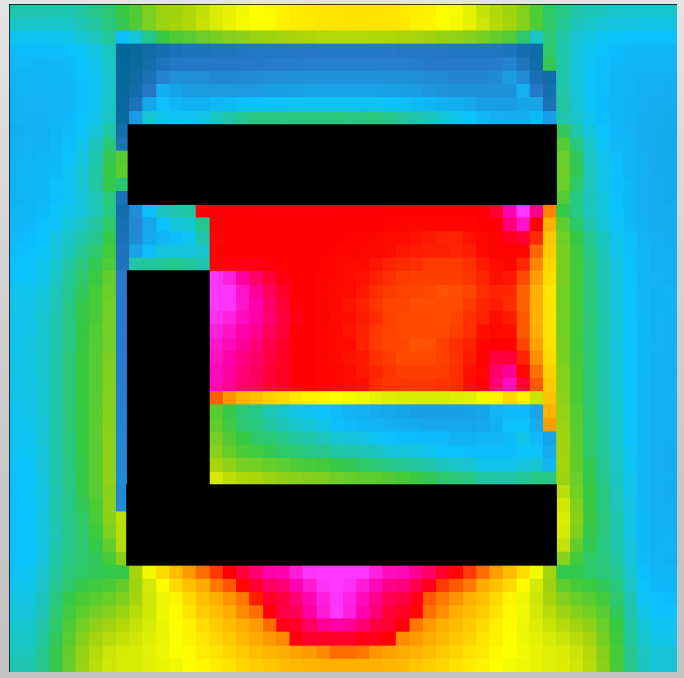

Opernplatz 12:00:00
31.07.2008
x/y cut at z=2m
N
PET
21.6 °C
23.8 °C
26.0 °C
28.2 °C
30.4 °C
32.7 °C
34.9 °C
37.1 °C
39.3 °C
41.5 °C








PET
21.51 °C
26.42 °C
31.33 °C
36.24 °C
41.15 °C
46.06 °C
50.98 °C
55.89 °C
60.80 °C
65.71 °C

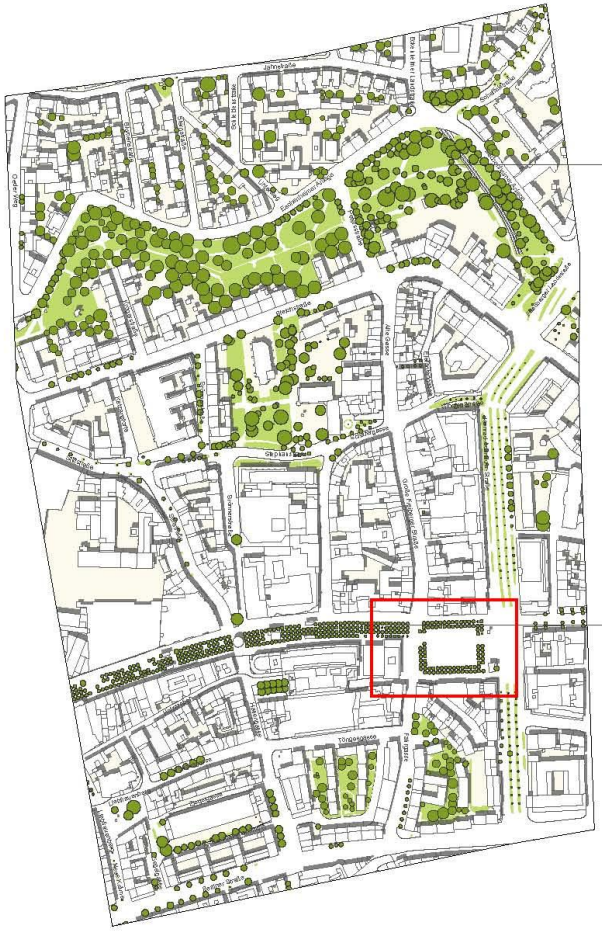


Stadt Frankfurt

Untersuchungsgebiet Innenstadt

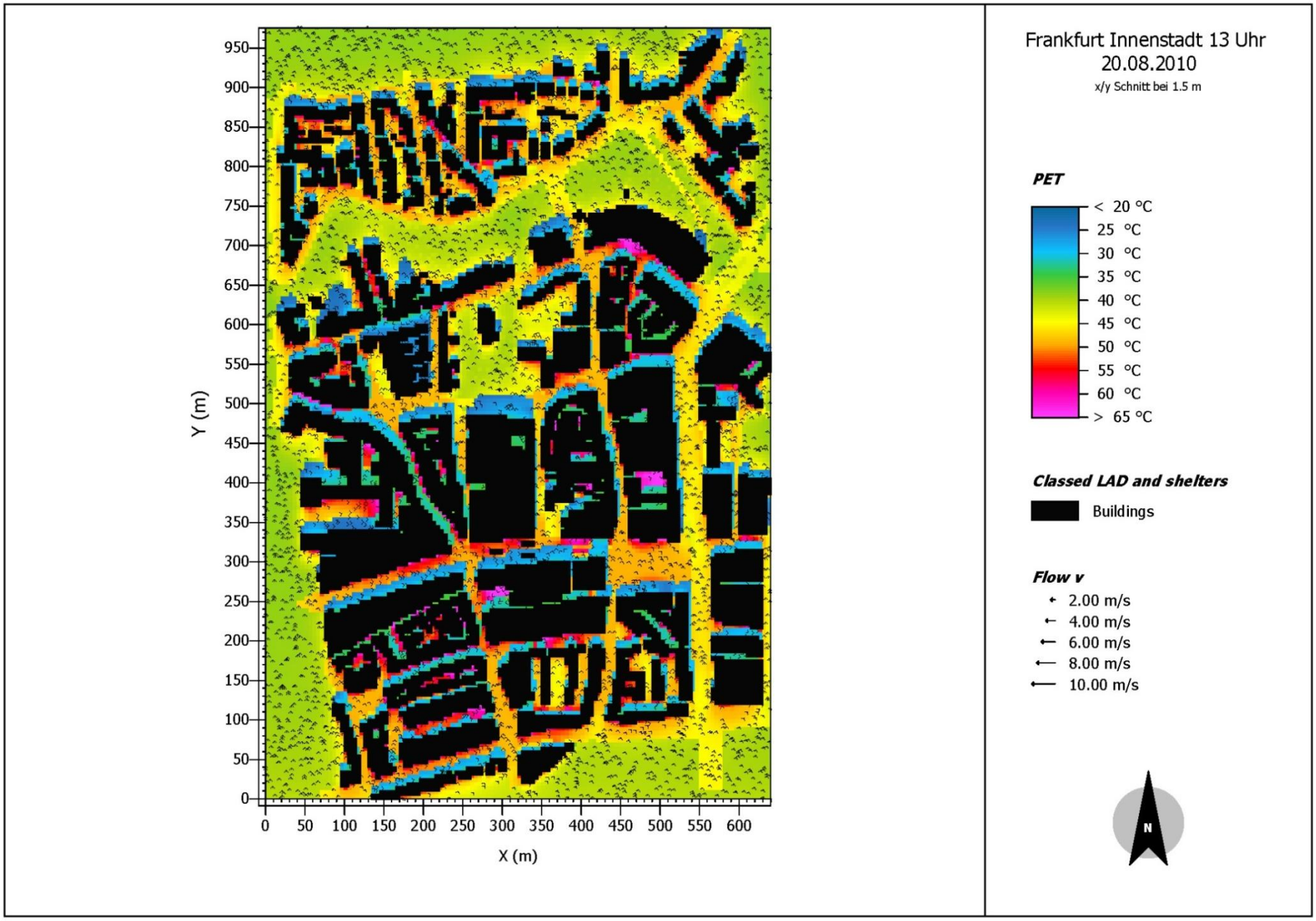
Höchste Überwärmungsstufe, verdichteter hitzestressgefährdeter Bereich ohne ausreichende Belüftung

Potentiale: klimatische Wirkung der Wallanlagen



Klimaplanatlas Frankfurt

Universität Kassel
Fachbereich Architektur Stadtplanung
und Landschaftsplanung
Fachgebiet Umweltmeteorologie


Frankfurt Innenstadt 13 Uhr
20.08.2010
x/y Schnitt bei 1.5 m
PET
< 20 °C
25 °C
30 °C
35 °C
40 °C
45 °C
50 °C
55 °C
60 °C
> 65 °C
Classed LAD and shelters
Buildings
Flow v
2.00 m/s
4.00 m/s
6.00 m/s
8.00 m/s
10.00 m/s
N
Y (m)
X (m)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950

Höhe z = 2 m, jeweils Differenz in °Kelvin, Tagsitu ation

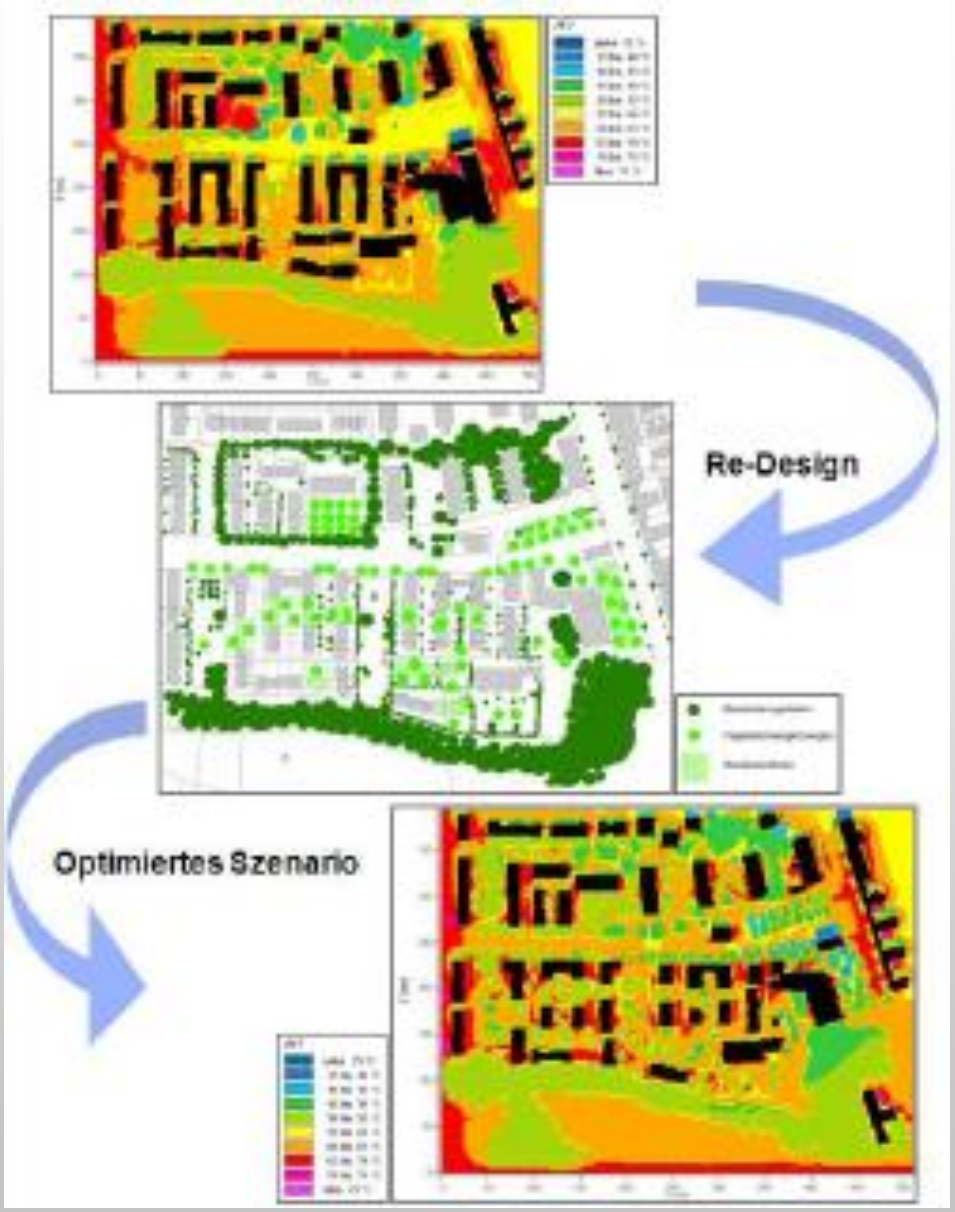
Zeit	Mittlere Luft-temperatur (°C) Ausgangs-szenario	Differenz Szenario "Bäume"	Differenz Szenario "Albedo-erhöhung"	Differenz Szenario "Fassaden-begrünung"	Differenz Szenario "Dachbe-grünung"	Differenz Szenario "Entsiegelung"	Differenz Szenario Fassaden-isolierung	Alle Maßnahmen
6:00	15.6	0.8	-0.1	0.5	0.1	0.1	-0.4	0.1
8:00	20.4	0.3	-0.5	0.1	0.0	0.0	-0.1	0.0
10:00	30.6	-1.7	-2.3	-0.6	0.0	-1.1	0.2	-2.3
12:00	42.8	-4.7	-4.7	-1.4	-0.1	-1.9	0.5	-5.7
14:00	50.2	**-5.7**	-6.0	-1.6	**-0.1**	-2.3	0.4	**-6.9**
16:00	49.3	**-6.0**	-6.2	-1.4	**-0.1**	-2.0	0.3	**-7.2**
18:00	44.0	-4.7	-5.7	-1.1	0.0	-1.4	0.1	-5.6
20:00	35.4	-2.6	-4.1	-0.5	0.0	-0.4	-0.1	-3.1
22:00	26.5	-1.2	-2.0	-0.1	0.0	-0.1	-0.2	-1.7

Ist-Siutation

Entwurf

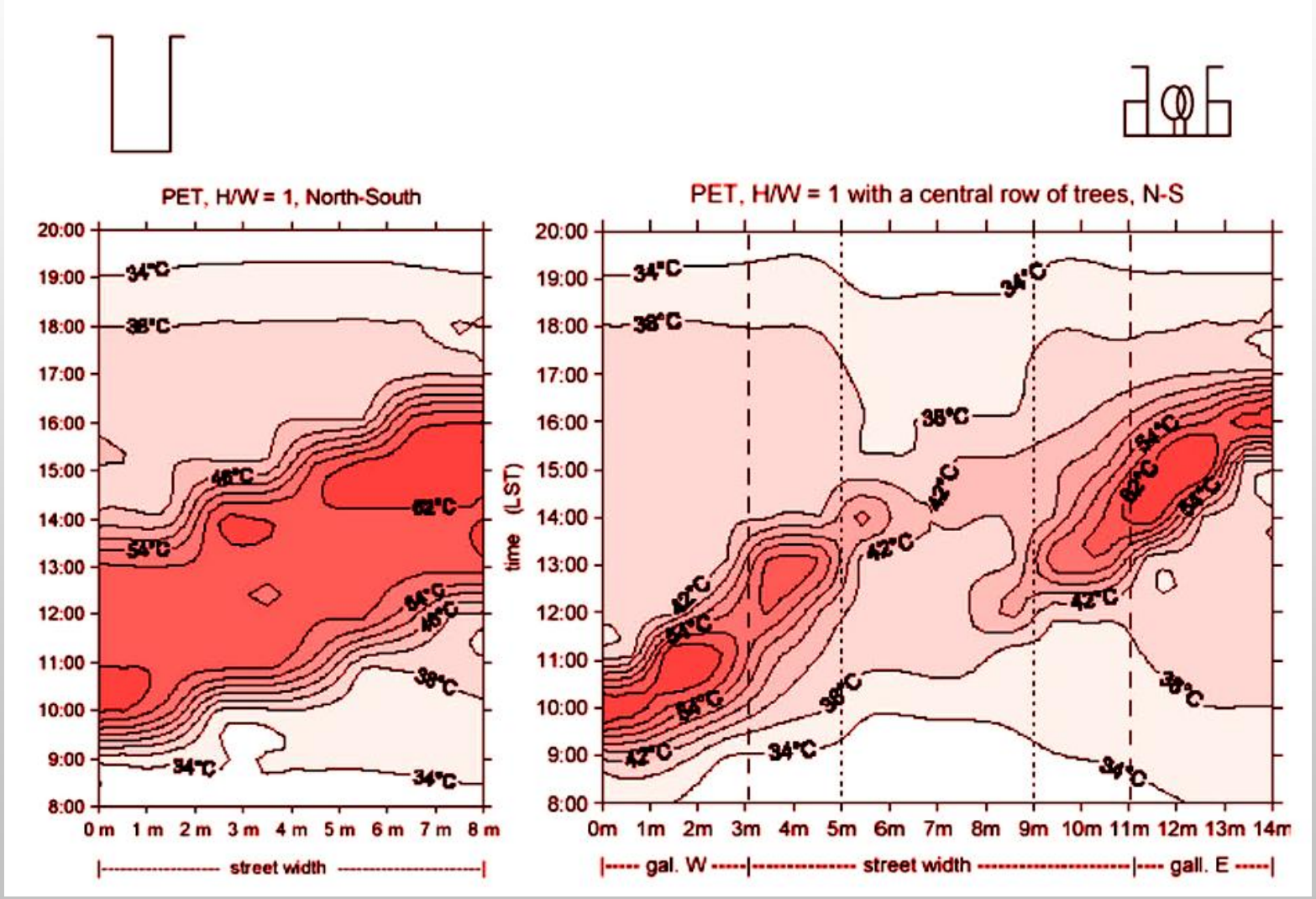
Auswirkungen

im Mikroklimabereich

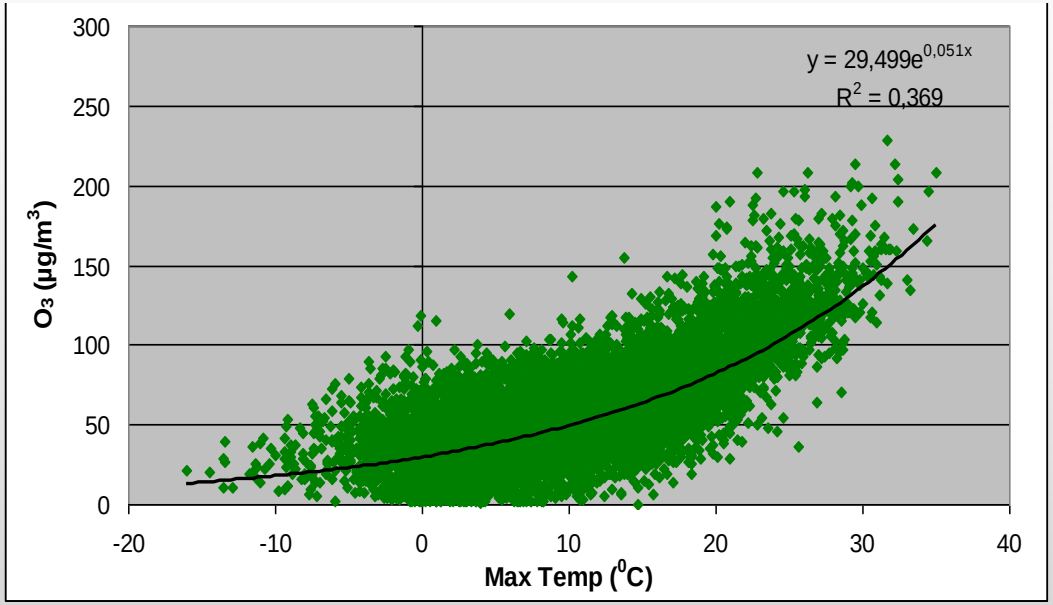


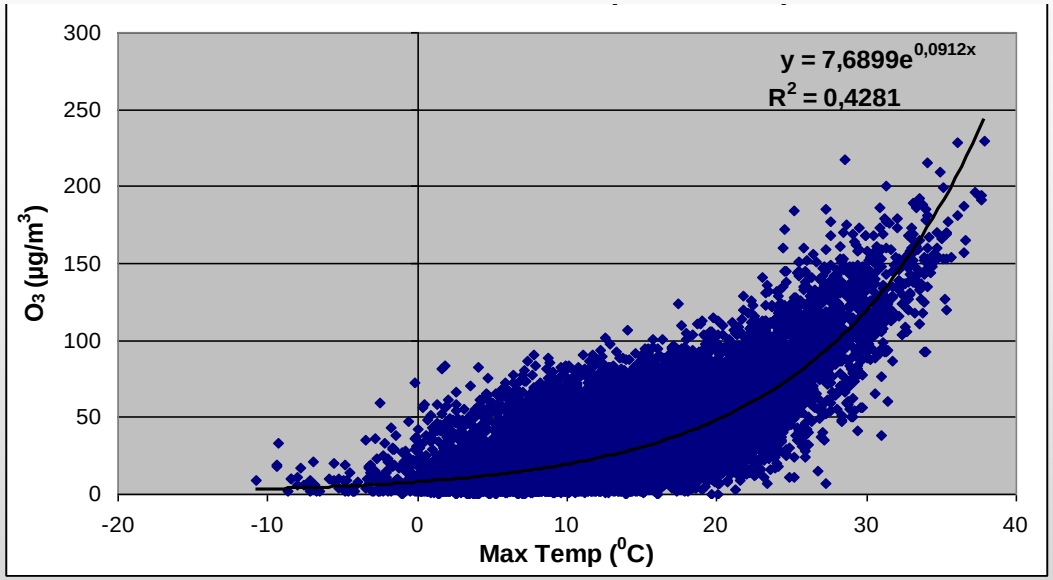
Mainz / Kassel (2009)

Einfluss der Stadtvegetation in extremen Klimaten auf die thermische Behaglichkeit



Zusammenhang zwischen Lufttemperaturen und Ozon an Messstellen in NRW (Kuttler 2010)





Klima Arten Matrix (Roloff 2008; Stewart& Hewitt 2002) nach den Kriterien der Winterhärte und Ozonbildung

z.B.
Geeignet: Feldahorn, Spitzahorn, gemeine Esche

Eingeschränkt geeignet: Kiefer, Platane

Ungeeignet: Silberpappel, Zitterpappel

Weitere Untersuchungen vor allem zur Sommerhärte (Wärmestrahlung) sind notwendig

Warum brauchen wir Stadtbäume?

gegen Kältestress
kann man sich schützen

gegen Hitzestress nur schwer

Vielen Dank!