WAGENINGEN UNIVERSITY & RESEARCH

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Improving the Environmental Quality of the Rivierenbuurt, The Hague

Problem description

The Rivierenbuurt in the Hague as a heat island

- Densely built
- Little room for vegetation
- Locals complain about heat
- Susceptible residents

Research questions

- What is the environmental quality (EQ)?
- How can the EQ be improved?
- Can the UHI estimation be improved using an upgraded version of the WRF model?

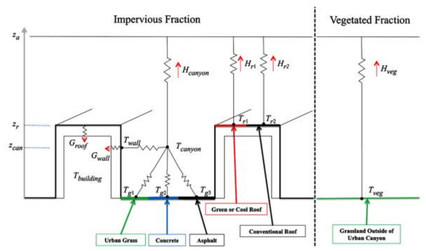
Methods

UCAM model

- LCZ
- WRF
- Parameters

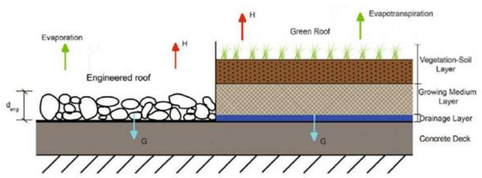
→ UHI → HI, AQI → EQI

- WRF to estimate UHI



WRF: new version

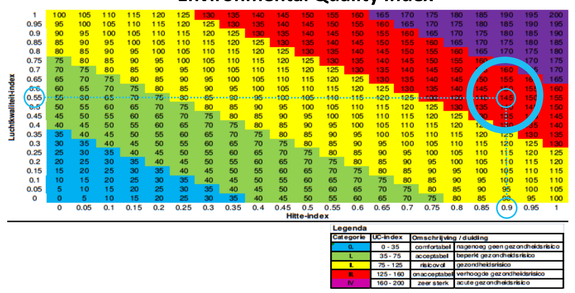
- Extra options in WRF model



Results

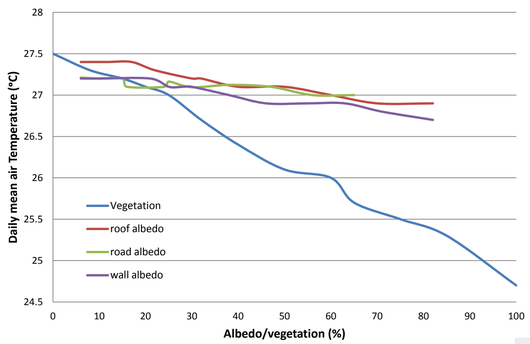
Factors defining the current environmental quality of the Rivierenbuurt

Environmental Quality Index

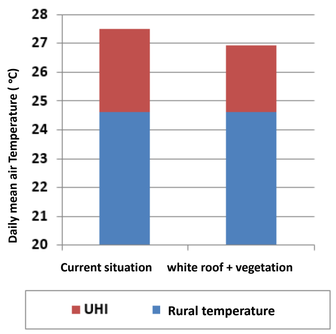


Improving the environmental quality of the Rivierenbuurt

Daily average temperature as a function of several parameters for the Rivierenbuurt



Temperature built-up after white roof + vegetation measure for the Rivierenbuurt



Results:

- Vegetation has the largest effect on T
- Roof- and road albedo follow
- In the Rivierenbuurt, road albedo is already quite high
- In the Rivierenbuurt, roof albedo is:
  1. currently low
  2. cheapest to improve

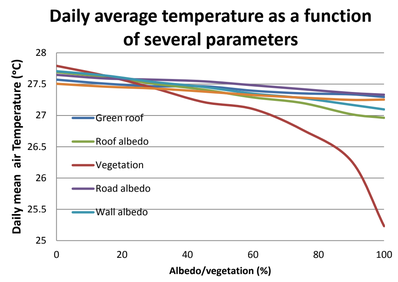
	current situation	white roof + vegetation	green roof + vegetation
UHI	2.91	2.33	2.34
HI	0.88	0.71	0.71
EQI	143	126	126
warm nights	20	19	19
health risk	237	210	210
	unacceptable	dangerous	dangerous

Possible interventions

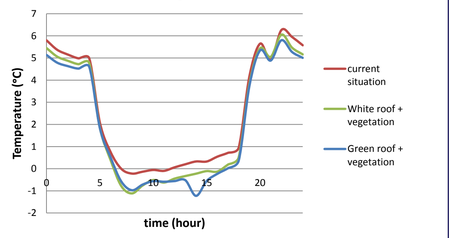
- White roofs
- Vegetation measures are challenging, though improvements are possible

Implementing new WRF

Daily average temperature as a function of several parameters



UHI



Results:

- Better initial environmental quality
- Higher temperatures without measures
- Large decrease in vegetation influence
- Smaller wall albedo influence
- Irrigation has no added value

	current situation	white roof + vegetation	green roof + vegetation
UHI	2.57	2.15	2.00
HI	0.78	0.65	0.61
EQI	133	120	116
warm nights	22	19	17
health risk	222	202	195
	unacceptable	dangerous	dangerous

Conclusions

The environmental quality of the Rivierenbuurt

- Current: EQI = 143, HI = 0.88, AQI = 0.55
- Option white roofs + vegetation is best, but new EQI is still dangerous.

WRF model: new version

- Option for green roofs simulates a lower EQI than our estimations
- Overall UHI effect is smaller, resulting in a lower EQI
- Irrigation of green roofs does not lower the EQI significantly

Discussion

EQ of the Rivierenbuurt

- General estimation AQI
- Options in UCAM are limited:
  - Small selection of LCZ
  - Limited selection of roof/wall/road types
  - Standard anthropogenic heat
  - No green roof option → estimation by changing roof albedo/vegetation fraction
- Estimation on green roof calculation in UCAM

WRF model: new version

- Is the lower UHI effect realistic?
- Uncertainty albedo: heterogeneity and disagreement in literature
- Irrigation option did not work → estimation using oasis effect

Abbreviations:

- EQ: Environmental Quality
- UHI: Urban Heat Island
- WRF: Weather Research Forecasting
- UCAM: Urban Climate Assessment and Management
- LCZ: Local Climate zone
- HI: Heat Index
- AQI: Air Quality Index
- EQI: Environmental Quality Index

- Steeneveld, G.J.; Klompmaker, J.O.; Groen, R.J.A.; Holtslag, A.A.M. (2016). An urban climate assessment and management tool for combined heat and air quality judgements at neighbourhood scales.
- Groen, R.; Zoete, J.; Klompmaker, J.; Schilt, M.; Steeneveld, G.J.; Koopmans, S.; Sluijter, K.; Van Den Hurk, B.; Eskes, H.; Wolters, D.; Min, E. (2013). UCAM: Urban Climate Assessment and Management Wijkgerichte beoordeling van hitte in de stad. Witteveen + Bos, WUR, KNMI

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