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Climate change impact on the drinking water distribution network temperature

BTO

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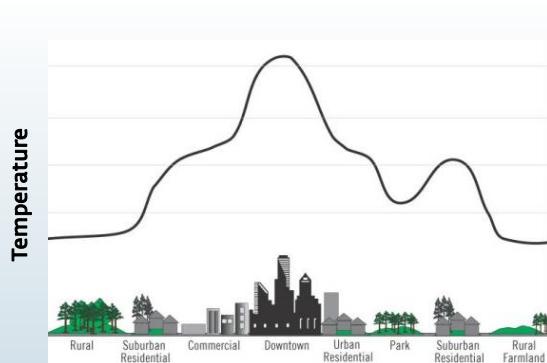
Shareholders 10
Dutch drinking
water companies



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Urban heat island effect (UHI)



- Is UHI only the tip of the iceberg?
- What about the sub-surface UHI?



Source: EPA website

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Background

- In the Netherlands water is distributed without chlorine.
→ 25°C is the maximum allowed temperature at the customer's tap.
- In 2006 1% of random sampling > 25°C.
- With climate change more samples may exceed 25°C.



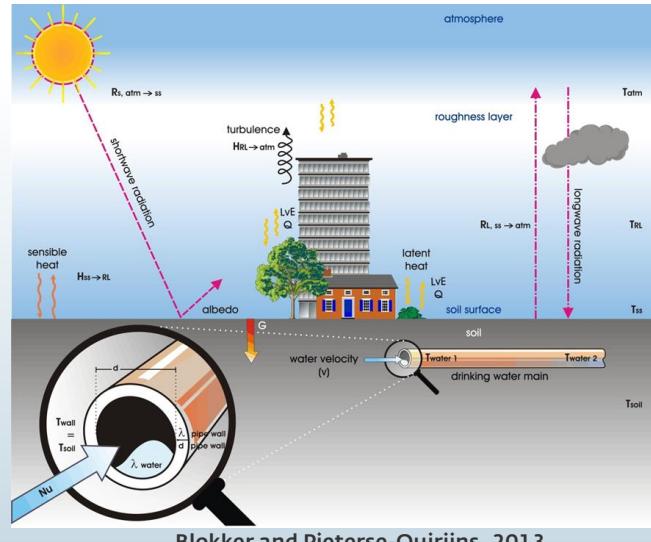
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Soil temperature model

Developed by Dutch water companies & KWR

The four heat transfer processes :

- atmosphere and soil surface
- atmosphere and roughness layer
- roughness layer and soil surface
- soil surface and soil

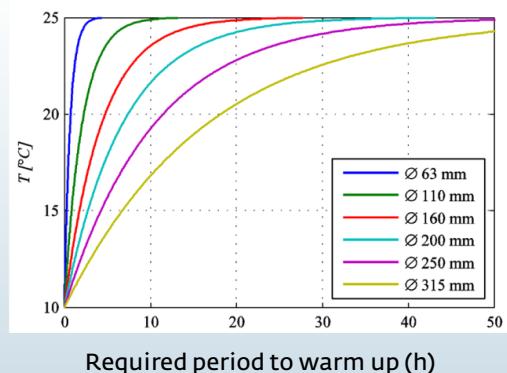


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Blokker and Pieterse-Quirijns, 2013

Why is soil temperature important?

- Water distribution pipes are located at 1.0 m depth.
- Previous studies showed that water in small pipes reaches quickly the soil temperature



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Hypothesis: Soil temperature in urban areas is higher than soil temperature in peri-urban areas

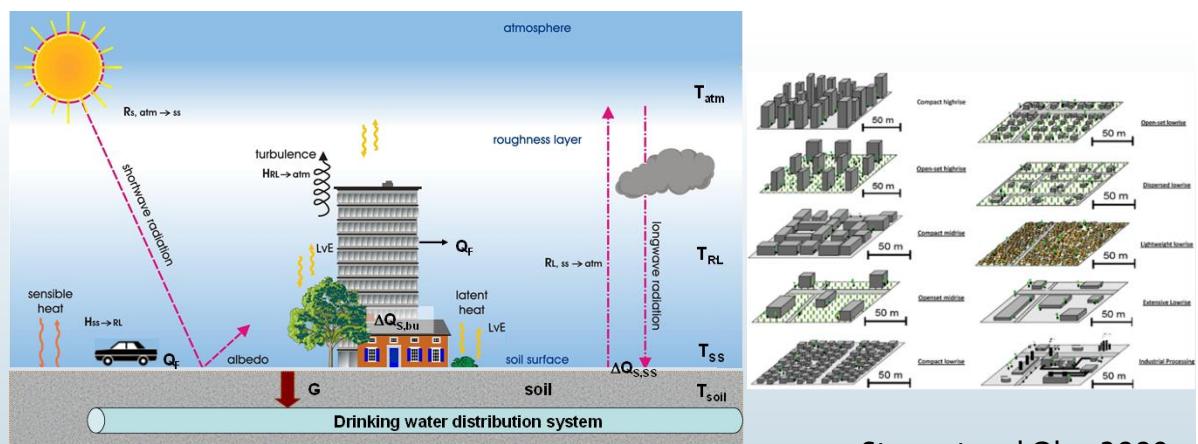


- Sandy soils in urban areas warm up more and faster than other soil types.
- UHI: limited evapotranspiration, anthropogenic heat sources and heat storage in buildings

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Soil temperature model + Local climate zones

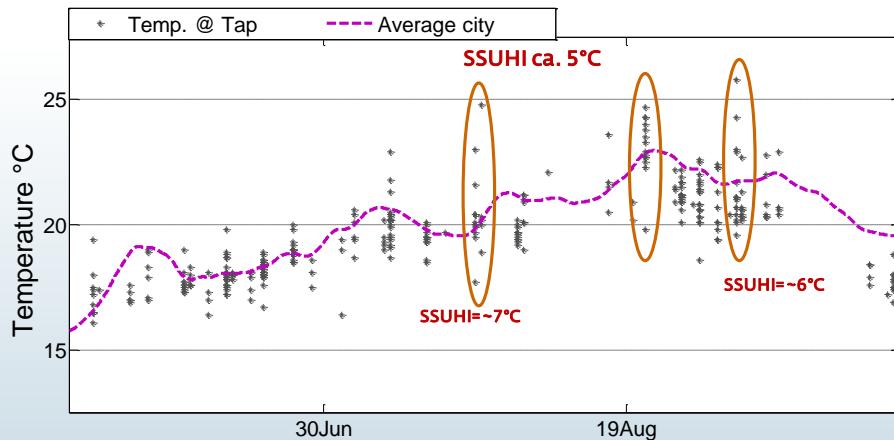


Stewart and Oke, 2009

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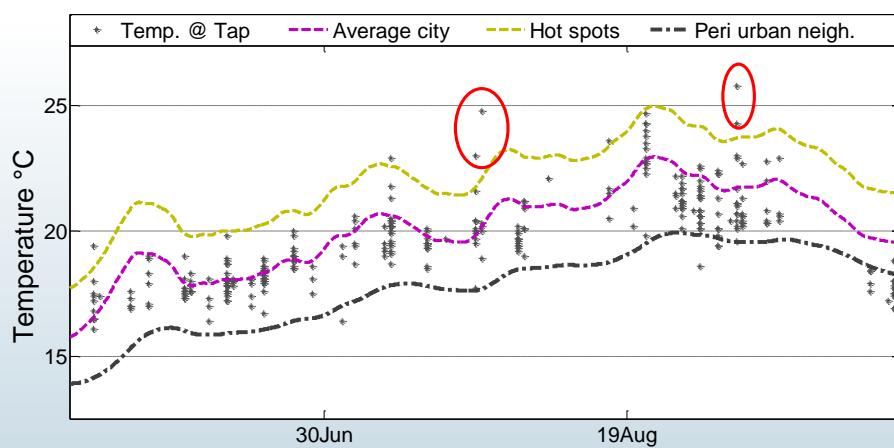
Average soil temperature in Rotterdam in 2012



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Three urban types simulated for Rotterdam Summer 2012



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How often will drinking water temperature exceed 25°C in 2050 in a warm summer?

KNMI '06 scenario: G scenario and W+ scenario

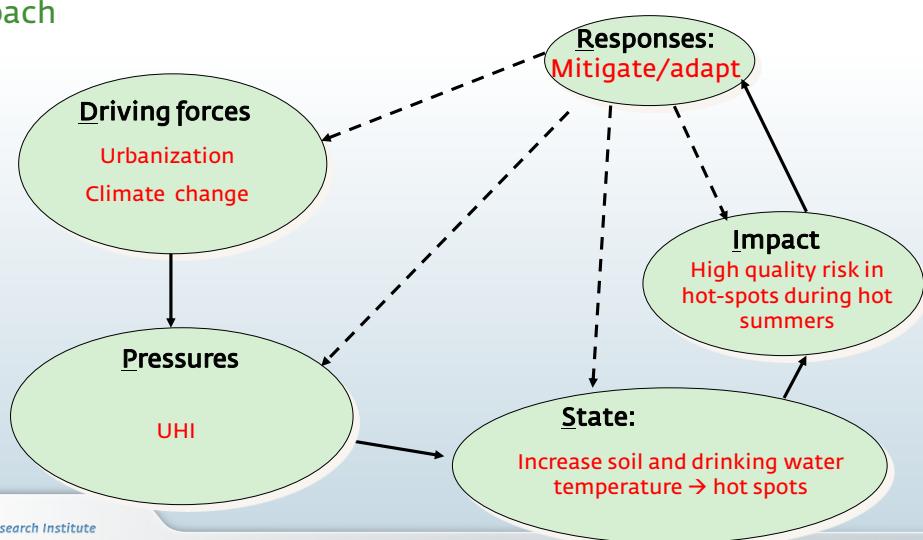
	Number of days drinking water T >25°			Number of days drinking water T >28°		
	2012	2050 (G)	2050 (W+)	2012	2050 (G)	2050 (W+)
Peri-urban neighbourhoods	0	0	0	0	0	0
Average city	0	0	7	0	0	0
Hot-spots	9	49	83	0	0	22

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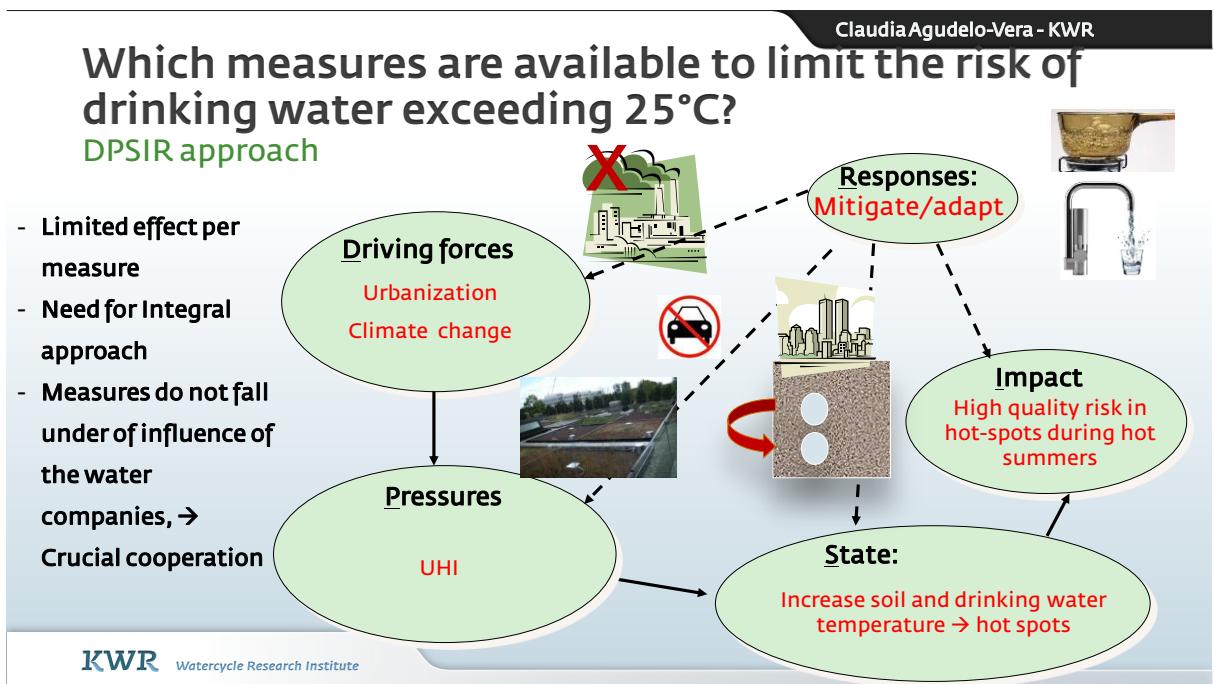
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Which measures are available to limit the risk of drinking water exceeding 25°C?

DPSIR approach



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Dutch water companies are front-runners

What about other countries?

- Recently Germany conducted a study to monitor urban soil temperature.
- Increasing temperature in the distribution networks can be a potential problem also in other countries
→ More research is needed.

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Conclusions

- In the future, the summers are expected to be warmer, this combined with the UHI effect will influence the soil temperature.
- In peri-urban areas and average city,
→ No risk that drinking water temperature > 25°C.
- Only in the hot-spots,
→ during warm summers the drinking water temperature > 25°C.
- Hot-spots are a combination of dry sand and high UHI.

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Take home message:

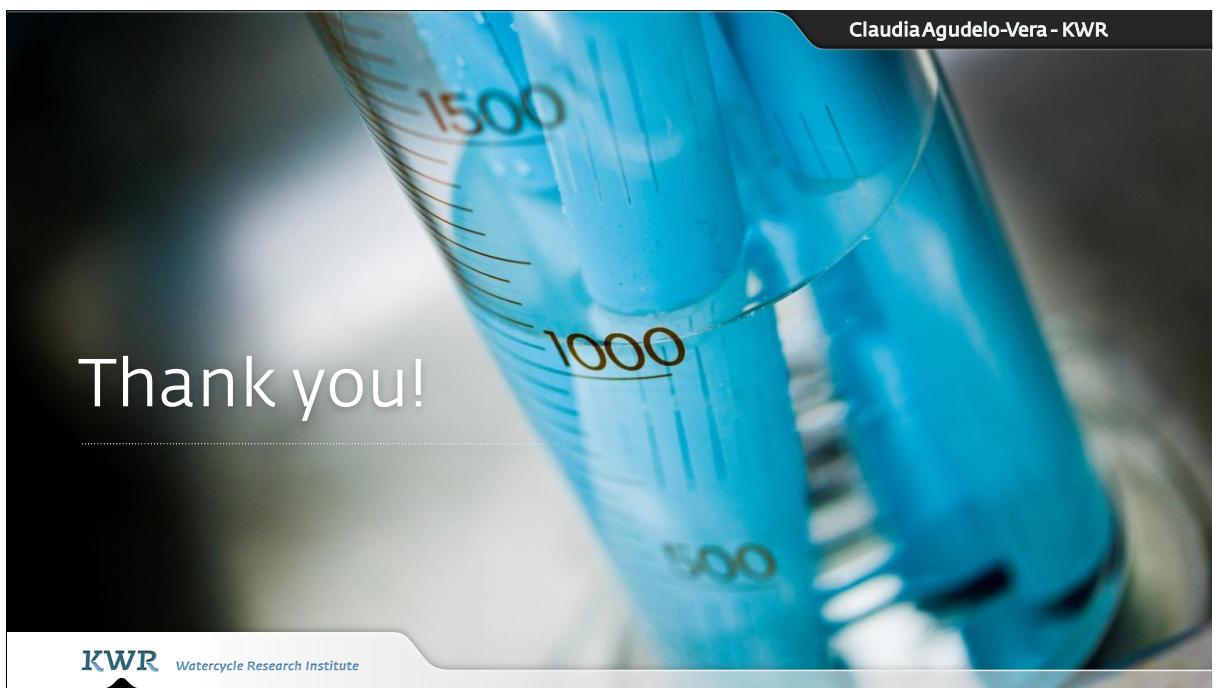
Urban heat island effect has more consequences than we know until now:

- Warming of urban soils → Sub-surface urban heat islands
- Large gradient on soil temperature at -1m & influencing temperature in the water distribution network

We have 35 years to identify and tackle the hot-spots:

- More research and monitoring: identify hot-spots & their sources
- working together is crucial to address urban challenges
 - This is already happening: Coalition for climate resilient cities (Vewin)

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