Monitoring of thermo-hydrological behaviour in Green Infrastructure

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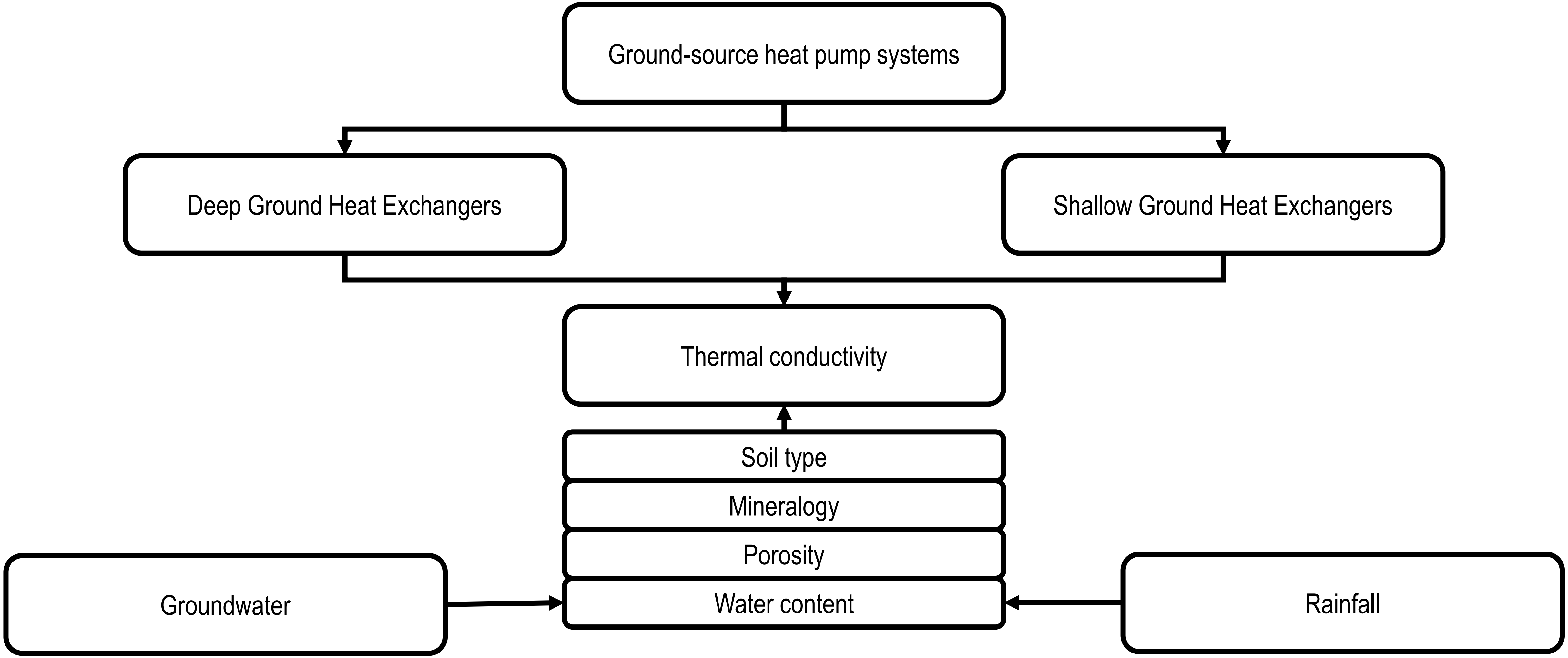
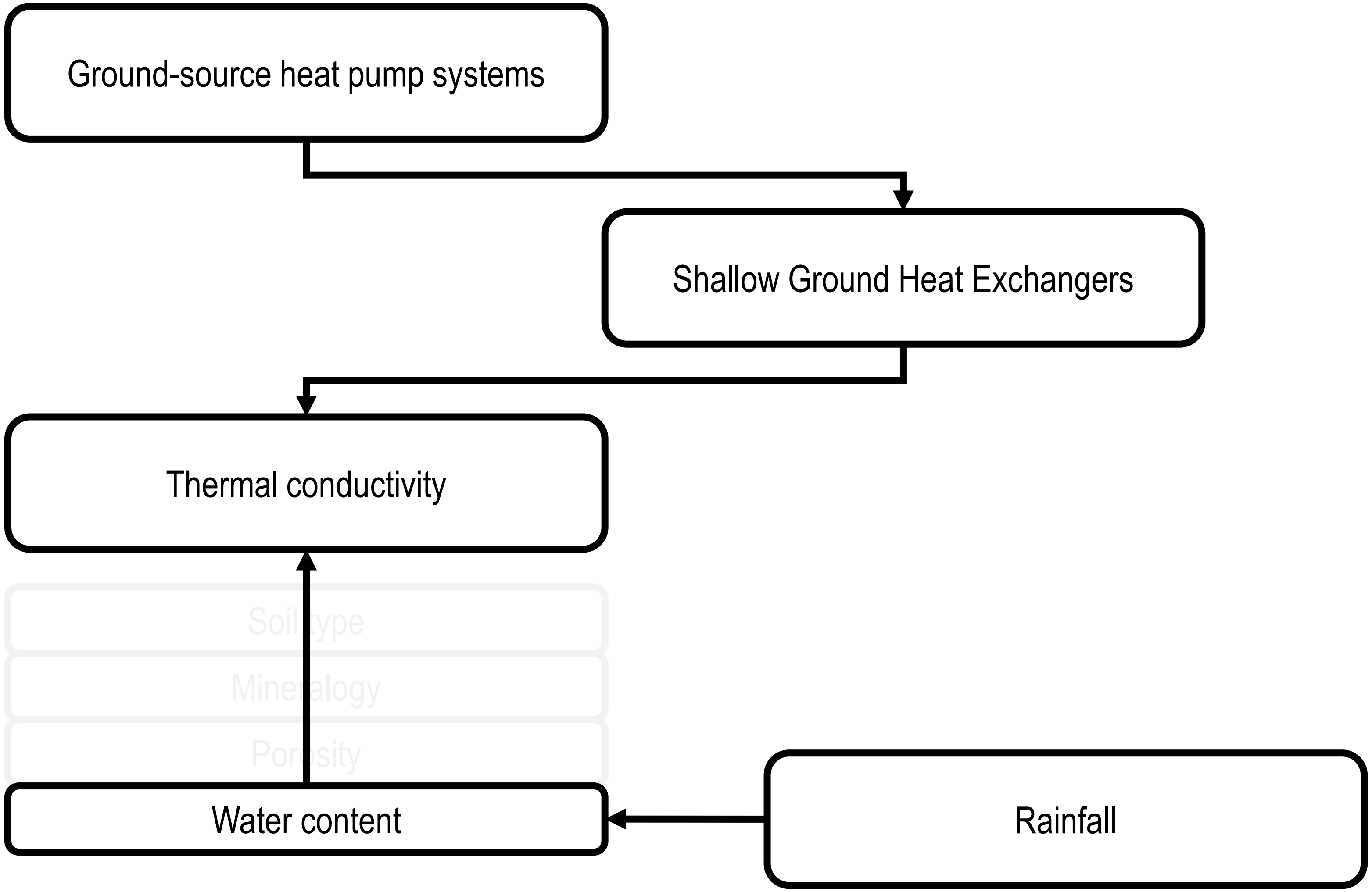

Ground-source heat pump systems
Deep Ground Heat Exchangers
Shallow Ground Heat Exchangers
Thermal conductivity
Soil type
Mineralogy
Porosity
Water content
Groundwater
Rainfall



- Roof precipitation drainage into the ground

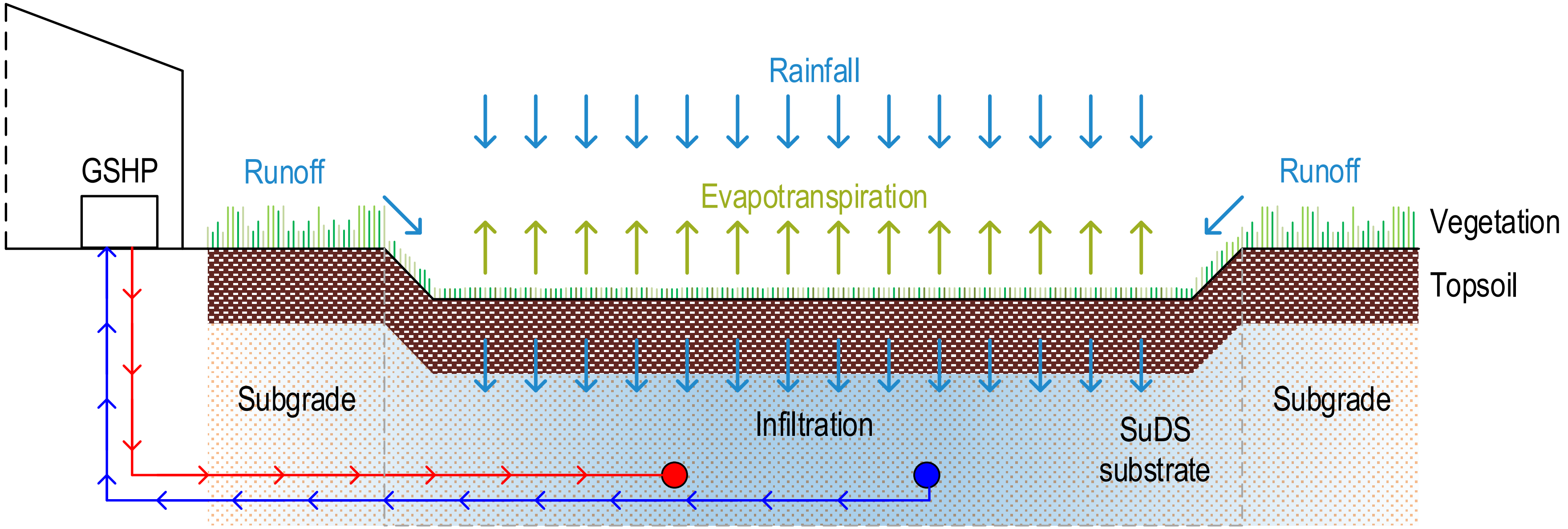
(Di Sipio and Bertermann, 2017)

- Irrigating trench areas

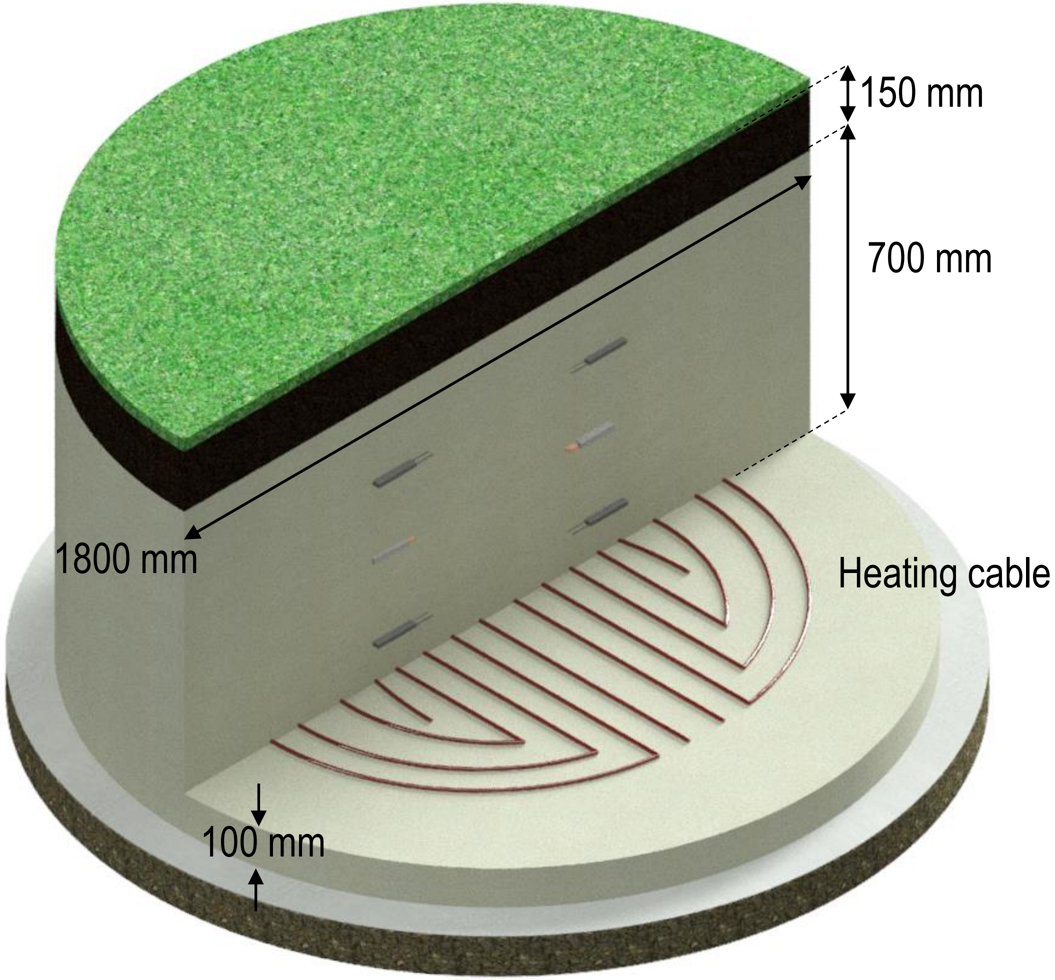
(Naylor et al., 2015)

- Rain garden and rainwater harvest

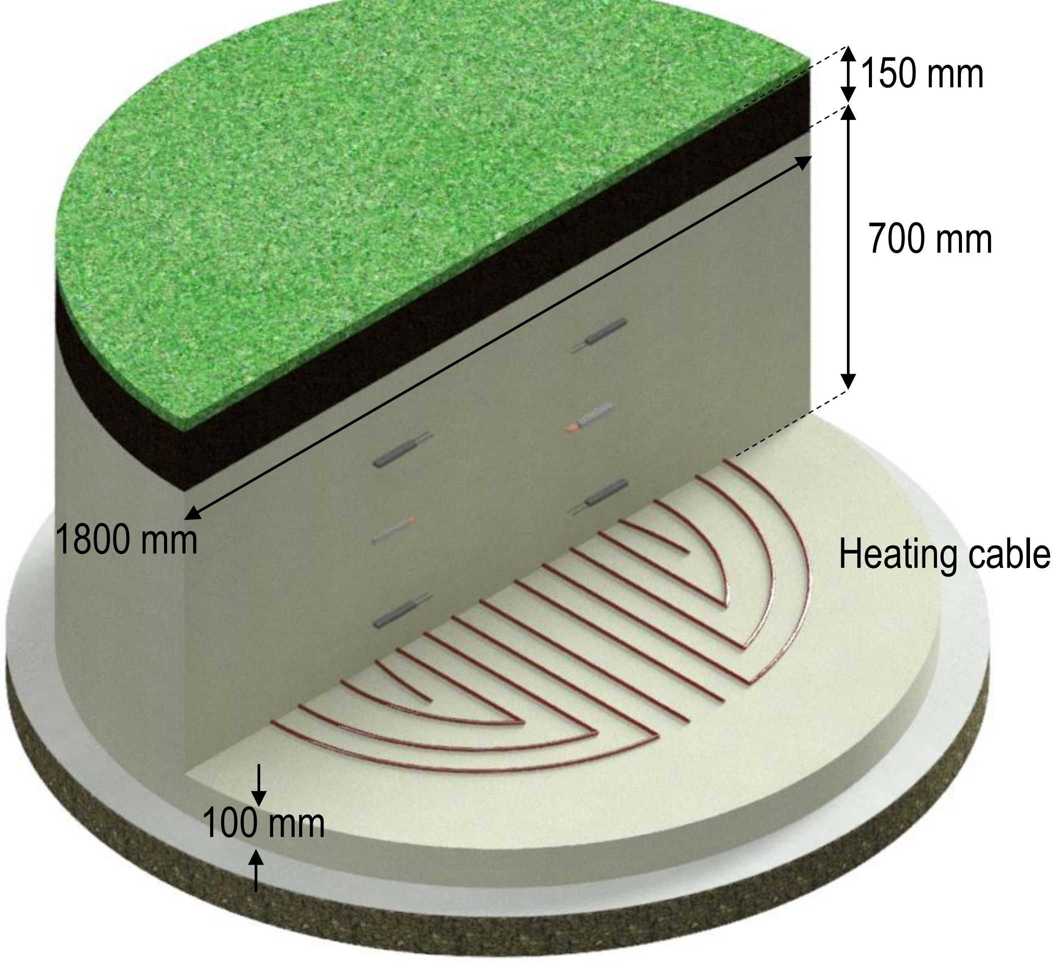
(Gao et al., 2016)

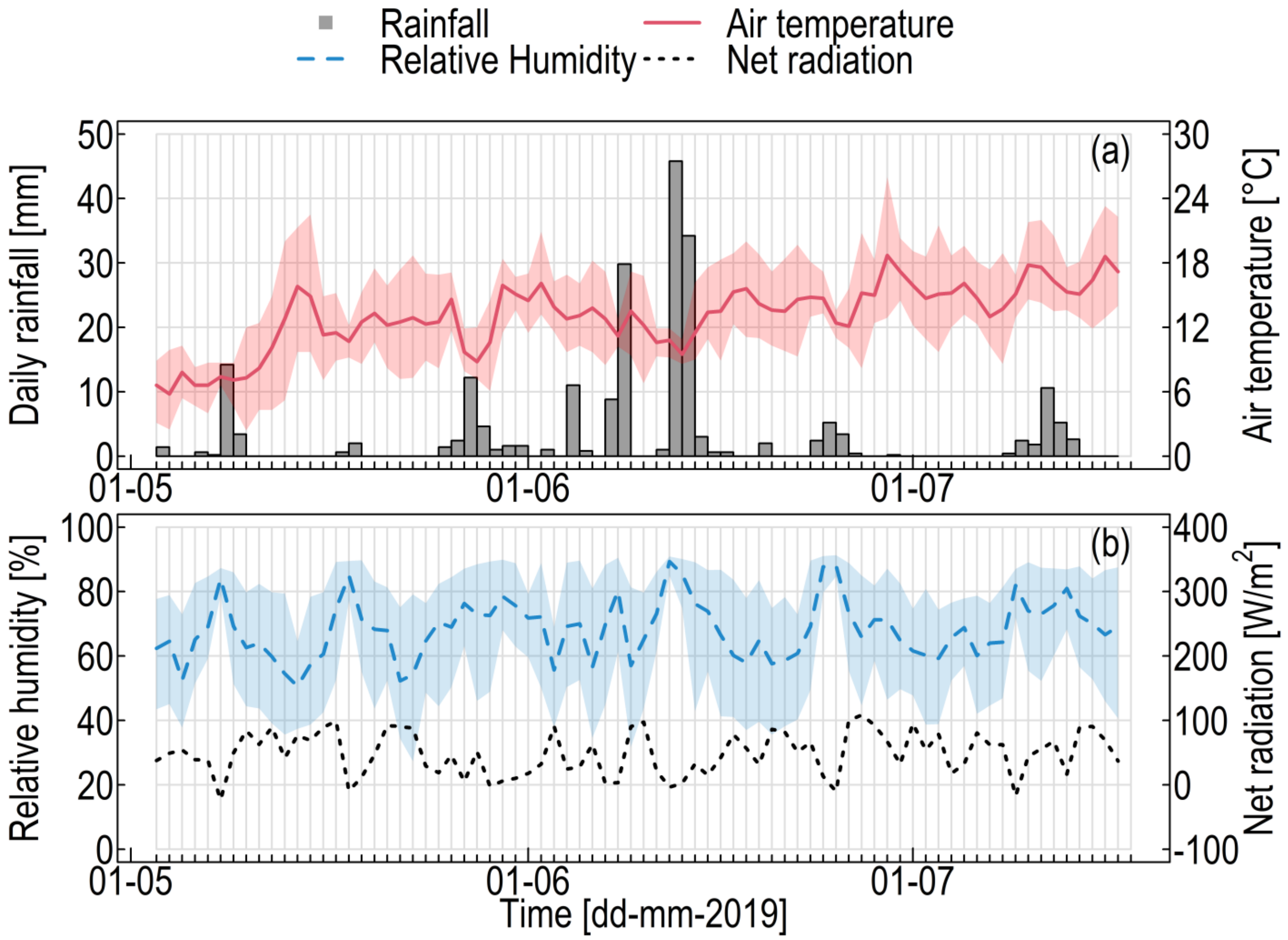


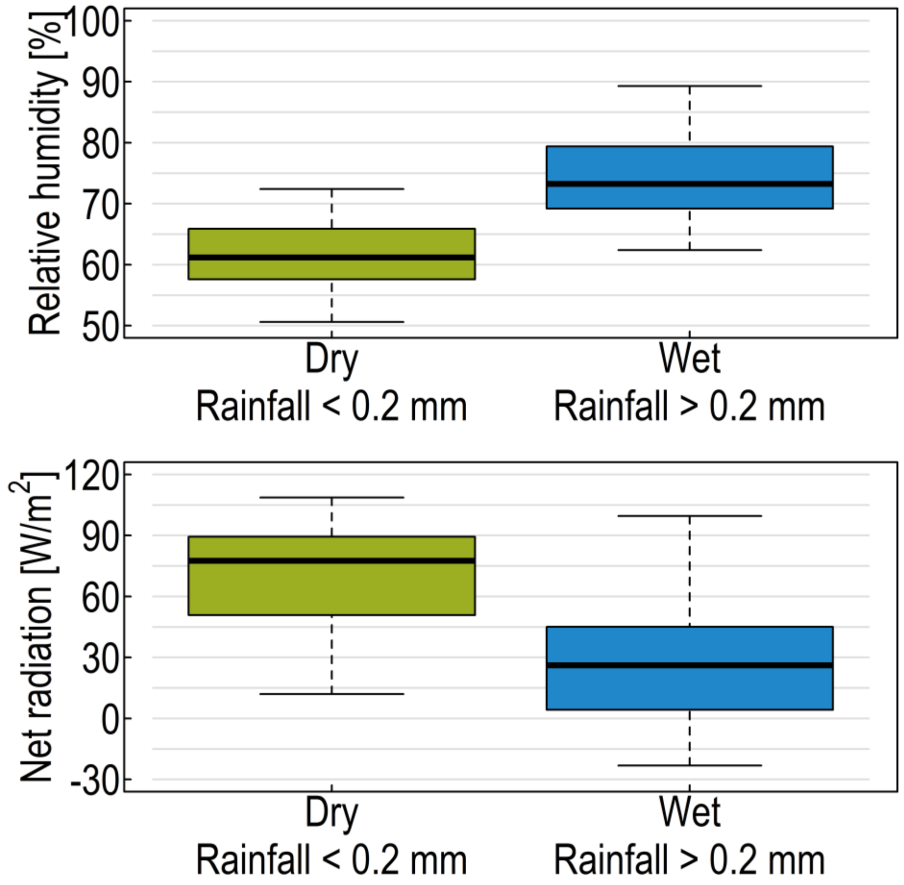
Combined ground heat exchanger – green infrastructure concept


150 mm
700 mm
1800 mm
Heating cable
100 mm

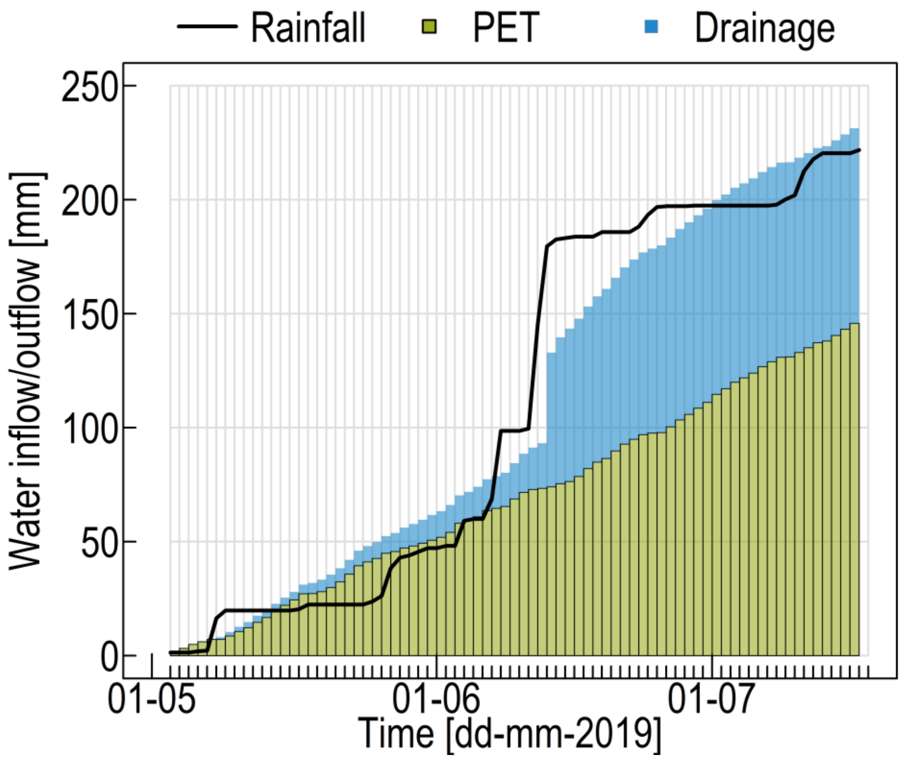
Depth [mm]	Parameter(s)
40	Soil temperature
70	Soil temperature
80	Heat flux
100	Soil temperature, VWC, Suction
150	Soil temperature
250	Soil temperature, VWC, Suction, Thermal Conductivity
350	Soil temperature, VWC, Suction, Thermal Conductivity
450	Soil temperature, VWC, Suction
550	Soil temperature, VWC, Suction, Thermal Conductivity
650	Soil temperature, VWC, Suction
750	Soil temperature, VWC, Suction, Thermal Conductivity
800	Soil temperature
840	Soil temperature
900	Soil temperature
940	Heat flux







modified from Yildiz and Stirling (2021)



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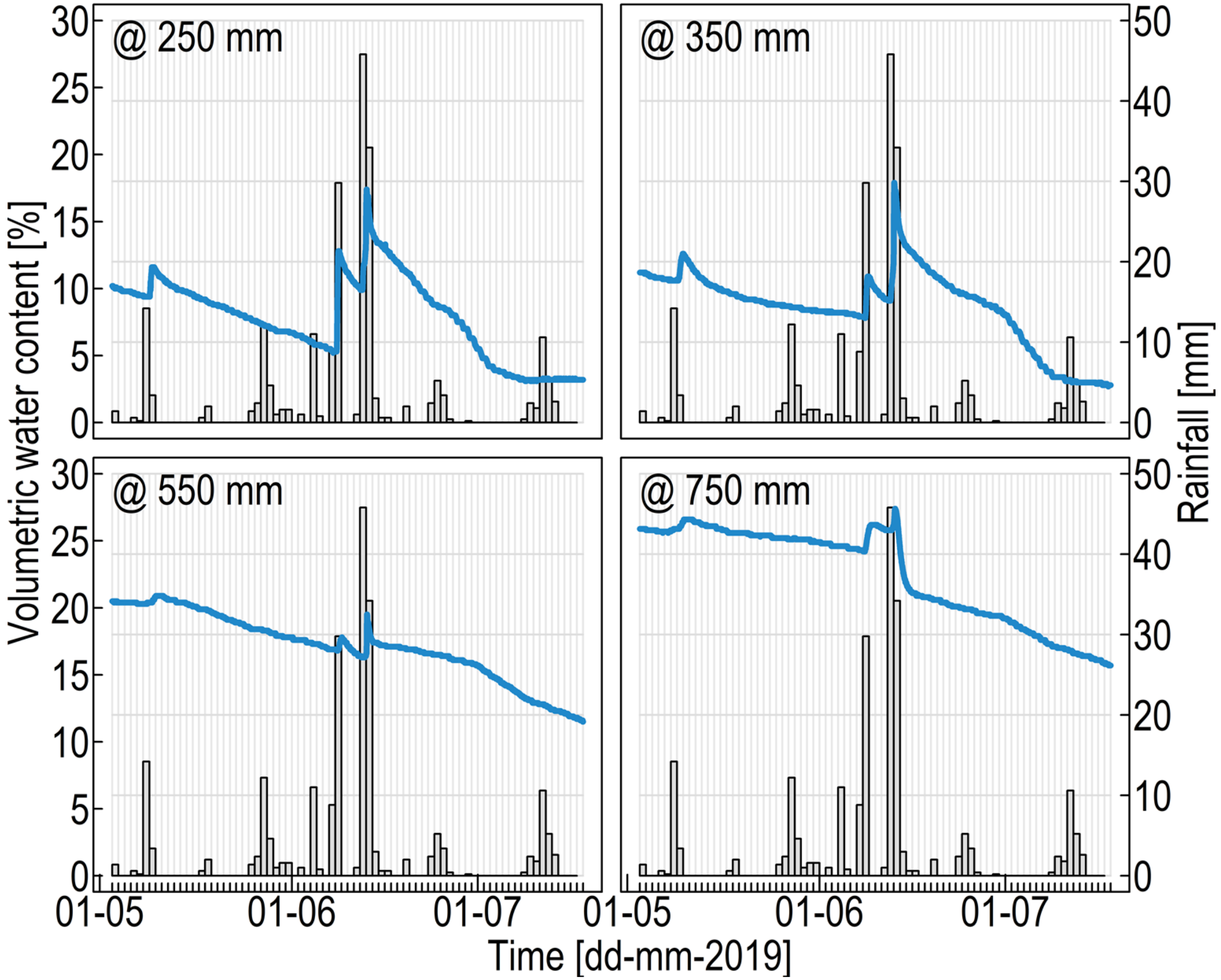

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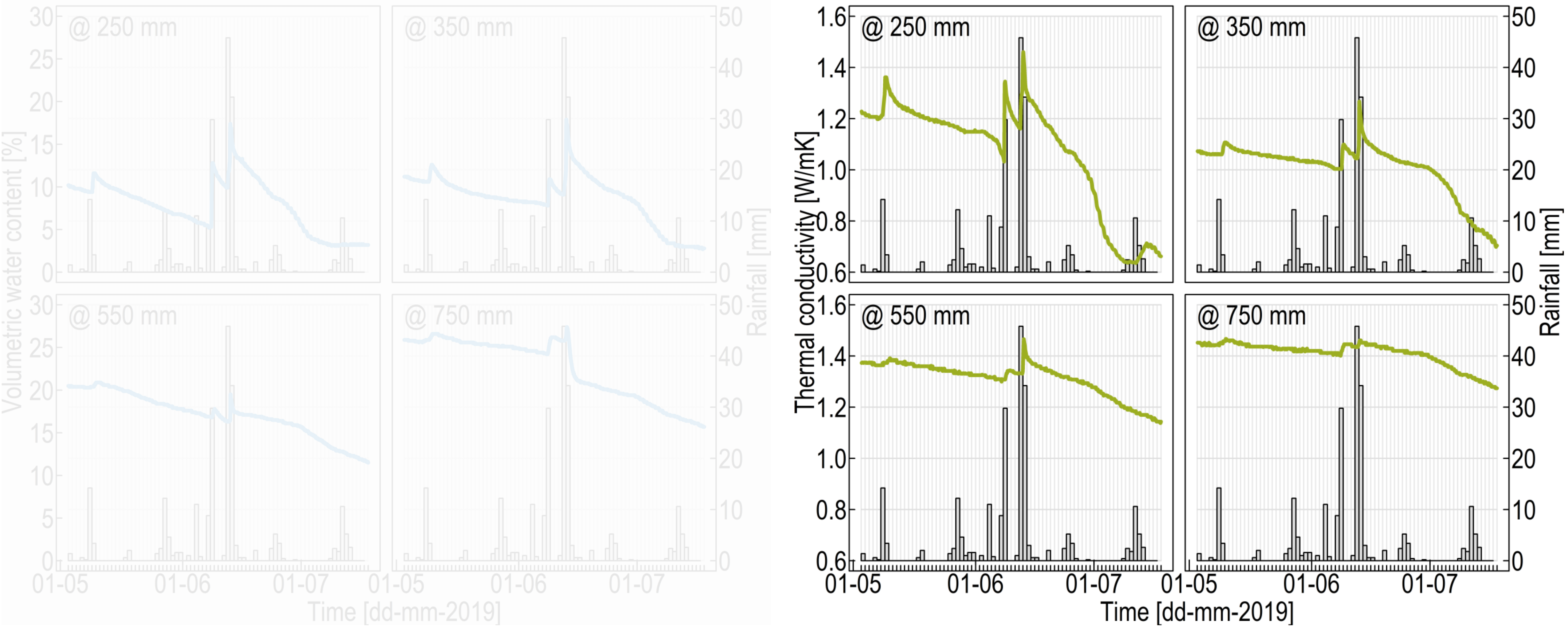

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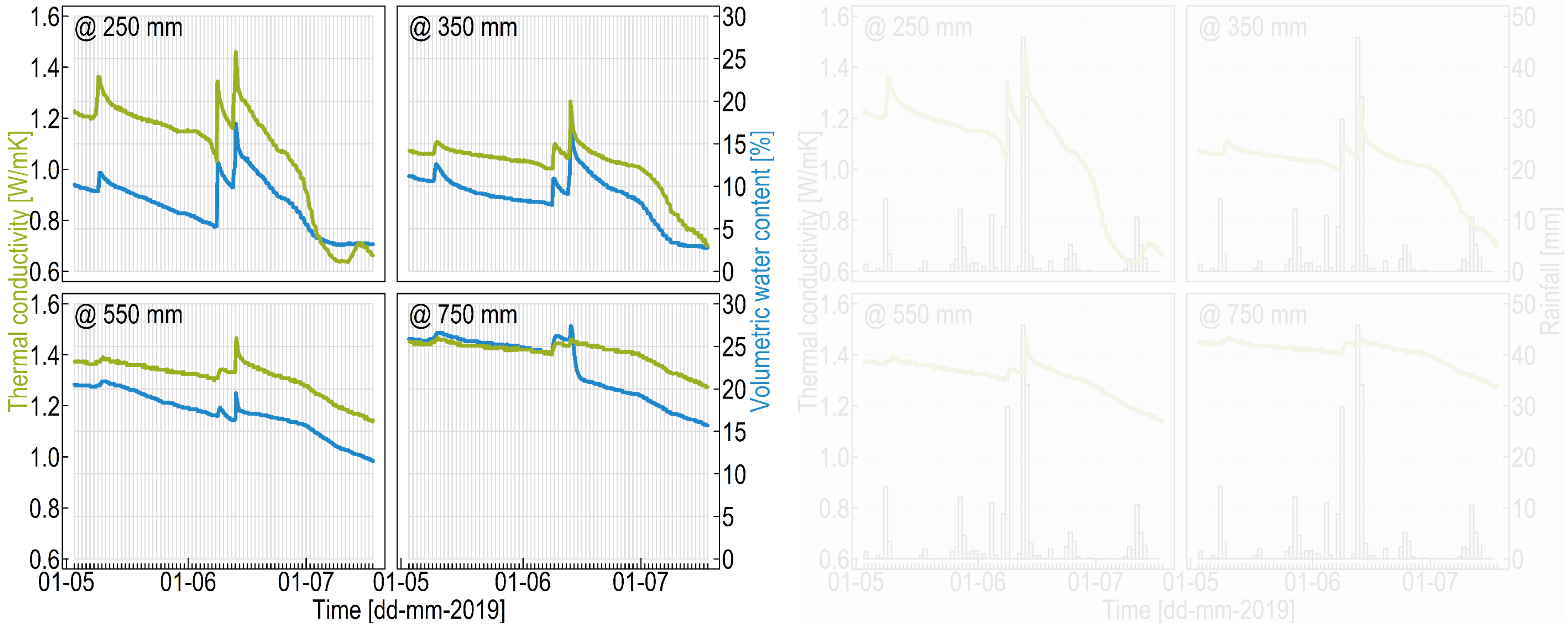

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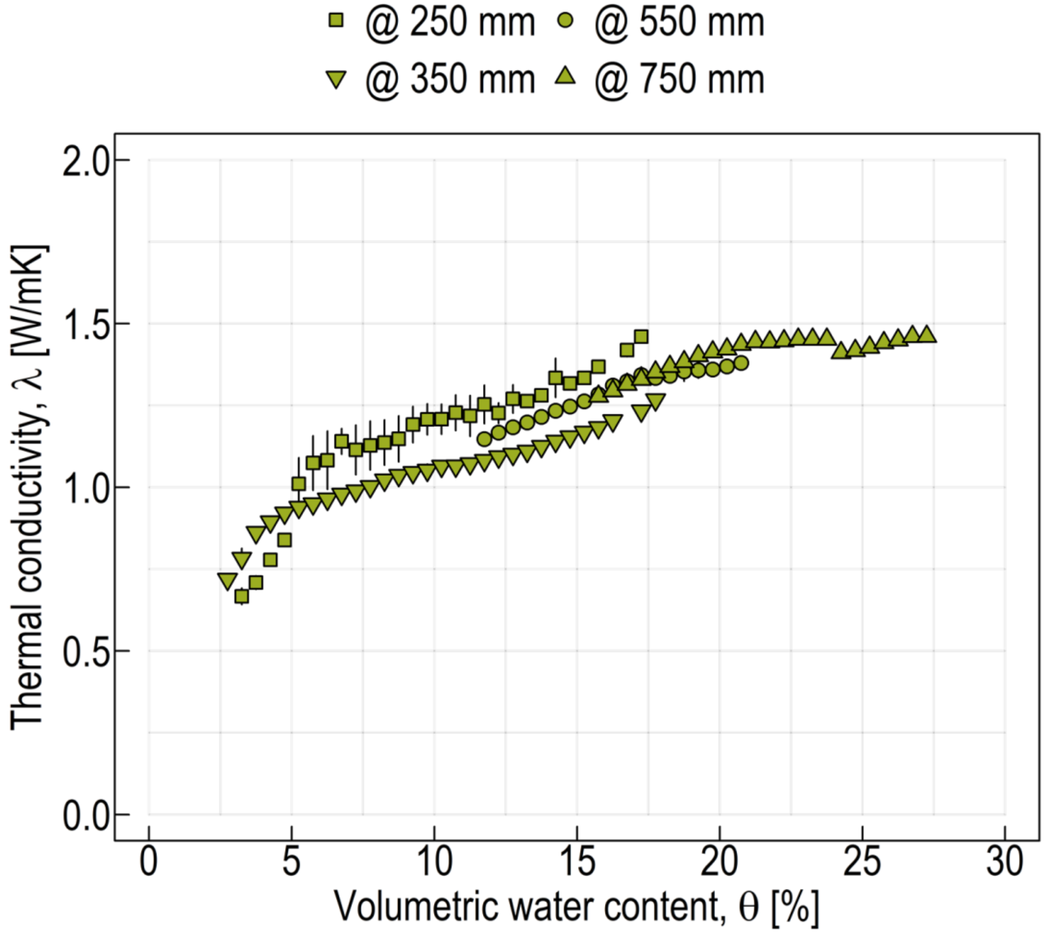

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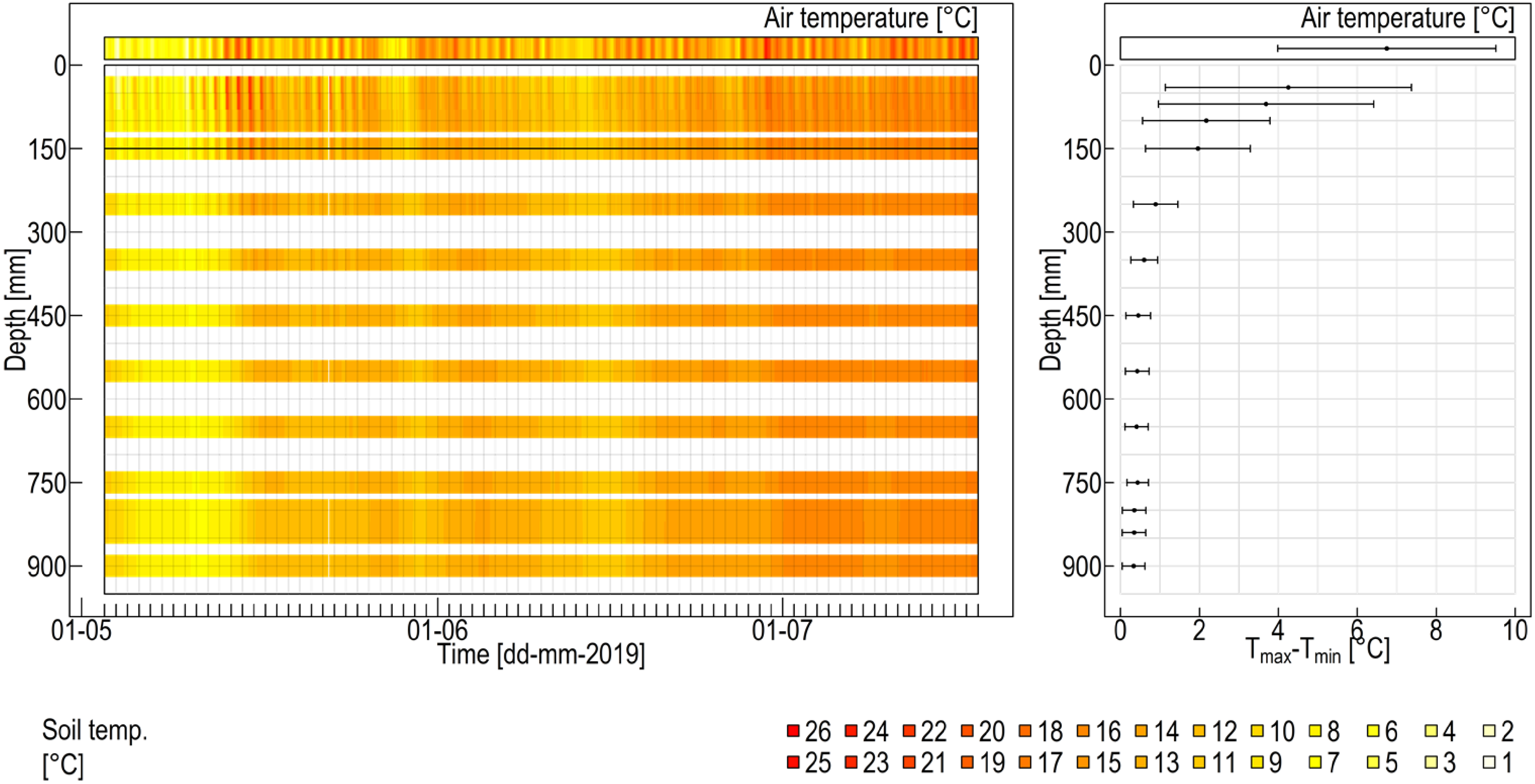
Air temperature [°C]
Depth [mm]
0
150
300
450
600
750
900
01-05
01-06
01-07
Time [dd-mm-2019]
Air temperature [°C]
Depth [mm]
0 2 4 6 8 10
T_{max}-T_{min} [°C]
Soil temp. [°C]
26 24 22 20 18 16 14 12 10 8 6 4 2
25 23 21 19 17 15 13 11 9 7 5 3 1

- Thermo-hydrological conditions within an engineered green infrastructure component are conducive to efficient ground heat exchange.
- The substrate maintained high thermal conductivity states, even under summer conditions.
- The monitored soil-water-atmosphere interaction has illustrated the highly thermo-hydrologically coupled response of a functioning green infrastructure component.
- Such co-located systems have the potential for significant mutual benefit in terms of environmental and economic performance, leading to a more attractive proposition for sustainable water-energy approaches in urban environments.

You can download these slides on anilyildiz.info/presentations

You can watch how we commissioned the lysimeter setup on youtube.com/watch?v=e4RBqE6g_Jg&t

Follow NGIF on Twitter for updates on our work @ngif_uk

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Journal publication:

Yildiz, A. and Stirling, R.A. 2021. Thermo-hydrological behaviour of green infrastructure: a comparative field and laboratory study. *Geomechanics for Energy and the Environment* 25, 100219. doi: 10.1016/j.gete.2020.100219.

All data is publicly available:

Yildiz, A. and Stirling, R.A. 2020. *PLEXUS @ NGIF - Field and laboratory measurements*. doi: 10.25405/data.ncl.c.5088419.v1.

All data analysis and visualisation scripts are available:

Yildiz, A. 2020. *Data analysis and visualisation for lysimeter data*. url: github.com/yildizanil/GETE-D-20-00044.