

Tido Strauss, 14.11.2022

Simulation of water temperature in mesocosms (2021)

Simulation of mesocosm water temperatures in 2021 using weather data from the weather station RWTH Aachen University (time resolution 10 minutes).

Weather data input:

Weather data with hourly time resolution needed for the hydrodynamic module in HyLaM: global radiation [$\text{J cm}^{-2}\text{s}^{-1}$], air temperature [$^{\circ}\text{C}$], wind speed [ms^{-1}], atmospheric pressure [hPa], and air humidity [%].

Model used:

Hydrodynamic lake model HyLaM (Strauss et al. 2017: The power of hybrid modelling: An example from aquatic ecosystems. Ecological Modelling 364:77-88.

<https://doi.org/10.1016/j.ecolmodel.2017.09.019>)

Assumptions: Water level 1m, Secchi depth: 75 cm.

Adaptations of the Aachen weather data: 20% reduction of global radiation (e.g. caused by covering by water plants), and 30% increase in wind speed

Results:

Data output of the simulation at 6 am and 4 pm.

The measured data are mostly well matched by the simulations using the adapted Weather data from Aachen. The summed deviations between simulations and measurements are 1.8°C in the morning (8 AM), 1.9°C in the afternoon (4 PM).

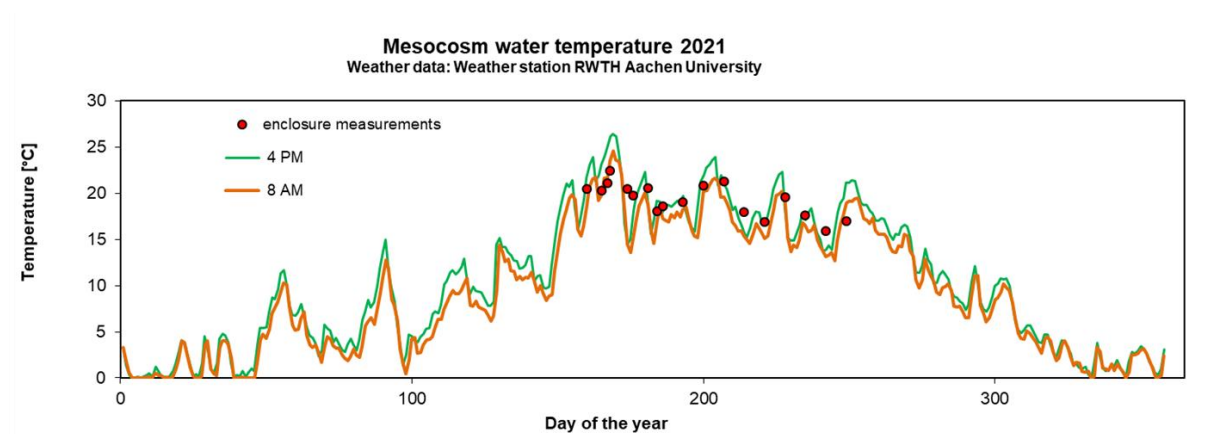


Fig. 1: Simulation **2021**, Field data from mesocosm GmbH, weather data from Aachen, Germany (+30% wind speed, -20% global radiation).

Additional data analysis:

Analysis / simulation of mesocosm water temperatures in 2021 using weather data from the weather station located 30 km from the mesocosms (mesocosm GmbH, Homberg, Germany) (data file: Weather-2013-2021_Station-35km-from-FNU-172mASL-Linden_MesocosmGmbH-ID:1404-66_Source-Hessisches-Landesamt-für-Naturschutz-Umwelt-und-Geologie_Stationnummer:1005_Stationcode-DEHE042-last-accessed-2022-22-07_www.hlnug.de)

Distances between stations:

Gießen, approx. 180 km östlich von Aachen (30 km from Homberg)

Kassel, approx. 240 km östlich von Aachen (60 km from Homberg)

Homberg, approx. 210 km east of Aachen

Results:

- A: Comparison of water temperature simulations in **2021** using Homberg (Gießen) weather data, and Aachen weather data. The mismatch between the Aachen (validated data) and Giessen weather data shows a clear inconsistency of the weather data from Gießen, these are not trustworthy.
- B: Comparison of simulations in **2019** using data from two weather stations near Homberg (Gießen, 30 km, and Kassel, 60 km distance). The comparison of the two weather stations Gießen and Kassel shows that Kassel does not fit quite as well, but could also be used if Gießen data are missing.
- C: Comparison of simulations in **2019** using data from the weather stations near Homberg (Gießen, 30 km) and RWTH Aachen University. The comparison of the weather stations Aachen and Gießen shows that Aachen weather data can also be used, provided that they sufficiently match the measurements in the mesocosms (see Figure C, but again Figure A).

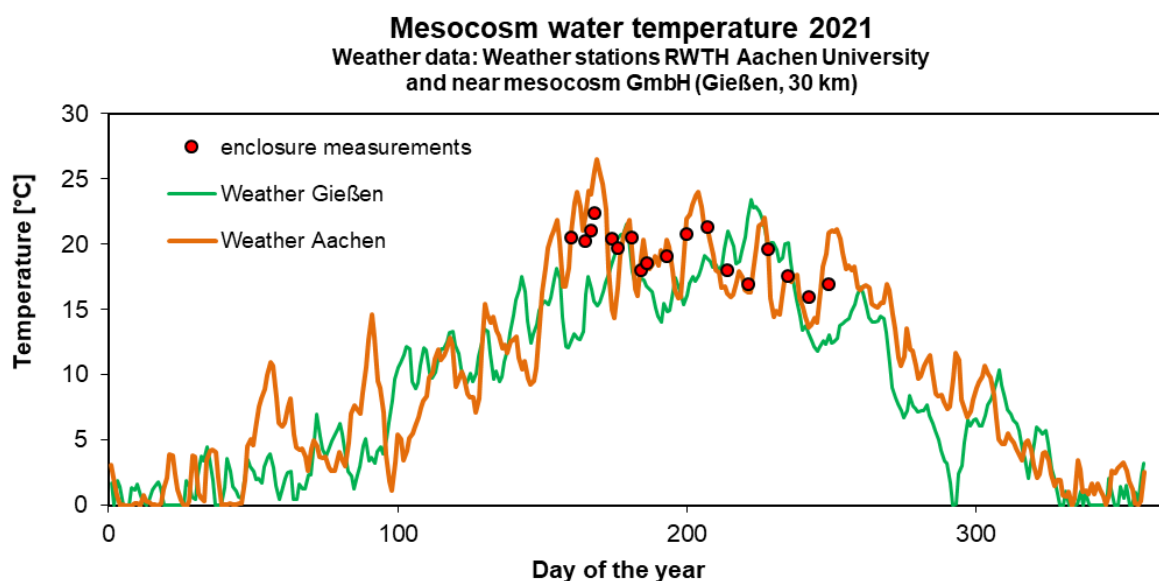


Fig. A: Simulation **2021**, Gießen and Aachen (+30% wind speed)

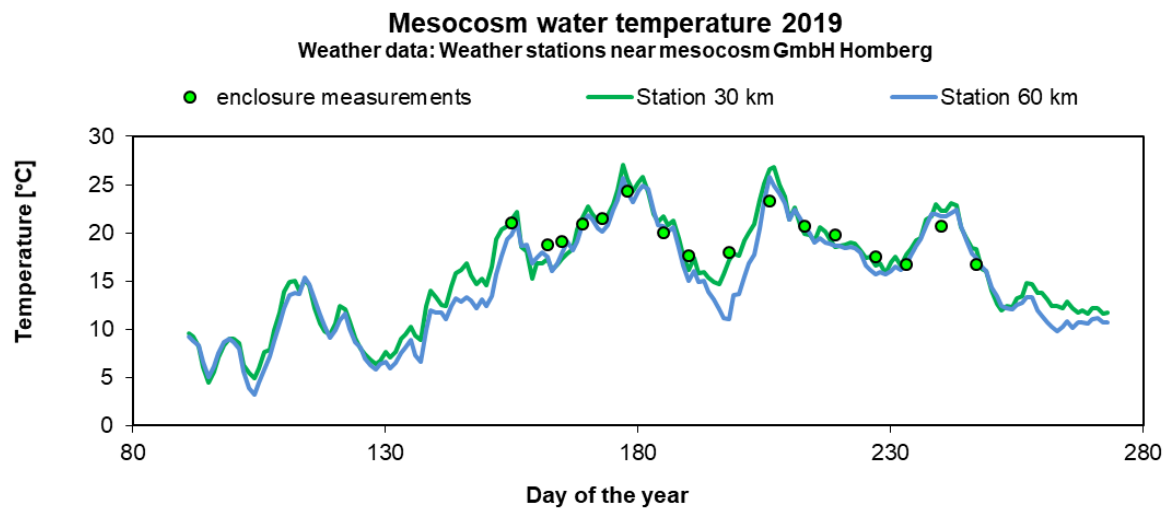


Fig. B: Simulation **2019**, weather stations near Homberg (Gießen, 30 km, and Kassel, 60 km)

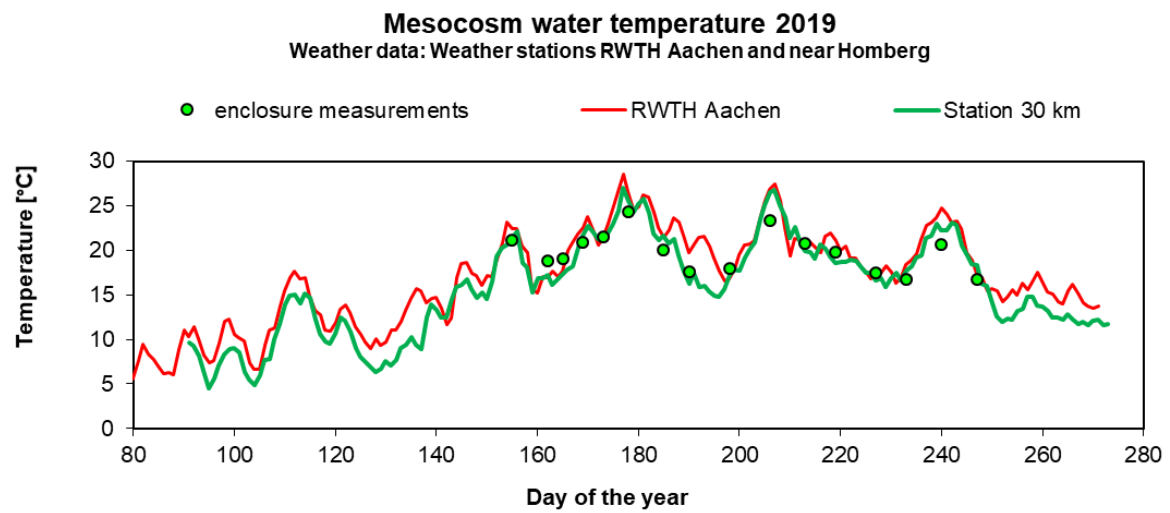


Fig. C: Simulation **2019**, weather stations near Homberg (Gießen, 30 km), and Aachen