

# Design and implementation of a Modelica library for glass greenhouses

## Greenhouse effect:

The greenhouse effect describes the effects of short-wave solar radiation on the greenhouse (Figure 1). Short-wave radiation (e.g. Light, UV-Rays) is transmitted through the greenhouse glass surface. Most of the radiation is absorbed by the floor, which in turn heats up and emits long-wave heat radiation (IR Radiation). The IR rays are reflected by the glass surfaces and again absorbed by the floor. This way most of the incoming energy is stored inside the greenhouse walls. As a result, the temperature inside the greenhouse rises.

## Model requirements:

- Simulation: accurate display of the Temperature inside a greenhouse over 24 hours
- Location: Campus of HS Pforzheim University with geometric orientation
- Greenhouse base area: 3 x 3 m
- Shading by surrounding buildings is neglected
- Adjustable ambient temperature
- Inside start temperature: 20°C

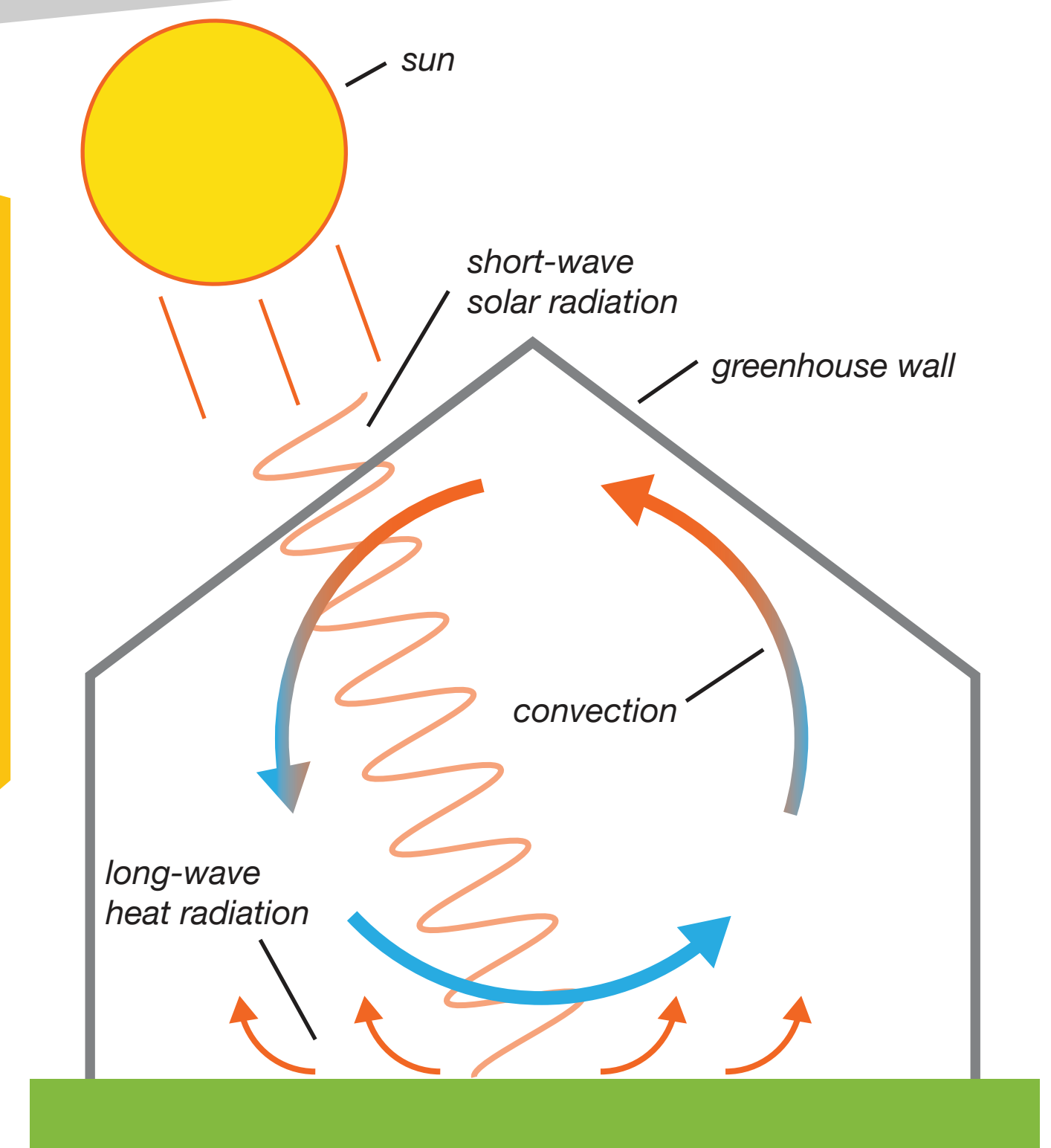


Figure1: Glasshouse effect

## Principle representation of the model and the variable parameters

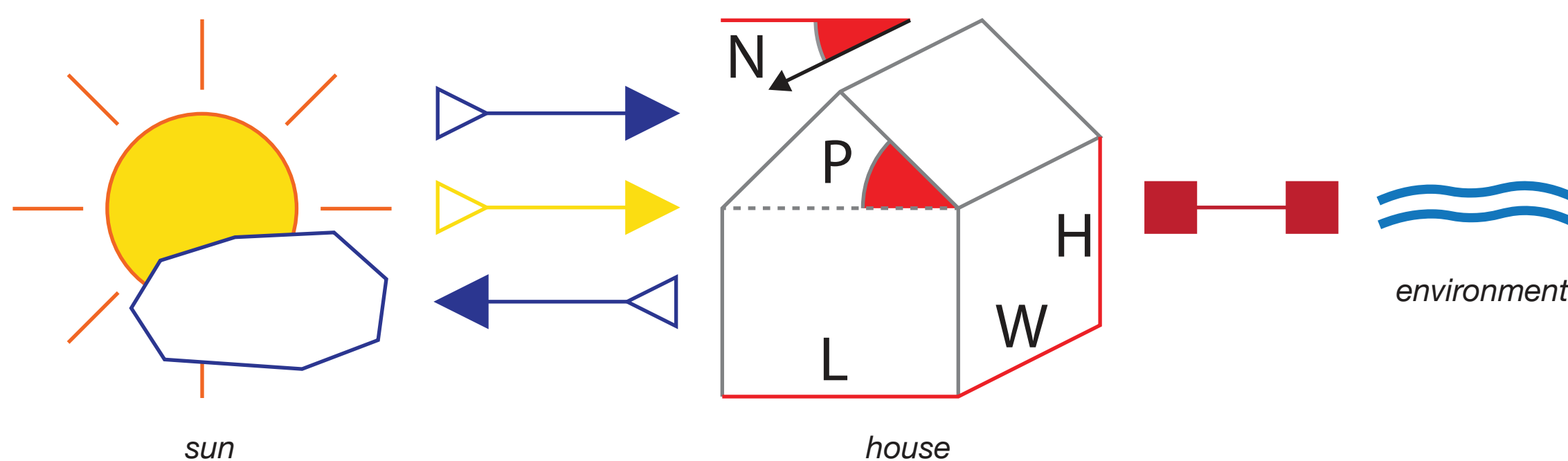


Figure 2: Outer model

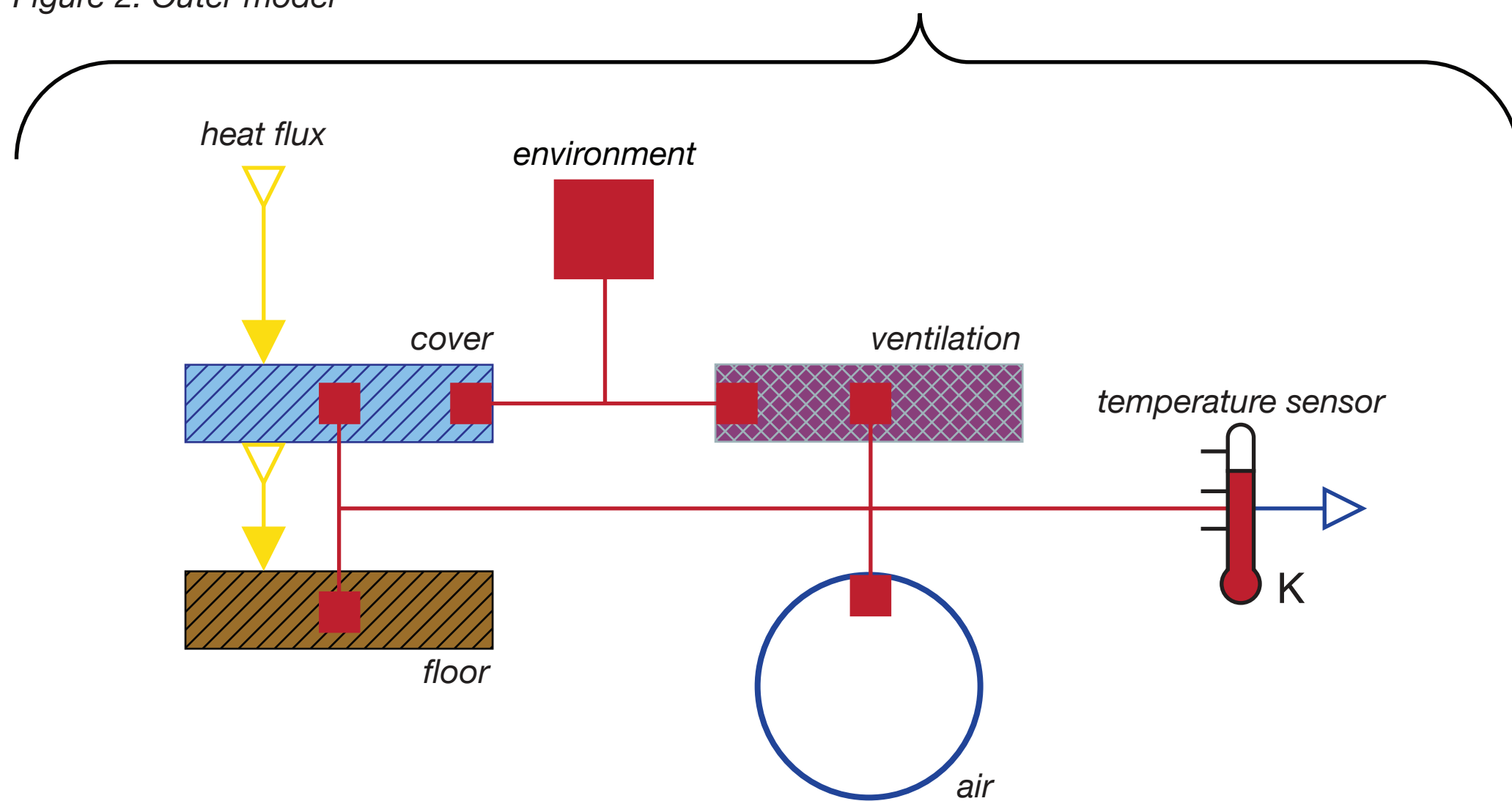


Figure 3: Inner model

## User adjustable model parameters (Figure 2):

Sun:

- Date
- Cloudiness

House:

- Global position parameters
- Geometry
- Thermal properties

Environment:

- Temperature profile

Inner model variables (Figure 3) depend on outer model implementation.

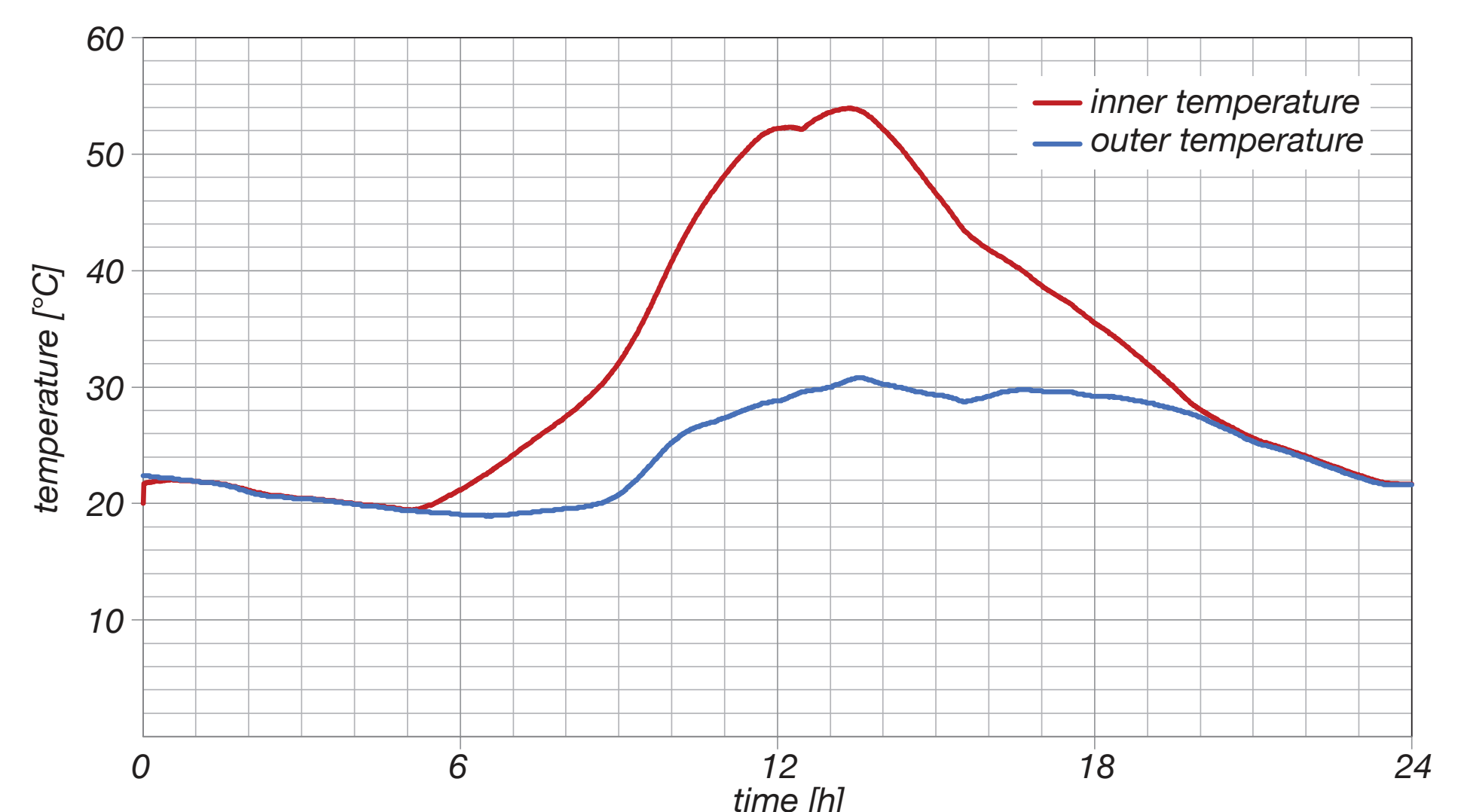


Figure 4: Temperature plot of an example simulation

## Simulation result (Figure 4)

- Temperature curves on 26.07.18
- Inactive ventilation
- Solar radiation heats up the greenhouse
- The influence of solar radiation is higher than the dissipated energy through the greenhouse wall

