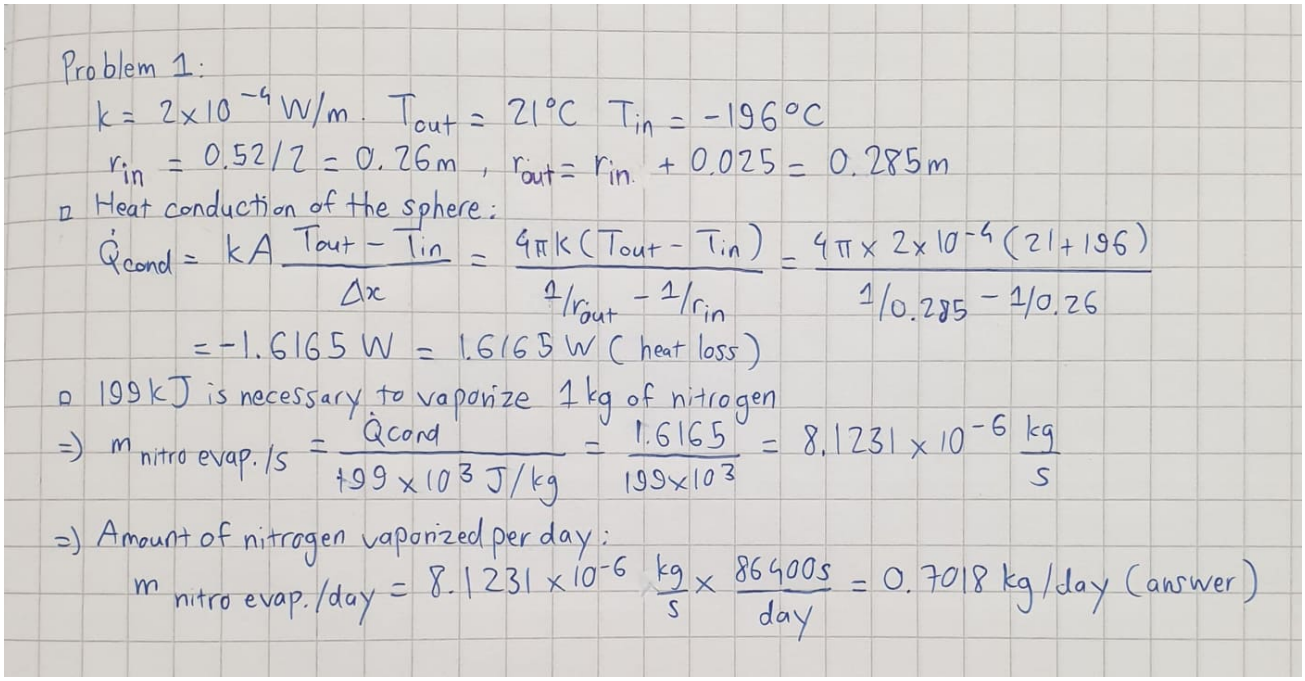
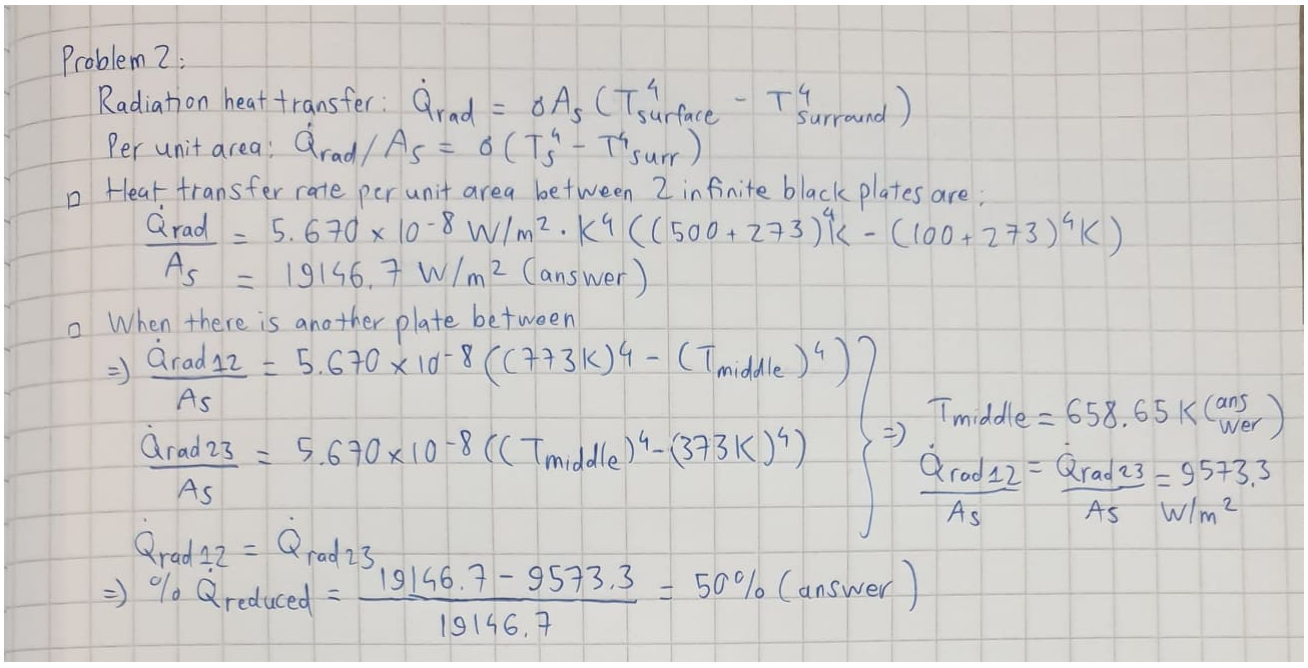
Thermodynamics and Heat Transfer LE6 Part 1
Nguyen Xuan Binh 887799

Problem 1: A certain superinsulation material having a thermal conductivity of 2 × 10-4 W/m.◦C is used to insulate a tank of liquid nitrogen that is maintained at -196◦C; 199 kJ is required to vaporize each kilogram mass of nitrogen at this temperature. Assuming that the tank is a sphere having an inner diameter (ID) of 0.52 m, estimate the amount of nitrogen vaporized per day for an insulation thickness of 2.5 cm and an ambient temperature of 21◦C. Assume that the outer temperature of the insulation is 21◦C (10 points)



Problem 2: Two infinite black plates at 500 and 100◦C exchange heat by radiation. Calculate the heat transfer rate per unit area. If another perfectly black plate is placed between the 500 and 100◦C plates, by how much is the heat transfer reduced? What is the temperature of the center plate (10 points)?

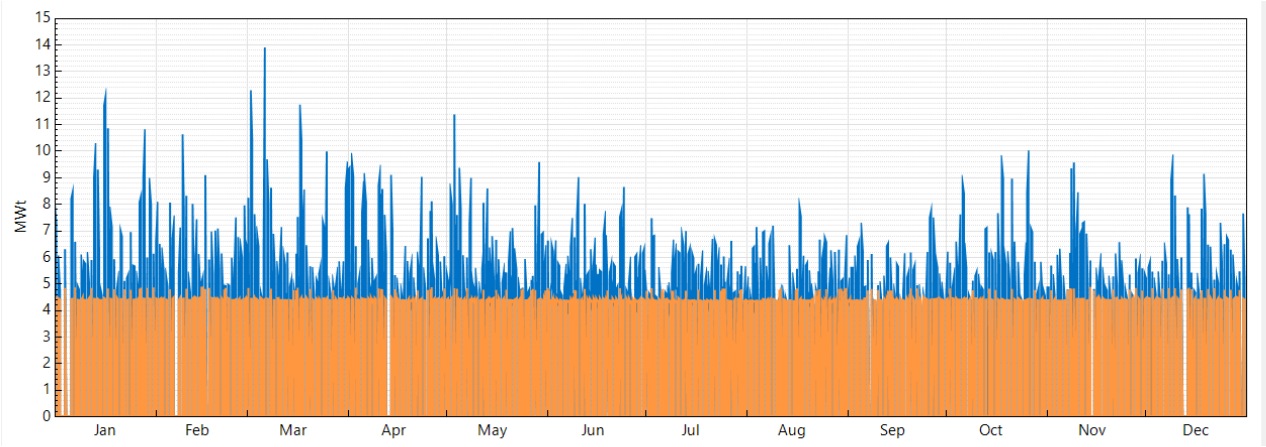


Problem 3: Regarding the lecture 11, describe the receiver power loss in a solar power tower system. You should report all figures regarding power loss in a power tower system, preheater, boiler and superheater parts as well as total values, (use SAM) (30 points).

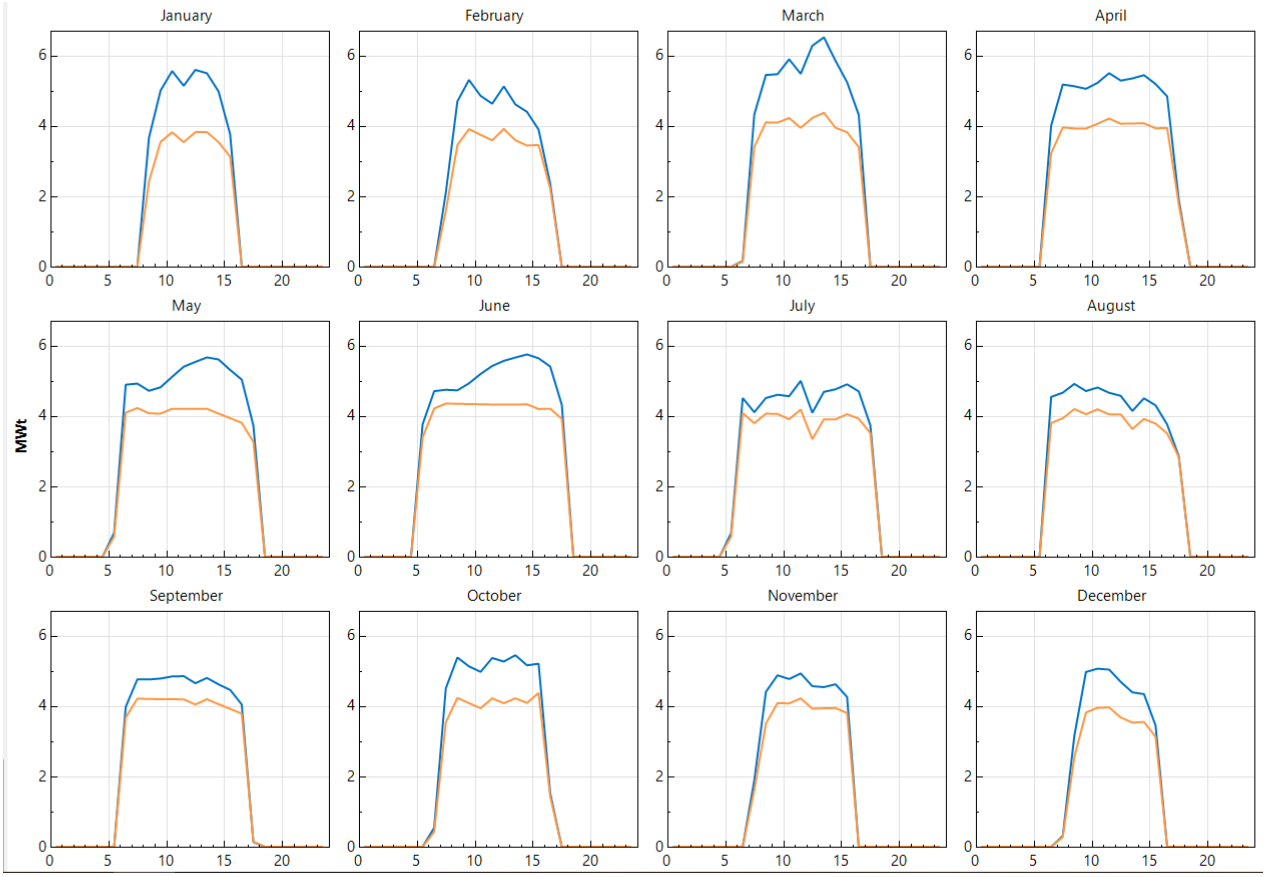
Since the solar power tower system receives radiation heat transfer from the sun as well as convection heat transfer from the surrounding flowing air and wind, there are mainly two kinds of loss: convection and radiation loss. Power loss in the solar power tower system are as follows:

- **Receiver Reheater power loss to convection (blue) and radiation (orange)**

Time Series

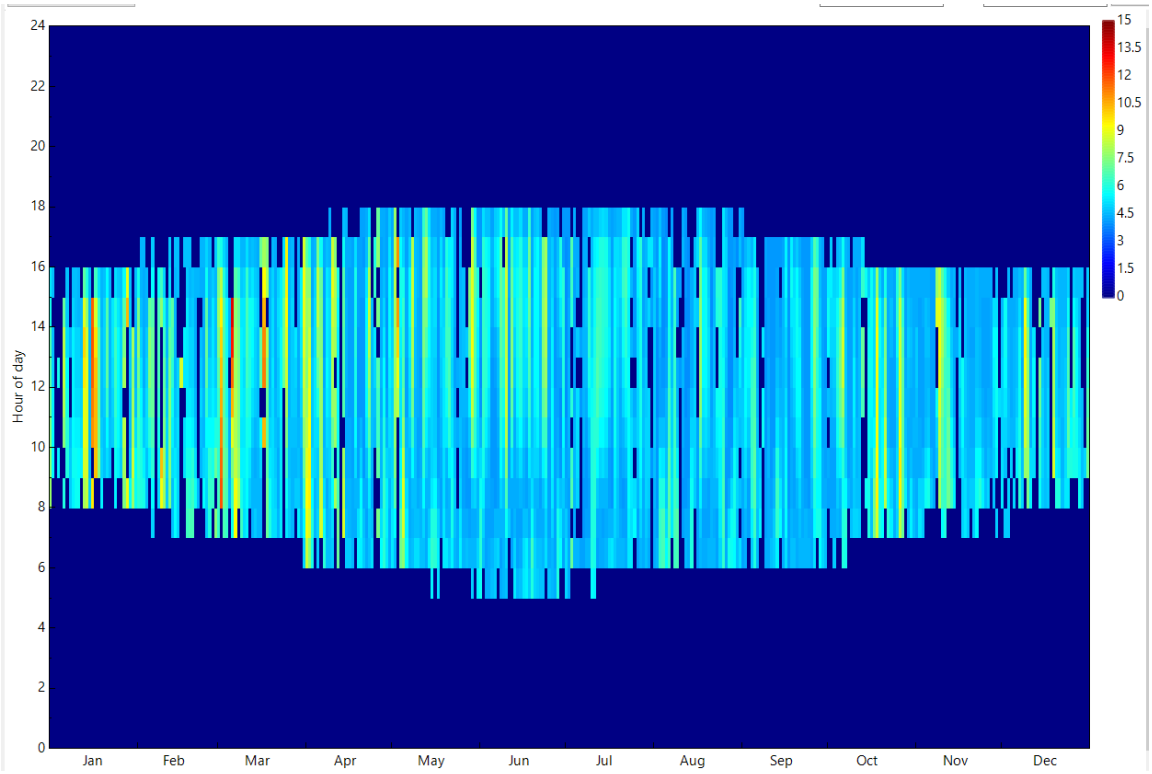


Monthly Profile

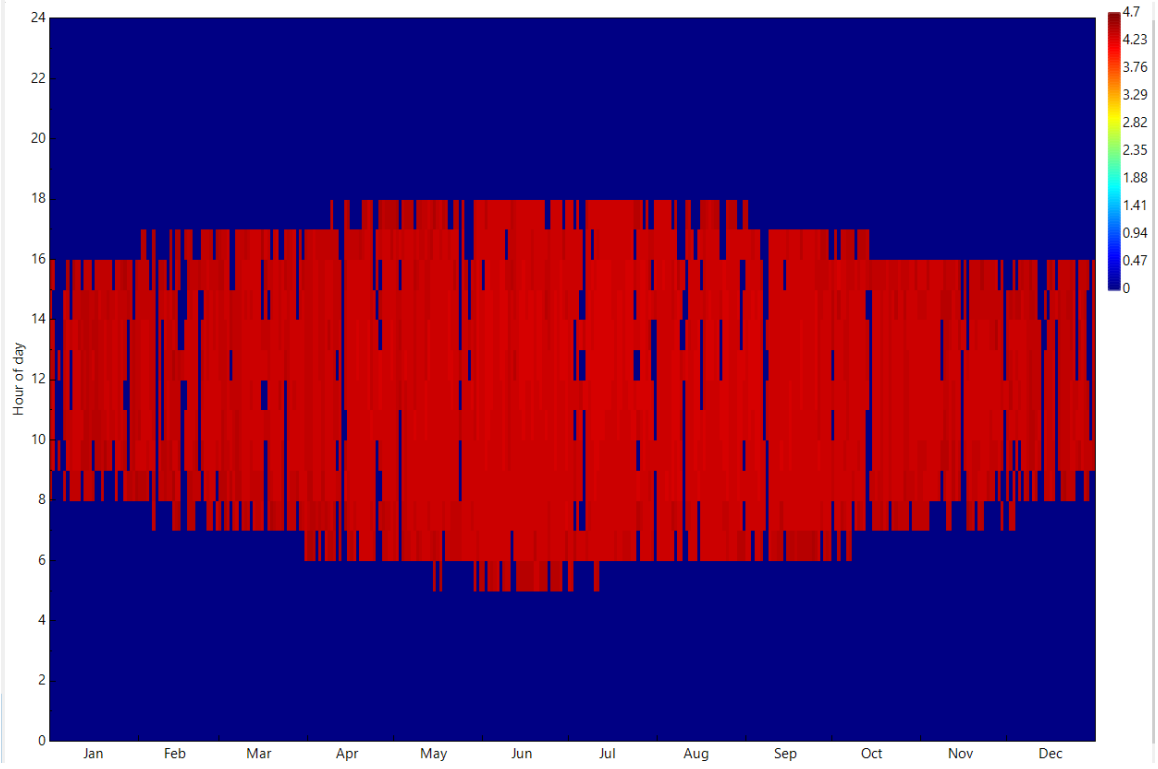


Heat Map

- Convection loss

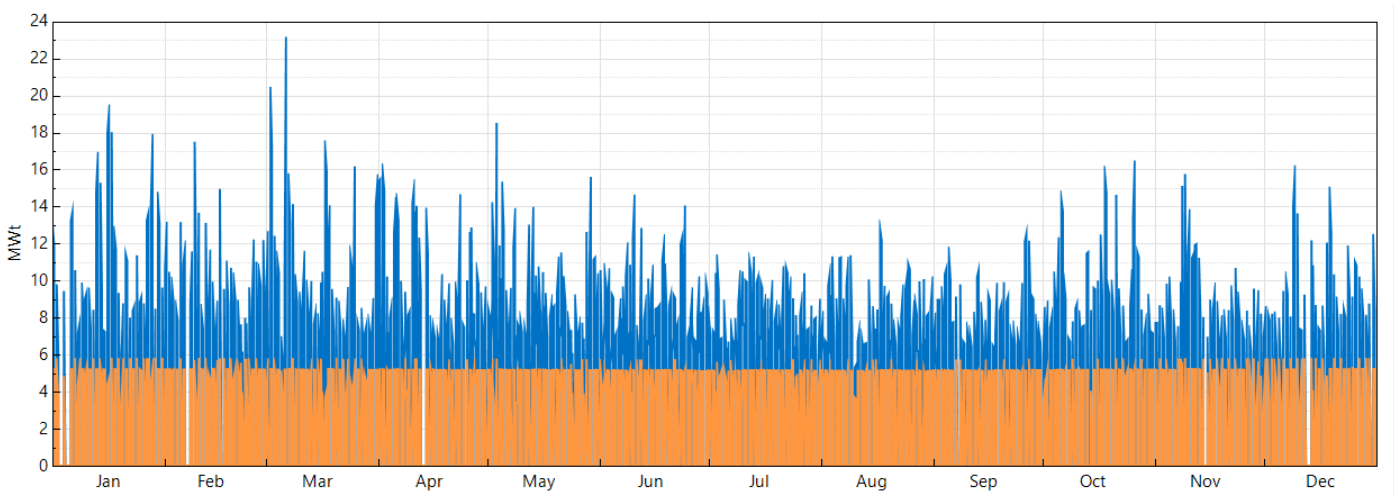


- Radiation loss

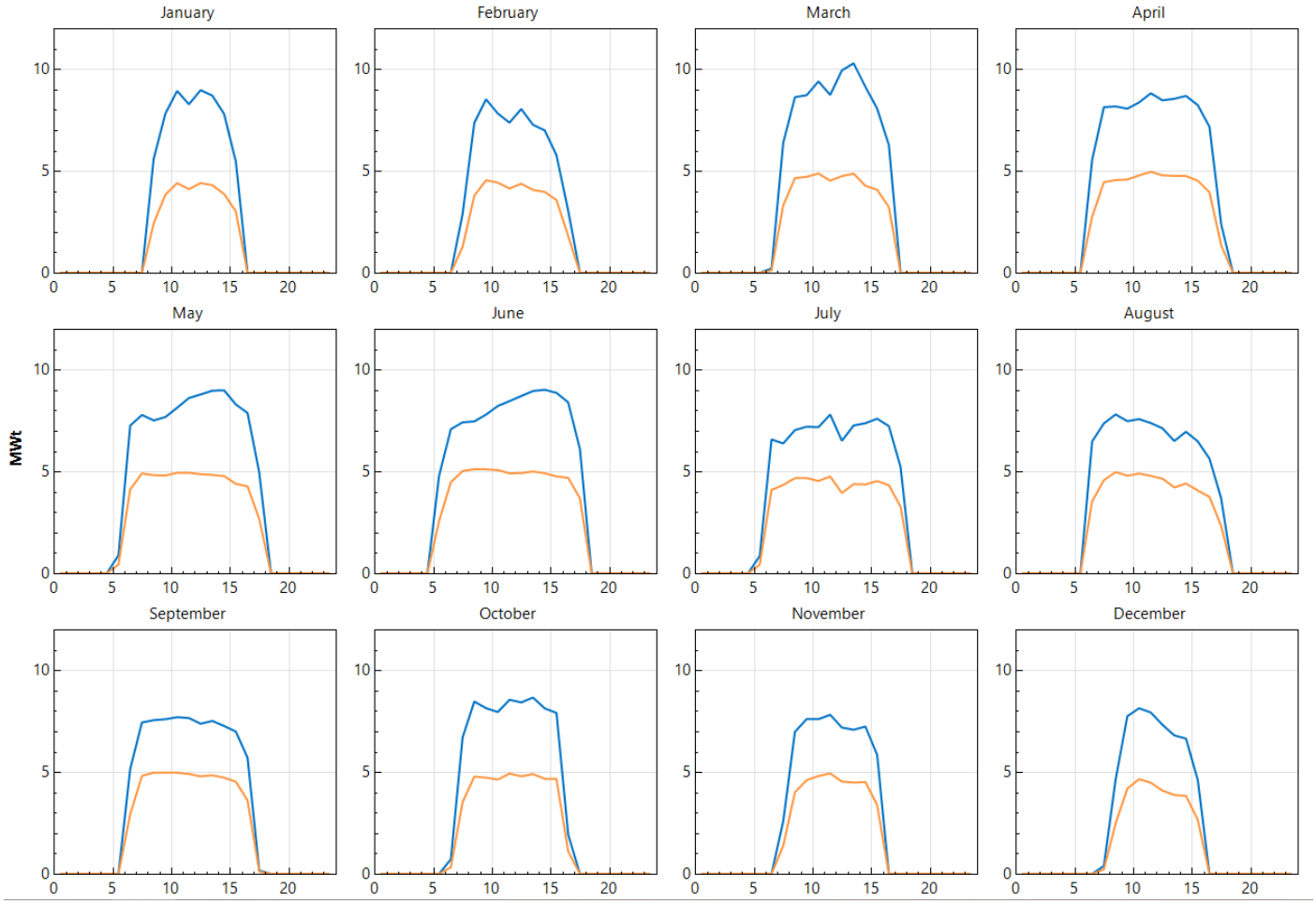


- **Receiver boiler power loss to convection (blue) and radiation (orange)**

Time Series

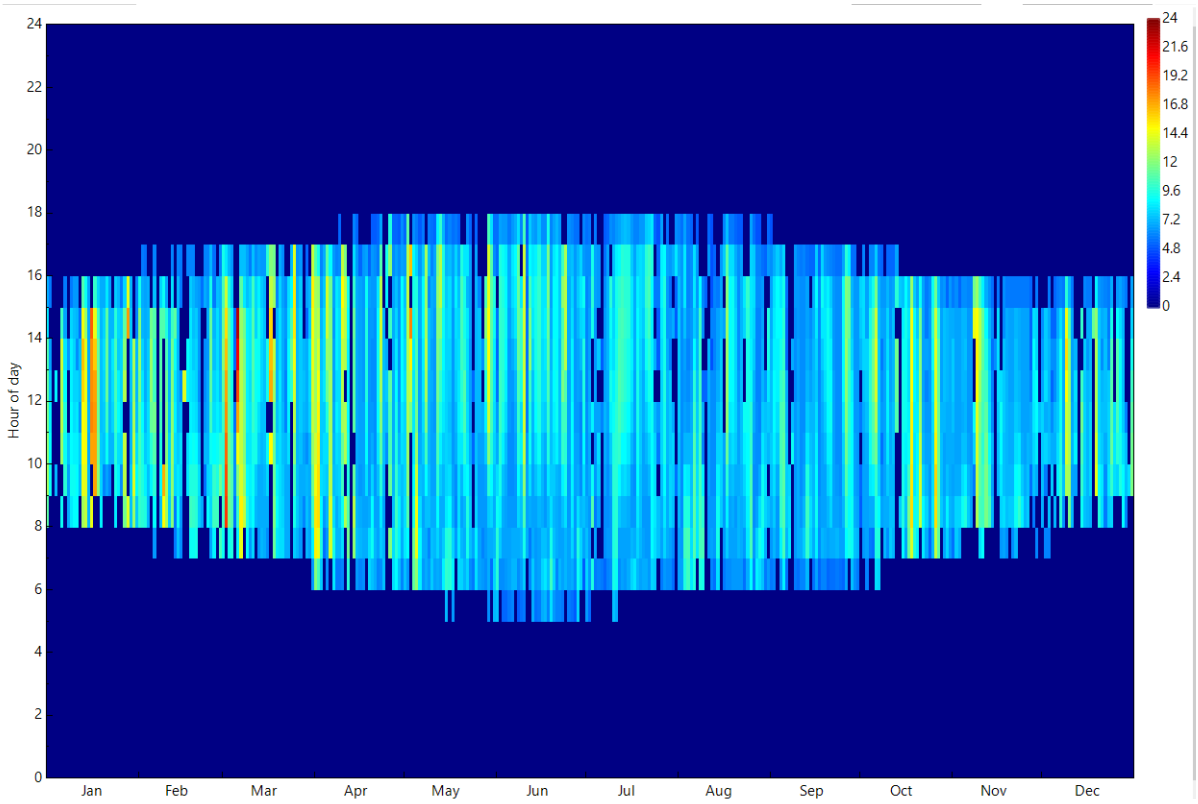


Monthly Profile

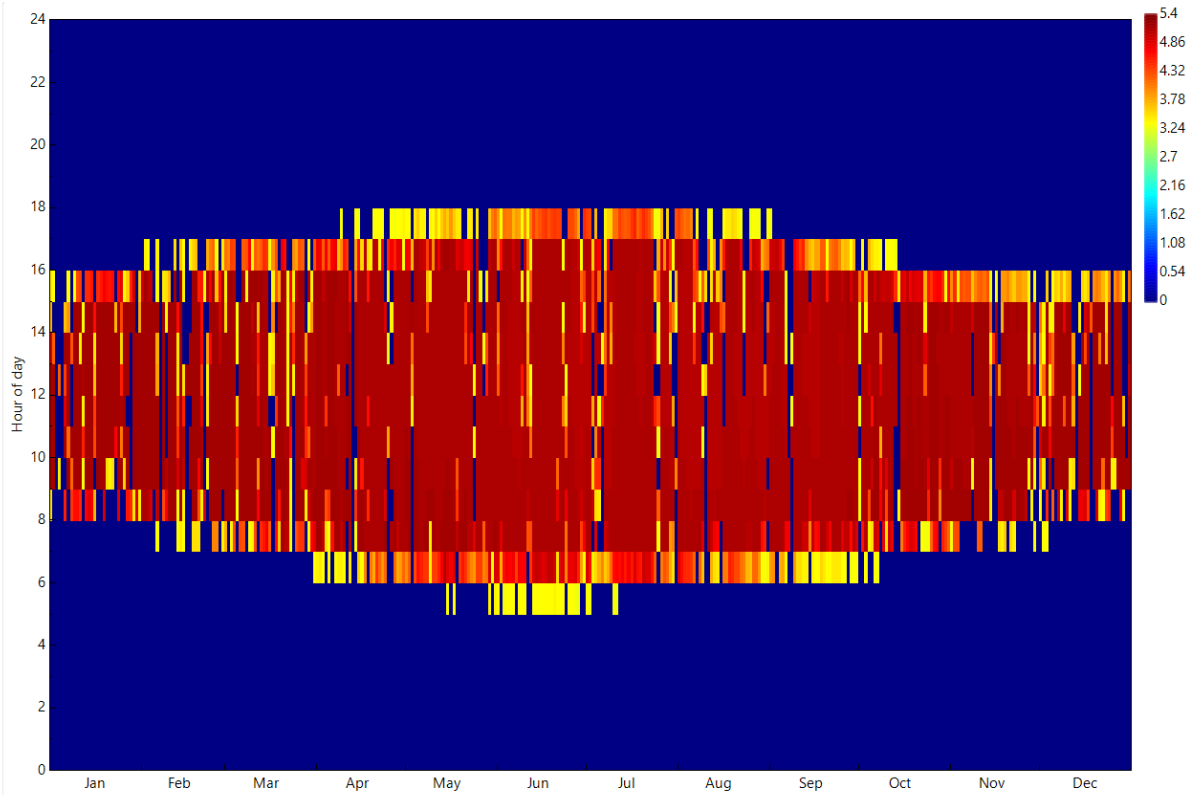


Heat Map

- Convection loss

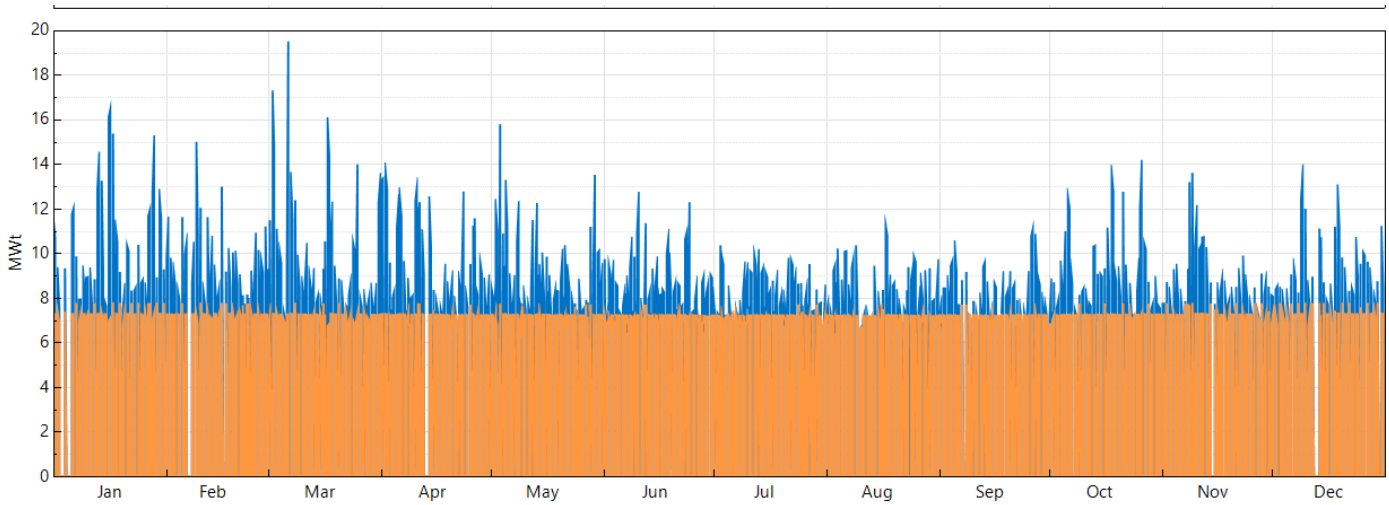


- Radiation loss

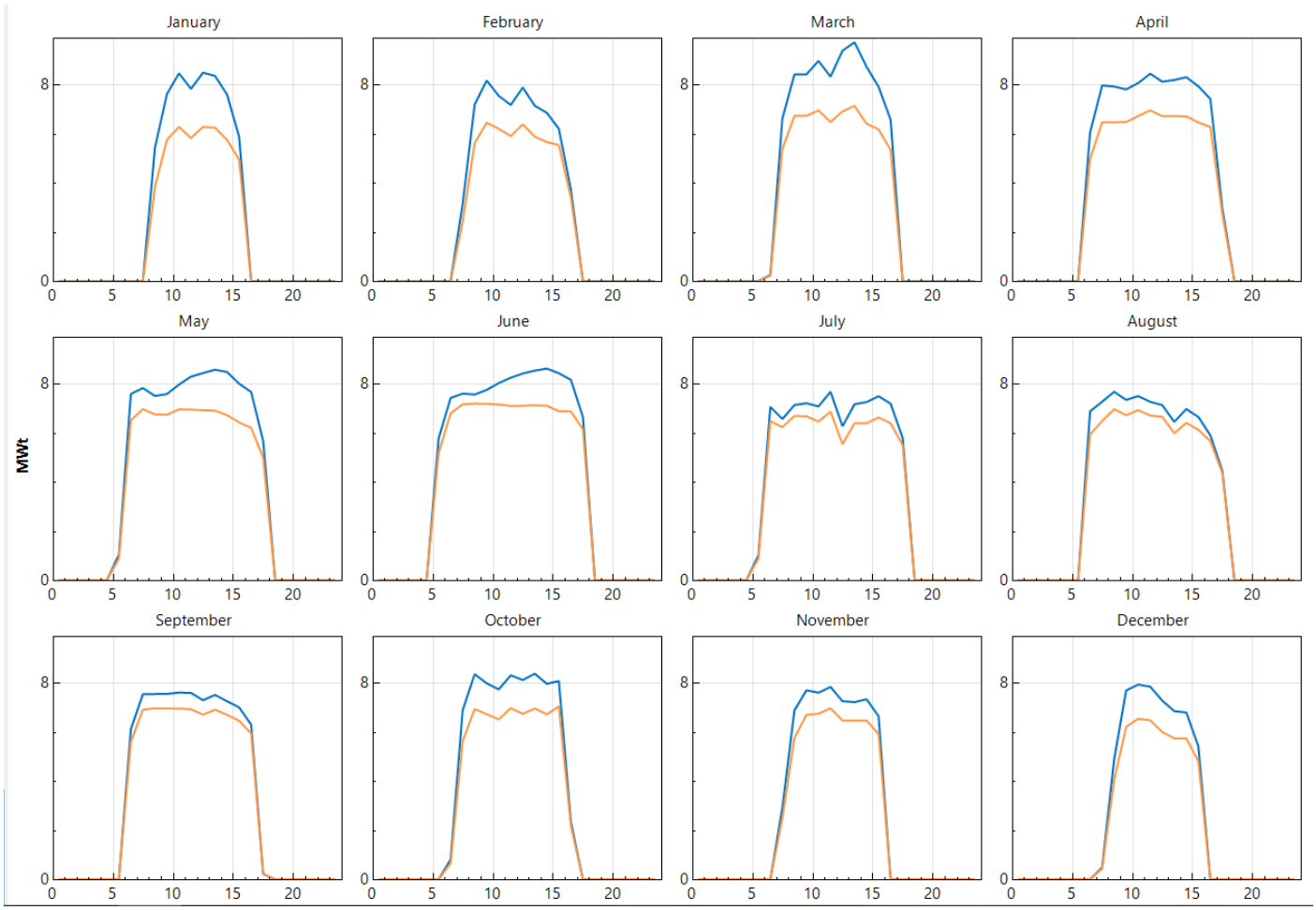


- **Receiver Superheater power loss to convection (blue) and radiation (orange)**

Time Series

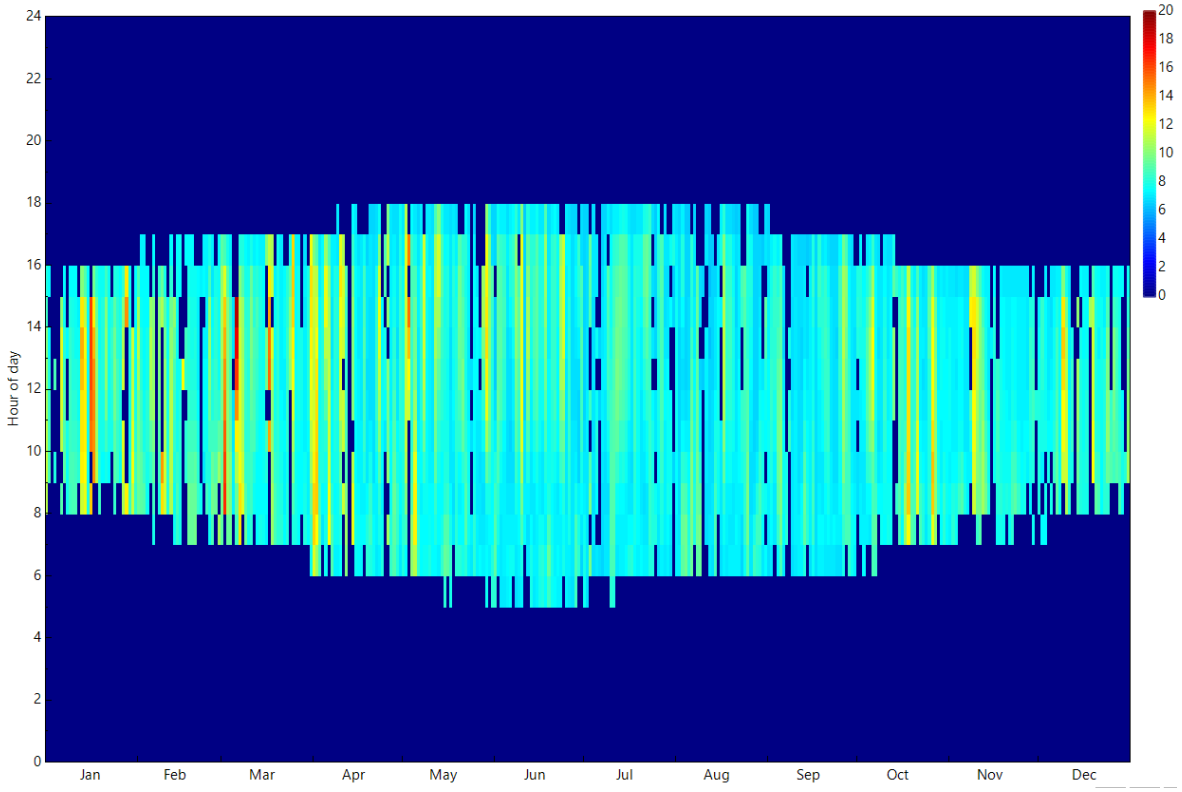


Monthly Profile

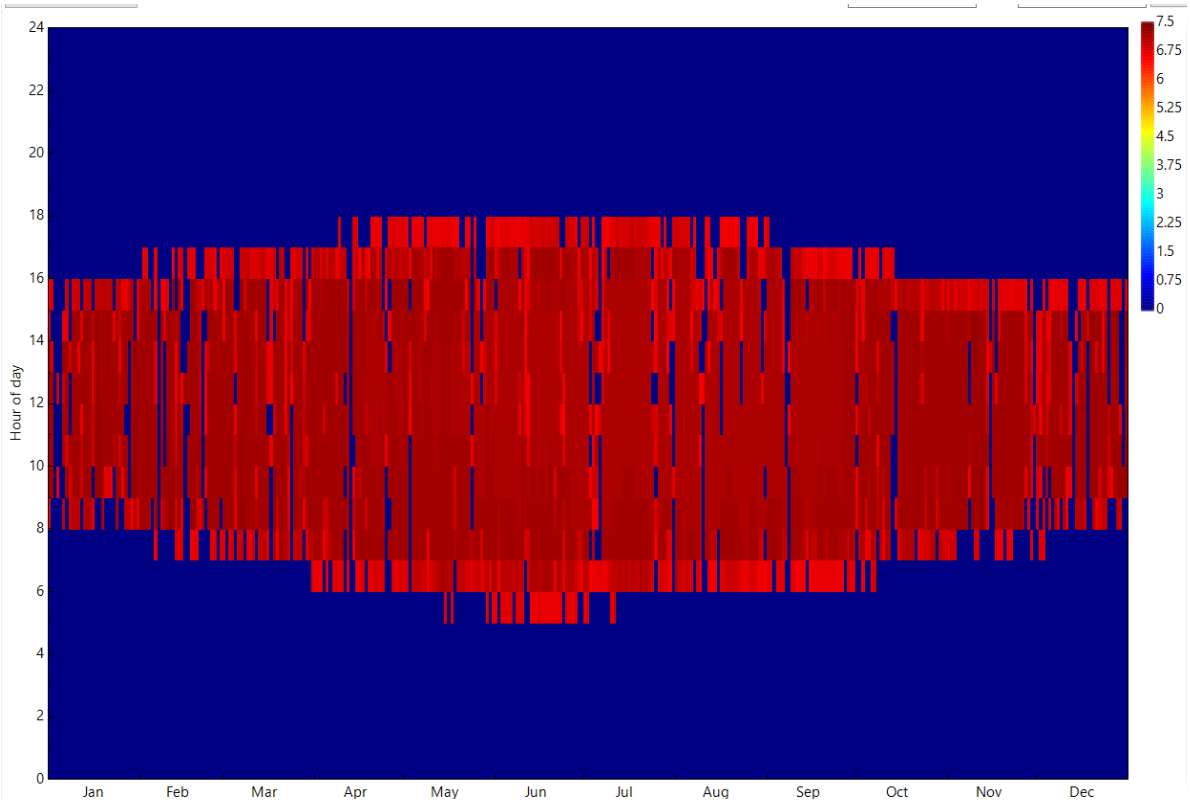


Heat Map

- Convection loss

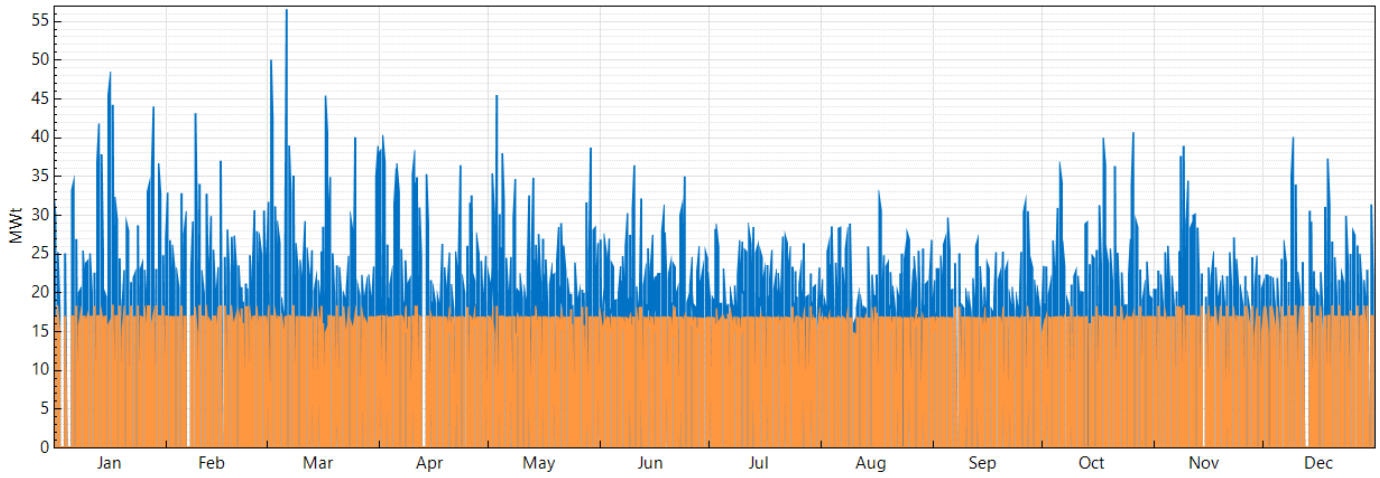


- Radiation loss

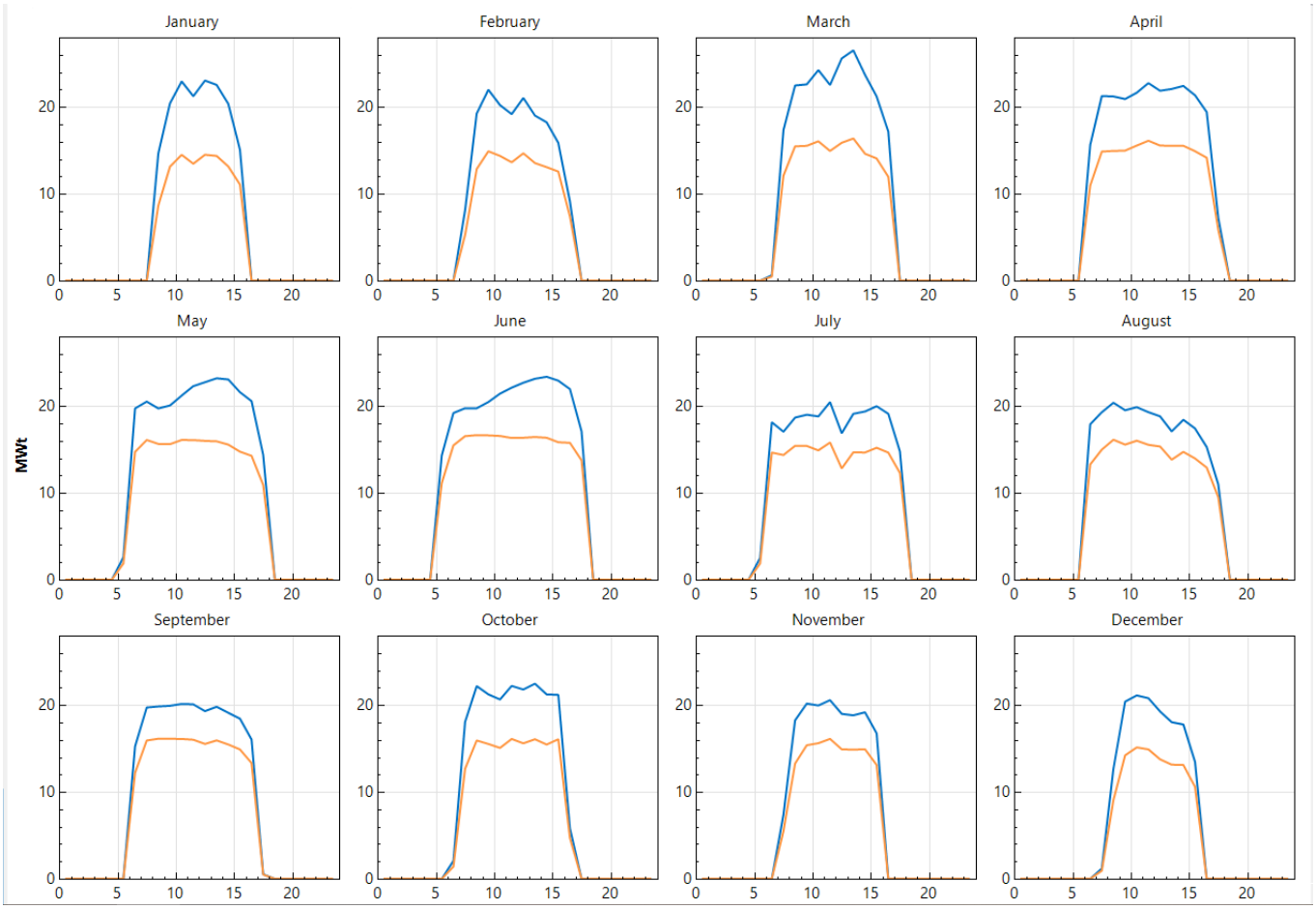


- **Total receiver power loss to convection (blue) and radiation (orange)**

Time Series

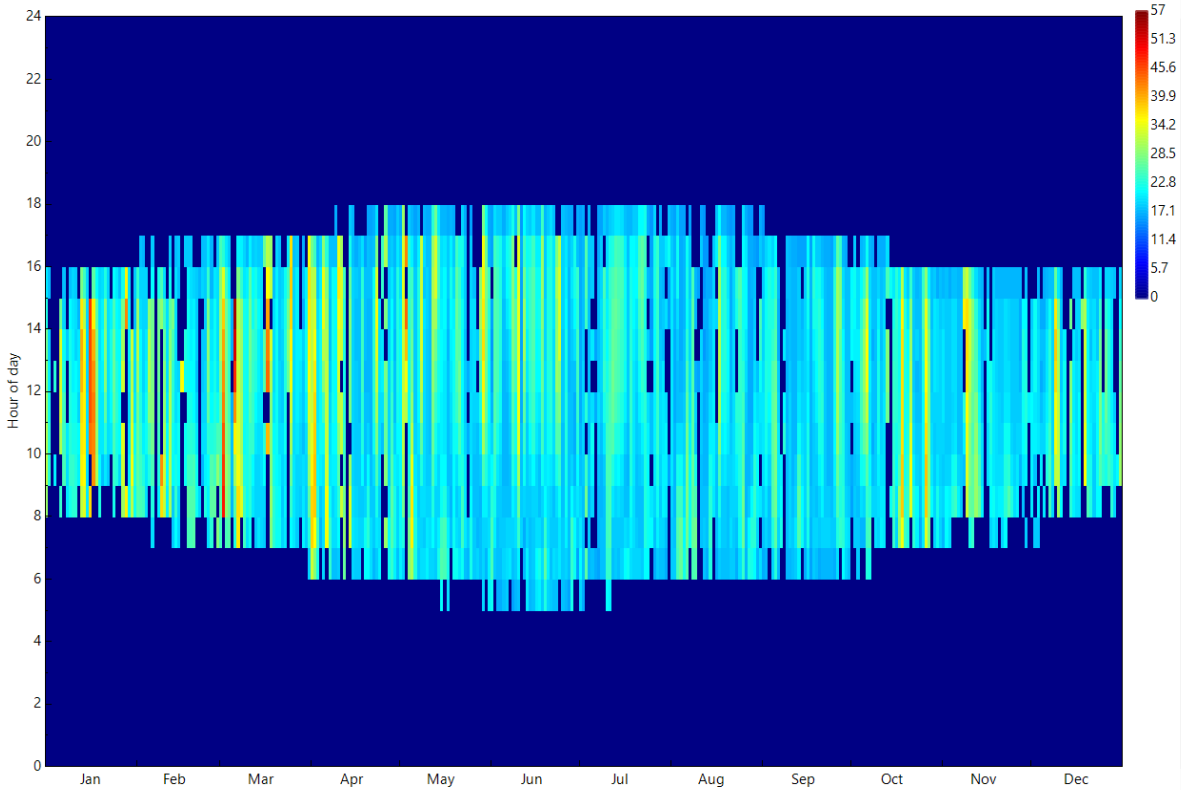


Monthly Profile



Heat Map

- Convection loss



- Radiation loss