

# ICSolar Model

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Consider the model of air and water interaction consisting of an initial inlet region (denoted by 0) and a pair of regions, an open region with pipe followed by a module, denoted by (1,2) satisfying

$$W_1 : \quad \dot{m}_w C_{p,w}(T_{w,1} - T_{w,0}) - h_{wa}(T_{a,1} - T_{w,1}) = 0 \quad (1)$$

$$A_1 : \quad \dot{m}_a C_{p,a}(T_{a,1} - T_{a,0}) - h_{wa}(T_{w,1} - T_{a,1}) - h_e(T_e - T_{a,1}) - h_i(T_i - T_{a,1}) = 0 \quad (2)$$

$$W_2 : \quad \dot{m}_w C_{p,w}(T_{w,2} - T_{w,1}) - Q_w = 0 \quad (3)$$

$$A_2 : \quad \dot{m}_a C_{p,a}(T_{a,2} - T_{a,1}) - Q_a = 0 \quad (4)$$

Where  $i$  and  $e$  are interior and exterior contributions. Each pair of these forms a ‘module’. In this work, we use

$$C_{p,w} = 4.218 kJ/(kgK) \quad (5)$$

$$\dot{m}_w = 0.0008483 kg/s \quad (6)$$

$$C_{p,a} = 1.005 kJ/(kgK) \quad (7)$$

$$\dot{m}_a = 0.384 kg/s \quad (8)$$

$$h_{wa} = 4.823 \times 10^{-5} kW/(Km) \quad (9)$$

$$h_i = 1.572 \times 10^{-4} kW/(Km) \quad (10)$$

$$h_e = 4.837 \times 10^{-4} kW/(Km) \quad (11)$$

$$(12)$$

With Initial and Boundary Conditions of  $T_{a,0} = 20C$ ,  $T_i = 25.0C$ ,  $T_e = 22.5C$ . At this point, we set  $Q_a = 0$  as the surrounding air acts like a reservoir and its effect is currently minimal. Our inputs are  $T_{w,0}$  and  $Q_w$  from experimental data. We take experimental data from the file `nov25_2.csv` located in the github repository.

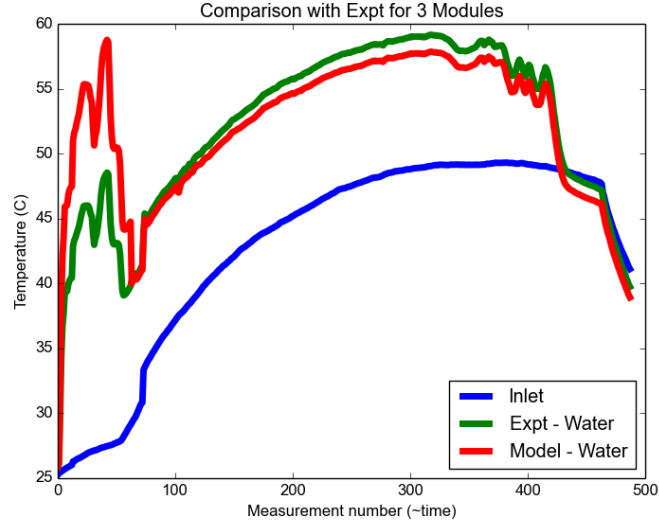


Figure 1: Comparison between experiment and model for 3 modules, water temperature in last module compared.

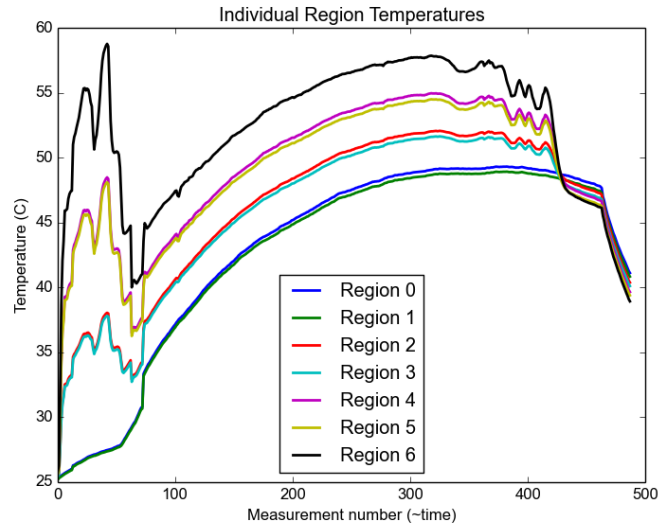


Figure 2: Model results for 3 module case, using experimental inputs. Regions 2,4,6 correspond to modules.

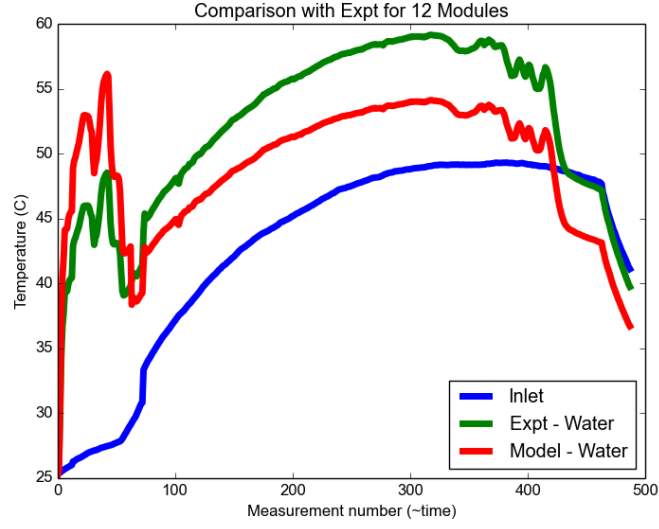


Figure 3: Comparison between experiment (3 modules) and model (12 modules), water temperature in last module compared.

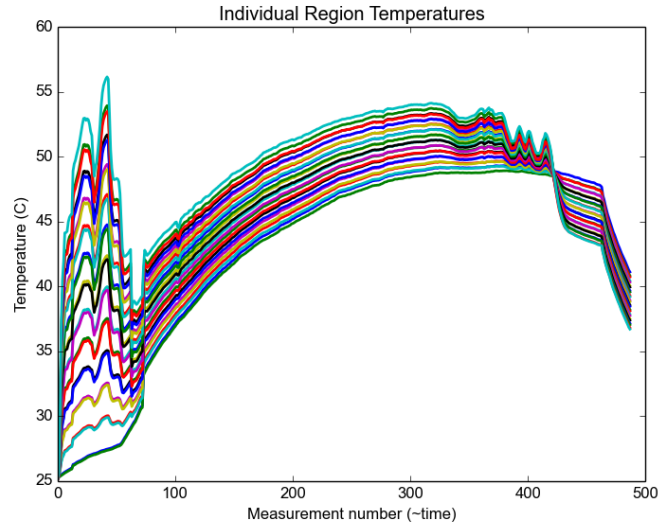


Figure 4: Model results for 3 module case, using experimental inputs. Legend not shown, but self explanatory.