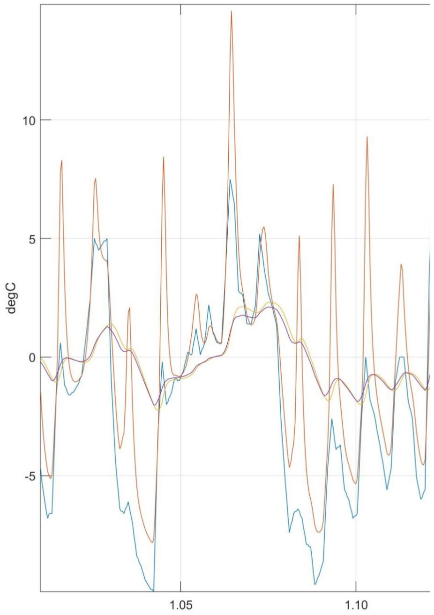
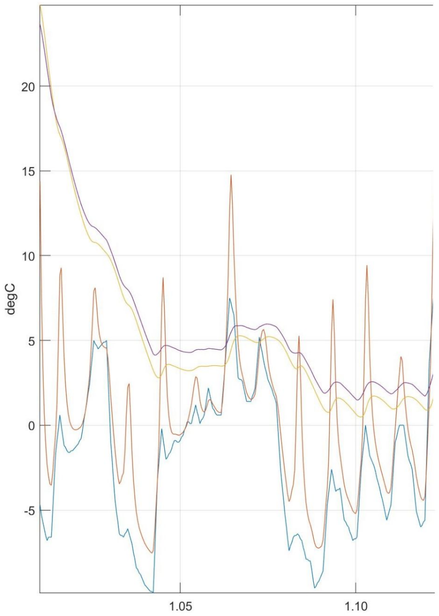
2D unsteady Heat-transfer with **warmup**
/
Imitating **3D Heat-transfer model**

2017170377 Kim Hanjoo



10
5
0
-5
degC
1.05
1.10

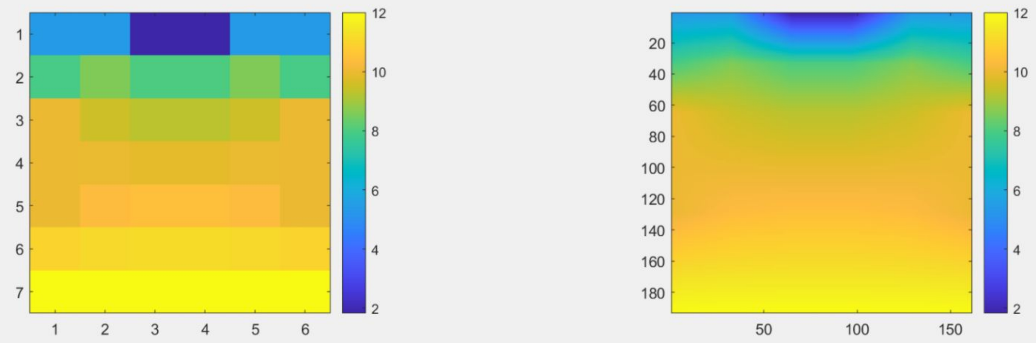


20
15
10
5
0
-5
degC
1.05
1.10

6-6-6-3D-Heat-transfer-model

simple **6-6-6 size 3D ground Heat-transfer model**

with unsteady 2D heat-transfer room model



https://github.com/suhyuuk/6-6-6-3D-Heat-transfer-model

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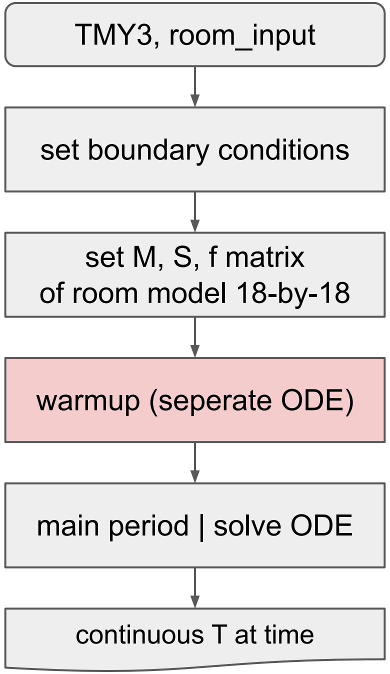
2D unsteady Heat-transfer with **warmup**

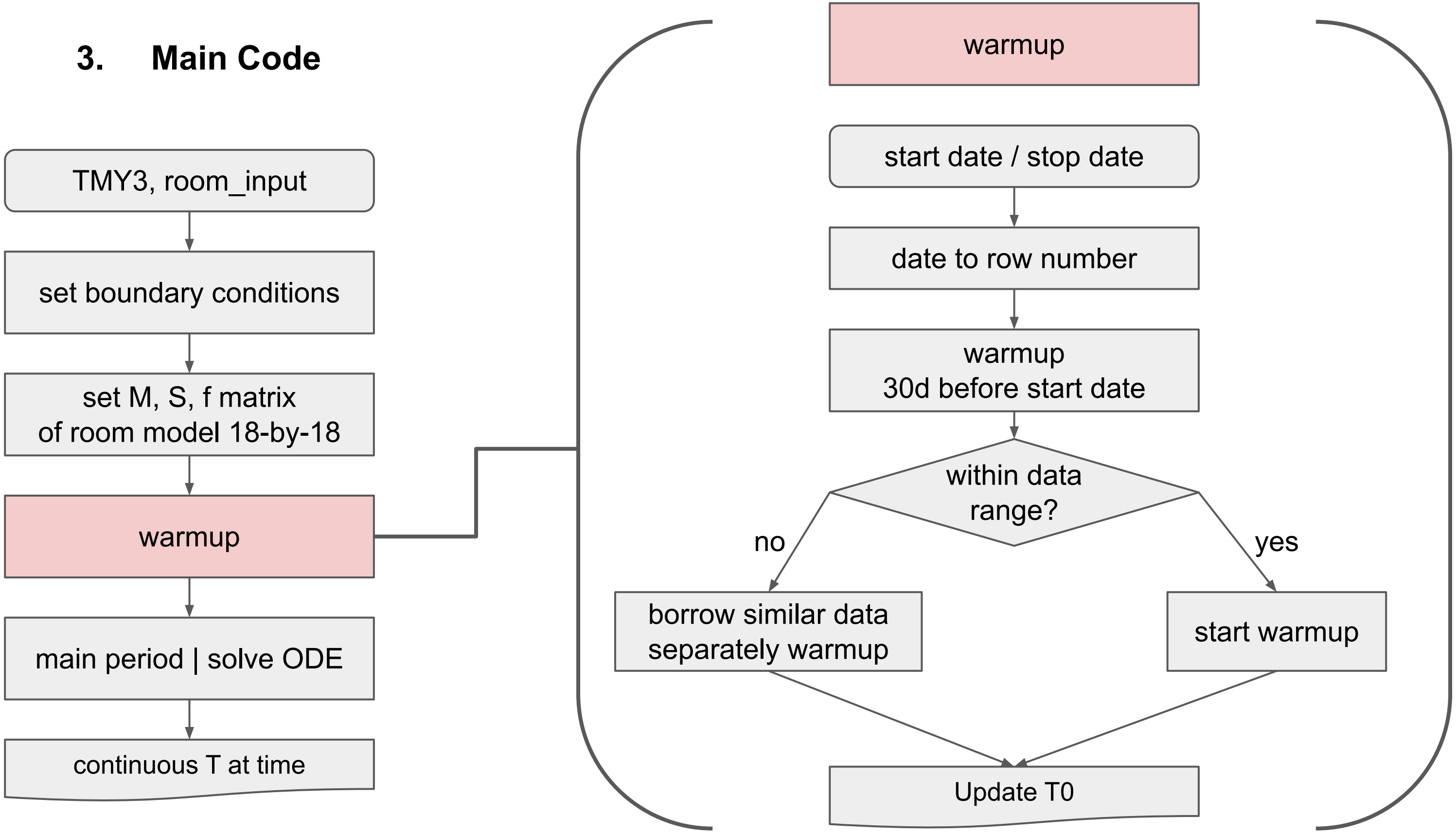
1) Algorithm

3. Main Code



1) Algorithm

3. Main Code



2) Code

0. set T01, T02

1. beyond the scope

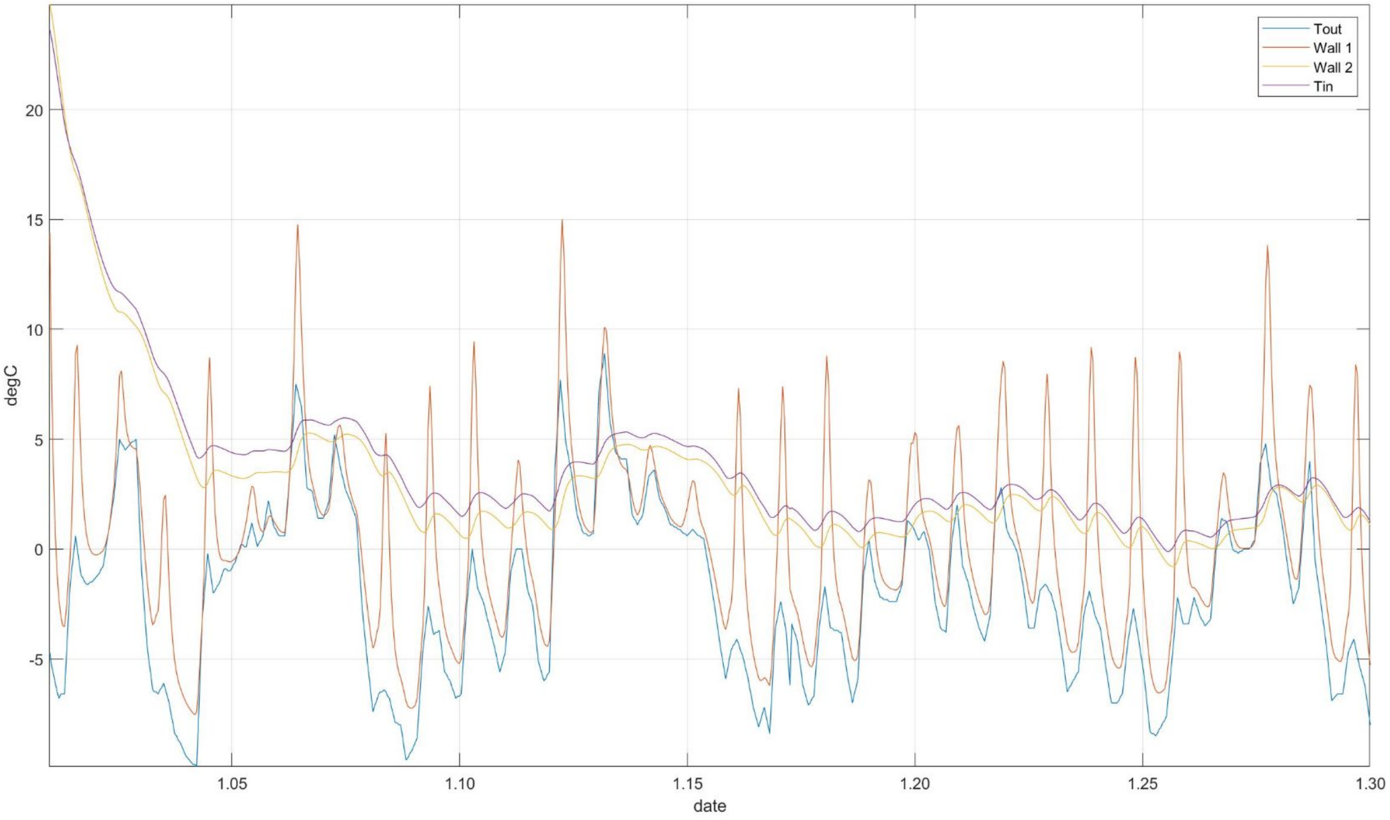
1-1) warmup in similar data

1-2) back to original data

2. within the scope

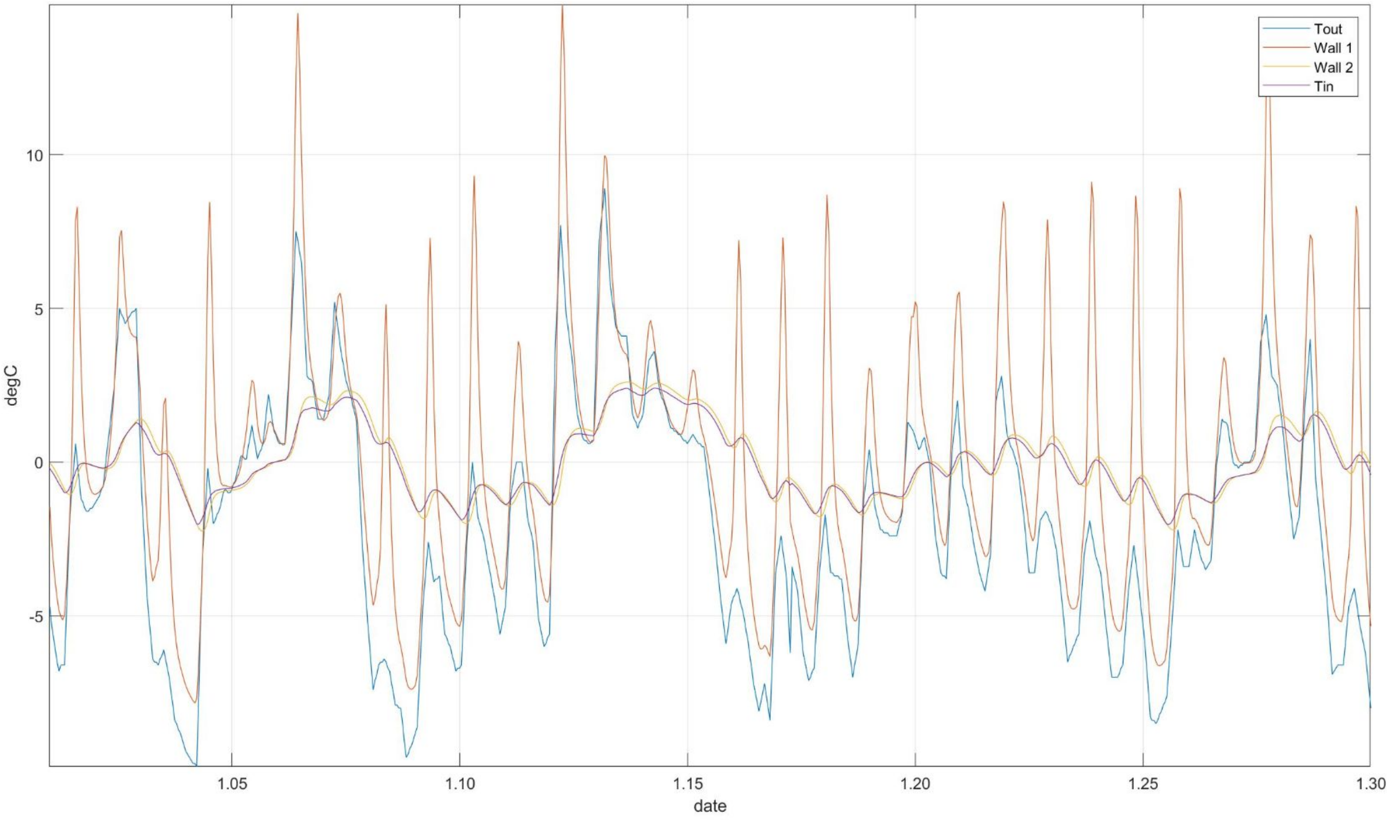
```
%% warmup
T_preheating1=zeros(24*30,N_node);
T_preheating2=zeros(24*30,N_node);

tspan=[0:1];

T01=T0;
T02=T0;

if D1-30*24<0
    D01=N_weather+D1-30*24+1;
    for i=1:30*24-D1
        f(16,1)=weather(D01+i-1,4);
        [t,T]=unsteady(tspan,T01,M,S,f);
        T01=T(end,:);
        T_preheating1(i,:)=T01;
    end
    T02=T_preheating1(30*24-D1,:);
    for i=1:D1
        f(16,1)=weather(i,4);
        [t,T]=unsteady(tspan,T02,M,S,f);
        T02=T(end,:);
        T_preheating2(i,:)=T02;
    end
end
if D1-30*24>0
    for i=1:30*24
        f(16,1)=weather(D1-30*24+1,4);
        [t,T]=unsteady(tspan,T01,M,S,f);
        T01=T(end,:);
        T_preheating2(i,:)=T01;
    end
end
T00=T_preheating2(end,:);
```

3) Plotting

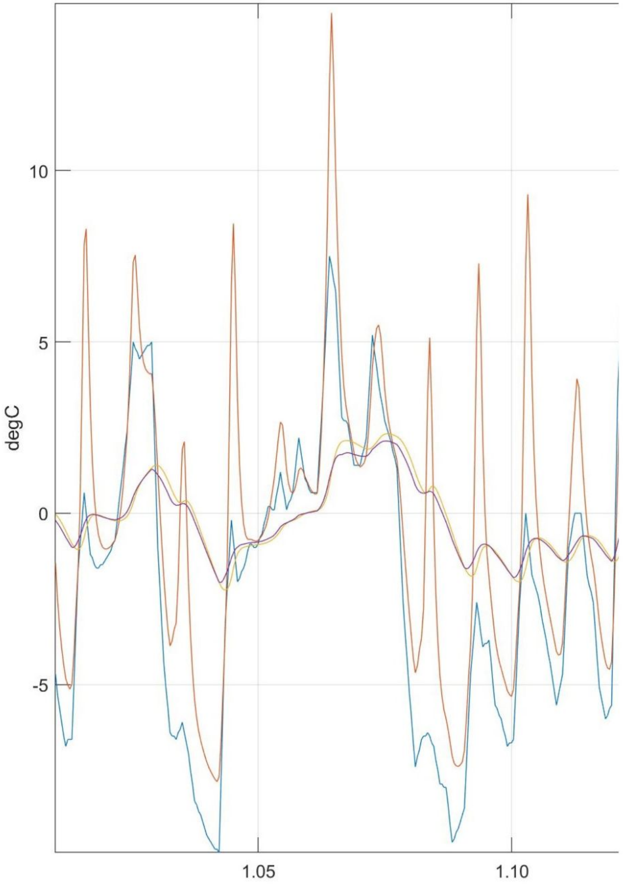


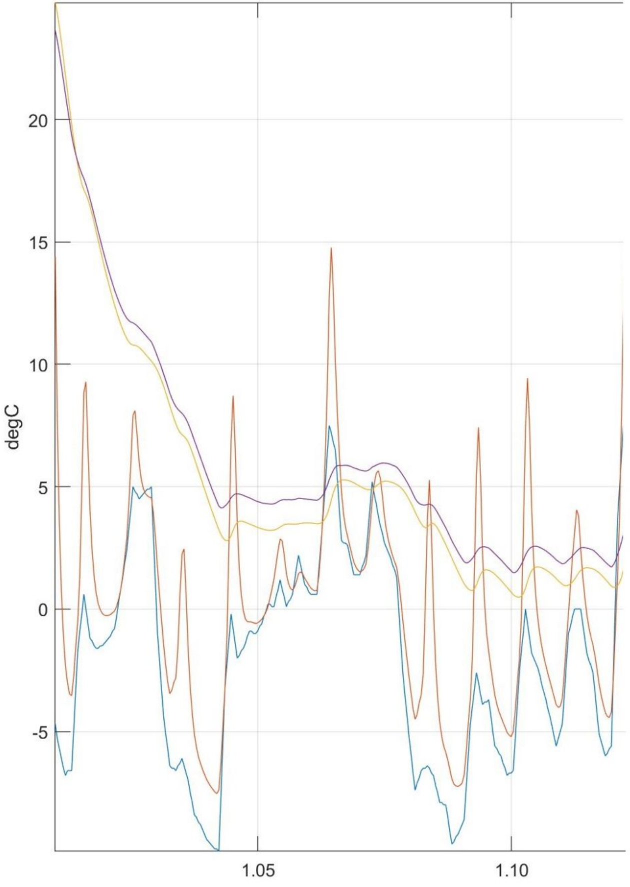
Tout
Wall 1
Wall 2
Tin
degC
date
20
15
10
5
0
-5
1.05
1.10
1.15
1.20
1.25
1.30

3) Plotting

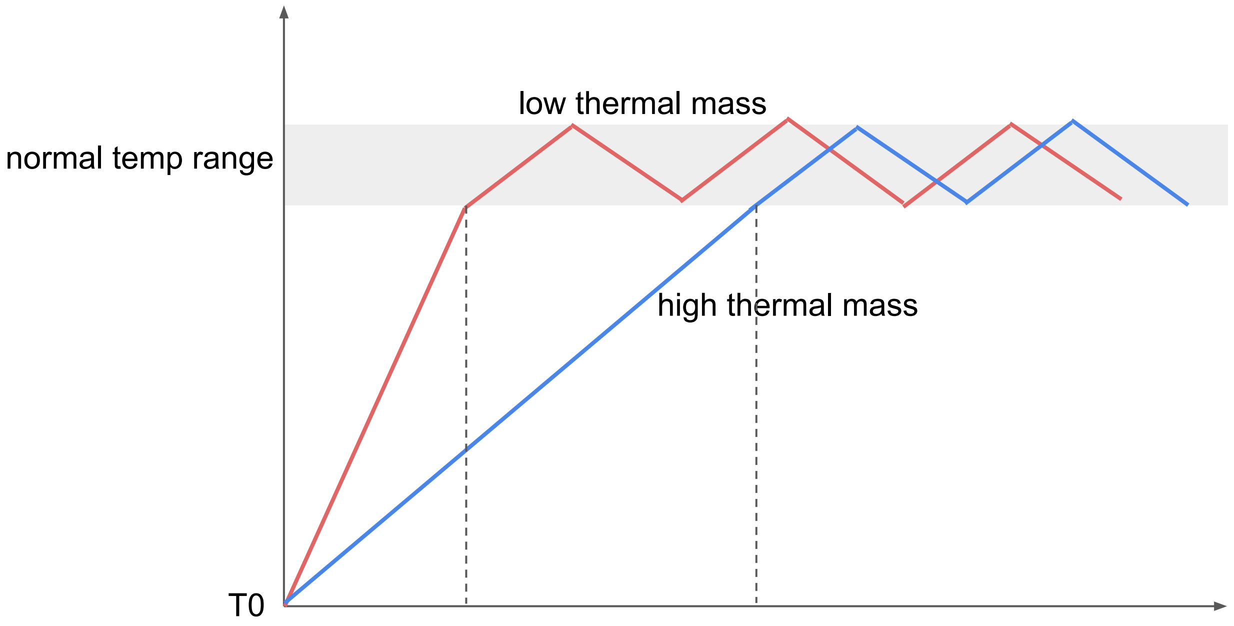


3) Plotting





3) Plus



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Imitating **3D Heat-transfer model**

0) Concept

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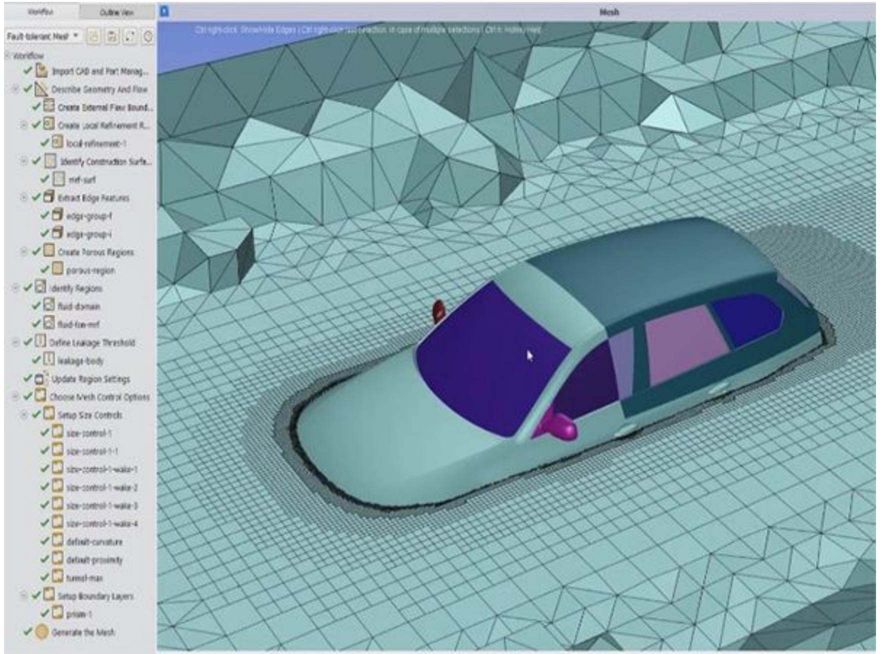
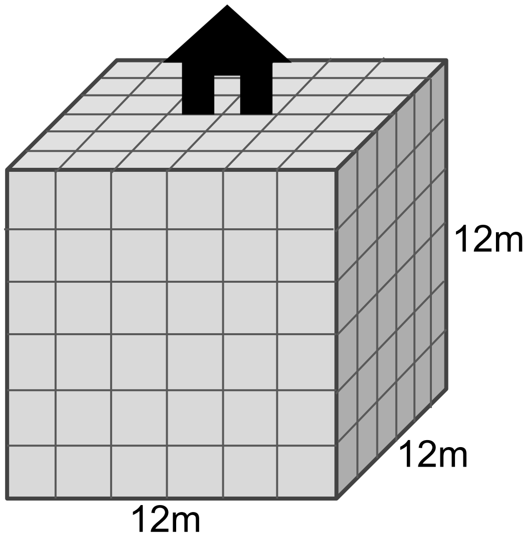


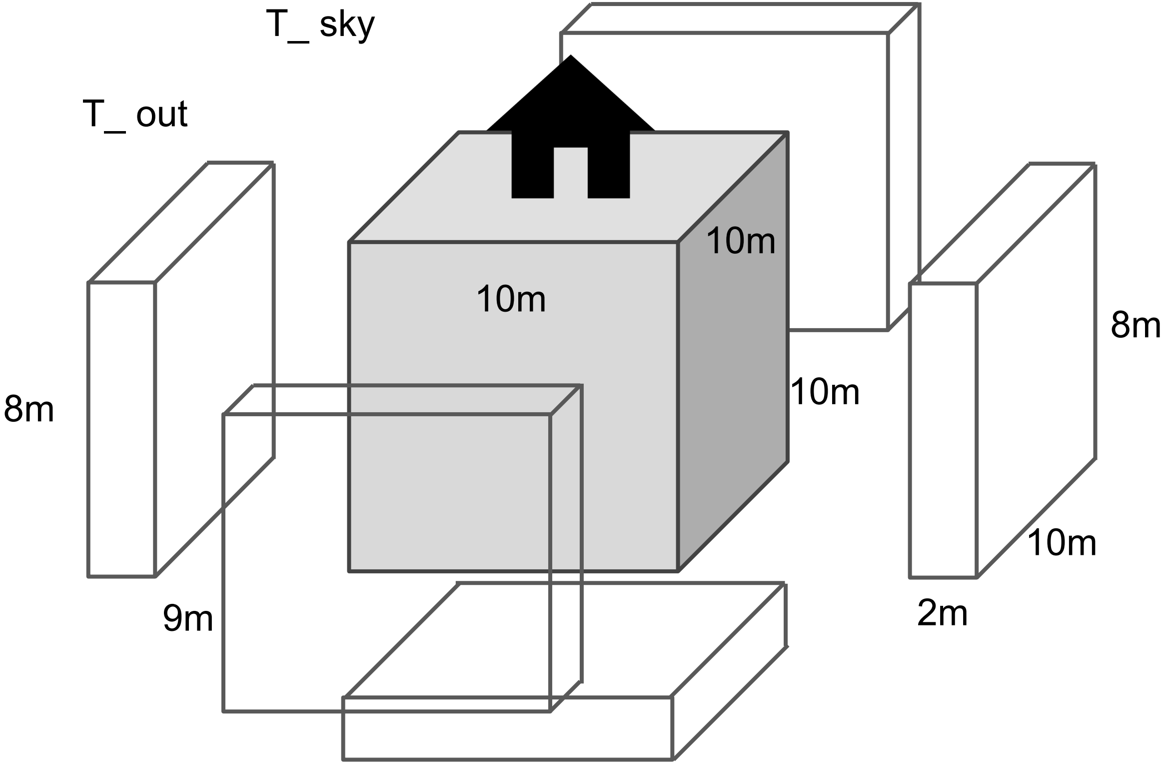
Workflow
Outline View
Mesh
Workflow
Import CAD and Part Manag...
Describe Geometry And Flow
Create External Flow Bound...
Create Local Refinement R...
local-refinement-1
Identify Construction Surfa...
mrf-surf
Extract Edge Features
edge-group-f
edge-group-i
Create Porous Regions
porous-region
Identify Regions
fluid-domain
fluid-for-mrf
Define Leakage Threshold
leakage-body
Update Region Settings
Choose Mesh Control Options
Setup Size Controls
size-control-1
size-control-1-1
size-control-1-wake-1
size-control-1-wake-2
size-control-1-wake-3
size-control-1-wake-4
default-curvature
default-proximity
tunnel-max
Setup Boundary Layers
prism-1
Generate the Mesh

0) Concept



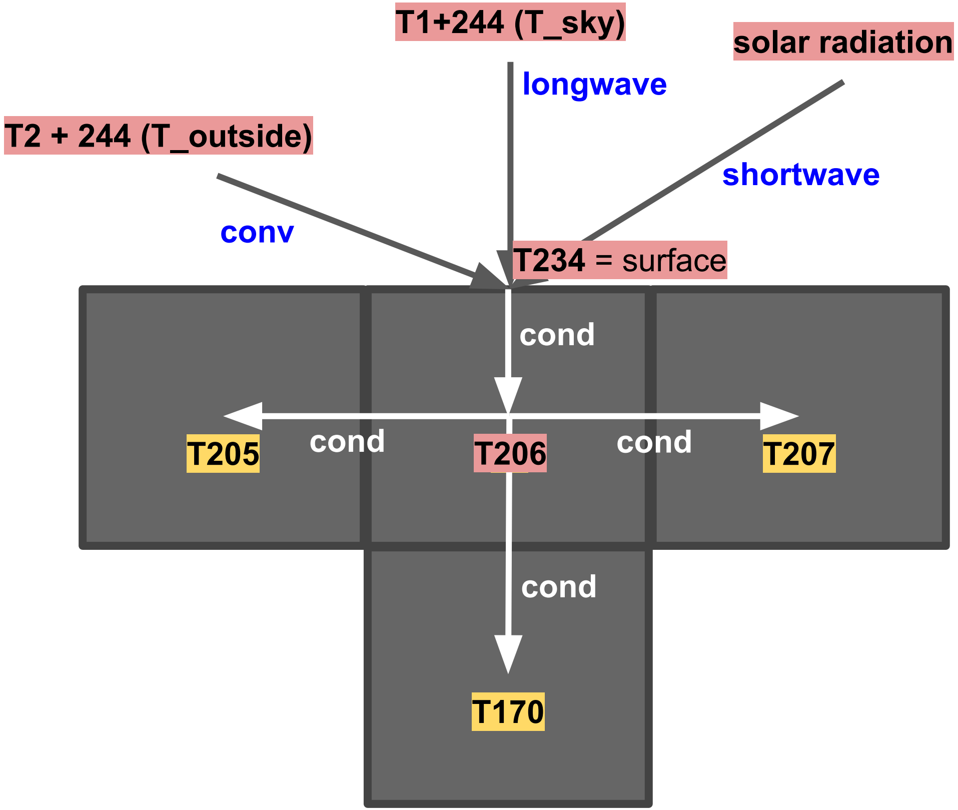
- **Mesh** 12m X 12m X 12m size ground
- **Cube** with **constant size** 2m interval
- **216 nodes (all 261 nodes)**

0) Concept



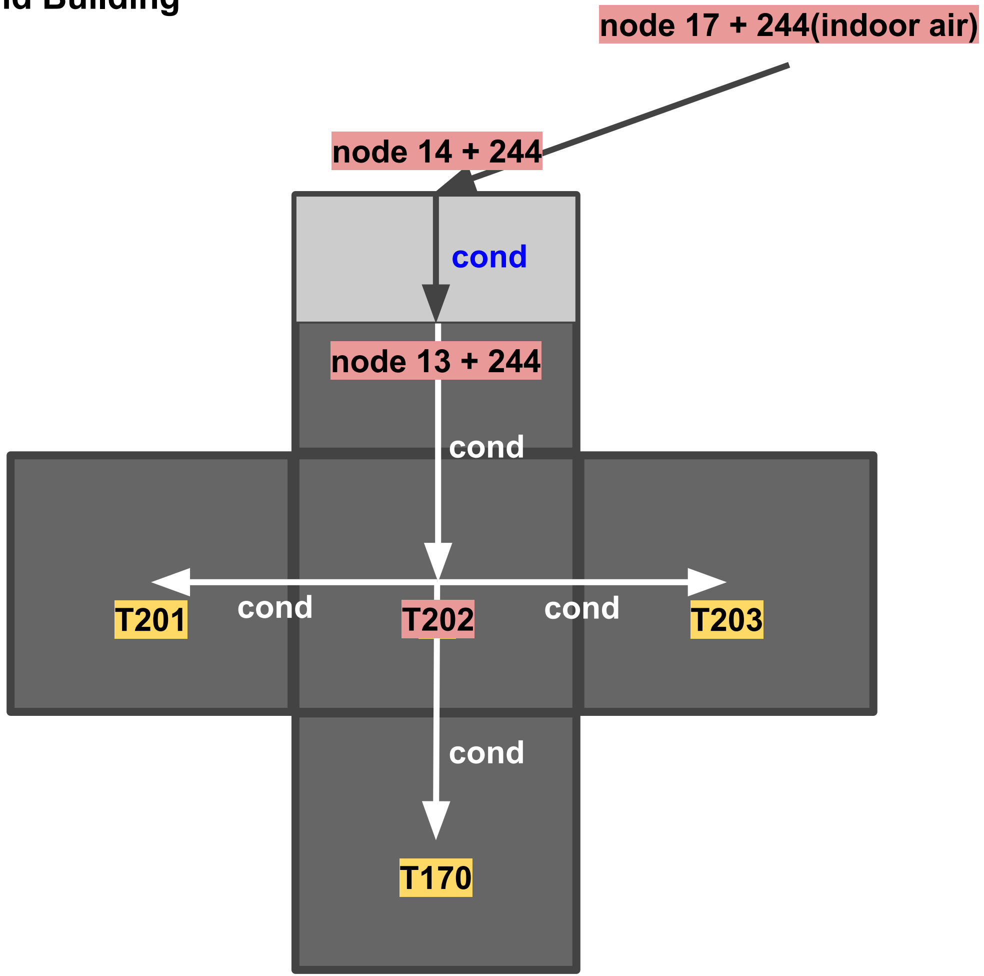
- **Boundary Conditions**

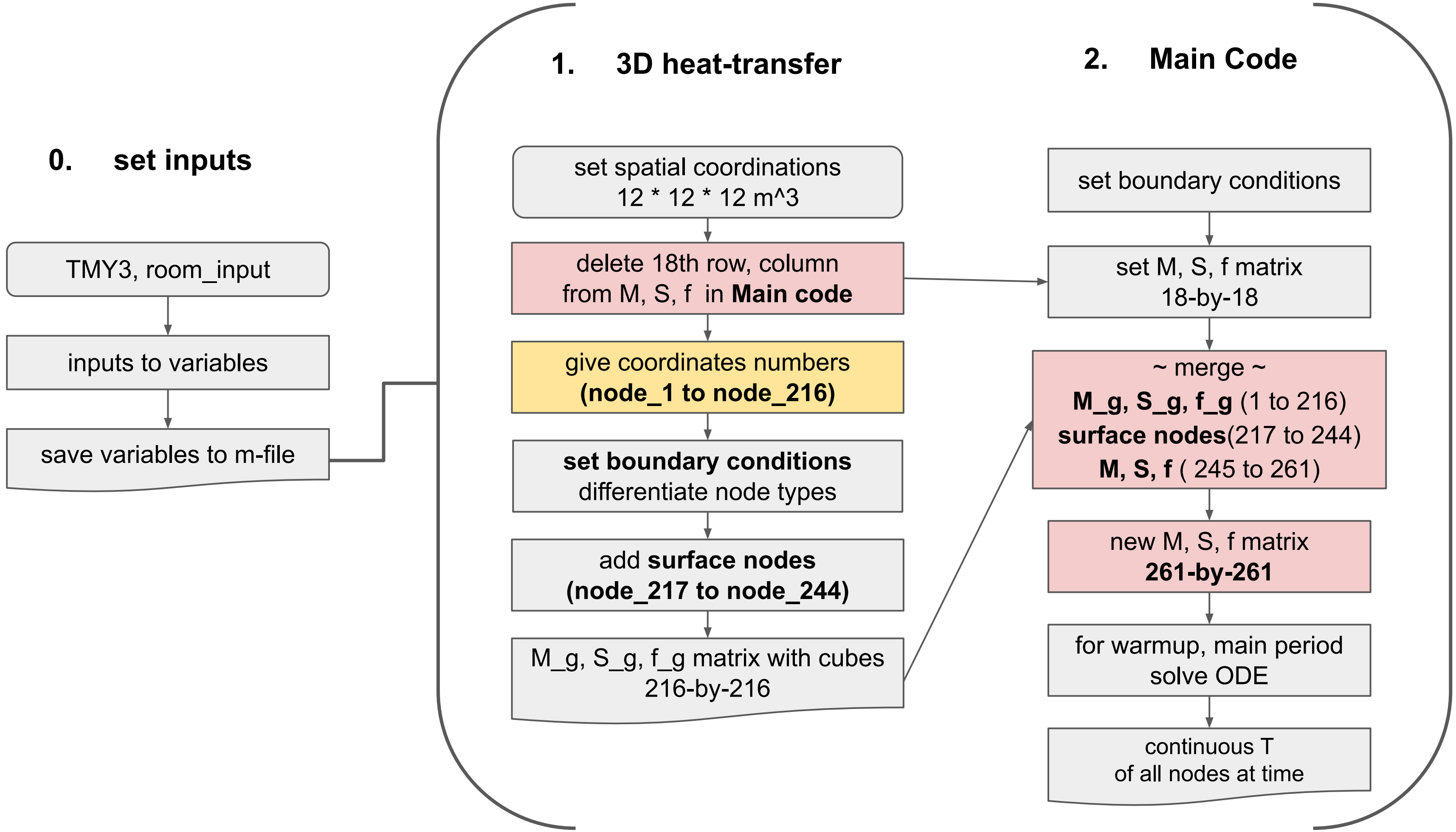
1) Surface Temperature



- T4 (**Top face** of the 6 * 6 * 6 space) is **not boundary condition**
- Need to add **surface nodes (T3)** and **heat transfers** to **M, S, f matrix**

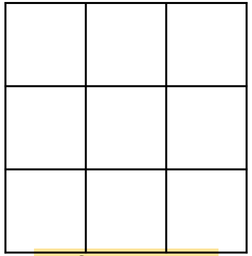
1) Connection of Ground and Building




0. set inputs
TMY3, room_input
inputs to variables
save variables to m-file
1. 3D heat-transfer
set spatial coordinations
12 * 12 * 12 m^3
delete 18th row, column
from M, S, f in Main code
give coordinates numbers
(node_1 to node_216)
set boundary conditions
differentiate node types
add surface nodes
(node_217 to node_244)
M_g, S_g, f_g matrix with cubes
216-by-216
2. Main Code
set boundary conditions
set M, S, f matrix
18-by-18
~ merge ~
M_g, S_g, f_g (1 to 216)
surface nodes(217 to 244)
M, S, f (245 to 261)
new M, S, f matrix
261-by-261
for warmup, main period
solve ODE
continuous T
of all nodes at time

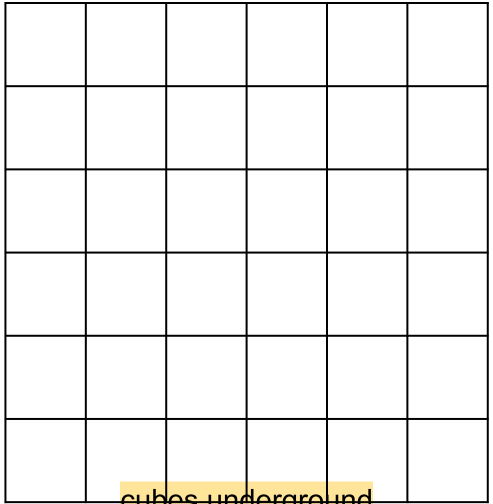
4) Making M, S matrix

M’, S’ matrix of surface nodes (28 - by - 28)



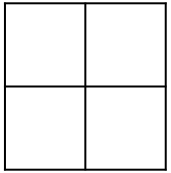
surface nodes
(node_217 to node_244)

M”, S” matrix of cubes underground (216 - by - 216)



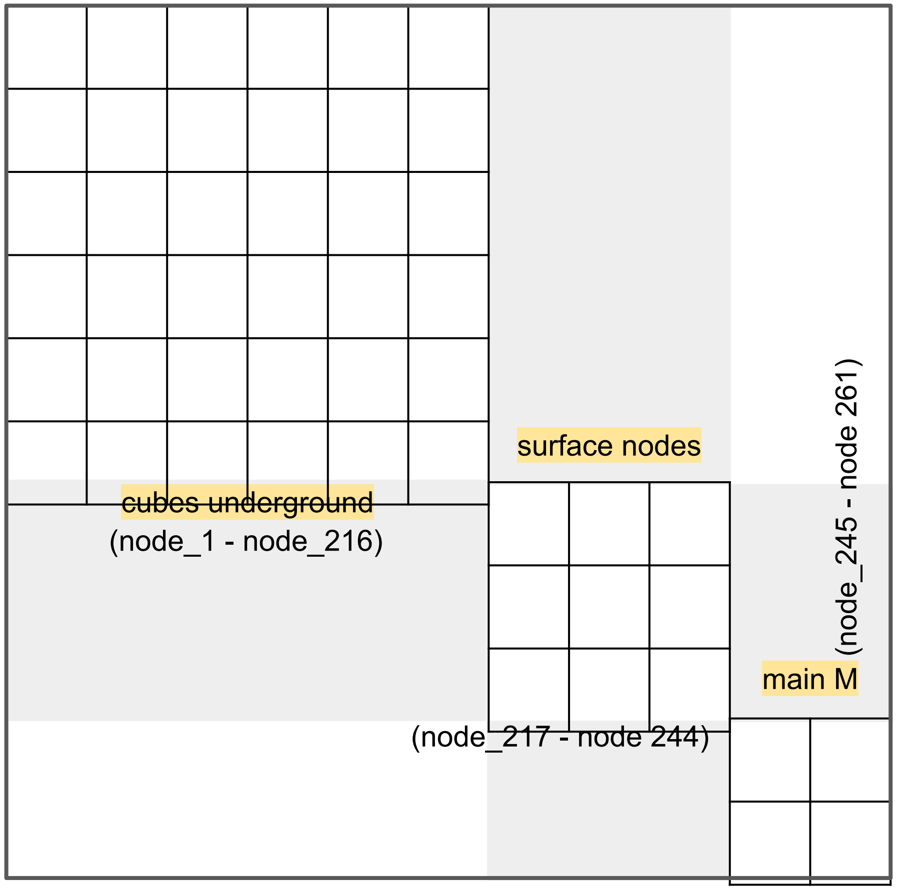
cubes underground
(node_1 to node_216)

M, S matrix of room model (**17 - by - 17**)

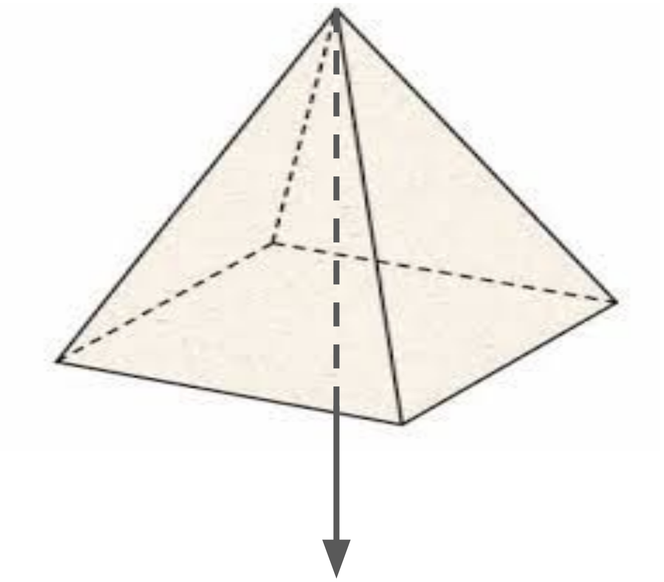


main nodes
(node_245 to node_261)

final M, S matrix (261 - by - 261)



4) M, S, f matrix

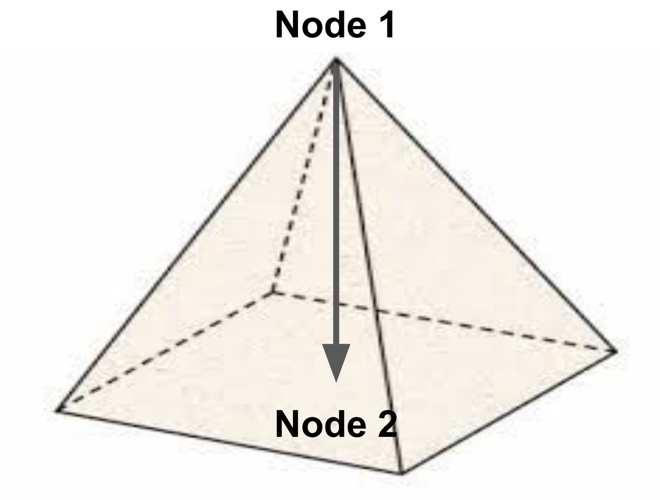


$$Q_{cond} = \int_0^2 k\,\frac{A(x)}{x}\,dx \times [1, -1; -1, 1]$$

$$A(x) = \begin{cases} 0 \le \;\; x \le \;\; 1 \;\; A(x) = (2x)^2 \\ 1 \le \;\; x \le \;\; 2 \;\; A(x) = 4(2-x)^2 \end{cases}$$

$$\therefore \;\; Q_{cond} \cong \;\; 3.09 \times k \times [1, -1; -1, 1]$$

4) M, S, f matrix

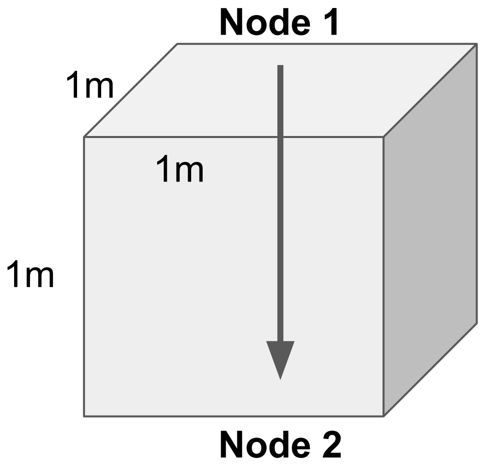


$$Q_{cond} = \int_0^1 k\,\frac{A(x)}{x}\,dx \times [1,\,-1;\,-1,1]$$

$$A(x) = (2x)^2$$

$$\therefore\quad Q_{cond} = 2 \times k \times [1,\,-1;\,-1,1]$$

4) M, S, f matrix

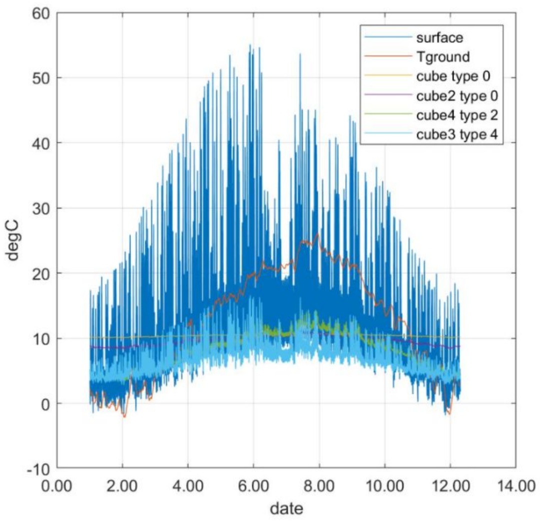


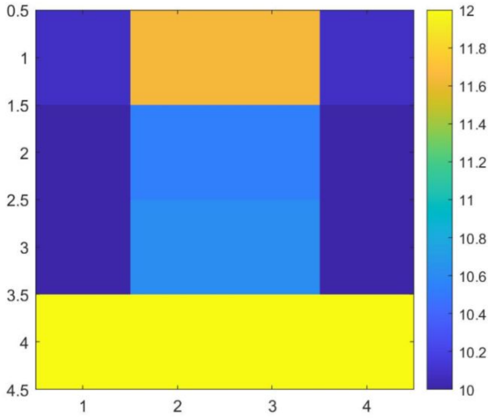
$$A(x) = 1m \times 1m$$

$$x = 1m$$

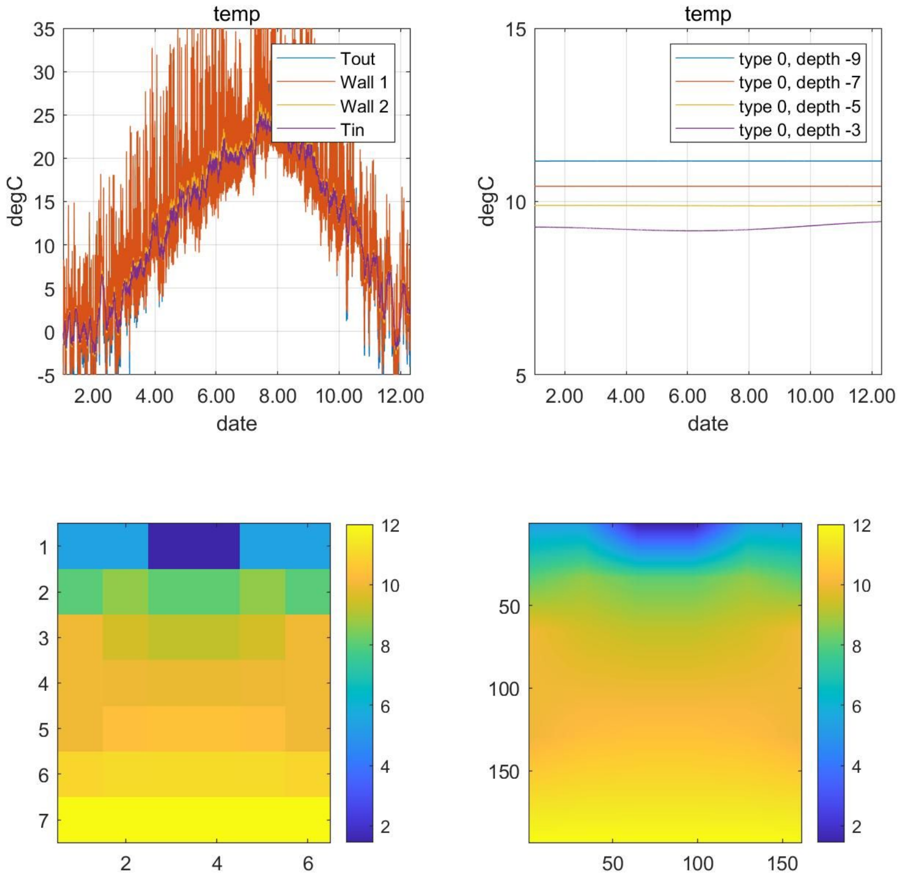
$$\therefore \quad Q_{cond} = 1 \times k \times [1, -1; -1, 1]$$

5) Simulation (4 - 4 - 4)





5) Simulation (6 - 6 - 6)



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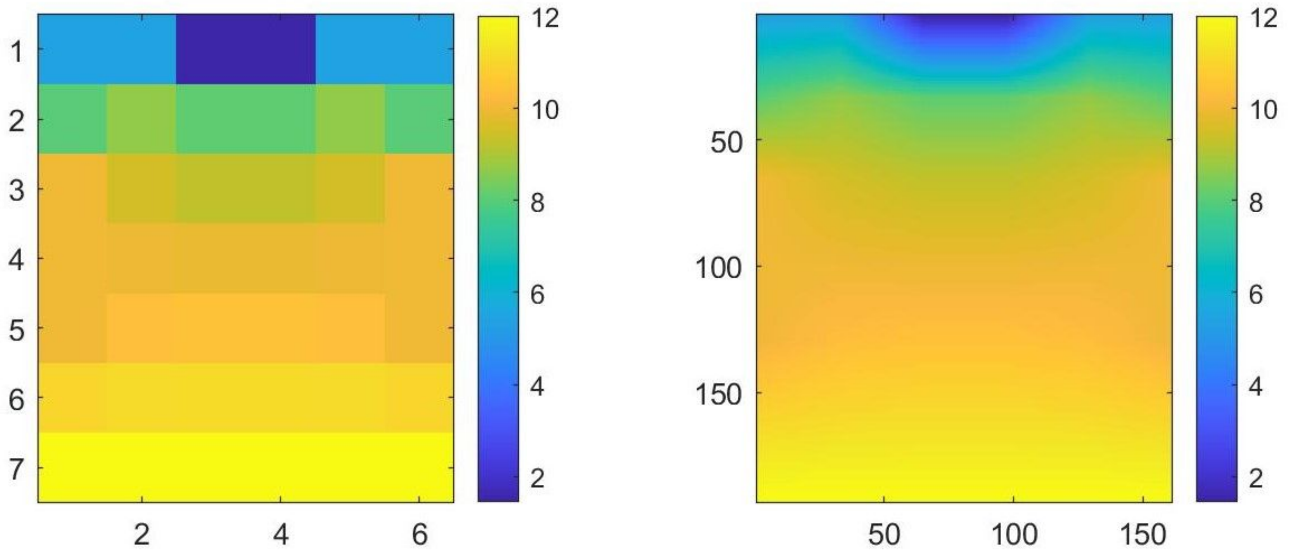

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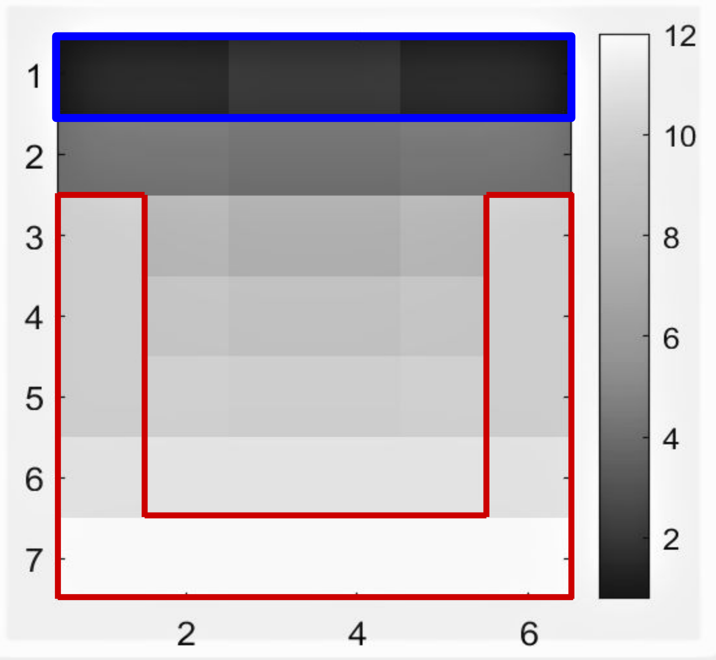

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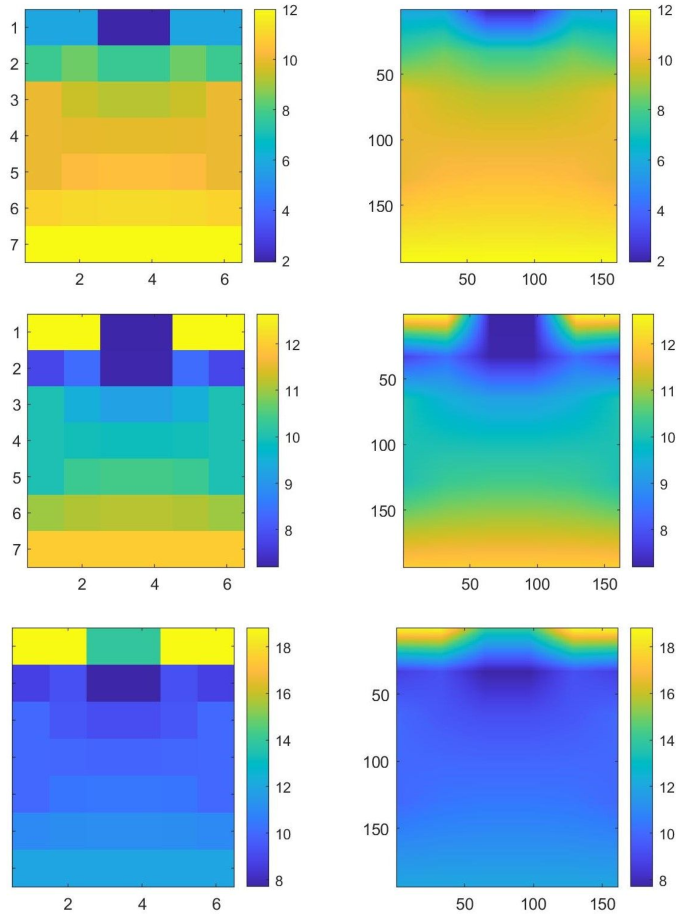
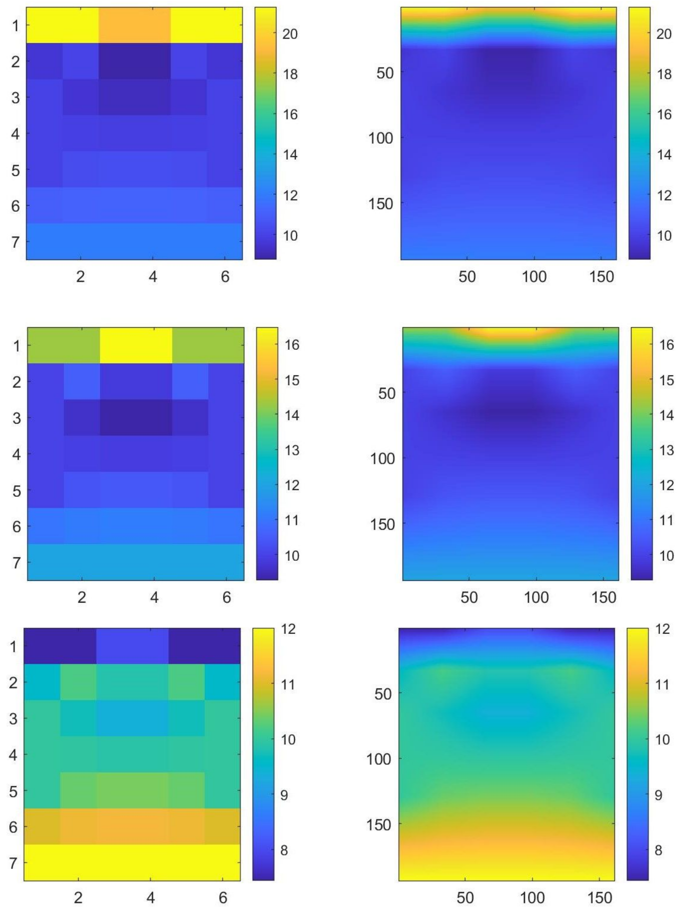


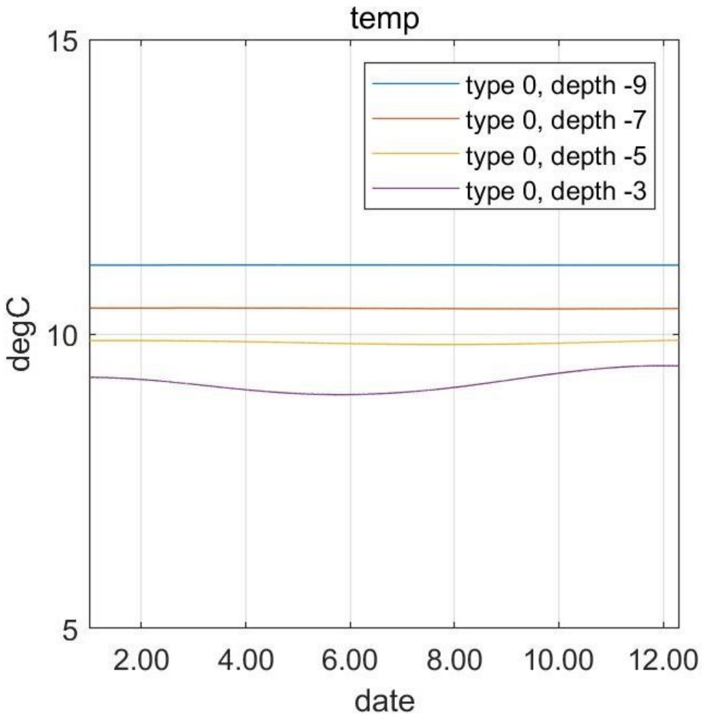
2, 4, 6

5) Simulation (6 - 6 - 6)

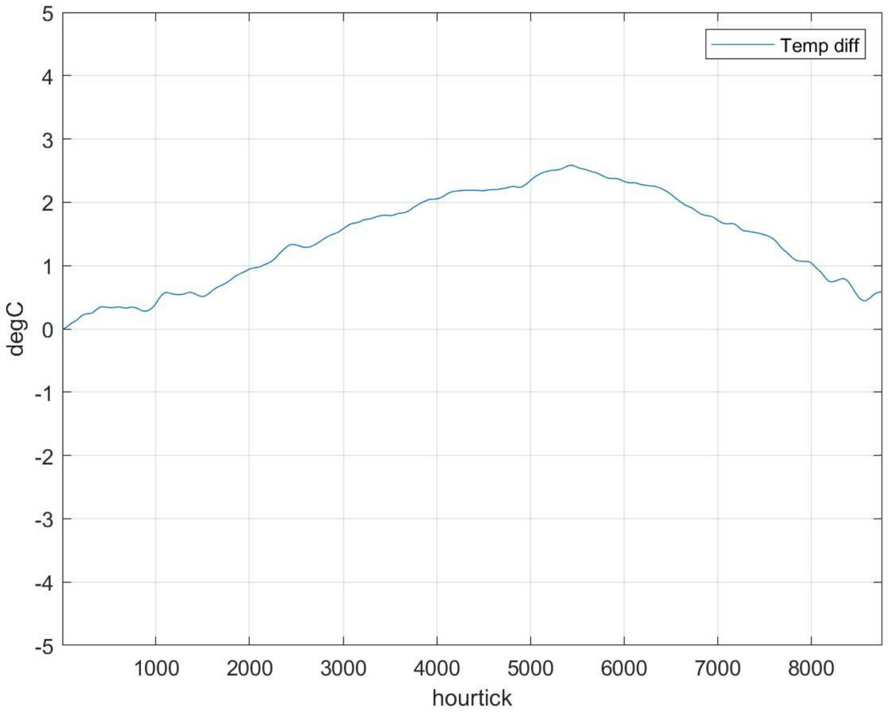


8, 10, 12

5) Simulation (6 - 6 - 6)



5) Simulation (6 - 6 - 6)



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Conclusion