planet\_temp is a MATLAB script to solve the one-dimensional heat equation:

where is density [kg/m3], is specific heat capacity [J/kgK], is temperature [K], is time [s], is depth [m] ( = 0 at the surface, negative at depth) and is thermal conductivity [W/mK].

The default boundary conditions are:

at the surface ( = 0)

at depth ( = d)

where is emissivity, is the Stefan-Boltzmann constant ( = 5.67 x 10-8 W/m2K4), is the solar flux [W/m2], is the solar zenith angle and is the heat flux [W/m2] in the positive z-direction at the lower boundary.

**User-specified variables:**

Note: The user can also change thermophysical properties. Conductivity and heat capacity are stored in arrays *k* and *c*, respectively. Density is stored in variable *rho*, emissivity in *e* and albedo in *a*.

See script for definitions of the following variables:

TOP/BOTTOM/TWO\_LAYER Set one of these variables to 1 and the others to 0

Fs Heat flux that illuminates surface ***when it is not in shadow***

w Set this to 0 if Fs is not a function of time

Fsurr Heat flux that illuminates surface ***at all times***

Qt Heat flux at the lower boundary

dz Spatial resolution [m]

dt Temporal resolution [s]

nt Number of time-steps (total simulation time = nt\*dt)

nt\_out Time-step interval at which to plot temperature profiles

nz Number of points along temperature profile (max. depth = nz\*dz)

T\_init Initial temperature profile

ntshadow From this time-step on, the surface is illuminated only by Fsurr

**To run the script:**

1. Open MATLAB.

2. Make sure planet\_temp.m is in the ‘Current Folder’.

3. Call “planet\_temp”.

**Output:**

Average, maximum, minimum temperature profiles are stored in *T\_avg*, *T\_max*, *T\_min*, respectively.

*T\_vs\_z* is a table with depth in the first column, and temperature profiles (at intervals of *nt\_out*) in the successive columns.