Check neglect of convection of enthalpy terms

In[549]:=
```
Remove["Global`*"]
```

In[550]:=
```
θvar = 298.15; (* θair *)
ψvar = 0;  (* ψr *)
```

In[552]:=
```
R = 8.3145; (*gas constant Joules per mole per Kelvin*)
```

In[553]:=
```
Patm = 1.013 × 10^5 ;(*atm pressure in Pa*)
```

In[554]:=
```
Al = .7(* .1263 oakair fraction, say 0.5 just mesophyll*)
Av = 1 - Al; (*Area fraction tissue in leaf from 2011 data 12.63%*)
```

Out[554]= 0.7

In[556]:=
```
Cpv = 28.03; (* Heat Capacity water vapor J/mol at 100 c wiki *)
```

In[557]:=
```
Cpl = 74.53; (* Heat Capacity water liquid J/mol at 100 or 25 c wiki *)
```

In[558]:=
$$c[\psi\_, \theta\_] := 1.28\ \frac{R\ 298.15}{Patm}\ Exp\left[-\frac{44\,000}{R}\left(\frac{1}{\theta}-\frac{1}{298.15}\right)\right]$$
$$Exp\left[\frac{\psi\ 18.07}{R\ \theta}\right]$$ (*mol fraction for psi in MPa*)

In[559]:=
```
Cvθ = ∂θ c[ψvar, θ]  /. θ → θvar (* linearization of dχ/dT 1/k *)
Cvψ = ∂ψ c[ψ, θvar]  /. ψ → ψvar (* linearization of dχ/dpsi 1/mpa *)
```

Out[559]= 0.00186474

Out[560]= 0.000228328

In[561]:=
```
kvh = .026;(* heat cond air J m-2 s-1 K-1*)
```

In[562]:=
```
klh = .28614;(* heat cond tissue*)
```

In[563]:=
```
λ = 44 000 - 43 (θvar - 298.15) (* Joules per Mol*)
```

Out[563]= 44 000.

In[564]:=
```
L = .72 × 131 × 10^(-6)(*-20 10^(-6)*)
```

Out[564]= 0.00009432

In[565]:=
```
SRsun = 400
```

Out[565]= 400

In[566]:=
```
Q = 0.2 * SRsun / L (* w m-3 volumetric heat source,
    .2 is fraction of total abs solar rad abs in spongy *)
```

Out[566]= 848 176.

In[567]:=
$$Dv = \frac{Patm}{R\,\theta var}\ 2.13 * \left(\frac{\theta var}{273.15}\right)^{1.8} *$$
10^(-5)(* cDv for mol frac drving force out of leaf *)

Out[567]= 0.00101901

In[568]:=
```
ktotal = 6.45 × 10^(-7);(* hyd cond leaf mol/m/s/mpa *)
```

In[569]:=
```
kl = (ktotal - .1263 Dv Cvψ) / (1 - .1263)(* hyd cond tissue  *)
```

Out[569]= 7.04606×10^{-7}

Groups

In[570]:=
$$\Pi\psi = 1 + \frac{Al\ klh + Av\ kvh}{\lambda\ Av\ Dv\ Cv\theta} + \frac{Al\ klh + Av\ kvh}{\lambda\ Al\ kl}\ \frac{Cv\psi}{Cv\theta}$$

Out[570]= 10.4707

In[571]:=
$$\Pi\theta = 1 + \frac{\lambda\ Al\ kl}{Al\ klh + Av\ kvh}\ \frac{Av\ Dv\ Cv\theta}{Al\ kl + Av\ Dv\ Cv\psi}$$

Out[571]= 1.10559

In[572]:=
$$\frac{1}{\Pi\psi} + \frac{1}{\Pi\theta}$$

Out[572]= 1.

In[573]:=
$$\Delta\theta = -\frac{Q\ L^2}{\Pi\theta\ (Al\ klh + Av\ kvh)}$$
(* Here neg as char gradients must have opp sign by mol con *)

Out[573]= -0.0327968

In[574]:=
$$\Delta\psi = \frac{Q\ L^2}{\Pi\psi\ \lambda\ Al\ kl}$$

Out[574]= 0.0332065

Terms

In[575]:=
$$CondTerm = \frac{Al\ klh + Av\ kvh}{\lambda\ Al\ kl}\left(\frac{\Delta\theta}{\Delta\psi}\right)$$
```
MolTerm = -1
```

Out[575]= -9.47066

Out[576]= -1

In[577]:=
$$MixTerm = \left(\frac{Cpl\ \Delta\theta}{\lambda} + \frac{Cpv\ Av\ Dv\ Cv\psi\ \Delta\theta}{\lambda\ Al\ kl}\right)$$

Out[577]= -0.0000585101

In[578]:=
$$SqTerm = \frac{Cpv\ Av\ Dv\ Cv\theta}{\lambda\ Al\ kl}\ \frac{\Delta\theta^2}{\Delta\psi}$$

Out[578]= 0.0000238498

In[579]:= $\mathbf{SourceTerm = \frac{Q\,L^2}{\lambda\,Al\,kl\,\Delta\psi}}$

Out[579]= 10.4707

Noting that temp and psi char grads opposite signs, treat temp as neg rel to source

In[580]:= **Econ = CondTerm + MolTerm - MixTerm + SqTerm + SourceTerm**

Out[580]= 0.00008236

In[581]:= **MixTerm - SqTerm**

Out[581]= -0.00008236

In[582]:= **CondTerm + MolTerm + SourceTerm**

Out[582]= 1.77636×10^{-15}