2-Layer Lake Model (according to Chapra 1997)

(1) Epilimnion heat balance: $V_e \rho C_p \frac{dT_e}{dt} = Q\rho C_p T_{in} - Q\rho C_p T_e \pm JA_s + v_t A_t \rho C_p (T_h - T_e)$
(2) Hypolimnion heat balance: $V_h \rho C_P \frac{dT_h}{dt} = v_t A_t \rho C_p (T_e - T_h)$
Putting surface heat flux into equation (1)
(3)
$\frac{dT_e}{dt} = \frac{Q}{V_e} T_{in} - \frac{Q}{V_e} T_e + v_t \frac{A_t}{V_e}(T_h - T_e) + \frac{J_{sw}}{\rho C_P H} + \frac{\sigma (T_{air}+273)^4 (A + 0.031\sqrt{e_{air}})(1-R_L)}{\rho C_P H} - \frac{\epsilon \sigma (T_e + 273)^4}{\rho C_P H} - \frac{c_1 f(U_W)(T_e - T_{air})}{\rho C_P H} - \frac{f(U_w)(e_{sat} - e_{air})}{\rho C_P H}$
and
(4) $\frac{dT_h}{dt} = v_t \frac{A_t}{V_h}(Te - T_h)$
with $H = \frac{A_s}{V_e}$
Breaking down the units of the heat fluxes:
(5) incoming shortwave radiation: $\frac{J_{sw}}{\rho C_P H} = \frac{cal * cm^2 * C}{cm^2 * d * cal} = \frac{C}{d}$
(6) incoming longwave radiation: $\frac{\sigma (T_{air}+273)^4 (A + 0.031\sqrt{e_{air}})(1-R_L)}{\rho C_P H} = \frac{cm^2 * C * cal * K^4}{cal * cm^2 * d * K^4} = \frac{C}{d}$
(7) backscattering longwave radiation: $\frac{\epsilon \sigma (T_e+273)^4}{\rho C_P H} = \frac{cm^2 * C * cal * K^4}{cal * cm^2 * d * K^4} = \frac{C}{d}$
(8) conduction: $\frac{c_1 f(U_W)(T_e - T_{air})}{\rho C_P H} = \frac{cm^2 * C * C * m^2}{cal * C * s^2} = \frac{cm^4 * C}{cal * s^2}$
(9) evaporation: $\frac{f(U_w)(e_{sat} - e_{air})}{\rho C_P H} = \frac{cm^2 * C * m^2}{cal * s^2} = \frac{cm^4 * C}{cal * s^2}$
Here:
c_1 is Bowen's coefficient (=0.47 mmHg per deg C;
$f(Uw)$ is a wind function, here by Brady, Graves and Geyer (1969): $f(Uw) = 19.0 + 0.95 * Uw^2$;
e_{sat} and e_{air} are saturation vapor pressure and air vapor pressure in mmHG.