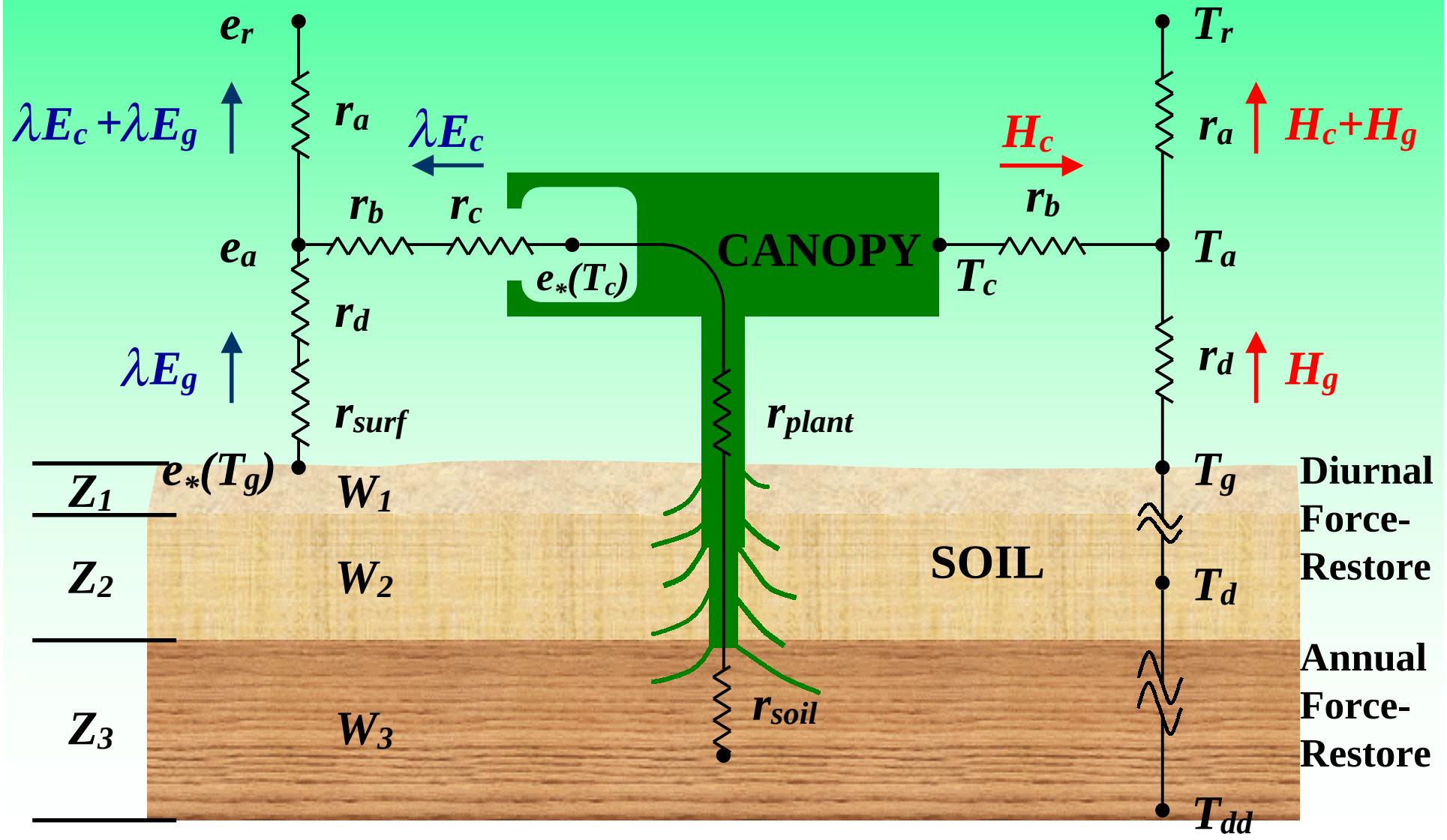
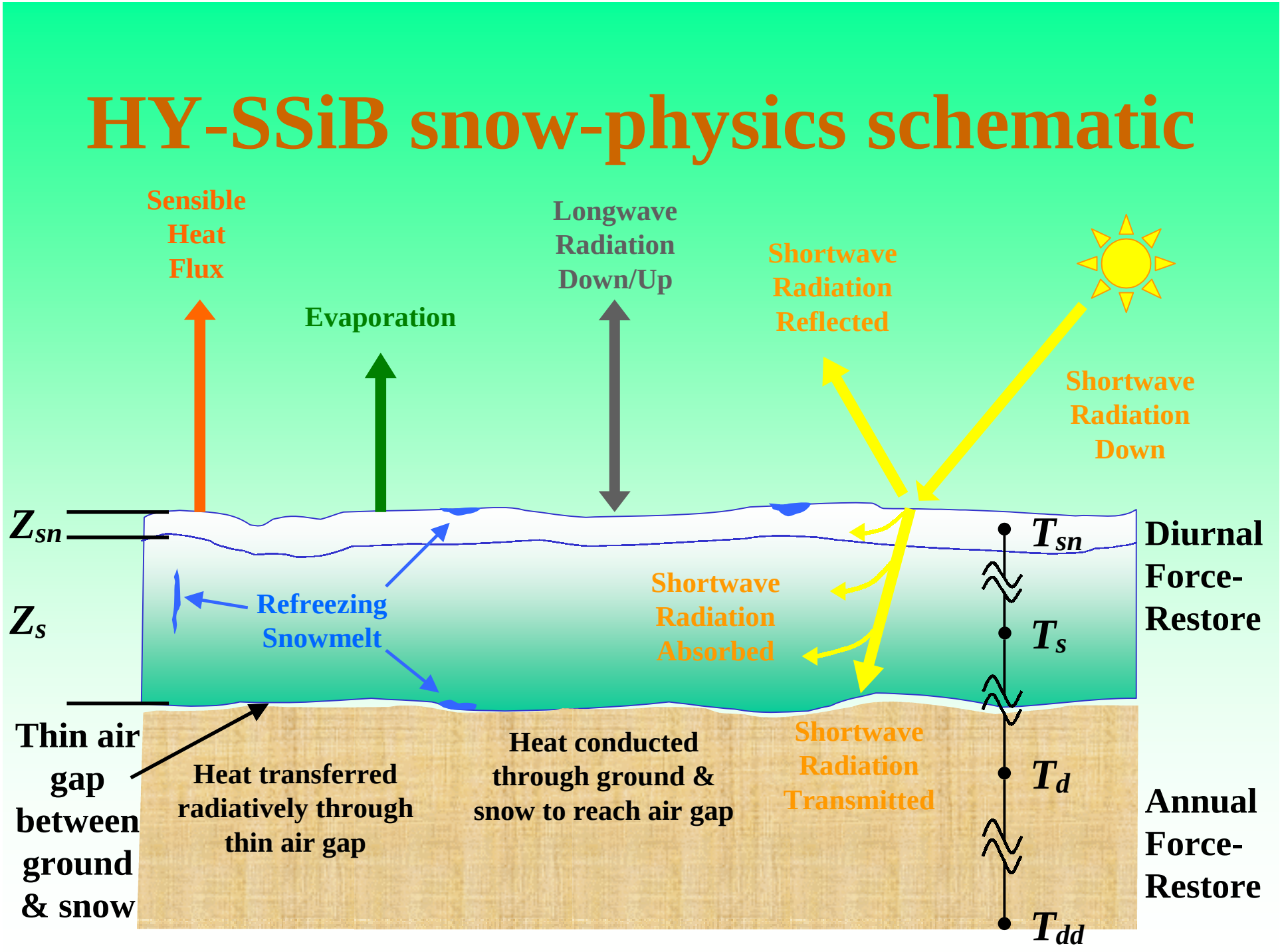
HY-SSiB surface layer schematic



HY-SSiB snow-physics schematic



HY-SSiB snow-physics features

- **Two snow layers – diurnal layer above bulk snow layer**
- **Diurnal force-restore layer allows for mid-winter melt**
- **Shortwave absorbed in snow or transmitted to ground**
- **Fluxes over snow held constant during melt conditions in implicit backward solution**
- **Frozen water and liquid water in snow pack**
- **Snow density and snow aging**
- **Fractional snow cover**

HY-SSiB snow-physics equations

Diurnal snow layer:

$$C_{sn}\frac{\partial T_{sn}}{\partial t} = Rn_{sn} - H_{sn} - \lambda E_{sn} - \frac{2\pi C_{sn}}{\tau}\left(T_{sn} - T_s\right)$$

Bulk snow layer:

$$C_s\frac{\partial T_s}{\partial t} = Rn_s + \kappa_c\left(T_d - T_s\right) + \frac{2\pi C_{sn}}{\tau}\left(T_{sn} - T_s\right)$$

C = Heat capacity
T = Temperature
t = time

Rn = Net Radiation
H = Sensible Heat Flux
E = Evaporation

λ = latent heat of vapor.
τ = 86400 sec
κ = Conductivity

HY-SSiB snow absorption and aging

Shortwave absorption in diurnal snow layer:

$$SW_{sn}[abs] = SW_{\downarrow}(1-\alpha)[1-\exp(-25Z_{sn})]$$

Snow aging (Verseghy, 1991):

$$\rho_s(t+\Delta t) = [\rho_s(t) - \rho_{\max}]\exp\left(-0.24\frac{\Delta t}{\tau}\right) + \rho_{\max}$$

$\boldsymbol{SW}$ = Shortwave Radiation

$\boldsymbol{Z_{sn}}$ = Diurnal snow depth

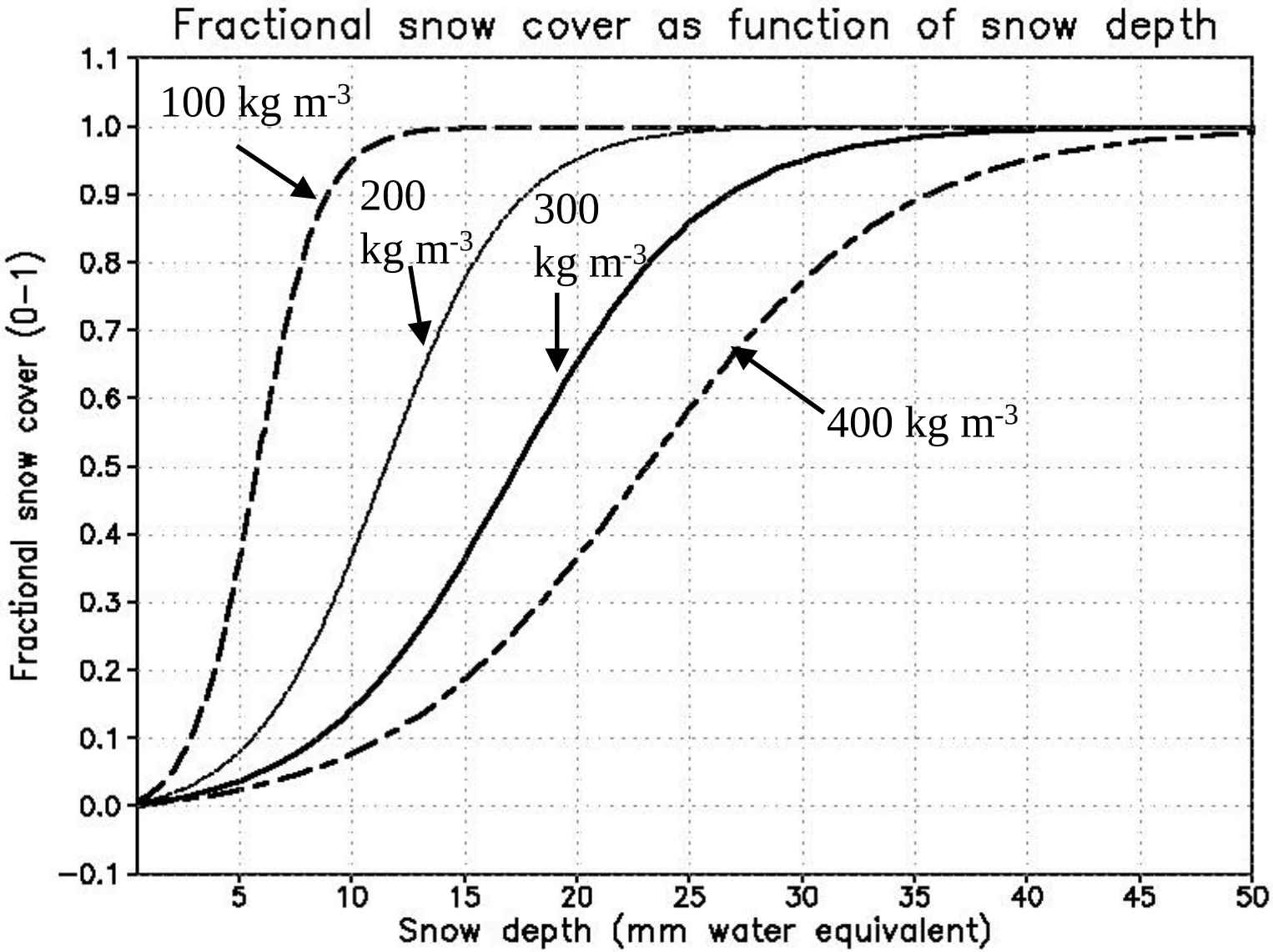
α = Albedo

$\boldsymbol{\rho}$ = snow density

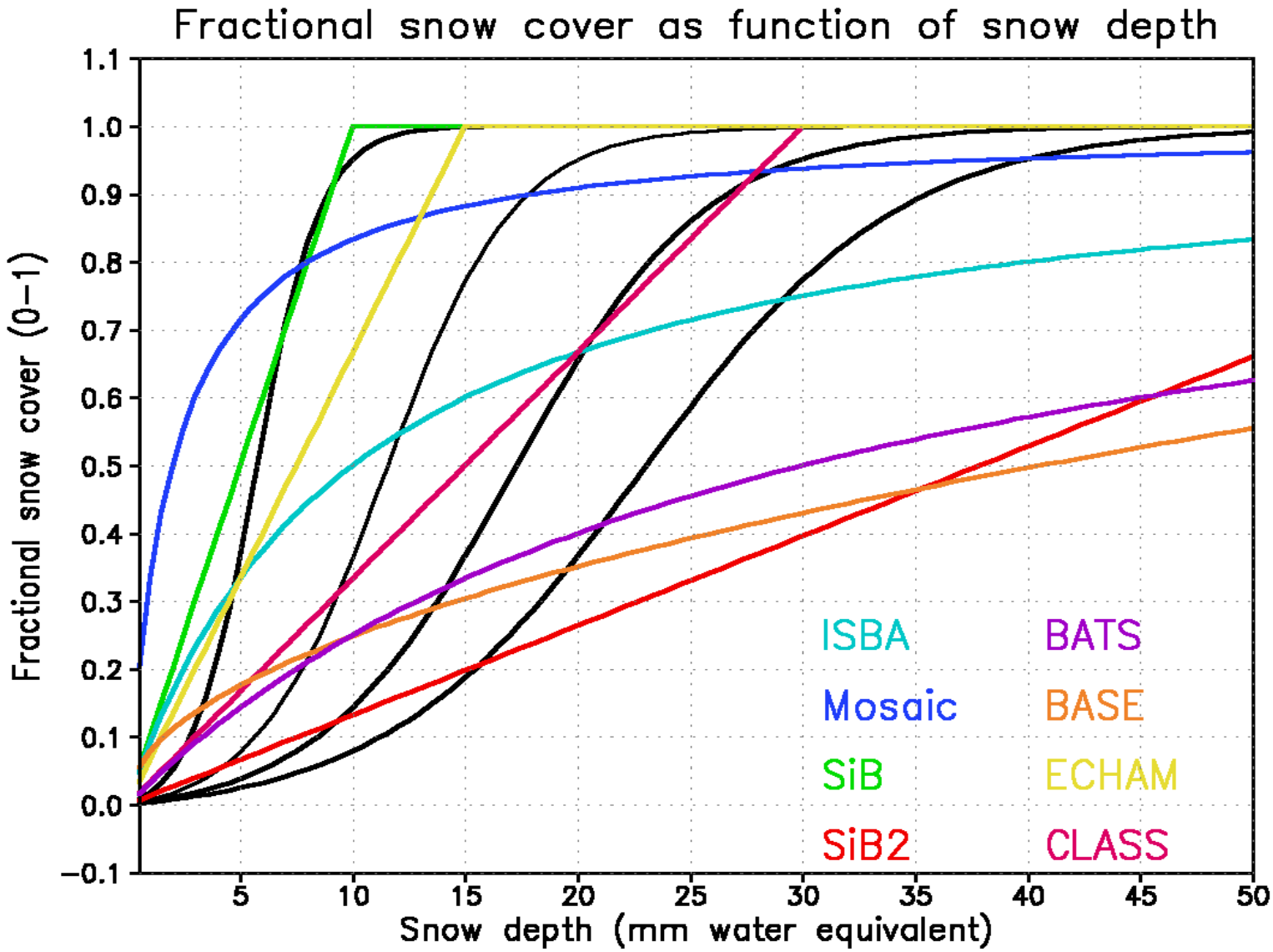
$\boldsymbol{\rho_{max}}$ = 300 kg m^{-3}

τ = 86400 sec

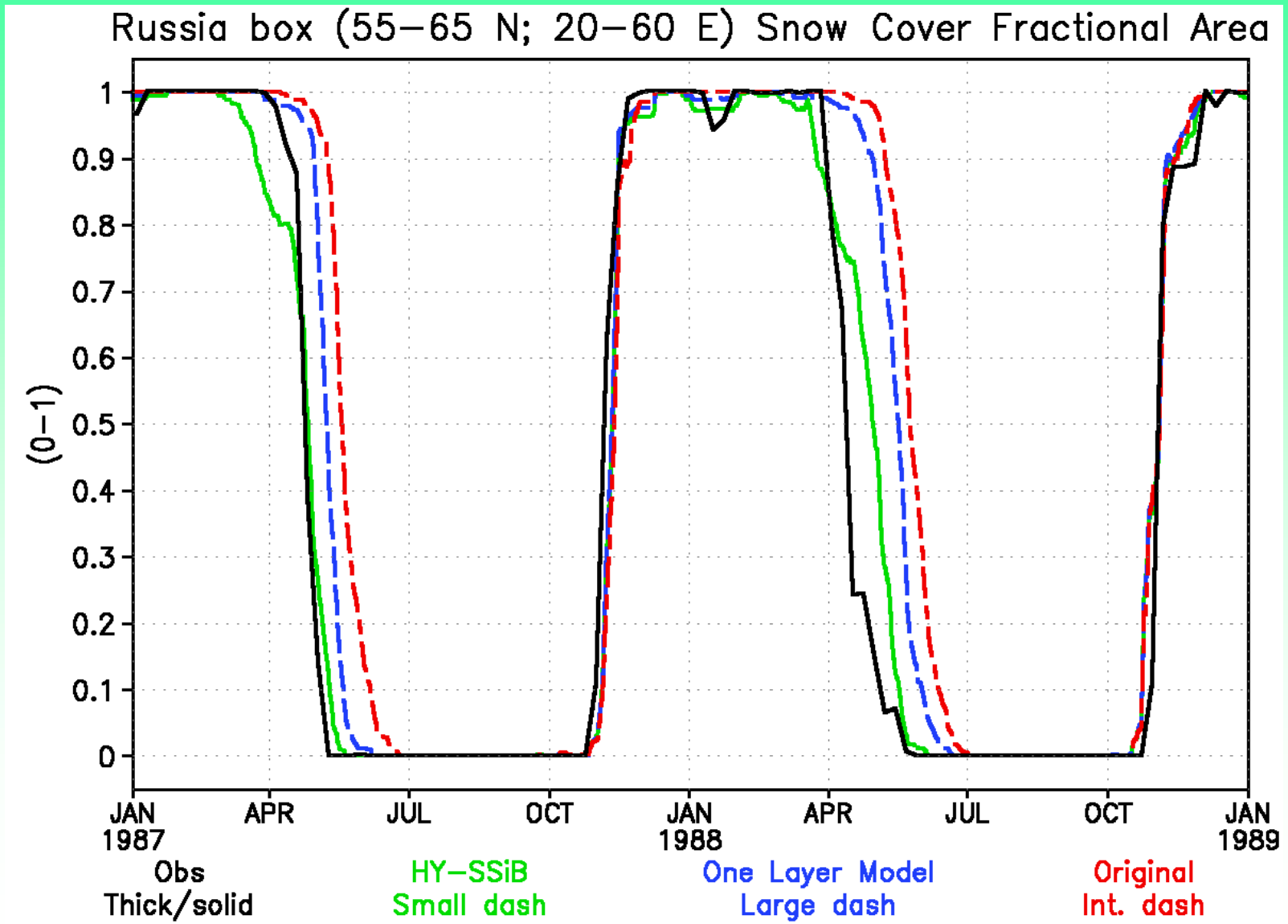
HY-SSiB fractional snow relation



HY-SSiB against other relations



HY-SSiB snowmelt results



HY-SSiB soil moisture results