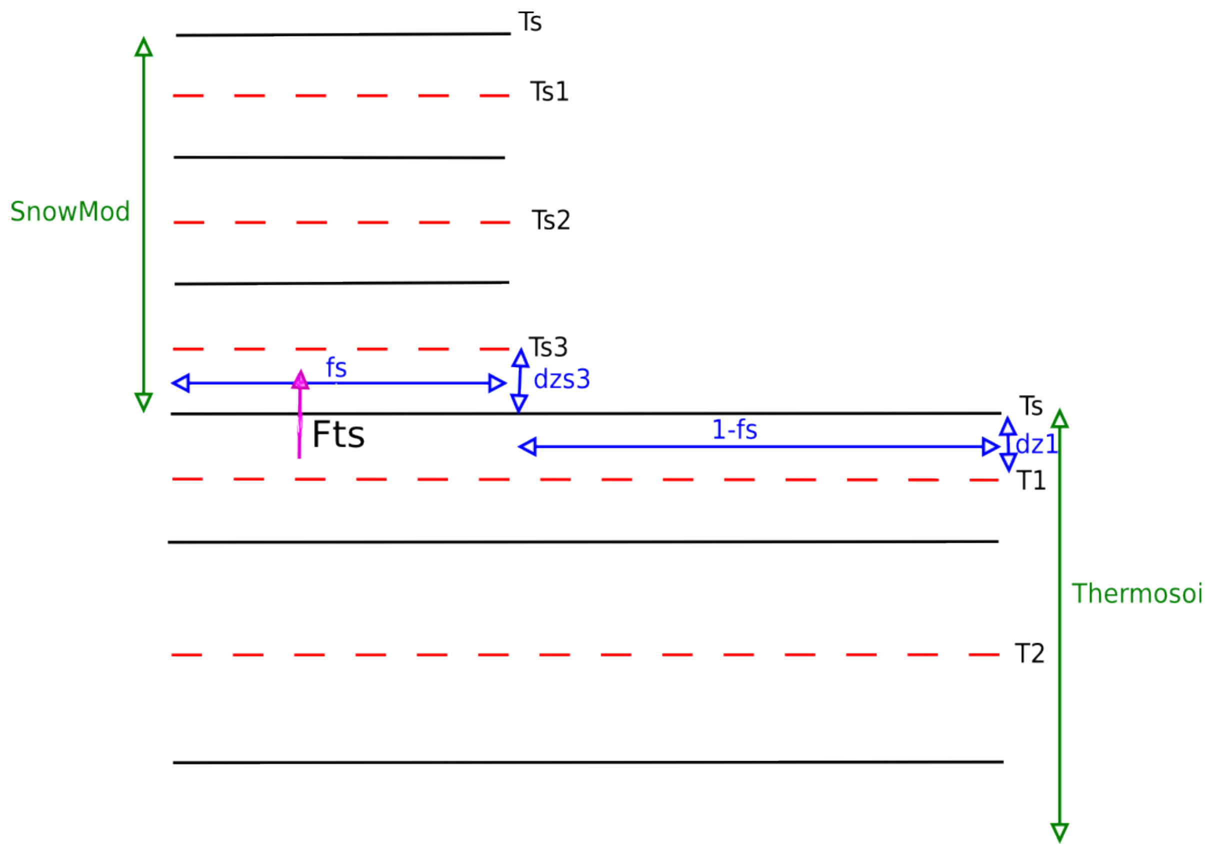
# Snow Fraction and coupling to Thermosoil




A treatment of the snow fraction is proposed which would ensure that for small values of snow mass, the snow model works properly and interfaces correctly with thermosoil.

The idea is that for snow mass below a threshold, the fraction of snow (fs) will become less than 1. We can choose a linear function of snow mass to compute fs below the threshold value. This will also ensure that as the snow amount decreases, the thickness of the 3 layers in the snow model does not become too small.

Below is a proposal for using that snow fraction in a consistent way which ensures that progressively, as the snow mass increases, the surface temperature given to thermosoil moves from the energy balance temperature to the lower snow pack temperature. In the same way the surface properties used in enerbil progressively move from the soil to the snow characteristics.

## Enerbil (t)

Enerbil computes a skin temperature (Ts) which is valid over the entire grid. This values then serves for the back substitution in the snow module and thermosoil.

# SnowMod – Pass 1

*Input : Ts*

The snow module computes the new temperature profile based on the grid box average surface temperature provided by enerbil.

The bottom of the snow pack temperature will serve for the coupling with thermosoil. Its height above the ground (dzs3) is needed to compute the heat flux between the snow pack and soil thermodynamics.

If fs=0 then at this stage SnowMod needs to set Ts1,Ts2,Ts3=Ts.

*Output : Ts3, dzs3*

# Thermosoil

*Input : Ts, Ts3, dzs3*

Thermosoil will use an effective surface temperature (Tseff) for its back substitution. This value is obtained by a simple pondering :

Tseff = fs Ts3 + (1-fs) Ts

Nota bene : it is assumed that the temperature of the bottom of the snow pack is the mean value of the lowest layer, i.e. Ts3. Using Ts2 we could (as for the skin temperature in thermosoil) estimate a more realistic bottom temperature.

The diagonalisation of the thermal profile will provide the surface layer heat capacity for the snow free fraction (Cs) and the heat flux through that same area (Gs).

With the new temperature profile thermosoil will also compute the heat flux going into the snow. It is simply obtained with :

Fts = (Ts3-T1)/(dzs3+dz1)

*Output : Fts, Cs, Gs*

# SnowMod – Pass 2

*Input : Fts*

The diagnolisation of the snow temperature profile can be done with Fts as a lower boundary condition. As done in thermosoil this yields the surface parameters needed for enerbil but only valid over the snow fraction. This will yield the heat capacity over the snow fraction (Css) and the heat flux coming from the snow (Gss).

*Output : Css, Gss*

## Enerbil (t+1)

*Input : Cs, Gs, Css, Gss*

Enerbil will sole the energy balance as before but using an effective heat capacity (Ceff) and ground heat flux (Geff) :

$C_{eff} = f_s C_{ss} + (1-f_s) C_s$

$G_{eff} = f_s G_{ss} + (1-f_s) G_s$