$$
\begin{aligned}
Q_{rad,IR} &= -\frac{1}{\rho_0 c_p}\frac{\partial}{\partial z}\left\{F^{\uparrow}(z) - F^{\downarrow}(z)\right\}, \\
F^{\uparrow}(z) &= \sum_i \Delta\nu \left\{\pi B_{\nu,i}(z=0)\mathcal{T}_i(0,z) + \int_0^z \pi B_{\nu,i}(z')\frac{d\mathcal{T}_i(z,z')}{dz'}\,dz'\right\}, \\
F^{\downarrow}(z) &= \sum \Delta\nu \left\{\int_z^{\infty} \pi B_{\nu,i}(z')\frac{d\mathcal{T}_i(z,z')}{dz'}\,dz'\right\}.
\end{aligned}
$$