```
! canopy_abs+scatt.f90   ~/fortran/radtpt    21-22 Feb. 09
!  For the math, see ~/fortran/radtpt/Fixing approximations.doc
      real K,ks,I,I0,Kdiff,Kdir
      write(6,'("aleaf,sleaf,xf,D0,I0,fleaf,Kdiff,Kdir,r")')
      read(5,*)aleaf,sleaf,xf,D0,I0,fleaf,Kdiff,Kdir,r
      write(6,'("Recap: aleaf, sleaf, xf, D0, I0, fleaf, Kdiff, Kdir, r=",/,2x,&
     & 9f8.3)')aleaf,sleaf,xf,D0,I0,fleaf,Kdiff,Kdir,r
      a=aleaf*Kdiff
      s=sleaf*Kdiff
      adir=aleaf*Kdir
      sdir=sleaf*Kdir
      fdir=fleaf*Kdir
      part1=-(1.+a/s)
      K=sqrt(2.*a*s+a*a)
      bplus=part1+K/s
      bminus=part1-K/s
      ks=adir+sdir+fdir
      Eplus=(exp(K*xf)-exp(-ks*xf))/(K+ks)
      Eminus=(exp(-ks*xf)-exp(-K*xf))/(K-ks)
      fac=exp(-K*xf)
      P1=(fdir-bminus*sdir)*I0*Eplus*fac
      ratio=(1.+r*bminus)/(1.+r*bplus)
      P2=(fdir-bplus*sdir)*I0*Eminus*ratio*fac
      P3=(bminus-bplus)*r*I0*exp(-ks*xf)*fac/(1.+r*bplus)
      denom=bminus-bplus*exp(-2.*K*xf)*(1.+r*bminus)/(1.+r*bplus)
      write(6,'("K,bplus,bminus,ks,Eplus,Eminus=",/,2x,6f9.3)')&
     &  K,bplus,bminus,ks,Eplus,Eminus
      write(6,'("fac,P1,ratio,P2,P3,denom=",/,2x,6f10.3)')&
     & fac,P1,ratio,P2,P3,denom
      Aplus0=((bminus-bplus)*D0+bplus*(P2-P1+P3))/(bminus-bplus*fac*fac*ratio)
      Aminus0=(Aplus0*bminus-(bminus-bplus)*D0)/bplus
      U0=(Aminus0-Aplus0)/(bminus-bplus)
      write(6,'("Aplus0=",f8.3,", Aminus0=",f8.3,", U0=",f8.3)')&
     & Aplus0,Aminus0,U0
      dx=0.01*xf
      abs=0.
      do  x=0.5*dx,xf-0.5*dx,dx
        Aplus=Aplus0*exp(-K*x)+(fdir-bplus*sdir)*I0*(exp(-ks*x)-exp(-K*x))/(K-ks)
        Aminus=Aminus0*exp(K*x)+(fdir-bminus*sdir)*I0*(exp(K*x)-exp(-ks*x))/(K+ks)
        D=(bminus*Aplus-bplus*Aminus)/(bminus-bplus)
        U=(Aminus-Aplus)/(bminus-bplus)
        I=I0*exp(-ks*x)
        absx=a*(D+U)+adir*I
        abs=abs+absx
        write(6,'("  x=",f6.3,": Aplus=",f8.3,", Aminus=",f8.3,/,&
       & 4x,"D=",f8.3,", U=",f8.3,", I=",f8.3,", absrate=",f8.3)')&
       & x,Aplus,Aminus,D,U,I,absx
      enddo
```

```
! Accounting
      abs_can=abs*dx
      Refl_toc=U0
      Aplusxf=Aplus0*fac+(fdir-bplus*sdir)*I0*Eminus
      Aminusxf=Aminus0*exp(K*xf)+(fdir-bminus*sdir)*I0*Eplus

      write(6,'("Aminus0,K*xf,fdir,bminus,sdir,I0,Eplus=",/,5x,&
     &  7f10.6)')Aminus0,K*xf,fdir,bminus,sdir,I0,Eplus

      Dxf=(bminus*Aplusxf-bplus*Aminusxf)/(bminus-bplus)
      write(6,'("Aplusxf=",f8.3,", Aminusxf=",f8.3,", Dxf=",f8.3)')&
     & Aplusxf,Aminusxf,Dxf
      abssoil=(Dxf+I0*exp(-ks*xf))*(1.-r)
      Totalout=Refl_toc+abs+abssoil
      Totalin=I0+D0
      write(6,'("Input: I0+D0 = ",f8.3)')Totalin
      write(6,'("Outputs:",/,3x,"Refl_toc=",f8.3,/,3x,"abs_can=",f8.3,&
     & /,3x,"abs_soil=",f8.3,/,"Total outputs=",f8.3)')Refl_toc,abs_can,abssoil,&
     & Refl_toc+abs_can+abssoil
      stop
      end
```