```
      subroutine consatrh(improve)
c    (r&h)  specify some constants in satice routine   ******
      common/cont/ c38,c358,c610,c149,c879,c172,c409,c76,c218,c580,c141
      common/bt/ dt,d2t,rijl2,dts,f5,rd1,rd2,bound,al,cp,ra,ck(8)
      common/size/ tnw,tns,tng,roqs,roqg,roqr
      common/rterv/ zrc,zgc,zsc,vrc0,vrc1,vrc2,vrc3,vgc,vsc
      common/b3cs/ ag,bg,as,bs,aw,bw,bgh,bgq,bsh,bsq,bwh,bwq
      common/rsnw/ alv,alf,als,t0,t00,avc,afc,asc,rn1,rn2,bnd2,rn3,rn4,
     1  rn5,rn50,rn51,rn52,rn53,rn6,rn60,rn61,rn62,rn63,rn7,rn8,rn9,
     2  rn10,rn101,rn102,rn10a,rn10b,rn10c,rn11,rn12,rn12a(31),
     3  rn12b(31),rn13(31),rn14,rn15,rn15a,rn16,rn171,rn172,rn17a,rn17b,
     4  rn17c,rn18,rn18a,rn19,rn191,rn192,rn19a,rn20,rn20a,rn20b,rn30,
     5  rn30a,rn21,bnd21,rn22,rn23,rn231,rn232,rn25,rn25a(31),rn31,beta,
     6  rn32,rn33,rn331,rn332,rn34,rn35
      common/icemass/ ami50,ami40
      common /BergCon/BergCon1(31),BergCon2(31)
     1               ,BergCon3(31),BergCon4(31)
      integer itaobraun   ! cccshie 4/25/02
      real cn0   ! cccshie 4/25/02
      dimension a1(31),a2(31)
      save
      data a1/.7939e-7,.7841e-6,.3369e-5,.4336e-5,.5285e-5,.3728e-5,
     1   .1852e-5,.2991e-6,.4248e-6,.7434e-6,.1812e-5,.4394e-5,.9145e-5,
     2   .1725e-4,.3348e-4,.1725e-4,.9175e-5,.4412e-5,.2252e-5,.9115e-6,
     3   .4876e-6,.3473e-6,.4758e-6,.6306e-6,.8573e-6,.7868e-6,.7192e-6,
     4   .6513e-6,.5956e-6,.5333e-6,.4834e-6/
      data a2/.4006,.4831,.5320,.5307,.5319,.5249,.4888,.3894,.4047,
     1   .4318,.4771,.5183,.5463,.5651,.5813,.5655,.5478,.5203,.4906,
     2   .4447,.4126,.3960,.4149,.4320,.4506,.4483,.4460,.4433,.4413,
     3   .4382,.4361/
c     ****************************************************************

      cp=1.004e7

      cpi=4.*atan(1.)
      cpi2=cpi*cpi
c        grvt=980.
      c38=3.799052e3
      c358=35.86
      c610=6.1078e3
      c149=1.496286e-5
      c879=8.794142
      c172=17.26939
      c409=4098.026
      c76=7.66
      c218=21.87456
      c580=5807.695
      c141=1.414435e7
c     ***************
         tca=2.43e3
         dwv=.226
         dva=1.718e-4
         amw=18.016
         ars=8.314e7
      t0=273.16
      t00=238.16
      alv=2.5e10
      alf=3.336e9
      als=2.8336e10
       avc=alv/cp
       afc=alf/cp
       asc=als/cp
      rw=4.615e6
      cw=4.187e7
      ci=2.093e7
c***   define the density and size distribution of precipitation
      roqr=1.
      tnw=.08
      roqs=.1
```



```
      tns=.16
      if(improve.ge.3) tns=0.08
      roqg=.4
      tng=.08
c***   define the coefficients used in terminal velocity
       ag=351.2
       bg=.37
       as=78.63154
       bs=.11
       if(improve.ge.3) as=151.01
       if(improve.ge.3) bs=.24
       aw=2115.
       bw=.8

c*** DJP: Perturbation test experiment
!        roqr=1.
!        tnw=.20
!        roqs=.1
!        roqg=.2
!        tns=.50
!        tng=.50
!        ag=150.
!        bg=.24
!        as=50.
!        bs=.1

       bgh=.5*bg
       bsh=.5*bs
       bwh=.5*bw
       bgq=.25*bg
       bsq=.25*bs
       bwq=.25*bw
      ga3=2.
      ga4=6.
      ga5=24.
      ga6=120.
      ga7=720.
      ga8=5040.
      ga9=40320.
        ga4g=11.63177
        ga3g=3.3233625
        ga5gh=1.608355
        if(bg.eq.0.37) ga4g=9.730877
        if(bg.eq.0.37) ga3g=2.8875
        if(bg.eq.0.37) ga5gh=1.526425
          ga3d=2.54925
          ga4d=8.285063
          ga5dh=1.456943
          if(bs.eq.0.57) ga3d=3.59304
          if(bs.eq.0.57) ga4d=12.82715
          if(bs.eq.0.57) ga5dh=1.655588
          if(bs.eq.0.11) ga3d=2.218906
          if(bs.eq.0.11) ga4d=6.900796
          if(bs.eq.0.11) ga5dh=1.382792
          ga6d=144.93124
ccccccc              rutledge and hobbs, 1984   ccccccccccccccccccccccccc
       ac1=as
       ac2=ag
       zrc=(cpi*roqr*tnw)**0.25
       zsc=(cpi*roqs*tns)**0.25
       zgc=(cpi*roqg*tng)**0.25
       vrc0=-26.7
       vrc1=20600./zrc
       vrc2=-204500./(zrc*zrc)
       vrc3=906000./(zrc*zrc*zrc)
       vsc=ac1*ga4d/(6.*zsc**bs)
       vgc=ac2*ga4g/(6.*zgc**bg)
cs      cd1=6.e-1
cs      cd2=4.*grvt/(3.*cd1)
```

```
cs      vgc=ga4g*sqrt(cd2*roqg/zgc)/6.
c      ****************************
       rn1=9.4e-15
       rn2=1.e-3
        bnd2=2.e-3
        esi=.1
        if(improve.eq.-1) esi=.01
        if(improve.ge.1) esi=0.01
        if(improve.ge.3) esi=0.025
       rn3=.25*cpi*tns*ac1*esi*ga3d
        esc=1.
        if(improve.ge.1) esc=0.5
       rn4=.25*cpi*esc*tns*ac1*ga3d
crh     eri=1.
        eri=.1
       rn5=.25*cpi*eri*tnw
        rn50=-.267e2*ga3
        rn51=5.15e3*ga4
        rn52=-1.0225e4*ga5
        rn53=7.55e3*ga6
        ami=1./(24.*6.e-9)
       rn6=cpi2*eri*tnw*roqr*ami
        rn60=-.267e2*ga6
        rn61=5.15e3*ga7
        rn62=-1.0225e4*ga8
        rn63=7.55e3*ga9
        esr=1.
        if(improve.le.2) esr=0.5*esr
       rn7=cpi2*esr*tnw*tns*roqs
        esr=1.
       rn8=cpi2*esr*tnw*tns*roqr
        egs=.1
        if(improve.eq.-1) egs=.01
       rn9=cpi2*egs*tns*tng*roqs
       rn10=4.*tns
        rn101=.65
        rn102=.44*sqrt(ac1/dva)*ga5dh
        rn10a=alv*als*amw/(tca*ars)
        rn10b=alv/tca
        rn10c=ars/(dwv*amw)
       rn11=2.*cpi*tns*tca/alf
clin    ami50=4.8e-7
        ami50=4.8e-7*(100./50.)**3
        if(improve.eq.-1) ami50=4.8e-7
        if(improve.ge.3) ami50=4.8e-7
        ami40=2.46e-7
        ami40=2.46e-7*.5**3
        if(improve.ge.3) ami40=2.46e-7
        eiw=1.
        ui50=100.
clin    ri50=5.e-3
        ri50=(100./50.)*5.e-3
        if(improve.ge.3) ri50=5.e-3
        cmn=1.05e-15
       rn12=cpi*eiw*ui50*ri50*ri50
       do 10 k=1,31
         y1=1.-a2(k)
        rn13(k)=a1(k)*y1/(ami50**y1-ami40**y1)
         rn12a(k)=rn13(k)/ami50
         rn12b(k)=a1(k)*ami50**a2(k)
         rn25a(k)=a1(k)*cmn**a2(k)
         BergCon1(k)=6.*a1(k)*ami50**(a2(k)-1.)
         BergCon2(k)=-2.*a1(k)*ami50**a2(k)*1.2
         BergCon3(k)=6.*a2(k)/((a2(k)+1.)*(a2(k)+2.))
     1              *a1(k)*ami50**(a2(k)-1.)
         BergCon4(k)=2.*(1.-a2(k))/((a2(k)+1.)*(a2(k)+2.))
     1              *a1(k)*ami50**a2(k)*1.2
   10 continue
        egc=1.
```



```
       rn14=.25*cpi*egc*ac2*tng*ga3g
        egi=.1
        if(improve.eq.-1) egi=.001
       rn15=.25*cpi*egi*tng*ac2*ga3g
        egi=1.
       rn15a=.25*cpi*egi*tng*ac2*ga3g
        egr=1.
       rn16=cpi2*egr*tng*tnw*roqr
       rn171=2.*cpi*tng*alv*dwv
        rn172=2.*cpi*tng*tca
        rn17a=.31*ga5gh*sqrt(ac2/dva)
        rn17b=cw-ci
        rn17c=cw
        apri=.66
        bpri=1.e-4
        bpri=0.5*bpri
       rn18=20.*cpi2*bpri*tnw*roqr
        rn18a=apri
       rn19=2.*cpi*tng*tca/alf
        rn191=.78
        rn192=.31*ga5gh*sqrt(ac2/dva)
        rn19a=cw/alf
       rn20=2.*cpi*tng
        rn20a=als*als*amw/(tca*ars)
        rn20b=als/tca
       rn30=2.*cpi*tng
        rn30a=alv*alv*amw/(tca*ars)
       rn21=1.e-3
cc        bnd21=1.e-3
        bnd21=1.5e-3
        erc=1.
       rn22=.25*cpi*erc*tnw
       rn23=2.*cpi*tnw
        rn231=.78
        rn232=.31*ga3*sqrt(3.e3/dva)
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
cccshie with scott braun's help, insert "pidep" and change "betah", "c0" in routine
ccc            "consat" (2d), "consatrh" (3d)
ccc       if ( itaobraun.eq.1 ) --> betah=0.5*beta=-.46*0.5=-0.23;   cn0=1.e-6
ccc       if ( itaobraun.eq.0 ) --> betah=0.5*beta=-.6*0.5=-0.30;    cn0=1.e-8
c     itaobraun=0  ! tao's original
         itaobraun=1   ! scott's
        if ( itaobraun.eq.0 ) then     ! tao's original
        cn0=1.e-8
        beta=-.6
        elseif ( itaobraun.eq.1 ) then ! scott's
c       cn0=1.e-8  ! special, if still use tao's
c       beta=-.6   ! special, if still use tao's
        cn0=1.e-6
        beta=-.46
        endif
        if(improve.eq.-1) then
          cn0=1.e-6
          beta=-.6
        endif
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
c      rn25=cn0/1000.
       rn25=cn0
       rn31=1.e-17
       rn32=4.*51.545e-4
       rn33=4.*tns
        rn331=.65
        rn332=.44*sqrt(ac1/dva)*ga5dh
        if(improve.le.2) esc=0.5
        amc=1./(24.*4.e-9)
       rn34=cpi2*esc*amc*ac1*roqs*tns*ga6d
       rn35=alv*alv/(cp*rw)
c      ****************************
       return
```

```
      end
```