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!
! This program computes TOA solar radiation every hour for any
! location on Earth and any day of year
!
! Input:  lat           [the latitude in degrees]
!         j             [the Julian day number or day of year]
! Output: q             [the solar flux per unit surface area in
!                     Wm^-2]
!         qdaily        [daily mean value of q]
!         h00           [the hour angle at sunrise or sunset in radians
!                     based on discrete time intervals of one hour]
!         h0            [the hour angle at sunrise or sunset in radians]
!                     [based on analytical form]
!         qinte         [daily mean value of q, from analytical form]
!
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!
! Modifications:
! 1) output zenith angle
! 2) add several other terms
!     Liang Yang 10/12/2005
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pi = 3.1415926
s0 = 1367.                    !Wm^-2

write(6,*) 'enter latitude in degrees (negative if in the
& southern hemisphere)'
read(5,*) lat
phi = lat*pi/180.0           !convert to radians

write(6,*) 'enter day of year (= 172 June 21 summer solstice;
& = 355 (Dec 21) winter solstice'
read(5,*) j

fe = 1 + 0.033*cos(2.*pi*j/365.) !the eccentricity factor
!or the relative distance
!between Earth and Sun
delta = 0.4093*sin(2*pi*j/365.0 - 1.405) !the solar declination
!in radians

qdaily = 0.0
write(6,*) 'hour of day, hour angle, zenith angle, Q'
do i=1,24
    t = i - 0.5                !the hour of day
    h = pi*(t-12.0)/12.0       !the hour angle in radians
    czen = sin(phi)*sin(delta)+cos(phi)*cos(delta)*cos(h)
    q = s0*fe*czen
    if (q.lt.0.) q = 0.         !negative means Sun is
!below horizon, set to zero
    if (q.gt.0.) h00 = h       !hour angle at sunset
    write(6,*) t,h*180.0/pi,acos(czen)*180.0/pi,q

    qdaily = qdaily + q        !get daily cumulative
enddo

qdaily = qdaily / 24.0        !daily mean

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h0      = acos(-tan(phi)*tan(delta))    !the hour angle at sunrise
                                           !or sunset
qinte   = (s0*fe/pi)*(h0*sin(phi)*sin(delta)+cos(phi)*cos(delta)
&        *sin(h0))                    !daily mean in analytical form

write(6,*) 'Qdiscrete, Qanalytical,Hdiscrete,Hanalytical'
write(6,*) qdaily,qinte,h00*180./pi,h0*180./pi

write(6,*) 'Declination      = ', delta*180./pi
write(6,*) 'Hanalytical      = ', h0*180./pi
write(6,*) 'Latitude         = ', phi*180./pi
write(6,*) 'Feccentricity   = ', fe
write(6,*) '(1st) = ', h0*sin(phi)*sin(delta)
write(6,*) '(2nd) = ', cos(phi)*cos(delta)*sin(h0)

stop
end

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