## Topnet Interception Model Theory

**Main Program**

**call** intercept(CV,RIT-(1-fsprinkler)\*rate\_irrig\*UNITS,AE,DT,CC,

+ CR,r1,UD) ! DGT 8/18/05 multiplied rate\_irrig by UNITS

r1=r1+(1-fsprinkler)\*rate\_irrig\*UNITS

sumce=sumce+ae

sumr1=sumr1+r1

c write(21,\*)'it,balcv,rit,cv,cvs,r1,ae', it,balcv,rit,cv,cvs,r1,ae

c cv is interception state variable [m] (input and returned)

c RIT is precipitation amount [m] (input)

c AE is reference evaporation amount [m] on input, and upon return is net evap

c from interception

c DT is time step [hr] (input)

c CC is interception capacity parameter [m] (input)

c CR is interception evaporation enhancement factor parameter (input)

c r1 net precipitation (throughfall + stemflow)

c ud is unsatisfied transpiration demand that goes through to soil.

r2 = r1 - ud ! Net forcing on the soil zone.

**subroutine** intercept(cv,RIT,AE,DelT,x1,CR,r1,UD)

X1 comes from CC and is canopy capacity

R1 is throughflow

UD is unsatisified demand

### Theory

The Interception Model is

S is interception storage in m

P is input rate m/hr

is potential evap rate m/hr

is vegetation multiplier for E

T is time in hr

Now the input to the subroutine is , (Accumulated Potential evaporation)

Normalization

With these the governing equation is

or cancelling

This can be written as

Now write a scaled time as

Now this equation is in a form where we can factor the denominator

into

with

larger root

smaller root

larger root

smaller root

Now the equation is

From a table of integrals (CRC 27th edition p239)

Make the substitution

The equation now is

So we have solution (integral), recognizing that and

Now if at ,

and at

Define

Then

and

Special case when , which occurs when

At , , therefore

and at

Now with this solution unnormalizing we have end of time step value

The original equation was

Expressed as an integral over

Denoting

we get

Therefore

Throughfall (accumulated over time step) is

Actual evaporation from interception (accumulated over time step) is

Unsatisified Evaporation demand (accumulated over the time step) is taken as

### Some R test code

S0=0.5

Ae=2

Dt=24

Cc=2.5

Cr=2.6

R=0

e=Ae/(Cc/Cr\*Dt)

p=R/(Cc\*Dt)

a=1+sqrt(e/(p+e))

b=2-a

Dt=Dt\*(p+e)

tt=-(S0-b)/(S0-a)\*exp(-(a-b)\*Dt)

S=(b+tt\*a)/(1+tt)