**Karst Model code**

program karstfor

!Set values for initial store volumes, fluxes, isotope composition and cave temperature.

integer :: TT

real :: T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, MEANT

real :: SOILSTOR, SOILSTORXP, SOIL18O, SOIL18OXP

real :: EPXSTORXP, EPXSTOR, EPX18O, EPX18OXP

real :: KSTSTOR1XP, KSTSTOR1, KSTSTOR118O, KSTSTOR118OXP

real :: KSTSTOR2XP, KSTSTOR2, KSTSTOR218O, KSTSTOR218OXP

real :: OVRFLOWXP, OVRFLOW, OVRFLOW18O, OVRFLOW18OXP

real :: DRIP118O, DRIP218O

real :: STAL1D18O, STAL2D18O, STAL3D18O

real :: STAL4D18O, STAL5D18O, STAL6D18O

TT=0

SOILSTORXP=50.

SOILSTOR=50.

EPXSTORXP=100.

EPXSTOR=100.

EPICAP=400.

KSTSTOR2XP=50.

KSTSTOR2=50.

SOIL18OXP=-5.

KSTSTOR1XP=230.

KSTSTOR1= 230.

KSTSTOR118O = -5.

KSTSTOR118OXP = -5.

OVRFLOWXP=20

OVRFLOW=20

OVRFLOW18O=-5.

OVRFLOW18OXP=-5.

OVCAP=100

D18OXP=-5.

T1=10.

T2=10.

T3=10.

T4=10.

T5=10.

T6=10.

T7=10.

T8=10.

T9=10.

T10=10.

T11=10.

MEANT=10.

EPX18O=-4.

EPX18OXP=-4.

KSTSTOR218OXP=-4.

KSTSTOR218O=-4.

DRIP218O=-4.

P=-4.

R=-4.

STAL1D18O=-4.

STAL2D18O=-4.

STAL3D18O=-4.

STAL4D18O=-4.

STAL5D18O=-4.

STAL6D18O=-4

open (unit=5,file='INPUT.PRN',status='OLD')

open (unit=6,file='OUTPUT.DAT',status='NEW')

!Reads the input file, which has the format 'number, month(1-12), PET, P, T, 18O.

25 read(unit=5,fmt="(I8, I8, 4F8.1)")TT,MM,EVPT,PRP,TEMPP,D18O

if (SOILSTORXP+PRP-EVPT.LT.0) then

EVPT=0

else

SOILSTOR=SOILSTORXP+PRP-EVPT

end if

! Prevents any flux when surface is near-frozen. In this case, 0.0 degree C

if(TEMPP.GT.0.0) then

F1=SOILSTOR\*0.2

else

F1=0

endif

!Increases epikarst store volume and generate overflow

EPXSTOR=EPXSTORXP+F1

if(EPXSTOR.GT.EPICAP) then

F4=EPXSTOR-EPICAP

else

F4=0

endif

! 0.08 term parameterised to maintain continuous F3 flux

F3=(EPXSTOR-F4)\*0.008

SOILSTOR=SOILSTOR-F1

EPXSTOR=EPXSTOR-F3-F4

KSTSTOR1=KSTSTOR1XP+F3

F5=KSTSTOR1\*0.005

KSTSTOR1=KSTSTOR1-F5

KSTSTOR2=KSTSTOR2XP+F4

if(KSTSTOR2.GT.OVCAP)then

F7=KSTSTOR2-OVCAP

else

F7=0

end if

KSTSTOR2=KSTSTOR2-F7

F6=KSTSTOR2\*0.002

KSTSTOR2=KSTSTOR2-F6

OVRFLOW=OVRFLOWXP+F7

F8=OVRFLOW\*0.001

OVRFLOW=OVRFLOW-F8

E=PRP+SOILSTORXP

if(E.LT.0.01)then

E=0.001

else

E=PRP+SOILSTORXP

end if

F=SOILSTORXP/E

G=PRP/E

! 0.03 term can be changed to enable evaporative fractionation in soil store

H=D18O+(EVPT\*0.03)

SOIL18O=(F\*SOIL18OXP)+(G\*H)

if(SOIL18O.GT.0.0001)then

SOIL18O=SOIL18OXP

endif

A=F1

B=A+EPXSTORXP

C=(EPXSTORXP/B)\*EPX18OXP

D=(A/B)\*SOIL18O

EPX18O=C+D

B1=F3+KSTSTOR1XP

C1=(KSTSTOR1XP/B1)\*KSTSTOR118OXP

D1=(F3/B1)\*EPX18O

KSTSTOR118O=C1+D1

P=D18O

R=D18OXP

DRIP118O=(EPX18O\*0.50)+(P\*.25)+(R\*.25)

DRIP218O=(EPX18O\*0.75)+(P\*0.25)

if(F4.LT.0.01)then

KSTSTOR218O=KSTSTOR218OXP

else

B2=F4+KSTSTOR2XP

C2=(KSTSTOR2XP/B2)\*KSTSTOR218OXP

D2=(F4/B2)\*EPX18O

KSTSTOR218O=C2+D2

end if

if(F7.LT.0.01) then

OVRFLOW18O=OVRFLOW18OXP

else

B3=F7+OVRFLOWXP

C3=(OVRFLOWXP/B3)\*OVRFLOW18OXP

D3=(F7/B3)\*KSTSTOR218O

OVRFLOW18O=C3+D3

end if

! Caculates temperature dependent fractionation using Kim and O'Niell. Other equations

! can be used. Also, monthly T averaging will be site specific.

MEANT=(T1+T2+T3+T4+T5+T6+T7+T8+T9+T10+T11+TEMPP)/12

if(KSTSTOR2.lt.0.01) then

STAL1D18O=-99.9

else

STAL1D18O=KSTSTOR218O+3.152+(-0.233\*MEANT)

end if

STAL2D18O=DRIP118O+3.152+(-0.233\*MEANT)

STAL3D18O=DRIP218O+3.152+(-0.233\*MEANT)

if (EPXSTOR.lt.0.01) then

STAL4D18O=-99.9

else

STAL4D18O=EPX18O+3.152+(-0.233\*MEANT)

end if

if (KSTSTOR1.lt.0.01) then

STAL5D18O=-99.9

else

STAL5D18O=KSTSTOR118O+3.152+(-0.233\*MEANT)

end if

if (OVRFLOW.lt.0.01) then

STAL6D18O=-99.9

else

STAL6D18O=OVRFLOW18O+3.152+(-0.233\*MEANT)

end if

! Output data for this timestep and update model terms

write(unit=6,fmt="(2I5,16F12.3)")TT,MM,F1,F3,F4,F5,F7,SOILSTOR,EPXSTOR,KSTSTOR1,KSTSTOR2,OVRFLOW, STAL1D18O,&

STAL2D18O,STAL3D18O,STAL4D18O,STAL5D18O,STAL6D18O

T1=T2

T2=T3

T3=T4

T4=T5

T5=T6

T6=T7

T7=T8

T8=T9

T9=T10

T10=T11

T11=TEMPP

EPX18OXP=EPX18O

EPXSTORXP=EPXSTOR

SOILSTORXP=SOILSTOR

SOIL18OXP=SOIL18O

KSTSTOR1XP=KSTSTOR1

KSTSTOR2XP=KSTSTOR2

OVRFLOWXP=OVRFLOW

KSTSTOR118OXP=KSTSTOR118O

KSTSTOR218OXP=KSTSTOR218O

OVRFLOW18OXP=OVRFLOW18O

D18OXP=D18O

! End of file after 12000 months (1000 years)

if (TT==60000) then

endfile(5)

else

goto 25

endif

end karstfor