Appendices

Appendix A

Glossary

Accuracy. The quality of an observation or **statistic**, derived from a number of observations, of being free from error. Accuracy denotes the ultimate excellence of data and computed results.

Batch process. A group of computer statements processed as an entity. Execution of a DOS batch file, such as AUTOEXEC.BAT, is an example of a batch process.

Capacity-based solute transport model. A capacity-based solute transport model defines changes in amounts of solute and water content in the soil, rather than rate of change. They are usually driven by the amounts of rainfall, ET, or irrigation, and only consider time indirectly.

Deterministic model. A mathematical model which presumes that a certain set of events leads to a uniquely definable outcome.

Empirical distribution function (EDF). A probability distribution function derived directly from observed data, rather than by fitting a theoretical distribution function to the data.

Ensemble. The set of all outcomes of a random experiment.

Ergodic hypothesis. This hypothesis states that inferences about the statistical structure of a stochastic function $U(x)$ may be based on a substitution of **ensemble** averages with spatial averages obtained from a single realization of $U(x)$. *Ergodicity* implies that the expected value, a model parameter, can be approximated by the mean of an actual realization over a sufficiently large domain.

Geostatistics. The study of phenomena that fluctuate in space. Originally the field started with the objective of improving forecasts of ore grade and reserves in mines, but the mathematical generality of the approach led to the application of geostatistics to other problems in the earth sciences. Although not all geostatistical methods are probabilistic in nature, the most important accomplishments have been in estimation and forecasting, extending the probabilistic methods of stochastic processes and time series analysis to the spatial domain. Geostatistical methods assume that the variation of soil properties over space can be modeled by a continuous random, but spatially correlated stochastic field; such properties are termed *regionalized variables*.

Latin hypercube sampling (LHS). A method or technique used to sample the values of random variates from their probability density functions. LHS uses a stratified sampling procedure to sample the values of the random variates, in contrast with the random sampling procedure in conventional Monte Carlo simulation.

Model Validation. The process of substantiating that the model, within its domain of applicability, behaves with satisfactory accuracy consistent with the study objectives.

Model Verification. The process of substantiating that the model is transformed, with sufficient accuracy, from one form to another (for example, the transformation of a model representation in a flow chart into an executable computer program).

Monte Carlo method. A number of procedures that use simulated random numbers to obtain a probabilistic approximation to the solution of a mathematical equation or model. problem. *Monte Carlo simulation* (MCS) in this research involves sequential generation of random input parameters of the model and subsequent deterministic solutions of the model (equation) for each *realization* of the input parameters.

p-value. The level of significance or p-value of a statistical test is the weight of evidence of rejecting the null hypothesis, given in terms of a probability.

Probability density function (PDF). For a continuous **random variable** (i.e., the random variables which can assume any value within some defined finite or infinite range), the probability density function expresses the probability that the **random variable** falls within some very small interval.

Random variable. A function X assigning one and only one real number $X(a) = x$ to each element a of a sample space. It is understood that a probabilistic function is also defined to account for the possibility that X takes certain values.

Range statistic. The range statistic expresses the percentage of observations within the range of an output variable simulated by a stochastic model.

Rate-based solute transport model. A rate model defines the instantaneous rate of change of water content in terms of the product of a hydraulic gradient and a rate parameter, the hydraulic conductivity, and then defines the rate of change of solute concentration in terms of convection and dispersion processes. A rate model is, by definition, driven by time.

Sensitivity analysis. Provides insight into the sensitivity of a model to input parameters and identifies which parameters have the greatest effect on model predictions. Sensitivity analysis of models are conducted by varying input parameters by a specified percentage and by computing its relative sensitivity, which gives the percent change in output to the percent change in input.

Spatial correlation length, spatial correlation scale. The spatial separation distance over which measurements of a property are statistically independent. Spatial variations with interdependence are commonly described with a *semivariogram* or a *correlogram*.

Spatial structure. An attribute denoting the possession of *spatial correlation*. In **geostatistics**, regionalized variables are characterized by having both random and structured fluctuations that are better modeled by random functions than by stochastically independent forms of **random variables** as used in classical statistics. The structured fluctuations is usually a combination of small scale, high frequency variations (*spatial correlation*) or large scale, low frequency variations (*spatial trend*).

Statistic. A function of observations comprising a sample. A statistic is usually, but not necessarily, an estimator of some parameter of a distribution function.

Stochastic model. A mathematical model that presumes the outcome to be uncertain and is structured to accommodate this uncertainty.

Stochastic-convective stream tube model. A stochastic stream tube model is made up of parallel, non-interacting one-dimensional columns (stream tubes) whose properties are locally homogeneous, but which vary from one column to the next.

Trend surface analysis. A statistical procedure used to partition the variance of a spatial random variable into two orthogonal components, one due to regional effects and the other due to local effects. The partitioning is usually achieved by estimating the variable using a polynomial equation in two perpendicular spatial axes. The polynomial equation is called a *trend surface* since it indicates any regional trends inherent in the data.

Vadose zone. The zone between ground surface and the top of the groundwater. This zone contains water, which is held to soil particles or other underground material by capillary forces. The term vadose zone is preferred over *unsaturated zone* because portions of the vadose zone may actually saturated even though the pressure of the water is below atmospheric pressure.

Appendix B

Opus-SF Program Listing

LISTING OF FORTRAN PROGRAM FOR MONTE CARLO SIMULATION OF OPUS

```
      PROGRAM OpusSF
C
C     Program to implement Opus in Monte-Carlo mode
C
      DIMENSION koutd(20),rin(50)
      EXTERNAL OPUS2
C
C     Read dates (max=20) for which output is desired
C
      OPEN(unit=51,file='outdate.txt',status='unknown')
      READ (51,*)ndate
      DO 10 i=1,ndate
            READ(51,*)koutd(i)
10    CONTINUE
      CLOSE(51)
C
C     ntr = no. of trials; nrv= no. of random variables
C
      OPEN (unit=11,file='opus.rin',status='old')
      READ (11,*)ntr,nrv
      READ (11,*)
      DO 20 intr=1,ntr
            READ (11,100)(rin(i),i=1,nrv)
            CALL OPUS2(intr,koutd,rin,nrv)
20    CONTINUE
100   FORMAT (8X,50F8.0)
      CLOSE (11)
      END
```

MODIFICATIONS TO OPUS CODE FOR GENERATING OUTPUT FROM MONTE CARLO SIMULATION

Modifications made to subroutines SLFILE and ANSTAT in the Opus source file OSTAT.FOR

```
CSZ
      SUBROUTINE SLFILE(intr,koutd1)
CSZ
. . .
. . .
. . .
CSZ
CSZ   Modifications for customized soil water content and chemical
CSZ   mass output from MCS
CSZ
CSZ
CSZ   Call subroutine CUSTOUT
CSZ
      CALL CUSTOUT(intr,koutd1,DEPL,DEPU,prpsx)
CSZ
      RETURN
      END
CSZ
CSZ   Subroutine for creating soil water and chemical output for
CSZ   each MCS trial.  Each output variable and each specified date are
CSZ   written in separate files.  This subroutine can handle upto 3
CSZ   chemicals and 10 specified output dates
CSZ
      SUBROUTINE CUSTOUT(intr,koutd1,DEPL,DEPU,prpsx)
CSZ
      COMMON/STATE/JDAY,JDATE,MO,PES,PET,AES,AET(4),SNO,ROOT(4),SEEP,
     +THER(4),WLCH,SW,TH(20),THE(20),RSW(4),NL,SOILIM,NDYR,GZTL,PFCOV
     +,STOLC,STOLE,STOLR,PSEV,ICRP,IRYR,STDRY,SRESD,SDD(4),ALAI(4),
     +DM(4),WLV(4),WRT(4),WFT(4),WOOD(4),RFSURF,REG(4),SMEI,PORMAC,
     +SUMER,PLOD,ITIL,TSNO,PMLCH,TCS,KL,PLHTA,TORGC(3),TLAI
      COMMON/SOIL/GZ(20),POR(20),RC(20),B15(10),PBUB(10),H(20),THR(20),
     +DZ(20),THS(20),DZB(20),RCB(20),IPRK,HOUT,THW(20),CONTHS(20),
     +TYAV,TSL(21),WL(20),CONTHM,DRSP,DDIMP,RCLM,HM,NLWT,NTI(20),
     +ILBR,NUTI(20),PCLAY(10),PSILT(10),PSAND(10)
      COMMON/IO/GZH(10),NSL,PSSO(10),PSRO(10),ROCON(10),
     +SOLCON(10),PERP(10),PERPC(10),SEDMPR,THRESH,
     +INTSP,ROPC(10),SDCPST(10),DKTOT,STMV,INUN1,INUN2,
     +INUN4,IOUT3,IOUTHY,IOUTSL,IOUT8,IOU,FOL,SOL,
     +WNOUT,WNHLR,WPLRO,SFAC,CFAC,PFAC,UFAC,JIDP,ICON
      COMMON /IOC/IWARN(5),IQUIT(5),IWARNR(5),ICHANG(5),
     +IU2(2,7),IU4(2,6),IU6(2,2),
     +TITLEM,TITLEP(3),TITLER
      COMMON /CONS/ AGRAV,DENH2O,WTDH2O,VNU,YALCON,BETA,BARENS,BARENC,
     +CMON(12)
      COMMON/PESTI/IAPLIC(5,15),DKFL(10),DKSOIL(10),DKOC(10),PPWLF(10),
     +NPST,PMSOL(20,10),FWASH(10),FRACA(5,15),FRACP(5,15),IPST
     +,TDRY,IDPST(2,10),BEXTR(10),PSOLUB(10),ROPST(10),SDMPST(10)
```

```
     +,CPQIR(10),PINRES(3,10),PPULF(10),CPADS(20,10),RELP(10)
     +,DKTHE(10),DKTEMP(10),ARRHC(10)
C
      CHARACTER*77 TITLEM,TITLEP,TITLER
      CHARACTER*2 IU2
      CHARACTER*4 IWARN,IQUIT,IWARNR,ICHANG,IU4,idpst
      CHARACTER*6 IU6
      CHARACTER*3 CMON
      CHARACTER*10 SWCDOUT(20),CH1DOUT(20),CH2DOUT(20),CH3DOUT(20)
      DIMENSION DEPL(20),DEPU(20),PRPSX(3,20)
CSZ
      DATA SWCDOUT/'swcd01.rou','swcd02.rou','swcd03.rou','swcd04.rou',
     +'swcd05.rou','swcd06.rou','swcd07.rou','swcd08.rou','swcd09.rou'
     +,'swcd10.rou','swcd11.rou','swcd12.rou','swcd13.rou',
     +'swcd14.rou','swcd15.rou','swcd16.rou','swcd17.rou',
     +'swcd18.rou','swcd19.rou','swcd20.rou'/,
     +CH1DOUT/'ch1d01.rou','ch1d02.rou','ch1d03.rou','ch1d04.rou',
     +'ch1d05.rou','ch1d06.rou','ch1d07.rou','ch1d08.rou','ch1d09.rou'
     +,'ch1d10.rou','ch1d11.rou','ch1d12.rou','ch1d13.rou',
     +'ch1d14.rou','ch1d15.rou','ch1d16.rou','ch1d17.rou',
     +'ch1d18.rou','ch1d19.rou','ch1d20.rou'/,
     +CH2DOUT/'ch2d01.rou','ch2d02.rou','ch2d03.rou','ch2d04.rou',
     +'ch2d05.rou','ch2d06.rou','ch2d07.rou','ch2d08.rou','ch2d09.rou'
     +,'ch2d10.rou','ch2d11.rou','ch2d12.rou','ch2d13.rou',
     +'ch2d14.rou','ch2d15.rou','ch2d16.rou','ch2d17.rou',
     +'ch2d18.rou','ch2d19.rou','ch2d20.rou'/,
     +CH3DOUT/'ch3d01.rou','ch3d02.rou','ch3d03.rou','ch3d04.rou',
     +'ch3d05.rou','ch3d06.rou','ch3d07.rou','ch3d08.rou','ch3d09.rou'
     +,'ch3d10.rou','ch3d11.rou','ch3d12.rou','ch3d13.rou',
     +'ch3d14.rou','ch3d15.rou','ch3d16.rou','ch3d17.rou',
     +'ch3d18.rou','ch3d19.rou','ch3d20.rou'/
CSZ
      IF (jdate.eq.koutd1) THEN
            ifil=1
            nfswc=60+ifil
            nfch1=80+ifil
            nfch2=100+ifil
            nfch3=120+ifil
      ELSE
            ifil=ifil+1
            nfswc=nfswc+1
            nfch1=nfch1+1
            nfch2=nfch2+1
            nfch3=nfch3+1
      ENDIF
CSZ
CSZ   Open output files and write headers
CSZ
      IF (intr.eq.1) THEN
            OPEN(unit=nfswc,file=swcdout(ifil),status='unknown')
            WRITE(nfswc,3000) (TITLEP(I),I=1,3)
            WRITE(nfswc,3001)TITLEM
            CALL MONDAY(JDATE,MON,IDM,JPYR)
            WRITE(nfswc,3002)CMON(MON),IDM,JPYR
            WRITE(nfswc,3003)'Layer','Depth (mm)'
            DO 10 L=1,IPRK
```

```
                  WRITE(nfswc,3004)L,DEPU(L),DEPL(L)
10          CONTINUE
            WRITE(nfswc,3005)
CSZ
            IF (npst.ge.1) THEN
                  OPEN(unit=nfch1,file=ch1dout(ifil),status='unknown')
                  WRITE(nfch1,3000) (TITLEP(I),I=1,3)
                  WRITE(nfch1,3001)TITLEM
                  CALL MONDAY(JDATE,MON,IDM,JPYR)
                  WRITE(nfch1,3006)CMON(MON),IDM,JPYR
                  WRITE(nfch1,3003)'Layer','Depth (mm)'
                  DO 20 L=1,IPRK
                        WRITE(nfch1,3004)L,DEPU(L),DEPL(L)
20                CONTINUE
                  WRITE(nfch1,3007)
            ENDIF
CSZ
            IF (npst.ge.2) THEN
                  OPEN(unit=nfch2,file=ch2dout(ifil),status='unknown')
                  WRITE(nfch2,3000) (TITLEP(I),I=1,3)
                  WRITE(nfch2,3001)TITLEM
                  CALL MONDAY(JDATE,MON,IDM,JPYR)
                  WRITE(nfch2,3008)CMON(MON),IDM,JPYR
                  WRITE(nfch2,3003)'Layer','Depth (mm)'
                  DO 30 L=1,IPRK
                        WRITE(nfch2,3004)L,DEPU(L),DEPL(L)
30                CONTINUE
                  WRITE(nfch2,3009)
            ENDIF
CSZ
            IF (npst.ge.3) THEN
                  OPEN(unit=nfch3,file=ch3dout(ifil),status='unknown')
                  WRITE(nfch3,3000) (TITLEP(I),I=1,3)
                  WRITE(nfch3,3001)TITLEM
                  CALL MONDAY(JDATE,MON,IDM,JPYR)
                  WRITE(nfch3,3010)CMON(MON),IDM,JPYR
                  WRITE(nfch3,3003)'Layer','Depth (mm)'
                  DO 40 L=1,IPRK
                        WRITE(nfch3,3004)L,DEPU(L),DEPL(L)
40                CONTINUE
                  WRITE(nfch3,3011)
            ENDIF
      ENDIF
CSZ
CSZ   Calculate depth-averaged soil water content and
CSZ   Write soil water output for each trial
CSZ
      TOTDEP=0.0
      SWDEP=0.0
      DO 99 L=1,IPRK
            D=DEPL(L)-DEPU(L)
            TOTDEP=TOTDEP+D
            SWDEP=SWDEP+TH(L)*D
99    CONTINUE
      SWDA=SWDEP/TOTDEP
CSZ
```

```
      WRITE(nfswc,3020)intr,SWDA,(TH(L),L=1,IPRK)
CSZ
      DO 100 J=1,NPST
            IF (J.eq.1) THEN
                  nf=nfch1
            ELSEIF (J.eq.2) THEN
                  nf=nfch2
            ELSE
                  nf=nfch3
            ENDIF
CSZ
CSZ   Calculate total mass and depth to center of mass of solute
CSZ   and Write chemical output for each trial
CSZ
            TMASS=0.0
            SUM1=0.0
            SUM2=0.0
            DO 101 L=1,IPRK
                  TMASS=TMASS+PRPSX(J,L)
                  D=DEPL(L)-DEPU(L)
                  Z=0.5*(DEPU(L)+DEPL(L))
                  SUM1=SUM1+PRPSX(J,L)*D*Z
                  SUM2=SUM2+PRPSX(J,L)*D
101         CONTINUE
            ZC=0.0
            IF (SUM2.GT.0.0) ZC=SUM1/SUM2
CSZ
            WRITE(nf,3021)intr,TMASS,ZC,(PRPSX(J,L),L=1,IPRK)
CSZ
100   CONTINUE
CSZ
3000  FORMAT(2X,50H SUBSURFACE OUTPUT DATA FILE FOR SIMULATION WITH: /
     +10X,17H  PARAMETER FILE: ,/(1H ,A))
3001  FORMAT(10X,20H WITH WEATHER FILE: /1H ,A/)
3002  FORMAT(/' ',52(1H*)/2X,38H SOIL WATER OUTPUT FROM OPUS-SF AS OF ,
     +,A3,2I3.2,2H :)
3003  FORMAT(/2x,a5,2x,a10)
3004  FORMAT(2H  ,I2,2(1X,F7.2))
3005  FORMAT(/2X,'TRIAL',3X,'SWC(DA)',2X,'SWC(01)',2X,'SWC(02)',2X,
     +'SWC(03)',2X,'SWC(04)',2X,'SWC(05)',2X,'SWC(06)',2X,'SWC(07)',
     +2X,'SWC(08)',2X,'SWC(09)',2X,'SWC(10)',2X,'SWC(11)',2X,
     +'SWC(12)',2X,'SWC(13)',2X,'SWC(14)',2X,'SWC(15)',2X,'SWC(16)',
     +2X,'SWC(17)',2X,'SWC(18)',2X,'SWC(19)',2X,'SWC(20)')
3006  FORMAT(/' ',46(1H*)/3X,38H CHEMICAL-1 OUTPUT FROM OPUS-SF AS OF ,
     +A3,2I3.2,2H :)
3007  FORMAT(/2X,'TRIAL',3X,'Total mass',2X,'Cent. mass',5X,'CH1(01)',
     +5X,'CH1(02)',5X,'CH1(03)',5X,'CH1(04)',5X,'CH1(05)',5X,'CH1(06)'
     +,5X,'CH1(07)',5X,'CH1(08)',5X,'CH1(09)',5X,'CH1(10)',5X,'CH1(11)
     +',5X,'CH1(12)',5X,'CH1(13)',5X,'CH1(14)',5X,'CH1(15)',5X,
     +'CH1(16)',5X,'CH1(17)',5X,'CH1(18)',5X,'CH1(19)',5X,'CH1(20)')
3008  FORMAT(/' ',46(1H*)/3X,38H CHEMICAL-2 OUTPUT FROM OPUS-SF AS OF ,
     +A3,2I3.2,2H :)
3009  FORMAT(/2X,'TRIAL',3X,'Total mass',2X,'Cent. mass',5X,'CH2(01)',
     +5X,'CH2(02)',5X,'CH2(03)',5X,'CH2(04)',5X,'CH2(05)',5X,'CH2(06)'
     +,5X,'CH2(07)',5X,'CH2(08)',5X,'CH2(09)',5X,'CH2(10)',5X,'CH2(11)
     +',5X,'CH2(12)',5X,'CH2(13)',5X,'CH2(14)',5X,'CH2(15)',5X,
```

```
     +'CH2(16)',5X,'CH2(17)',5X,'CH2(18)',5X,'CH2(19)',5X,'CH2(20)')
3010  FORMAT(/' ',46(1H*)/3X,38H CHEMICAL-3 OUTPUT FROM OPUS-SF AS OF ,
     +A3,2I3.2,2H :)
 3011 FORMAT(/2X,'TRIAL',3X,'Total mass',2X,'Cent. mass',5X,'CH3(01)',
     +5X,'CH3(02)',5X,'CH3(03)',5X,'CH3(04)',5X,'CH3(05)',5X,'CH3(06)'
     +,5X,'CH3(07)',5X,'CH3(08)',5X,'CH3(09)',5X,'CH3(10)',5X,'CH3(11)
     +',5X,'CH3(12)',5X,'CH3(13)',5X,'CH3(14)',5X,'CH3(15)',5X,
     +'CH3(16)',5X,'CH3(17)',5X,'CH3(18)',5X,'CH3(19)',5X,'CH3(20)')
3020  FORMAT(2X,I5,2X,21(F8.4,1X))
3021  FORMAT(2X,I5,2X,22(F11.4,1X))
CSZ
      RETURN
      END
CSZ
CSZ   End of modifications for customized soil water content and
CSZ   chemical mass output from MCS
CSZ
C-----------------------------------------------------------------------
CSZ
      SUBROUTINE ANSTAT(TC,IYR,SNOFLG,intr)
CSZ
C
C     Modified 3/92 to produce annual summary of chemical balance by
C     Month
C     4/92 to add printout of N leached and N in runoff
C
      COMMON/IO/GZH(10),NSL,PSSO(10),PSRO(10),ROCON(10),
     +SOLCON(10),PERP(10),PERPC(10),SEDMPR,THRESH,
     +INTSP,ROPC(10),SDCPST(10),DKTOT,STMV,INUN1,INUN2,
     +INUN4,IOUT3,IOUTHY,IOUTSL,IOUT8,IOU,FOL,SOL,
     +WNOUT,WNHLR,WPLRO,SFAC,CFAC,PFAC,UFAC,JIDP,ICON
      COMMON /IOC/IWARN(5),IQUIT(5),IWARNR(5),ICHANG(5),
     +IU2(2,7),IU4(2,6),IU6(2,2),TITLEM,TITLEP(3),TITLER
      CHARACTER*2 IU2
      CHARACTER*4 IWARN,IQUIT,IWARNR,ICHANG,IU4
      CHARACTER*6 IU6
      CHARACTER*77 TITLEM,TITLEP,TITLER
C
      COMMON/STATE/JDAY,JDATE,MO,PES,PET,AES,AET(4),SNO,ROOT(4),SEEP,
     +THER(4),WLCH,SW,TH(20),THE(20),RSW(4),NL,SOILIM,NDYR,GZTL,PFCOV
     +,STOLC,STOLE,STOLR,PSEV,ICRP,IRYR,STDRY,SRESD,SDD(4),ALAI(4),
     +DM(4),WLV(4),WRT(4),WFT(4),WOOD(4),RFSURF,REG(4),SMEI,PORMAC,
     +SUMER,PLOD,ITIL,TSNO,PMLCH,TCS,KL,PLHTA,TORGC(3),TLAI
      COMMON/STATS/ TOTR(12),TOTQ(12),TOTET(12),TOPERC(12),
     +SWLD(12),TMSNO(12),MO1,INUN,SWIN,TOTEP,TOTPEP,TOTSD(12),
     +TOTNRO(12),TONLCH(12),TODR(12),TTRANS(12),TEVAP(12)
      COMMON /RMETR/ TCMAX(366),TCMIN(366),RAD(366),TA(12),TCMN,TCMX,
     +RD,HDL,YLS,YLC,IFRAN,IPAN,RAMX,COEFF,LEV,PRW(2,12),PW(12),
     +ALFG(12),BETG(12),TXMD,ATX,SGX,AGX,BGX,TXMW,TN,AMTN,SGN,AGN,
     +BGN,RMD,AR,CVRD,ACVRD,RMW,CVRW,ACVRW,DWDT,DWDR,TCFMX(12),
     +TCFMN(12),PEVCF(12),PEVMX,ALBS,APH,IFGEN,IFT,seed,pan(12)
      COMMON /STRESS/ RNDNL,RNDWL,SUMNL,SUMWL,RMDSN(12),RMDSW(12),
     +TDSN(12),TDSW(12)
      COMMON/PESTI/IAPLIC(5,15),DKFL(10),DKSOIL(10),DKOC(10),PPWLF(10),
     +NPST,PMSOL(20,10),FWASH(10),FRACA(5,15),FRACP(5,15),IPST
     +,TDRY,IDPST(2,10),BEXTR(10),PSOLUB(10),ROPST(10),SDMPST(10)
```

```
     +,CPQIR(10),PINRES(3,10),PPULF(10),CPADS(20,10),RELP(10)
     +,DKTHE(10),DKTEMP(10),ARRHC(10)
      common/pestab/ tpsin(10,12), tpsep(10,12), tpsrs(10,12),
     +tpsdk(10,12), tpsro(10,12), tpsla(10,12),
     +sumpin(10), sumpsep(10), sumpres(10),
     +sumpdk(10), sumpro(10), sumpair(10)
      COMMON /LIMITS/ LDPH,IBYR,IEDATE,MOB,MOE
      COMMON /NOPTS/ IFOUT,IHOP,IFSED,IFNUT,IFPEST,IFDRAN
      COMMON /CONS/ AGRAV,DENH2O,WTDH2O,VNU,YALCON,BETA,BARENS,BARENC,
     +CMON(12)
C
      logical first
      Character*30 fmu1(10), fmu2(10), fmu3(10)
      Character*10 fmc1(3,10), fmc2(3,10), fmc3(3,10), fma1, fma2,
     +fmb1,fmb2,fma3,fmb3
      Character*4 idpst
      CHARACTER*3 CMON,MANN
      Character*2 fa(5), fb(5), ff(6)
      CHARACTER*1 SNOFLG
CSZ
CSZ   Modifications for customized water balance and chemical balance
CSZ   output from MCS (limit: 5 simulation years, 3 chemicals)
CSZ
CSZ   Declarations for customized W & C balance output files
CSZ
      CHARACTER*10 WBRN(5),WBET(5),WBSP(5),WBSW(5)
      CHARACTER*10 C1IN(5),C1DK(5),C1RS(5),C1LC(5)
      CHARACTER*10 C2IN(5),C2DK(5),C2RS(5),C2LC(5)
      CHARACTER*10 C3IN(5),C3DK(5),C3RS(5),C3LC(5)
CSZ
C
      Equivalence (fa(1),fma3),(fb(1),fmb3)
      Equivalence (fmu1(1),fmc1(1,1)),(fmu2(1),fmc2(1,1)),
     +(fmu3(1),fmc3(1,1))
      Dimension tpinit(10)
C
      data first /.true./
      DATA MANN /'TOT'/
      Data fa/'F9','  ',') ','  ','  '/,fb/'X,','F9','  ','))',','  '/
      Data fma1/'(/2x,A3,4X'/,fmb1/'( 6X,3H   '/,fma2/',A3,A4,1X,'/,
     +fmb2/',A3,A4,6(1'/
      Data ff/'.2','.3','.4','.5','.6','.7'/
CSZ
CSZ   Data statements for customized W & C balance file names
CSZ
      DATA WBRN/'wbrny1.rou','wbrny2.rou','wbrny3.rou',
     +'wbrny4.rou','wbrny5.rou'/
      DATA WBET/'wbety1.rou','wbety2.rou','wbety3.rou',
     +'wbety4.rou','wbety5.rou'/
      DATA WBSP/'wbspy1.rou','wbspy2.rou','wbspy3.rou',
     +'wbspy4.rou','wbspy5.rou'/
      DATA WBSW/'wbswy1.rou','wbswy2.rou','wbswy3.rou',
     +'wbrny4.rou','wbrny5.rou'/
      DATA C1IN/'c1iny1.rou','c1iny2.rou','c1iny3.rou',
     +'c1iny4.rou','c1iny5.rou'/
      DATA C1DK/'c1dky1.rou','c1dky2.rou','c1dky3.rou',
```

```
     +'c1dky4.rou','c1dky5.rou'/
      DATA C1RS/'c1rsy1.rou','c1rsy2.rou','c1rsy3.rou',
     +'c1rsy4.rou','c1rsy5.rou'/
      DATA C1LC/'c1lcy1.rou','c1lcy2.rou','c1lcy3.rou',
     +'c1lcy4.rou','c1lcy5.rou'/
      DATA C2IN/'c2iny1.rou','c2iny2.rou','c2iny3.rou',
     +'c2iny4.rou','c2iny5.rou'/
      DATA C2DK/'c2dky1.rou','c2dky2.rou','c2dky3.rou',
     +'c2dky4.rou','c2dky5.rou'/
      DATA C2RS/'c2rsy1.rou','c2rsy2.rou','c2rsy3.rou',
     +'c2rsy4.rou','c2rsy5.rou'/
      DATA C2LC/'c2lcy1.rou','c2lcy2.rou','c2lcy3.rou',
     +'c2lcy4.rou','c2lcy5.rou'/
      DATA C3IN/'c3iny1.rou','c3iny2.rou','c3iny3.rou',
     +'c3iny4.rou','c3iny5.rou'/
      DATA C3DK/'c3dky1.rou','c3dky2.rou','c3dky3.rou',
     +'c3dky4.rou','c3dky5.rou'/
      DATA C3RS/'c3rsy1.rou','c3rsy2.rou','c3rsy3.rou',
     +'c3rsy4.rou','c3rsy5.rou'/
      DATA C3LC/'c3lcy1.rou','c3lcy2.rou','c3lcy3.rou',
     +'c3lcy4.rou','c3lcy5.rou'/
CSZ
      isimyr=IYR-IBYR+1
CSZ
      PRR = 0.
      PRV = 0.
      PRET = 0.
      PRPRK = 0.
      PRDR = 0.
      PRSED = 0.
      PRNLCH = 0.
      PRNRO = 0.
4     CONTINUE
CSZ
CSZ   Write header in main output file for 1st trial
CSZ
      IF(intr.eq.1) THEN
CSZ
            WRITE(IOUT3,2001)
2001        FORMAT(' ------------------- NOTE: S = SNOWFALL, I = ',
     +      'IRRIGATION,  M = SNOWMELT')
C
            If(IFNUT .ge.1) Then
                  Write (IOUT3,2009) IYR,(IU2(IOU,1),I=1,5),IU4(IOU,1),
     +            IU2(IOU,5),IU2(IOU,7)
                  IF(IYR.EQ.IBYR) WRITE(IOUT3,1011) SWIN
            Else
                  WRITE (IOUT3,2000) IYR,(IU2(IOU,1),I=1,5),IU4(IOU,1)
                  IF(IYR.EQ.IBYR) WRITE(IOUT3,1001) SWIN
            End If
CSZ
      ENDIF
CSZ
CSZ   Assigning file numbers to customized water balance files
CSZ
      nfrn=200+(isimyr-1)*10+1
```

```
      nfet=200+(isimyr-1)*10+2
      nfsp=200+(isimyr-1)*10+3
      nfsw=200+(isimyr-1)*10+4
CSZ
CSZ   Open and write header in customized water balance output files
CSZ
      IF(intr.eq.1) THEN
            OPEN (unit=nfrn,file=wbrn(isimyr),status='unknown')
            OPEN (unit=nfet,file=wbet(isimyr),status='unknown')
            OPEN (unit=nfsp,file=wbsp(isimyr),status='unknown')
            OPEN (unit=nfsw,file=wbsw(isimyr),status='unknown')
            WRITE (nfrn,3001)
            WRITE (nfet,3001)
            WRITE (nfsp,3001)
            WRITE (nfsw,3002)
      ENDIF
CSZ
      st = 0.
CSZ
      CALL SUMST(1440.,0.,TC,0.,0.,st,SNOFLG,intr)
CSZ
      MO1 = MO
CSZ   NMO = MOE-MOB+1
CSZ   IF(NMO.LT.0) NMO = NMO+12
CSZ   I = MOB-1
CSZ   DO 10 J=1,NMO
CSZ         I = I+1
CSZ   IF(I.GT.12) I=1
CSZ
CSZ   Giving another name for initial water storage at
CSZ   start of simulation
CSZ
      SWINIT=SWIN
CSZ
      DO 10 i=mob,moe
            SWO = SWIN
            IF(I.GT.MOB) SWO = SWLD(I-1)
C           DSW = SWO - SWLD(I)
C           BNET = TOTR(I) + DSW - TOTQ(I) - TOTET(I) - TOPERC(I)
            TWRITE = TOPERC(I)
            IF(IFDRAN.GE.1) TWRITE = TODR(I)
CSZ
CSZ   Write monthly water balance to main output file for 1st trial
CSZ
            IF(intr.eq.1) THEN
CSZ
                  If(IFNUT .LE. 0) Then
                  WRITE(IOUT3,1000) CMON(I),TOTR(I),TOTQ(I),TOTET(I),
     +            TWRITE,SWLD(I),TOTSD(I)
                  Else
                  WRITE(IOUT3,1010) CMON(I),TOTR(I),TOTQ(I),TOTET(I),
     +            TWRITE,SWLD(I),TOTSD(I),TONLCH(I),totnro(i)
                  End If
CSZ
            ENDIF
CSZ
```

```
            PRR = PRR + TOTR(I)
            PRV = PRV + TOTQ(I)
            PRET = PRET + TOTET(I)
            PRPRK = PRPRK + TOPERC(I)
            PRSED = PRSED + TOTSD(I)
            PRNLCH = PRNLCH + TONLCH(I)
            PRNRO = PRNRO + TOTNRO(I)
            IF(IFDRAN.GT.0) PRDR = PRDR + TODR(I)
10    CONTINUE
      SWO = SWLD(MOE)
C     DSW = SWIN - SWO
      SWIN = SWO
C     BNET = PRR + DSW - PRV - PRET - PRPRK
      UPRK = PRPRK
      IF(IFDRAN.GT.0) UPRK = PRDR
CSZ
CSZ   Write annual water balance to main output file for 1st trial
CSZ
      IF(intr.eq.1) THEN
CSZ
            If(IFNUT .le. 0) Then
            WRITE(IOUT3,1002)MANN,PRR,PRV,PRET,UPRK,PRSED
            Else
            WRITE(IOUT3,1012)MANN,PRR,PRV,PRET,UPRK,PRSED,Prnlch,prnro
            End If
            WRITE(IOUT3,1004)
CSZ         I = MOB - 1
CSZ         DO 20 J = 1,NMO
CSZ               I = I + 1
CSZ               IF (I.GT.12) I = 1
CSZ
            DO 20 i=mob,moe
                  WRITE (IOUT3,1003) CMON(I), TDSN(I), RMDSN(I),
     +            TDSW(I),RMDSW(I)
20          CONTINUE
CSZ
      ENDIF
CSZ
CSZ   Write monthly and annual water balance to customized
CSZ   water balance files
CSZ   (Note: Nitrate balance not considered. Using the
CSZ   customized output with IFDRAN=1 may lead to error in
CSZ   percolation estimates)
CSZ
      WRITE (nfrn,3005)intr,(TOTQ(i),i=1,12),PRV
      WRITE (nfet,3005)intr,(TOTET(i),i=1,12),PRET
      WRITE (nfsp,3005)intr,(TOPERC(i),i=1,12),PRPRK
      WRITE (nfsw,3005)intr,SWINIT,(SWLD(i),i=1,12)
CSZ
CSZ   Routines for chemical output
CSZ
      If(ifpest .gt. 0) Then
            If(first) Then
            Do 21 n = 1,npst
                  tpinit(n) = sumpres(n)*1000.
                  fmc1(1,n) = fmb1
```

```
                  fmc1(2,n) = fma2
                  fmc2(1,n) = fma1
                  fmc2(2,n) = fmb2
                  fmc3(1,n) = fmb1
                  fmc3(2,n) = fmb2
21          Continue
            First = .false.
            End If
            MOC = MO1
            Call MONDAY(jdate,moc,idt,kyr)
            If(IDT .gt. 1) Call Chemtab(MOC)
CSZ
CSZ   Write header in subsurface output file for 1st trial
CSZ
      IF(intr.eq.1) THEN
CSZ
      Write (ioutsl,2500) iyr
CSZ
      ENDIF
CSZ
CSZ   Assigning file numbers to customized chemical balance files
CSZ
      nf1in=300+(isimyr-1)*10+1
      nf1dk=300+(isimyr-1)*10+2
      nf1rs=300+(isimyr-1)*10+3
      nf1lc=300+(isimyr-1)*10+4
      nf2in=400+(isimyr-1)*10+1
      nf2dk=400+(isimyr-1)*10+2
      nf2rs=400+(isimyr-1)*10+3
      nf2lc=400+(isimyr-1)*10+4
      nf3in=500+(isimyr-1)*10+1
      nf3dk=500+(isimyr-1)*10+2
      nf3rs=500+(isimyr-1)*10+3
      nf3lc=500+(isimyr-1)*10+4
CSZ
CSZ   Open and write header in customized chemical balance
CSZ   output files (limit: 3 chemicals)
CSZ
      IF(intr.eq.1) THEN
            IF (npst.ge.1) THEN
                  OPEN (unit=nf1in,file=c1in(isimyr),status='unknown')
                  OPEN (unit=nf1dk,file=c1dk(isimyr),status='unknown')
                  OPEN (unit=nf1rs,file=c1rs(isimyr),status='unknown')
                  OPEN (unit=nf1lc,file=c1lc(isimyr),status='unknown')
                  WRITE (nf1in,3011)
                  WRITE (nf1dk,3012)
                  WRITE (nf1rs,3012)
                  WRITE (nf1lc,3012)
            ENDIF
CSZ
            IF (npst.ge.2) THEN
                  OPEN (unit=nf2in,file=c2in(isimyr),status='unknown')
                  OPEN (unit=nf2dk,file=c2dk(isimyr),status='unknown')
                  OPEN (unit=nf2rs,file=c2rs(isimyr),status='unknown')
                  OPEN (unit=nf2lc,file=c2lc(isimyr),status='unknown')
                  WRITE (nf2in,3011)
```

```
                  WRITE (nf2dk,3012)
                  WRITE (nf2rs,3012)
                  WRITE (nf2lc,3012)
            ENDIF
CSZ
            IF (npst.ge.3) THEN
                  OPEN (unit=nf3in,file=c3in(isimyr),status='unknown')
                  OPEN (unit=nf3dk,file=c3dk(isimyr),status='unknown')
                  OPEN (unit=nf3rs,file=c3rs(isimyr),status='unknown')
                  OPEN (unit=nf3lc,file=c3lc(isimyr),status='unknown')
                  WRITE (nf3in,3011)
                  WRITE (nf3dk,3012)
                  WRITE (nf3rs,3012)
                  WRITE (nf3lc,3012)
            ENDIF
      ENDIF
CSZ
C     Set up appropriate format for each chemical amount
      mol = moe-1
      if(kyr.eq.ibyr) Then
            If(mol .lt. mob) mol = mob
      End If
      if(mol .le. 0) mol = 12
      Do 25 j=1,npst
            NV = 0
            if(tpsin(j,Mol) .gt. 0.) then
                  NV = NINT(alog10(tpsin(j,mol)))
            Else
                  NV = 2
            End If
            If(NV .ge. 6) Then
                  NF = 1
            Else If (NV .le. -1) Then
                  NF = 6
            Else
                  NF = 6 - NV
            End If
            fa(2) = ff(nf)
            fb(3) = ff(nf)
            fmc1(3,j) = fma3
            fmc2(3,j) = fmb3
            fmc3(3,j) = fmb3
25    Continue
C     Write(*,47)fmu1(1),fmu2(1),fmu3(1)
47    Format(3(2x,a30))
CSZ
CSZ   Write annual chemical balance to subsurface output file
CSZ   for 1st trial
CSZ
      IF(intr.eq.1) THEN
CSZ
      If(IYr .eq. IBYR) Then
            Do 29 j=1,npst
                  write(ioutsl,fmu1(j)) (idpst(k,j),k=1,2),
     +            tpinit(j)
29          Continue
```

```
      End If
C
      Do 30 M=mob,moe
            Write(ioutsl,fmu2(1)) CMON(M),(idpst(k,1),k=1,2),tpsin(1,M),
     +      tpsla(1,M),tpsdk(1,M),tpsrs(1,M),tpsro(1,M),tpsep(1,M)
            If(npst .gt. 1) Then
            Do 31 j=2,npst
                  Write(IOUTSL,fmu3(j)) (idpst(k,j),k=1,2),tpsin(j,M),
     +            tpsla(j,M),tpsdk(j,M),tpsrs(j,m),tpsro(j,M),tpsep(j,M)
31          Continue
            End If
30    Continue
CSZ
      ENDIF
CSZ
CSZ   Write monthly chemical balance to customized files
CSZ
      Do 41 j=1,npst
            nfin=200+j*100+(isimyr-1)*10+1
            nfdk=200+j*100+(isimyr-1)*10+2
            nfrs=200+j*100+(isimyr-1)*10+3
            nflc=200+j*100+(isimyr-1)*10+4
            WRITE (nfin,3015)intr,(tpsin(j,i),i=1,12)
            WRITE (nfdk,3016)intr,(tpsdk(j,i),i=1,12)
            WRITE (nfrs,3016)intr,(tpsrs(j,i),i=1,12)
            WRITE (nflc,3016)intr,(tpsep(j,i),i=1,12)
41    Continue
      End If
CSZ
      IF(intr.eq.1) THEN
CSZ
      If(iedate .gt. jdate .and. IFNUT .ge. 1) Then
C     Residue outfile headers if necessary:
            If(iabs(ifout) .eq. 7) Then
                  Write(9,2121)
            Else If(iabs(ifout) .eq. 8) Then
                  Write(9,2123)
            End If
      End If
CSZ
      ENDIF
CSZ
      MOB = 1
      TOTEP = 0.
      TOTPEP = 0.
1000  FORMAT(1H ,A3,4(2x,F8.2),3X,F8.2,3x,f8.3)
1010  FORMAT(1H ,A3,5(2X,F7.2),2X,F7.3,2(2X,f7.2))
1001  FORMAT(45X,F10.2)
1011  FORMAT(39X,F10.2)
1002  FORMAT(1H ,A3,4(2X,F8.2),14x,F8.3)
1012  FORMAT(1H ,A3,4(2X,F7.2),9x,2x,F7.3,2(2X,F7.2))
1003  FORMAT (1H ,A3,F12.4,F5.1,F9.4,F5.1)
1004  FORMAT (//9X,'Nstress Days  Wstress Days '/)
2000  FORMAT(///,23X,35HANNUAL SUMMARY FOR CALENDAR YEAR 19,I2.2,//7X,
     +49H PRECIP    RUNOFF  TOT. ET.   SEEPAGE    SOIL W. ,
     +10H  SEDIMENT  ,/3X,4(8X,A2),9X,A2,7X,A4/)
```

```
2009  FORMAT(///,23X,35HANNUAL SUMMARY FOR CALENDAR YEAR 19,I2.2,//6X,
     +44H Precip   Runoff    E.T.   Seepage  Profile ,
     +24H Sediment   NO3     TotN,/43x,5HWater,T63,14HLeach   Runoff /,
     +4X,5(7X,A2),5X,A4,10X,A2,'/',A2/)
2500  Format(//'      Accounting of Applied Chemicals for Year 19',I2,
     +/'-------------------------------------------------------------
     +--------------'/73H Month  Chemical   Total   Lost in    Decayed
     + Resident   Runoff    Seep /35H          Name     Input   Air/Hvst
     +,24x,4H Out,5x,4H Out/'-----------------------------------------
     +-------------------------------'/25x,15H --- gm./ha.--- ,/)
2101  Format(9x,a3,a4,2x,F9.1)
2102  Format(/2x,A3,4x,A3,A4,1x,6(1x,F9.1))
2103  Format(9x,A3,A4,1x,6(1x,F9.1))
2121  format(/4x,'day  strucc(1) metabc(1) strucc(2) metabc(2)',
     +    '   som1c     som2c     som3c'/)
2123  format(/'  day   struce(1,1) struce(1,2) metabe(1,1) metabe(1,2)',
     +   ' struce(2,1) struce(2,2) metabe(2,1) metabe(2,2) '/
     +   '        struce(3,1) struce(3,2) metabe(3,1) metabe(3,2)',
     +   '    som1e(1)  ',
     +   '  som1e(2)    som2e(1)    som2e(2)    som3e(1)    som3e(2)'/
     +8x,'  parent(2)   secndy(2)      occlud        tno3  ',
     +   ' tminrl(1)   tminrl(2)')
CSZ
CSZ   Format statements for customized W & C balance files
CSZ
3001  FORMAT(1X,'Trial',7X,'Jan',7X,'Feb',7X,'Mar',7X,'Apr',7X,
      1 'May',7X,'Jun',7X,'Jul',7X,'Aug',7X,'Sep',7X,'Oct',7X,'Nov',
      2 7X,'Dec',7X,'Tot')
3002  FORMAT(1X,'Trial',6X,'Init',7X,'Jan',7X,'Feb',7X,'Mar',7X,
     +'Apr',7X,'May',7X,'Jun',7X,'Jul',7X,'Aug',7X,'Sep',7X,'Oct',
     +7X,'Nov',7X,'Dec')
3005  FORMAT(1X,I5,13(2X,F8.3))
3011  FORMAT(1X,'Trial',8X,'Jan',8X,'Feb',8X,'Mar',8X,
     +'Apr',8X,'May',8X,'Jun',8X,'Jul',8X,'Aug',8X,'Sep',8X,'Oct',
     +8X,'Nov',8X,'Dec')
3012  FORMAT(1X,'Trial',8X,'Jan',8X,'Feb',8X,'Mar',8X,'Apr',8X,
     +'May',8X,'Jun',8X,'Jul',8X,'Aug',8X,'Sep',8X,'Oct',8X,'Nov',
     +8X,'Dec')
3015  FORMAT(1X,I5,12(1X,F10.2))
3016  FORMAT(1X,I5,12(1X,F10.2))
CSZ
      RETURN
      END
CSZ
CSZ   End of modifications for customized water balance and chemical
CSZ   balance output from MCS
CSZ
```

Appendix C

Soil Physical Property Measurements at the Nomini Creek Site

Table C1. Particle size analysis of soil samples, collected from the 8x8 m grid (Figure 16), at the Nomini Creek site.

X (m)	Y (m)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Texture†
0	0	0-0.15	69.7	22.6	7.7	SL
0	0	0.15-0.3	65.5	25.6	8.9	SL
0	0	0.3-0.45	55.9	29.7	14.4	SL
0	0	0.45-0.6	58.5	22.5	19.0	SL
0	0	0.6-0.75	69.1	15.9	15.0	SL
0	0	0.75-0.9	75.4	11.4	13.2	SL
0	0	0.9-1.05	82.3	9.3	8.4	LS
0	0	1.05-1.2	88.0	8.7	3.3	S
0	0	1.2-1.35	89.6	8.9	1.5	S
0	0	1.35-1.5	82.8	12.1	5.1	LS
0	8	0-0.15	68.2	22.9	8.9	SL
0	8	0.15-0.3	55.5	27.2	17.3	SL
0	8	0.3-0.45	57.1	23.6	19.3	SL
0	8	0.45-0.6	75.4	10.3	14.3	SL
0	8	0.6-0.75	79.6	9.2	11.2	SL
0	8	0.75-0.9	89.9	4.5	5.6	S
0	16	0-0.15	65.1	26.9	8.0	SL
0	16	0.15-0.3	52.2	31.0	16.8	SL
0	16	0.3-0.45	48.1	27.9	24.0	SCL
0	16	0.45-0.6	57.4	20.3	22.3	SCL
0	16	0.6-0.75	68.3	15.9	15.8	SL
0	16	0.75-0.9	78.3	9.8	11.9	SL
0	24	0-0.15	65.7	27.5	6.8	SL
0	24	0.15-0.3	64.9	19.1	16.0	SL
0	24	0.3-0.45	63.6	15.6	20.8	SCL
0	24	0.45-0.6	72.6	11.4	16.0	SL
0	24	0.6-0.75	77.9	9.9	12.2	SL
0	24	0.75-0.9	80.5	8.3	11.2	SL
0	32	0-0.15	63.0	29.3	7.7	SL
0	32	0.15-0.3	55.3	34.5	10.2	SL
0	32	0.3-0.45	49.9	36.9	13.2	L
0	32	0.45-0.6	44.4	37.5	18.1	L
0	32	0.6-0.75	42.0	32.4	25.6	L
0	32	0.75-0.9	52.9	24.4	22.7	SCL
0	32	0.9-1.05	69.7	15.3	15.0	SL
0	32	1.05-1.2	77.8	10.0	12.2	SL
0	32	1.2-1.35	87.6	5.7	6.7	LS
0	32	1.35-1.5	91.7	4.3	4.0	S

X (m)	Y (m)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Texture†
8	0	0-0.15	73.7	20.8	5.5	SL
8	0	0.15-0.3	60.2	30.1	9.7	SL
8	0	0.3-0.45	47.3	35.4	17.3	L
8	0	0.45-0.6	45.5	31.9	22.6	L
8	0	0.6-0.75	55.3	22.0	22.7	SCL
8	0	0.75-0.9	68.0	15.0	17.0	SL
8	8	0-0.15	72.4	21.7	5.9	SL
8	8	0.15-0.3	66.4	23.1	10.5	SL
8	8	0.3-0.45	77.2	14.6	8.2	SL
8	8	0.45-0.6	86.5	7.2	6.3	LS
8	8	0.6-0.75	92.2	3.5	4.3	S
8	8	0.75-0.9	93.3	5.0	1.7	S
8	16	0-0.15	71.6	22.7	5.7	SL
8	16	0.15-0.3	59.4	25.0	15.6	SL
8	16	0.3-0.45	65.1	17.5	17.4	SL
8	16	0.45-0.6	80.5	8.4	11.1	SL
8	16	0.6-0.75	91.3	3.2	5.5	S
8	16	0.75-0.9	92.9	2.3	4.8	S
8	24	0-0.15	71.4	23.4	5.2	SL
8	24	0.15-0.3	63.1	27.3	9.6	SL
8	24	0.3-0.45	54.2	28.9	16.9	SL
8	24	0.45-0.6	60.5	20.2	19.3	SL
8	24	0.6-0.75	72.2	12.3	15.5	SL
8	24	0.75-0.9	83.6	4.9	11.5	LS
8	32	0-0.15	66.9	23.0	10.1	SL
8	32	0.15-0.3	57.5	29.3	13.2	SL
8	32	0.3-0.45	52.0	30.5	17.5	SL
8	32	0.45-0.6	47.9	26.3	25.8	SCL
8	32	0.6-0.75	55.5	21.4	23.1	SCL
8	32	0.75-0.9	70.4	12.3	17.3	SL
16	0	0-0.15	73.3	20.5	6.2	SL
16	0	0.15-0.3	62.9	26.5	10.6	SL
16	0	0.3-0.45	42.1	37.4	20.5	L
16	0	0.45-0.6	39.6	34.7	25.7	L
16	0	0.6-0.75	52.8	27.9	19.3	SL
16	0	0.75-0.9	70.8	16.1	13.1	SL
16	8	0-0.15	70.7	20.4	8.9	SL
16	8	0.15-0.3	54.9	23.2	21.9	SCL
16	8	0.3-0.45	66.4	14.3	19.3	SL
16	8	0.45-0.6	81.3	6.9	11.8	SL
16	8	0.6-0.75	87.1	12.1	0.8	S
16	8	0.75-0.9	92.4	3.1	4.5	S
16	16	0-0.15	69.9	22.6	7.5	SL
16	16	0.15-0.3	55.4	26.8	17.8	SL
16	16	0.3-0.45	54.8	23.8	21.4	SCL
16	16	0.45-0.6	68.2	18.2	13.6	SL
16	16	0.6-0.75	84.4	8.4	7.2	LS
16	16	0.75-0.9	90.7	4.0	5.3	S
16	24	0-0.15	73.0	20.0	7.0	SL
16	24	0.15-0.3	63.3	23.2	13.5	SL
16	24	0.3-0.45	65.5	17.7	16.8	SL
16	24	0.45-0.6	79.3	7.5	13.2	SL
16	24	0.6-0.75	89.7	2.9	7.4	S
16	24	0.75-0.9	91.8	3.2	5.0	S

X (m)	Y (m)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Texture†
16	32	0-0.15	66.4	26.4	7.2	SL
16	32	0.15-0.3	68.7	22.0	9.3	SL
16	32	0.3-0.45	60.8	26.2	13.0	SL
16	32	0.45-0.6	59.4	22.3	18.3	SL
16	32	0.6-0.75	72.7	12.3	15.0	SL
16	32	0.75-0.9	79.7	7.1	13.2	SL
24	0	0-0.15	77.4	16.8	5.8	LS
24	0	0.15-0.3	61.3	26.0	12.7	SL
24	0	0.3-0.45	47.0	26.7	26.3	SCL
24	0	0.45-0.6	58.0	18.5	23.5	SCL
24	0	0.6-0.75	64.5	18.1	17.4	SL
24	0	0.75-0.9	73.7	14.2	12.1	SL
24	8	0-0.15	72.8	20.5	6.7	SL
24	8	0.15-0.3	54.4	31.1	14.5	SL
24	8	0.3-0.45	46.0	36.7	17.3	L
24	8	0.45-0.6	57.9	28.2	13.9	SL
24	8	0.6-0.75	69.7	16.3	14.0	SL
24	8	0.75-0.9	75.3	9.1	15.6	SL
24	16	0-0.15	73.0	20.5	6.5	SL
24	16	0.15-0.3	62.6	22.4	15.0	SL
24	16	0.3-0.45	72.4	12.3	15.3	SL
24	16	0.45-0.6	84.3	6.9	8.8	LS
24	16	0.6-0.75	89.7	4.0	6.3	S
24	16	0.75-0.9	92.7	3.5	3.8	S
24	24	0-0.15	70.2	22.3	7.5	SL
24	24	0.15-0.3	58.0	25.2	16.8	SL
24	24	0.3-0.45	61.1	22.1	16.8	SL
24	24	0.45-0.6	82.0	9.0	9.0	LS
24	24	0.6-0.75	90.7	2.9	6.4	S
24	24	0.75-0.9	94.9	2.1	3.0	S
24	32	0-0.15	73.2	21.9	4.9	SL
24	32	0.15-0.3	73.3	22.0	4.7	SL
24	32	0.3-0.45	61.3	24.6	14.1	SL
24	32	0.45-0.6	65.3	19.7	15.0	SL
24	32	0.6-0.75	72.6	15.8	11.6	SL
24	32	0.75-0.9	79.8	9.4	10.8	SL
32	0	0-0.15	78.7	17.4	3.9	LS
32	0	0.15-0.3	74.3	20.0	5.7	SL
32	0	0.3-0.45	54.5	29.5	16.0	SL
32	0	0.45-0.6	51.7	31.0	17.3	L
32	0	0.6-0.75	51.6	32.3	16.1	L
32	0	0.75-0.9	46.9	30.8	22.3	L
32	8	0-0.15	77.4	17.3	5.3	LS
32	8	0.15-0.3	64.7	27.0	8.3	SL
32	8	0.3-0.45	48.3	35.9	15.8	L
32	8	0.45-0.6	48.5	32.7	18.8	L
32	8	0.6-0.75	54.1	26.8	19.1	SL
32	8	0.75-0.9	72.2	14.2	13.6	SL
32	16	0-0.15	74.4	19.5	6.1	SL
32	16	0.15-0.3	63.2	23.7	13.1	SL
32	16	0.3-0.45	59.9	20.5	19.6	SL
32	16	0.45-0.6	76.0	10.3	13.7	SL
32	16	0.6-0.75	89.2	4.7	6.1	S
32	16	0.75-0.9	91.1	2.5	6.4	S

X (m)	Y (m)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Texture†
32	24	0-0.15	74.0	20.2	5.8	SL
32	24	0.15-0.3	65.0	22.0	13.0	SL
32	24	0.3-0.45	64.9	16.6	18.5	SL
32	24	0.45-0.6	80.9	7.8	11.3	SL
32	24	0.6-0.75	89.0	7.7	3.3	S
32	24	0.75-0.9	94.3	2.1	3.6	S
32	32	0-0.15	70.9	22.7	6.4	SL
32	32	0.15-0.3	61.6	17.8	20.6	SCL
32	32	0.3-0.45	65.9	15.0	19.1	SL
32	32	0.45-0.6	75.3	11.3	13.4	SL
32	32	0.6-0.75	79.8	8.4	11.8	SL
32	32	0.75-0.9	83.5	7.2	9.3	LS
40	0	0-0.15	74.3	21.3	4.4	SL
40	0	0.15-0.3	68.0	26.8	5.2	SL
40	0	0.3-0.45	57.7	31.3	11.0	SL
40	0	0.45-0.6	49.5	28.5	22.0	L
40	0	0.6-0.75	49.0	26.0	25.0	SCL
40	0	0.75-0.9	58.3	21.9	19.8	SL
40	8	0-0.15	79.6	16.8	3.6	LS
40	8	0.15-0.3	59.0	30.8	10.2	SL
40	8	0.3-0.45	48.6	31.0	20.4	L
40	8	0.45-0.6	47.1	27.9	25.0	SCL
40	8	0.6-0.75	58.4	20.9	20.7	SCL
40	8	0.75-0.9	74.0	13.4	12.6	SL
40	16	0-0.15	74.3	18.8	6.9	SL
40	16	0.15-0.3	53.7	29.4	16.9	SL
40	16	0.3-0.45	58.2	23.1	18.7	SL
40	16	0.45-0.6	71.4	13.9	14.7	SL
40	16	0.6-0.75	78.4	9.4	12.2	SL
40	16	0.75-0.9	84.2	6.4	9.4	LS
40	24	0-0.15	72.5	19.9	7.6	SL
40	24	0.15-0.3	63.6	18.5	17.9	SL
40	24	0.3-0.45	77.5	8.2	14.3	SL
40	24	0.45-0.6	86.6	4.6	8.8	LS
40	24	0.6-0.75	90.9	2.4	6.7	S
40	24	0.75-0.9	91.9	3.9	4.2	S
40	32	0-0.15	64.6	24.4	11.0	SL
40	32	0.15-0.3	53.0	26.7	20.3	SCL
40	32	0.3-0.45	68.1	15.5	16.4	SL
40	32	0.45-0.6	81.7	7.6	10.7	LS
40	32	0.6-0.75	89.2	4.1	6.7	S
40	32	0.75-0.9	91.7	2.7	5.6	S
48	0	0-0.15	64.5	29.5	6.0	SL
48	0	0.15-0.3	54.2	37.9	7.9	SL
48	0	0.3-0.45	47.7	41.5	10.8	L
48	0	0.45-0.6	52.5	36.3	11.2	SL
48	0	0.6-0.75	48.6	35.4	16.0	L
48	0	0.75-0.9	43.2	35.3	21.5	L
48	0	0.9-1.05	41.9	33.5	24.6	L
48	0	1.05-1.2	50.8	25.9	23.3	SCL
48	0	1.2-1.35	63.5	21.0	15.5	SL
48	0	1.35-1.5	75.4	15.1	9.5	SL

X (m)	Y (m)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Texture†
48	8	0-0.15	72.5	23.6	3.9	SL
48	8	0.15-0.3	68.8	25.5	5.7	SL
48	8	0.3-0.45	58.5	31.8	9.7	SL
48	8	0.45-0.6	55.9	33.7	10.4	SL
48	8	0.6-0.75	56.3	34.9	8.8	SL
48	8	0.75-0.9	50.9	34.3	14.8	L
48	16	0-0.15	74.4	20.2	5.4	SL
48	16	0.15-0.3	61.1	30.2	8.7	SL
48	16	0.3-0.45	46.9	35.3	17.8	L
48	16	0.45-0.6	42.2	34.6	23.2	L
48	16	0.6-0.75	56.8	20.4	22.8	SCL
48	16	0.75-0.9	75.2	11.7	13.1	SL
48	24	0-0.15	76.7	16.6	6.7	SL
48	24	0.15-0.3	60.0	25.6	14.4	SL
48	24	0.3-0.45	66.7	17.1	16.2	SL
48	24	0.45-0.6	80.9	7.1	12.0	SL
48	24	0.6-0.75	88.5	3.8	7.7	LS
48	24	0.75-0.9	90.0	6.0	4.0	S
48	32	0-0.15	69.6	23.2	7.2	SL
48	32	0.15-0.3	57.1	27.3	15.6	SL
48	32	0.3-0.45	62.4	19.8	17.8	SL
48	32	0.45-0.6	79.4	9.2	11.4	SL
48	32	0.6-0.75	89.2	6.9	3.9	S
48	32	0.75-0.9	93.2	3.6	3.2	S
48	32	0.9-1.05	94.6	0.8	4.6	S
48	32	1.05-1.2	94.1	3.7	2.2	S
48	32	1.2-1.35	94.7	4.6	0.7	S
48	32	1.35-1.5	93.4	1.9	4.7	S

† SL - Sandy Loam; SCL - Sandy Clay Loam; LS - Loamy Sand; S - Sand.

Table C2. Bulk density (ρ_b), water retention, and saturated hydraulic conductivity (K_s) of soil cores collected at the Nomini Creek site.

Coordinates			ρ_b	Soil water (m^3 m^{-3}) retained at pressures (kPa)						K_s
X (m)	Y (m)	Depth (m)	(g cm^{-3})	0	10	30	50	100	1500	(cm h^{-1})
6	3	0-0.05	1.47	0.325	0.182	0.143	0.142	0.131	0.064	10.03
6	3	0.15-0.2	1.40	0.281	0.170	0.136	0.133	0.122	0.106	—†
6	3	0.3-0.35	1.66	0.345	0.274	0.238	0.230	0.217	0.178	—
6	3	0.45-0.5	1.42	0.331	0.253	0.209	0.197	0.179	0.137	—
6	15	0-0.05	1.69	0.273	0.206	0.173	0.167	0.159	0.147	0.29
6	15	0.15-0.2	1.68	0.281	0.213	0.170	0.160	0.151	0.109	0.24
6	15	0.3-0.35	1.59	0.327	0.249	0.206	0.194	0.179	0.134	2.72
6	15	0.45-0.5	1.61	0.315	0.186	0.138	0.128	0.118	0.091	14.79
6	27	0-0.05	1.80	0.311	0.242	0.203	0.198	0.192	0.147	0.96
6	27	0.15-0.2	1.74	0.270	0.222	0.189	0.179	0.166	0.188	4.26
6	27	0.3-0.35	1.77	0.300	0.241	0.198	0.186	0.173	0.156	0.56
6	27	0.45-0.5	1.66	0.323	0.270	0.227	0.215	0.197	0.140	0.20
18	3	0-0.05	1.73	0.291	0.201	0.176	0.170	0.159	0.156	0.73
18	3	0.15-0.2	1.77	0.304	0.221	0.191	0.178	0.164	0.091	3.48
18	3	0.3-0.35	1.17	0.368	0.232	0.193	0.179	0.164	0.103	—
18	3	0.45-0.5	1.66	0.394	0.330	0.299	0.282	0.262	0.215	0.02
18	15	0-0.05	1.70	0.315	0.212	0.179	0.167	0.159	0.161	1.76
18	15	0.15-0.2	1.55	0.312	0.203	0.171	0.158	0.148	0.109	2.84
18	15	0.3-0.35	1.69	0.316	0.233	0.198	0.183	0.167	0.114	0.94
18	15	0.45-0.5	1.46	0.373	0.196	0.163	0.155	0.149	0.125	11.51
18	27	0-0.05	1.71	0.319	0.192	0.164	0.159	0.153	0.137	7.94
18	27	0.15-0.2	1.58	0.280	0.191	0.162	0.150	0.138	0.145	10.36
18	27	0.3-0.35	1.67	0.351	0.245	0.205	0.189	0.175	0.160	6.22
18	27	0.45-0.5	1.53	0.428	0.218	0.170	0.152	0.140	0.096	—
30	3	0-0.05	1.44	0.285	0.136	0.134	0.144	0.136	0.127	6.34
30	3	0.15-0.2	1.68	0.267	0.131	0.115	0.111	0.127	0.123	7.00
30	3	0.3-0.35	1.62	0.347	0.218	0.182	0.176	0.162	0.174	—
30	3	0.45-0.5	1.65	0.327	0.233	0.202	0.194	0.172	0.124	—
30	15	0-0.05	1.65	0.288	0.178	0.157	0.164	0.154	0.165	1.97
30	15	0.15-0.2	1.78	0.279	0.188	0.162	0.159	0.149	0.116	1.89
30	15	0.3-0.35	1.63	0.334	0.242	0.212	0.207	0.198	0.200	3.63
30	15	0.45-0.5	1.52	0.354	0.157	0.127	0.123	0.113	0.088	10.26
30	27	0-0.05	1.57	0.297	0.172	0.161	0.166	0.159	0.147	1.99
30	27	0.15-0.2	1.57	0.305	0.179	0.168	0.163	0.153	0.138	8.59
30	27	0.3-0.35	1.54	0.442	0.267	0.233	0.231	0.232	0.169	—
30	27	0.45-0.5	1.47	0.348	0.185	0.150	0.144	0.132	0.109	18.99
42	3	0-0.05	1.41	0.386	0.152	0.137	0.135	0.130	0.114	30.05
42	3	0.15-0.2	1.64	0.364	0.198	0.190	0.203	0.203	0.110	—
42	3	0.3-0.35	1.59	0.343	0.201	0.173	0.168	0.156	0.089	4.53
42	3	0.45-0.5	1.52	0.387	0.219	0.188	0.178	0.167	0.178	25.51
42	15	0-0.05	1.48	0.364	0.162	0.153	0.151	0.142	0.132	—
42	15	0.15-0.2	1.49	0.387	0.169	0.143	0.137	0.126	0.100	—
42	15	0.3-0.35	1.77	0.365	0.257	0.234	0.227	0.214	0.157	1.20
42	15	0.45-0.5	1.71	0.351	0.280	0.260	0.252	0.239	0.191	0.01
42	27	0-0.05	1.69	0.325	0.183	0.173	0.187	0.180	0.143	6.21
42	27	0.15-0.2	1.57	0.336	0.171	0.158	0.158	0.158	0.127	—
42	27	0.3-0.35	1.62	0.379	0.224	0.196	0.189	0.178	0.205	—
42	27	0.45-0.5	1.65	0.332	0.167	0.145	0.141	0.135	0.138	7.10

† K_s could not be determined accurately due to insufficient sample

Appendix D

GLEAMS-SF Program Listing

LISTING OF DOS BATCH PROGRAM FOR MONTE CARLO SIMULATION OF GLEAMS

```
@echo off
cls
:initial
MCCON
RSMCF
:start
MCCON
if exist ENDMC.DAT goto :end
GHYDP
copy erobas.par ero.par
GPESTP
GLMS22
rem The following executable is specific for each Monte-Carlo run, and
rem should be modified to store the desired output:
rem Read And Store Output UniQuE
RASOUT
type w01.out >> wbrn.gro
type w02.out >> wbsp.gro
type w03.out >> wbet.gro
type w04.out >> c1lc.gro
type v01.out >> swcd01.gro
type v02.out >> swcd02.gro
type v03.out >> swcd03.gro
type v04.out >> swcd04.gro
type v05.out >> swcd05.gro
type v06.out >> swcd06.gro
type v07.out >> swcd07.gro
type v08.out >> swcd08.gro
type v09.out >> swcd09.gro
type v10.out >> swcd10.gro
type v11.out >> swcd11.gro
type v12.out >> swcd12.gro
type v13.out >> swcd13.gro
type v14.out >> swcd14.gro
type v15.out >> swcd15.gro
type v16.out >> swcd16.gro
type v17.out >> swcd17.gro
type v18.out >> swcd18.gro
type v19.out >> swcd19.gro
type v21.out >> cm1d01.gro
type v22.out >> cm1d02.gro
type v23.out >> cm1d03.gro
```

```
type v24.out >> cm1d04.gro
type v25.out >> cm1d05.gro
type v26.out >> cm1d06.gro
type v27.out >> cm1d07.gro
type v28.out >> cm1d08.gro
type v29.out >> cm1d09.gro
type v30.out >> cm1d10.gro
type v31.out >> cm1d11.gro
type v32.out >> cm1d12.gro
type v33.out >> cm1d13.gro
type v34.out >> cm1d14.gro
type v35.out >> cm1d15.gro
type v36.out >> cm1d16.gro
type v37.out >> cm1d17.gro
type v38.out >> cm1d18.gro
type v39.out >> cm1d19.gro
cls
RSMCF
goto :start
:end
FINALMC
```

LISTING OF FORTRAN ROUTINE TO GENERATE OUTPUT FROM MONTE CARLO SIMULATION OF GLEAMS

```
C
C     Program for customizing selected output from MCS of GLEAMS
C     Outputs: Soil water depth by layer for specific dates,
C     Chemical mass by layer for specific dates,
C     Monthly runoff, percolation, ET, and pesticide leaching losses
C     Limits: 20 specified dates, 1 chemical, 10 layers, 3 years
C     Dougherty Plain horizon characteristics used for calculating
C     depth-averaged soil water content and solute center of mass
C
      CHARACTER*10 swcdout(20),cm1dout(20)
      REAL sout(10),swc(10),runo(36),perc(36),evtr(36),pslc(36)
      INTEGER koutd(20),kmond(36)
      OPEN(unit=1,file='outdate.txt',status='old')
      OPEN(unit=2,file='mccon.dat',status='old')
      OPEN(unit=3,file='svar.out',status='old')
      OPEN(unit=11,file='w01.out',status='unknown')
      OPEN(unit=12,file='w02.out',status='unknown')
      OPEN(unit=13,file='w03.out',status='unknown')
      OPEN(unit=14,file='w04.out',status='unknown')
      DATA swcdout/'v01.out','v02.out','v03.out','v04.out','v05.out',
     +'v06.out','v07.out','v08.out','v09.out','v10.out','v11.out',
     +'v12.out','v13.out','v14.out','v15.out','v16.out','v17.out',
     +'v18.out','v19.out','v20.out'/,
     + cm1dout/'v21.out','v22.out','v23.out','v24.out','v25.out',
     +'v26.out','v27.out','v28.out','v29.out','v30.out','v31.out',
     +'v32.out','v33.out','v34.out','v35.out','v36.out','v37.out',
     +'v38.out','v39.out','v40.out'/
C
C     Read dates on which soil water and chemical mass output is desired
C
      READ(1,*)ndate
      DO 10 i=1,ndate
            READ (1,*)koutd(i)
10    CONTINUE
      CLOSE(1)
C
C     Read trial number
C
      READ(2,*)itrial
C
C     Open customized soil water and chemical mass output files
C
      IF(itrial.eq.1)THEN
            DO 30 j=1,ndate
                  nfswc=20+j
                  nfcm1=40+j
                  OPEN(unit=nfswc,file=swcdout(j),status='unknown')
                  WRITE(nfswc,1000)koutd(j)
                  WRITE(nfswc,*)
                  WRITE(nfswc,1001)
```

```
                  OPEN(unit=nfcm1,file=cm1dout(j),status='unknown')
                  WRITE(nfcm1,1002)koutd(j)
                  WRITE(nfcm1,*)
                  WRITE(nfcm1,1003)
30          CONTINUE
      ENDIF
C
C     Start with the GLEAMS selected output file
C
      DO 40 i=1,2
40    READ(3,*)
C
      j=1
      nfswc=20
      nfcm1=40
      imo=1
C
      DO 100 i=1,3500
            READ(3,*)idate
            IF(idate.EQ.0)GOTO 200
            IF(idate.EQ.koutd(j))THEN
                  nfswc=nfswc+1
                  nfcm1=nfcm1+1
                  OPEN(unit=nfswc,file=swcdout(j),status='unknown')
                  OPEN(unit=nfcm1,file=cm1dout(j),status='unknown')
C
C     Read and write customized soil water and chemical mass output
C
                  READ(3,1004)(sout(k),k=1,10)
C     Calculate soil water content for each layer
                  swc(1)=sout(1)/1.0
                  swc(2)=sout(2)/9.67
                  swc(3)=sout(3)/9.67
                  swc(4)=sout(4)/9.67
                  swc(5)=sout(5)/15.0
                  swc(6)=sout(6)/15.0
                  swc(7)=sout(7)/15.0
                  swc(8)=sout(8)/15.0
                  swc(9)=sout(9)/15.0
                  swc(10)=sout(10)/15.0
C     Calculate depth-averaged soil water content in profile
                  swcda=(1.0*swc(1)+9.67*(swc(2)+swc(3)+swc(4))+15.0*
     +            (swc(5)+swc(6)+swc(7)+swc(8)+swc(9)+swc(10)))/120.0
                  WRITE(nfswc,1005)itrial,swcda,(swc(k),k=1,10)

                  READ(3,1004)(sout(k),k=1,10)
C     Calculate total pesticide mass in profile
                  tmass=0.0
                  DO 50 k=1,10
                        tmass=tmass+sout(k)
50                CONTINUE
C     Calculate depth to solute center of mass in profile
      cmasnum=(sout(1)*1.0*0.5+sout(2)*9.67*5.835+sout(3)*9.67*15.5+
     +sout(4)*9.67*25.165+sout(5)*15.0*37.5+sout(6)*15.0*52.5+
     +sout(7)*15.0*67.5+sout(8)*15.0*82.5+sout(9)*15.0*97.5+
     +sout(10)*15.0*112.5)
```

```
      cmasden=(sout(1)*1.0+(sout(2)+sout(3)+sout(4))*9.67+
     +sout(5)+sout(6)+sout(7)+sout(8)+sout(9)+sout(10))*15.0)
                  IF(cmasden.GT.0.0)THEN
                        cmass=cmasnum/cmasden
                  ELSE
                        cmass=0.0
                  ENDIF
                  WRITE(nfcm1,1006)itrial,tmass,cmass,(sout(k),k=1,10)
                  j=j+1
C
C     Read monthly water and chemical balance output
C
            ELSEIF(idate.EQ.2002)THEN
                  IF(itrial.EQ.1)THEN
                        kmond(imo)=kmo
                  ENDIF
                  BACKSPACE 3
                  READ(3,1007)runo(imo)
                  READ(3,1007)perc(imo)
                  READ(3,1007)evtr(imo)
                  READ(3,1007)pslc(imo)
                  imo=imo+1
            ENDIF
            IF(itrial.EQ.1.AND.idate.GT.10000)kmo=idate
100   CONTINUE
200   CONTINUE
C
C     Write monthly water and chemical balance output
C
      nmo=imo-1
      IF(itrial.EQ.1)THEN
            WRITE(11,1008)
            WRITE(11,1009)(kmond(imo),imo=1,nmo)
            WRITE(12,1010)
            WRITE(12,1009)(kmond(imo),imo=1,nmo)
            WRITE(13,1011)
            WRITE(13,1009)(kmond(imo),imo=1,nmo)
            WRITE(14,1012)
            WRITE(14,1009)(kmond(imo),imo=1,nmo)
      ENDIF
      WRITE(11,1013)itrial,(runo(imo),imo=1,nmo)
      WRITE(12,1013)itrial,(perc(imo),imo=1,nmo)
      WRITE(13,1013)itrial,(evtr(imo),imo=1,nmo)
      WRITE(14,1013)itrial,(pslc(imo),imo=1,nmo)
      STOP ' '
1000  FORMAT(2x,'GLEAMS-SF: Soil water depth (cm) by layer on --',I6)
1001  FORMAT(2x,'Trial',3x,'SWC(DA)',3x,'SWC(01)',3x,'SWC(02)',3x,
     +'SWC(03)',3x,'SWC(04)',3x,'SWC(05)',3x,'SWC(06)',3x,'SWC(07)',
     +3x,'SWC(08)',3x,'SWC(09)',3x,'SWC(10)')
1002  FORMAT(2x,'GLEAMS-SF: Chemical mass (g/ha) by layer on --',I6)
1003  FORMAT(2x,'Trial',3x,'TotMass',3x,'CenMass',3x,'CM1(01)',3x,
     +'CM1(02)',3x,'CM1(03)',3x,'CM1(04)',3x,'CM1(05)',3x,'CM1(06)',
     +3x,'CM1(07)',3x,'CM1(08)',3x,'CM1(09)',3x,'CM1(10)')
1004  FORMAT(5x,10f12.6)
1005  FORMAT(2x,i5,11f10.4)
1006  FORMAT(2x,i5,12f10.4)
```

```
1007  FORMAT(5x,f12.6)
1008  FORMAT(2x,'GLEAMS-SF: Monthly runoff volume (cm)')
1009  FORMAT(2x,'Trial',36(5x,i5))
1010  FORMAT(2x,'GLEAMS-SF: Monthly percolation volume (cm)')
1011  FORMAT(2x,'GLEAMS-SF: Monthly evapotranspiration (cm)')
1012  FORMAT(2x,'GLEAMS-SF: Monthly pesticide leaching (g/ha)')
1013  FORMAT(2x,i5,36f10.4)
      END
```