SUBROUTINE WQ3D(ISTL\_,IS2TL\_)

USE GLOBAL

USE WQ\_RPEM\_MODULE

USE RESTART\_MODULE

USE CALCSERMOD,ONLY: CALCSER

IMPLICIT NONE

REAL(RKD), STATIC :: DAYNEXT

REAL(RKD), STATIC :: SUNDAY1, SUNDAY2

REAL , STATIC :: SUNSOL1, SUNSOL2

REAL , STATIC :: SUNFRC1, SUNFRC2, WQTSDTINC

REAL :: TIMTMP,RATIO,SOLARAVG,WTEMP,WQTT,TT20

INTEGER :: ISTL\_,IS2TL\_

INTEGER :: IWQTAGR,IWQTSTL,ISMTICI

INTEGER :: M1,M2,L,K,NMALG,NW

INTEGER, STATIC :: M

REAL(RKD), EXTERNAL :: DSTIME

REAL(RKD) :: TTDS ! MODEL TIMING TEMPORARY VARIABLE

DATA IWQTAGR,IWQTSTL,ISMTICI/3\*0/

IF( N == 1 )THEN ! Qian: N: Global counter of iterations based on DT

WQTSDTINC = 0.

ENDIF

! \*\*\* SET THE HYDRODYNAMIC TIMESTEP

IF( ISDYNSTP == 0 )THEN

DELT=DT ! Qian: Time step for initial conditions

ELSE

DELT=DTDYN

ENDIF

! \*\*\* INCREMENT THE WATER QUALITY TIMESTEP

WQKCNT=WQKCNT+DELT/86400.

! \*\*\* SET THE INITIAL DAYNEXT VALUE

IF( ITNWQ == 0 )THEN

DAYNEXT=DBLE(INT(TIMEDAY))+1.

ENDIF

! \*\*\* PMC - NEW IMPLEMENTATION TO USE DAILY (FROM HOURLY) SOLAR RADIATION FOR ALGAL GROWTH

IF( ITNWQ == 0 .AND. IWQSUN > 1 .AND. NASER > 0 )THEN

! \*\*\* BUILD THE DAILY AVERAGE SOLAR RADIATION FROM THE ASER DATA

SUNDAY1 = DAYNEXT-1.

SUNDAY2 = DAYNEXT

! \*\*\* FIND 1ST POINT

M = 1

DO WHILE (TSATM(1).TIM(M) < SUNDAY1)

M = M+1

END DO

! \*\*\* BUILD THE AVERAGE DAILY SOLAR RADIATION

M1 = 0

M2 = 0

SUNSOL1 = 0.0

DO WHILE (TSATM(1).TIM(M) < SUNDAY1)

M1 = M1+1

IF( TSATM(1).VAL(M,6) > 0. )THEN

M2 = M2+1

SUNSOL1=SUNSOL1+TSATM(1).VAL(M,6)

ENDIF

M = M+1

END DO

IF( M1 > 0 )THEN

SUNFRC1=FLOAT(M2)/FLOAT(M1)

SUNSOL1=SUNSOL1/FLOAT(M1)

ELSE

SUNFRC1=1.0

ENDIF

! \*\*\* BUILD THE AVERAGE DAILY SOLAR RADIATION

M1 = 0

M2 = 0

SUNSOL2 = 0.

DO WHILE (TSATM(1).TIM(M) < SUNDAY2)

M1 = M1+1

IF( TSATM(1).VAL(M,6) > 0. )THEN

M2 = M2+1

SUNSOL2=SUNSOL2+TSATM(1).VAL(M,6)

ENDIF

M = M+1

END DO

IF( M1 > 0 )THEN

SUNFRC2=FLOAT(M2)/FLOAT(M1)

SUNSOL2=SUNSOL2/FLOAT(M1)

ELSE

SUNFRC2=1.

ENDIF

ENDIF

! \*\*\* READ INITIAL CONDITIONS

IF( ITNWQ == 0 )THEN

IF( IWQICI == 1 ) CALL WQICI

IF( IWQICI == 2 ) CALL WQWCRST\_IN

! \*\*\* READ TIME/SPACE VARYING ALGAE PARAMETERS

!IF(IWQAGR == 1 .AND. ITNWQ == IWQTAGR) CALL WQAGR(IWQTAGR)

IF( IWQAGR == 1 ) CALL WQAGR(IWQTAGR) ! HARDWIRE FOR TEMPORALLY CONSTANT

! \*\*\* READ TIME/SPACE VARYING SETTLING VELOCITIES

!IF(IWQSTL == 1 .AND. ITNWQ == IWQTSTL) CALL RWQSTL(IWQTSTL)

IF( IWQSTL == 1 ) CALL RWQSTL(IWQTSTL) ! HARDWIRE FOR TEMPORALLY CONSTANT

ENDIF

! \*\*\* READ BENTHIC FLUX IF REQUIRED

! \*\*\* CALL SPATIALLY AND TIME VARYING BENTHIC FLUX HERE. ONLY CALL WQBENTHIC

! \*\*\* IF SIMULATION TIME IS >= THE NEXT TIME IN THE BENTHIC FILE.

IF( IWQBEN == 2 )THEN

IF( ISDYNSTP == 0 )THEN

TIMTMP=(DT\*FLOAT(N)+TCON\*TBEGIN)/86400.

ELSE

TIMTMP=TIMEDAY

ENDIF

IF( TIMTMP >= BENDAY )THEN

CALL WQBENTHIC(TIMTMP)

ENDIF

ENDIF

! \*\*\* UPDATE POINT SOURCE LOADINGS

IF( IWQPSL == 1 )THEN

! \*\*\* MASS LOADING BC'S

CALL RWQPSL

ELSEIF( IWQPSL == 2 )THEN

! \*\*\* CONCENTRATION BASED BC'S

CALL CALCSER(ISTL\_)

ENDIF

CALL WQWET

! \*\*\* READ SEDIMENT MODEL INITIAL CONDITION

IF( IWQBEN == 1 )THEN

IF( ISMICI == 1 .AND. ITNWQ == ISMTICI) CALL RSMICI(ISMTICI)

ENDIF

! \*\*\* UPDATE OLD CONCENTRATIONS

! \*\*\* CALCULATE PHYSICAL TRANSPORT

! \*\*\* WQV(L,K,NW) SENT TO PHYSICAL TRANSPORT AND TRANSPORTED

! \*\*\* VALUE RETURNED IN WQV(L,K,NW)

CALL CALWQC(ISTL\_,IS2TL\_) !transports (advects/disperses) WQV

! \*\*\* UPDATE WATER COLUMN KINETICS AND SEDIMENT MODEL

! \*\*\* OVER LONGER TIME INTERVALS THAN PHYSICAL TRANSPORT

IF( ITNWQ == 0 .OR. WQKCNT >= WQKINUPT )THEN

DTWQ = WQKCNT

DTWQO2 = DTWQ\*0.5

WQKCNT = 0.

! \*\* UPDATE SOLAR RADIATION INTENSITY

! WQI1 = SOLAR RADIATION ON PREVIOUS DAY

! WQI2 = SOLAR RADIATION TWO DAYS AGO

! WQI3 = SOLAR RADIATION THREE DAYS AGO

! \*\*\* UPDATE OCCURS ONLY WHEN THE SIMULATION DAY CHANGES.

IF( TIMEDAY > DAYNEXT )THEN ! \*\*\* DS-INTL: FORCE A SOLAR DAY UPDATE

WQI3 = WQI2

WQI2 = WQI1

WQI1 = WQI0OPT

IF( IWQSUN > 0 )WQI0OPT = 0.0

DAYNEXT=DAYNEXT+1.

ENDIF

IF( IWQSUN > 1 .AND. NASER > 0 )THEN

IF( TIMEDAY > SUNDAY2 )THEN

! \*\*\* BUILD THE DAILY AVERAGE SOLAR RADIATION FROM THE ASER DATA

SUNDAY1 = SUNDAY2

SUNSOL1 = SUNSOL2

SUNFRC1 = SUNFRC2

! \*\*\* BUILD THE AVERAGE DAILY SOLAR RADIATION

M1 = 0

M2 = 0

SUNSOL2 = 0.

SUNDAY2 = SUNDAY2+1.

DO WHILE (TSATM(1).TIM(M) < SUNDAY2)

M1 = M1+1

IF( TSATM(1).VAL(M,6) > 0. )THEN

M2 = M2+1

SUNSOL2=SUNSOL2+TSATM(1).VAL(M,6)

ENDIF

M = M+1

IF( M > TSATM(1).NREC )THEN

M = TSATM(1).NREC

EXIT

ENDIF

END DO

IF( M1 > 0 )THEN

SUNFRC2=FLOAT(M2)/FLOAT(M1)

SUNSOL2=SUNSOL2/FLOAT(M1)

ELSE

SUNFRC2=1.

ENDIF

ENDIF

ENDIF

! \*\* READ SOLAR RADIATION INTENSITY AND DAYLIGHT LENGTH

! NOTE: IWQSUN=1 CALLS SUBROUTINE WQSUN WHICH READS THE DAILY

! SOLAR RADIATION DATA FROM FILE SUNDAY.INP WHICH

! ARE IN UNITS OF LANGLEYS/DAY.

! IWQSUN=2 USES THE HOURLY SOLAR RADIATION DATA FROM ASER.INP

! COUPLED WITH THE COMPUTED OPTIMAL DAILY LIGHT TO

! LIMIT ALGAL GROWTH.

! IWQSUN=3 USES THE DAILY AVERAGE SOLAR RADIATION DATA COMPUTED

! FROM THE HOURLY ASER.INP AND THE COMPUTED OPTIMAL DAILY

! LIGHT TO LIMIT ALGAL GROWTH.

! IWQSUN>1 USES THE DAILY AVERAGE SOLAR RADIATION DATA COMPUTED

! FROM THE HOURLY ASER.INP DATA. CONVERTS WATTS/M\*\*2 TO

! LANGLEYS/DAY USING 2.065. COMPUTES THE FRACTION OF

! DAYLIGHT AND ADJUSTS FOR PHOTOSYNTHETIC ACTIVE RADIATION BY

! PARADJ (~0.43)

!

IF( IWQSUN == 0 )THEN

WQI0OPT = WQI0

ELSEIF( IWQSUN == 1 )THEN

CALL WQSUN

WQI0=SOLSRDT

WQFD=SOLFRDT

! \*\*\* OPTIMAL SOLAR RADIATION IS ALWAYS UPDATED BASED ON DAY AVERAGED

WQI0OPT = MAX(WQI0OPT, WQI0)

ELSEIF( IWQSUN > 1 .AND. NASER > 0 )THEN

! \*\*\* SOLAR RADIAION COMES FROM ASER FILE. IWQSUN: 2-USE TIMING FROM ASER, 3-DAILY AVERAGE COMPUTED FROM ASER

RATIO = (TIMEDAY-SUNDAY1)

SOLARAVG = RATIO\*(SUNSOL2-SUNSOL1)+SUNSOL1

WQFD = RATIO\*(SUNFRC2-SUNFRC1)+SUNFRC1

! \*\*\* SOLAR RADIATION IN LANGLEYS/DAY

WQI0 = PARADJ\*2.065\*SOLARAVG

IF( IWQSUN == 2 )THEN

! \*\*\* OPTIMAL SOLAR RADIATION IS ALWAYS UPDATED BASED ON DAY AVERAGED. USE 10 LANGLEYS/DAY TO PREVENT DIVISION BY ZERO LATER.

WQI0OPT = MAX(WQI0OPT, WQI0, .1)

IF( LDAYLIGHT .AND. (NASER > 1 .OR. USESHADE) )THEN

SOLARAVG = 0.

DO L=2,LA

SOLARAVG = SOLARAVG + SOLSWRT(L)

ENDDO

SOLARAVG = SOLARAVG/FLOAT(LA-1)

ELSE

! \*\*\* Spatially Constant Atmospheric Parameters

SOLARAVG = SOLSWRT(2)

ENDIF

! \*\*\* SOLAR RADIATION IN LANGLEYS/DAY

WQI0 = PARADJ\*2.065\*SOLARAVG

WQFD=1.

ELSE

! \*\*\* OPTIMAL SOLAR RADIATION IS ALWAYS UPDATED BASED ON DAY AVERAGED

WQI0OPT = MAX(WQI0OPT, WQI0)

ENDIF

ENDIF

! \*\*\* LOAD WQV INTO WQVO FOR REACTION CALCULATION

NMALG=0

IF( IDNOTRVA > 0 ) NMALG=1

DO NW=1,NWQV+NMALG

IF( ISTRWQ(NW) > 0 .OR. (NMALG == 1 .AND. NW == NWQV+NMALG) )THEN

DO K=1,KC

DO L=2,LA

WQVO(L,K,NW) = WQV(L,K,NW)

ENDDO

ENDDO

ENDIF

ENDDO

! \*\*\* SET UP LOOK-UP TABLE FOR TEMPERATURE DEPENDENCY OVER -10 degC TO 50 degC

WTEMP=WQTDMIN

DO M1=1,NWQTD

TT20 = WTEMP-20.0

WQTT = WQKFCB \* WQTFCB\*\*TT20 \* DTWQO2

WQTD1FCB(M1) = 1.0 - WQTT

WQTD2FCB(M1) = 1.0 / (1.0 + WQTT)

WTEMP=WTEMP + WQTDINC

ENDDO

! \*\*\* CALCULATE KINETIC SOURCES AND SINKS

TTDS=DSTIME(0)

IF( ISWQLVL == 0 ) CALL WQSKE0

IF( ISWQLVL == 1 ) CALL WQSKE1

IF( ISWQLVL == 2 ) CALL WQSKE2

IF( ISWQLVL == 3 ) CALL WQSKE3

IF( ISWQLVL == 4 ) CALL WQSKE4

TWQKIN=TWQKIN+(DSTIME(0)-TTDS)

! \*\*\* DIAGNOSE NEGATIVE CONCENTRATIONS

IF( IWQNC > 0 )CALL WWQNC

! \*\*\* CALL SEDIMENT DIAGENSIS MODEL

IF( IWQBEN == 1 )THEN

TTDS=DSTIME(0)

CALL SMMBE

TWQSED=TWQSED+(DSTIME(0)-TTDS)

ENDIF

! \*\*\* RPEM

IF( ISRPEM > 0 )THEN

CALL CAL\_RPEM

ENDIF

ENDIF ! \*\*\* ENDIF ON KINETIC AND SEDIMENT UPDATE

! \*\*\* UPDATE WATER QUALITY TIMESTEP

ITNWQ = ITNWQ + 1

RETURN

END