

MEMO : EN/INPA /DHL-05
SUBJECT: LIST OF PARAMETERS FOR STRATIF
TO : PASM-ELETRONORTE
FROM : JOHANNES SMITS
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INTRODUCTION

THE ENCLOSED LIST OF PARAMETERS FOR THE THERMAL STRATIFICATION MODEL STRATIF PRESENTS AN EXPLANATION OF THE PARAMETER NAMES, USED IN THE MOST RECENT VERSION. BASICALLY, THIS IS THE VERSION WHICH RESULTED FROM THE FIRST PHASE OF THIS PROJECT. THIS LIST OF PARAMETERS WILL BE PART OF A MANUAL, WHICH IS TO APPEAR IN DUE TIME.

THE PARAMETERS HAVE BEEN LISTED BELOW ACCORDING TO A FEW PRINCIPLES. THE FIRST LEVEL OF DISTINCTION CONCERNS THE FUNCTION OF PARAMETERS IN THE MODEL. THE FUNCTIONS ARE: (1) INPUT, (2) VARIABLE, (3) PARAMETER, (4) OUTPUT, (5) PROGRAM COORDINATION. THE SECOND LEVEL OF DISTINCTION RELATES TO THE DISCIPLINE. THE DISCIPLINES ARE: (A) THERMAL STRATIFICATION, (B) HYDROLOGY AND MASS TRANSPORT, (C) GEOMETRY, (D) ENERGY, (E) AUXILIARY. A THIRD LEVEL HAS BEEN FOUND IN THE TYPE OF PARAMETER: INTEGER, INTEGER ARRAY, REAL, REAL ARRAY. THE FOURTH AND FINAL LEVEL IS THE ALPHABETIC ORDER.

LIST OF PARAMETERS FOR STRATIE

1. INPUT

A) THERMAL STRATIFICATION

DTMP1 : STRUCTURAL TEMPERATURE DIFFERENCE BETWEEN MEASURED AND REAL TEMPERATURE FOR INFLOW 1 (OC)
DTMP2 : STRUCTURAL TEMPERATURE DIFFERENCE BETWEEN MEASURED AND REAL TEMPERATURE FOR INFLOW 2 (OC)
DTMP3 : STRUCTURAL TEMPERATURE DIFFERENCE BETWEEN MEASURED AND REAL TEMPERATURE FOR INFLOW 3 (OC)
TEQ : EQUILIBRIUM TEMPERATURE OF THE EPILIMNION (OC)
TI1 : TEMPERATURE OF INFLOW 1 (OC)
TI2 : TEMPERATURE OF INFLOW 2 (OC)
TI3 : TEMPERATURE OF INFLOW 3 (OC)
TZERO : INITIAL TEMPERATURE OF THE RESERVOIR (OC)

B) HYDROLOGY AND MASS TRANSPORT

DISP : VERTICAL DISPERSION COEFFICIENT AT THE THERMOCLINE (M²/D)
QI1 : FLOW RATE OF INFLOW 1 (M³/S)
QI2 : FLOW RATE OF INFLOW 2 (M³/S)
QI3 : FLOW RATE OF INFLOW 3 (M³/S)
HSEL() : POSITIONS OF THE CENTERS OF THE OUTLETS (MAX. 3) RELATIVE TO THE LOWEST BOTTOM LEVEL (M)
QOS() : FLOW RATES OF THE OUTFLOWS (MAXIMALLY 3) (M³/S)

C) GEOMETRY

AMAX : MAXIMAL SURFACE AREA OF THE RESERVOIR (KM²)
EXPO : EXPONENT OF AREA-DEPTH AND VOLUME-DEPTH RELATIONS
GAMMA : COEFFICIENT OF AREA-DEPTH AND VOLUME-DEPTH RELATIONS
HMAX : MAXIMAL WATER LEVEL (DEPTH) RELATIVE TO THE LOWEST BOTTOM LEVEL (M)
HZERO : INITIAL WATER LEVEL, RELATIVE TO THE LOWEST BOTTOM LEVEL (M)
RESL : RESERVOIR LENGTH AT HMAX, THE SHORTEST DISTANCE BETWEEN THE DAM AND THE MAYOR INFLOW (KM)

D) ENERGY

CD : DRAG COEFFICIENT (*10 000)
CVEG : COEFFICIENT ACCOUNTING FOR THE EFFECT OF THE DROWNED VEGETATION AND THE GEOMETRY ON ENTRAINMENT (=1 OR >1)
ETC : ENERGY TRANSFER COEFFICIENT AIR-WATER (W/(M².OC))
W : WINDSPEED AT A HEIGHT OF 10 M (M/S)

E) AUXILIARY

IBEGIN : FIRST MONTH (YEAR-1900 AND MONTH)
IEND : FINAL MONTH (YEAR-1900 AND MONTH)
INTER : OPTION NUMBER FOR INTERM. OUTPUT OF ENERGIES (0=NO, 1=YES)
IOUT : OPTION NUMBER FOR DISTRIBUTION OF OUTFLOW OVER EPILIMNION AND HYPOLIMNION (1=ACCORDING TO RELATIVE EPILIMNION VOLUME, 2=ACCORDING TO CRITICAL DISCHARGE, METHOD OF FISCHER ET AL.)
ITITLE : OPTION NUMBER FOR HEADING IN OUTPUT (0=NO, 1=YES)
LYEAR : YEAR
LY : YEAR

LMONTH : MONTH
 LM : MONTH
 NTS : NUMBER OF Timesteps WITHIN DELTAT FOR THE COMPUTATION OF THE TEMPERATURE
 DELTAT : Timestep FOR THE THERMAL STRATIFICATION (USUALLY 30.45 D)
 EPSIL : CRITERIUM FOR INCLUSION OF ENTRAINMENT (M). ENTRAINMENT IS INCLUDED IF EPSIL < THE CHANGE OF POSITION OF THE THERMOCLINE OVER A Timestep.

2. VARIABLES

A) THERMAL STRATIFICATION

HHYO : POSITION OF THE THERMOCLINE RELATIVE TO THE LOWEST BOTTOM LEVEL (M)
 TE : TEMPERATURE OF THE EPILIMNION (OC)
 TH : TEMPERATURE OF THE HYPOLIMNION (OC)
 AT() : SURFACE AREA AT THE THERMOCLINE (M2)
 DH() : POSITION OF THE THERMOCLINE RELATIVE TO THE WATER SURFACE (M)
 VEPI() : VOLUME OF THE EPILIMNION (M3)
 VHYP() : VOLUME OF THE HYPOLIMNION (M3)

B) HYDROLOGY AND MASS TRANSPORT

QI : TOTAL INFLOW (M3/S)
 QIE : TOTAL INFLOW INTO THE EPILIMNION (M3/S)
 QIE1 : INFLOW INTO THE EPILIMNION COMING FROM INFLOW 1 (M3/S)
 QIE2 : INFLOW INTO THE EPILIMNION COMING FROM INFLOW 2 (M3/S)
 QIE3 : INFLOW INTO THE EPILIMNION COMING FROM INFLOW 3 (M3/S)
 QIH : TOTAL INFLOW INTO THE HYPOLIMNION (M3/S)
 QIH1 : INFLOW INTO THE HYPOLIMNION COMING FROM INFLOW 1 (M3/S)
 QIH2 : INFLOW INTO THE HYPOLIMNION COMING FROM INFLOW 2 (M3/S)
 QIH3 : INFLOW INTO THE HYPOLIMNION COMING FROM INFLOW 3 (M3/S)
 QO : TOTAL OUTFLOW (M3/S)
 QOE : TOTAL OUTFLOW FROM THE EPILIMNION (M3/S)
 QOH : TOTAL OUTFLOW FROM THE HYPOLIMNION (M3/S)
 QVERT : VERTICAL FLOW ACROSS THE THERMOCLINE (M3/S)

C) GEOMETRY

HAV : AVERAGE DEPTH (M)
 RESL1 : ACTUAL RESERVOIR LENGTH (M)
 A() : SURFACE AREA OF RESERVOIR (M2)
 H() : WATER LEVEL RELATIVE TO THE LOWEST BOTTOM LEVEL (DEPTH) (M)
 VTOT() : TOTAL VOLUME (M3)

D) ENERGY

EFLUX : NET ENERGY FLUX ACROSS THE ATMOSPHERE-WATER INTERFACE (W/M2)
 EKW : KINETIC ENERGY PRODUCTION BY WIND (W/M2)
 EKR : KINETIC ENERGY PRODUCTION BY RIVER INFLOW (W/M2)
 EPA : POTENTIAL ENERGY PRODUCTION RESULTING FROM THE NET FLUX OF ENERGY BETWEEN ATMOSPHERE AND WATER (W/M3)
 EPR : POTENTIAL ENERGY PRODUCTION BY RIVER INFLOW (W/M3)
 VHE : AVERAGE HORIZONTAL FLOW VELOCITY IN THE EPILIMNION (M/S)
 VHH : AVERAGE HORIZONTAL FLOW VELOCITY IN THE HYPOLIMNION (M/S)
 VHORI : AVERAGE HORIZONTAL FLOW VELOCITY DIFFERENCE BETWEEN

EPI LIMNION AND HYPOLIMNION (M/S)

E) AUXILIARY

AN : SURFACE AREA AFTER TIMESTEP DELTB (M2)
AO : SURFACE AREA BEFORE TIMESTEP DELTB (M2)
HN : DEPTH OF RESERVOIR AFTER TIMESTEP DELTB (M)
TEN : EPI LIMNION TEMPERATURE AFTER TIMESTEP DELTB (OC)
TE1 : EPI LIMNION TEMPERATURE WHEN DISPERSION IS INCLUDED (OC)
THN : HYPOLIMNION TEMPERATURE AFTER TIMESTEP DELTB (OC)
TH1 : HYPOLIMNION TEMPERATURE WHEN DISPERSION IS INCLUDED (OC)
VEPIN : EPI LIMNION VOLUME AFTER TIMESTEP DELTB (M3)
VEPIO : EPI LIMNION VOLUME BEFORE TIMESTEP DELTB (M3)
VHYPO : HYPOLIMNION VOLUME AFTER TIMESTEP DELTB (M3)
VHYPOO : HYPOLIMNION VOLUME BEFORE TIMESTEP DELTB (M3)
VTOTN : TOTAL VOLUME AFTER TIMESTEP DELTB (M3)
VTOTO : TOTAL VOLUME BEFORE TIMESTEP DELTB (M3)

3. PARAMETERS

B) HYDROLOGY AND MASS TRANSPORT

QCRIT : CRITICAL OUTFLOW, ABOVE WHICH WATER WILL BE WITHDRAWN FROM THE EPI LIMNION (M3/S)

C) GEOMETRY

VMAX : MAXIMAL VOLUME OF THE RESERVOIR (M3)

D) ENERGY

ALPHA : COEFFICIENT OF THERMAL EXPANSION OF WATER (1/OC)
BETHA : COEFFICIENT FOR THE TEMPERATURE DEPENDENCY OF THE DENSITY OF WATER
CE : COEFFICIENT PRESENTLY WITHOUT FUNCTION
CP : SPECIFIC HEAT COEFFICIENT OF WATER (J/(KG.OC))
G : ACCELERATION OF GRAVITY (M/S2)
RHO : DENSITY OF WATER (KG/M3)
RHDA : DENSITY OF AIR (KG/M3)
RHTE : DENSITY OF THE WATER IN THE EPI LIMNION (KG/M3)
RHTEH : DENSITY OF THE WATER IN THE HYPOLIMNION (KG/M3)
RHTR1 : DENSITY OF THE WATER FROM INFLOW 1 (KG/M3)
RHTR2 : DENSITY OF THE WATER FROM INFLOW 2 (KG/M3)
RHTR3 : DENSITY OF THE WATER FROM INFLOW 3 (KG/M3)

E) AUXILIARY

CIPI1 : FRACTION OF INFLOW 1 ENTERING THE EPI LIMNION
CIPI2 : FRACTION OF INFLOW 2 ENTERING THE EPI LIMNION
CIPI3 : FRACTION OF INFLOW 3 ENTERING THE EPI LIMNION
COEPI : FRACTION OF THE TOTAL OUTFLOW COMING FROM THE EPI LIMNION
COHYPO : FRACTION OF THE TOTAL OUTFLOW COMING FROM THE HYPOLIMNION
DGRAV : VERTICAL DENSITY GRADIENT FOR RHTEQ AND RHTM (KG/M4)
DRHO : DENSITY DIFFERENCE BETWEEN EPI LIMNION AND HYPOLIMNION (KG/M3)
ORLOB : THE ORLOB NUMBER
RHTEQ : DENSITY OF WATER AT EQUILIBRIUM TEMPERATURE (KG/M3)
RHTM : DENSITY OF WATER AT MINIMUM TEMPERATURE (KG/M3)
CSO(I) : FRACTION OF OUTFLOW 1, 2 OR 3 COMING FROM THE EPI LIMNION

4. OUTPUT

A) THERMAL STRATIFICATION

AT2 : SURFACE AREA AT THE THERMOCLINE (KM²)
DLT : TEMPERATURE DIFFERENCE BETWEEN EPILIMNION AND HYPOLIMNION (OC)
HHYPO2 : LEVEL OF THERMOCLINE RELATIVE TO LOWEST BOTTOM LEVEL (M)
RAT : RATIO OF THE SURFACE AREA AT THE THERMOCLINE AND THE SURFACE AREA OF THE RESERVOIR
RVE : RATIO OF THE EPILIMNION VOLUME AND THE TOTAL VOLUME
TO : AVERAGE TEMPERATURE OF THE OUTFLOW (OC)
VEPI2 : VOLUME OF THE EPILIMNION (M³)
VHYPO2 : VOLUME OF THE HYPOLIMNION (M³)
DELT(,) : TEMPERATURE DIFFERENCE BETWEEN EPILIMNION AND HYPOLIMNION FOR EACH YEAR AND EACH MONTH (OC)
HEPI(,) : THICKNESS OF EPILIMNION FOR EACH YEAR AND EACH MONTH (OC), IS POSITION OF THE THERMOCLINE RELATIVE TO THE WATER SURFACE FOR EACH YEAR AND EACH MONTH (OC)
HYPO(,) : THICKNESS OF HYPOLIMNION FOR EACH YEAR AND EACH MONTH (OC), IS POSITION OF THE THERMOCLINE RELATIVE TO THE LOWEST BOTTOM LEVEL FOR EACH YEAR AND EACH MONTH (OC)
TEPI(,) : TEMPERATURE OF THE EPIL. FOR EACH YEAR AND EACH MONTH (OC)
TOUT(,) : AVERAGE OUTFLOW TEMPERATURE FOR EACH YEAR AND EACH MONTH (OC)

B) HYDROLOGY AND MASS TRANSPORT

QIN(,) : TOTAL INFLOW FOR EACH YEAR AND EACH MONTH (M³/S)
QEIN(,) : TOTAL EPILIMNION INFLOW FOR EACH YEAR AND EACH MONTH (M³/S)
QHIN(,) : TOTAL HYPOLIMNION INFLOW FOR EACH YEAR AND EACH MONTH (M³/S)
QOUT1(,) : OUTFLOW 1 FOR EACH YEAR AND EACH MONTH (M³/S)
QOUT2(,) : OUTFLOW 2 FOR EACH YEAR AND EACH MONTH (M³/S)
QOUT3(,) : OUTFLOW 3 FOR EACH YEAR AND EACH MONTH (M³/S)

C) GEOMETRY

A2 : SURFACE AREA OF THE RESERVOIR (KM²)
RVT : RATIO OF TOTAL VOLUME AND MAXIMAL VOLUME
VTOT2 : TOTAL VOLUME OF THE RESERVOIR (M.KM²)
DEPTH(,) : WATER LEVEL RELATIVE TO THE LOWEST BOTTOM LEVEL FOR EACH YEAR AND EACH MONTH (M)

D) ENERGY

WIND(,) : WINDSPEED AT A HEIGHT OF 10 M FOR EACH YEAR AND EACH MONTH (M/S)

E) AUXILIARY

LDATE : DATE (YEAR AND MONTH)

5. PROGRAM COORDINATION

A) THERMAL STRATIFICATION

DVHYPO : DIFFERENCE IN VOLUME OF THE HYPOL. OVER TIMESTEP DELTB (M³)
HH : AVERAGE POSITION OF THE THERMOCLINE OF TWO SUBSEQUENT STEPS OF ITERATION (M)
HHO : VALUE OF HH IN THE PRECEEDING ITERATION STEP (M)
TX : THE MINIMUM OF HYPOLIMNION TEMP. AND INFLOW TEMP. (OC)

TX1 : HYPOLIMNION TEMPERATURE OR EPILIMNION TEMPERATURE (OC)
TX2 : HYPOLIMNION TEMPERATURE OR EPILIMNION TEMPERATURE (OC)
TX3 : HYPOLIMNION TEMPERATURE OR EPILIMNION TEMPERATURE (OC)

B) HYDROLOGY AND MASS TRANSPORT

DLEV : DIFFERENCE BETWEEN LEVELS OF THERMOCLINE AND OUTLET (M)

C) GEOMETRY

DVTOT : DIFFERENCE IN TOTAL VOLUME OVER A TIMESTEP DELTB (M3)

D) ENERGY

F1 : ENTRAINMENT ENERGY FUNCTION

F2 : ENERGY FUNCTION

F3 : RELATIVE SURFACE AREA AT WATER SURFACE

F4 : RELATIVE SURFACE AREA AT THERMOCLINE

F5 : ENERGY FLUX FACTOR

F6 : VOLUME FACTOR (M3/S)

F7 : DISPERSIVE FLUX OF THERMAL ENERGY ((M3.OC)/(M2.D))

F8 : TOTAL THERMAL ENERGY INFLOW ((M3.OC)/S)

E) AUXILIARY

IP : PARAMETER FOR COORDINATION OF PRINTING HEADING IN OUTPUT

IYEAR : NUMBER OF YEAR

NIT : NUMBER OF ITERATION STEPS

DELTB : TIMESTEP WITHIN DELTAT FOR THE COMPUTATION OF TEMPERATURE (S)