PŘÍLOHA C:

MANUÁL A SOFTWARE MODELU KINFIL

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Obsah

Anotace

Model KINFIL je určen pro stanovení návrhových průtoků ovlivněných antropogenní činností, jako např. změna kultur, odlesnění nebo urbanizace, a simulaci významných odtokových procesů.

1. Úvod

Model KINFIL je založen na kombinaci teorie infiltrace a transformace přímého odtoku kinematickou vlnou (Overton, Meadows, 1976; Stephenson, Meadows, 1986; Beven, 1986, 2006). Osvědčil se na řadě experimentálních povodí při rekonstrukci historických povodňových případů a osvědčuje se, podobně jako ostatní modely kinematické vlny, v řadě případů simulace povrchového odtoku, způsobujícího erozi půdy (Kovář, 1992, 2000). Tento model používá fyzikálně-geometrické (fyziografické), hydraulické a klimatické parametry povodí, které se dají určit z mapových a jiných podkladu při absenci přímých pozorování a při zohlednění důsledku antropogenní činnosti v povodí (Morgan, Nearing, 2011). Model je určen přednostně pro stanovení návrhových průtoků pro různé „scénářové situace dané touto činností, jako je změna kultur, odlesnění, urbanizace aj. Současná verze modelu KINFIL je založena na infiltrační teorii Greena a Ampta se zavedením koncepce výtopy podle Meina a Larsona (1973) a Morel-Seytouxe (Morel-Seytoux, Verdin, 1981; Morel-Seytoux, 1982):

$$K_s \left(\frac{z_f + H_f}{z_f} \right) = (\theta_s - \theta_i) \frac{dz_f}{dt} \tag{1}$$

$$S_f = (\theta_s - \theta_i) \, . H_f \tag{2}$$

$$t_p = \frac{S_f}{i \, (\frac{i}{K_s} - 1)} \tag{3}$$

kde K_s je nasycená hydraulická vodivost (m/s), z_f hloubka infiltrační fronty (m), θ_s nasycená půdní vlhkost (–),θ_i počáteční půdní vlhkost (–),H_f sací tlak pod infiltrační frontou (m), i intenzita deště (m/s), S_f retenční součinitel sacího tlaku (m), t_p doba výtopy (s) a t čas (s).

Základním úkolem je určení parametru nasycené hydraulické vodivosti K_s a retenčního součinitele sacího tlaku S_f (při stavu polní vodní kapacity – PVK). Přímým řešením na malých je experimentálních plochách je měření těchto parametru. Na větších povodích je to pak využití dříve odvozených vztahu mezi těmito parametry a hodnotami čísel odtokových křivek CN (Curve Number), dnes dobře propracované metody a ve světě široce používané (US SCS, 1972, 1986). Indexové hodnoty CN korespondují s konceptuálními hodnotami půdních parametru K_s a S_f (PVK): CN = f (K_s, S_f). Druhým komponentem modelu KINFIL je jeho část simulující propagaci a transformaci přímého odtoku (Beven, 2006). Řešená parciální diferenciální rovnice popisuje neustálený pohyb, aproximovaný kinematickou vlnou (po zanedbání nevýznamných rychlostních clenu dynamické St. Venantovy rovnice) po ploše různě uspořádaných a podle topografických podmínek různě skloněných rovinných desek:

$$\frac{\partial y}{\partial t} + \alpha m y^{m-1} \frac{\partial y}{\partial x} = i_e \, (t) \tag{4}$$

kde x, y, t jsou souřadnice délky, hloubky, času (m, m, s), α, m hydraulické parametry a i_e (t) je intenzita efektivního deště (m/s).

Tato rovnice je převedena do tvaru konečných diferencí a řešena explicitním numerickým schématem. Pro praktické řešení je povodí geometrizováno rozdělením do tří komponent: kaskády desek, konvergentních a divergentních segmentu a úseku koryta toku tak, aby simulace topografických ploch povodí byla dostatečně reprezentativní. Počáteční podmínky řešení diferenčního schématu jsou zadány pro tzv. nulové hodnoty hloubek vody (tj. jestliže $y(x, 0) = 0$ pro všechny souradnice polohy x). Horní okrajová podmínka je dána polohou každé rovinné desky v kaskádě, případně horní hranou segmentu. Pro soustředěné neustálené proudění v korytě bývá používáno submodelu Muskingum-Cunge (Cunge, 1969), jehož autoři zavedli zjednodušující předpoklady do rovnice kinematické vlny transformované korytem toku.

2. Infiltrační přístup

Řešení vychází z teorie Greena a Ampta v úpravě Morel-Seytouxe, založené na výpočtu tzv. doby výtopy t_p. V rovnicích se uplatnují dva parametry:

- nasycená hydraulická vodivost K_s (m/s),
- retenční součinitel sacího tlaku S_f (m): $S_f = (\theta_s - \theta_i).H_f$, kde θ_s je vlhkost pudy při nasycení (–),θ_i počáteční vlhkost (–),θ_{FC} vlhkost při polní vodní kapacitě (–) a H_f sací tlak na infiltrační frontě.

Sorptivita půdy při polní vodní kapacitě (m/s^{0,5}) je pak dána vztahem:

$$S\,(\theta_{FC}) = S\,(\theta_{FC}) = \sqrt{2K_s\,.S_f} \qquad (5)$$

Z rovnice Greena a Ampta:

$$v_f = K_s\,.\left[i + \frac{(\theta_s - \theta_i)\,.\,H_f}{W}\right] \qquad (6)$$

kde W je kumulativní infiltrace (m), a z teorie Meina a Larsona (1973) o stanovení doby výtopy byly Morel-Seytouxem odvozeny infiltrační rovnice (Morel-Seytoux, 1976). Pro déšť o konstantní intenzitě se kumulativní infiltrace W v case t, $t_p < t < t_D$, vypočítá ze vztahu:

$$W = W_p + S\,(\theta_i)AR\left[\sqrt{t - t_p + \frac{t_p}{2}\,(AR)^3} - \sqrt{\frac{t_p}{2}(AR)^3}\right] + K_s\,(t - t_p) \qquad (7)$$

kde

$$AR = \frac{i_+}{i_+ - 1}, \qquad i_+ = \frac{i}{K_s}, \qquad W_p = i\,.t_p \qquad (8)$$

Počátek výtopy ($t = t_p$) pro déšť s konstantní intenzitou se stanoví z podmínek (Mein, Larson, 1973) $\theta_i \rightarrow \theta_s$ a $v_f = i$. Kumulativní infiltrace v době výtopy t_p je pak:

$$W_P = v_f\,.t_p = i_p\,.t_p \qquad (9)$$

kde i_p je intenzita deště v době výtopy (pro déšť s konstantní intenzitou $i_p = i$).

Obdobně pro případ deště s proměnlivou intenzitou platí:

$$W = W_p + S\left(W_p, \theta_i\right) + \left[\sqrt{t - t_p + BR} - \sqrt{BR}\right] + K_s\,(t - t_p) \qquad (10)$$

kde

$$S\left(W_p, \theta_i\right) = \sqrt{\frac{2K_s\,(S_F + W_p)^2}{S_F}} \qquad (BR) = \frac{1}{2}\,\frac{(S_F + W_p)^2}{K_s\,S_f\,(\frac{i_p}{K_s} - 1)} \tag{11}$$

3. Transformace přímého odtoku

Model kinematické vlny je model s rozdělenými parametry (distributed model), je možné ho použít na různých geometrických útvarech, jako:

- kaskáda rovinných desek,
- konvergentní nebo divergentní segmenty,
- soustředěný odtok v úsecích říčních koryt.

Proudění vody po přímém nepropustném svahu simulovaného širokou rovinnou deskou (resp. konvergentním segmentem) je možné vyjádřit rovnici kinematické vlny jako

$$\frac{\partial y}{\partial t} + \frac{\partial q}{\partial x} = i_e\,(t)(+\,\frac{q}{L - x} \tag{12}$$

$$q = \alpha\,.\,y^m \tag{13}$$

kde q je průtok na jednotkovou šíři svahu (m^2/s), i_e (t) je laterální přítok, neboli intenzita, efektivního deště (m/s), α, m jsou hydraulické parametry, L je poloměr konvergentního segmentu, t a x jsou souřadnice času (s) a polohy (m). Spojením rovnic dostáváme

$$\frac{\partial y}{\partial t} + m\alpha y^{m-1}\frac{\partial y}{\partial x} = i_e\,(t)(+\,\frac{\alpha y^m}{L - x} \tag{14}$$

Soustředěný odtok v říčních korytech je řešen metodou Muskingum-Cunge (Cunge, 1969):

$$K\,\frac{d}{dt}\left(XQ_j\right) + (1 - X)Q_{j+1} = Q_j - Q_{j+1} \tag{15}$$

Model kinematické vlny podle explicitního numerického schématu má řešení (Lax, Wendroff, 1960) pro hloubky vodního proudu:

$$\begin{aligned} y_j^{i+1} = y_j - \frac{\Delta t}{2\Delta x}\,.\,(\alpha y_{j+1}^m - \alpha y_{j-1}^m - 2\Delta x\,\left(i_e\right)_j\big) \\ + \frac{(\Delta t)^2}{4\,(\Delta x)^2}\,.\,\left(\alpha y_{j+1}^{m-1} + \alpha y_j^{m-1}\right)\left(\alpha y_{j+1}^m - \alpha y_j^m - \Delta x\,.\,(i_e)_j\right) \\ - \frac{(\Delta t)^2}{4(\Delta t)^2}\,.\,\left(\alpha y_j^{m-1} + \alpha y_{j-1}^{m-1} - \Delta x\,.\,(i_e)_j\right) + \frac{\Delta t}{2}\left[(i_e)_j^{i+1} - (i_e)_j\right] \end{aligned} \tag{16}$$

V této rovnici jsou všechny proměnné, které nejsou označeny horním indexem $i + 1$, považovány za probíhající v časovém kroku i ($i + \Delta t = t + \Delta t$). Dolní index j označuje plošný krok x ($j + \Delta x = x + \Delta x$).

Numerická stabilita řešení je zajištěna, pokud pro časový a polohový krok platí:

$$c\,\frac{\Delta t}{\Delta x} \leq 1 \tag{17}$$

kde pro desku

$$c = m\,.\,y^{m-1} \tag{18}$$

Kromě řešení následných hloubek y_j^{i+1} řeší model KINFIL i ostatní proměnné procesu tvorby a transformace povrchového odtoku, především hydraulické rychlosti v_j^i:

$$v_j^i = \alpha_j\,.\,(y_j^i)^{m_j-1} \tag{19}$$

dále třecí rychlosti $(v\,*)_j^i$:

$$(v\,*)_j^i = \sqrt{g\,.Y_j\,.\,y_j^i} \tag{20}$$

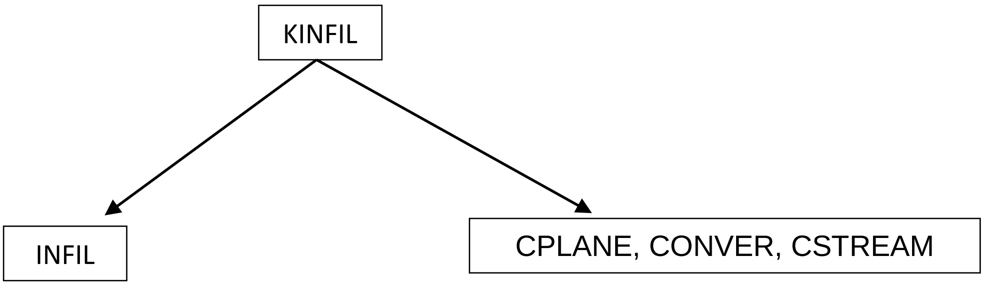
a tangenciální napětí τ_j^i:

$$\tau_j^i = \rho\,.\,g.Y_{j\,.}\,y_j^i \tag{21}$$

kde α_j, m_j jsou hydraulické parametry, Y_j sklon pozemku (-), g gravitační zrychlení (m/s^2) a ρ hustota vody (kg/m^3).

4. Struktura modelu KINFIL

Model KINFIL se skládá ze dvou základních částí:



První část modelu je infiltrační submodel INFIL (celistvý modul), obsahující řešení infiltračního procesu, založeného na teorii Greena a Ampta, jak je výše popsáno. Součástí řešení je nalezení ekvivalence $CN = f(K_s, S_f)$. Dílčí podprogramy části INFIL jsou:

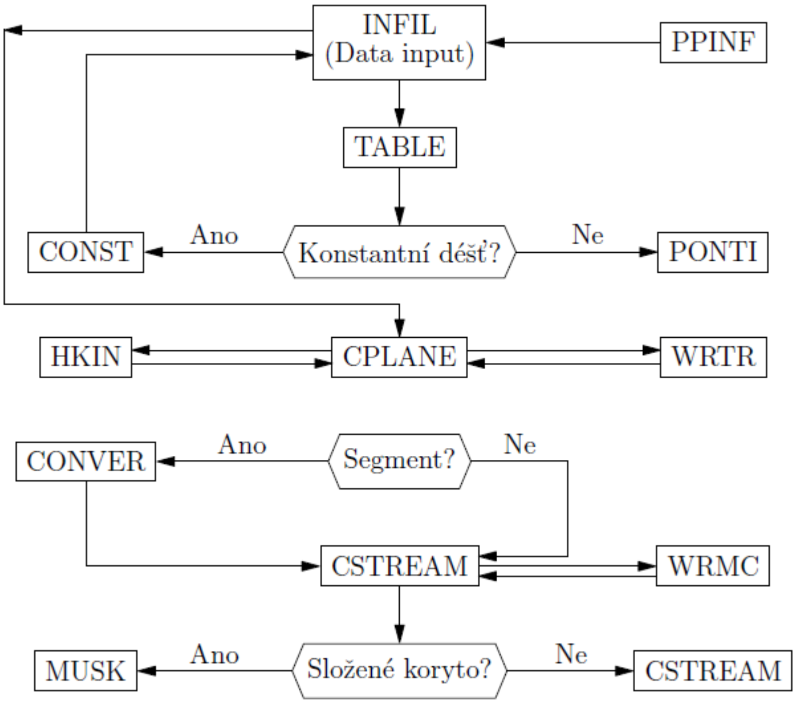
- PONTI: výpočet doby výtopy,
- CONST: infiltrace z deště o konstantní intenzitě,
- PPFIND: infiltrace z deště o proměnlivé intenzitě,
- TABLE: přirazení parametru dle $CN = f(K_s, S_f)$.

Druhou částí je transformační submodel KINFIL, který řeší transformaci přímého odtoku. Procedura CPLANE je určena k simulaci odtoku po geometrizované kaskádě desek, procedura CONVER po segmentech, CSTREAM říční úseky. Numerické schéma řešení je explicitní, Laxe-Wendroffa. Pro řešení soustředěného odtoku po říčních úsecích s laterálními přítoky (CPLANE, CONVER) je možno alternativně řešit metodou MUSKINGUM-CUNGE, která je rovněž obsahem modelu KINFIL, jako samostatná procedura. Všechny tyto zmíněné procedury jsou vzájemně kompatibilní a tvoří model KINFIL. Přidružené pomocné procedury a funkce jsou:

- WRTR: pro tisk mezivýsledků CPLANE a CONVER

- WRMC: pro tisk mezivýsledků CSTREAM

- HKIN: pro řešení numerického schématu Lax-Wendroff



Popsaný model KINFIL je typickým příkladem modelu simulačního typu, popisující významný srážko-odtokový případ a nikoliv empirický model erozního procesu typu univerzální rovnice ztráty pudy (Wischmeier, Smith, 1978; Váška, 2000; Janeček et al., 2002).

Potřeba vstupních dat modelu je v následujících tabulkách, rozlišujících model KINFIL na část INFIL a část KIN. Popis parametru i proměnných je stručně v tabulkách uveden. Vzory vstupních dat jsou poskytnuty v přílohách A a B, jednotlivé symboly v nich značí

- část INFIL:

SUBOPT1, 2, 3, 4	logické proměnné (0 nebo 1)
QO	počáteční průtok (m^3/s)
KT	koeficient nasycené hydraulické vodivosti (mm/hod)
SO	koeficient sorptivity (mm/hod^{0,5})
P	celková výška srážky (mm)
TD	doba trvání deště (hod)
CN	číslo odtokové křivky (není nutné)
N	počet pořadnic deště (-)
JJ	počet pořadnic hydrogramu (-)
DELT	délka časového kroku (hod)
RAIN (I)	výšky deště v časových krocích – pořadnic hyetogramu (mm)
FLAG	návěstí zda pokračovat (1), nebo zastavit (2)

- část KIN:

NPL	počet soustav desek/segmentu (–)
PP	počet desek/segmentu v kaskádě jedné soustavy (–)
SLOPE	sklon svahu (–)
LENGTH	délka svahu (m)
WIDTH	šířka svahu (m)
OBST	překážka na svahu – relativně v desetinném zlomku záběru (–)
MAN	Manningova drsnost n (–)
FRIC	hydraulická turbulence (0.6)

`TYPF`	typ proudění (1.67)
`DELT`	délka časového kroku KIN (s)
`TDELT`	celková doba trvání případu (s)
`NN`	počet poradnic efektivního deště (–)
`EFF RAIN (I)`	pořadnice efektivního deště z části INFIL (mm)
`FLAG`	návěstí zda pokračovat (1), nebo zastavit (0)

Posledními dvěma přílohami jsou ukázky výpočtu obou částí modelu KINFIL (INFIL a KIN).

5. Literatura

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A Vzor vstupních dat – část INFIL

```
TREBSIN, Locality 6, 23.7.2008 AREA=30m2, DRY, DT=1min, maize (Info-hlavička)
 0   0   0   0    (SUBPT1, 2, 3, 4)
0 (QO)
7.84     15.21     16.10     0.250      80.00 (KT, SO, P, TD, CN)
 15   20  0.0167 (N, JJ, DELT)
0.98    1.08    1.08    1.08    1.08    1.08    1.08    1.08    1.08    1.08
1.08    1.08    1.08    1.08    1.08 (EFF RAIN (I), I = 1,NN)
1 (FLAG)
TREBSIN, Locality , 23.7.2008 AREA=30m2, WET, DT=1min, maize (dtto)
 0   0   0   0
0
7.84     8.21      16.17     0.250      80.00
 16   20  0.0167
0.05    1.08    1.08    1.08    1.08    1.08    1.08    1.08    1.08    1.08
1.08    1.08    1.08    1.08    1.08
0
```

B Vzor vstupních dat – část KIN

```
0.0 (QO)
TREBSIN, Locality 6,23.7.2008,DT=1min,AREA=30m2,DRY,maize  (Info-hlavička)
  1 (NPL)
  1 (PP)
0.128     10.0      3.0       0.0       0.10      0.6       1.67 (SLOPE, LENGHT, WIDTH, OBST,
MAN, FRIC, TYPF)
60.0      1200.0 (DELT, TDELT)
 16 (NN)
0.000   0.000   0.016   0.147   0.296   0.384   0.444   0.487   02117   0.549
0.571   0.591   0.607   0.621   0.634   0.645 (EFF RAIN (I), I = 1,NN)
1 (FLAG)
TREBSIN, Locality 6,23.7.2008,DT=1min,AREA=30m2,WET,maize  (dtto)
  1
  1
0.128     10.0      3.0      0.0       0.10      0.6      1.67
60.0      1200.0
 16
0.000   0.176   0.421   0.554   0.619   0.660   0.688   0.710   0.727   0.740
0.752   0.762   0.770   0.777   0.784   0.790
0
```

C Výstup z části INFIL

```
 T H E    I N F I L T R A T I O N    M O D E L

  *********************************************************
  THE KW-INFILTRATION MODEL COMPUTES NET RAINFALL FROM GROSS ONE USING
  MEIN - LARSON AND MOREL - SEYTOUX INFILTRATION FORMULAE
  FLOOD HYDROGRAPH CAN BE COMPUTED USING UH CONVOLUTION


  IF SUBOPT1=1, VARIABLE RAINFALL RATES IS USED
  IF SUBPT1=0, CONSTANT RAINFALL IS USED
  IF SUBPT2=0, USER INPUTS KT AND SFFC
  IF SUBPT2=1, KT AND SFFC ARE COMPUTED FROM CN
  IF SUBPT3=1, MEASURED DISCHARGES SHOULD BE READ
  IF SUBPT4=0, EROSION PROGRAM IS IMPLEMENTED


  NAME OF CATCHMENT:
  TREBSIN, Locality 6 23.7.2008 AREA=30 m2 DRY DT=1min maize
  *************************************************************
  SUBOPT1= 0   SUBOPT2= 0   SUBOPT3= 0
  SUBOPT4= 0

  HYDRAULIC CONDUCTIVITY, KT =   7.840 MM/HR
  SORPTIVITY, SO =  15.210 MM/HR**0.5
  STORAGE SUCTION FACTOR, SFFC =  14.754 MM
  TOTAL PRECIP, P =  16.100 MM
  DURATION TIME,TD =    .250 HR

  OUTPUT OF SUBROUTINE CONST, CONSTANT RAINFALL
```

```
BY INFILTRATION APPROACH
PONDING TIME TP=       .032  HR
   T(HR)      W(MM)   DELW(MM) IR(MM/HR)  R(MM/HR)     RE(MM/HR)  RER(MM/HR)

     .032     2.045      2.045
     .017      .000       .000       .000       .980       .000       .000
     .033     2.149       .104     63.442      1.080       .016       .016
     .050     3.078       .928     55.578      1.080       .147       .147
     .067     3.857       .779     46.650      1.080       .296       .296
     .083     4.548       .691     41.401      1.080       .384       .384
     .100     5.180       .632     37.838      1.080       .444       .444
     .117     5.768       .588     35.215      1.080       .487       .487
     .134     6.322       .554     33.179      1.080       .521       .521
     .150     6.849       .527     31.539      1.080       .549       .549
     .167     7.353       .504     30.182      1.080       .571       .571
     .184     7.838       .485     29.034      1.080       .591       .591
     .200     8.306       .468     28.047      1.080       .607       .607
     .217     8.760       .454     27.186      1.080       .621       .621
     .234     9.201       .441     26.426      1.080       .634       .634
     .250     9.631       .430     25.750      1.080       .645       .645
     .267      .000       .000       .000       .000       .000       .000

MASS BALANCE CHECK
EXCESS PRECIP=   6.469  MM
CUMULATIVE INFILTRATION=   9.631  MM
RETENTION=    .000  MM
TOTAL PRECIP=  16.100  MM


NAME OF CATCHMENT:
TREBSIN, Locality 6 23.7.2008 AREA=30 m2 WET DT=1min maize
************************************************************
SUBOPT1= 0   SUBOPT2= 0   SUBOPT3= 0
SUBOPT4= 0

HYDRAULIC CONDUCTIVITY, KT =   7.840 MM/HR
SORPTIVITY, SO =   8.210 MM/HR**0.5
STORAGE SUCTION FACTOR, SFFC =   4.299 MM
TOTAL PRECIP, P =  16.170 MM
DURATION TIME,TD =    .250 HR

OUTPUT OF SUBROUTINE CONST, CONSTANT RAINFALL
BY INFILTRATION APPROACH
PONDING TIME TP=       .009  HR
   T(HR)      W(MM)   DELW(MM) IR(MM/HR)  R(MM/HR)     RE(MM/HR)  RER(MM/HR)

     .009      .593       .593
     .017     1.001       .408     54.156       .050       .176       .176
     .033     1.660       .659     39.449      1.080       .421       .421
     .050     2.186       .527     31.527      1.080       .554       .554
     .067     2.648       .461     27.628      1.080       .619       .619
     .083     3.068       .421     25.189      1.080       .660       .660
     .100     3.460       .392     23.477      1.080       .688       .688
     .117     3.831       .371     22.189      1.080       .710       .710
     .134     4.185       .354     21.176      1.080       .727       .727
     .150     4.524       .340     20.351      1.080       .740       .740
     .167     4.853       .328     19.662      1.080       .752       .752
     .184     5.171       .319     19.076      1.080       .762       .762
     .200     5.481       .310     18.569      1.080       .770       .770
     .217     5.784       .303     18.126      1.080       .777       .777
     .234     6.080       .296     17.733      1.080       .784       .784
     .250     6.371       .290     17.382      1.080       .790       .790
     .267      .000       .000       .000       .000       .000       .000

MASS BALANCE CHECK
EXCESS PRECIP=   9.799  MM
CUMULATIVE INFILTRATION=   6.371  MM
RETENTION=    .000  MM
TOTAL PRECIP=  16.170  MM
```

D Výstup z části KIN

```
MODEL KINFIL: HYDRAULIC VARIABLES,
FINAL HYDROGRAPH
------------------------------------------------------------
LEGEND:
H(J,I) ... Depth of water (m)
VE(J,I) ... Velocity of water flow (m/s)
TAU(J,I) ... Shear stress (Pa)
VSTAR(J,I) ... Shear velocity (m/s)

  NAME OF CATCHMENT:  TREBSIN, Locality 6,30.7.2008,DT=1min,AREA=30m2,DRY,maize
  ************************************************************
  DESCRIPTION OF PLANES:
  ----------------------
  SLOPES(-)     LENGTHS(M)     WIDTHS(M)     MAN.ROUGHNESS     M-FLOWTYPE
      .128        10.000          3.000          .1000           1.6700
  ----------------------------------------------------------------------
  LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
  ------------------------------------------------------------
    .0076     .0380     .1900    1.6700

  PLANE   1   AT TIME     2
  J= 1   T=      2
     H(J,I):    .0000   .0000   .0000   .0000   .0000   .0000
    VE(J,I):    .0000   .0007   .0007   .0007   .0007   .0007
   TAU(J,I):    .0000   .0035   .0035   .0035   .0035   .0035
  VSTR(J,I):    .0000   .0019   .0019   .0019   .0019   .0019
  ------------------------------------------------------------
      1            2          .03          .000
  ------------------------------------------------------------
  LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
  ------------------------------------------------------------
    .0076     .0380     .1900    1.6700

  PLANE   1   AT TIME     3
  J= 1   T=      3
     H(J,I):    .0000   .0001   .0001   .0001   .0001   .0001
    VE(J,I):    .0000   .0055   .0055   .0055   .0055   .0055
   TAU(J,I):    .0000   .0795   .0798   .0798   .0798   .0798
  VSTR(J,I):    .0000   .0089   .0089   .0089   .0089   .0089
  ------------------------------------------------------------
      2            3          .05          .000
  ------------------------------------------------------------
  LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
  ------------------------------------------------------------
    .0076     .0380     .1900    1.6700

  PLANE   1   AT TIME     4
  J= 1   T=      4
     H(J,I):    .0000   .0002   .0003   .0003   .0003   .0003
    VE(J,I):    .0000   .0138   .0143   .0143   .0143   .0143
   TAU(J,I):    .0000   .3125   .3307   .3310   .3310   .3310
  VSTR(J,I):    .0000   .0177   .0182   .0182   .0182   .0182
  ------------------------------------------------------------
      3            4          .07          .000
  ------------------------------------------------------------
  LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
  ------------------------------------------------------------
    .0076     .0380     .1900    1.6700

  PLANE   1   AT TIME     5
  J= 1   T=      5
     H(J,I):    .0000   .0004   .0006   .0006   .0006   .0006
    VE(J,I):    .0000   .0203   .0237   .0244   .0244   .0244
   TAU(J,I):    .0000   .5559   .7041   .7325   .7345   .7346
  VSTR(J,I):    .0000   .0236   .0265   .0271   .0271   .0271
  ------------------------------------------------------------
      4            5          .08          .000
  ------------------------------------------------------------
  LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
  ------------------------------------------------------------
    .0076     .0380     .1900    1.6700

  PLANE   1   AT TIME     6
  J= 1   T=      6
```

```
   H(J,I):    .0000   .0005   .0008   .0009   .0010   .0010
  VE(J,I):    .0000   .0232   .0295   .0328   .0342   .0345
 TAU(J,I):    .0000   .6787   .9741  1.1433  1.2152  1.2298
VSTR(J,I):    .0000   .0261   .0312   .0338   .0349   .0351
------------------------------------------------------------
    5            6          .10          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     7
J= 1   T=      7
   H(J,I):    .0000   .0006   .0009   .0011   .0012   .0013
  VE(J,I):    .0000   .0246   .0320   .0370   .0405   .0424
 TAU(J,I):    .0000   .7424  1.1011  1.3654  1.5615  1.6768
VSTR(J,I):    .0000   .0272   .0332   .0370   .0395   .0409
------------------------------------------------------------
    6            7          .12          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     8
J= 1   T=      8
   H(J,I):    .0000   .0006   .0009   .0012   .0014   .0015
  VE(J,I):    .0000   .0255   .0334   .0390   .0433   .0466
 TAU(J,I):    .0000   .7845  1.1744  1.4777  1.7284  1.9263
VSTR(J,I):    .0000   .0280   .0343   .0384   .0416   .0439
------------------------------------------------------------
    7            8          .13          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     9
J= 1   T=      9
   H(J,I):    .0000   .0006   .0010   .0012   .0015   .0016
  VE(J,I):    .0000   .0262   .0344   .0402   .0449   .0487
 TAU(J,I):    .0000   .8147  1.2246  1.5488  1.8242  2.0603
VSTR(J,I):    .0000   .0285   .0350   .0394   .0427   .0454
------------------------------------------------------------
    8            9          .15          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    10
J= 1   T=     10
   H(J,I):    .0000   .0007   .0010   .0013   .0015   .0017
  VE(J,I):    .0000   .0267   .0351   .0411   .0460   .0501
 TAU(J,I):    .0000   .8382  1.2626  1.6006  1.8907  2.1459
VSTR(J,I):    .0000   .0290   .0355   .0400   .0435   .0463
------------------------------------------------------------
    9           10          .17          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    11
J= 1   T=     11
   H(J,I):    .0000   .0007   .0010   .0013   .0015   .0018
  VE(J,I):    .0000   .0271   .0357   .0418   .0468   .0510
 TAU(J,I):    .0000   .8572  1.2928  1.6411  1.9415  2.2083
VSTR(J,I):    .0000   .0293   .0360   .0405   .0441   .0470
------------------------------------------------------------
   10           11          .18          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    12
```

```
J= 1   T=     12
   H(J,I):    .0000   .0007   .0010   .0013   .0016   .0018
  VE(J,I):    .0000   .0274   .0361   .0424   .0475   .0518
 TAU(J,I):    .0000   .8727  1.3174  1.6739  1.9822  2.2573
VSTR(J,I):    .0000   .0295   .0363   .0409   .0445   .0475
------------------------------------------------------------
   11           12          .20          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    13
J= 1   T=     13
   H(J,I):    .0000   .0007   .0011   .0014   .0016   .0018
  VE(J,I):    .0000   .0277   .0365   .0429   .0480   .0524
 TAU(J,I):    .0000   .8861  1.3383  1.7014  2.0160  2.2976
VSTR(J,I):    .0000   .0298   .0366   .0412   .0449   .0479
------------------------------------------------------------
   12           13          .22          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    14
J= 1   T=     14
   H(J,I):    .0000   .0007   .0011   .0014   .0016   .0019
  VE(J,I):    .0000   .0279   .0368   .0432   .0485   .0529
 TAU(J,I):    .0000   .8974  1.3560  1.7248  2.0446  2.3314
VSTR(J,I):    .0000   .0300   .0368   .0415   .0452   .0483
------------------------------------------------------------
   13           14          .23          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    15
J= 1   T=     15
   H(J,I):    .0000   .0007   .0011   .0014   .0016   .0019
  VE(J,I):    .0000   .0281   .0371   .0436   .0489   .0534
 TAU(J,I):    .0000   .9075  1.3717  1.7453  2.0696  2.3607
VSTR(J,I):    .0000   .0301   .0370   .0418   .0455   .0486
------------------------------------------------------------
   14           15          .25          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    16
J= 1   T=     16
   H(J,I):    .0000   .0007   .0011   .0014   .0017   .0019
  VE(J,I):    .0000   .0283   .0374   .0439   .0492   .0538
 TAU(J,I):    .0000   .9167  1.3859  1.7637  2.0919  2.3868
VSTR(J,I):    .0000   .0303   .0372   .0420   .0457   .0489
------------------------------------------------------------
   15           16          .27          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    17
J= 1   T=     17
   H(J,I):    .0000   .0004   .0007   .0009   .0012   .0014
  VE(J,I):    .0000   .0176   .0265   .0334   .0391   .0441
 TAU(J,I):    .0000   .4520   .8309  1.1751  1.4863  1.7737
VSTR(J,I):    .0000   .0213   .0288   .0343   .0386   .0421
------------------------------------------------------------
   16           17          .28          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700
```

```
PLANE   1   AT TIME    18
J= 1   T=     18
   H(J,I):    .0000   .0002   .0004   .0006   .0008   .0010
  VE(J,I):    .0000   .0117   .0189   .0251   .0305   .0353
 TAU(J,I):    .0000   .2466   .5030   .7648  1.0221  1.2761
VSTR(J,I):    .0000   .0157   .0224   .0277   .0320   .0357
------------------------------------------------------------
   17           18          .30          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    19
J= 1   T=     19
   H(J,I):    .0000   .0001   .0003   .0004   .0006   .0007
  VE(J,I):    .0000   .0085   .0143   .0195   .0242   .0287
 TAU(J,I):    .0000   .1523   .3306   .5242   .7249   .9342
VSTR(J,I):    .0000   .0123   .0182   .0229   .0269   .0306
------------------------------------------------------------
   18           19          .32          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    20
J= 1   T=     20
   H(J,I):    .0000   .0001   .0002   .0003   .0004   .0006
  VE(J,I):    .0000   .0065   .0113   .0157   .0197   .0237
 TAU(J,I):    .0000   .1028   .2326   .3789   .5353   .7039
VSTR(J,I):    .0000   .0101   .0153   .0195   .0231   .0265
------------------------------------------------------------
   19           20          .33          .000
------------------------------------------------------------

THE OVERLAND FLOW HYDROGRAPH:
ORDIN.NO.      TIME(HOURS)  DISCHARGE Q (L/S)


  1              .033              .000
  2              .050              .001
  3              .067              .011
  4              .083              .043
  5              .100              .101
  6              .117              .170
  7              .133              .214
  8              .150              .240
  9              .167              .257
 10              .183              .269
 11              .200              .279
 12              .217              .288
 13              .233              .295
 14              .250              .301
 15              .267              .307
 16              .283              .187
 17              .300              .108
 18              .317              .064
 19              .333              .040
THE MASS BALANCE CHECK:
-------------------------
TOTAL INFLOW DEPTH:        6.58  MM
TOTAL OUTFLOW DEPTH:       6.35  MM




NAME OF CATCHMENT:  TREBSIN, Locality 6,30.7.2008,DT=1min,AREA=30m2,WET,maize
************************************************************
DESCRIPTION OF PLANES:
----------------------
SLOPES(-)     LENGTHS(M)     WIDTHS(M)     MAN.ROUGHNESS     M-FLOWTYPE
    .128        10.000          3.000          .1000           1.6700
----------------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
```

```
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     2
J= 1   T=      2
   H(J,I):    .0000   .0001   .0001   .0001   .0001   .0001
  VE(J,I):    .0000   .0097   .0098   .0098   .0098   .0098
 TAU(J,I):    .0000   .1855   .1879   .1879   .1879   .1879
VSTR(J,I):    .0000   .0136   .0137   .0137   .0137   .0137
------------------------------------------------------------
    1            2          .03          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     3
J= 1   T=      3
   H(J,I):    .0000   .0005   .0005   .0005   .0005   .0005
  VE(J,I):    .0000   .0208   .0228   .0229   .0229   .0229
 TAU(J,I):    .0000   .5783   .6627   .6693   .6695   .6695
VSTR(J,I):    .0000   .0240   .0257   .0259   .0259   .0259
------------------------------------------------------------
    2            3          .05          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     4
J= 1   T=      4
   H(J,I):    .0000   .0006   .0009   .0010   .0010   .0011
  VE(J,I):    .0000   .0260   .0327   .0354   .0361   .0362
 TAU(J,I):    .0000   .8074  1.1354  1.2802  1.3182  1.3229
VSTR(J,I):    .0000   .0284   .0337   .0358   .0363   .0364
------------------------------------------------------------
    3            4          .07          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     5
J= 1   T=      5
   H(J,I):    .0000   .0007   .0010   .0013   .0015   .0016
  VE(J,I):    .0000   .0276   .0361   .0417   .0455   .0474
 TAU(J,I):    .0000   .8818  1.3149  1.6350  1.8612  1.9801
VSTR(J,I):    .0000   .0297   .0363   .0404   .0431   .0445
------------------------------------------------------------
    4            5          .08          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     6
J= 1   T=      6
   H(J,I):    .0000   .0007   .0011   .0014   .0016   .0018
  VE(J,I):    .0000   .0284   .0373   .0437   .0487   .0526
 TAU(J,I):    .0000   .9220  1.3855  1.7514  2.0596  2.3127
VSTR(J,I):    .0000   .0304   .0372   .0418   .0454   .0481
------------------------------------------------------------
    5            6          .10          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     7
J= 1   T=      7
   H(J,I):    .0000   .0008   .0011   .0014   .0017   .0019
  VE(J,I):    .0000   .0290   .0382   .0447   .0500   .0545
 TAU(J,I):    .0000   .9491  1.4304  1.8141  2.1439  2.4347
VSTR(J,I):    .0000   .0308   .0378   .0426   .0463   .0493
------------------------------------------------------------
    6            7          .12          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
```

```
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     8
J= 1   T=      8
   H(J,I):    .0000   .0008   .0012   .0015   .0018   .0020
  VE(J,I):    .0000   .0294   .0387   .0455   .0509   .0555
 TAU(J,I):    .0000   .9691  1.4626  1.8580  2.1996  2.5042
VSTR(J,I):    .0000   .0311   .0382   .0431   .0469   .0500
------------------------------------------------------------
    7            8          .13          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME     9
J= 1   T=      9
   H(J,I):    .0000   .0008   .0012   .0015   .0018   .0020
  VE(J,I):    .0000   .0297   .0392   .0460   .0515   .0563
 TAU(J,I):    .0000   .9842  1.4867  1.8905  2.2403  2.5536
VSTR(J,I):    .0000   .0314   .0386   .0435   .0473   .0505
------------------------------------------------------------
    8            9          .15          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    10
J= 1   T=     10
   H(J,I):    .0000   .0008   .0012   .0015   .0018   .0021
  VE(J,I):    .0000   .0299   .0395   .0464   .0520   .0568
 TAU(J,I):    .0000   .9956  1.5050  1.9150  2.2708  2.5903
VSTR(J,I):    .0000   .0316   .0388   .0438   .0477   .0509
------------------------------------------------------------
    9           10          .17          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    11
J= 1   T=     11
   H(J,I):    .0000   .0008   .0012   .0015   .0018   .0021
  VE(J,I):    .0000   .0301   .0398   .0467   .0524   .0572
 TAU(J,I):    .0000  1.0058  1.5208  1.9356  2.2960  2.6202
VSTR(J,I):    .0000   .0317   .0390   .0440   .0479   .0512
------------------------------------------------------------
   10           11          .18          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    12
J= 1   T=     12
   H(J,I):    .0000   .0008   .0012   .0016   .0018   .0021
  VE(J,I):    .0000   .0303   .0400   .0470   .0527   .0576
 TAU(J,I):    .0000  1.0143  1.5341  1.9531  2.3174  2.6452
VSTR(J,I):    .0000   .0318   .0392   .0442   .0481   .0514
------------------------------------------------------------
   11           12          .20          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    13
J= 1   T=     13
   H(J,I):    .0000   .0008   .0012   .0016   .0019   .0021
  VE(J,I):    .0000   .0304   .0402   .0472   .0530   .0579
 TAU(J,I):    .0000  1.0212  1.5449  1.9674  2.3349  2.6658
VSTR(J,I):    .0000   .0320   .0393   .0444   .0483   .0516
------------------------------------------------------------
   12           13          .22          .000
------------------------------------------------------------
```

```
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    14
J= 1   T=     14
   H(J,I):    .0000   .0008   .0012   .0016   .0019   .0021
  VE(J,I):    .0000   .0306   .0403   .0474   .0532   .0582
 TAU(J,I):    .0000  1.0278  1.5549  1.9803  2.3505  2.6841
VSTR(J,I):    .0000   .0321   .0394   .0445   .0485   .0518
------------------------------------------------------------
   13           14          .23          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    15
J= 1   T=     15
   H(J,I):    .0000   .0008   .0012   .0016   .0019   .0021
  VE(J,I):    .0000   .0307   .0405   .0476   .0534   .0584
 TAU(J,I):    .0000  1.0329  1.5631  1.9911  2.3636  2.6994
VSTR(J,I):    .0000   .0321   .0395   .0446   .0486   .0520
------------------------------------------------------------
   14           15          .25          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    16
J= 1   T=     16
   H(J,I):    .0000   .0008   .0013   .0016   .0019   .0022
  VE(J,I):    .0000   .0308   .0406   .0478   .0536   .0586
 TAU(J,I):    .0000  1.0378  1.5706  2.0007  2.3753  2.7130
VSTR(J,I):    .0000   .0322   .0396   .0447   .0487   .0521
------------------------------------------------------------
   15           16          .27          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    17
J= 1   T=     17
   H(J,I):    .0000   .0004   .0007   .0010   .0013   .0015
  VE(J,I):    .0000   .0176   .0273   .0349   .0411   .0465
 TAU(J,I):    .0000   .4511   .8675  1.2498  1.5985  1.9219
VSTR(J,I):    .0000   .0212   .0295   .0354   .0400   .0438
------------------------------------------------------------
   16           17          .28          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    18
J= 1   T=     18
   H(J,I):    .0000   .0002   .0004   .0006   .0008   .0011
  VE(J,I):    .0000   .0112   .0188   .0253   .0311   .0364
 TAU(J,I):    .0000   .2282   .4960   .7766  1.0563  1.3329
VSTR(J,I):    .0000   .0151   .0223   .0279   .0325   .0365
------------------------------------------------------------
   17           18          .30          .000
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    19
J= 1   T=     19
   H(J,I):    .0000   .0001   .0003   .0004   .0006   .0008
  VE(J,I):    .0000   .0079   .0138   .0192   .0242   .0289
 TAU(J,I):    .0000   .1356   .3144   .5145   .7262   .9464
VSTR(J,I):    .0000   .0116   .0177   .0227   .0269   .0308
------------------------------------------------------------
   18           19          .32          .000
```

```
------------------------------------------------------------
LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):
------------------------------------------------------------
  .0076     .0380     .1900    1.6700

PLANE   1   AT TIME    20
J= 1   T=      20
   H(J,I):    .0000   .0001   .0002   .0003   .0004   .0006
  VE(J,I):    .0000   .0060   .0108   .0153   .0195   .0236
 TAU(J,I):    .0000   .0899   .2168   .3641   .5252   .6974
VSTR(J,I):    .0000   .0095   .0147   .0191   .0229   .0264
------------------------------------------------------------
   19           20          .33          .000
------------------------------------------------------------

THE OVERLAND FLOW HYDROGRAPH:
ORDIN.NO.      TIME(HOURS)  DISCHARGE Q (L/S)


  1              .033              .004
  2              .050              .037
  3              .067              .114
  4              .083              .224
  5              .100              .291
  6              .117              .317
  7              .133              .332
  8              .150              .343
  9              .167              .351
 10              .183              .358
 11              .200              .364
 12              .217              .369
 13              .233              .373
 14              .250              .377
 15              .267              .380
 16              .283              .214
 17              .300              .116
 18              .317              .065
 19              .333              .039
THE MASS BALANCE CHECK:
-------------------------
TOTAL INFLOW DEPTH:        9.54  MM
TOTAL OUTFLOW DEPTH:       9.34  MM
```

6. Software - zdrojový program modelu KINFIL (FORTRAN)

INFIL – data TŘEBSÍN

```
$DEBUG
$NOTRUNCATE
      PROGRAM EINFIL
C     VERSION OF INFIL MODEL FOR EROSION
C     - KBUK FES CULS PRAGUE, 2014
C     NAME OF FILE EINFIL.FOR
      COMMON/A1/DELT,QU,N,P,TD,CN,II
      COMMON/A2/KT,TP,RP,WP,K
      COMMON/A3/MO,DAY,YEAR,SFFC,S,SO
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A5/AR(5)
      COMMON/A6/SF,RETEN
      COMMON/A7/CUMP(250)
      COMMON/A8/AREA,L,Y,NN,NF
      COMMON/A9/DELTA(250),CNM
      COMMON/A10/DELP(250),QA(250),TM(250),QM(250)
      COMMON/A11/SUBPT1,SUBPT2,SUBPT3,SUBPT4
      COMMON/A12/TL
      COMMON/A13/CNAME(20)
      INTEGER QU,SUBPT1,SUBPT2,SUBPT3,SUBPT4,DAY,YEAR
      REAL KT,L
      CHARACTER*12 NDFILE
      CHARACTER*8 FNAME$
      OPEN(UNIT=5,FILE='treb4sim.dta',STATUS='OLD')
      OPEN(UNIT=7,FILE='treb4sim.out',STATUS='UNKNOWN')
      OPEN(UNIT=1,FILE='NDFILE',STATUS='UNKNOWN')
   62 FORMAT(2X,56(1H*))
C
   63 FORMAT(2X,'T H E    I N F I L T R A T I O N    M O D E L '/)
   64 FORMAT(2X,'THE KW-INFILTRATION MODEL COMPUTES NET RAINFALL FROM GR
      *OSS ONE USING'/2X,'MEIN - LARSON AND MOREL - SEYTOUX INFILTRATION
      *FORMULAE')
   61 FORMAT(2X,'FLOOD HYDROGRAPH CAN BE COMPUTED USING UH CONVOLUTION')
      WRITE(6,63)
      WRITE(6,62)
      WRITE(6,64)
      WRITE(6,61)
      WRITE(6,51)
      WRITE(7,63)
      WRITE(7,62)
      WRITE(7,64)
      WRITE(7,61)
      WRITE(7,51)
   51 FORMAT(//,2X,'IF SUBOPT1=1, VARIABLE RAINFALL RATES IS USED',/
     *2X,'IF SUBPT1=0, CONSTANT RAINFALL IS USED',
     */,2X,'IF SUBPT2=0, USER INPUTS KT AND SFFC'/
     *2X,'IF SUBPT2=1, KT AND SFFC ARE COMPUTED FROM CN'/
     *2X,'IF SUBPT3=1, MEASURED DISCHARGES SHOULD BE READ'/
     *2X,'IF SUBPT4=0, EROSION PROGRAM IS IMPLEMENTED'//)
C
   76 FORMAT(20A4)
  100 READ(5,76)CNAME
C
   65 FORMAT(2X,'NAME OF CATCHMENT:'/2X,20A4/2X,60(1H*))
      WRITE(6,65)CNAME
      WRITE(7,65)CNAME
      READ(5,38)SUBPT1,SUBPT2,SUBPT3,SUBPT4
   38 FORMAT(I2,2X,I2,2X,I2,2X,I2)
      READ(5,72)IDENT
   72 FORMAT(I1)
      WRITE(6,39)SUBPT1,SUBPT2,SUBPT3,SUBPT4
      WRITE(7,39)SUBPT1,SUBPT2,SUBPT3,SUBPT4
   39 FORMAT(2X,'SUBOPT1=',I2,3X,'SUBOPT2=',I2,3X,'SUBOPT3=',I2/
     *2X,'SUBOPT4='I2)
      IF(SUBPT2.EQ.0)GO TO 40
      READ(5,41)P,TD,CN,CNM
   41 FORMAT(4F10.3)
      WRITE(6,42)P,TD,CN
      WRITE(7,42)P,TD,CN
   42 FORMAT(2X,'STORM DEPTH P =',F10.3,2X,'MM'/2X,'STORM DURATION TD ='
     *,F10.3,2X,'HR'/2X,'CURVE NUMBER CN=',F10.3,2X,'(-)')
```

```
C     READ '(A12)',NDFILE
      CALL TABLE
      GO TO 43
   40 READ(5,2)KT,SO,P,TD,CN
    2 FORMAT(5F10.3)
      SFFC=(SO**2)/(2.0*KT)
      WRITE(6,15)KT,SO,SFFC,P,TD
      WRITE(7,15)KT,SO,SFFC,P,TD
   15 FORMAT(/,2X,'HYDRAULIC CONDUCTIVITY, KT =',F8.3,1X,'MM/HR',/,2X,
     *'SORPTIVITY, SO =',F8.3,1X,'MM/HR**0.5',/2X,
     *'STORAGE SUCTION FACTOR, SFFC =',F8.3,1X,'MM',/,
     *2X,'TOTAL PRECIP, P =',F8.3,1X,'MM',/,2X,'DURATION TIME,TD =',F8.3
     *,1X,'HR',)
      GO TO 8
   43 READ(5,27)AREA,L,Y,RETEN
   27 FORMAT(4F10.5)
      WRITE(6,28)AREA,L,Y
      WRITE(7,28)AREA,L,Y
   28 FORMAT(2X,'AREA=',F10.5,2X,'KM2',
     */,2X,'LENGTH TO DIVIDE=',F10.2,2X,'M'/2X,
     *'AVG CATCHMENT SLOPE=',F10.2,2X,'PERCENT')
    8 READ(5,9)N,II,DELT
    9 FORMAT(I3,2X,I3,2X,F10.5)
c     WRITE(6,20)N,II,DELT
c     WRITE(7,20)N,II,DELT
   20 FORMAT(/,2X,'N=',I3,5X,'II =',I3,5X,'DELT =',F10.5/)
C
C     WRITE(6,49)
C     WRITE(7,49)
   49 FORMAT(2X,'N IS NUMBER OF TIME STEPS IN USERS STORM'/
     *2X,'II IS NUMBER OF TIME STEPS IN REQUIRED HYDROGRAPH'/
     *2X,'DELT IS LENGHT OF TIME STEP IN HR'/
     *2X,'INPUT RAIN IS IN MM/HR',/)
C
      IF(IDENT.NE.1)GOTO 33
C
      READ(5,11)DAY,MO,YEAR
   11 FORMAT(I2,2X,I2,2X,I2)
      READ(5,16)(AR(I),I=1,5)
   16 FORMAT(5F8.0)
C
      WRITE(6,13)DAY,MO,YEAR
      WRITE(7,13)DAY,MO,YEAR
   13 FORMAT(2X,'DATE OF EVENT:',I2,'/',I2,'/','19',I2,/)
   14 FORMAT(2X,'ANTECEDENT DAILY RAIN AR(I):'/2X,5F7.1/)
      WRITE(6,14)(AR(I),I=1,5)
      WRITE(7,14)(AR(I),I=1,5)
      READ(5,31)QM(1)
   31 FORMAT(F10.3)
      WRITE(6,48)QM(1)
      WRITE(7,48)QM(1)
   48 FORMAT(2X,'INITIAL DISCHARGE OBSERVED: QM(1)=',F10.3,1X,'M3/S,'/)
   33 CONTINUE
C     SCREEN CONTROL
C     READ '(A12)',NDFILE
   99 T(1)=DELT
      DO 22 I=2,II
   22 T(I)=T(I-1)+DELT
      READ(5,10)(R(I),I=1,N)
   10 FORMAT(10F8.0)
    3 FORMAT(2X,10F7.2,/,2X,10F7.2,/,2X,10F7.2,/,2X,10F7.2,/,2X,10F7.2,/
     *,2X,10F7.2,/,2X,10F7.2,/2X,10F7.2,/2X,10F7.2,/2X,10F7.2,/2X,10F7.2
     */2X,10F7.2,/2X,10F7.2,/2X,10F7.2,/2X,10F7.2,/)
   32 FORMAT(2X,10F6.3,/,2X,10F6.3,/,2X,10F6.3,/,2X,10F6.3,/,2X,10F6.3,/
     *,2X,10F6.3,/,2X,10F6.3,/2X,10F6.3,/2X,10F6.3,/2X,10F6.3,/2X,10F6.3
     */2X,10F6.3,/2X,10F6.3,/2X,10F6.3,/2X,10F6.3,/)
   52 CONTINUE
C     WRITE(6,36)
C     WRITE(7,36)
   36 FORMAT(2X,'TIME STEPS, HOURS')
C     WRITE(6,3) (T(I),I=1,II)
   45 CONTINUE
C     WRITE(6,23)
C     WRITE(7,3) (T(I),I=1,II)
C     WRITE(7,23)
   23 FORMAT(2X,'RAINFALL INTENSITIES, MM/HR')
C     WRITE(6,3)(R(I),I=1,N)
```

```
C     WRITE(7,3)(R(I),I=1,N)
C     COMPUTE CUMULATIVE STEP PRECIP,  CUMP
      DO 24 I=1,N
      IF(I.EQ.1)GO TO 25
      CUMP(I)=CUMP(I-1)+R(I)*(T(I)-T(I-1))
      GO TO 24
   25 CUMP(I)=R(I)*T(I)
   24 CONTINUE
C     WRITE(6,26)
C     WRITE(7,26)
   26 FORMAT(2X,'STEPS OF CUMULATIVE PRECIP (MM)')
C     WRITE(6,3)(CUMP(I),I=1,N)
C     WRITE(7,3)(CUMP(I),I=1,N)
      IF(SUBPT3.EQ.0)GO TO 80
      READ(5,56)(QM(I),I=1,II)
   56 FORMAT(10F8.0)
      WRITE(6,57)
      WRITE(7,57)
   57 FORMAT(2X,'THE OBSERVED DISCHARGE VALUES IN M3/S',/)
C     IF(IDENT.EQ.0)GO TO 74
C     DO 75 I=1,II
C  75 QM(I)=QM(I)*0.001
   74 CONTINUE
      WRITE(6,32)(QM(I),I=1,II)
      WRITE(7,32)(QM(I),I=1,II)
   80 CONTINUE
    5 READ(5,73)NEXT
   73 FORMAT(I1)
      SF=SFFC
C     SCREEN CONTROL
C     READ '(A12)',NDFILE
      IF(SUBPT1.EQ.1)GO TO 30     !
      CALL CONST
      GO TO 66
   30 CONTINUE
      CALL PONTI
C     READ '(A12)',NDFILE
      CALL PPINF
   66 CONTINUE
      PRINT *,'**** END OF INFILTRATION PART OF MODEL ****'
      IF(SUBPT4.EQ.0)GO TO 6
      PRINT *,'**** BEGINING OF ROUTING PART OF MODEL ****'
      SRER=0.0
      DO 7 I=1,N
    7 SRER=SRER+RER(I)
      IF(SRER.LE.0.0)GO TO 6
   12 CALL UH
C     SCREEN CONTROL
C     READ '(A12)',NDFILE
      CALL ROUTE
C     SCREEN CONTROL
C     READ '(A12)',NDFILE
      IF(IDENT.EQ.1)CALL GODFI
C     SCREEN CONTROL
      READ '(A12)',NDFILE
      write(*,'(A\)')' NAME OF EVENT DATA:'
      read(*,'(A)')FNAME$
      open(unit=8,file=FNAME$)
C     write(8,'(2x,i3,3f8.3)')(i,r(i),rer(i),qa(i),i=1,ii)
      write(8,'(2x,i3,f8.3)')(i,qa(i),i=1,ii)
      DO 4 I=1,II
    4 QA(I)=0.0
      close(8)
    6 CONTINUE
      IF(NEXT.NE.0) GO TO 100
   70 STOP
      END
      SUBROUTINE PONTI
      COMMON/A1/DELT,QU,N,P,TD,CN,II
      COMMON/A2/KT,TP,RP,WP,K
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A6/SF,RETEN
      DIMENSION PT(250)
      REAL KT
C
C     THIS SUBROUTINE CALCULATES PONDING TIME FOR A VARIABLE RAINFALL
C     INTENSITY EVENT
```

```
c     WRITE(6,33)
c     WRITE(7,33)
   33 FORMAT(/2X,60(1H*),/)
      WRITE(6,27)
      WRITE(7,27)
   27 FORMAT(/,2X,'OUTPUT OF SUBROUTINE PONTI',/)
      I=0
   10 I=I+1
      IF(I.GT.N)GOTO 18
      IF(R(I).LE.KT)GOTO 10
      IF(I.EQ.1)GOTO 11
      II=I-1
      SUMP=0.
      DO 12 J=1,II
      IF(J.EQ.1)GOTO 14
      SUMP=SUMP+R(J)*(T(J)-T(J-1))
      GOTO 12
   14 SUMP=SUMP+R(J)+T(J)
   12 CONTINUE
      PT(I)=T(I-1)+(1./R(I))*((SF/((R(I)/KT)-1.))-SUMP)
C     TEST COMPUTED PONDING TIME AGAINST PREVIOUS TIME STEP
      IF(PT(I)-T(I-1))13,13,17
   13 TP=T(I-1)
      RP=R(I)
      GOTO 23
C     TEST COMPUTED PONDING TIME AGAINST TIME STEP OF CONSIDERATION
   17 IF(PT(I)-T(I))15,15,10
   11 PT(I)=(1./R(I))*(SF/((R(I)/KT)-1.))
      IF(PT(I).GT.T(I))GO TO 10
   15 TP=PT(I)
      RP=R(I)
   23 K=0
      WP=0.0
      DO 20 J=1,N
      IF(T(J).GT.TP)GO TO 20
      IF(J.EQ.1)GO TO 21
      WP=WP+R(J)*(T(J)-T(J-1))
      GO TO 22
   21 WP=WP+R(J)*T(J)
   22 K=K+1
   20 CONTINUE
      IF(K.EQ.0)GO TO 25
      WP=WP+RP*(TP-T(K))
      GO TO 26
   25 WP=RP*TP
   26 WRITE(6,24)TP,RP,WP
      WRITE(7,24)TP,RP,WP
   24 FORMAT(2X,'PONDING TIME=',F8.3,1X,'HR',5X,'PONDING RAINFALL=',
     *F8.3,2X,'MM/HR'/2X,'DEPTH OF RAIN INFILTRATED PREVIOUS TO PONDING=
     *',F8.3,1X,'MM')
      IF(K.GT.0)GO TO 28
      GO TO 16
   28 WRITE(6,29)K,T(K)
      WRITE(7,29)K,T(K)
   29 FORMAT(2X,'LAST FULL TIME STEP T(',I3,')=',F8.3,1X,'HR')
      GO TO 16
   18 WRITE(6,19)
      WRITE(7,19)
   19 FORMAT(2X,'PONDING NEVER OCCURS')
   16 continue
      RETURN
      END
      SUBROUTINE CONST
      COMMON/A1/DELT,QU,N,P,TD,CN,II
      COMMON/A2/KT,TP,RP,WP,K
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A6/SF,RETEN
      COMMON/A8/AREA,L,Y,NN,NF
      COMMON/A10/DELP(250),QA(250),TM(250),QM(250)
      DIMENSION W(250),DELW(250),IR(250)
      REAL KT,IR
C
C     THIS SUBROUTINE COMPUTES EXCESS RAINFALL BY INFILTRATION EQUATION
C     FOR A CONSTANT INTENSITY EVENT
C
c     WRITE(6,33)
c     WRITE(7,33)
```

```
   33 FORMAT(/2X,60(1H*),/)
      WRITE(6,21)
      WRITE(7,21)
   21 FORMAT(/,2X,'OUTPUT OF SUBROUTINE CONST, CONSTANT RAINFALL '/
     *2X,'BY INFILTRATION APPROACH',)
      CR=P/TD
      SORP =SQRT(2.*KT*SF)
      RSTAR=CR/KT
      IF(RSTAR.LE.1.)GO TO 4
C     COMPUTE MEIN AND LARSON PONDING TIME
      TP=SF/(CR*(RSTAR-1.0))
      Write(6,35)TP
      Write(7,35)TP
   35 format(2x,'PONDING TIME TP= ',2X,f8.3,2X,'HR')
      IF(TP.GE.TD)GO TO 4
      KK=0
      DO 22 I=1,N
      IF(T(I).GE.TP)GO TO 22
      KK=KK+1
   22 CONTINUE
      M=KK+1
      RATIO=RSTAR/(RSTAR-1.0)
      WP=CR*TP
      B=0.5*TP*(RATIO**3)
      DO 20 I=M,N
      W(I)=WP+SORP*RATIO*(SQRT(T(I)-TP+B)-SQRT(B))+KT*(T(I)-TP)
      IF(I.EQ.M)GO TO 11
      DELW(I)=W(I)-W(I-1)
      IR(I)=DELW(I)/(T(I)-T(I-1))
      GO TO 12
   11 DELW(I)=W(I)-WP
      IR(I)=DELW(I)/(T(I)-TP)
   12 CONTINUE
      IF(CR-IR(I))13,13,14
   13 IR(I)=CR
      RE(I)=0.0
      IF(I.EQ.M)GO TO 15
      DELW(I)=CR*(T(I)-T(I-1))
      W(I)=W(I-1)+DELW(I)
      GO TO 20
   15 DELW(I)=CR*(T(I)-TP)
      W(I)=W(I-1)+DELW(I)
      GO TO 20
   14 RE(I)=CR-IR(I)
   20 CONTINUE
C     SUBTRACT RETENTION
      RET=RETEN
      DO 27 I=M,N
      IF(I.EQ.M)GO TO 23
      PS=RE(I)*(T(I)-T(I-1))
      IF(RET-PS)26,25,25
   26 RER(I)=(PS-RET)/(T(I)-T(I-1))
      RET=0.0
      GO TO 27
   23 PS=RE(I)*(T(I)-TP)
      IF(RET-PS)24,25,25
   24 RER(I)=(PS-RET)/(T(I)-TP)
      RET=0.0
      GO TO 27
   25 RER(I)=0.0
      RET=RET-PS
   27 CONTINUE
    5 IFLAG=0
      DO 28 I=M,N
      IF(RER(I).EQ.0.0.AND.IFLAG.EQ.0)GO TO 28
      IFLAG=IFLAG+1
      DELP(IFLAG)=RER(I)*DELT
      TM(IFLAG)=T(I)
   28 CONTINUE
      NK=N+1    !
      DO 36 I=1,NK
      RE(I)=RE(I)*DELT
      RER(I)=RER(I)*DELT
   36 CONTINUE
      NIN=INT(TD/DELT)+1
c     DO 1 I=NIN,N
c     R(I)=0.0
```

```
c      RE(I)=0.0
c      RER(I)=0.0
     1 CONTINUE
C      READ '(A12)',NDFILE
       NF=IFLAG
       WRITE(6,17)
       WRITE(7,17)
    17 FORMAT(5X,'T(HR)',6X,'W(MM)',3X,'DELW(MM)',1X,'IR(MM/HR)',2X,'R(MM
      */HR)',5X,'RE(MM/HR)',2X,'RER(MM/HR)',/)
       WRITE(6,18)TP,WP,WP
       WRITE(7,18)TP,WP,WP
    18 FORMAT(1X,3F10.3)
       DO 16 I=1,NK
       WRITE(6,19)T(I),W(I),DELW(I),IR(I),R(I),RE(I),RER(I)
       WRITE(7,19)T(I),W(I),DELW(I),IR(I),R(I),RE(I),RER(I)
    19 FORMAT(1X,7F10.3)
    16 CONTINUE
C      READ '(A12)',NDFILE
C      CHECK MASS BALANCE
       WRITE(6,7)
       WRITE(7,7)
     7 FORMAT(/,2X,'MASS BALANCE CHECK',)
       PECONS=P-W(N)
     6 RET=RETEN-RET
       WRITE(6,10)PECONS,W(N),RET,P
       WRITE(7,10)PECONS,W(N),RET,P
    10 FORMAT(2X,'EXCESS PRECIP=',F8.3,2X,'MM',/,2X,
      *  'CUMULATIVE INFILTRATION=',F8.3,2X,'MM',/,
      *2X,'RETENTION=',F8.3,2X,'MM',/,
      *2X,'TOTAL PRECIP=',F8.3,2X,'MM'//)
       IF(NF.EQ.0)GO TO 4
       GO TO 2
     4 WRITE(6,3)
       WRITE(7,3)
     3 FORMAT(/,5X,'ALL RAINFALL INFILTRATES - NO RUNOFF IS PRODUCED',//)
C      SCREEN CONTROL
     2 CONTINUE
C      READ '(A12)',NDFILE
       RETURN
       END
       SUBROUTINE TABLE
       COMMON/A1/DELT,QU,N,P,TD,CN,II
       COMMON/A2/KT,TP,RP,WP,K
       COMMON/A3/MO,DAY,YEAR,SFFC,S,SO
       COMMON/A11/SUBPT1,SUBPT2,SUBPT3,SUBPT4
       INTEGER DAY,YEAR
       REAL KT
       WRITE(6,33)
       WRITE(7,33)
    33 FORMAT(/2X,60(1H*),/)
       WRITE(6,28)
       WRITE(7,28)
    28 FORMAT(/,2X,'OUTPUT OF SUBROUTINE TABLE',/)
       IF(CN.LE.75.)GO TO 11
       KT=(100.-CN)/12.4
       GO TO 12
    11 IF(CN.LE.36.)GO TO 13
       KT=31.394-0.391*CN
       GO TO 12
    13 KT=47.066-0.823*CN
    12 CONTINUE
       IF(CN.LE.65.)GOTO 14
       SORP=(100.-CN)/2.512
       GO TO 15
    14 SORP=30.251-0.146*CN
    15 CONTINUE
       SFFC=(SORP**2)/(2.*KT)
       WRITE(6,19)KT,SFFC
       WRITE(7,19)KT,SFFC
    19 FORMAT(2X,'HYDRAULIC CONDUCTIVITY KT=',F10.3,2X,'MM/HR',/,2X,'STOR
      *AGE SUCTION FACTOR AT FIELD CAPACITY SFFC=',F10.3,2X,'MM',/)
       WRITE(6,33)
       WRITE(7,33)
       RETURN
       END
       SUBROUTINE PPINF
       COMMON/A1/DELT,QU,N,P,TD,CN,II
```

```
      COMMON/A2/KT,TP,RP,WP,K
      COMMON/A3/MO,DAY,YEAR,SFFC,S,SO
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A6/SF,RETEN
      COMMON/A8/AREA,L,Y,NN,NF
      COMMON/A10/DELP(250),QA(250),TM(250),QM(250)
      DIMENSION W(250),DELW(250),IR(250)
      INTEGER DAY,YEAR
      REAL IR,KT
C
C     THIS SUBROUTINE COMPUTES POST-PONDING INFILTRATION FOR A VARIABLE
C     INTENSITY RAINFALL EVENT
      WRITE(6,33)
      WRITE(7,33)
   33 FORMAT(/2X,60(1H*),/)
      WRITE(6,21)
      WRITE(7,21)
   21 FORMAT(/2X,'OUTPUT OF SUBROUTINE PPINF, VARIABLE RAINFALL'/
     *2X,'INFILTRATION APPROACH'/)
      RSORP=SQRT(2.*KT*((SF+WP)**2)/SF)
      RSTARP=RP/KT
      B=0.5*((SF+WP)**2)/(KT*SF*((RSTARP-1.)**2))
      M=K+1
      DO 10 I=M,N
      W(I)=WP+RSORP*(SQRT(T(I)-TP+B)-SQRT(B))+KT*(T(I)-TP)
      IF(I.EQ.M)GO TO 11
      DELW(I)=W(I)-W(I-1)
      IR(I)=DELW(I)/(T(I)-T(I-1))
      GO TO 12
   11 DELW(I)=W(I)-WP
      IR(I)=DELW(I)/(T(I)-TP)
   12 CONTINUE
      IF(R(I)-IR(I))13,13,14
   13 IR(I)=R(I)
      RE(I)=0.0
      IF(I.EQ.M)GO TO 15
      DELW(I)=R(I)*(T(I)-T(I-1))
      W(I)=W(I-1)+DELW(I)
      GO TO 10
   15 DELW(I)=R(I)*(T(I)-TP)
      W(I)=W(I-1)+DELW(I)
      GO TO 10
   14 RE(I)=R(I)-IR(I)
   10 CONTINUE
C     SUBTRACT RETENTION
      RET=RETEN
      DO 27 I=M,N
      IF(I.EQ.M)GO TO 23
      PS=RE(I)*(T(I)-T(I-1))
      IF(RET-PS)26,25,25
   26 RER(I)=(PS-RET)/(T(I)-T(I-1))
      RET=0.0
      GO TO 27
   23 PS=RE(I)*(T(I)-TP)
      IF(RET-PS)24,25,25
   24 RER(I)=(PS-RET)/(T(I)-TP)
      RET=0.0
      GO TO 27
   25 RER(I)=0.0
      RET=RET-PS
   27 CONTINUE
      IFLAG=0
      DO 28 I=M,N
      IF(RER(I).EQ.0.0.AND.IFLAG.EQ.0)GO TO 28
      IFLAG=IFLAG+1
      DELP(IFLAG)=RER(I)*DELT
      TM(IFLAG)=T(I)
   28 CONTINUE
C     READ '(A12)',NDFILE
      NF=IFLAG
      WRITE(6,9)
      WRITE(7,9)
    9 FORMAT(5X,'T(HR) = TIME'/,15X,'W(MM) = CUMULATIVE INFILTRATION'/,
     *15X,'DELW(MM) = INCREMENTAL INFILTRATION'/,
     *15X,'IR(MM/HR) = INFILTRATION RATE'/,
     *15X,'R(MM/HR) = RAINFALL RATE'/,
     *15X,'RE(MM/HR) = RAINFALL RATE AFTER INFILTR. SUBTRACTED'/,
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```
     *15X,'RER(MM/HR) = NET RAINFALL AFTER RETENTION SUBTRACTED'/)
      WRITE(6,17)
      WRITE(7,17)
   17 FORMAT(5X,'T(HR)',6X,'W(MM)',3X,'DELW(MM)',1X,'IR(MM/HR) ','R(MM/
     *HR)',5X,'RE(MM/HR)',2X,'RER(MM/HR)',/)
      WRITE(6,18)TP,WP,WP
      WRITE(7,18)TP,WP,WP
   18 FORMAT(1X,3F10.3)
      DO 16 I=M,N
      WRITE(6,19)T(I),W(I),DELW(I),IR(I),R(I),RE(I),RER(I)
      WRITE(7,19)T(I),W(I),DELW(I),IR(I),R(I),RE(I),RER(I)
   19 FORMAT(1X,7F10.3)
   16 CONTINUE
C     READ '(A12)',NDFILE
C     CHECK MASS BALANCE
      WRITE(6,7)
      WRITE(7,7)
    7 FORMAT(/,2X,'MASS BALANCE CHECK',/)
      PE=0.0
      IF(NF.EQ.0)GO TO 6
      DO 8 I=1,NF
    8 PE=PE+DELP(I)
    6 RET=RETEN-RET
      WRITE(6,20)PE,W(N),RET,P
      WRITE(7,20)PE,W(N),RET,P
   20 FORMAT(2X,'EXCESS PRECIP=',F8.3,2X,'MM',/,
     *2X,'CUMULATIVE INFILTRATION=',F8.3,2X,'MM',/,
     *2X,'RETENTION=',F8.3,2X,'MM',/,
     *2X,'TOTAL PRECIP=',F8.3,2X,'MM',/)
      IF(NF.EQ.0)GO TO 5
      GO TO 3
    5 WRITE(6,4)
      WRITE(7,4)
    4 FORMAT(5X,'ALL RAINFALL INFILTRATES - NO RUNOFF IS PRODUCED',/)
C     SCREEN CONTROL
    3 CONTINUE
C     READ '(A12)',NDFILE
      RETURN
      END
      SUBROUTINE UH
      COMMON/A1/DELT,QU,N,P,TD,CN,II
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A8/AREA,L,Y,NN,NF
      COMMON/A9/DELTA(250),CNM
      COMMON/A10/DELP(250),QA(250),TM(250),QM(250)
      COMMON/A12/TL
      DIMENSION RATIOT(20),RATIOQ(20),QQT(250)
      REAL L
C
      WRITE(6,33)
      WRITE(7,33)
   33 FORMAT(2X,60(1H*),/)
      WRITE(6,20)
   20 FORMAT(/,2X,'OUTPUT OF SUBROUTINE UH',/)
C
      S=25.4*((1000./(CN-5.0))-10.)
      TL=(((3.28*L)**0.8)*(((0.04*S)+1.0)**0.7))/(1900.0*(Y**0.5))
    5 TTP=(DELT/2.)+TL
      D=0.25*TTP
      IF(DELT.LE.D)GO TO 9
      WRITE(6,6)DELT,D
      WRITE(7,6)DELT,D
    6 FORMAT(2X,'THE TIME STEP OF',F5.2,1X,
     *'HR IS GREATER THAN 0.25 TIME TO PEAK',/2x,' WHICH IS',F5.2,
     *1X,'HR',2X,'SO THE RESULTING HYDROGRAPH MAY BE JAGGED',/)
    9 CONTINUE
      WRITE(6,24)TL,TTP
      WRITE(7,24)TL,TTP
   24 FORMAT(2X,'WATERSHED LAG TIME =',F8.3,'HR',/,2X,'TIME TO PEAK=',
     *F8.3,'HR')
      DO 10 I=1,20
      IF(I.EQ.1)GO TO 11
      RATIOQ(I)=RATIOQ(I-1)+0.05
      GO TO 10
   11 RATIOQ(I)=0.05
   10 CONTINUE
      RATIOT(1)=.47
```

```
      RATIOT(2)=.60
      RATIOT(3)=.69
      RATIOT(4)=.78
      RATIOT(5)=.85
      RATIOT(6)=.92
      RATIOT(7)=.97
      RATIOT(8)=1.02
      RATIOT(9)=1.08
      RATIOT(10)=1.16
      RATIOT(11)=1.24
      RATIOT(12)=1.32
      RATIOT(13)=1.41
      RATIOT(14)=1.51
      RATIOT(15)=1.62
      RATIOT(16)=1.75
      RATIOT(17)=1.91
      RATIOT(18)=2.15
      RATIOT(19)=2.60
      RATIOT(20)=5.00
      NN=INT(5*TTP/DELT)
      XNN=5*TTP/DELT
      IF(XNN.GT.FLOAT(NN))NN=NN+1
      IF(NN.LE.N)GO TO 27
      NPLUS=N+1
      DO 28 I=NPLUS,NN
   28 T(I)=T(I-1)+DELT
   27 CONTINUE
      DO 12 I=1,NN
      TTTP=T(I)/TTP
      IF(TTTP.GE.5.)GO TO 15
      IFLAG=1
      DO 13 J=1,20
      IF(TTTP.LE.RATIOT(J))GO TO 13
      IFLAG=IFLAG+1
   13 CONTINUE
      IF(IFLAG.GT.1)GO TO 14
      QQT(I)=(TTTP/RATIOT(1))*RATIOQ(1)
      GO TO 12
   14 QQT(I)=((TTTP-RATIOT(IFLAG-1))/(RATIOT(IFLAG)-RATIOT(IFLAG-1)))
      QQT(I)=QQT(I)*(RATIOQ(IFLAG)-RATIOQ(IFLAG-1))
      QQT(I)=QQT(I)+RATIOQ(IFLAG-1)
      GO TO 12
   15 QQT(I)=1.0
   12 CONTINUE
      DO 16 I=1,NN
      IF(I.EQ.1)GO TO 25
      DELTA(I)=(QQT(I)-QQT(I-1))
      GO TO 16
   25 DELTA(I)=QQT(I)
   16 CONTINUE
      SUMDEL=0.0
      DO 21 I=1,NN
   21 SUMDEL=SUMDEL+DELTA(I)
      DO 23 I=1,NN
   23 DELTA(I)=DELTA(I)/SUMDEL
      WRITE(6,8)
      WRITE(7,8)
    8 FORMAT(/,10X,'UNIT HYDROGRAPH',/,3X,'TIME(HR)',10X,'DIMENSIONLESS
     *ORDINATES'/)
      DO 22 I=1,NN
      WRITE(6,17)T(I),DELTA(I)
      WRITE(7,17)T(I),DELTA(I)
   17 FORMAT(1X,F10.3,17X,F10.3)
   22 CONTINUE
      RETURN
      END
      SUBROUTINE ROUTE
      COMMON/A1/DELT,QU,N,P,TD,CN,II
      COMMON/A2/KT,TP,RP,WP,K
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A8/AREA,L,Y,NN,NF
      COMMON/A9/DELTA(250),CNM
      COMMON/A10/DELP(250),QA(250),TM(250),QM(250)
      COMMON/A11/SUBPT1,SUBPT2,SUBPT3,SUBPT4
      COMMON/A12/TL
      DIMENSION DD(250)
      MM=NN+NF-1
```

```
      NPLUS=NF+1
      IF(NPLUS.LE.1)NPLUS=2
      IF(MM.LE.1)MM=3
      DO 10 I=NPLUS,MM
      TM(I)=TM(I-1)+DELT
   10 DELP(I)=0.0
      NPLUS=NN+1
      IF(MM.LT.150)GOTO 25
      MM=150
      NPLUS=149
   25 CONTINUE
      DO 11 I=NPLUS,MM
   11 DELTA(I)=0.0
      WRITE(6,17)
      WRITE(7,17)
   17 FORMAT(/,1X,'F L O O D  H Y D R O G R A P H  C O M P U T A T I O N
     *'/10X,' B Y  C N - I N F I L  M O D E L ',/)
      WRITE(6,20)
      WRITE(7,20)
   20 FORMAT(1X,65(1H*))
      WRITE(6,21)
      WRITE(7,21)
   21 FORMAT(/,2X,'T(HR) = TIME AT THE END OF EACH STEP'/
     *2X,'DD(MM/HR) = RATE OF RAINFALL EXCESS'/
     *2X,'DELP(MM) = INCREMENTAL DEPTH OF EXCESS RAINFALL'/
     *2X,'QA(M3/S) = DISCHARGES COMPUTED'/
     *2X,'QM(M3/S) = DISCHARGES OBSERVED (IF SO)'///)
      WRITE(6,40)
      WRITE(7,40)
   22 FORMAT(1X,F5.2,4X,F8.2,4X,F8.2,4X,F8.3,4X,F8.3)
   23 FORMAT(1X,F5.2,4X,F8.2,4X,F8.2,4X,F8.3)
   24 FORMAT(1X,60(1H-))
      WRITE(6,24)
      WRITE(7,24)
      IF(SUBPT3.EQ.0)GO TO 29
      IF(II.LT.MM)GO TO 29
      DO 27 I=II,MM
   27 QM(I)=QM(II)
   29 CONTINUE
      DO 14 I=1,MM
   14 DD(I)=DELP(I)/DELT
C     CONVOLUTION OPERATION
      DO 13 I=1,MM
      QA(I)=0.0
      DO 13 J=1,I
      QA(I)=QA(I)+DELP(J)*DELTA(I-J+1)
   13 CONTINUE
C     CONVERT FROM MM/HR TO M3/S
      DO 30 I=1,MM
      QA(I)=(AREA/3.6)*QA(I)/DELT
      QA(I)=QA(I)*CNM
   30 CONTINUE
      IF(SUBPT3.EQ.0)GO TO 31
   40 FORMAT(2X,'T(HR)',3X,'DD(MM/HR)',3X,'DELP(MM)',4X,'QA(M3/S)',4X,
     *'QM(M3/S)'/)
      DO 2 I=1,MM
    2 QM(I)=QM(I)-QM(1)
      DO 9 I=1,MM
      IJ=K+I
      QM(I)=QM(IJ)
      IF(QM(I).LE.0.0)QM(I)=0.0
      WRITE(6,22)TM(I),DD(I),DELP(I),QA(I),QM(I)
      WRITE(7,22)TM(I),DD(I),DELP(I),QA(I),QM(I)
    9 CONTINUE
      GO TO 42
   31 CONTINUE
      DO 8 I=1,MM
      WRITE(6,23)TM(I),DD(I),DELP(I),QA(I)
      WRITE(7,23)TM(I),DD(I),DELP(I),QA(I)
    8 CONTINUE
   42 CONTINUE
      RETURN
      END
      SUBROUTINE GODFI
      COMMON/A1/DELT,QU,N,P,TD,CN,II
      COMMON/A4/T(250),R(250),RE(250),RER(250)
      COMMON/A7/CUMP(250)
```

```
      COMMON/A8/AREA,L,Y,NN,NF
      COMMON/A10/DELP(250),QA(250),TM(250),QM(250)
      COMMON/A13/CNAME(20)
      INTEGER QU
      REAL L
C
C     EVALUATION OF RESULTS
C
      II=N
      SQ2=0.
      SQM2=0.
      SUMC=0.
      SUMQ=0.
      SMQ=0.
      DO 1 I=1,N
    1 SMQ=SMQ+QM(I)
      SMQ=SMQ/N
      DO 2 I=1,N
      SQ2=SQ2+(QM(I)-QA(I))**2
      SQM2=SQM2+(QM(I)-SMQ)**2
    2 CONTINUE
      RI=(SQM2-SQ2)/SQM2
      PE=(SQRT(SQ2/N))/SMQ
      F1=0.
      F2=0.
      QMAX=0.
      QAMAX=0.
      DO 3 I=1,N
      F2=QA(I)-QM(I)
      F2=ABS(F2)*QM(I)
      F1=F1+F2
    3 CONTINUE
      DO 4 I=1,N
      IF(QM(I).GT.QMAX)QMAX=QM(I)
      IF(QA(I). GT.QAMAX)QAMAX=QA(I)
      SUMQ=SUMQ+QM(I)
      SUMC=SUMC+QA(I)
    4 CONTINUE
      DEV=(F1*200.0)/(FLOAT(N)*(QMAX*QMAX))
      PEAK=(QMAX-QAMAX)/QMAX
      PEAK=PEAK*100.
      TVOL=(SUMQ-SUMC)/SUMQ
      TVOL=TVOL*100.
C     PRINT EVALUTION OF RESULTS
      WRITE(6,20)
   20 FORMAT(2X//)
      WRITE(6,21)
      WRITE(7,21)
   21 FORMAT(2X,'THE GOODNES OF FITTING CRITERIA',/2X,32(1H-)/)
   22 FORMAT(2X,'COEFFICIENT OF DETERMINATION RE=',F7.2/
     *2X,'COEFFICIENT OF VARIATION PE=',F7.2/
     *2X,'SCHULTZE HYDROL.DEVIATION DEV=',F7.2/
     *2X,'PEAK ERROR PEAK(PERC)=',F7.2/
     *2X,'TOTAL RUNOFF ERROR TVOL(PERC)=',F7.2//)
      WRITE(6,22)RI,PE,DEV,PEAK,TVOL
      WRITE(6,20)
      WRITE(7,22)RI,PE,DEV,PEAK,TVOL
      WRITE(7,20)
      RETURN
      END
```

KIN – data TŘEBSÍN

```
$DEBUG
$NOTRUNCATE
      PROGRAM CPLANEKS
C     PROGRAM PLANEK SERVES FOR DESIGN DISCHARGES COMPUTATION
C     IT IS A VERSION OF CPLANE WITH SUMMATION OF PARTIAL PLANES
C     AND SEGMENTS AS AN INPUT TO CSTREAM OR MUSK PROGRAMMES
C     NAME OF FILE: CPLANEKS.FOR
      COMMON/A1/DELT,PP,N,P,TD,CN,II,IT,IL,IK,TTM,TDR
      COMMON/A4/T(150),R(150),RE(150),RER(150),QAB(150)
      COMMON/A5/SO(10),DLN(10),WI(10),WID(10),AK1(10),ALPHA(10),AM(10)
      COMMON/A8/AREA,L,Y,NN,NF,TIM,DT
      COMMON/A9/FRNM(10),FRIC(10),DX(10),PBAC(10),AR(10),AL(10),PR(10)
      COMMON/A10/DELP(150),QA(150),TM(150),QM(150),TIND(150),QAA(150)
```

```
      COMMON/A12/H(11,150),VE(11,150),TAU(11,150),VSTR(11,150)
      COMMON/A13/CNAME(20)
      COMMON/A14/NPL,QAW(20,150),qcw(20,150)
      INTEGER PP,PPP,PM,FLAG,J,I,IT,IL,N,II,NPL,K
      REAL HKIN,HBAC,HCEN,HFOR,RO,GA,DEL,TIME,QL,AK11,AM1,PBAC1,PR1
      REAL PEFF,EFR,Q0
      DIMENSION QC(150)
      PARAMETER(PM=150)
      PARAMETER(PPP=10)
C     PARAMETER(PP=3)
      CHARACTER*12 NDFILE
C     CHARACTER*30 START
      CHARACTER*8 FNAME$
C
C     PURPOSE: TO SOLVE THE KINEMATIC WAVE EQUATION FOR OVERLAND FLOW
C              ON A CASCADE OF PLANES UNDER RAINFALL, USING THE SECOND
C              ORDER EXPLICIT FINITE-DIFFERENCE LAX-WENDROFF SCHEME.
C              THE BACKWARDS FINITE DIFFERENCE SCHEME IS USED AT THE
C              END OF EACH PLANE. THE VARIABLE WIDTHS OF PLANES CAN
C              ALSO BE USED FOR A SEGMENT FLOW SIMULATION.
C
C
      RO=1000.0
      GA=9.81
      K=0
      OPEN(UNIT=5,FILE='TREB9.DTA',STATUS='OLD')
      OPEN(UNIT=7,FILE='TREB9.OUT',STATUS='UNKNOWN')
      OPEN(UNIT=1,FILE='NDFILE',STATUS='UNKNOWN')
C     INPUT OF DATA
C     READ INITIAL DISCHARGE (for design discharges obviously Q0=0.0)
   97 FORMAT(F10.4)
      READ(5,97)Q0
C     beginning of cycle data reading
  100 PRINT *,'GIVE THE NAME OF DATA FILE:      '
C     READ '(A12)',NDFILE
C     READ IN DATA FILE
   99 FORMAT(20A4)
      READ(5,99)CNAME
   98 FORMAT(2X,60(1H*))
C     READ NUMBER OF GEOMETRIC ELEMENTS (PLANES, SEGMENTS) TO BE SUMMED
      READ(5,105)NPL
C     READ THE NUMBER OF PLANES IN A CASCADE, PP
      READ(5,105)PP
C     READ THE PLANE PARAMETERS:
C     SLOPE SO(J), LENGTH DLN(J), WIDTH WID(J), OBSTACKLES AR(J),
C     MANNING ROUGHNESS FRNM(J), FRICTION FRIC(J), FLOW TYPE AM(J).
  101 FORMAT(7F10.4)
      DO 2 J=1,PP
      READ(5,101)SO(J),DLN(J),WID(J),AR(J),FRNM(J),FRIC(J),AM(J)
    2 CONTINUE
  102 FORMAT(2F10.2)
  103 FORMAT(10F8.3)
      READ(5,102)DELT,TTM
      RCO=3600.
  105 FORMAT(I3)
      READ(5,105)N
      READ(5,103)(RER(I),I=1,N)
      TDLN=0.
      SI=0.
      DO 17 I=1,N
      RER(I)=RER(I)/0.01665    ! 1 min
C     RER(I)=RER(I)/0.08325    ! 5 min
C     RER(I)=RER(I)/0.1665     ! 10 min
C     RER(I)=RER(I)/0.5        ! 30 min
      SI=SI+RER(I)
   17 CONTINUE
      SI=SI*(DELT/RCO)
      DO 18 J=1,PP
   18 TDLN=TDLN+DLN(J)
      PAR=(TDLN/1000.)*(WID(1)/1000.)
C     TRANSFER FROM MM/HR TO M/S
      RER(1)=RER(1)/RCO/1000.0
      T(1)=DELT
      DO 3 I=2,N
      RER(I)=RER(I)/RCO/1000.0
      T(I)=T(I-1)+DELT
    3 CONTINUE
```

```
  112 FORMAT(I1)
      READ(5,112)NEXT
C
    4 PRINT *,'GIVE TIME INCREMENT (DT):      '
      READ *,DT
C     PRINT *,'GIVE TIME INTERVAL FOR WRITING INTERMEDIATE RESULTS:    '
C     PRINT *,'RECOMMENDATION:TIM SHOULD EQUAL PREFERABLY TO DELT, '
C     PRINT *,'BUT NOT NECESSARILLY'
C     READ *,TIM
C
C     INITIAL CONDITIONS
      TIM=DELT
      TIME=TIM
      TTIM=30.0
      IL=11
      IK=0
      DO 6 J=1,PP
      FRNM(J)=FRNM(J)*1.0   !
      AL(J)=ATAN(SO(J))
      AK1(J)=SQRT(8.0*GA*SO(J)/FRIC(J))
      ALPHA(J)=SQRT(SO(J))/FRNM(J)
      DX(J)=DLN(J)/10.0
      FRNM(J)=FRNM(J)/1.0   !
      IF(AR(J).LE.1.0)THEN
      WI(J)=1.0-AR(J)
      ELSE
      WI(J)=1.0*AR(J)
      ENDIF
      DO 5 I=1,IL
      H(J,I)=0.0
    5 CONTINUE
    6 CONTINUE
      IT=0
C     WRITING INITIAL DATA
  113 FORMAT(2X,'NAME OF CATCHMENT:',2X,20A4/2X,60(1H*))
      WRITE(6,113)CNAME
      WRITE(7,113)CNAME
  107 FORMAT(2X,'OUTPUT OF SUBROUTINE CPLANE:'/2X,28(1H*))
C     WRITE(6,107)
C     WRITE(7,107)
  104 FORMAT(2X,'SIMULATION OF OVERLAND FLOW IN THE CASCADE OF PLANES'/
     *2X,'(EXPLICIT FINITE DIFFERENCE SCHEME OF LAX-WENDROFF):'/)
C
C     PRINTING DETAILED SUBHEADINGS
  106 FORMAT(2X,'INTERIM RESULTS OF SIMULATION:'/2X,30(1H-))
C     WRITE(6,104)
C     WRITE(7,104)
  108 FORMAT(2X,'NUMBER OF PLANES IN A CASCADE:',3X,I2)
  109 FORMAT(2X,'DESCRIPTION OF PLANES:'/2X,22(1H-)/2X,'SLOPES(-)',5X,
     *'LENGTHS(M)',5X,'WIDTHS(M)',5X,'MAN.ROUGHNESS',5X,'M-FLOWTYPE')
  110 FORMAT(4X,F6.3,5X,F9.3,6X,F9.3,8X,F7.4,10X,F7.4)
  111 FORMAT(2X,70(1H-))
C     WRITE(6,108)PP
C     WRITE(7,108)PP
      WRITE(6,109)
      WRITE(7,109)
      DO 16 J=1,PP
      WRITE(6,110)SO(J),DLN(J),WID(J),FRNM(J),AM(J)
      WRITE(7,110)SO(J),DLN(J),WID(J),FRNM(J),AM(J)
   16 CONTINUE
      WRITE(6,111)
      WRITE(7,111)
C     WRITE(6,106)
C     WRITE(7,106)
C
C     START OF SIMULATION
      DO 1 TD=DT,TTM,DT
      DO 7 I=1,N
           IF(TD.LE.T(1))THEN
             EFR=RER(1)
           ELSE IF(TD.GT.T(N))THEN
             EFR=0.0
           ELSE IF(TD.LE.T(I).AND.TD.GT.T(I-1))THEN
             EFR=RER(I)
             GO TO 7
           ENDIF
    7 CONTINUE
```

```
C     PREPARATION OF EFFECTIVE RAIN (PEFF) FOR EACH SLOPE
      DO 8 J=1,PP
      PEFF=EFR*WI(J)
      DDT=TD-DT
      IF(DDT.LT.0.001) PR(J)=PEFF
      PBAC(J)=PR(J)
      PR(J)=PEFF
    8 CONTINUE
C     START OF SPACE SIMULATION FOR DIFFERENT SLOPES
      DO 10 J=1,PP
C     RESET VALUES FOR THE NEXT TIME STEP
      I=2
      HBAC=H(J,I-1)
      HCEN=H(J,I)
      HFOR=H(J,I+1)
C     COMPUTATION PROCEDURE
      DO 9 I=2,IL
      FLAG=0
      IF(I.EQ.IL)FLAG=1
      DX1=DX(J)
      AK11=AK1(J)
      ALP=ALPHA(J)
      AM1=AM(J)
      PBAC1=PBAC(J)
      PR1=PR(J)
      H(J,I)=HKIN(HBAC,HCEN,HFOR,DT,DX1,ALP,AK11,AM1,PBAC1,PR1,FLAG)
      IF(H(J,I).LT.0.0)THEN
      H(J,I)=0.
      IF(H(PP,IL).LE.0.)THEN
      IT=INT(TD+0.01)
      CALL WRTR
      PRINT *,'------>COMPUTATIONAL BLOCK  '
      GOTO 20
      ENDIF
      CONTINUE
      ENDIF
C     RESET VALUES FOR CALCULATION ON THE NEXT GRIDPOINT
      IF(I.GT.1.AND.I.LT.IL-1)THEN
      HBAC=HCEN
      HCEN=HFOR
      HFOR=H(J,I+2)
      ENDIF
    9 CONTINUE
C     TEST OF STABILITY
      IF(H(J,IL).GT.0.)DEL=DX(J)/(AM(J)*ALPHA(J)*H(J,IL)**(AM(J)-1.0))
      IF(DT.GT.DEL.AND.DEL.GT.0.0)THEN
      PRINT *,'STABILITY CONDITIONS ARE NOT FULFILLED AT T  '
      ENDIF
      IF(J.NE.PP)THEN
      QL=ALPHA(J)*H(J,IL)**AM(J)*WI(J)*WID(J)
      H(J+1,1)=(QL/WI(J+1)/WID(J+1)/ALPHA(J+1))**(1.0/AM(J+1))
      ENDIF
   10 CONTINUE
C     TEST WHETHER TO WRITE INTERIM RESULTS
C
   11 IT=INT(TD+0.01)
      IF(ABS(IT-TIME).LT.0.01)THEN
        IF(H(PP,IL).GT.2E-6)THEN
        CALL WRTR
        ENDIF
      TIME=TIME+TIM
      ENDIF
C     END OF THE TIME CYCLE
    1 CONTINUE
      WRITE(6,'(A)')'   '
      WRITE(7,'(A)')'   '
   13 FORMAT(2X,'THE OVERLAND FLOW HYDROGRAPH: '/
     *       2X,'ORDIN.NO.',6X,'TIME(HOURS)',2X,'DISCHARGE Q (L/S)'//)
      WRITE(6,13)
      WRITE(7,13)
      DO 15 JK=1,IK
      QAB(JK)=QAA(JK)*1000.0
      WRITE(6,14)JK,TIND(JK),QAB(JK)
      WRITE(7,14)JK,TIND(JK),QAB(JK)
   14 FORMAT(2X,I3,8X,F10.3,8X,F10.3)
   15 CONTINUE
C     MASS BALANCE CHECK
```

```
      DELE=DELT/3600.
      SQ=0.
      DO 19 I=1,IK
   19 SQ=SQ+QAA(I)
      SQ=SQ*DELE*3.6/PAR
  114 FORMAT(2X,'THE MASS BALANCE CHECK:'/2X,25(1H-),/
     *2X,'TOTAL INFLOW DEPTH:',4X,F8.2,2X,'MM',/,
     *2X,'TOTAL OUTFLOW DEPTH:',3X,F8.2,2X,'MM',/////)
      WRITE(6,114)SI,SQ
      WRITE(7,114)SI,SQ
      GOTO 120
C     SUMMATION OF OUTFLOW DEPTH FROM ALL AREAS (PLANES +SEGMENTS)
      K=K+1
      DO 25 I=1,IK
      IF(K.EQ.1)THEN
      QAW(K,I)=QAA(I)
      ELSE
      QAW(K,I)=QAW(K-1,I)+QAA(I)
      ENDIF
   25 CONTINUE
      IF(NEXT.NE.0) GO TO 100
      WRITE(6,116)
      WRITE(7,116)
      WRITE(6,117)K,NPL
      WRITE(7,117)K,NPL
      DO 26 I=1,IK
      QAW(K,I)=Q0+QAW(K,I)
      WRITE(6,115)I,TIND(I),QAW(K,I)
      WRITE(7,115)I,TIND(I),QAW(K,I)
      QC(I)=QAW(K,I)
   26 CONTINUE
c     qaw(k,i) values are up to now summative, which means that
c     qaw(npl,i) values are equal to total values qc(i).
c     next procedure computes outflow qcw from partial ares k=1,npl.
      do 27 k=1,npl
      do 27 i=1,ik
      if(k.eq.1)then
      qcw(k,i)=qaw(1,i)
      else
      qcw(k,i)=qaw(k,i)-qaw(k-1,i)
      endif
   27 continue
  116 FORMAT(2X,'SUM OF THE HYDROGRAPH ORDINATES FROM ALL PARTIAL AREAS'
     */2X,60(1H*))
  115 FORMAT(2X,I3,6X,F10.3,6X,F10.3)
  117 FORMAT(2X,'K= ',I3,5X,'NPL= ',I3)
   20 CONTINUE
C     SCREEN CONTROL
      READ '(A12)',NDFILE
C     Data for graphs preparation
      write(*,'(A\)')' NAME OF EVENT DATA:'
      read(*,'(A)')fname$
      open(unit=8,file=fname$)
      write(8,'(2x,i3,2f8.3)')(i,tind(i),qaa(i),i=1,ik)
c     output data for all planes
c     READ '(A12)',NDFILE
c     write(*,'(A\)')' NAME OF DETAILED EVENT DATA:'
c     read(*,'(A)')fname$
c     Pozor na formatovani tabulky- max.pocet sloupcu =12(12f6.3)
c     write(8,'(1x,6f10.3)')((qcw(k,i),k=1,npl),i=1,ik)   !
  120 CONTINUE
      CLOSE (8)
      PRINT *,    '******END OF CASCADE OF PLANES******'
      if(next.eq.1)goto 100
   12 STOP
      END
      FUNCTION HKIN(HBAC,HCEN,HFOR,DT,DX1,ALP,AK11,AM1,PBAC1,PR1,FLAG)
      INTEGER FLAG
      REAL HN1,HN2,HN3,HN4,DT,DX1,ALP,AK11,AM1,PBAC1,PR1
      IF(FLAG.EQ.0)THEN
      HN1=DT/2.0/DX1*(ALP*HFOR**AM1-ALP*HBAC**AM1-2.0*DX1*PBAC1)
      HN2=(DT/DX1)**2.0/2.0*(ALP*AM1*HFOR**(AM1-1.)+ALP*AM1*HCEN**
     *(AM1-1.))*(ALP*HFOR**AM1-ALP*HCEN**AM1-DX1*PBAC1)
      HN3=(DT/DX1)**2.0/2.0*(ALP*AM1*HCEN**(AM1-1.)+ALP*AM1*HBAC**
     *(AM1-1.))*(ALP*HCEN**AM1-ALP*HBAC**AM1-DX1*PBAC1)
      HN4=DT/2.0*(PR1-PBAC1)
      HKIN=HCEN-HN1+HN2-HN3+HN4
```

```
      ELSE IF(FLAG.EQ.1)THEN
      HN1=DT/DX1*(ALP*HFOR**AM1-ALP*HCEN**AM1-DX1*PBAC1)
      HN2=(DT/DX1)**2.0/2.0*(ALP*AM1*HFOR**(AM1-1.)+ALP*AM1*HCEN**
     *(AM1-1.))*(ALP*HFOR**AM1-ALP*HCEN**AM1-DX1*PBAC1)
      HN3=(DT/DX1)**2.0/2.0*(ALP*AM1*HCEN**(AM1-1.)+ALP*AM1*HBAC**
     *(AM1-1.))*(ALP*HCEN**AM1-ALP*HBAC**AM1-DX1*PBAC1)
      HN4=DT/2.0*(PR1-PBAC1)
      HKIN=HFOR-HN1+HN2-HN3+HN4
      ENDIF
      AK11=ALP
      RETURN
      END
      SUBROUTINE WRTR
      COMMON/A1/DELT,PP,N,P,TD,CN,II,IT,IL,IK,TTM,TDR
      COMMON/A4/T(150),R(150),RE(150),RER(150),QAB(150)
      COMMON/A5/SO(10),DLN(10),WI(10),WID(10),AK1(10),ALPHA(10),AM(10)
      COMMON/A8/AREA,L,Y,NN,NF,TIM,DT
      COMMON/A9/FRNM(10),FRIC(10),DX(10),PBAC(10),AR(10),AL(10),PR(10)
      COMMON/A10/DELP(150),QA(150),TM(150),QM(150),TIND(150),QAA(150)
      COMMON/A12/H(11,150),VE(11,150),TAU(11,150),VSTR(11,150)
      INTEGER J,I,IL,IT,PM,PP
      REAL X1,TK1,TK2,TK3,TK4
      PARAMETER(PM=150)
C     PARAMETER(PP=3)
C     CHARACTER*12 NDFILE
C
C     WRITING RESULTS
C
C     LIMITS FOR CRITICAL SHEAR STRESS TK
      TK1=0.0076
      TK2=0.038
      TK3=0.19
      TK4=1.67
      IT=IT/60
   32 FORMAT(2X,'LIMITS FOR CRITICAL SHEAR STRESS TAUcr(Pa):  '/
     *2X,60(1H-))
      WRITE(6,32)
      WRITE(7,32)
   33 FORMAT(2X,F7.4,3X,F7.4,3X,F7.4,3X,F7.4/)
      WRITE(6,33)TK1,TK2,TK3,TK4
      WRITE(7,33)TK1,TK2,TK3,TK4
      DO 21 J=1,PP
      DO 22 I=1,IL
      VE(J,I)=ALPHA(J)*H(J,I)**(AM(J)-1.)
      TAU(J,I)=9810.0*SO(J)*H(J,I)
      X1=9.81*SO(J)*H(J,I)
      VSTR(J,I)=SQRT(X1)
   22 CONTINUE
      QA(J)=ALPHA(J)*H(J,IL)**AM(J)*WI(J)*WID(J)
C     PRINT INTERIM RESULTS
C     DISCHARGE AT L IN L/S
   23 FORMAT(2X,'J=' ,I2,'   T=  ',I5,/
     *2X,'   H(J,I): ',6F8.4,/
     *2X,'  VE(J,I): ',6F8.4)
   34 FORMAT(2X,' TAU(J,I): ',6F8.4/
     *2X,'VSTR(J,I): ',6F8.4/2X,60(1H-))
      WRITE(6,'(2X,A,I2,3X,A,I4)') 'PLANE  ',J,  'AT TIME  ',IT
      WRITE(7,'(2X,A,I2,3X,A,I4)') 'PLANE  ',J,  'AT TIME  ',IT
      WRITE(6,23)J,IT,(H(J,I),I=1,11,2),(VE(J,I),I=1,11,2)
      WRITE(7,23)J,IT,(H(J,I),I=1,11,2),(VE(J,I),I=1,11,2)
      WRITE(6,34)(TAU(J,I),I=1,11,2),(VSTR(J,I),I=1,11,2)
      WRITE(7,34)(TAU(J,I),I=1,11,2),(VSTR(J,I),I=1,11,2)
   21 CONTINUE
C     WRITE(6,'(I5,10F6.3)')IT,(QA(J),J=1,PP)
C     WRITE(7,'(A)')'        '
C     WRITE(7,'(I5,10F6.3)')IT,(QA(J),J=1,PP)
C     WRITE(6,27)
C     WRITE(7,27)
   27 FORMAT(2X,60(1H-))
C     WRITE(6,'(A)')'  '
C     WRITE(7,'(A)')'  '
   29 SIT=0.0
      DO 30 J=1,PP
      IF(J.EQ.PP) THEN
      JK=INT(J/PP)
      IK=IK+JK
      QAA(IK)=QA(J)
```

```
   SIT=SIT+IT
   TIND(IK)=SIT/60.0
   WRITE(6,24)IK,IT,TIND(IK),QAA(IK)
   WRITE(7,24)IK,IT,TIND(IK),QAA(IK)
24 FORMAT(3X,I4,9X,I4,6X,F7.2,7X,F7.3)
   ENDIF
30 CONTINUE
   WRITE(6,27)
   WRITE(7,27)
31 RETURN
   END
```