TRAINING WORKSHOP

"FLOW AND SEDIMENT TRANSPORT MODELING IN RIVER BASINS USING TELEMAC 2D AND 3D NUMERICAL CODES"

February 26-28, 2022

Sediment transport module - GAIA

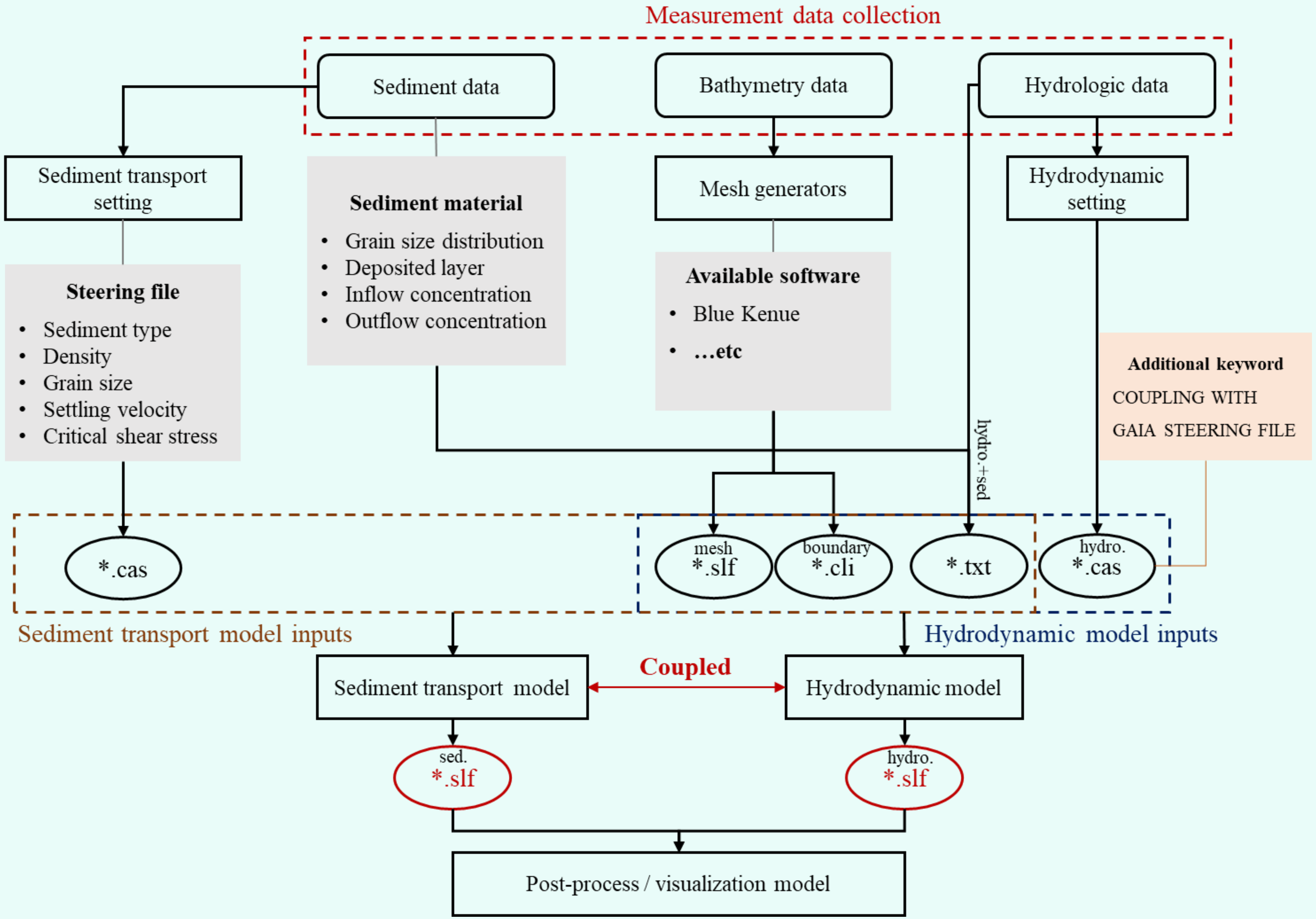
Steering GAIA: parameters and data files

Chen Peng-An

chen.an.83c@st.kyoto-u.ac.jp

IWaRM

Structure of sediment transport



Input file: BOUNDARY CONDITION FILE

Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/
/
/---------------------------------------------------------------------
/                        FILE DEFINITION
/---------------------------------------------------------------------
/
BOUNDARY CONDITIONS FILE          : 'BOTTOM_BC.cli'
GEOMETRY FILE                     : 'Bottom_50m.slf'
RESULTS FILE                      : 'Magat_V2.slf'
/
```

```
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9473   394  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9457   395  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9445   396  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9440   397  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9439   398  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9435   399  #
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9436   400  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9446   401  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9470   402  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9477   403  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9486   404  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9498   405  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9503   406  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9507   407  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9508   408  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9504   409  # newBoundary (9436 -
9504)
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9499   410  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9491   411  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9494   412  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9496   413  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9495   414  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9492   415  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9489   416  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9464   417  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9427   418  #
2 2 2  0.000 0.000 0.000 0.000 2 0.000 0.000 0.000   9384   419  #
```

LIHBOR	LIUBOR	LIVBOR	LITBOR	
2	2	2	2	Solid wall.
2	0	2	2	Solid wall with zero U.
2	2	0	2	Solid wall with zero V.
2	0	0	2	Solid wall with zero U and V.
4	4	4	4	Free H, free velocities, free T.
5	4	4	4	Prescribed H, free velocities, free T.
5	4	0	4	Prescribed H, free U, zero V, free T.
5	0	4	4	Prescribed H, zero U, free V, free T.
1	1	1	4	Incident wave, free tracer.
4	5	5	5	Free H, prescribed Q, prescribed T.
4	5	0	5	Free H, prescribed Q with zero V, prescribed T.
4	0	5	5	Free H, prescribed Q with zero U, prescribed T.
4	6	6	5	Free H, prescribed velocities, prescribed T.
5	5	5	5	Prescribed H and Q, prescribed T.
5	6	6	5	Prescribed H and velocities, prescribed T.

Coupled with GAIA

Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/
/
/---------------------------------------------------------------------
/                        FILE DEFINITION
/---------------------------------------------------------------------
/
BOUNDARY CONDITIONS FILE             : 'BOTTOM_BC.cli'
GEOMETRY FILE                        : 'Bottom_50m.slf'
RESULTS FILE                         : 'Magat_V2.slf'
LIQUID BOUNDARIES FILE       = Magat_Boundary.txt /hydrograph B.C. file
/
/---------------------------------------------------------------------
/                          GENERAL OPTIONS
/---------------------------------------------------------------------
/
TITLE : 'Magat'
/
VARIABLES FOR GRAPHIC PRINTOUTS              : 'U,V,F,H,B,S,Q,W,L,T*'
TIME STEP                                    : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                         : 20592
GRAPHIC PRINTOUT PERIOD                      : 10
LISTING PRINTOUT PERIOD                      : 10
TIDAL FLATS                                              : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS          : 1
/
/
/---------------------------------------------------------------------
/                              COUPLING
/---------------------------------------------------------------------
COUPLING WITH                                            : 'GAIA'
GAIA STEERING FILE                                  : 'Gaia_Magat_2D.cas' /steering file nar
/
/                        BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                        :189.02; 0.0 /downstream boundary (water level)
PRESCRIBED FLOWRATES                         :0.0; 301 /upstream boundary (inflow discharge)
PRESCRIBED TRACERS VALUES                    :0.0; 1.26 /upstream boundary (inflow sediment)
/
/---------------------------------------------------------------------
/                         INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                           :'CONSTANT ELEVATION'
INITIAL ELEVATION                            : 189.02 /initial water level
/
```

Magat_Sc3_variant-Inflow_CorBC

新增 排序 檢視 ...

« Telemac_training › material › Magat2D_trail › CorrectBC_Magat › Magat_Sc3_variant-Inflow_CorBC

material
20220218
Bathymetr
Blue Kenu
Hydrologi
Magat2D_
2020BC
CorrectB

名稱	修改日期	類型	大小
Bottom_50m.slf	2022/2/17 下午 04:17	SLF 檔案	364 KB
BOTTOM_BC.cli	2022/2/18 下午 02:44	CLI 檔案	71 KB
gai_Magat.slf	2022/2/22 上午 10:46	SLF 檔案	922,523 KB
Gaia_Magat_2D.cas	2022/2/18 下午 03:53	CAS 檔案	2 KB
Magat_2D.cas	2022/2/22 下午 07:36	CAS 檔案	5 KB
Magat_Boundary.txt	2022/2/26 下午 12:02	文字文件	5 KB
Magat_V2.slf	2022/2/22 上午 10:46	SLF 檔案	768,827 KB

Gaia_Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/---------------------------------------------------------------------/
/ FILES
/---------------------------------------------------------------------/
GEOMETRY FILE                     = Bottom_50m.slf
BOUNDARY CONDITIONS FILE          = BOTTOM_BC.cli
RESULTS FILE                      = gai_Magat.slf
/---------------------------------------------------------------------/
/ OUTPUTS                                                             /
/---------------------------------------------------------------------/
 VARIABLES FOR GRAPHIC PRINTOUTS : 'U,V,H,S,R,B,E,TOB,KS'
/evolution du fond
 MASS-BALANCE : YES
/---------------------------------------------------------------------/
/  PHYSICAL OPTIONS
/---------------------------------------------------------------------/
 CLASSES TYPE OF SEDIMENT : CO
 CLASSES SEDIMENT DENSITY : 2650.0
 CLASSES SEDIMENT DIAMETERS = 0.000008
 CLASSES SETTLING VELOCITIES : -9
 NUMBER OF LAYERS FOR INITIAL STRATIFICATION : 1
 LAYERS INITIAL THICKNESS : 0.D0
 LAYERS MASS TRANSFER : 0.D0
 LAYERS PARTHENIADES CONSTANT : 5.D-3
 LAYERS MUD CONCENTRATION : 900.D0
 LAYERS CRITICAL EROSION SHEAR STRESS OF THE MUD : 0.05
 CLASSES CRITICAL SHEAR STRESS FOR MUD DEPOSITION : 1000
 SKIN FRICTION CORRECTION : 0
```

Physical parameters: Suspended load transport

- **Suspended load:** with the solution of the advection-diffusion equation (ADE) plus closures for erosion and deposition fluxes, equilibrium concentration
  - **two-dimensional advection-diffusion equation:**

$$\frac{\partial hC}{\partial t} + \frac{\partial hUC}{\partial x} + \frac{\partial hVC}{\partial y} = \frac{\partial}{\partial x}\left(h\varepsilon_s \frac{\partial C}{\partial x}\right) + \frac{\partial}{\partial y}\left(h\varepsilon_s \frac{\partial C}{\partial y}\right) + E - D$$

where $C = C(x,y,t)$ is the depth-averaged concentration **expressed in g/l**, (U,V) are the depth-averaged components of the velocity in the x and y directions, respectively, ε_s is the turbulent diffusivity of the sediment, often related to the eddy viscosity $\varepsilon_s = \nu_t/\sigma_c$, with σ_c the Schmidt number. In our case, $\sigma_c = 1.0$.

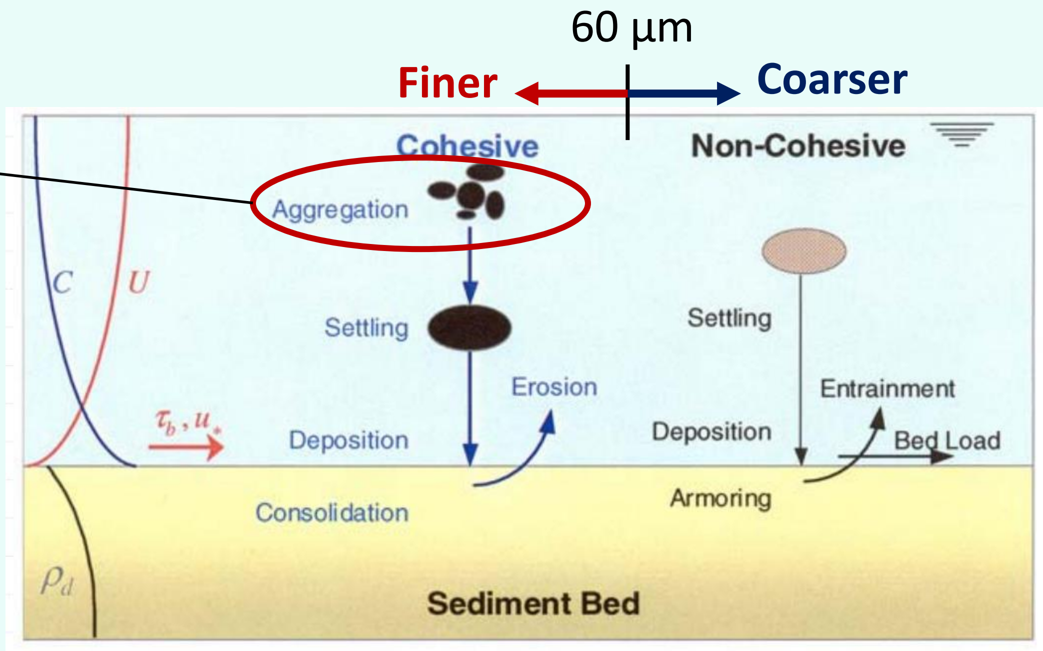
  - **three-dimensional advection-diffusion equation:**

$$\frac{\partial C}{\partial t} + \frac{\partial uC}{\partial x} + \frac{\partial vC}{\partial y} + \frac{\partial wC}{\partial z} - \frac{\partial w_s C}{\partial z} = \frac{\partial}{\partial x}\left(\varepsilon_s \frac{\partial C}{\partial x}\right) + \frac{\partial}{\partial y}\left(\varepsilon_s \frac{\partial C}{\partial y}\right) + \frac{\partial}{\partial y}\left(\varepsilon_s \frac{\partial C}{\partial z}\right)$$

where $C = C(x,y,z,t)$ is the concentration **expressed in g/l**, (u,v,w) are the components of the velocity in the x, y and z directions, respectively. w_s is the sediment settling velocity. ε_s is the turbulent diffusivity of the sediment, often related to the eddy viscosity $\varepsilon_s = \nu_t/\sigma_c$, with σ_c the Schmidt number. In our case $\sigma_c = 1.0$.

Sediment transport: Cohesive suspended load

Aggregation of flocs can lead to the formation of macro-flocs larger than 100 µm.



In GAIA, cohesive sediments are accounted by solving the 2D advection-diffusion equation:

$$\frac{\partial hC}{\partial t} + \frac{\partial hUC}{\partial x} + \frac{\partial hVC}{\partial y} = \frac{\partial}{\partial x}\left(h\varepsilon_s \frac{\partial C}{\partial x}\right) + \frac{\partial}{\partial y}\left(h\varepsilon_s \frac{\partial C}{\partial y}\right) + (E - D)$$

$C = C(x,y,t)$ is the depth-averaged concentration **expressed in g/l**, (U,V) are the depth-averaged components of the velocity in the x and y directions, respectively, ε_s is the turbulent diffusivity of the sediment. Variables E and D are respectively the erosion and deposition fluxes.

Advection-diffusion equation:

- **Numerical treatment of the diffusion terms:**

The keyword OPTION FOR THE DIFFUSION OF TRACER (integer type, set = 1 by default) allows to choose the treatment of the diffusion terms in the advection-diffusion equation 2.1 for the depth-averaged suspended concentration:

- = 1: the diffusion term is solved in the form $\nabla \cdot (\varepsilon_s \nabla T)$
- = 2: the diffusion term is solved in the form $\frac{1}{h}\nabla \cdot (h\varepsilon_s \nabla T)$

This keyword must be activated in the steering file of TELEMAC-2D; user can refer to the corresponding user manual for further details.

- **Numerical treatment of the advection terms**

The choice for the scheme for the treatment of the advection terms can be done with the keyword SCHEME FOR ADVECTION OF SUSPENDED SEDIMENTS (integer type, set = 5 by default):

```
1="CHARACTERISTICS"
2="SUPG"
3="CONSERVATIVE N-SCHEME"
4="CONSERVATIVE N-SCHEME"
5="CONSERVATIVE PSI-SCHEME"
13="EDGE-BASED N-SCHEME"
14="EDGE-BASED N-SCHEME"
15="ERIA SCHEME"
```

- **Method of characteristics** (1)
  - Unconditionally stable and monotonous
  - Diffusive for small time steps, Not conservative
- **Method Streamline Upwind Petrov Galerkin SUPG** (2)
  - Based on the Courant number criteria
  - Less diffusive for small time steps, Not conservative
- **Conservative N-scheme (similar to finite volumes)** (3, 4)
  - Solves the continuity equation under its conservative form
  - Recommended for correction on convection velocity
  - Courant number limitation (sub-iterations to reduce time step)
- **Edge-based N-scheme NERD** (13, 14)
  - Same as 3 and 4 but adapted to tidal flats
  - Based on positive-depth algorithm
- **Distributive schemes PSI** (5)
  - fluxes corrected according to the tracer value: relaxation of Courant number criteria, less diffusive than schemes 4, 14 but larger CPU time
  - Should not be applied for tidal flats
- **Eria scheme** (15)
  - Works for tidal flats

It is recommended to use the schemes 4 or 14 for a good compromise between accuracy and computational time (specially if tidal flats are present).

Sediment transport: Bedload transport

In contrast to SISYPHE, in GAIA bedload fluxes are computed in terms of (dry) mass transport rate per unit width, without pores.

The dimensionless current-induced sediment transport rate (Φ_b) is expressed:

$$\Phi_b = \frac{Q_b}{\sqrt{g(s-1){D_{50}}^3}}$$

where, Q_b is the bedload transport rate per unit width (m^2/s); $s = \rho_s/\rho_a$ is the relative density; ρ_s and ρ_a is the density of sediment and clear ware (kg/m^3), respectively; D_{50} means sediment grain size (m).

To obtain the sediment transport rate, the bedload transport formulas are commonly computed as the function of Shield number (θ):

$$\theta = \frac{\mu \tau_b}{(\rho_s - \rho_a) g d}$$

where, μ is the skin friction's correction factor.

Solved by bedload transport formula

Keyword `BED-LOAD TRANSPORT FORMULA FOR ALL SANDS` (integer type variable, set to = 1 by default) can be used to set a bedload transport formula. Available formulas in GAIA for bedload transport are:

```
1 : MEYER-PETER and MUELLER
2 : EINSTEIN-BROWN
3 : ENGELUND-HANSEN + CHOLLET ET CUNGE (total sediment transport)
10: WILCOCK AND CROWE
30: ENGELUND-HANSEN (total sediment transport)
7 : VAN RIJN
```

For example, the keyword `BED-LOAD TRANSPORT FORMULA FOR ALL SANDS = 7` sets the van Rijn formula. Please note that bedload transport formulas 3 and 30 account for the total sediment transport.

Sediment Exchanges: Non-cohesive sediment

For non-cohesive sediments, the net sediment flux *E - D* is therefore determined based on the concept of equilibrium concentration:

$$(E-D)_{z_{ref}} = w_s \left(C_{eq} - C_{z_{ref}} \right)$$

The equilibrium near-bed concentration determined by using an empirical formula.

The near-bed concentration, evaluated at the interface between the bed load and the suspended load, $z = z_{ref}$.

Zyserman-Fredsoe

$$C_{eq} = \frac{0.331(\theta' - \theta_{cr})^{1.75}}{1 + 0.72(\theta' - \theta_{cr})^{1.75}},$$

Bijker

$$C_{eq} = \frac{Q_b}{b\, z_{ref}\, u_*}$$

van Rijn

$$C_{eq} = 0.015\, d_{50} \frac{(\theta'/\theta_{cr} - 1)^{3/2}}{z_{ref} D_*^{0.3}}$$

Soulsby & van Rijn

$$C_{eq} = \begin{cases} A_{ss} \left(\sqrt{U_c^2 + \frac{0.018}{C_D} U_w^2} - U_{cr} \right)^{2.4} & \text{if} \geq U_{cr} \\ 0.0 & \text{otherwise} \end{cases}$$

In 2D cases, the near-bed concentration is computed assuming a Rouse profile for the vertical concentration distribution, which is theoretically valid in uniform steady flow conditions:

$$C(z) = C_{z_{ref}} \left(\frac{z-h}{z} \frac{a}{a-h} \right)^R, \tag{4.1}$$

where R is the Rouse number defined by

$$R = \frac{w_s}{\kappa u_*}, \tag{4.2}$$

with κ the von Karman constant ($\kappa = 0.4$), u_* the friction velocity corresponding to the total bed shear stress, and a the reference elevation above the bed elevation. The distance a, defined variously by various authors, is taken to be very close to the bed.

By depth-integration of the Rouse profile (4.3), the following relation can be established between the depth-averaged concentration and the reference concentration (near-bed concentration):

$$C_{z_{ref}} = FC,$$

where:

$$F^{-1} = \left(\frac{z_{ref}}{h} \right)^R \int_{z_{ref}/h}^{1} \left(\frac{1-u}{u} \right)^R du. \tag{4.3}$$

In GAIA, the following expression is used to compute F:

$$F^{-1} = \begin{cases} \frac{1}{(1-Z)} B^R \left(1 - B^{(1-R)}\right) & \text{if} R \neq 1 \\ -B \log B & \text{if} R = 1 \end{cases}$$

with $B = z_{ref}/h$.

Sediment Exchanges: Cohesive and mixed sediment

Erosion flux

The erosion flux is computed with the Partheniades formula. For uniform beds, the erosion flux is related to the excess of applied bed shear stress to the bed shear strength at the bed surface:

$$E = \begin{cases} M\left[\left(\frac{\tau_b}{\tau_{ce}}\right) - 1\right] & \text{if } \tau_b > \tau_{ce} \\ 0 & \text{otherwise} \end{cases}$$

where M the Krone-Partheniades erosion law constant [kg/m^2/s] and τ_{ce} the critical bed shear stress.

The composition of the sediment mixture in the surface (active) layer is taken into consideration when computing the critical shear stress for erosion and the erosion rate. This is achieved by combining the critical shear stresses for erosion for all the sediment classes (cohesive and non-cohesive), according to [30]:

- If the mass of cohesive sediment as a fraction of the mixture is $\geq 50\%$, then the erosion rate and critical shear stress for cohesive sediment alone is used.
- If the mass of cohesive sediment as a fraction of the mixture is $\leq 30\%$, then the erosion rate for non-cohesive sediment is used and the critical shear stress for non-cohesive sediment is used with a correction.
- If the mass of cohesive sediment as fraction of the mixture is $\geq 30\%$ and $\leq 50\%$, then the values are interpolated between the previous values.

Sediment Exchanges: Cohesive and mixed sediment

Deposition flux

The deposition flux for mud is computed by the expression:

$$D = w_s C \left[1 - \left(\frac{\sqrt{\tau_b/\rho}}{u^{cr}_{*mud}} \right)^2 \right]$$

where u^{cr}_{*mud} is the critical shear velocity for mud deposition, expressed in [m/s] and computed as $\sqrt{\tau_{d,mud}/\rho}$ with $\tau_{d,mud}$ provided by the keyword `CLASSES CRITICAL SHEAR STRESS FOR MUD DEPOSITION` (real type, set to = `1000.` N/m^2 by default).

Settling velocity, it can be specified by the user or calculated by the model as a function of grain diameter, keyword **SETTLING VELOCITIES** (real list, =-9 by default).

$$w_s = \begin{cases} \dfrac{(s-1)gd_{50}^2}{18\nu}, & \text{if } d_{50} \leq 10^{-4} \\ \dfrac{10\nu}{d_{50}} \left(\sqrt{1 + 0.01 \dfrac{(s-1)gd_{50}^3}{\nu^2}} - 1 \right), & \text{if } 10^{-4} \leq d_{50} \leq 10^{-3} \\ 1.1\sqrt{(s-1)gd_{50}}, & \text{otherwise} \end{cases}$$

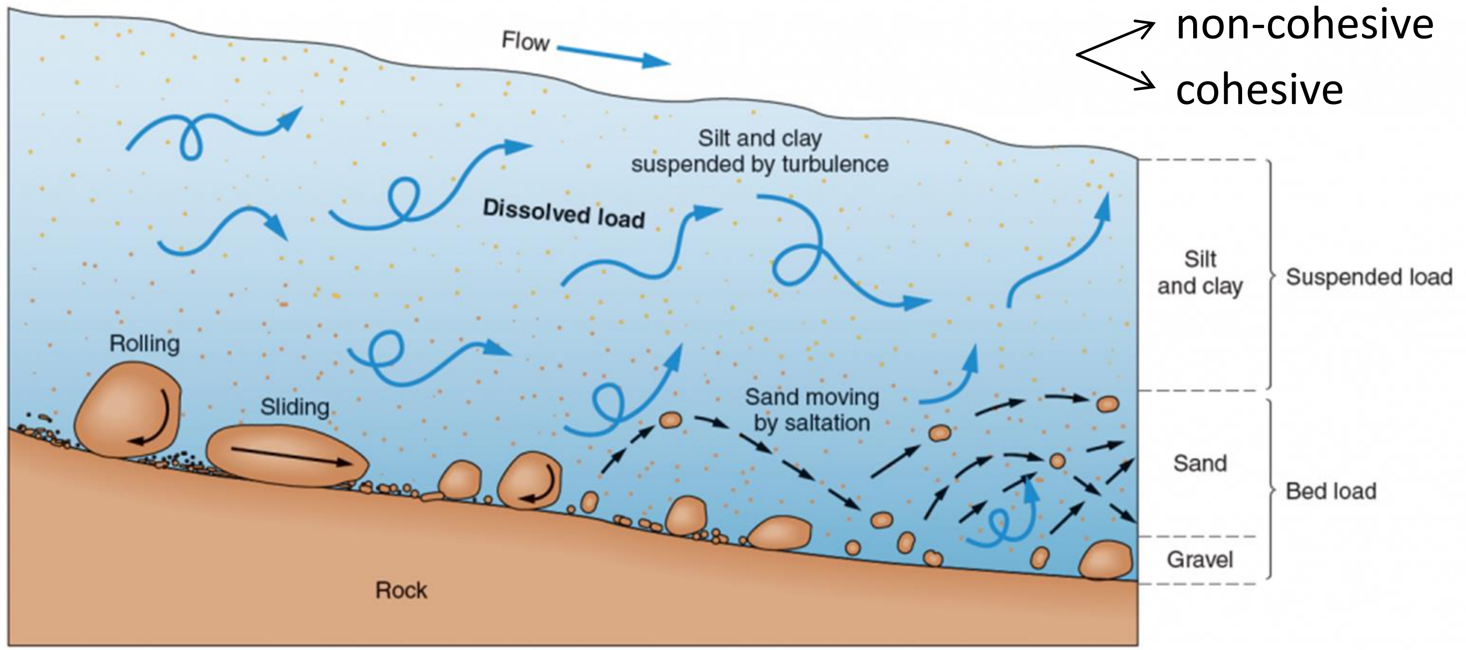
with $s = \rho_s/\rho_0$ is the relative density and g is the acceleration of the gravity.

Coupled with GAIA

Gaia_Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/---------------------------------------------------------------------/
/ FILES
/---------------------------------------------------------------------/
GEOMETRY FILE                      = Bottom_50m.slf
BOUNDARY CONDITIONS FILE           = BOTTOM_BC.cli
RESULTS FILE                       = gai_Magat.slf
/---------------------------------------------------------------------/
/ OUTPUTS                                                             /
/---------------------------------------------------------------------/
 VARIABLES FOR GRAPHIC PRINTOUTS : 'U,V,H,S,R,B,E,TOB,KS'
/evolution du fond
 MASS-BALANCE : YES
/---------------------------------------------------------------------/
/  PHYSICAL OPTIONS
/---------------------------------------------------------------------/
 CLASSES TYPE OF SEDIMENT : CO
 CLASSES SEDIMENT DENSITY : 2650.0
 CLASSES SEDIMENT DIAMETERS = 0.000008
 CLASSES SETTLING VELOCITIES : -9
 NUMBER OF LAYERS FOR INITIAL STRATIFICATION : 1
 LAYERS INITIAL THICKNESS : 0.D0
 LAYERS MASS TRANSFER : 0.D0
 LAYERS PARTHENIADES CONSTANT : 5.D-3
 LAYERS MUD CONCENTRATION : 900.D0
 LAYERS CRITICAL EROSION SHEAR STRESS OF THE MUD : 0.05
 CLASSES CRITICAL SHEAR STRESS FOR MUD DEPOSITION : 1000
 SKIN FRICTION CORRECTION : 0
/---------------------------------------------------------------------/
/ NUMERICAL OPTIONS
/---------------------------------------------------------------------/
 ADVECTION-DIFFUSION SCHEME WITH SETTLING VELOCITY : 1 / SET_DIF scheme
 SOLVER FOR DIFFUSION OF SUSPENSION = 1
```



(http://worldrivers.net/2020/03/31/sediment-transport/)

non-cohesive
cohesive

Cohesive suspended sediment transportation

Physical parameters: settling velocity

Gaia_Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/---------------------------------------------------------------------/
/ FILES
/---------------------------------------------------------------------/
GEOMETRY FILE                    = Bottom_50m.slf
BOUNDARY CONDITIONS FILE         = BOTTOM_BC.cli
RESULTS FILE                     = gai_Magat.slf
/---------------------------------------------------------------------/
/ OUTPUTS                                                             /
/---------------------------------------------------------------------/
 VARIABLES FOR GRAPHIC PRINTOUTS : 'U,V,H,S,R,B,E,TOB,KS'
/evolution du fond
 MASS-BALANCE : YES
/---------------------------------------------------------------------/
/  PHYSICAL OPTIONS
/---------------------------------------------------------------------/
 CLASSES TYPE OF SEDIMENT : CO
 CLASSES SEDIMENT DENSITY : 2650.0
 CLASSES SEDIMENT DIAMETERS = 0.000008
 CLASSES SETTLING VELOCITIES : -9
 NUMBER OF LAYERS FOR INITIAL STRATIFICATION : 1
 LAYERS INITIAL THICKNESS : 0.D0
 LAYERS MASS TRANSFER : 0.D0
 LAYERS PARTHENIADES CONSTANT : 5.D-3
 LAYERS MUD CONCENTRATION : 900.D0
 LAYERS CRITICAL EROSION SHEAR STRESS OF THE MUD : 0.05
 CLASSES CRITICAL SHEAR STRESS FOR MUD DEPOSITION : 1000
 SKIN FRICTION CORRECTION : 0
/---------------------------------------------------------------------/
/ NUMERICAL OPTIONS
/---------------------------------------------------------------------/
 ADVECTION-DIFFUSION SCHEME WITH SETTLING VELOCITY : 1 / SET_DIF scheme
 SOLVER FOR DIFFUSION OF SUSPENSION = 1
```

$$w_s = \begin{cases} \dfrac{(s-1)gd_{50}^2}{18\nu}, & \text{if } d_{50} \le 10^{-4} \\ \dfrac{10\nu}{d_{50}}\left(\sqrt{1+0.01\dfrac{(s-1)gd_{50}^3}{\nu^2}}-1\right), & \text{if } 10^{-4} \le d_{50} \le 10^{-3} \\ 1.1\sqrt{(s-1)gd_{50}}, & \text{otherwise} \end{cases}$$

with $s = \rho_s/\rho_0$ is the relative density and g is the acceleration of the gravity.

Rubey:

$$w_s = \frac{[1.636(s-1)d_{50}^3 + 9\nu^2]^{0.5} - 3\nu}{500d}$$

```
!                 **********************
                  SUBROUTINE SETTLING_VEL
!                 **********************
!***********************************************************************
! GAIA
!***********************************************************************
!
!>@brief  Compute the settling velocities according to the Stokes,
!!     Zanke and Van Rijn formulation, in case of non cohesive
!!     sediments. Sets the default value, in case of cohesive
!!     sediments.
!!
!
!!-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
!
      USE DECLARATIONS_GAIA
      IMPLICIT NONE
!
!!-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      INTEGER          :: ICLA
      DOUBLE PRECISION   :: DENS
!
!
!     SETTLING VELOCITY
!
      DO ICLA = 1, NSICLA
        IF(XWC0(ICLA).LT.-3) THEN
!         SETTLING VELOCITY IS NOT GIVEN IN THE PARAMETER FILE AND INITIALISED
HERE
!         IF T3D: SETTLING VELOCITY IS POTENTIALY MODIFIED IN 3D AND THEN GIVEN
TO GAIA
!     IF T2D: ?
          DENS = (XMVS0(ICLA) - XMVE) / XMVE
          IF (DCLA(ICLA).LT.1.D-4) THEN
            XWC0(ICLA) = DENS * DCLA(ICLA) *
     &                 DCLA(ICLA) * GRAV / ( 18.D0 * VCE )
          ELSEIF (DCLA(ICLA).LT.1D-3) THEN
            XWC0(ICLA) = 10.D0 * VCE / DCLA(ICLA) *
     &        (SQRT( 1.D0 + 0.01D0* DENS * GRAV *
     &         DCLA(ICLA)**3.D0 / (VCE*VCE) ) -1.D0 )
          ELSE
            XWC0(ICLA) = 1.1D0 * SQRT( DENS * GRAV * DCLA(ICLA) )
          ENDIF
        ELSEIF (XWC0(ICLA).EQ.-1) THEN
          DENS = (XMVS0(ICLA) - XMVE) / XMVE
          XWC0(ICLA) =(XMVE * (SQRT((1636/XMVE) * DENS *
     &                 DCLA(ICLA)**3.D0 + 9 * VCE * VCE) - 3 * VCE )) /
     &                 (500 * DCLA(ICLA))
        ENDIF
        XWC(ICLA)=XWC0(ICLA)
      ENDDO
!
      RETURN
      END
```

TRAINING WORKSHOP

"FLOW AND SEDIMENT TRANSPORT MODELING IN RIVER BASINS USING TELEMAC 2D AND 3D NUMERICAL CODES"

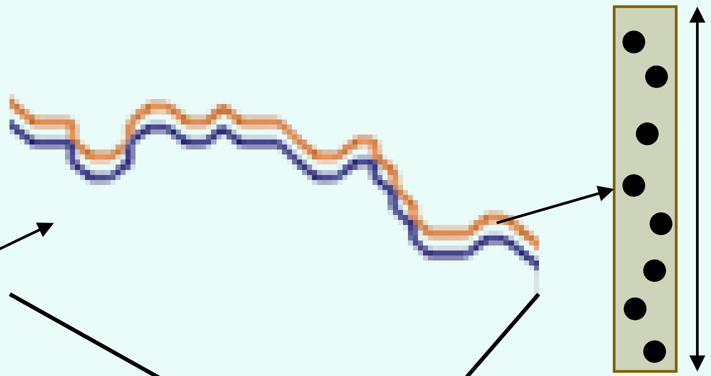
February 26-28, 2022

Physical parameters: Accumulated deposition layer

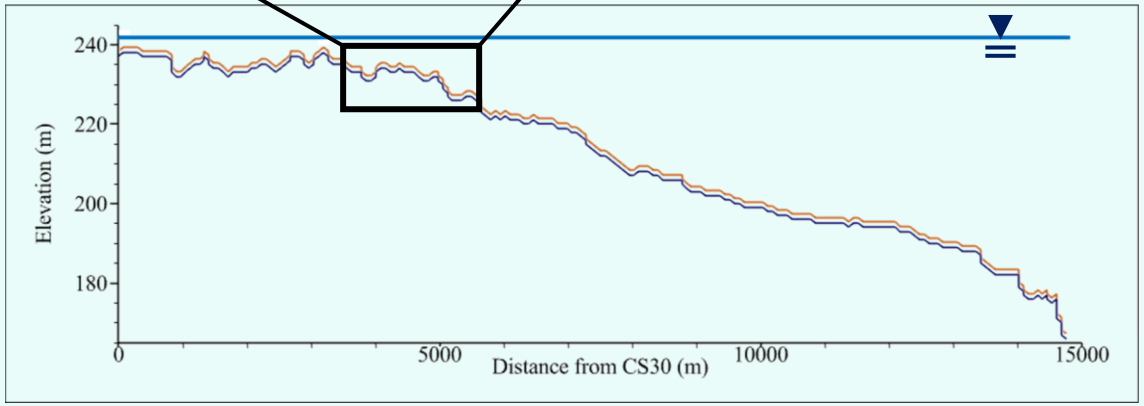
Gaia_Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/---------------------------------------------------------------------/
/ FILES
/---------------------------------------------------------------------/
GEOMETRY FILE                     = Bottom_50m.slf
BOUNDARY CONDITIONS FILE          = BOTTOM_BC.cli
RESULTS FILE                      = gai_Magat.slf
/---------------------------------------------------------------------/
/ OUTPUTS                                                             /
/---------------------------------------------------------------------/
 VARIABLES FOR GRAPHIC PRINTOUTS : 'U,V,H,S,R,B,E,TOB,KS'
/evolution du fond
 MASS-BALANCE : YES
/---------------------------------------------------------------------/
/  PHYSICAL OPTIONS
/---------------------------------------------------------------------/
 CLASSES TYPE OF SEDIMENT : CO
 CLASSES SEDIMENT DENSITY : 2650.0
 CLASSES SEDIMENT DIAMETERS = 0.000008
 CLASSES SETTLING VELOCITIES : -9
 NUMBER OF LAYERS FOR INITIAL STRATIFICATION : 1
 LAYERS INITIAL THICKNESS : 0.D0
 LAYERS MASS TRANSFER : 0.D0
 LAYERS PARTHENIADES CONSTANT : 5.D-3
 LAYERS MUD CONCENTRATION : 900.D0
 LAYERS CRITICAL EROSION SHEAR STRESS OF THE MUD : 0.05
 CLASSES CRITICAL SHEAR STRESS FOR MUD DEPOSITION : 1000
 SKIN FRICTION CORRECTION : 0
/---------------------------------------------------------------------/
/ NUMERICAL OPTIONS
/---------------------------------------------------------------------/
 ADVECTION-DIFFUSION SCHEME WITH SETTLING VELOCITY : 1 / SET_DIF scheme
 SOLVER FOR DIFFUSION OF SUSPENSION = 1
```



- **1 m depth**
- **Concentration= 150 g/l**
- **Grain size= 15 μm**



Physical parameters: Accumulated deposition layer

Gaia_Magat_2D.cas - 記事本

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