TRAINING WORKSHOP

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

February 26-28, 2022

2D hydrodynamics TELEMAC-2D

Steering Telemac-2D: parameters and data files

Chen Peng-An

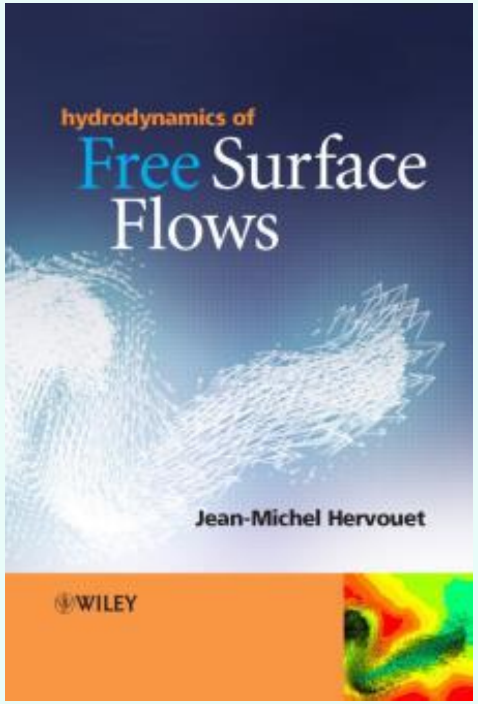
chen.an.83c@st.kyoto-u.ac.jp

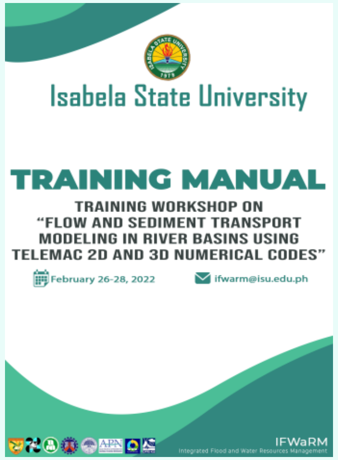
IWaRM

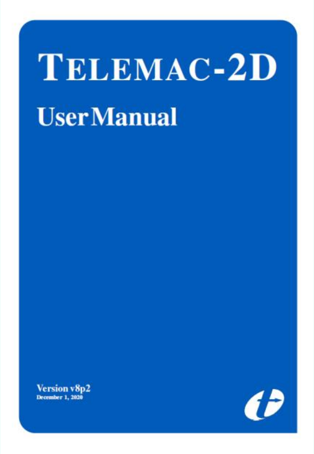
TRAINING WORKSHOP
"FLOW AND SEDIMENT TRANSPORT MODELING IN RIVER BASINS USING TELEMAC 2D AND 3D NUMERICAL CODES"
February 26-28, 2022

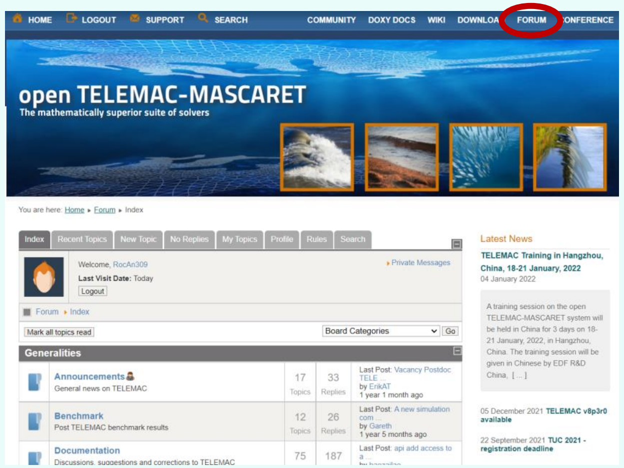
Sources of information

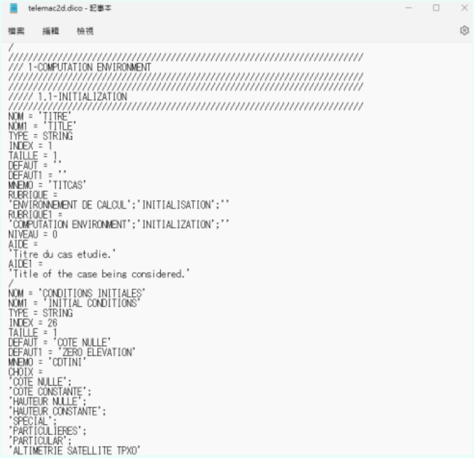
- User manual
- Reference manual
- Forum and Frequently Asked Questions
- Guide to programming in the Telemac system
- Release notes for every new version



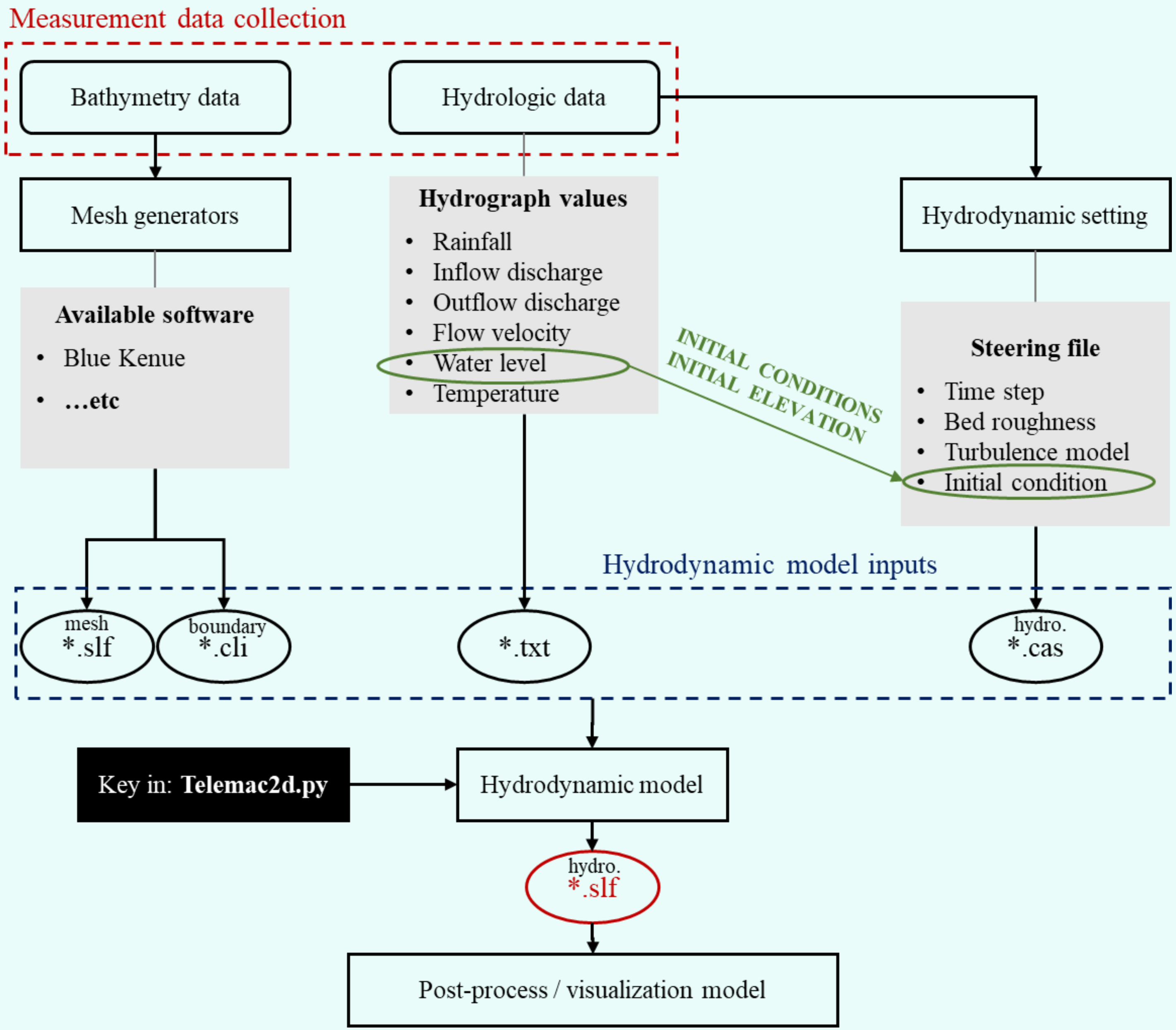








Structure of hydrodynamic



Warning !!

Experiment model
- Flume experiment
- Physical model

Numerical model
- SRH-2D
- FLOW-3D
- ANSYS-CFX
- TELEMAC

Machine learning
- ANN
- DNN

Data files

The mandatory input files:

- **Steering file:** contains all the computational options (physical, numerical aspect, etc.).
- **Geometry file:** contains the mesh information, and a description of the type of boundaries.
- **Liquid boundaries file:** provides the time-varying imposed values at liquid boundaries.

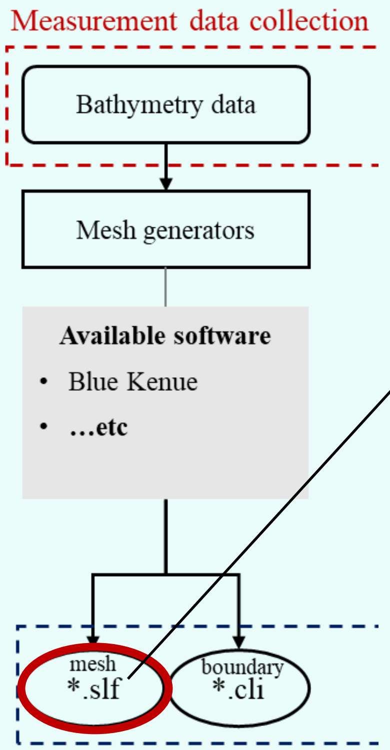
The optional input files:

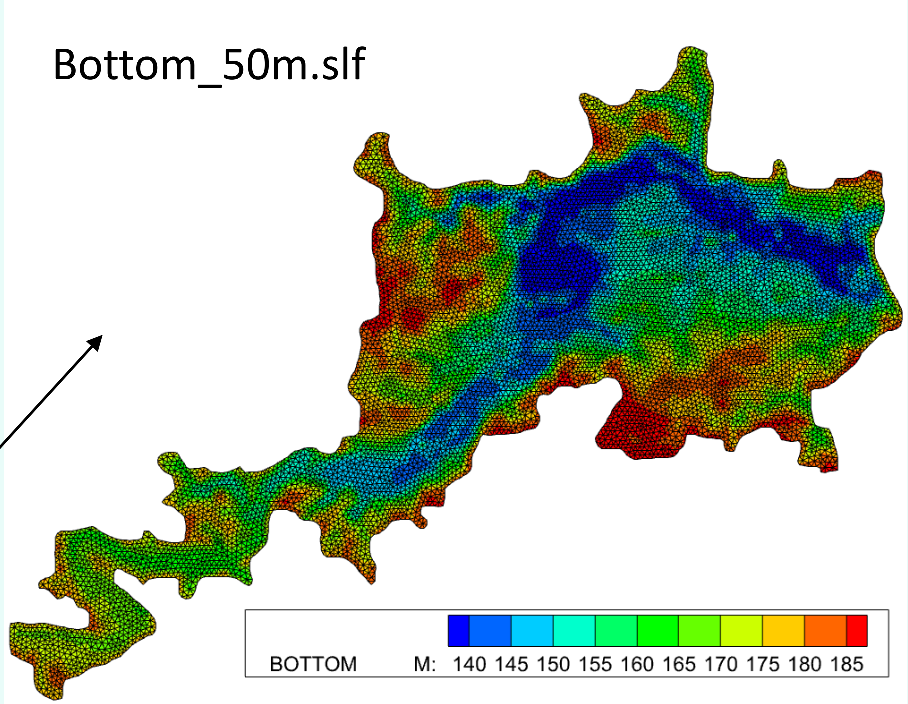
- **Fortran file:** the user could modify the existing subroutines and announce the additional equations for the computation.
- **Previous computation file:** provides the initial conditions from the previous results for the restart calculation.
- **Stage-discharge curves file:** gives an appropriate discharge-elevation law for determining the prescribed elevation.
- **Sources file:** enables the user to set the time-dependent conditions, including discharge and tracers concentration, for the sources.

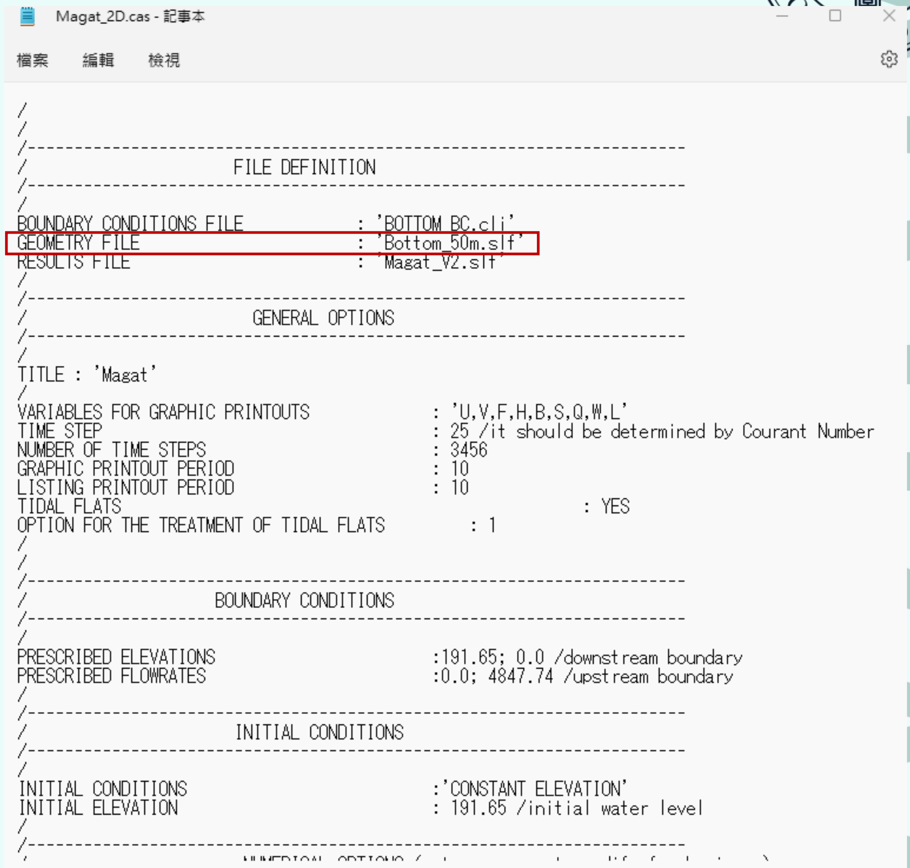
The output files:

- **3D result file:** contains the results associated with three-dimensional simulation.
- **2D result file:** contains the results associated with two-dimensional simulation.

Input file: GEOMETRY FILE



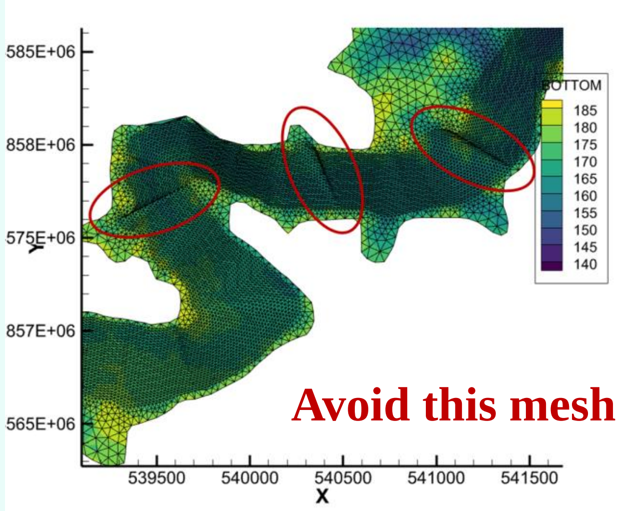




Magat_2D.cas - 記事本

檔案 編輯 檢視

```
/
/
/---------------------------------------------------------------------
/                      FILE DEFINITION
/---------------------------------------------------------------------
/
BOUNDARY CONDITIONS FILE          : 'BOTTOM_BC.cli'
GEOMETRY FILE                     : 'Bottom_50m.slf'
RESULTS FILE                      : 'Magat_V2.slf'
/
/---------------------------------------------------------------------
/                      GENERAL OPTIONS
/---------------------------------------------------------------------
/
TITLE : 'Magat'
/
VARIABLES FOR GRAPHIC PRINTOUTS            : 'U,V,F,H,B,S,Q,W,L'
TIME STEP                                  : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                       : 3456
GRAPHIC PRINTOUT PERIOD                    : 10
LISTING PRINTOUT PERIOD                    : 10
TIDAL FLATS                                          : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS         : 1
/
/
/---------------------------------------------------------------------
/                      BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                      :191.65; 0.0 /downstream boundary
PRESCRIBED FLOWRATES                       :0.0; 4847.74 /upstream boundary
/
/---------------------------------------------------------------------
/                      INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                         :'CONSTANT ELEVATION'
INITIAL ELEVATION                          : 191.65 /initial water level
/
/---------------------------------------------------------------------
```



Input file: BOUNDARY CONDITION FILE

Measurement data collection

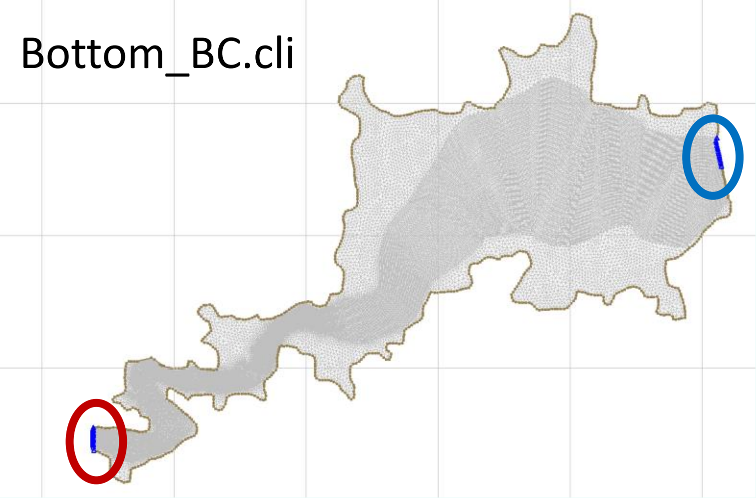
Bathymetry data

Mesh generators

Available software
- Blue Kenue
- **…etc**

mesh *.slf

boundary *.cli



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  #
```

Boundary condition: constant

```
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'
/
```

4	5	5	0.000000	0.000000	0.000000	0.000000	5	0.000000	0.000000	0.000000	14	1
2	2	2	0.000000	0.000000	0.000000	0.000000	2	0.000000	0.000000	0.000000	10	2
2	2	2	0.000000	0.000000	0.000000	0.000000	2	0.000000	0.000000	0.000000	124	3

Depth (LIHBOR)

Velocity (LIUBOR and LIVBOR)

Tracer(s) (LITBOR)

Global number of point

Boundary number of point. May be modified to any value, saved as boundary_colour in Fortran

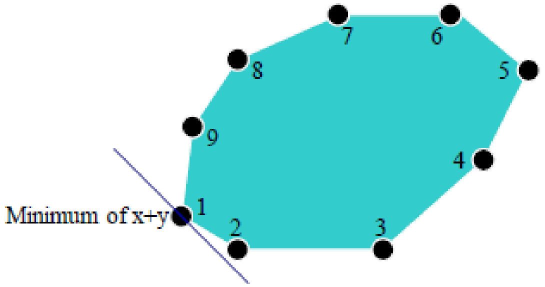
Types of boundary conditions:

- 2 = wall with free slip
- 4 = free boundary
- 6 = prescribed velocity (for U and V)

0 = wall with no slip condition
5 = prescribed value (discharge if U and V)

Practical combinations:

– Wall with free slip	: 2 2 2	...	2
– Wall with no slip condition	: 2 0 0	...	2
– Prescribed discharge, free depth	: 4 5 5	...	5
– Prescribed depth, free velocity	: 5 4 4	...	4
– Prescribed velocity, free depth	: 4 6 6	...	5
– Prescribed velocity and depth	: 5 6 6	...	5



Prescribed values of boundary conditions, wall friction, flux law for tracers
Taken into account if boundary type = 5 or 6

Here only taken as profile (a discharge is asked)

				UBOR	VBOR			TBOR				
4	5	5	0.000000	0.500000	0.000000	0.000000	5	6.000000	0.000000	0.000000	14	1
4	5	5	0.000000	1.000000	0.000000	0.000000	5	0.000000	0.000000	0.000000	14	1
4	5	5	0.000000	1.000000	0.000000	0.000000	5	0.000000	0.000000	0.000000	14	1
4	5	5	0.000000	0.500000	0.000000	0.000000	5	0.000000	0.000000	0.000000	14	1
2	2	2	0.000000	0.000000	0.000000	0.000000	2	0.000000	0.000000	0.000000	10	2
2	2	2	0.000000	0.000000	0.000000	0.000000	2	0.000000	0.000000	0.000000	15	2
5	6	6	3.000000	1.000000	0.000000	0.000000	2	0.000000	0.000000	0.000000	124	3
			HBOR	UBOR	VBOR	AUBOR			ATBOR	BTBOR		

Here really taken

Friction coefficient of wall (depends on law chosen)

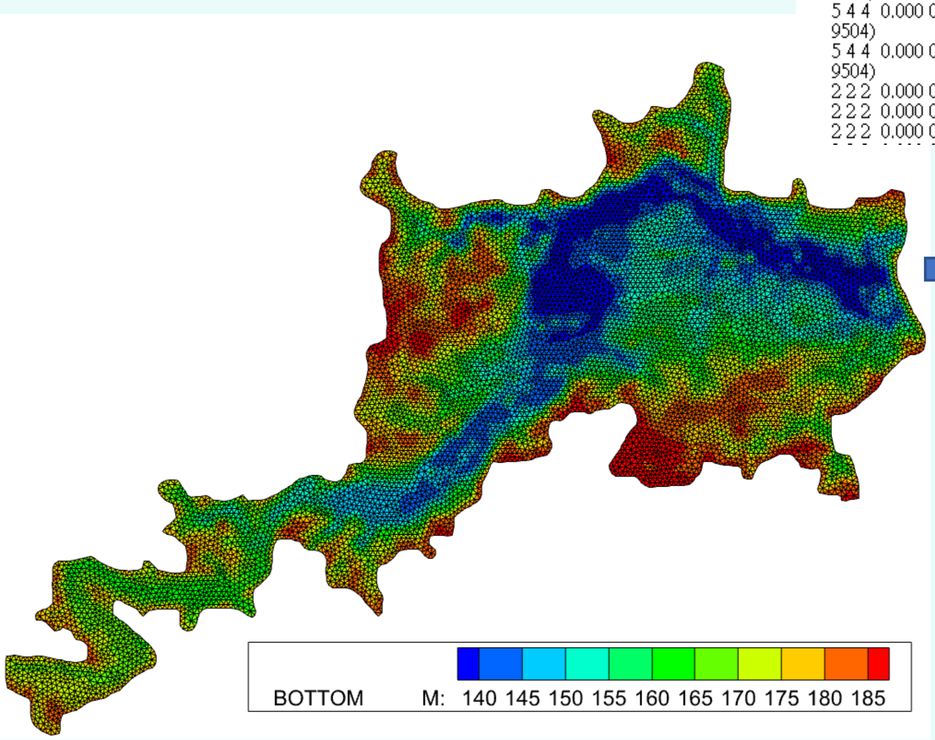
Boundary condition: constant

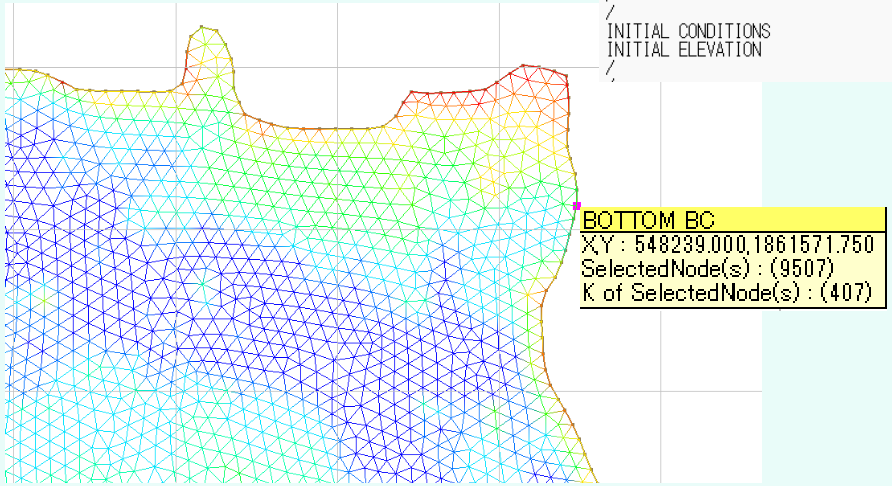
```
2 2 2  0.000 0.000 0.000 0.000  2  0.000 0.000 0.000     9439    398  #
2 2 2  0.000 0.000 0.000 0.000  2  0.000 0.000 0.000     9435    399  #
5 4 4  0.000 0.000 0.000 0.000  2  0.000 0.000 0.000     9436    400  # newBoundary (9436 -
9504)
5 4 4  0.000 0.000 0.000 0.000  2  0.000 0.000 0.000     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  #
```

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'
/
/---------------------------------------------------------------------
/                        GENERAL OPTIONS
/---------------------------------------------------------------------
/
TITLE : 'Magat'
/
VARIABLES FOR GRAPHIC PRINTOUTS              : 'U,V,F,H,B,S,Q,W,L'
TIME STEP                                    : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                         : 3456
GRAPHIC PRINTOUT PERIOD                      : 10
LISTING PRINTOUT PERIOD                      : 20
TIDAL FLATS                                           : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS         : 1
/
/
/---------------------------------------------------------------------
/                        BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                        :191.65; 0.0 /downstream boundary
PRESCRIBED FLOWRATES                         :0.0; 4847.74 /upstream boundary
/
/---------------------------------------------------------------------
/                        INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                           :'CONSTANT ELEVATION'
INITIAL ELEVATION                            : 191.65 /initial water level
/
```





Boundary condition: hydrograph

Constant B.C.

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'
/
/---------------------------------------------------------------------
/                         GENERAL OPTIONS
/---------------------------------------------------------------------
/
TITLE : 'Magat'
/
VARIABLES FOR GRAPHIC PRINTOUTS            : 'U,V,F,H,B,S,Q,W,L'
TIME STEP                                  : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                       : 3456
GRAPHIC PRINTOUT PERIOD                    : 10
LISTING PRINTOUT PERIOD                    : 20
TIDAL FLATS                                          : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS         : 1
/
/
/---------------------------------------------------------------------
/                         BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                      :191.65; 0.0 /downstream boundary
PRESCRIBED FLOWRATES                       :0.0; 4847.74 /upstream boundary
/
/---------------------------------------------------------------------
/                         INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                         :'CONSTANT ELEVATION'
INITIAL ELEVATION                          : 191.65 /initial water level
/
```

Variant B.C.

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
/
```

Magat_Boundary.txt - 記事本

檔案 編輯 檢視

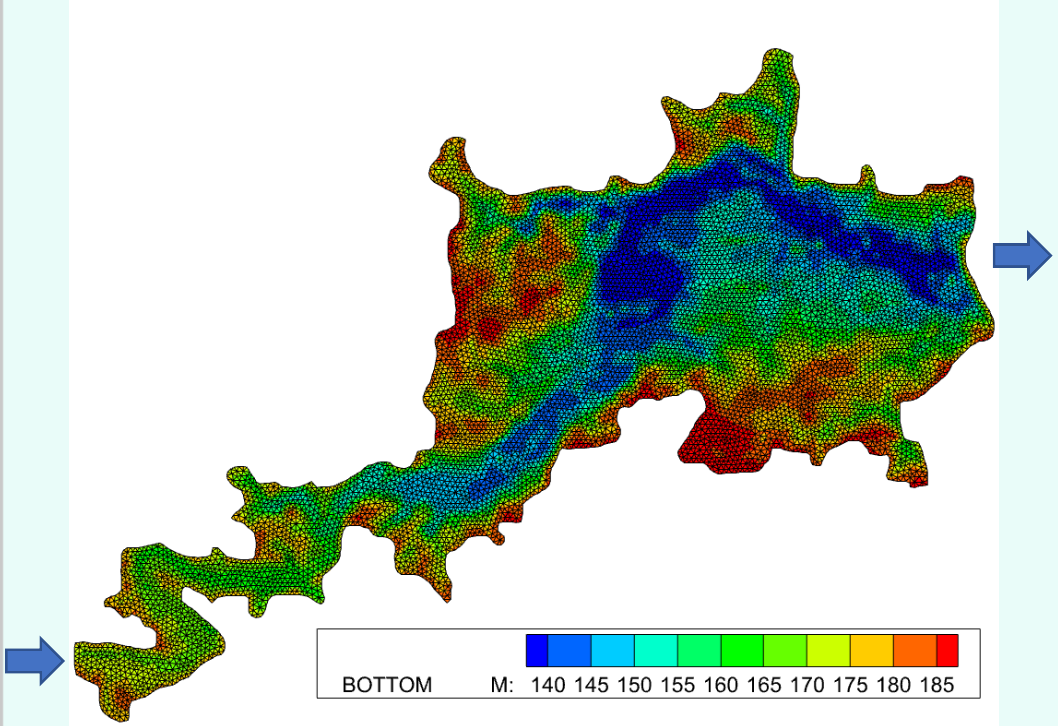
#

T	SL(1)	Q(2)	TR(1,1)		TR(2,1)
s	m	m3/s	kg/m3	kg/m3	
0	189.02	301	0	1.26209784	
3600	189.04	408	0	1.700375418	
7200	189.07	453	0	1.88397049	
10800	189.11	535	0	2.2176069	
14400	189.16	675	0	2.784938155	
18000	189.34	1751	0	7.087911415	
21600	189.53	1823	0	7.373416954	
25200	189.74	2009	0	8.10995036	
28800	189.95	2108	0	8.501411778	
32400	190.17	2184	0	8.80167725	
36000	190.35	1896	0	7.662657678	
39600	190.51	1784	0	7.218796697	
43200	190.65	1517	0	6.158340916	

TRAINING WORKSHOP
"FLOW AND SEDIMENT TRANSPORT MODELING IN RIVER BASINS USING TELEMAC 2D AND 3D NUMERICAL CODES"
February 26-28, 2022

Initial condition

```
/
VARIABLES FOR GRAPHIC PRINTOUTS          : 'U,V,F,H,B,S,Q,W,L'
TIME STEP                                : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                     : 3456
GRAPHIC PRINTOUT PERIOD                  : 10
LISTING PRINTOUT PERIOD                  : 20
TIDAL FLATS                                          : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS     : 1
/
/
/---------------------------------------------------------------------
/                      BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                    :191.65; 0.0 /downstream boundary
PRESCRIBED FLOWRATES                     :0.0; 4847.74 /upstream boundary
/
/---------------------------------------------------------------------
/                        INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                       :'CONSTANT ELEVATION'
INITIAL ELEVATION                        : 191.65 /initial water level
/
```



Case of a first run:

- Keyword for the depth INITIAL *CONDITIONS*
  - *ZERO ELEVATION,*
  - *CONSTANT ELEVATION combined with INITIAL ELEVATION,*
  - *ZERO DEPTH,*
  - *CONSTANT DEPTH + INITIAL DEPTH*
  - *PARTICULAR , initial* depth to be programmed in CONDIN
- Think of dry zones on liquid boundaries or weirs (possible but problem well posed ?).
- Free surface and velocity can be initialised by FUDAA-PREPRO and Blue Kenue
- No keyword for the velocity: it is set to zero in CONDIN but may be initialised

Computation continued (restart):

- *COMPUTATION CONTINUED = YES*
- *PREVIOUS COMPUTATION FILE*
- *PREVIOUS COMPUTATION FILE FORMAT*
- *INITIAL TIME SET TO ZERO (YES/NO)*

Library

C:\opentelemac-mascaret\v8p3r1\sources\telemac2d

telemac2d

新增 排序 檢視 ...

本機 > Windows (C:) > opentelemac-mascaret > v8p3r1 > sources > telemac2d

Folders: telemac2 / telemac3 / tomawa / waqtel / notebook / optionals / scripts / sources / api / artemis / gaia / khione / mascare / nestor / postel3d / sisyphe / stbtel / telemac2

名稱	修改日期	類型	大小
telemac2d.cmdf	2022/1/31 下午 09:59	CMDF 檔案	22 KB
telemac2d.dico.dep	2022/1/31 下午 09:59	DEP 檔案	7 KB
telemac2d.dico	2022/1/31 下午 09:59	DICO 檔案	265 KB
ad_get_telemac2d.F	2022/1/31 下午 09:59	F 檔案	3 KB
ad_set_telemac2d.F	2022/1/31 下午 09:59	F 檔案	3 KB
ad_telemac2d_checkpoint.f	2022/1/31 下午 09:59	F 檔案	23 KB
akepin.f	2022/1/31 下午 09:59	F 檔案	4 KB
aksain.f	2022/1/31 下午 09:59	F 檔案	2 KB
assignstr.f	2022/1/31 下午 09:59	F 檔案	3 KB
astro.f	2022/1/31 下午 09:59	F 檔案	9 KB
bilan.f	2022/1/31 下午 09:59	F 檔案	10 KB
bilant1.f	2022/1/31 下午 09:59	F 檔案	11 KB
bord.f	2022/1/31 下午 09:59	F 檔案	14 KB
bord_tidal_bc.f	2022/1/31 下午 09:59	F 檔案	16 KB
bord_tide.f	2022/1/31 下午 09:59	F 檔案	23 KB
bord_tide_misc.f	2022/1/31 下午 09:59	F 檔案	24 KB
breach.f	2022/1/31 下午 09:59	F 檔案	19 KB
buse.f	2022/1/31 下午 09:59	F 檔案	25 KB

telemac2d.dico - 記事本

檔案 編輯 檢視

```
in the ¥telkey{RESULTS FILE}.'
/
NOM = 'VARIABLES POUR LES SORTIES GRAPHIQUES'
NOM1 = 'VARIABLES FOR GRAPHIC PRINTOUTS'
TYPE = STRING
INDEX = 2
TAILLE = 1
DEFAUT = 'U;V;H;B'
DEFAUT1 = 'U;V;H;B'
MNEMO = 'VARDES'
CHOIX =
'U="vitesse suivant l axe des x (m/s)"';
'V="vitesse suivant l axe des y (m/s)"';
'C="celerite des ondes (m/s)"';
'H="hauteur d eau (m)"';
'S="cote de surface libre (m)"';
'B="cote du fond (m)"';
'F="nombre de Froude"';
'Q="debit scalaire du fluide (m2/s)"';
'Ti="traceur i etc."';
'T*="Tous les traceurs de 1 a 9."';
'T1*="Tous les traceurs 10 a 19."';
'K="energie turbulente du modele k-epsilon (J/kg)"';
'E="dissipation de l energie turbulente (W/kg)"';
'D="viscosite turbulente (m2/s)"';
'I="debit suivant l axe des x (m2/s)"';
'J="debit suivant l axe des y (m2/s)"';
'M="vitesse scalaire (m/s)"';
'X="vent suivant l axe des x (m/s)"';
'Y="vent suivant l axe des y (m/s)"';
'P="pression atmospherique (Pa)"';
'W="coefficient de frottement sur le fond"';
'A="derive en x (m)"';
'G="derive en y (m)"';
'L="nombre de Courant"';
'N="variable supplementaire N"';
'O="variable supplementaire O"';
'R="variable supplementaire R"';
'Z="variable supplementaire Z"';
'MAXZ="cote maximum (m)"';
'TMXZ="temps de la cote maximum (s)"';
'MAXV="vitesse maximum (m/s)"';
'TMXV="temps de la vitesse maximum (s)"';
'US="vitesse de frottement (m/s)"';
'G1="gradient 1, etc."';
'TAU_S="TAU_S"';
'1/R="1/R (1/m)"';
'OMEGA="OMEGA"';
'WDIST="distance au mur le plus proche (m)"';
'ZRL="niveau de reference pour Nestor (m)"'
```

```
CHOIX1 =
'U="velocity along x axis (m/s)"';
'V="velocity along y axis (m/s)"';
'C="wave celerity (m/s)"';
'H="water depth (m)"';
'S="free surface elevation (m)"';
'B="bottom elevation (m)"';
'F="Froude number"';
'Q="scalar flowrate of fluid (m2/s)"';
'Ti="tracer i etc."';
'T*="All the tracers 1 to 9."';
'T1*="All the tracers 10 to 19."';
'K="turbulent kinetic energy in k-epsilon model (J/kg)"';
'E="dissipation of turbulent energy (W/kg)"';
'D="turbulent viscosity (m2/s)"';
'I="flowrate along x axis (m2/s)"';
'J="flowrate along y axis (m2/s)"';
'M="scalar velocity (m/s)"';
'X="wind along x axis (m/s)"';
'Y="wind along y axis (m/s)"';
'P="air pressure (Pa)"';
'W="friction coefficient"';
'A="drift along x (m)"';
'G="drift along y (m)"';
'L="Courant number"';
'N="supplementary variable N"';
'O="supplementary variable O"';
'R="supplementary variable R"';
'Z="supplementary variable Z"';
'MAXZ="maximum elevation (m)"';
'TMXZ="time of maximum elevation (s)"';
'MAXV="maximum velocity (m/s)"';
'TMXV="time of maximum velocity (s)"';
'US="friction velocity (m/s)"';
'G1="gradient 1, etc."';
'TAU_S="TAU_S"';
'1/R="1/R (1/m)"';
'OMEGA="OMEGA"';
'WDIST="distance to the closest wall (m)"';
'ZRL="reference level for Nestor (m)"'
APPARENCE =
'DYNLIST'
RUBRIQUE =
'ENVIRONNEMENT DE CALCUL';'FICHIERS DE SORTIE';'FICHIERS RESULTATS'
RUBRIQUE1 =
'COMPUTATION ENVIRONMENT';'OUTPUT FILES';'RESULTS FILES'
```

Output 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'
/
/---------------------------------------------------------------------
/                        GENERAL OPTIONS
/---------------------------------------------------------------------
/
TITLE : 'Magat'
/
VARIABLES FOR GRAPHIC PRINTOUTS                 : 'U,V,F,H,B,S,Q,W,L'
TIME STEP                                       : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                            : 3456
GRAPHIC PRINTOUT PERIOD                         : 10
LISTING PRINTOUT PERIOD                         : 20
TIDAL FLATS                                                   : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS          : 1
/
/
/---------------------------------------------------------------------
/                     BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                           :191.65; 0.0 /downstream boundary
PRESCRIBED FLOWRATES                            :0.0; 4847.74 /upstream boundary
/
/---------------------------------------------------------------------
/                       INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                              :'CONSTANT ELEVATION'
INITIAL ELEVATION                               : 191.65 /initial water level
/
```

v8p3r1.exe

```
    RELATIVE ERROR IN VOLUME AT T =       0.8500E+05 S :     0.5106554E-14
PRERES: MAXIMUM COURANT NUMBER:     0.8164218
PRERES: MAXIMUM COURANT NUMBER:     0.8164247

================================================================================
ITERATION     3420    TIME: 23 H 45 MIN   0.0000 S   (    85500.0000 S)
--------------------------------------------------------------------------------
                          ADVECTION STEP
--------------------------------------------------------------------------------
                     DIFFUSION-PROPAGATION STEP
CVTRVF_NERD_2 (SCHEME 13 OR 14):    1 ITERATIONS
GRACJG (BIEF) :         17 ITERATIONS, ABSOLUTE PRECISION:    0.9611798E-04
POSITIVE DEPTHS OBTAINED IN      1 ITERATIONS
--------------------------------------------------------------------------------
                          K-EPSILON MODEL
GRACJG (BIEF) :          3 ITERATIONS, RELATIVE PRECISION:    0.8298886E-09
GRACJG (BIEF) :          2 ITERATIONS, ABSOLUTE PRECISION:    0.3474233E-10
--------------------------------------------------------------------------------
                       BALANCE OF WATER VOLUME
    VOLUME IN THE DOMAIN :    0.6097747E+09 M3
    FLUX BOUNDARY    1:     -4847.988      M3/S  ( >0 : ENTERING  <0 : EXITING )
    FLUX BOUNDARY    2:      4847.740      M3/S  ( >0 : ENTERING  <0 : EXITING )
    RELATIVE ERROR IN VOLUME AT T =       0.8550E+05 S :     0.2531828E-14
PRERES: MAXIMUM COURANT NUMBER:     0.8164372
PRERES: MAXIMUM COURANT NUMBER:     0.8164434

================================================================================
ITERATION     3440    TIME: 23 H 53 MIN  20.0000 S   (    86000.0000 S)
--------------------------------------------------------------------------------
                          ADVECTION STEP
--------------------------------------------------------------------------------
                     DIFFUSION-PROPAGATION STEP
CVTRVF_NERD_2 (SCHEME 13 OR 14):    1 ITERATIONS
GRACJG (BIEF) :         17 ITERATIONS, ABSOLUTE PRECISION:    0.9333245E-04
POSITIVE DEPTHS OBTAINED IN      1 ITERATIONS
--------------------------------------------------------------------------------
                          K-EPSILON MODEL
GRACJG (BIEF) :          3 ITERATIONS, RELATIVE PRECISION:    0.8228000E-09
GRACJG (BIEF) :          2 ITERATIONS, ABSOLUTE PRECISION:    0.3434575E-10
--------------------------------------------------------------------------------
                       BALANCE OF WATER VOLUME
    VOLUME IN THE DOMAIN :    0.6097746E+09 M3
    FLUX BOUNDARY    1:     -4847.853      M3/S  ( >0 : ENTERING  <0 : EXITING )
    FLUX BOUNDARY    2:      4847.740      M3/S  ( >0 : ENTERING  <0 : EXITING )
    RELATIVE ERROR IN VOLUME AT T =       0.8600E+05 S :     0.1628478E-15
PRERES: MAXIMUM COURANT NUMBER:     0.8164556
PRERES: MAXIMUM COURANT NUMBER:     0.8164706
```

Physical parameters: Time step

Magat_2D.cas - 記事本

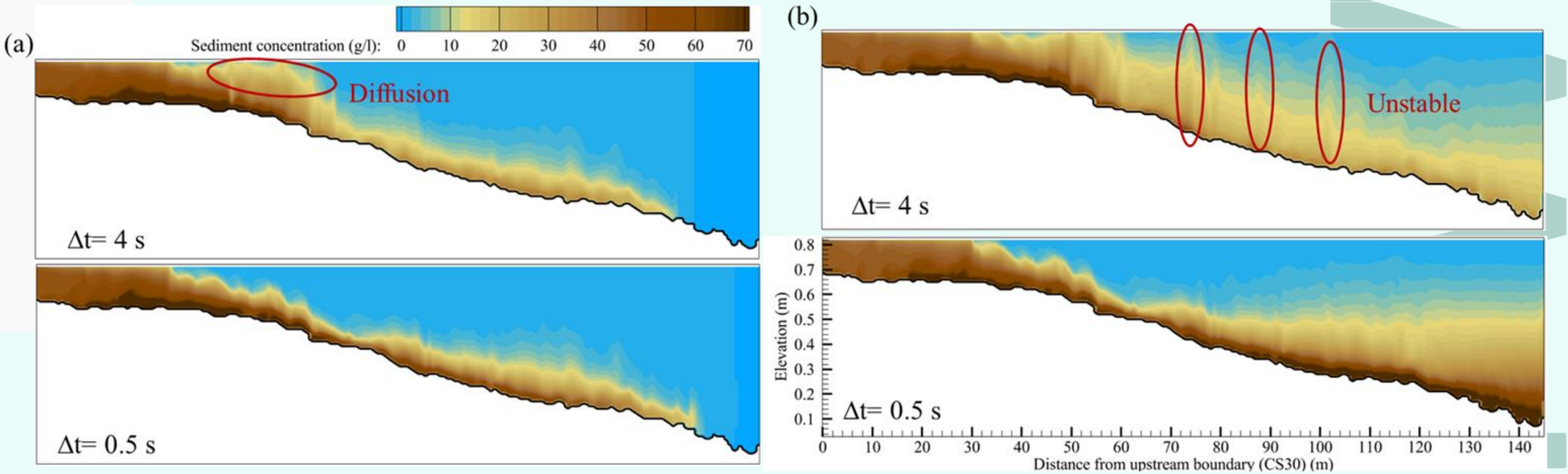
檔案 編輯 檢視

```
/
/
/---------------------------------------------------------------------
/                        FILE DEFINITION
/---------------------------------------------------------------------
/
BOUNDARY CONDITIONS FILE            : 'BOTTOM_BC.cli'
GEOMETRY FILE                       : 'Bottom_50m.slf'
RESULTS FILE                        : 'Magat_V2.slf'
/
/---------------------------------------------------------------------
/                        GENERAL OPTIONS
/---------------------------------------------------------------------
/
TITLE : 'Magat'
/
VARIABLES FOR GRAPHIC PRINTOUTS              : 'U,V,F,H,B,S,Q,W,L'
TIME STEP                                    : 25 /it should be determined by Courant Number
NUMBER OF TIME STEPS                         : 3456
GRAPHIC PRINTOUT PERIOD                      : 10
LISTING PRINTOUT PERIOD                      : 20
TIDAL FLATS                                                : YES
OPTION FOR THE TREATMENT OF TIDAL FLATS          : 1
/
/
/---------------------------------------------------------------------
/                        BOUNDARY CONDITIONS
/---------------------------------------------------------------------
/
PRESCRIBED ELEVATIONS                        :191.65; 0.0 /downstream boundary
PRESCRIBED FLOWRATES                         :0.0; 4847.74 /upstream boundary
/
/---------------------------------------------------------------------
/                        INITIAL CONDITIONS
/---------------------------------------------------------------------
/
INITIAL CONDITIONS                           :'CONSTANT ELEVATION'
INITIAL ELEVATION                            : 191.65 /initial water level
/
```

Related to Courant number

$$u\frac{\Delta t}{\Delta x}$$

To stay in stability:
- In general: smaller than 1
- Telemac: smaller than 10



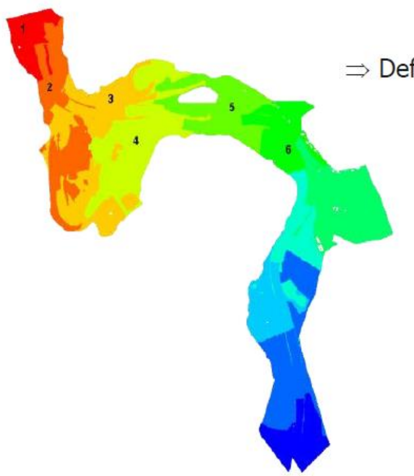
Physical parameters: friction

keyword *LAW OF BOTTOM FRICTION*

- 0 : no friction.
- 1 : Haaland law.
- 2 : Chézy law.
- 3 : Strickler law.
- 4 : Manning law.
- 5 : Nikuradse law.
- 6 : Log law of the wall (only for solid boundaries)
- 7 : Colebrooke_White law.

Value given by *FRICTION COEFFICIENT* *(dimension depends on law...)*

Several zones with different coefficients and friction laws



⇒ Definition by zones or categories

- The Nikuradse law, the velocity profile within the logarithmic layer is considered. It means that the bed roughness could be changeable according to water depth.

- Chezy:

$$\begin{cases} F_x = -\dfrac{u}{\cos\alpha}\dfrac{g}{hC^2}\sqrt{u^2+v^2} \\ F_y = -\dfrac{v}{\cos\alpha}\dfrac{g}{hC^2}\sqrt{u^2+v^2} \end{cases} ; C = Kh^{1/6}$$

- Manning:

$$\begin{cases} F_x = -\dfrac{u}{\cos\alpha}\dfrac{gm^2}{h^{4/3}}\sqrt{u^2+v^2} \\ F_y = -\dfrac{v}{\cos\alpha}\dfrac{gm^2}{h^{4/3}}\sqrt{u^2+v^2} \end{cases} ; m = \dfrac{1}{K}$$

- Nikuradse:

$$\begin{cases} F_x = -\dfrac{u}{\cos\alpha}\dfrac{g}{hC^2}\sqrt{u^2+v^2} \\ F_y = -\dfrac{v}{\cos\alpha}\dfrac{g}{hC^2}\sqrt{u^2+v^2} \end{cases} ; C = 7.83\ln\left(12\dfrac{h}{Ks}\right)$$

❖ Ramette formula: $k = 8.2\sqrt{g}/k_s^{1/6}$

where R_h is the hydraulic radius, which can be equal to D under the condition of the very large canals; k is the Strickler coefficient, and k_s means the asperity size.

Physical parameters: turbulence

- Cst spend the least computational time
- k-ω and *k-ε* yield the most accurate results.

```
NOM = 'MODELE DE TURBULENCE'
NOM1 = 'TURBULENCE MODEL'
TYPE = INTEGER
INDEX = 7
TAILLE = 1
DEFAUT = 1
DEFAUT1 = 1
MNEMO = 'ITURB'
CHOIX =
'1="VISCOSITE CONSTANTE"';
'2="ELDER"';
'3="MODELE K-EPSILON"';
'4="SMAGORINSKI"';
'5="LONGUEUR DE MELANGE"';
'6="SPALART-ALLMARAS"'
CHOIX1 =
'1="CONSTANT VISCOSITY"';
'2="ELDER"';
'3="K-EPSILON MODEL"';
'4="SMAGORINSKI"';
'5="MIXING LENGTH"';
'6="SPALART-ALLMARAS"'
```

Turbulence schemes		Cautions
Horizontal	Vertical	
Constant viscosity		✓ In Cst, the global (molecular and turbulent) viscosity should be provided by the user (In this study: 10^{-6} m^2/s). ✓ In other turbulence models, molecular viscosity is prescribed by users, and turbulent viscosity is calculated by models.
Smagorinsky		✓ If Smag is used for the vertical turbulence model, the horizontal aspect is automatically set as Smag. ✓ On the contrary, Smag in the horizontal aspect can be used with every possible turbulence for the vertical aspects.
k-ε		✓ It is impossible to mix *k-ε* and *k-ω* in horizontal and vertical aspects.
k-ω		
Mixing-length model		✓ The ML is only available for vertical diffusivity of velocities calculation.

- In theory, the *κ-ω* is suitable to simulate the flow field in close to construction situation.
- Compare to *κ-ε*, the simulation from cross-section profile, especially bottom reach and outlets are better.

Sources and sinks

Sources and sinks

A series of keywords:

- *ABSCISSAE OF SOURCES* nearest point in the mesh will be taken!
- *ORDINATES OF SOURCES*
- *WATER DISCHARGE OF SOURCES*
- *VALUES OF THE TRACERS AT THE SOURCES*
- *VELOCITIES OF THE SOURCES ALONG X*
- *VELOCITIES OF THE SOURCES ALONG Y*

If variable in time:

- Last four programmed in DEBSCE, TRSCE, VUSCE, VVSCE

For variations in time see also in user manual *SOURCES FILE*

```
/------------------------------------------------------------------------
/  SOURCES/SINKS CONDITIONS
/------------------------------------------------------
/
 SOURCES FILE                                 : 'src_shihmen.txt'
/
// ST; SCI; PPI; PRO
 ABSCISSAE OF SOURCES             :   -274686.0419;-273567.4975;
 -273897.4715; -273878.8334
 ORDINATES OF SOURCES             :    2745181.1915;2744863.0935;
 2745009.6477; 2745005.1908
 ELEVATIONS OF SOURCES            :     220;192.5; 173; 169.5
 WATER DISCHARGE OF SOURCES  :  -300; -13.5; -357.66; -33.36
/ VELOCITIES OF THE SOURCES ALONG X  :  1.43; 2.71; 1.89; 3.93
/ VELOCITIES OF THE SOURCES ALONG Y  :  2.47; 0.48; 10.74; 22.3
/--> SEDIMENTS
 VALUE OF THE TRACERS AT THE SOURCES = 0.0; 0.0; 0.0; 0.0
/
```

src_shihmen.txt - 記事本

檔案 編輯 檢視

```
T      Q(1)   Q(2)  Q(3)  Q(4)
s      m3/s   m3/s  m3/s  m3/s
0      -204.66      -13.5 -50.67      -33.36
3600   -204.91      -13.5 -49.61      -33.36
7200   -205.23      -13.5 -48.56      -33.36
10800  -205.58      -13.5 -49.61      -33.36
14400  -205.84      -13.5 -49.61      -33.36
18000  -206.17      -13.5 -49.61      -33.36
```

Physical parameters: numerical options

```
/---------------------------------------------------------------------------
/                    NUMERICAL OPTIONS (not necessary to modify for beginner)
/---------------------------------------------------------------------------
/
MASS-BALANCE                                 : YES
SOLVER                                                 : 1
SOLVER OPTION                                          : 2
SOLVER ACCURACY                              : 1.E-4
MAXIMUM NUMBER OF ITERATIONS FOR SOLVER      : 1000
PRECONDITIONING                            : 2
TYPE OF ADVECTION                            : 14;14
SUPG OPTION                                  : 0;0
DISCRETIZATIONS IN SPACE                     : 11; 11
MATRIX STORAGE                                                : 3
IMPLICITATION FOR DEPTH                      : 1.0
IMPLICITATION FOR VELOCITY                             : 1.0
VELOCITY PROFILES                            : 1;1
MASS-LUMPING ON H                            : 1.0
MASS-LUMPING ON VELOCITY                     : 1.0
MASS-LUMPING ON TRACERS                      : 1.0
TREATMENT OF THE LINEAR SYSTEM               : 2
FREE SURFACE GRADIENT COMPATIBILITY              : 0.5
CONTINUITY CORRECTION                        : YES
TREATMENT OF NEGATIVE DEPTHS                 : 2
OPTION FOR LIQUID BOUNDARIES                     : 1;1
OPTION FOR THE DIFFUSION OF VELOCITIES           : 1
/
```

Equations solved: *EQUATIONS*

- **SAINT-VENANT EF**
- **SAINT-VENANT VF**
- **BOUSSINESQ (non linear waves)**

Type of discretisation : *DISCRETIZATIONS IN SPACE*

- **3 values : velocity, depth, tracers**

Example: *DISCRETIZATIONS IN SPACE* **: 12;11;11 (default: 11;11;11)**

- **11 : linear triangle**
- **12 : quasi-bubble triangle**
- **13 : quadratic triangle**

- **In practice : 11;11 or 12;11 (13;11 very expensive and only with primitive equations)**

- **Other solution to suppress wiggles:**

- **COMPATIBILITY OF FREE SURFACE GRADIENT: 0.9 (should be between 1 and 0)**

One keyword: *TYPE OF ADVECTION* **(for velocity, depth, tracers, k-epsilon)**

Since version 6.0, valid for all programmes in the Telemac system

1 : Method of characteristics.
2 : Streamline Upwind Petrov Galerkin (semi-implicit). *SUPG.*
3 : Explicit finite volumes
4 : N distributive scheme (for Telemac-2D = scheme 3, different for Telemac-3D)
5 : PSI distributive scheme (Positive Streamwise Invariant)
6 : PSI scheme on non conservative equation (obsolete)
7 : N scheme on non conservative equation (obsolete)
13 : Edge-based variant of scheme 3 (works with tidal flats)
14 : Edge-based variant of scheme 4 (works with tidal flats, =13 for Telemac-2D)

Value for depth should always be 5 but this does not correspond to PSI scheme

Scheme 1 well suited for advection of velocities

Refer to user manual

Generally 1;5;4 ou 1;5;14 if tidal flats is good

N, PSI and finite volumes are conditionally stable.
Telemac automatically does the necessary sub-iterations (if less than 100).
Schemes 13 and 14 iterate differently.

SOLVER (of main linear system giving depth or depth and velocity)
SOLVER ACCURACY (1.E-4 to 1.E-6)
MAXIMUM NUMBER OF ITERATIONS FOR SOLVER
SOLVER OPTION (only for GMRES: dimension of Krylov space)
PRECONDITIONING
INFORMATION ABOUT SOLVER (yes/no to have a report on the process)

SOLVER FOR DIFFUSION OF TRACERS
ACCURACY FOR DIFFUSION OF TRACERS (1.E-7 to 1.E-10)
MAXIMUM NUMBER OF ITERATIONS FOR DIFFUSION OF TRACERS
SOLVER OPTION FOR TRACERS DIFFUSION
PRECONDITIONING FOR DIFFUSION OF TRACERS
(missing)

SOLVER FOR K-EPSILON MODEL
ACCURACY OF K (1.E-7 to 1.E-10)
ACCURACY OF EPSILON (1.E-7 to 1.E-10)
MAXIMUM NUMBER OF ITERATIONS FOR K AND EPSILON
OPTION FOR THE SOLVER FOR K-EPSILON MODEL
PRECONDITIONING FOR K-EPSILON MODEL
INFORMATION ABOUT K-EPSILON MODEL

General recommendations

NEVER USE IT AS A BLACK BOX !

- ✓ Understand the physical background and governing equations
- ✓ Keep in mind the limitations and assumptions leading to the equations
- ✓ Have a basic understanding of numerical methods
- ✓ First try the model on simple test cases
- ✓ Test the influence of grid size and time step
- ✓ Test the influence of input data (both physical and numerical)