New Telemac-2D features for v6p2 links from New version features

The main new features of this version 6.2 are:

- Better treatment of waves with pseudo-wave equation
- Weirs now work in parallel + description in a dedicated file
- Rain and evaporation (including values of tracers in rain)
- New numbering for tracers on sources and boundaries
- Culvert now independent from sources point + description in a dedicated file + dynamic allocation of related variables
- Tubes or bridges as hydraulic structures (similar to culvert but could flow in charge or at free surface)
- Tracer decrease law integration during computation (Only T90 law for the moment)
- Restarts: may be done from a given record number in the previous computation file
- Breaches management (bottom evolution)
- A treatment of the problem of spurious overwhelming of loosely discretised dykes
- 2 new finite volume schemes: HLLC and WAF
- 2 new databases of harmonic constants to force open boundary conditions

New or modified key-words:

"IMPLICITATION FOR DEPTH" (IMPLICITATION POUR LA HAUTEUR) / "IMPLICITATION FOR VELOCITY" (IMPLICITATION POUR LA VITESSE)

In version 6.0, these two parameters (TETAC and TETAU in Fortran) were set to 1. in the case of wave equation (TREATMENT OF THE LINEAR SYSTEM=2). This hardcoded modification has now been suppressed (in version 6.1 for velocity, in version 6.2 for depth). This was done to obtain a better treatment of waves and tsunamis (less damping). Consequently some cases may have different results even if the steering file is not changed. This can be corrected by adding in your steering:

For example a steering file with:

TREATMENT OF THE LINEAR SYSTEM: 2 IMPLICITATION FOR DEPTH: 0.55

Should be changed into:

TREATMENT OF THE LINEAR SYSTEM: 2 IMPLICITATION FOR DEPTH: 1.

To get the same results than version 6.1 and 6.2. Versions prior to 6.1 need also a line: IMPLICITATION FOR VELOCITY: 1.

RAIN OR EVAPORATION:

The new keywords are exactly the same as in Telemac-3D:

RAIN OR EVAPORATION (PLUIE OU EVAPORATION)

Logical, default: no

RAIN OR EVAPORATION IN MM PER DAY (PLUIE OU EVAPORATION EN MM PAR JOUR)

Double precision, default: 0.D0

In the case of tidal flats, evaporation is a priori limited by the available local quantity of water (this may not be satisfactory). There is no such limitation for rain, however it is not sure that the flow of rain on dry land is correct and infiltrations are not included, this is a further topic of research. Tracers are dealt with, but their value in rain or in evaporated phase is so far supposed to be 0 (which is wrong for temperature).

"VALUES OF TRACERS IN THE RAIN" (VALEURS DES TRACEURS DANS LA PLUIE)

Real array (as many as tracers), default: 0.D0

This keyword has been introduced to take into account the temperature of the rain (which was assumed to be 0 so far). Only real rain will be taken into account, i.e. with positive values of the keyword RAIN OR EVAPORATION IN MM PER DAY.

WEIRS:

It now works in parallel mode, with two changes in the documentation:

The list of points of weirs is now given in the:

WEIRS DATA FILE (FICHIER DE DONNEES DES SEUILS) instead of FORMATTED DATA FILE 1 previously

This list must now be given with global numbers instead of boundary points numbering (i.e. last but one column in boundary conditions file instead of last column in the same file).

CULVERTS:

The list of points of culverts is now given in the:

CULVERT DATA FILE (FICHIER DE DONNEES DES SIPHONS) instead of FORMATTED DATA FILE 1 previously

The two first parameter of each culvert must now be the global numbers instead of source numbering. The sources are no longer used for culvert.

TUBES/BRIDGES:

The Tubes had been added in order to allow taking in account during the simulation the discharge of a tube (or the lower section of a bridge) with could flow at free surface or in charge. The direction for the flow exit is automatically compute from the position of entry and exits nodes.

The list of points of tubes is given in the:

TUBES DATA FILE (FICHIER DE DONNEES DES BUSES)

The parameters of tubes are:

- The global numbers of Entry and Exits points
- The head-loss coefficient when working as an inflow (for point 1 and 2)
- The head-loss coefficient when working as an outflow (for point 1 and 2)
- The width of the tube
- The height of the tube
- An integer flag for flow direction
  - 0 – Both directions
  - 1 – Only from Entry to Exit
  - 2 – Only from Exit to Entry
  - 3 – No flow

- The linear head-loss of tube
- The elevation of Entry and Exits points

The sources are not used for tubes.

TRACER DECREASE:

It is now possible to take in account the decrease of tracer without modifying the difsou.f subroutine. The decrease law is select with the keyword: LAW OF TRACERS DEGRADATION (LOI DE DEGRADATION DES TRACEURS) For the moment only 2 laws are available: • 0 : No decrease (the actual situation by default) • 1 : Law in F(T90 in h) – The usual law for bacteriologic degradation The coefficient for the law 1 is given using the keyword: COEFFICIENT 1 FOR LAW OF TRACERS DEGRADATION (COEFFICIENT 1 DE LA LOI DE DEGRADATION DES TRACEURS). Other laws could now be implemented just by adding a new value to the keyword LAW OF TRACERS DEGRADATION. If a new law require more than 1 coefficient, it's possible to add a new keyword COEFFICIENT 2 FOR LAW OF TRACERS DEGRADATION by duplication (in dictionary and declarations_telemac2d)

BREACHES MANAGEMENT

In the version 6.2, the management of bottom evolution in order to represent breaches in dikes has been added. A new logical keyword BREACH (BRECHE) is available to activate this functionality. The description of breaches is made in a dedicated file: BREACHES DATA FILE (FICHIER DE DONNEES DES BRECHES). As a first implementation, only the bottom lowering was coded. The opening of breaches by widening is not available. 3 options are available for breach generation:

- 1 : Start at a given time;
- 2 : Start when the average water level on dike exceed a given value;
- 3 : Start when the water level at a specific point exceed a given value.

All the required information should be given in the BREACHES DATA FILE which follows this form.

Number of BREACHES

3

Width of Polygon defining the breaches

15.0

Commentary – Upstream Breach

Option for breach generation

2

Opening duration (0.0 = instantaneous)

0.0

Final level of breach

5.9

Control level of breach (breach exist if water level exceed this value)

7.2

Number of points on the dike axis where the breach will appear

4

Description of dike axis

2000.0 37.5

2041.0 37.5

2082.0 37.5

2100.0 37.5

Commentary – Middle Breach

Option for breach generation

3

Opening duration (0.0 = instantaneous)

300.0

Final level of breach

5.5

Number of control point (global mesh)

9406

Control level of breach

6.0

Number of points on the dike axis where the breach will appear

4

Description of dike axis

2450.0 37.5

2500.0 37.5

2520.0 37.5

2550.0 37.5

Commentary – Downstream breach

Option for breach generation

1

Start time of breach generation

2000.0

Opening duration (0.0 = instantaneous)

600.0

Final level of breach

5.0

Number of points on the dike axis where the breach will appear

4

Description of dike axis

2900.0 37.5

2920.0 37.5

2950.0 37.5

3000.0 37.5

Suppressed key-words:

FRICTION COEFFICIENT VARIABLE IN SPACE (COEFFICIENT DE FROTTEMENT VARIABLE EN ESPACE)

This keyword has been suppressed, as announced in previous versions. The friction coefficient is always treated as variable in space.

Modifications in user subroutines or new subroutines:

Subroutine PROSOU has new arguments. Separation of terms coming from sources and those coming from culvert and addition of terms due to tubes.

Subroutine DIFSOU has new arguments. Separation of terms coming from sources and those coming from culvert and addition of terms due to tubes.

Functions SL, VIT and TR: argument N is now the global point number of the original mesh, so these functions can be implemented with hardcoded point numbers and it will work in parallel.

Function TR: Modification of the index for tracer at boundaries when read in the LIQUID BOUNDARIES FILE.

Function TRSCE: Modification of the index for tracer at sources when read in the SOURCES FILE.

Subroutine LECBREACH is a new subroutine in charge to read the breaches date file and allocate the variables used.

Subroutine BREACH is the core of breach management which compute the bottom variation according to the breaches parameter

Modifications in LIQUID BOUNDARIES FILE (FICHIER DES FRONTIERES LIQUIDES): (Modification also available in Telemac-3D)

The tracer is now described with two index: TR(Ib, It) where Ib is the boundary number (same number as Q or SL or V) and It is the index of tracer (between 1 and the number of tracers). This separation allow a simple description of this file and ensure the preservation of the system when the user change the number of tracers (by the past, the index was the result of a computation taking account the number of tracer)

Modifications in SOUCES FILE (FICHIER DES SOURCES): (Modification also available in Telemac-3D)

The tracer is now described with two index: TR(Is, It) where Is is the source number (same number as Q) and It is the index of tracer (between 1 and the number of tracers). This separation allow a simple description of this file and ensure the preservation of the system when the user change the number of tracers or the number of sources (by the past, the index was the result of a computation taking account the number of tracer and the number of sources)

New Finite volume schemes (in Telemac2D)

2 new schemes are added to list the choices of finite volumes schemes:

1-The HLLC (Harten Lax Leer-Contact) scheme is one of the most used schemes in the literature. It is of first order in time and space.

2-The WAF (Weighted Averaged Flux) is an "upgrade" of the HLLC scheme. It is of 2nd order in time and space. The use of these schemes is possible by using key-word "FINITE VOLUME SCHEME" =5 for HLLC and =6 for WAF. Recall that, in order to use finite volumes, it is necessary to add the following key-words:

EQUATIONS = 'SAINT-VENANT VF'

VARIABLE TIME-STEP = YES

DESIRED COURANT NUMBER = …

DURATION = …

Databases of harmonic constants to force open boundary conditions

Two new databases of harmonic constants are now available in order to calculate the open boundary conditions:

- the TPXO global tidal solution and other regional and local tidal solutions from Oregon State University (OSU),
- the regional NEA (North East Atlantic) atlas.

Three keywords of version 6.1 still remain:

OPTION FOR TIDAL BOUNDARY CONDITIONS (OPTION POUR LES CONDITIONS AUX LIMITES DE MAREE)

Integer, default: 0 (no tide)

Kind of tides to simulate. For real tides, option 1 is recommended when using JMJ database (mandatory in other cases). Possible calibration with the keywords COEFFICIENT TO ADJUST TIDAL RANGE, COEFFICIENT TO CALIBRATE TIDAL VELOCITIES and COEFFICIENT TO ADJUST SEA LEVEL: 0: No tide (default value), 1: Real tide (recommended methodology), 2: Astronomical tide (for JMJ database only), 3: Mean spring tide (for JMJ database only), 4: Mean tide (for JMJ database only), 5: Mean neap tide (for JMJ database only), 6: Astronomical neap tide (for JMJ database only), 7: Real tide – methodology before 2010 – (for JMJ database only).

HARMONIC CONSTANTS FILE (FICHIER DES CONSTANTES HARMONIQUES): Name of the file which contains the harmonic constants extracted from one database of harmonic constants, for every node of the open boundaries.

TIDAL MODEL FILE (FICHIER DU MODELE DE MAREE): Name of the geometry file of the model from which harmonic constants are extracted for JMJ database.

New name of keyword ASCII DATABASE FOR TIDE (BASE ASCII DE DONNEES DE MAREE) in French: Name of the database of harmonic constants extracted from the tidal model file for JMJ database. The old name in version 6.1 was TIDE DATA BASE (BASE DE DONNEES DE MAREE).

New keywords have been introduced: TIDAL DATA BASE (BASE DE DONNEES DE MAREE)

Integer, no default

Choice of the harmonic constants database to use to calculate boundary conditions: 1: JMJ (already exists in version 6.1), 2: TPXO (or other solutions from OSU), 3: LEGOS-NEA. For JMJ database, please indicate the location of the files bdd_jmj and geofin with keywords ASCII DATABASE FOR TIDE and TIDAL MODEL FILE. For TPXO, other solutions from OSU and LEGOS-NEA, the users have to download the files of harmonic constituents on the internet: http://volkov.oce.orst.edu/tides for tidal solutions from OSU or http://sirocco.omp.obs-mip.fr/outils/Tugo/Produits/TugoProduits.htm for NEA.

COEFFICIENT TO CALIBRATE TIDAL RANGE (COEFFICIENT DE CALAGE DU MARNAGE)

Real, default: 1.

Coefficient to calibrate the tidal range at open boundary conditions.

COEFFICIENT TO CALIBRATE TIDAL VELOCITIES (COEFFICIENT DE CALAGE DES VITESSES DE COURANT)

Real, default: 999999.

Coefficient to calibrate the tidal velocities at open boundary conditions. Default value 999999. means that the square root of COEFFICIENT TO CALIBRATE TIDAL RANGE is taken.

COEFFICIENT TO CALIBRATE SEA LEVEL (COEFFICIENT DE CALAGE DU NIVEAU DE MER) Real, default: 0. Coefficient to calibrate the sea level.

GEOGRAPHIC SYSTEM (SYSTEME GEOGRAPHIQUE) Real, no default

Geographic coordinates system in which the numerical model is built. Please indicate the corresponding zone with the keyword ZONE NUMBER IN GEOGRAPHIC SYSTEM: 0: defined by the user, 1: WGS84 longitude/latitude in real degrees, 2: WGS84 Northern UTM, 3: WGS84 Southern UTM, 4: Lambert, 5: Mercator for TELEMAC.

ZONE NUMBER IN GEOGRAPHIC SYSTEM (NUMERO DE FUSEAU OU PROJECTION DANS LE SYSTEME GEOGRAPHIQUE) Real, no default

Number of zone when using a plane projection. Please indicate the geographic system in which the numerical model is built with the keyword GEOGRAPHIC SYSTEM: 1: Lambert 1 North, 2: Lambert 2 Center, 3: Lambert 3 South, 4: Lambert 4 Corsica, 22: Lambert 2 Extended, 30: UTM zone, e. g.

BINARY DATABASE 1 FOR TIDE (BASE BINAIRE 1 DE DONNEES DE MAREE) and BINARY DATABASE 2 FOR TIDE (BASE BINAIRE 2 DE DONNEES DE MAREE): Names of the binary databases which contain harmonic constants. In the case of the OSU satellite altimetry model, this file should be for free surface level, for instance h_tpxo7.2 (for binary database 1) or tidal velocities, for instance u_tpxo7.2 (for binary database 2).

MINOR CONSTITUENTS INFERENCE (INTERPOLATION DE COMPOSANTES MINEURES) Logical, default: NO For tidal databases from OSU only, logical to indicate if inference of minor constituents is done from the ones read in input files linked to keywords BINARY DATABASE 1 FOR TIDE and BINARY DATABASE 2 FOR TIDE.

Documentation correction:

In the description of culverts, the description of a1 and a2 should be inverted with the description of d1 and d2.

Other corrections:

The mass balance of tracers now takes into account implicit source terms.
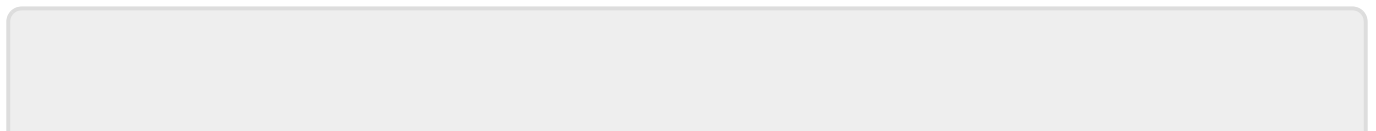
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