**VALIDATION OF NON-CONSERVATIVE TRACER TRANSPORT MODEL IN TELEMAC 2D**

| | |
|---|---|
| **Title** | **Validation of decaying tracer transport module in telemac-2D using a hypothetical one-dimensional river flow with constant depth and velocity** |
| **Last update** | **July 2013** |
| **Version** | **TELEMAC-2D 6.2** |

## 1.1 PURPOSE

To demonstrate that TELEMAC-2D can model the transport of non-conservative tracer in a flow.

## 1.2 LINKED CLAIMS

- Claim 2.2.1.11 TELEMAC-2D can be used to follow the behavior of tracers (either conservative or decaying).

## 1.3 APPROACH

The validation is processed with a hypothetical one-dimensional flow with constant velocity (0.03m/s) and constant depth (10m).

Geometry:

- Channel length = 11400m
- Channel width = 50m

Channel Mesh:

- 2850 triangular elements
- 1716 nodes
- Size of triangles = 40m(along the channel bank) *10m(along the channel width)

Initial condition:

- The concentration of the tracer is 30mg/l at the left boundary nodes and 0mg/l at all other nodes.
- Constant velocity 0.03 m/s
- Constant water height 10m

Boundary conditions:

- Left inlet boundary:
    - Constant velocity of 0.03m/s
    - Constant tracer concentration of 30 mg/l for first 6 hours, 0 mg/L after.
- Right outlet boundary:
    - Constant velocity of -0.03m/s
    - Free tracer concentration
- Lateral boundaries: solid smooth boundary

Bottom:

- Flat bottom without friction

Parameters for non-conservative tracers:

- Number of tracer: 1
- Coefficient for diffusion of tracers: 30 $m^2/s$
- Decay rate: 0; 1.0/day; 2.0/day

Numerical parameters:

- Tracer:
    - Advection of tracer : method of characteristics
    - Solver for diffusion of tracer: conjugate gradient method
    - Accuracy: $10^{-10}$
- Flow and velocity:
    - No diffusion
    - No advection

Time data:

- Time step: 100 sec
- Simulation period: 518400 sec (6 days)

## 1.4 RESULTS

The tracer concentration time series of analysis and simulation at X =2000m are compared. Visually the solution produced by TELEMAC-2D shows very good agreement with the exact solution. For 6 days of simulation duration, when Kd =0 or Kd=1/day, the model peak time is 5 minutes earlier than the exact peak time; and for Kd =2, the time difference is less than 2 minutes.

## 1.5 CONCLUSIONS

TELEMAC reproduces accurately the transport of non-conservative tracers.

## 1.6 Steering file:

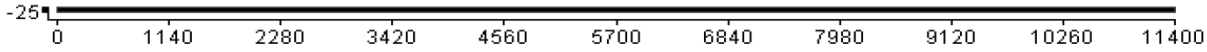
```
/*****************************************************
TITLE = 'Simple tracer decay for Channel-Coarse mesh'
/*****************************************************
/---------------------------------------------
/ COMPUTER INFORMATIONS
/---------------------------------------------
/
GEOMETRY FILE             = 'COARSE.slf'
BOUNDARY CONDITIONS FILE = 'BOTTOM_COARSE.cli'
RESULTS FILE              = 'COARSERes.slf'
FORTRAN FILE              = 'princi.f'
/
/---------------------------------------------
/ GENERAL INFORMATIONS - OUTPUTS
/---------------------------------------------
/
TITLE                            = 'Channel 2D Tracer'
VARIABLES FOR GRAPHIC PRINTOUTS  = 'U,V,H,S,Q,T1'
GRAPHIC PRINTOUT PERIOD          = 1
LISTING PRINTOUT PERIOD          = 100
VALIDATION                       = NO
MASS-BALANCE                     = YES
TIME STEP                        = 100
NUMBER OF TIME STEPS             = 5184
INFORMATION ABOUT SOLVER         = YES
/
/---------------------------------------------
/  INITIAL CONDITIONS
/---------------------------------------------
/
COMPUTATION CONTINUED           = NO
INITIAL CONDITIONS              = 'PARTICULAR'
/
/---------------------------------------------
/  BOUNDARY CONDITIONS
/---------------------------------------------
/
```

```
PRESCRIBED VELOCITIES               = -0.03;0.03
PRESCRIBED TRACERS VALUES           =  0.;30.
/
/-----------------------------------------------
/  CONTROL SECTIONS
/-----------------------------------------------
/
PRINTING CUMULATED FLOWRATES = yes
SECTIONS INPUT FILE  = Control_Section.dat
SECTIONS OUTPUT FILE = Control_Section_Output.dat
/
/-----------------------------------------------
/  PHYSICAL PARAMETERS
/-----------------------------------------------
/
LAW OF BOTTOM FRICTION           = 0
/-----------------------------------------------
/  NUMERICAL PARAMETERS
/-----------------------------------------------
/
SOLVER FOR DIFFUSION OF TRACERS    =  1
MAXIMUM NUMBER OF ITERATIONS FOR DIFFUSION OF TRACERS = 1200
ACCURACY FOR DIFFUSION OF TRACERS = 1.E-10
TIDAL FLATS                        = NO
ADVECTION OF U AND V               = NO
ADVECTION OF H                     = NO
ADVECTION OF TRACERS               = YES
TYPE OF ADVECTION                  = 1
DIFFUSION OF VELOCITY               =NO
CONTINUITY CORRECTION              = YES
/**********************************
/NON_CONSERVATIVE TRACER IS ADDED
/**********************************
NUMBER OF TRACERS = 1
NAMES OF TRACERS = 'TRAC MG/L'
COEFFICIENT FOR DIFFUSION OF TRACERS = 30.
&FIN
```

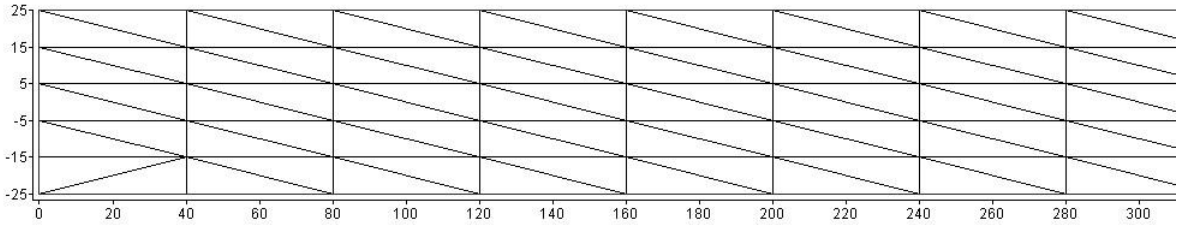
## 1.7 Figures

Mesh and initial state:

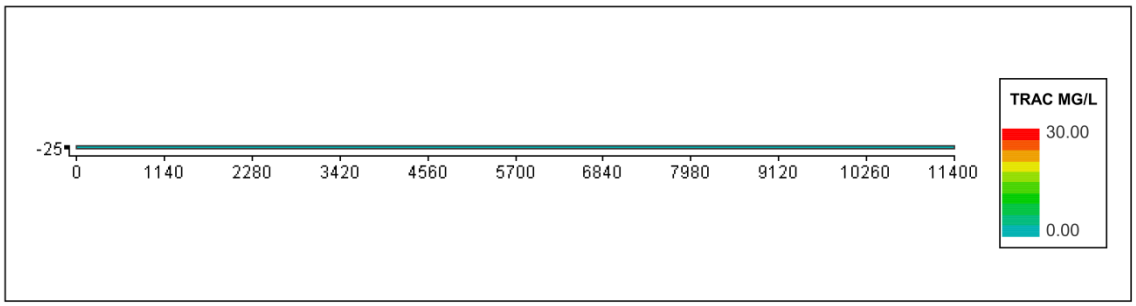
Mesh:



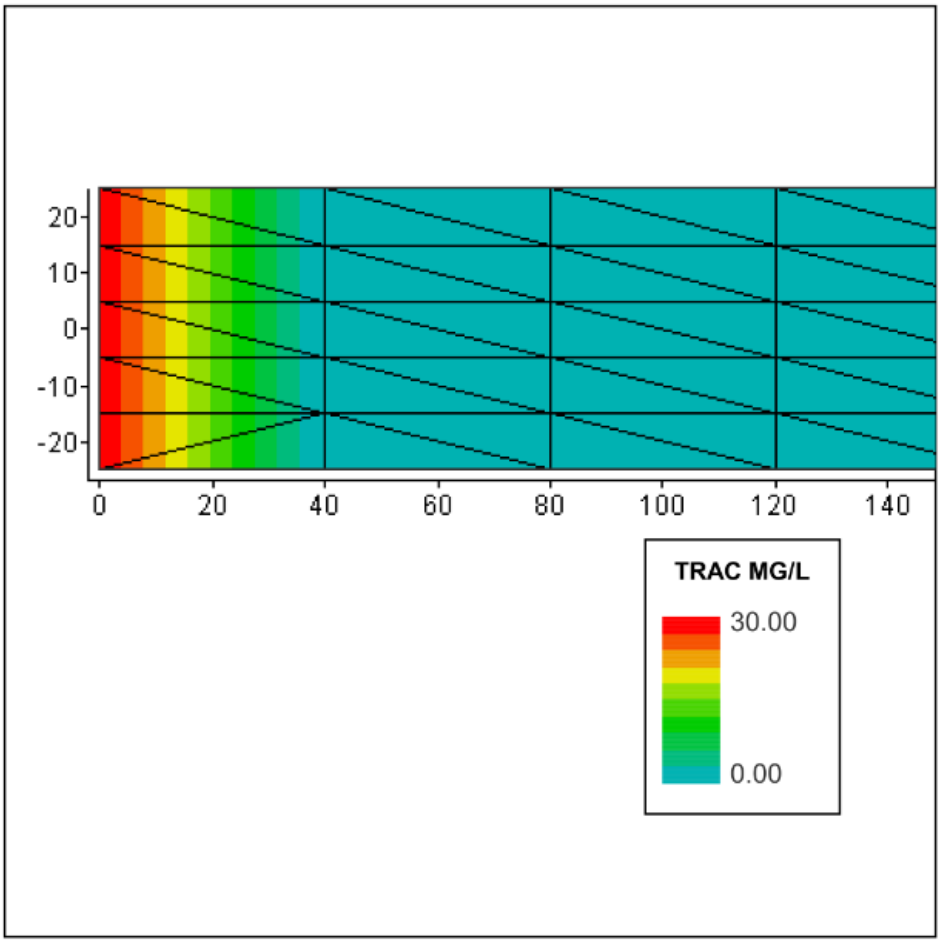

Zoom:




Initial state of tracer:



Zoom:



Comparison between analytical solution and telemac-2D solution for non-conservative tracer transport: