Introduction to TELEMAC-2D

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TELEMAC-2D at glance

TELEMAC 2D

- Industrial code developed by EDF consortium (free and open source)
- Based on approximation of 2D (de Saint-Venant Equations) SWEs solutions
- Numerical scheme:

Finite elements (SUPG) or Finite volumes (Roe ou cinétique)

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• Spatial /temporal discretization:

Non-structured /CFL criterion dependent

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Wetting and drying treatment:

Uses threshold value to ensure positivity preservation of computed water depth (mass creation occurs)in finite elements and finite volumes (Roe). The finite volumes cinétique → positivity of solution is ensured

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TELEMAC-2D at glance

• Flow regime changes treatment:

Finite elements → upwinding treatment to handle flow regime changes Finite volumes (Roe and cinétique) → handle numerical discontinuities

Operational aspects

OS: Windows and Linux GUI: No official GUI, third-party tools avaliable parallel computing: Yes

• Scalability:

The same simulation can be run on your laptop as on university's supercomputer

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Open source, means no license limitations (in contrary to DHI Mike21)

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TELEMAC2D solves Saint-Venant equations

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Additionally user may define a tracer which will be transported by advection-diffusion equation.

A tracer can be a passive pollutant but also heat (temperature).

$$\frac{\partial h}{\partial t} + u \cdot \vec{\nabla}(h) + h div(\vec{u}) = S_h \qquad \text{continuity}$$

$$\frac{\partial u}{\partial t} + \vec{u} \cdot \vec{\nabla}(u) = -g \frac{\partial Z}{\partial x} + S_x + \frac{1}{h} div(hv_t \vec{\nabla} u) \qquad \text{momentum along x}$$

$$\frac{\partial v}{\partial t} + \vec{u} \cdot \vec{\nabla}(v) = -g \frac{\partial Z}{\partial y} + S_y + \frac{1}{h} div(hv_t \vec{\nabla} v) \qquad \text{momentum along y}$$

$$\frac{\partial T}{\partial t} + \vec{u} \cdot \vec{\nabla}(T) = S_T + \frac{1}{h} div(hv_T \vec{\nabla} T) \qquad \text{tracer conservation}$$

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How to use TELEMAC2D?

Telemac computational engine is separated from mesh generator, pre/post-

processors

Pros:

- You can prepare simulation with your laptop and run it on a supercomputer
- You can split the job between several people

Cons:

•That's a bit non-intuitive concept, which comes form '80s, however it's still

popular between open source models









Mesh generation

There is no official mesh generator for TELEMAC

Blue Kenue (BK) from Canadian Hydraulic Center (CHC) is a free software with mesh

generating capabilities, compatible with TELEMAC

BK accepts the following file formats with input topography:

•.asc ARC Info ASCII raster files

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- •.shp ESRI shape files with lines or points
- •.xyz text files with topography points

All input data should be prepared in the same coordinate system

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Each simulation in TELEMAC is driven by a *case file*

Case files are text files (yet another legacy from '80s)

Text files are vey convenient if you want to quickly make some tiny changes (like

value of one parameter, timestep, etc.)

However maintaining a strict format

KEY = VALUE is hard for humans

Small typos may lead to annoying errors

,	C (
/ INPUT-OUTPUT, FILES			
STEERING FILE	='casl'		
GEOMETRY FILE	='casl-geol'		
RESULTS FILE	='res2d-dryDomain'		
FRICTION DATA FILE	='geol'		
BOUNDARY CONDITIONS FILE	='casl-cas2.conlim'		
/			
VARIABLES FOR GRAPHIC PR	INTOUTS =U,V,US,H,F,L,S		
LISTING PRINTOUT PERIOD	=50		
GRAPHIC PRINTOUT PERIOD	=500		
,			
/ NUMERICAL PARAMETERS			
INITIAL TIME SET TO ZERO	=true		





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For ease of use of case files, a graphical pre-processor Fudaa-prepro can be

used to generate or modify case files



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FILES	dependent keywords:			
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NUMERICAL PARAMETE	propagation step. All the currently available methods are variations			
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None	2: conjugate residual			
PHYSICAL CONSTANTS	4: minimum error			
·	5: conjugate gradient squared (not implemented)			
	6: conjugate gradie	ot cousred stabilised ((castab)	

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Running a simulation scenario

•Telemac installation requires FORTRAN compiler and several auxiliary tools

(python, perl etc.).

•In order to save time on installation and configuration a virtual installation

(through VirtualBox) can be used.

•Telemac is launched from a command prompt (bash shell) by typing

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telemac2d.py caseFile

📼 marcin@brutus: ~/wymiana/symulacje/var 💶 💌 🗙
marcin@brutus:~/wymiana/symulacje/var\$ telemac2d.py cas1
Loading Options and Configurations
V771p21p10
<pre> parsing configuration file: /home/marcin/telemac/v7p2r0/configs/systel.cfg</pre>
Running your CAS file for:
+> configuration: debgfopenmpi +> root: /home/marcin/telemac/v7p2r0
reading the main module dictionary =
<pre> processing the main CAS file(s) +> running in English</pre>
handling temporary directories
checking coupling between codes
checking parallelisation
first pass at copying all input files

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For post-processing of Telemac results you can use: Fudaa Pre-pro, it provides nice animation and reporting capabilities



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Blue Kenue – a windows freeware software, provided by CHC, the same which can be used for mesh generation

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OpenEarthTools – a set of MATLAB, R , Python tools, which are capable of processing Telemac results.

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One of the biggest advantages of Telemac is the possibility to perform 3D simulations with the same mesh The only required thing is enter the number of layers 3D simulations can be used for water quality simulation, sediment transport Variable density in 3D simulation also provides capabilities of simulating hot water discharges and fresh-salty water mixing









References

Telemac homepage with comunity forum:

http://opentelemac.org

Fudaa-prepro http://prepro.fudaa.fr/

Blue Kenue https://www.nrc-cnrc.gc.ca/eng/solutions/advisory/blue_kenue_index.html

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Virtual Box for virtual installation of TELEMAC: https://www.virtualbox.org/

Open Earth Tools

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https://publicwiki.deltares.nl/display/OET/OpenEarth

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