Qual2_TREE - USER GUIDE -

INSTRUCTIONS FOR THE USE OF THE PROGRAM

DISCLAIMER

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ACRONYMS

The acronyms in the following table are used throughout this document:

SFDN	space filling drainage network, i.e., the connected set of steepest directions theoretically
	followed by runoff
CN	channel network: a subset of the SFDN
DEM	a data set (here a file in ASCII raster format) containing the "depitted" terrain elevation,
	from which the SFDN and the CN are computed.
Q2T	the name of the program (Qual_2_Tree)

PROGRAM INSTALLATION

The compressed file *Q2T.zip* contains the files needed for running the code in a *WINDOWS* environment, along with 3 *DEMs* (with extension.grd: see below), which are the test cases presented in the paper.

The user should either uncompress the file at the root of a C disk or uncompress the file at any other directory of a disk

In the first case, a directory called Q2T is created and the program is ready to use, by clicking on the *Q2T.exe* icon inside that directory.

In the second case, the user has to modify the 2 paths within the text file named *"list_of_directories"*, as suggested in the following lines:

1	Let us suppose that the files have been uncompressed within the directory	
	$D:\programs\dummyname2\water_quality\Q2T\$	
	(in general we recommend not to use a path longer than 120 characters). In this directory you will find these data	
	in out Iist_of_directories Ø2T	
	Q2T.exe is the executable file and <i>list_of_directories</i> is an ASCII file with the names of two sub directories, necessary for the input-output operation of the program. The input file will be contained in the "in" sub-directory and the results of the water-quality computations will be in the "output" sub-directory. Some intermediate files containing geomorphological information are created by the program and written in the "in" sub-directory.	
	the program and written in the "in" sub-directory.	

2	Using a text editor, open the file <i>list_of_directories</i> and change the default paths	
	C:\Q2T\in C:\Q2T\out with	
	D:\programs\dummyname2\water_quality\Q2T\\in D:\programs\dummyname2\water_quality\Q2T\\out	

That's all. No other operation is needed for the installation. The program is now ready to use, by clicking on the *Q2T.exe* icon. In order to use the program, please have a look at the following pages and then refer directly to the test cases. The program is very simple to use.

FORMAT OF INPUT DEM FILES

The program works on ASCII DEM files, written according to the non-proprietary ARC/INFO ASCII GRID format, with *grd* extension. See the *.grd* files provided as test case or read <u>http://en.wikipedia.org/wiki/Esri_grid</u>.

It is fundamental that

- 1) the DEM has already been depitted, i.e., that a connected path with positive slopes already exists joining the cells of the DEM to the basin outlet.
- 2) the basin outlet must be located along the outer boundary of the basin (not necessarily of the DEM!).

PROGRAM LIMITATIONS

The program can operate on DEM with number of rows and columns up to 1500 x 1500. The program was written in DELPHI and was tested under WINDOWS 7, WINDOWS 8 and WINDOWS 10 OS.

Please, note that this program has been written for scientific and technical use only. Starting from an original version, this program has been tested and made as much user-friendly as possible. However, some details could certainly be improved by professional programmers who are not the Authors of the paper. For instance, we couldn't program the dynamic zooming of the panels, but we don't think this is a real limitation.

PROGRAM USE AND TUTORIALS

The program is provided along with 3 separate short stand-alone tutorials, by which the user can understand how the program works and what are the available options. Tutorials 1, 2 and 3 make reference to the test cases discussed in the paper.

The use of the code is straightforward. In the following, the '.' is used to indicate the decimal place and groups of thousands are not separated. This is the type of convention used throughout this manual. There are 7 main options that are here presented in a visual way and explored in the tutorials.

R	22_Tree -Model for Space-Distributed Assessment of River Water Quality	IN/OUT:
	In/Out Drainage Networks Local Data WaterQuality Computations	1 is used for the
	Selec and Visualize DEM	selection and the
		visualization of the
		DEM on the screen
C	💋 Q2_Tree -Model for Space-Distributed Assessment of River Water Quality	DRAINAGE
	In/Out Drainage Networks Local Data WaterQuality Computations	NETWORKS
	1 Compute SEDN and CN	Commend 1 for de
	3 Show CN	Commana 1 jinas
		watershed and
		activates the
		computation of the
		SFDN and CN.
		Command 2 shows
		Ine identified CN
D	Q2_Tree -Model for Space-Distributed Assessment of River Water Quality	LUCAL DATA
	In/Out Drainage Networks Local Data WaterQuality Computations	Command 1 is used
	1 Info xyz	to browse the DEM
	7 Find cell	elevations in the
		neighbourhood of a
		Command 2 is used
		to find the location
		of a cell on the
		basis of its
		coordinates (matrix
		or geographic)
E	Q2_Iree -Model for Space-Distributed Assessment of River Water Quality -	COMPUTATIONS
	In/Out Drainage Networks Local Data WaterQuality Computations	com chinorys
	1 Read Pollutants file	Command 1 is used
	2 Generate default file of parameters	to read the user-
	3 Compute Water Quality	defined list of
	4 Output variables selection	pollutant sources
	5 Show graph	diversions.
		Command 2
		generates the list of
		parameters used by
		the solver
		<i>Commana</i> 5 solves the equations of the
		model
		Command 4 allows
		the selection of the
		quantities to be
		written on the
		print-out of the
		Command 5 shows
		the x-y graphs for
		the 6 variables



LIST OF OUTPUT FILES

During the pre-processing of the DEM, several ASCII files are written on disk. These files allow a complete description of the SFDN and CN of the watershed (files with extension *1sf*, *2sf*, *1dr* and *2dr*). Finally, during the Water Quality Computation process, the files containing the results along the selected subset of the CN are both in a format directly readable by MATLAB and as a text file with explicative captions (files with extension *out*).

directory	name and extension	content
out	namefile.1sf,	complete topological description of the SFDN
out	namejue.251	complete tenclogical description of the CN
oui	namefile.2dr	complete topological description of the Civ
in	namefile.esp	These two files are needed for the shading of the watershed
	namefile.rad	relief during the DEM visualization phase.
out	namefile+row_col.out	This file is an ASCII file containing all the data required by the user with Command 4 of panel E above (in the following, E.4).
		<i>row</i> and <i>col</i> are the number of the row and of the column in the DEM of the initial point of the selected path along the CN for the variables printout.
		The format of this file is explained in the following
out	<i>namefile+MATLAB</i> .out	This file is an ASCII file containing all the data required by the user with Command 4 of panel E above (in the following, E.4). The file has the same informative content of the previous one but does not contain any explicative label, so that it can be easily read by any visualization program. A possible set of reading instructions for MATLAB are provided in the following
out	namefile.wqp	This file is an ASCII file created for internal use by the program. For each point along the selected CN, it contains all the preliminary data needed for the use of the solver. The format of this file is explained in the following

FORMAT OF SOME OUTPUT FILES

Command 4 of panel E above (in the following, E.4). Accordingly, the format of this file can vary if only some variables are required. In the following we will make reference to the case that all the variables have been selected by the user to be written on the file. The files contains the data starting from the point selected by the user on the CN (row and col are the number of the row and of the column in the DEM of the initial point), down to the watershed outlet.At the beginning of the file there is a list of the variables: 1 north [m] 2 east [m] 3 distance [km] 4 z [m]3 distance [km] 4 z [m]4 z [m] 5 Q [m^3/sk] 6 Area [m^2] 7 slope [m/m] 8 width [m] 9 Ks [m(I/3)%] 10 T of water along the river [°C] 11 Y [m] 12 U [m/s] 13 tao [Pa] 14 Rair_coeff [-] 15 Ox. Satur. [mg/L] 16 CBOD [mg/L] 17 Norg [mg/L] 18 NH4 [mg/L] 19 NO3 [mg/L] 19 NO3 [mg/L] 21 SOD [mg/L] 22 # of discharge points upstream of current station 23 dr of transit between local cell and the following 24 T of air [°C] 25 T of contribution q [°C] 26 Sont Wave [W/m2] 27 Sensible Heat [W/m2] 28 Sensible Heat [W/m2] 29 Latent Heat [W/m2] 29 Latent Heat [W/m2] 29 Sensible Heat [W/m2] 20 Sensible Heat [W/m2] 20 Sensible Heat [W/m2] 20 Sensible Heat [W/m2] 21 After the last line of this matrix, a list of the parameters used in the required, the file will look like 1 2 5 5128780.000 1619340.000 0.1092 After the last line of this matrix, a list of the parameters used in the required. is listed in the the corresponding identificative neurone, is listed	namefile+row_col.out	This file is an ASCII file containing all the data required by the user with
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8 Width [m] 9 Ks [m(1/3)/s] 10 T of water along the river [°C] 11 Y [m] 12 U [m/s] 13 tao [Pa] 14 Rair_coeff. [-] 15 Ox. Satur. [mg/L] 16 CBOD [mg/L] 17 Norg [mg/L] 18 NH4 [mg/L] 19 NO3 [mg/L] 20 DO [mg/L] 21 SOD [g/(m2)/day] 22 # of discharge points upstream of current station 23 dt of transit between local cell and the following 24 T of air [°C] 25 T of contribution q [°C] 26 Short Wave [W/m2] 27 Long Wave [W/m2] 29 Latent Heat [W/m2] 29 Latent Heat [W/m2] 29 These data are then listed in matrix format listed under the corresponding identificative number. For instance, if only the north, east and Q have been required, the file will look like 1 2 5 5128940.000 1619340.000 0.1085 5128780.000 1619340.000 0.1092 After the last line of this matrix, a list of the parameters used in the reduction of the accurations is listed		/ slope [m/m]
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solution of the equations is listed		After the last line of this matrix a list of the parameters used in the
I SOTULION OF THE CONTROLS IN TISTED.		solution of the equations is listed.

namefile+MATLAB.out	This file is like the one described above, but contains only the matrix of
	the required variables. This makes it easier to read it automatically by
	some program used for data visualization. For instance, if MATLAB is
	used this file can be easily read by the set of instructions
	used, this the can be easily lead by the set of histractions
	nemofile (C:\02T\out\vollegementice 160m MATTAD out);
	namelile 'C.\Q21\out\Vallecamonica_160m_MAILAB.out',
	IOad(Inamerire)/
	as that single vestors can be easily handled and platted. For instance, if all
	so that single vectors can be easily handled and proteed. For instance, if an
	the variables have been selected by the user with command E.4 above,
	single vectors can be read as:
	z = risultati(:,4);
	Q = risultati(:,5);
	Area = risultati(:,6);
	<pre>slope = risultati(:,7);</pre>
	width = risultati(:,8);
	ks = risultati(:,9);
	T = risultati(:,10);
	depth = risultati(:,11);
	U = risultati(:, 12);
	<pre>bed_shear_stress = risultati(:,13);</pre>
	Rair_coeff = risultati(:,14);
	Ox_saturation = risultati(:,15);
	CBOD = risultati(:, 16);
	Norg = risultati(\cdot , 1/);
	NH4 = risultati(:, 18);
	NO3 = risultati(:, 19);
	DO = IISUItati(.,20),
	SOD = risuitati(.,21),
	<pre>pollutant_input = risultati(:,22); dt transit time = rigultati(:,22);</pre>
	$dt_transit_trans = risuitatr(.,23),$
	and so on for following columns
namofilo wan	This file is an ASCII file created for internal use by the program. For each
namejue.wqp	missing is an ASCH the created for internal use by the program. For each
	point along the selected CN, the following quantities are listed:
	n r c east north distance z slope Area Tlocal Tinput Ks
	width Q_immission Ci_imm i=16 Q_diversion
	where <i>n</i> is a code used in the coding of the CN, <i>r</i> and <i>c</i> are the row and the
	column in the DEM of the corresponding cell O immission and
	O diversion are the local discharge associated to the pollutant loads or
	<u>C</u> _urversion are the river at the select 1, 11, C, it is the
	withdrawn from the river at the selected cell. C1_imm is the concentration
	of the 6 variables associated to the pollutant load, if present.