Reference

Content

1 Introduction

FLUVEX (FLUVial EXpert) is a program that allows to estimate discharge, velocity distribution and other hydraulic variables in cross-sections and river channels. It assumes uniform or non-uniform one-dimensional flow conditions. The main features are

- Uniform flow calculation with Horton-Einstein formula for open and closed cross-sections
- Manning-Strickler formula for bed shear.
- Lindner formula for flow resistance of vegetation.
- Velocity distribution calculation with zero-eq. turbulence model.
- Generating of streamtubes for channel generation
- Bed load calculation with Meyer-Peter/Müller or VAW formula.
- Backwater calculation for sub- and supercritical flows
- Modelling of transport and mixing of tracers and heat (stream-tube approach).
- unsteady flood routing with:
    - spatial discretization with four-point (Preissman) or box scheme
    - time solution with implicit newton-raphson scheme (crank-nicolson)

This documentation describes how to use **FLUVEX** for your specific river data. Before starting you should have specified the cross-section geometry on an input file. If you intend to compute steady or unsteady flows in a river reach you also have to specify the topology of the reach, i.e. the location of the cross-sections and the boundary conditions (discharge, water levels).

The input is given in free format using predefined keywords (see http://www.fluvial.ch/m/syntax.html for more details). Keywords starting with double arrow allow to structure the input. The default name of the input file is 'inx'. The output is writen to the file 'out'.

In a command shell the program can be started by typing

```
program_path/fluvex inputfile outputfile
```

or simply by typing

```
program_path/fluvex
```

where `program_path` denotes the directory where the executable is located.

2 Cross-Section Reference

The following keywords are used to specify the cross-section data.

Input	Unit	Describtion
`title 'name'`	string	'**name**' is a string (max. 64 characters) that is stored on the result file and appears in the header of the plots
`>>global`		main keyword for the definition of friction values
`defkst r`	$m^{1/3}/s$	default for the Strickler value.
`defn r`	$s/m^{1/3}$	default for Manning's n.
`defcv r`	-	mixing coefficient (def=0.11) that affects the lateral mixing of momentum and tracers. Hint: Default values can be set several times.
`label 'xxx'`	string	name of the label (3 characters long) to which the following values are related.
`kst r`		Strickler's k value of the label.
`n r`		Manning's n value of the label.
`vegetation r`	m^{-1}	friction losses factor due to vegetation, defined as r=d/(ax*ay*cw) with d=diameter of elements[m], ax/ay=distance between elements[m] in x- and y-direction, cw=flow resistance coefficient[-] of an element. Hint: There is a predefined label 'def' with the default friction value (defstrickler or defmanning) and no vegetation.
`table_values i`	-	number of discharge values stored in tables used for backwater calculation. (def=100)
`grid_values i`	-	maximal number of grid points for velocity calculation (def=40, max=my)
`grid_spacing r`	m	minimal spacing between calculation points for velocity distribution. (def=1.0m)
`circle400`		if the full circle of the angle of the cross-section is 400 degree (default=360).
`>>section`		main keyword for the definition of cross-sections.
`bed r`	m	highest level for the active bed (used for bedload calculation).
`locate r1 r2 r3`	m,m,°	r1,r2 are the x,y coordinates of the origin of the cross-section, and r3 is the angle of the cross-section measured clock wise from the y-axis (only used for 2d plots).
`compound`		the conveyance is calculated using the distribution formula (the same that is used for the velocity distribution instead of Horton-Einstein which is the default). Hint: A section with vegetation is assumed to be a compound channel.
`main`		by default the water level is equal for the whole section. If `main` is set the next cross-section is filled from the talweg in such a way that side channels stay dry as long as they are not connected with the main channel.

Input	***Unit***	***Describtion***

`cs 'csname' r1 r2`
`r11 r12 'xxx'`
`r21 r22 'xxx'`
`r31 r32 'xxx'`
`. . .`
	km, m	record for the cross-section definition. 'csname' is the name of the cross-section (max. 8 characters long), r1 is the relative distance along the river [km] and r2 is the elevation of the bed level [m]. The offset (i.e. distance from the left border) is stored in the first column and the bed level is stored in the 2nd column. In the 3rd column the local friction values are specified using the labels defined in the >>set section. The specified label holds from the present to the next polygon point where an other label is defined.

`origin r1 r2`		assumes r1, r2 as the origin of the coordinate system, i.e. it translates the origin to this point.
>>		ends the input reading.

3 Branch Reference

The following keywords are used to specify the river branch data.

Input	*Unit*	*Describtion*
>>branch		main keyword for the definition of a river branch.
cs 'csname' r1 r2		csname is the name of the cross-section as defined on the file with the cross-section data. r1[km] is the location. r2[m] defines a vertical shift of the profile (default=0).
repeat i r1 r2	-,m,-	used to repeat the same cross-section for i times. r1[m] is the distance between the cross-sections and r2[-] is the bed slope.
inflow r	m³/s	discharge of the in-/outflow between the preceding and the following section. For unsteady flows replace r by ** and add a timetable with time and inflow in the 1st and 2nd column, respectively.
waterlevel r	m	water level of the preceding section. For unsteady flows replace r by ** and add a timetable with time and waterlevel in the 1st and 2nd column, respectively.
froude r	-	froude number of the preceding section (default=1.0).
hq **r11 r12** **r21 r22** **. .**		defines a waterlevel-discharge relation in a table format. The water level [m] is defined in the first column and the discharge [m³/s] is defined in the second column.
weir r1 r2 r3	m,m,-	weir discharge with Poleni formula. r1 is the level of the weir crest, r2 is the width of the weir and r3 is the poleni-coefficient (default=0.58).
gate r1 r2 r3	m,m, m	discharge through a gate openin. r1 is the level of the gate bottom, r2 is the width of the gate and r3 is the opening of the gate
leftside **rightside**		position of lateral in-/outflows (used for mixing)
		Hint: Weir, gate and hq can be freely combined. The total flow is the sum over all structures.
data 'name' **x1 y1** **x2 y2** **. .**	string km, m	allows to plot measured waterlevel data on plots (e.g. for backwater calculations). 'name' is a string to denote the data on the plots, followed by a list of measurements with the distance in the first column and the waterlevel in the second column.
>>compute		to define parameters for unsteady flow computation
start r	h	start time [h] of the simulation (default=0)
end r	h	time where simulation will end (default=1h)
time_step r	h	length of time step (default=0.1h)
theta r	-	weigthing factor for implicit crank-nicolson scheme (must be between 0.5 and 1.0, default=0.55)
cfl r	-	limiting cfl number for mixing (default=0.8)

4 Bed Evolution Reference

The following keywords are used to specify mobile bed calculations.

Input	Unit	Describtion
>>bed_evolution		
d30 r	m	diameter of particle such that 30% of sample is finer
dm r	m	mean diameter of particles
d90 r	m	diameter of particle such that 90% of sample is finer
		Note: For branches with variable particle sizes (d30, dm, and d90) the values can be given as e.g. **d90 r1 r2 r3** where r1 is the diameter, r2 and r3 are the lower and upper distance [km] of the interval where the diameter r1 holds.
theta_crit r	-	critical shields factor (default=0.05)
repose r	-	tangens of angle of repose of bank material (default=1.0)
density r	kg/m^3	density of the bed material (default=2650 kg/m^3)
porosity r	-	porosity of the bed material (default=0.30)
inflow_rate r	-	sediment flow rate expressed relative to the water inflow. For negative values of the inflow rate a local equilibrium is assumed (=default).
vaw		uses VAW-formula (Smart/Jäggi) for bed load instead of the Meyer-Peter/Müller formula (=default)
rock_depth r1 r2 r3	m,km,km	defines a rock level below the initial bed level. r1 [m] is the rockdepth that is valid within a reach defined by r2 and r3, where r2 [km] is the distance of the first section and r3 [km] is the distance of the last section
write r 'name'	km, string	writes timetable of transport rates and bed load at position r[km] to file 'name' for further usage (e.g. input into spreadsheet)

5 Mixing Reference

The following keywords are used to specify mixing data.

Input	*Unit*	*Describtion*
>>mixing		
tubes i	-	number of stream-tubes (default=10)
source_cs i	-	cross-section number of the source (as defined in the topolgy list of the reach data)
source_pos i	-	lateral position of a point source as the number of the stream tube starting from the left border
source_pos i1 to i2	-	lateral position of a line source where i1 and i2 define the left and right ends of the source
load r	g/s or K/ (m^3s)	steady load of the source at the site that has been set previously. The units are [g/s] for a tracer and [K m-3 s-1] for a thermal source (with K=Kelvin) Note: Location of the source must be defined before the load!
load ** **r11 r12** **r21 r22** **. .**		same as above for an unsteady load with the time [h] in the first column and the load in the second column
diffusivity_coeff r		inverse prandtl number (def=2) for lateral mixing of the tracer/heat. Hint: For local changes of the lateral mixing, modify the 'defcv' of the cross-sections!
decay_rate r	h-1	linear decay rate of the tracer (not for heat sources, def=0)
thermal		indicates that it is a heat source (else it is a tracer source).
surface_flux r	W/(m^2 K)	surface heat exchange coefficient (only for heat sources, def=0)
>>output		for the specification of the output format.
interval r	h	plotting interval for river mixing calculations (def=1h).
width_factor r	-	width of the sections for 2d plots is multiplied by the factor r (default=1). It also affects transversal plots in POP.

Note: The results of the mixing calculation are stored on a direct-access file (default-name rxres) that can be read with the postprocessor POP (see the download section).