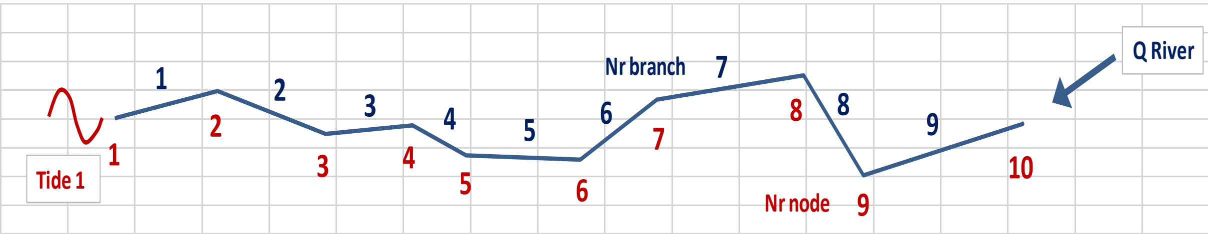
Manual Latipas (Latihan Pasang Surut)

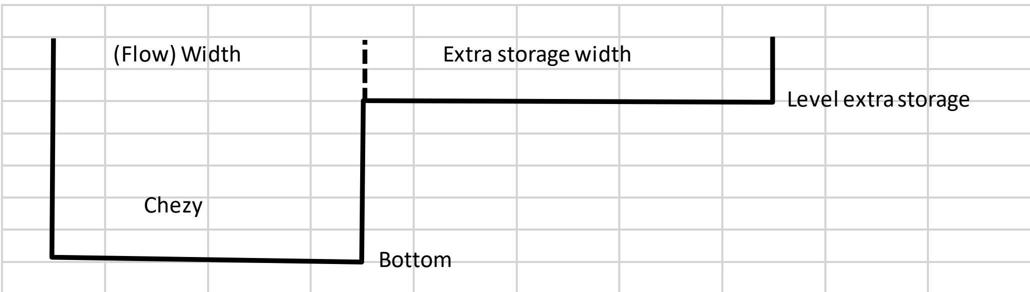
1. *Background*

The general idea is to get insight in the relation between the astronomic aspects of tides and the behavior of tidal waves in seas and rivers. To do so, a one dimensional string of branches is connected to a boundary node in which the tide is composed by adding the 7 most important tidal constituents. The astronomic input consists of the 4 main constituents (M2, S2, K1, O1). The other 3 (N2, K2, P1) are added with the relations from equilibrium theory. The hydraulic input consists of the bathymetry of the channels in the string (Depth, Flow Width, Length, Roughness and Storage Width).



Node 1 is always a tidal boundary condition. In the last node (number of nodes = number of branches + 1), a river discharge (which also can be 0, in case of a bay).

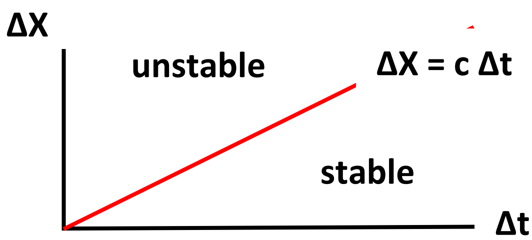
The branch data are as follows:



All dimensions are in m; the Chezy roughness value is in √m/s.

The calculation scheme is explicit, meaning that all values at the new time level are calculated with information of the old time level only.

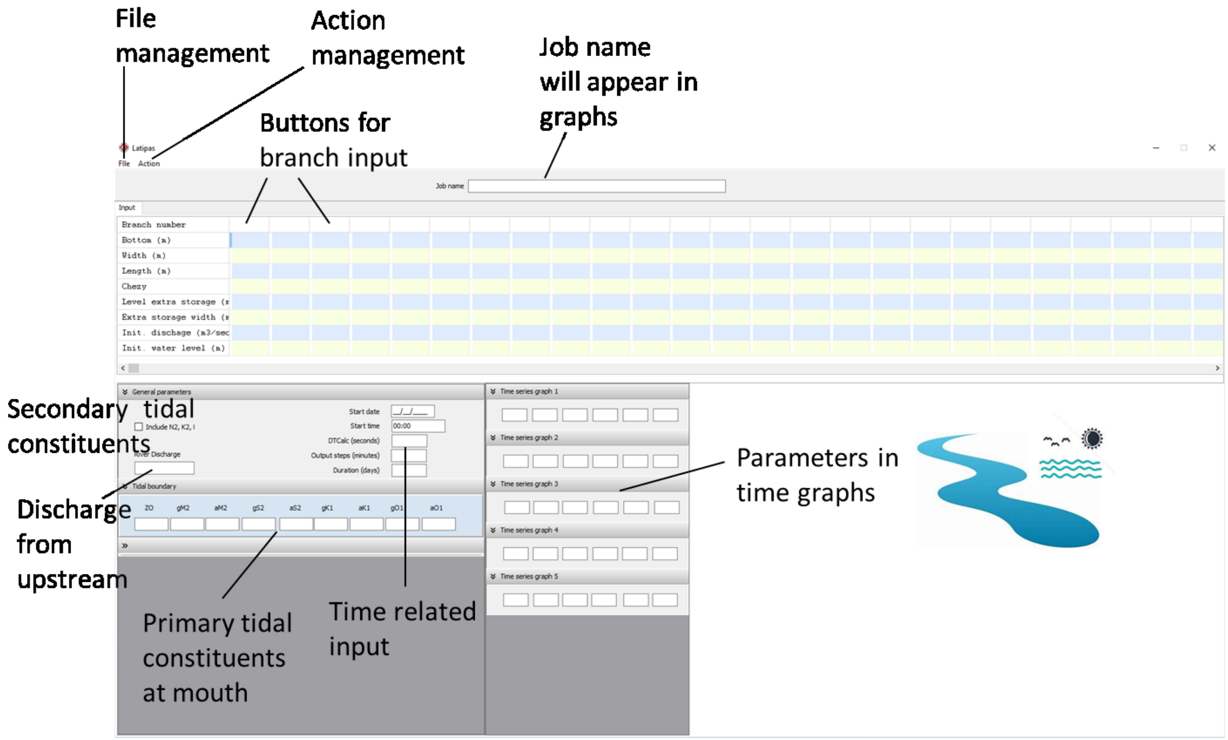
That means limitations to length and/or time steps: ***Δt < Δx/c***, for all branches. Δt is the calculation time step (DTCalc), Δx the branch length and c the wave celerity. c = √gd, in which g = acceleration of gravity and d = depth.



In words one could say: the calculation should not leap forward in time or space beyond the wave.

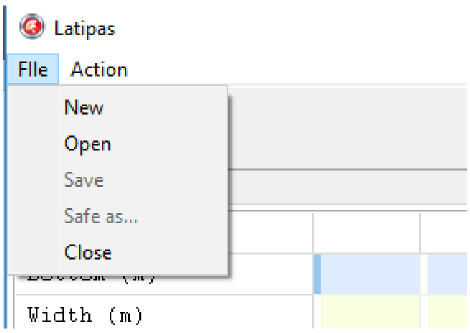
2. *Input*

Opening screen Latipas



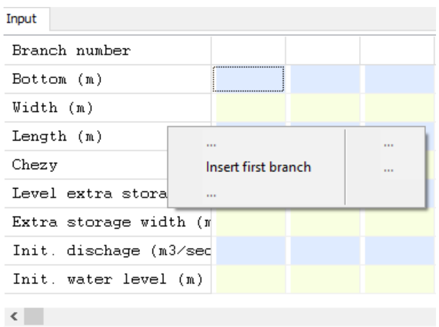
File management

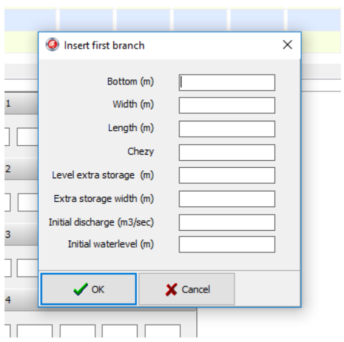
New: Create a new file
Open: Open an existing file



Branch input 1

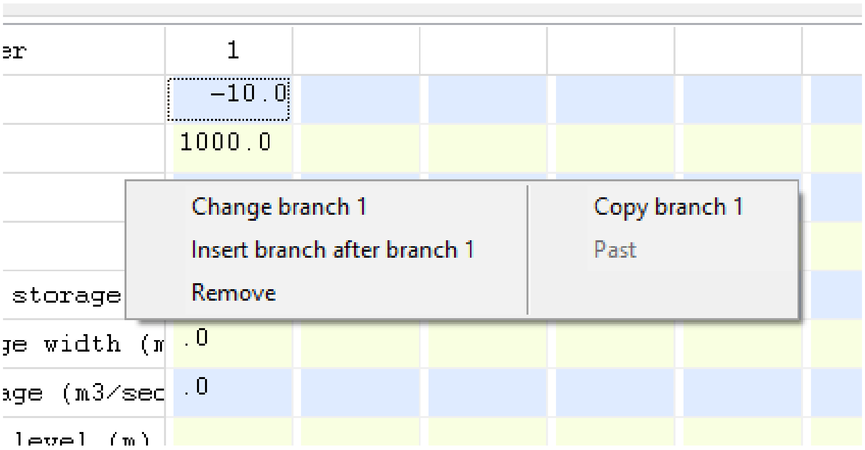
Click 1st branch button, start with 1st branch and fill in table. Bottom, width, length and Chezy are mandatory. Default values other parameters are 0





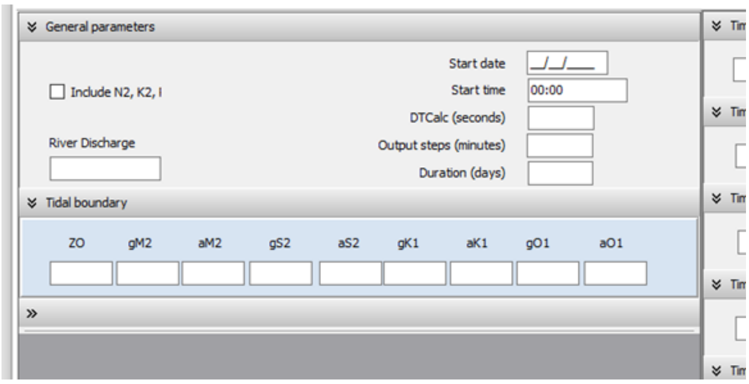
Note: The bottom means 'bottom position', not depth! So , when the bottom is 10 m below 0-level, the input is -10. The 0-level can be chosen by the user.

Branch input 2



For next branches: Always click on the last branch (here branch 1). ***Insert branch after branch 1*** gives a new empty table for branch 2. ***Copy branch 1*** will copy the data of branch 1 and Paste will create branch 2 with these data, and so on.

General input



The column at the right hand side is for the *time parameters,* The bottom row is for the *primary tidal constituents,* the top box left for the *additional tidal constituents* and the left box in the middle for the *river discharge.*

Time parameters

1. Start date: 10/12/2018: 10 December 2018
2. Start time: 09:00
3. DTCalc (seconds): timestep in calculations
   Note: DTCalc should be smaller than the minimum value of Branch length/wave celerity, in formula: DT < DX/c, where c = √(g.depth) (for all branches). See background
4. Output steps (minutes): time between output is given in tables and graphs
5. Duration (days): total time for which values are calculated

Primary tidal constituents

The are the 4 constituents as given in the Admiralty Tide Tables. Z_0 is the chart datum level, g is in degrees (0-360) and a is in m.

Additional tidal constituents

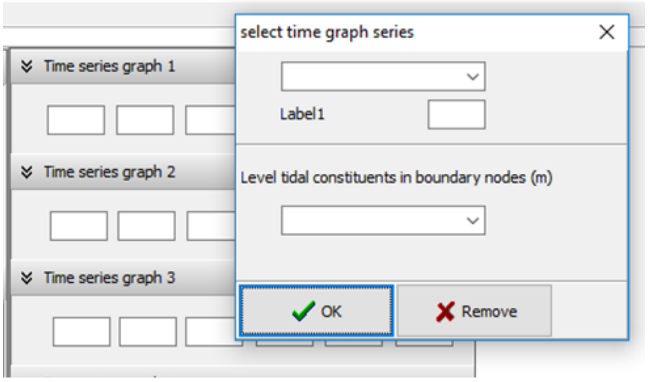
Additional to the primary constituents, the program can add 3 more: N2, K2 and P1. The are related to M2, S2 and K1 respectively, according to equilibrium theory (N2/M2 = 0.192, K2/S2 = 0.272, P1/K1 = 0.331).

River discharge

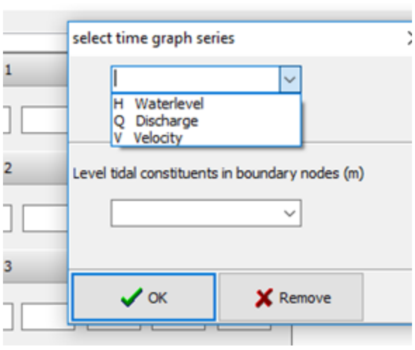
The inflow at the upstream end of the river (upstream of last branch)

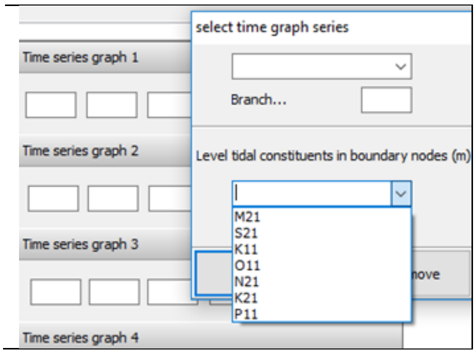
Time series input

Double click in one of the boxes of a time series graph row. In the first box you can choose from water level, discharge or velocity. In the second box you fill in the node or branch number.



Or choose the next row to select one of tidal constituents in node nr 1 (mouth of river or estuary)

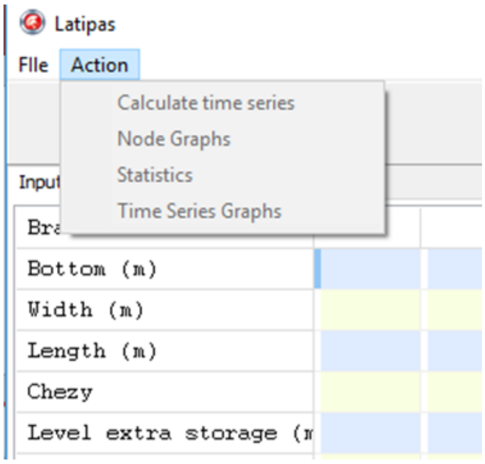




Action management

First, with ‘Calculate time series’ the program will produce results for water levels, discharges and velocities throughout all branches. These results are stored in a table. From this table, graphical results can be derived. ‘Node Graphs’ are cross-sections of this table at a certain time level, while the ‘Time Series Graphs’ are cross-sections at a certain location.

With ‘Statistics’, an overview of minimum, average and maximum values is presented for all water levels, discharges and velocities.

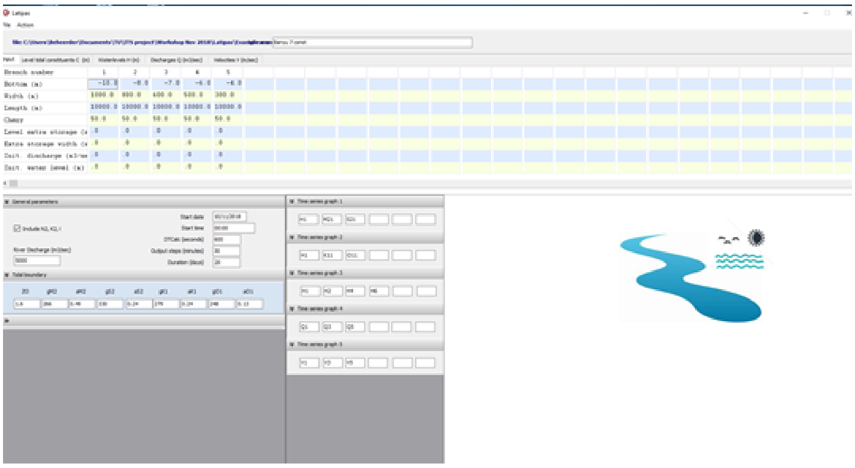


Note: Every time you open a Latipas file, you have to recalculate (‘Calculate time series’) to see results. The program does not save the calculations. Also, when you change something in the input (branch dimensions, tidal data, river discharge, calculations have to be done again.

Only the Time series input can be changed without recalculation, because this makes use of the result table which is available and remains the same.

3. Output

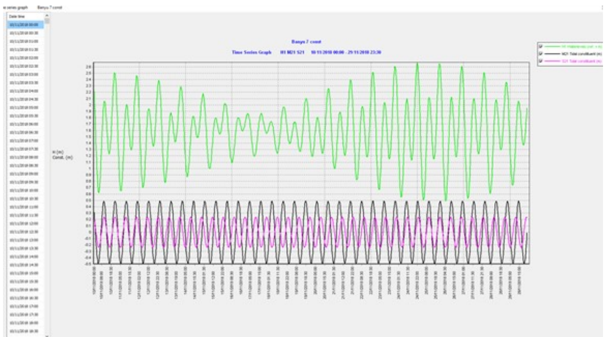
The output is described with the following example:



A river mouth with a total length of 50 km, 5 branches with varying width and depth. A river discharge of 5000 m3/s and a tidal boundary with a mixed tide.

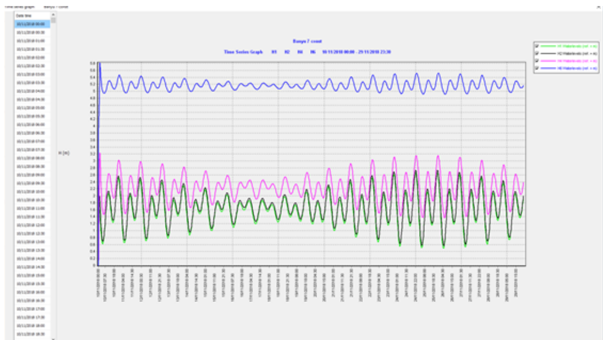
The first Time Series Graph is the water level at the mouth with the constituents M2 and S2. When M2 and S2 coincide, it is springtide, when they are opposite it is neaptide.

Note: Thanks to the average level of 1.6 m in the boundary condition, the constituents in the graph are clearly visible! Otherwise it would be difficult to see.

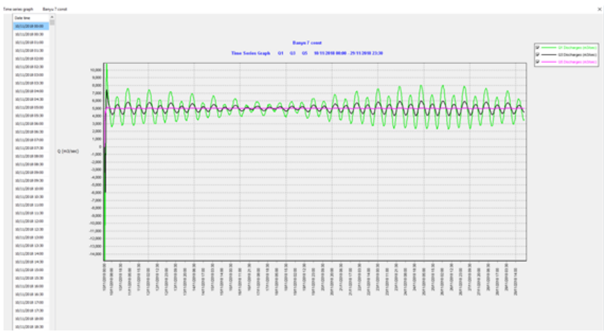


This graph shows the water level along the estuary (nodes 1, 2,4,6). Near the mouth, the water level hardly changes, More upstream the level gets higher and the amplitude becomes smaller.

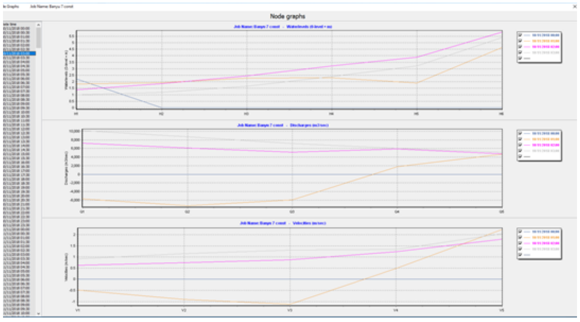
Note: The initial water level at all nodes and the initial discharge in all branches are 0. It takes some time (here only a few hours) to get into "full swing".



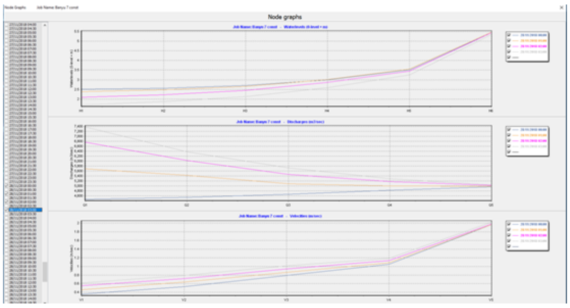
This graph shows the discharge in branch 1, 3 and 5. The average is 5000 m3/s, as is the river input. In branch 5 it is nearly constant, towards the river mouth, the tides cause variation. Note again the initial period of



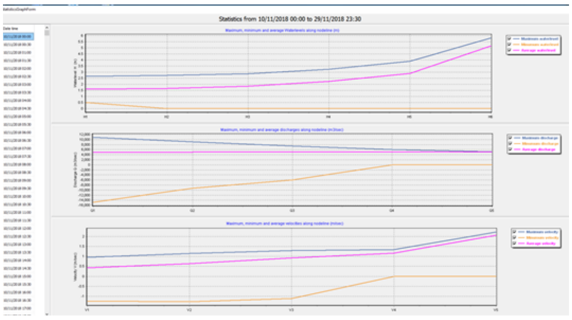
These are the node graphs (parameters along the river at a certain time). In a node graph, 5 time level boxes can be ticked, giving 5 node graphs. Here the first few hours are depicted and the initial phase is clearly visible: At t = 0, all water levels are 0, only the tidal boundary has a certain value.



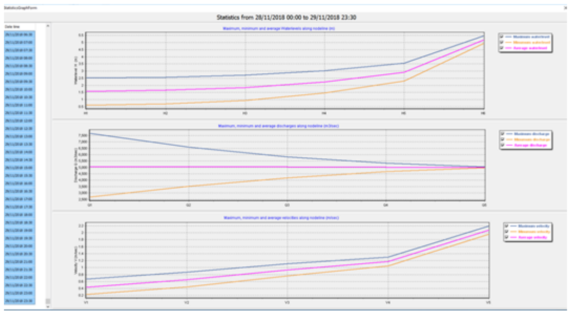
Here node graphs are given when the calculation process is in full swing. These graphs make more sense form a hydraulic point of view.



With “Statistics” the minimum, average and maximum water levels, discharges and velocities along the river are given. Default is the presentation of the whole calculation period (here 20 days).



Again, it makes more sense to show the statistics after the initial period. That can be done by selecting the desired period in the left column with date and time. Choose e.g. one or two full days.



The graphs can be processed further in two ways:

- It can be exported as a bitmap picture to incorporate in documents
- It can be converted into a file (Comma Separated format), which can be read into a spreadsheet program.

Note: Date and time is not converted into Excel format correctly but the date/time column can easily be replaced manually with Excel formatted data