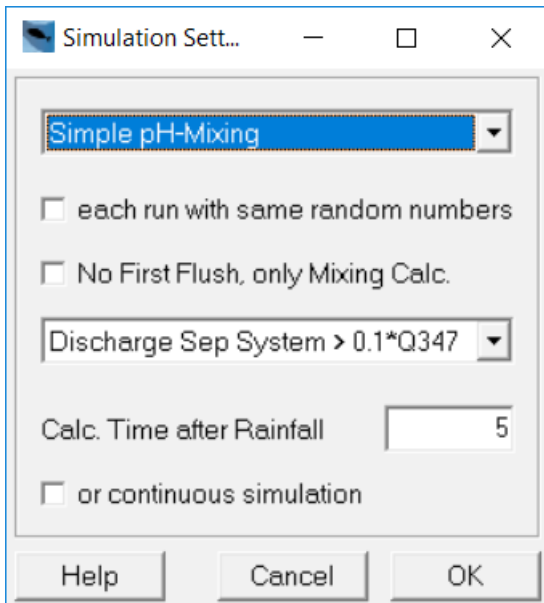# REBEKA Update 2.3
New Features and Improvements

Improvements in the Simulation

The following new options were introduced:

No First Flush, only Mixing Calculation

If this option is activated then TSS is modeled as a solute, i.e. the resulting TSS concentration is calculated from the mixture of the different inflows (wastewater and stormwater flow, constant or file inflow) taking into account their concentrations. This option is not the same as First Flush Coefficient b = 1. With this setting, the TSS concentration is constant over a rainfall event. The resulting TSS concentration is calculated as the quotient of the total TSS load to the total discharge per rainfall event.

Calculation Time after Rainfall

Until now, this value could only be changed in the INI file. It determines how long after the rainfall end is further modeled. The default value of 5 means that 5 times the maximum of the storage constants of the combined and separate sewer system catchments is simulated further (e.g. St. c. CSS = 20 min, St. c. SSS = 10 min => Maximum = 20 min => Calculation time = 5 x 20 min = 100 min, i.e. simulation will continue 100 min after the end of the rainfall, unless another rain event follows sooner). Increasing this value is recommended if tank emptying (tank volume / flow to WWTP) is longer than the calculation time after rainfall end (a warning will be displayed in the information window). Even better in this case is performing a continuous simulation (see next point), because then the tank is not considered empty at the beginning of a new rainfall event.

Continuous Simulation

If this option is activated then a continuous simulation is performed, i.e. simulation continous until the beginning of the next rainfall event. The tank is not considered empty at the beginning of a new event, but has the current filling with water and substances.

With this option, a first-flush calculation is not possible and the option "no first flush, only mixing calculation" is automatically activated.

Additions to Simulation Results

Following additions were made to the results of the deterministic simulation:

Annual and Event Statistics

The table has been supplemented by two columns indicating the maximum discharge rates per year for the combined and separate sewer system.

In addition, four new items are available in the pop-up menu to display extreme value statistics of the discharge rates from CSO and SSO and the discharges in the receiving water before and after the overflows.

If one of these items is selected, a table with the discharges, their rank and annuality appears. This table is automatically copied to the clipboard and can be pasted with Ctrl-V, for example be inserted into a spreadsheet.

The maximum discharge rates and those with annuality = 1 year also appear in the results of the deterministic simulation in the subsections combined and separate sewer system.

Results of the deterministic Simulation

Under "Results / Deterministic Simulation", in the "Combined System" window, the discharge proportion of NH4 load in the wastewater is displayed (in %) and whether the minimum requirements according to the new stormwater directive are fullfilled. If the NH4 concentration in the rainwater was not set to 0 for the simulation, an approximate calculation is carried out, which

```
Disch. NH4 WW Load/Total WW Load [%]              0.80
=> Minimum requirements of the directive (< 2%) are met!

Maximum discharge rate [m3/s]                     4.687
Discharge rate for z = la [m3/s]                  1.793
```

| Clipboard | Save | | Print | Close |

```
Disch. NH4 WW Load/Total WW Load [%]              0.80 (approx.)
=> Minimum requirements of the directive (< 2%) are met!

Maximum discharge rate [m3/s]                     4.687
Discharge rate for z = la [m3/s]                  1.793
```

| Clipboard | Save | | Print | Close |
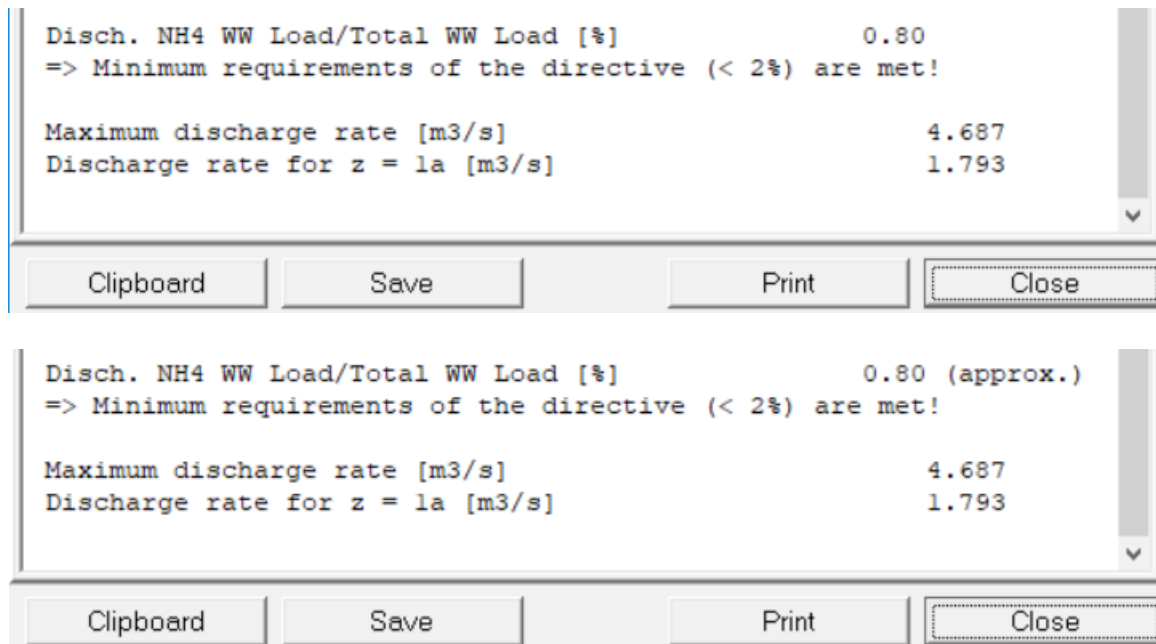
usually agrees well with the exact calculation (see figures above with stormwater concentration 0 and 0.5 mg/l). The discharge proportion of NH4 load is also calculated for old projects, i.e. no new calculation is necessary, just the opening of the project. However, for the display of the maximum discharge rates and them with annuality 1, a new simulation is required.

Copying Results of the det. Simulation directly to the Clipboard

Under "Results" there is a new menu item "Det. Sim.Results => Clipboard "(see next figure), which copies the results of the deterministic simulation directly to the clipboard (instead of" Results / Deterministic Simulation / Clipboard ").

More precise Determination of the following Quantities

- Combined sewer system: Overflow volume per year [m3] if the connected area is 0 and only inflow from a file exists

- Combined sewer system: Runoff Volume to WWTP during Wet Weather per year [m3]

- Combined sewer system: TSS Load to WWTP during Wet Weather per year [kg]

- Combined and separate sewer system: TSS Load retained in CSO Tank per Year [kg] (TSS sedimented in the tank)

These mean values were possibly determined inaccurately, if the simulation duration deviated strongly from whole years.

Results of the stochastic Simulation

The probabilities to fullfill the STORM limit values are now displayed to the right of the cummulative probability curves (window "Critical Events" and "TSS immission"). Click on the text to copy it to the clipboard. These results can also be copied to the clipboard by "Results / Stoch. Sim. Results => Clipboard" (then both the critical events and the TSS immissions are copied).
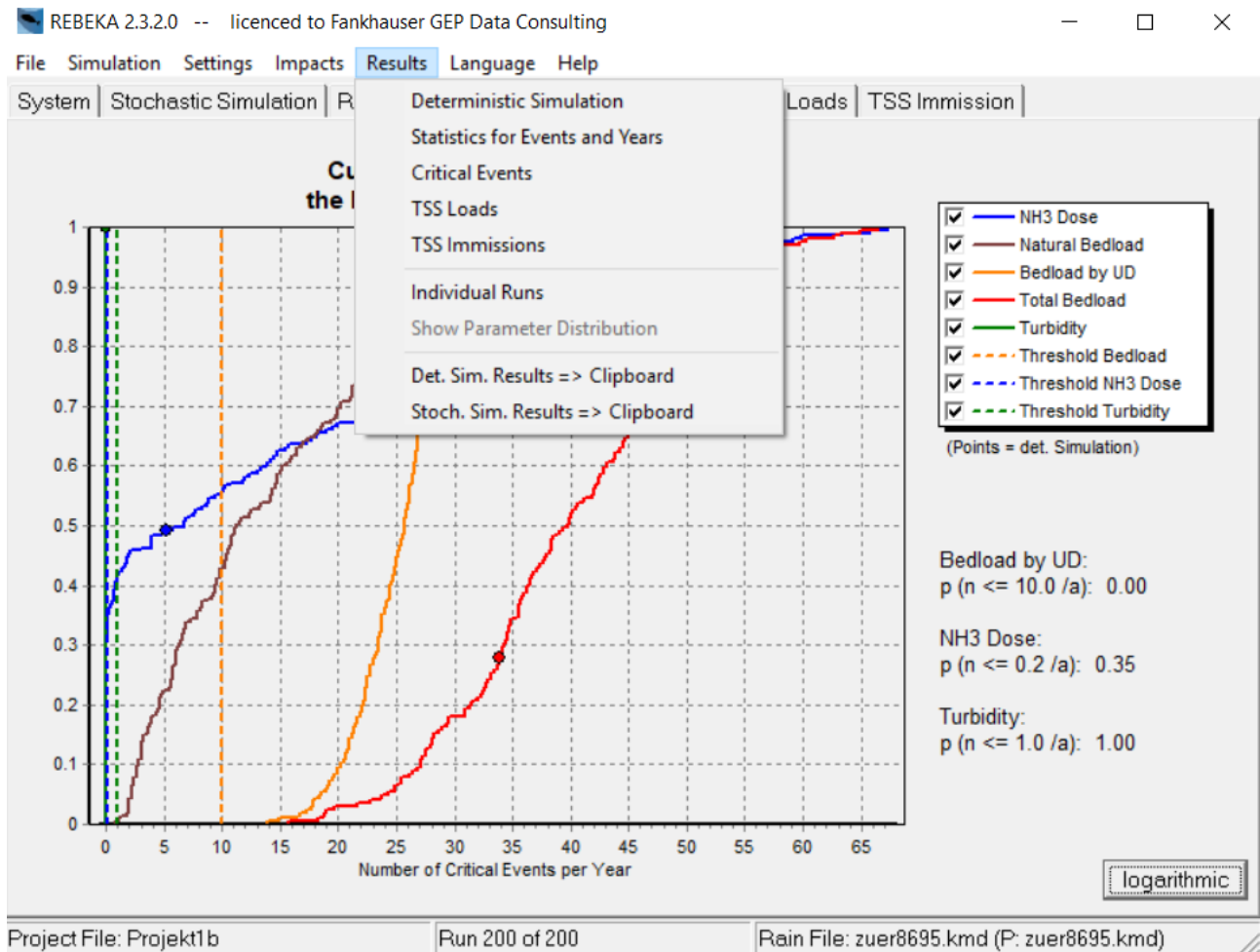

These results are also shown in the results of det. simulation under immissions. An example:

Bedload by UD p (n <= 10.0/a)	0.00
NH3 Dose p (n <= 0.2/a)	0.35
Turbidity p (n <= 1.0/a)	1.00
Colmation p (t <= 20%)	1.00
Toxicity p (t <= 5%)	0.53
O2 Depletion p (t <= 10%)	0.92

By „Results / Det. Sim. Results => Clipboard" all results can be directly copied to the clipboard and pasted to another program (e.g. Excel).

By clicking on the points in the cummulative probability curves, different quantiles are displayed instead of the standard deviation (see fig. below).
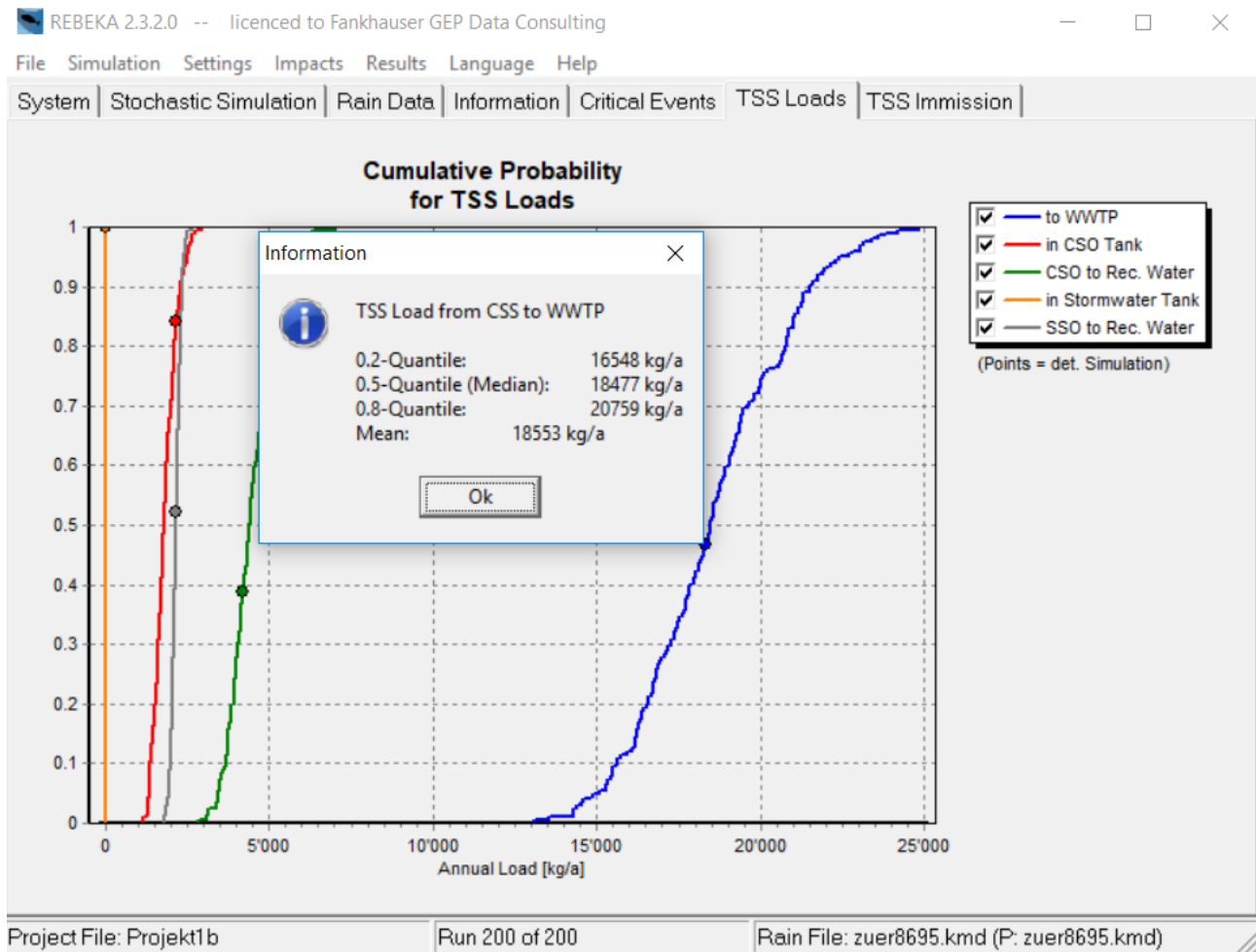
Improvement in the modeling of a constant inflow

When choosing a constant inflow, a rainfall intensity can now be specified, above which the

constant inflow should be active. If the rainfall intensity falls below this value, the inflow is 0. This makes the simulation of a throttle flow from an upstream CSO more realistic. Nevertheless, it is recommended to do the modeling with two separate projects (one for the upstream CSO and one for the following structure) and to use the throttling flow of the first project stored in a file as an inflow in the second project.

User Interface Improvements

- **Status bar:** Click on project name or rainfall data filename to copy the corresponding path to the clipboard (useful for the documentation).

- **Status bar:** Right-clicking on project name or rainfall data filename opens a file explorer window of the corresponding folder.

- Window **Inflow data from file** (after clicking on "Inflow") and window **Merge two flow files** (after clicking on "File / Merge Two Flow Files"): The width of the window is adapted to the lengths of the file names. In addition, the width can be changed manually.

- **Windows 10 Compatibility:** If certain subwindows are minimized, sometimes it is not possible to make them visible again. When the menu item is selected again, they reappear in the old position and with the old size.

- **Help Update** (German, English, French, for Italian the English help is activated, since no Italian translation is available)

- **Warning in Information window** if sedimentation efficiency factor > 0 and tank volume = 0

- **Warning in Information window** if tank emptying > minimal calculation time after end of rainfall

- **Error correction** for false umlauts during HTML export of the table with upper and lower limits of the parameter values (table **Parameter Variation**)

- **Warning in Information window** for constant inflow: will be set to zero if inflow from file (until now warning was only in English)

Other Changes

- **Additional column in the _step.csv file** with the TSS conc. in the outflow of the combined sewer system

- **Two additional columns in the _det.csv file** with the maximum discharge rates per event for the combined and separate sewer system

- **Calculation of shear stress** τ is no longer performed iteratively per time step, but a Q-τ table is created before the simulation and τ is subsequently determined at each time step from Q by interpolation from the table values.

- **Installation of a log window**, which becomes visible with Ctrl-Alt L and shows the sequence of the program start. This makes it easier to see when an error occurred when it originated. In the calculation, information about the interpolation of the Q-τ relationship is also written there.

- **Improvement:** "Save file as": if flow to WWTP saved into file is active, the dialog for entering the file name is called (previously the name was adopted, which meant that without changing the name, the old file was overwritten during a simulation without warning)