SUNY User Manual

Brukermanual, SUNY

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SUNY User Manual (Brukermanual, SUNY)

Sammendrag:

Dette er manualen til software for beregning av usikkerhet i saltmålinger. (saltfortynningsmålinger)

This is the manual for the software for calculating uncertainty in salt-measurements. (salt dilution measurements)

Se også/see also

Rapport 29/2020. Uncertainty of salt discharge measurement - The SUNY Framework (ISBN: 978-82-410-2050-6)

Link aug. 2020: https://alexandrehauet.shinyapps.io/SUNY_Salt_Dilution/

Emneord:

Vannføring, vannføringsmåling, salt, fortynning, saltfortynning, saltmåling, nøyaktighet, usikkerhet, usikkerhetsberegning, måleusikkerhet, feilkilder, GUM, HUG, kvalitet

Discharge, discharge measurement, salt, dilution, salt dilution, salt measurement, accuracy, uncertainty, uncertainty calculation, measurement uncertainty, sources of error, GUM, HUG, quality

Forord

Denne rapporten er en av flere rapporter om usikkerhet i vannføringsmålinger skrevet av Alexandre Christophe Hauet, PhD, for hydrometriseksjonen på NVE. Hydrometri - Teknikk og feltdrift HHT, Hydrologisk avdeling, NVE.

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SUNY v01 User Manual

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Contents

1 Introduction

SUNY stands for **S**alt **UN**certaint**Y**. It is an application based on R Shiny language allowing to compute the uncertainty of salt dilution discharge measurement using the instantaneous injection method with Sommer TQ-Tracer's instruments. This document is a technical manual describing how to use the application, and the reader should refer to the SUNY Technical Paper for a detailed description of the computation of the uncertainty. The uncertainty computation is working only for measurement using 2 probes.

2 Export file from TQ-Commander

SUNY uses .xml files exported from the Sommer TQ-Commander software. Once you have processed your measurement with TQ-Commander, save your file and go to Synchronization (Figure 1).

In the Synchronization menu, choose Export Mode using XML-File format. Select a destination folder, then select the file you want to export and press the arrow, (Figure 2).
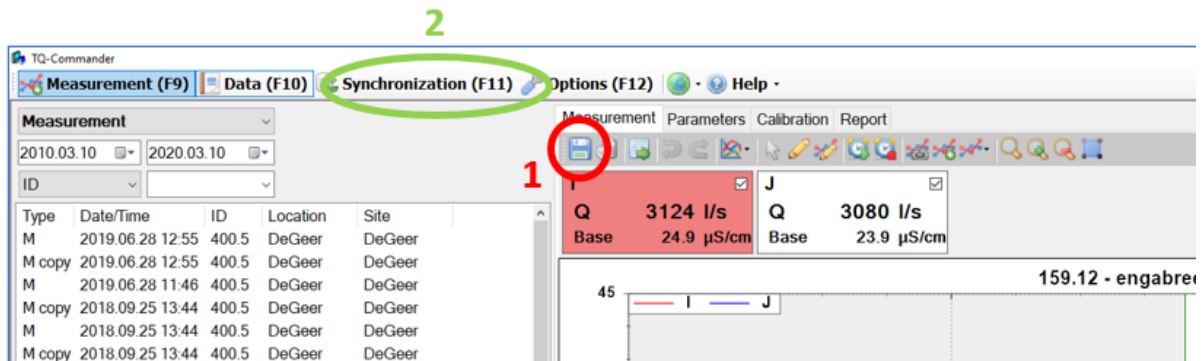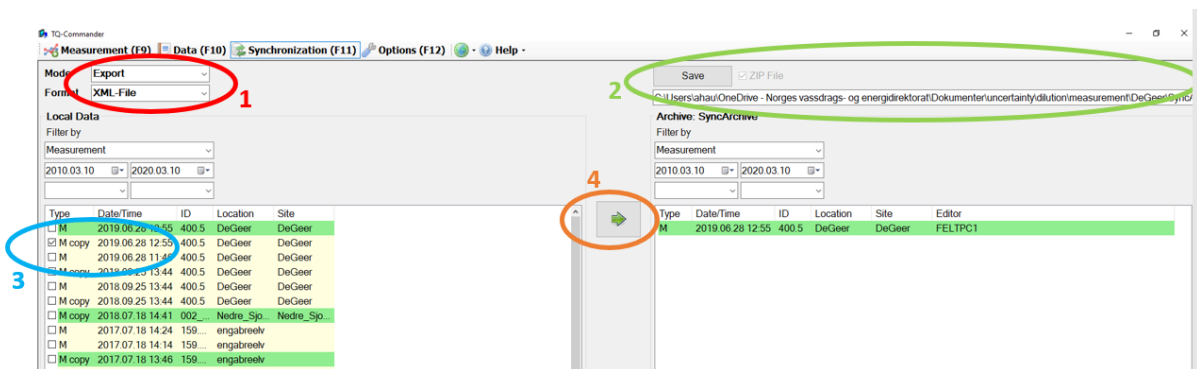
Figure 1: Export data from TQ-Commander - 1

Figure 2: Export data from TQ-Commander - 2

A file called SyncArchive.zip is created in the destination folder. Unzip the .xml file corresponding to your measurement (the file name should start with M_).

3   Process file in SUNY

- Launch SUNY from https://alexandrehauet.shinyapps.io/SUNY_Salt_Dilution/.

- Click on 1 - Select .XML and select the xml file exported from TQ-Commander (see Section 2).

- Click on 2 - Open Measurement. The App displays :

  - In the side panel, a table with some parameters exported from TQ-commander, and some default values of uncertainty. It is possible to modify the time of

beginning and ending of the integration of the tracer wave, and to modify the default values of uncertainty.

– In the Main panel, the name and code of the station and the date of the measurement are displayed together with the mean discharge and the discharges measured by the two probes. The conductivity measured by the two probes are plotted with the selected time of beginning and ending of the integration of the tracer wave. The range of the calibration is shown with green highlighted color, and red when out of the range of the calibration. At the bottom of the panel, a table display measurement from each probe including the discharge, the base conductivity at the beginning and end of the tracer wave, the conductivity reach at the peak of the tracer wave and the difference between the peak and the base conductivity.

– In the Calibration panel, the calibration points and the associated linear fit are displayed for the two probes. We also display the range of conductivity covered by the tracer wave. On the right side, a figure shows the difference between the measured conductivity and the linear model fitted.

- Click on 3 - Compute Uncertainty. Following the framework described in the SUNY Technical Paper and the values of the table in the side panel, SUNY computes the value of the different error sources and the total uncertainty. The total uncertainty, at a confidence level of 95%, is displayed together with the mean discharge value. The budget of the uncertainty sources are shown as a lollipop graphic in the main panel.

4   Input values and default uncertainties

Once a measurement is open, a table is displayed in the side panel with the input values found on the xml file and some default values of uncertainty.

- Mass of salt (g) correspond to the mass of salt injected and is extracted from the xml file. The corresponding uncertainty is set as 0,5% by default. User can modify that value in case the weighting of the injected salt was not accurate.

- Flask Volume (mL) is the volume of the flask used for the calibration, and is extracted from the xml file. The tolerance of the flask is set as 0,1%, corresponding to a plastic Class A flask and its sensitivity to temperature. If a glass Class A flask is used, the tolerance must be decreased to 0,05% by the user. If a Class B flask is used, the tolerance must be increased to 0,2%.

- Pipette Volume (ml) is the volume of the pipette used for the additions during the calibration.

– It's default tolerance is 1%, corresponding to the tolerance of manual single-channel pipette. User can modify this value if using a different quality of pipette.

– Operator/Environment effect takes into account some errors in the handling of the pipette, or errors due to a difference of temperature between the pipette and the water. The default value of uncertainty is set to 2%, from laboratory experiments conducted at EDF (Poncet 2017). User can modify this value.

- Concentration of calib. solution (mg/L) is the concentration of the solution used for the additions during the calibration, extracted from the xml file. It's uncertainty is set to 1%. User can modify this value depending on the protocol used for the preparation of the calibration solution.

- Wave begining (s) is the time set by user in TQ-Commander to define the begining of the salt wave, extracted from the xml file. User can modify that value in **SUNY**. If so, the discharge computed by **SUNY** can differ from the one computed by TQ-Commander.

- Wave ending (s) is the time set by user in TQ-Commander to define the end of the salt wave, extracted from the xml file. User can modify that value in **SUNY**. If so, the discharge computed by **SUNY** can differ from the one computed by TQ-Commander. An uncertainty is associated to the location of the end of the wave, rating the accuracy of the identification of the end of the wave. The default value is an uncertainty of 10% of the wave length, corresponding to a fair quality. If the wave shape is very clear and the quality of the location of the end of the wave is very precise, the user must decrease the uncertainty to 5%. If the wave is long or noisy and the location of the end of the signal is difficult, the uncertainty must be increased to 20%.

- Probes resolution (uS/cm) is the resolution of the conductivity probes, extracted from the xml file.

- Tracer loss indicates the mass of salt that may have been lost during the injection, or in the river (sedimentation). By default, this value is set to 0 g.

- Flow steadiness is an uncertainty accounting for the possible unsteadiness of the flow, meaning that the discharge changed during the wave of tracer. If this happen, the possible discharge variation (in m^3/s) between the beginning and the end of the tracer wave must be given.

- Residual systematic errors represent the bias of the method itself, or the residual error if the measurement is perfectly realised. The default value is 0%, and user can change it.

- Base conductivity variation accounts for a possible variation of the base conductivity during the tracer wave. The default value is 0 microS/cm, and user can change it.

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- **Temperature** accounts for the sensitivity of the measurement of conductivity to the temperature. If the temperature is measured during the tracer wave, like with the TQ-Tracer, then the uncertainty of the probe, 0,5°is used. If the temperature is not measured, the user must increase this uncertainty to 5°.

5   Uncertainty computation

The total uncertainty is expressed at the 95% confidence level, and display together with the mean discharge value. It is the combination of the uncertainty sources displayed in the lollipop graphic :

- **Mixing**: uncertainty due to a bad mixing of the tracer, computed using the difference of discharge measured by the two probes.

- **Probe resolution and noise**: uncertainty due to the resolution of the sensors and to the noise of the signal, computed as the dispersion of the signal before and after the tracer wave.

- **Location of end**: uncertainty due to the accuracy of the location of the end of the wave. It depends on the wave shape and on the value given by the user in the input table.

- **Calibration law**: uncertainty due to the accuracy of the equipment used for the calibration (flask and pipette, and the operator and environment effects) and to the uncertainty of the calibration solution, given by the user in the input table.

- **Temperature**: uncertainty due to the accuracy of the temperature probe, or to the absence of temperature probe, following the user input.

- **Range of calibration**: uncertainty if the measurement conductivity range is not in agreement with the calibration conductivity range, for example if the wave peak is greater than the highest point of the calibration, if the measurement base is lower than the lowest point of the calibration.

- **Mass of salt**: uncertainty in the mass of salt injected. It is given by the user in the input table.

- **Sampling**: uncertainty due to the limited number of points describing the tracer wave. If the wave is very short and only described with few points, the uncertainty will be high.

- **Base conductivity**: uncertainty due to a possible variation of the base conductivity during the tracer wave. It is given by the user in the input table.

- **Residual errors**: uncertainty due to the bias of the method itself. It is given by the user in the input table.

- **Flow steadiness**: uncertainty due to the unsteadiness of the flow, meaning that the discharge changed during the wave of tracer. It is given by the user in the input table.

- **Tracer loss**: uncertainty due to a possible loss of salt during the injection, or in the river (sedimentation). It is computed with a rectangular distribution bounded by the user input (possible loss in g, M_{loss} as:

$$u(loss) = \frac{M_{loss}}{\sqrt{3} \cdot M_{inj}} \tag{1}$$

- **Time**: uncertainty due to the accuracy of the measurement of the time between the recording of conductivity. The default value is 0%.

For the details of the complete uncertainty framework (computation of each error sources,combination of uncertainty sources), the reader can refer to the SUNY Technical Paper)

References

[Pon17]   N. Poncet. *Qualification d'un fluorimètre pour l'amélioration de la méthode de jaugeage par dilution globale à la Rhodamine.* University Grenoble-Alpes, 2017.

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