TECHNISCHE UNIVERSITÄT WIEN

Institut für Wassergüte
Ressourcenmanagement und Abfallwirtschaft

A monitoring network platform for **automated data assessment** and its **long-term application** as surveillance system for transboundary water pollution

Andreas Winkelbauer, Roland Fuiko, Ernis Saračević, Sascha Weilguni, Lukas Nemeth and Matthias Zessner

IWAG, TU Wien

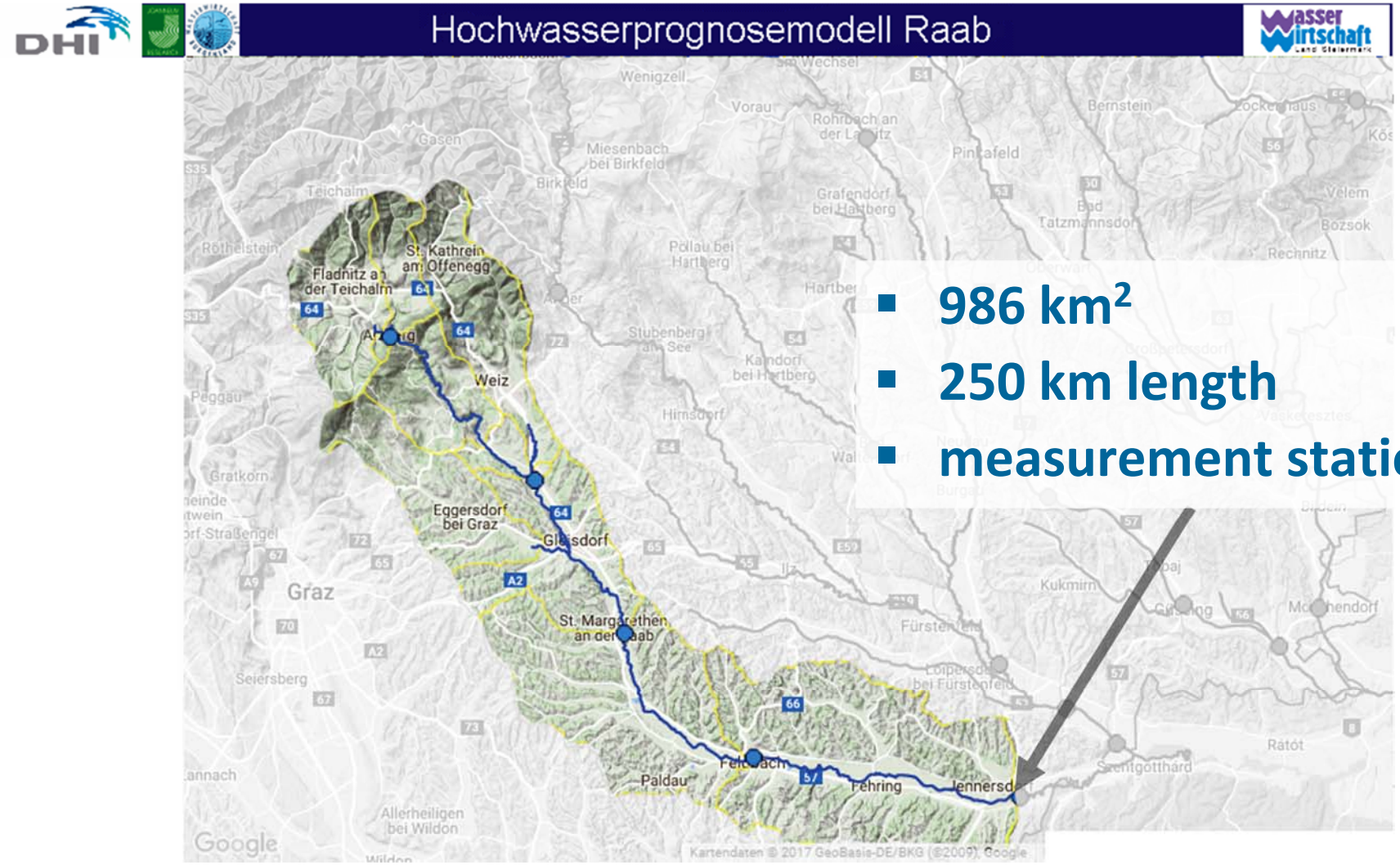
River Basins 2017, Vienna

19th and 20th June, 2017

contents

- **motivation**
- **implementation**
- **lessons learned** and **discussion**

motivation: Raab



- 986 km²
- 250 km length
- measurement station

Source:
Wasserportal Burgenland *http://wasser.bgld.gv.at/hochwasser/hochwasserprognosemodell-raab.html*
Hydrographie Steiermark *http://app.hydrographie.steiermark.at/bilder/Hochwasserzentrale/Source/RaabOverview_at_Pub.htm*
BMLFUW: Hochwasserrisiko-Managementplan 2015. *https://wasser.umweltbundesamt.at/hwkarten/RMP_PDF_Verrechtlicht/AT1021_RMP_2015.pdf*

2007: motivation

- industrial **point source pollution**
- 2007: **foam** conflict AT-HU
- monitoring stations for **water quality** and **foam** index (HU)


SI 1 (11.4.2007, Q=4,2 m³/s)


SI 3 (19.5.2007, Q=3,2 m³/s)


SI 5 (23.11.2006, Q=3,1m³/s)

Source: M. Zessner et al. (2007): *Nachhaltige Wassergütewirtschaft Raab, Online-Monitoring*. Endbericht.

2017: Raab weir in Jennersdorf (AT)

implementation: housing

measured parameters

	parameter	principle	range
NH_4 □N	Ammoniacal Nitrogen	ion-sensitive	0.02 – 10.00 mg/L
		gas-sensitive	0.02 – 5.00 mg/L
Cl	Chloride	ion-sensitive	0 – 300 mg/L
K	Potassium	ion-sensitive	0 – 10 mg/L
EC	Conducitivity	conductive	0 – 2000 µS/cm
		inductive	200 – 20000 µS/cm
NO_3 □N	Nitrate Nitrogen	UV□absorption	0 – 15 mg/L
		ion-sensitive	0 – 35 mg/L
pH	pH□Value	potentiometric	0 – 14
PO_4 -P	Orthophosphate	photometric	0.0035 – 1mg/L
O_2	Oxygen	luminescence	0.05 – 20 mg/L
SS	Suspended Solids	90°□scattered light	1 mg/L – 50 g/L
T	Temperature	PT 100	0 – 50 °C
TOC	Total Organic Carbon	UV-absorption	0 – 60 mg/L
TP	Total Phosphorous	photometric	0.0035 – 1 mg/L

Source: R. Fuiko et al. (2016): *Nachhaltige Wassergütewirtschaft Raab, Online-Monitoring*. Endbericht.

data acquisiton

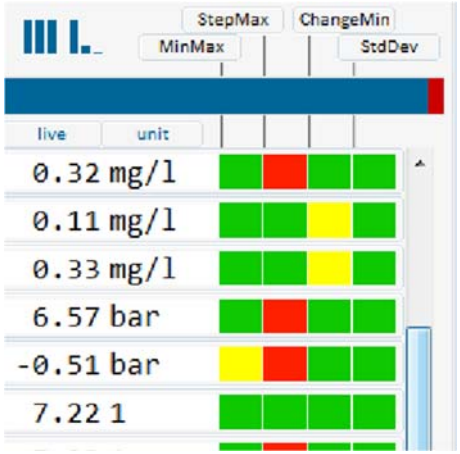
- in the **time domain**
  - combine **datasources** (formats, protocols) at sampling time (10x/h)
  - data **encapsulation, synchronization** and **completeness**
  - manufacturer independent, **consistent**, open **data format**
  - *data channel = timing + measurement value + metadata:*

- it's all about the **timing**...
  - consistent sampling time instance for **continuous**, **discontinuous** and **batch** systems
  - dynamic system state adaptation and **event based triggers**

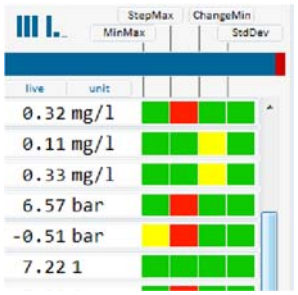
Source:
A. Winkelbauer (2014) et al.: *Crucial elements and technical implementation of intelligent monitoring networks*. DOI:10.2166/wst.2014.415

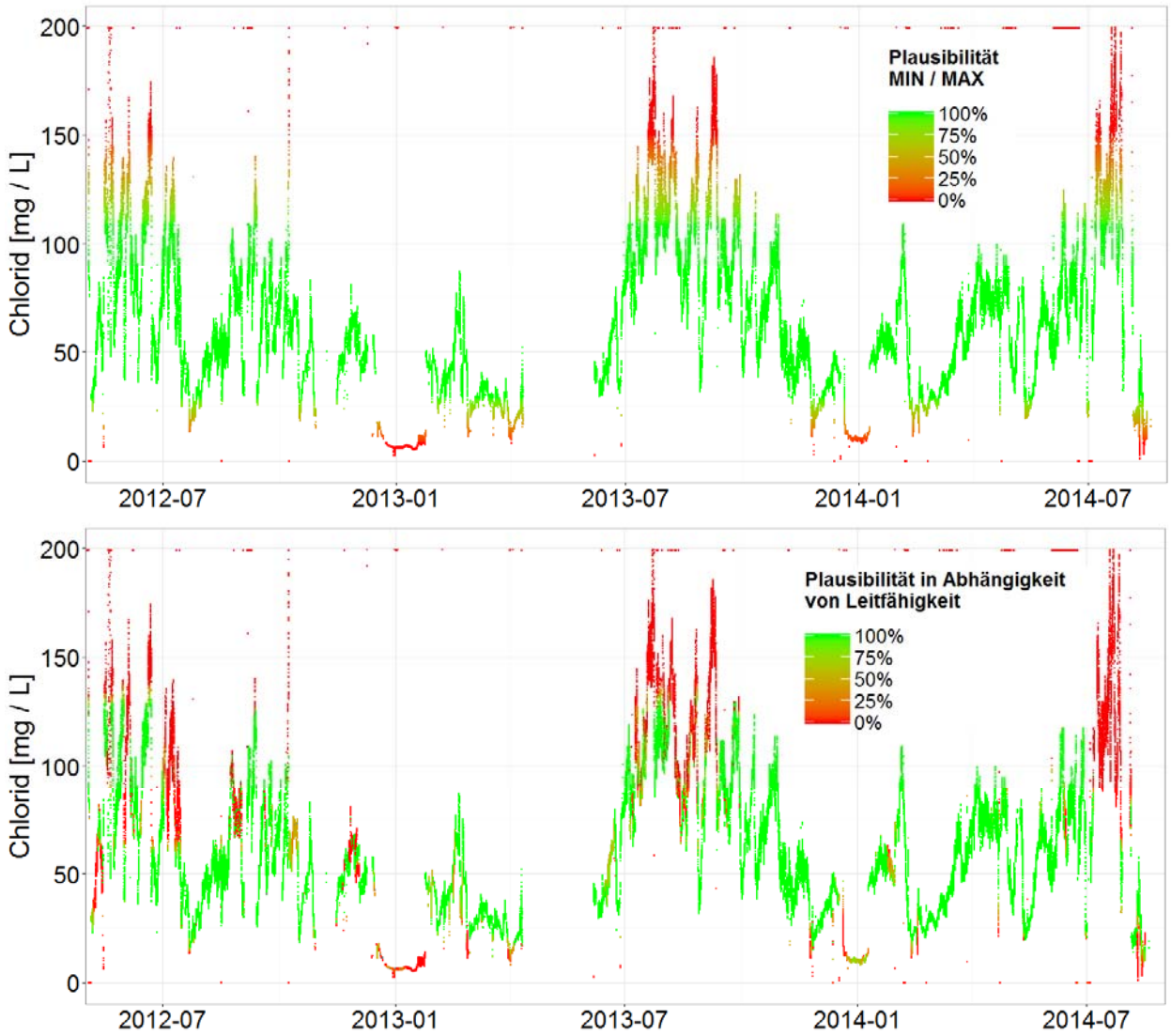
data plausibility

- automatic **assessment**
- data check and classification **on-site**
- statistical tests:
  min/max, step, standard deviation and cross-correlations
- automated **data quality labelling**
- **application** and **site specific** plausibility boundaries
- instant **alarming** via e-Mail and SMS



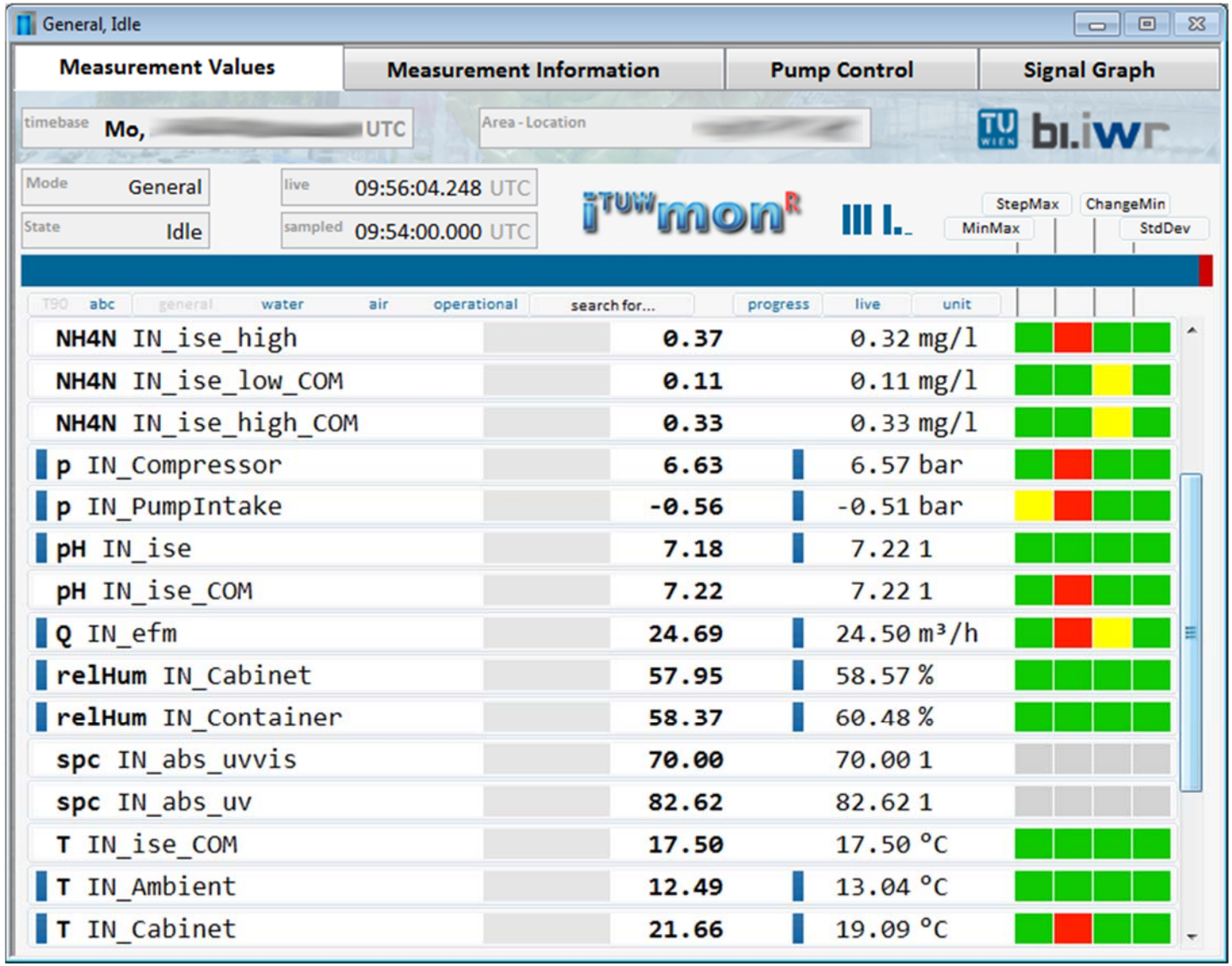
data plausibility example: Chloride





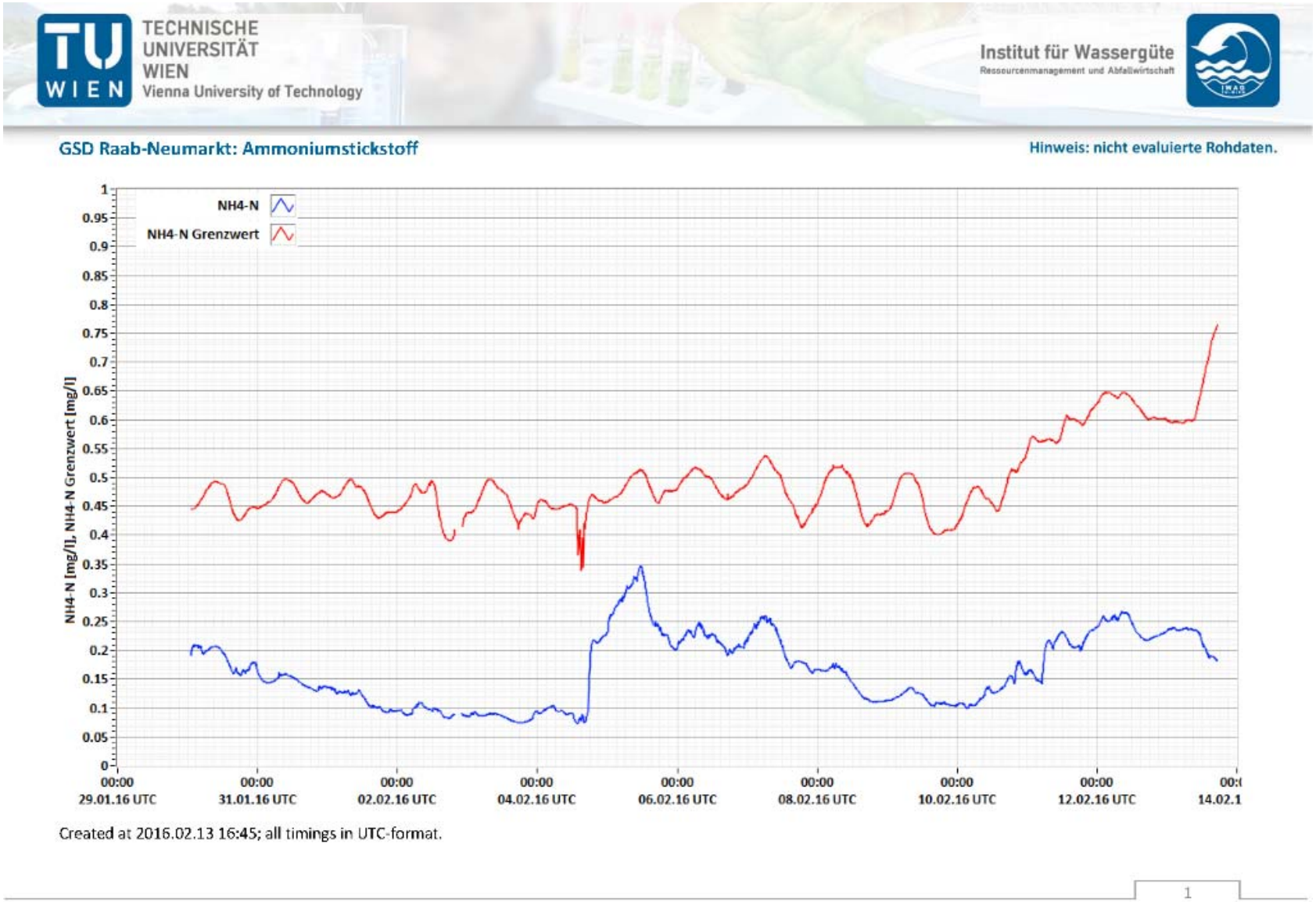
Source: R. Fuiko, A. Winkelbauer (2015): *Automatisierte Plausibilitätsprüfung von on-line Messdaten*. 10. DWA-Fachtagung MSR, Kassel.

iTUWmon user interface



Source: A. Winkelbauer (2016): *Datenmanagement: Vom Sensor zum Report*. WIM239, ISBN 978-3-85234-134-7, S. 53–78.

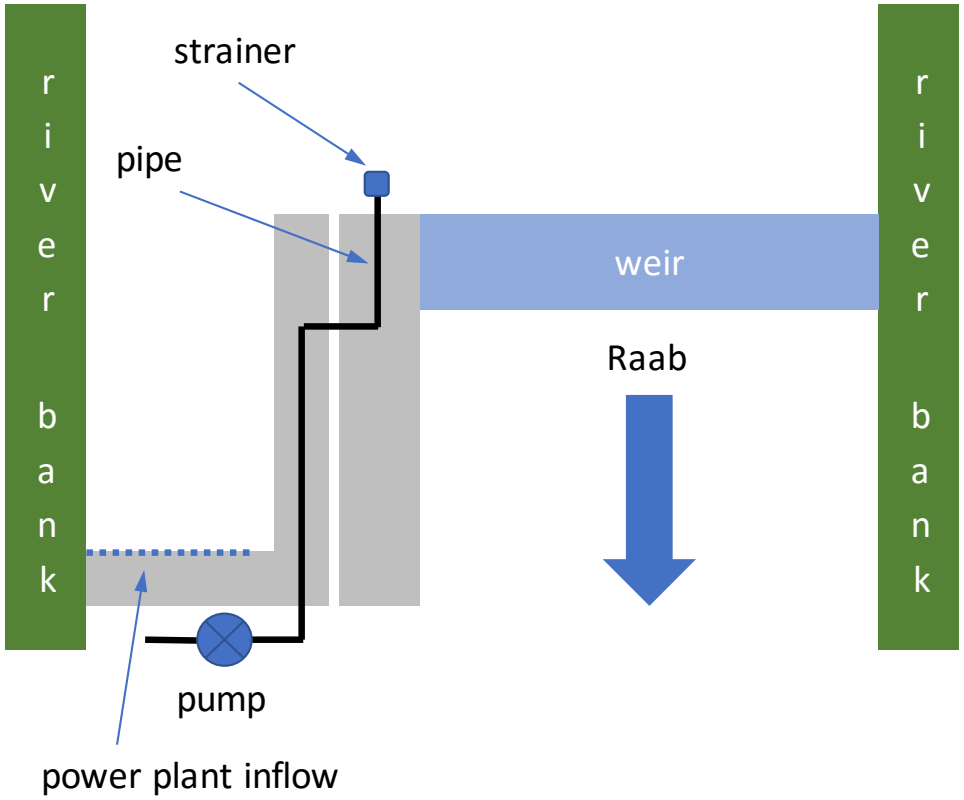
Automatic Data Report ADR



Source: IWAG (2016): *Auto Data Report Raab*. http://iwr.tuwien.ac.at/wasser/raab.html

lessons learned: silting

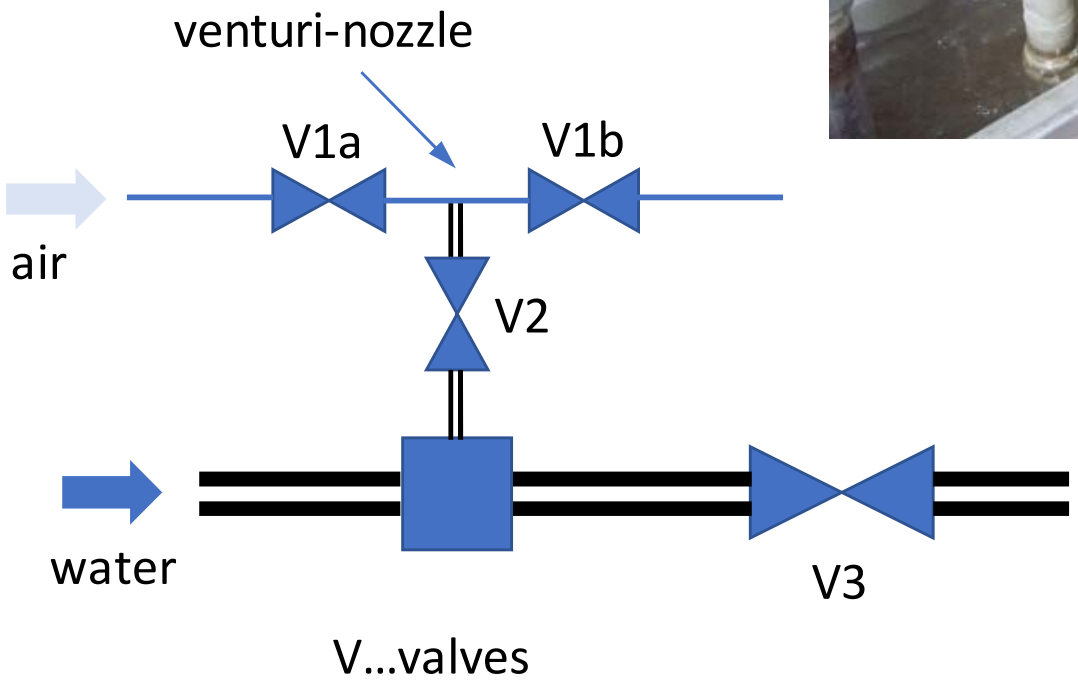
- suction point **relocation**
- scheduler **adaption** for cleaning (pressurized air)



Source: K. Schilling et al. (2013): *Nachhaltige Wassergütewirtschaft Raab, Online-Monitoring*. Endbericht.

probe suction

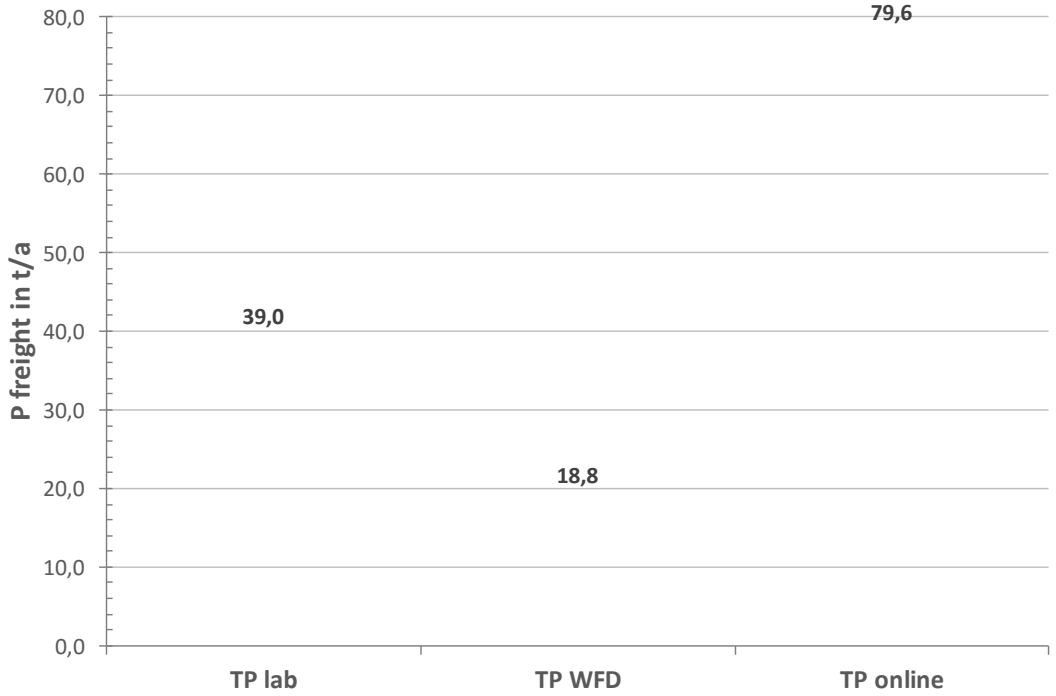
- pneumatic **venturi** evacuation unit
- enhanced **control** and surveillance necessary



Source: adapted from
K. Schilling et al. (2013): *Nachhaltige Wassergütewirtschaft Raab, Online-Monitoring*. Endbericht.

TP load

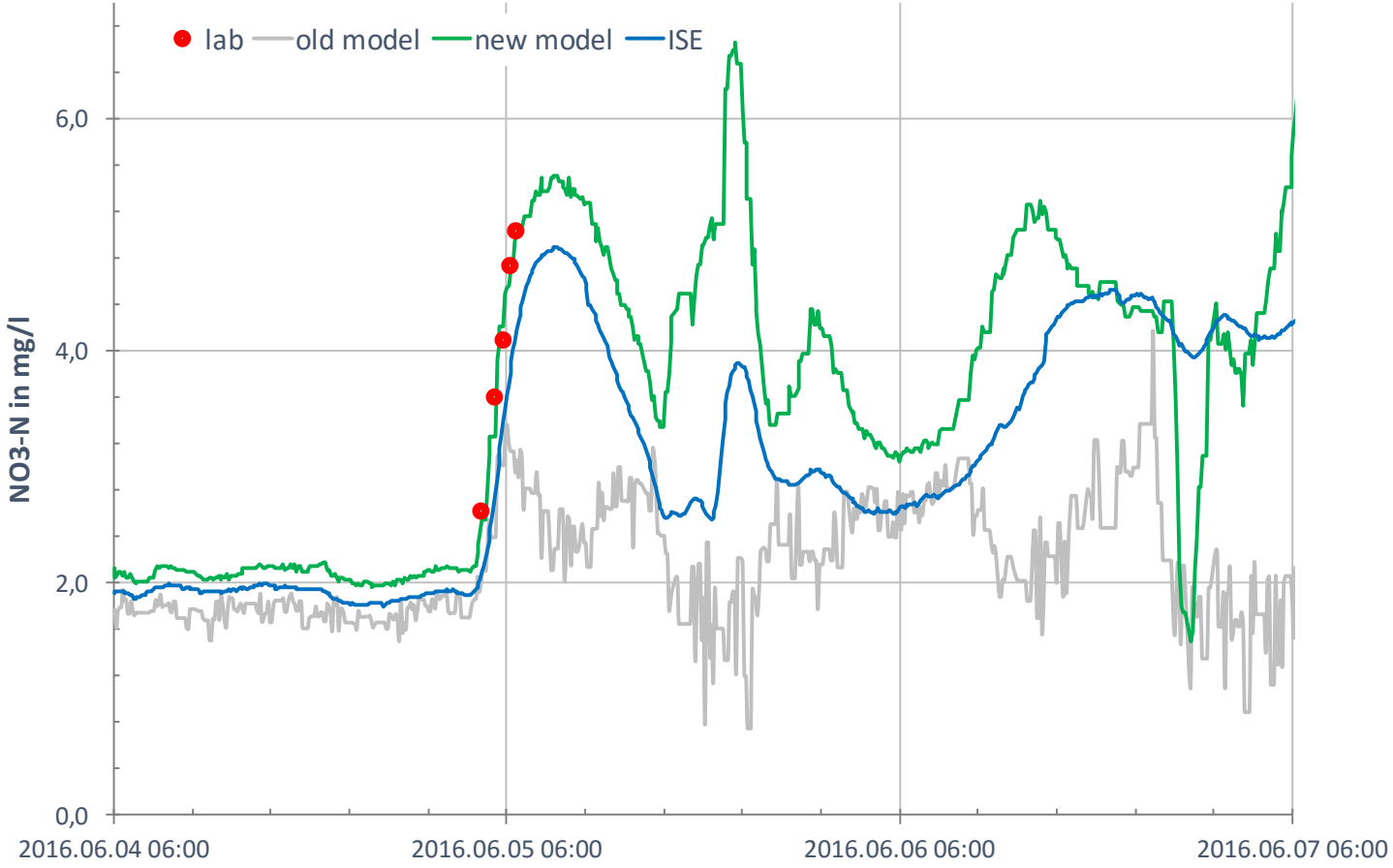
- autosampler with **24 bottles** á 1 liter
- reasonable **reference sampling distribution** during events
- based on e. g. **turbidity**
- water framework directive WFD: **12 samples/a**
- **loads** in 2016:
  online vs. WFD
  → factor 4 (!)



Source: R. Fuiko et al. (2016): *Nachhaltige Wassergütewirtschaft Raab, Online-Monitoring*. Endbericht.

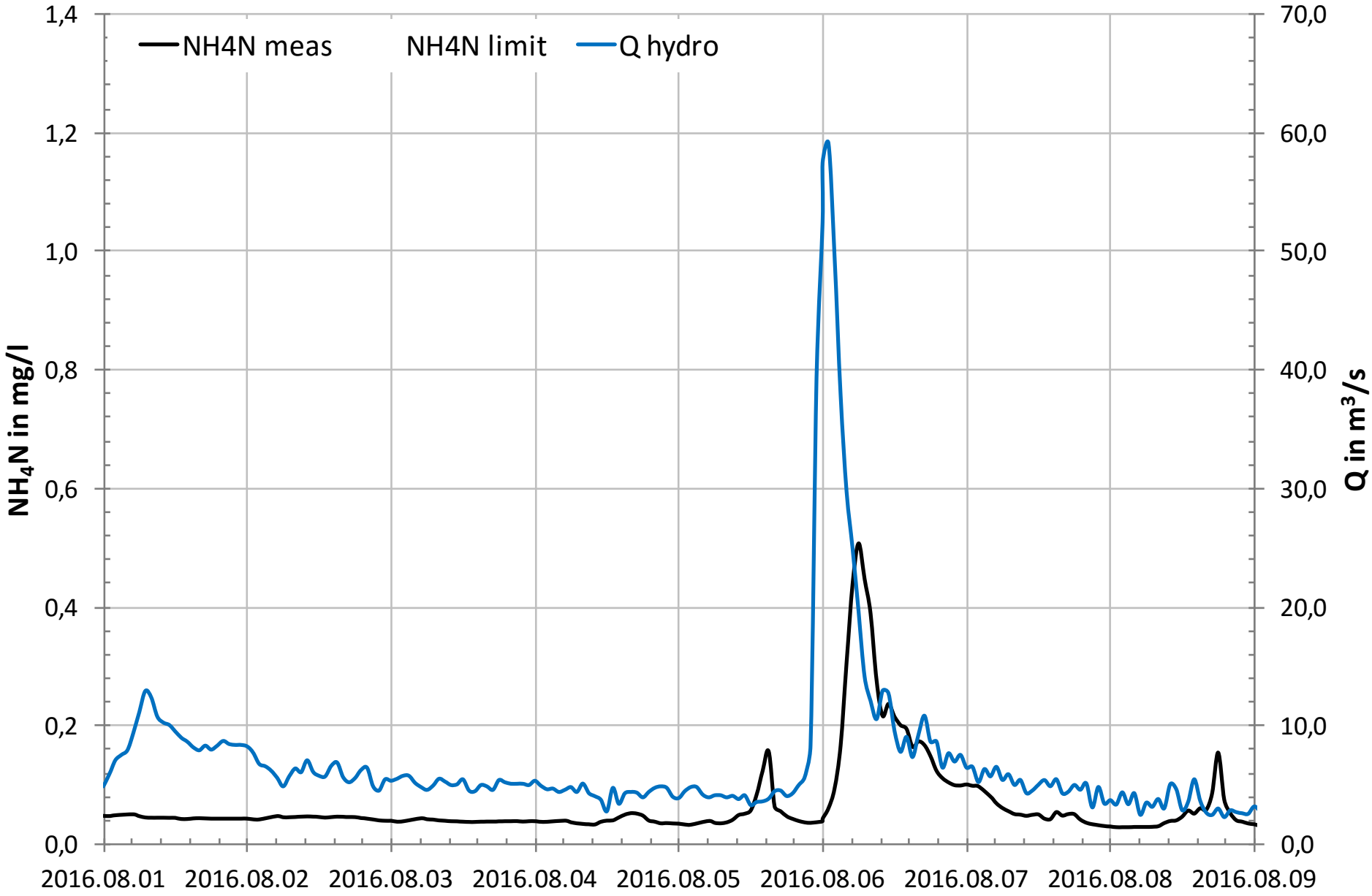
NO_3-N partial least square modeling

- **> 70** laboratory **samples** to catch dynamics
- site specific, **local calibration** necessary

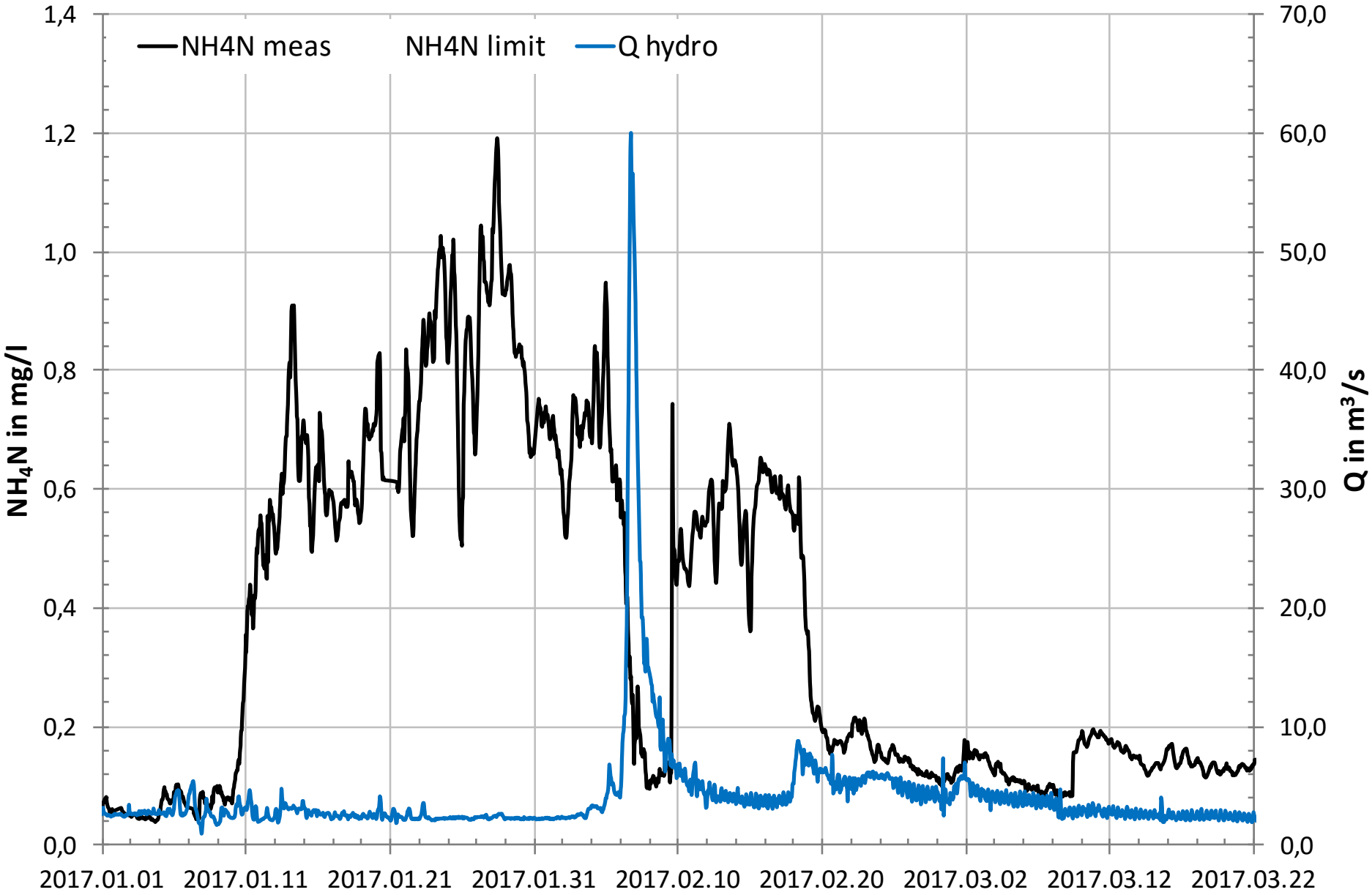


Source: R. Fuiko et al. (2016): *Nachhaltige Wassergütewirtschaft Raab, Online-Monitoring*. Endbericht.

NH_4-N pollution event 2016



NH_4-N pollution event 2017



discussion

- water quality **monitoring**
  - common data structure and data export tools
  - bypass-solution for in-house measurements
  - timing control fundamental
- data **plausibility** assessment and **modeling**
  - site-specific
  - high number of well placed reference samples necessary
  - mention cross-correlations
- **data to information?**

Project: NaWas – Nachhaltige Wassergütewirtschaft an der Raab,
funded by BMLFUW, Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft

Contact:
Institute for Water Quality, Resource and Waste Management
Andreas Winkelbauer
TU Wien
Karlsplatz 13/226-1
A-1040 Wien
awinkelbauer@iwag.tuwien.ac.at
(+43 1) 58801-22661