

Near-infrared spectroscopy (NIRS) for a real-time monitoring of the biogas process

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Background

The role of flexible biogas production to cover diurnal peaks for electricity supply and stabilize the grid frequency gains in importance. Consequently a continuous access on control variables and online measurements to monitor the biogas process is required.

Objectives

- Recording of **changes** in substrate specific characteristics like volatile fatty acids (VFA) with variable feeding.
- Determination of the **time needed to stabilize** the biocenosis after load changing.
- Detection of **process instabilities** depending on frequency of substrate changes or impact loads.

Material



source: Andrea Stockl

Fig. 1 240 liter laboratory digester, **NIR-sensor** (Bruker)



source: Andrea Stockl

Fig. 2 automatic feeding system

Methods

Basic feeding:

Biogas digester with optimized load management

- organic loading rate of $2.5 \text{ kg oDM (m}^3 \cdot \text{d)}^{-1}$
- feeding with maize and grass silage every 2 hours

Additional load:

Variable load management

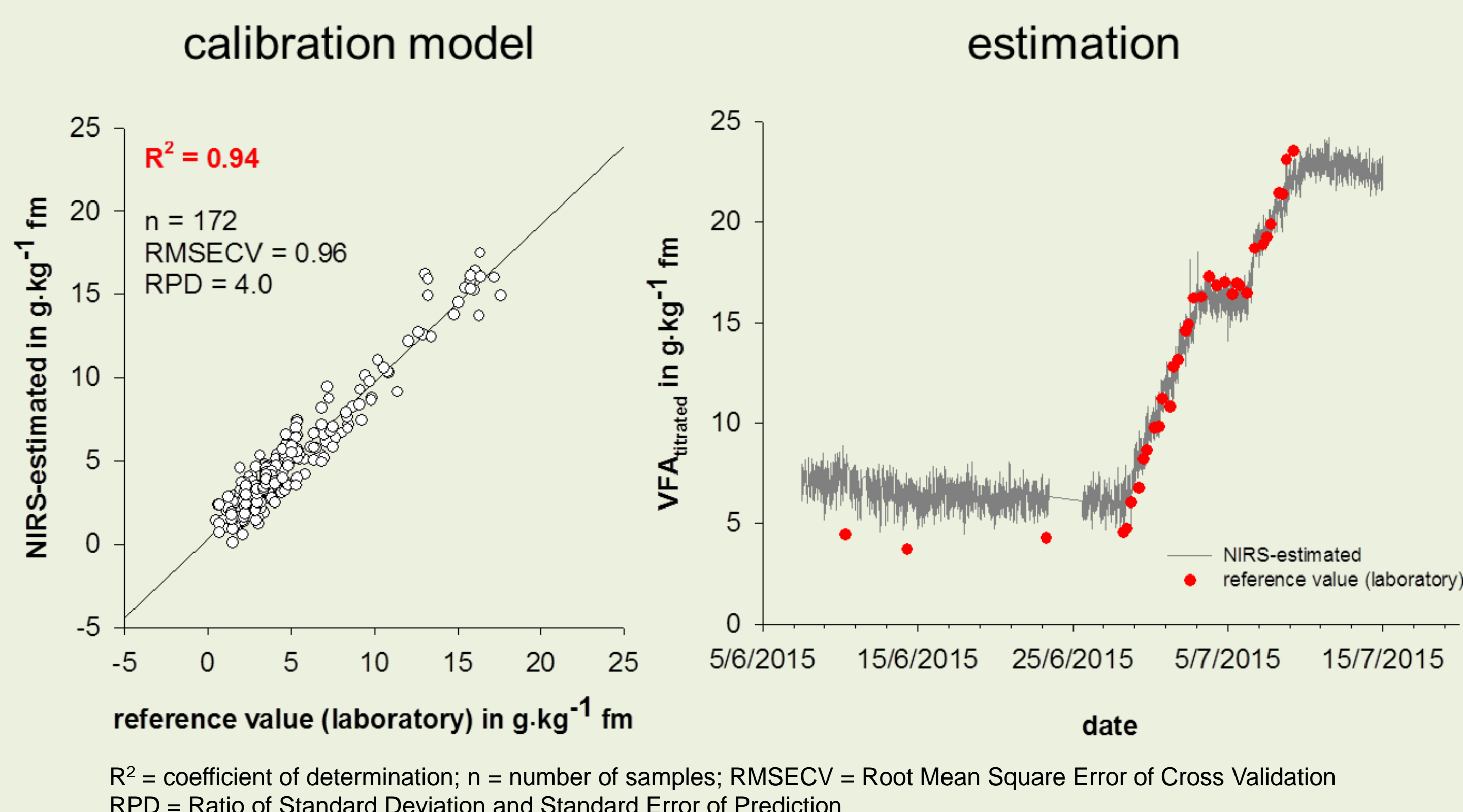
- manually impact load with shredded wheat once a day up to an organic loading rate of $8 \text{ kg oDM (m}^3 \cdot \text{d)}^{-1}$

Goal:

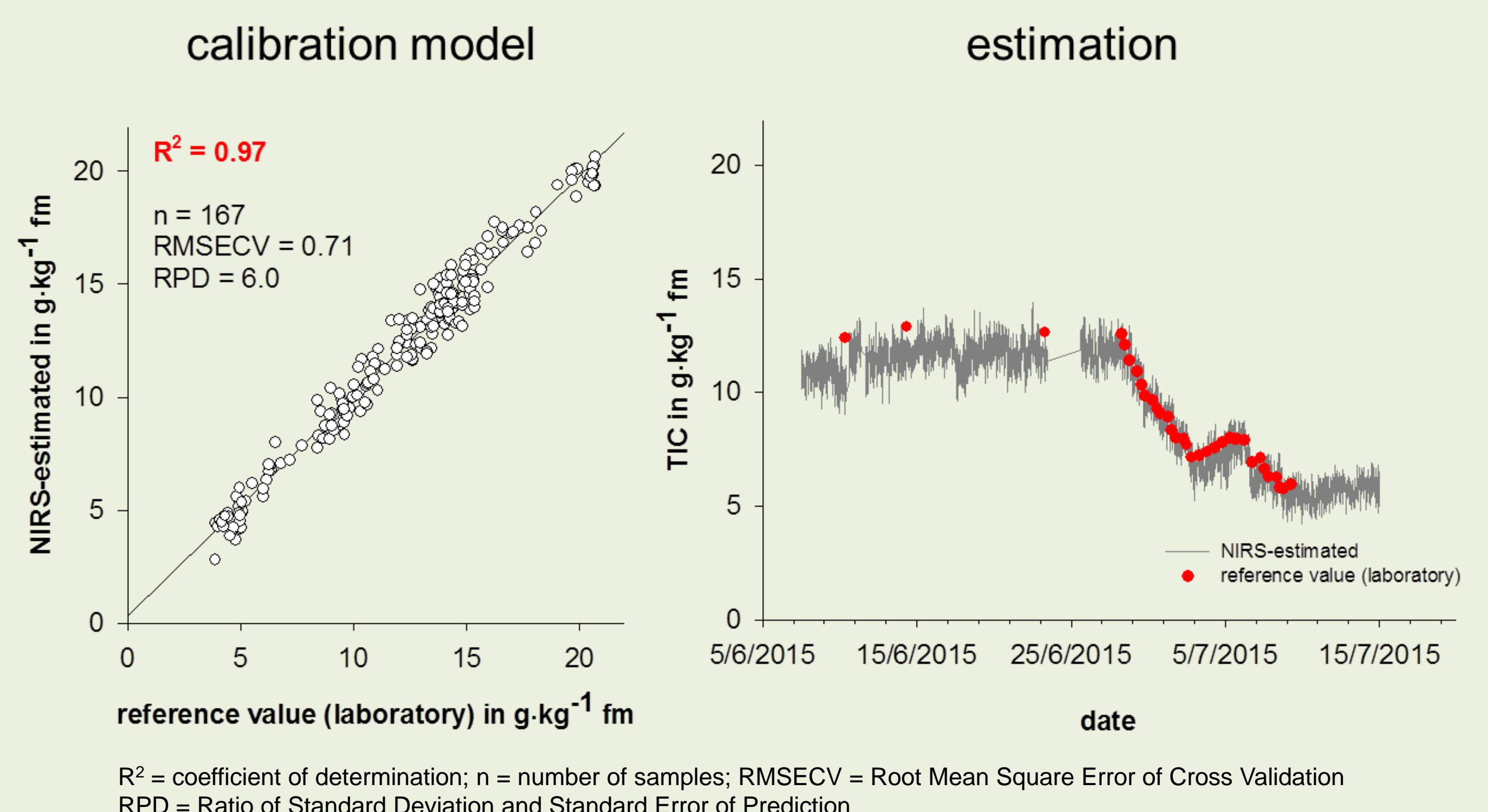
→ Determination of volatile fatty acids titrated ($\text{VFA}_{\text{tit.}}$), acetic and propionic acid, the buffer capacity (TIC, total inorganic carbon) and organic dry matter in the digester

Results (calibration model and estimation of unknown samples)

volatile fatty acids titrated ($\text{VFA}_{\text{tit.}}$)



buffer capacity (total inorganic carbon, TIC)



Possibilities of NIR-sensory:

- **Precise calibration models** for monitoring specific biogas process parameters.
- **Time-consuming** laboratory analysis can be **avoided**.
- Changes of **tendency** can be detected precisely!

Confines of NIR-sensory:

- **Precision** in calibration development and in laboratory analysis is essential.
- **Extrapolation** of calibration models out of the concentration range is **not possible**.
- **Continuous model adaption** is necessary.