

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

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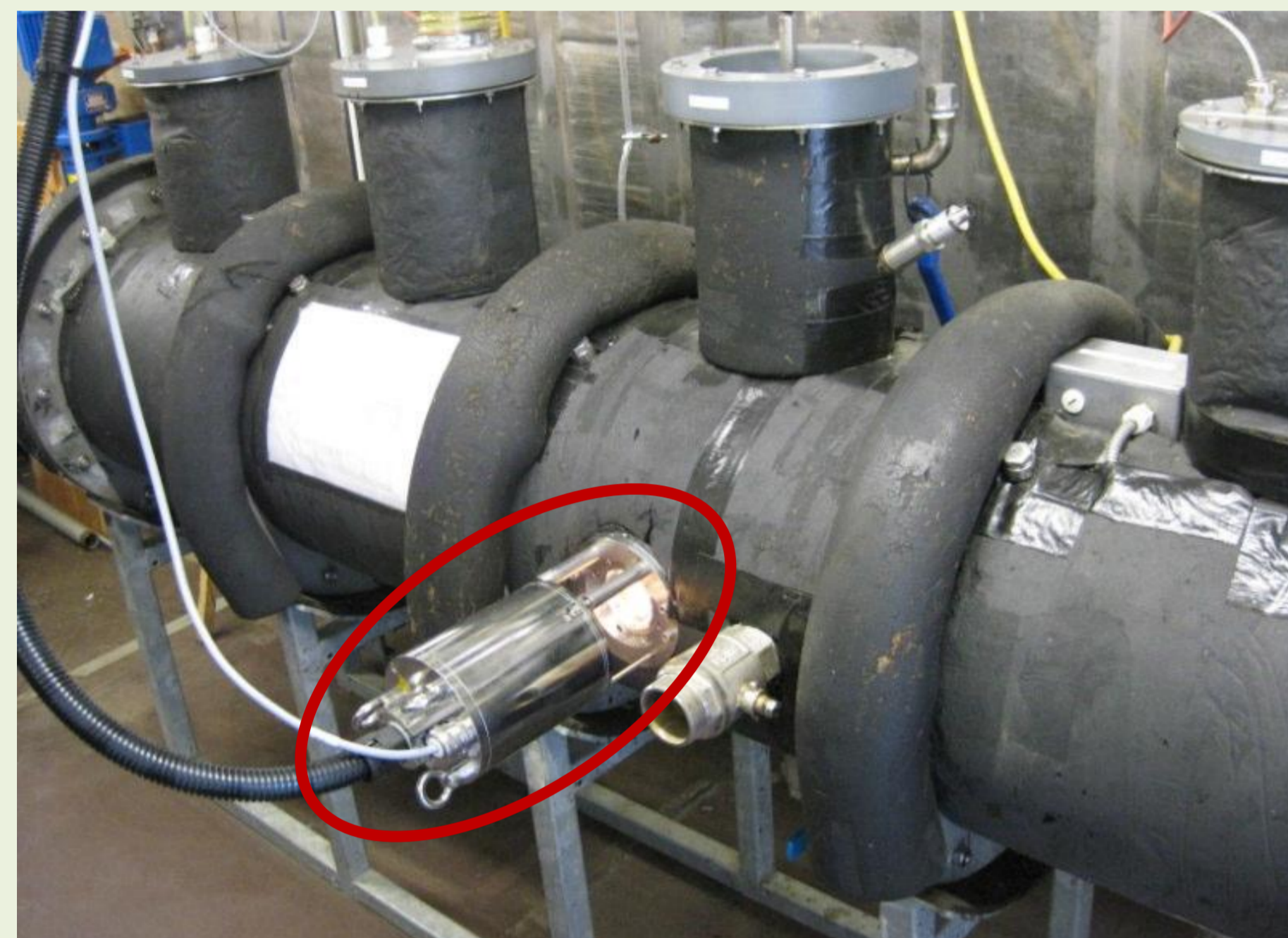
Background

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 kg oDM (m³·d)⁻¹
- feeding with maize and grass silage every 2 hours

Additional load:

Variable load management

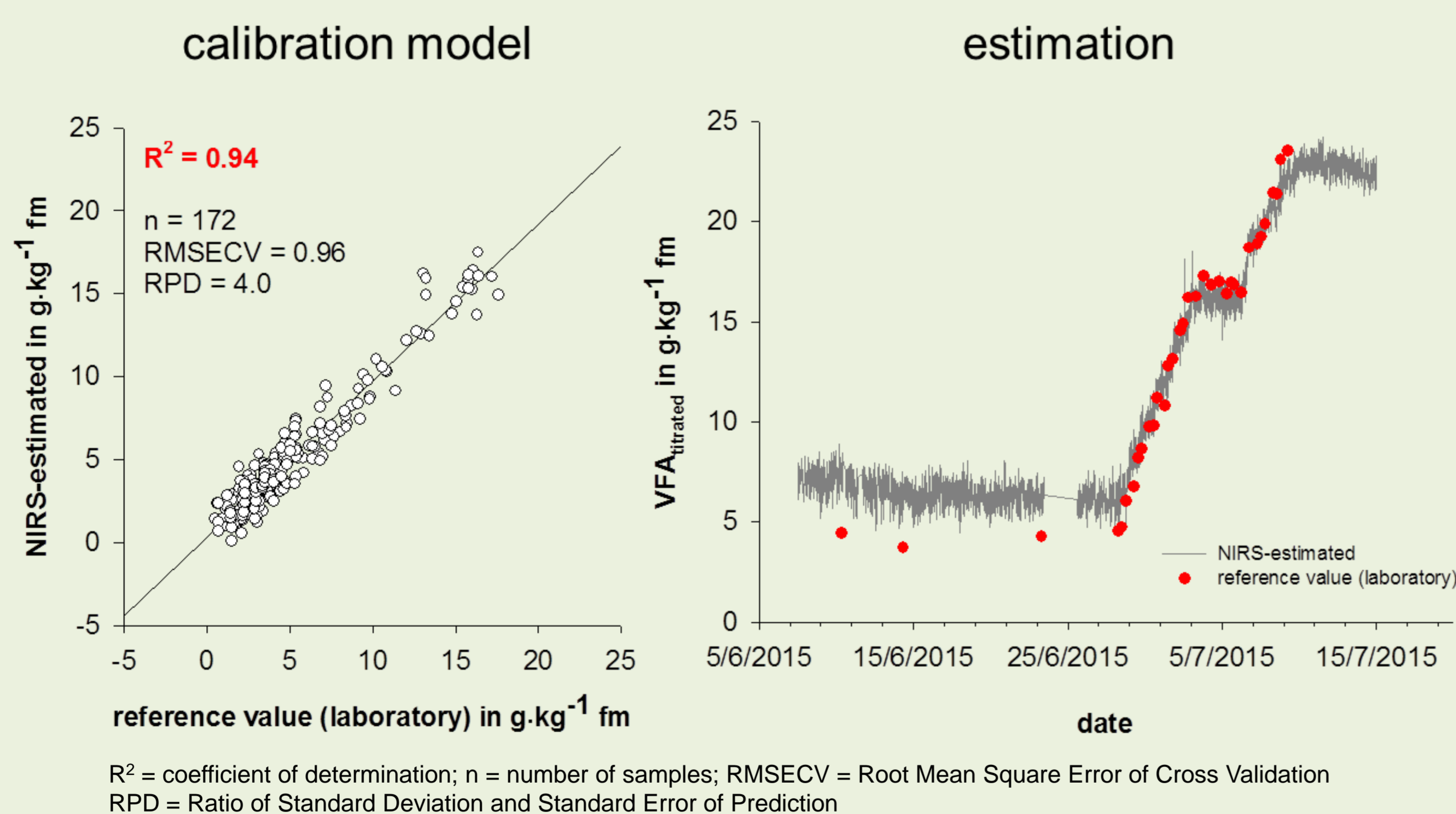
- manually impact load with shredded wheat once a day up to an organic loading rate of 8 kg oDM (m³·d)⁻¹

Goal:

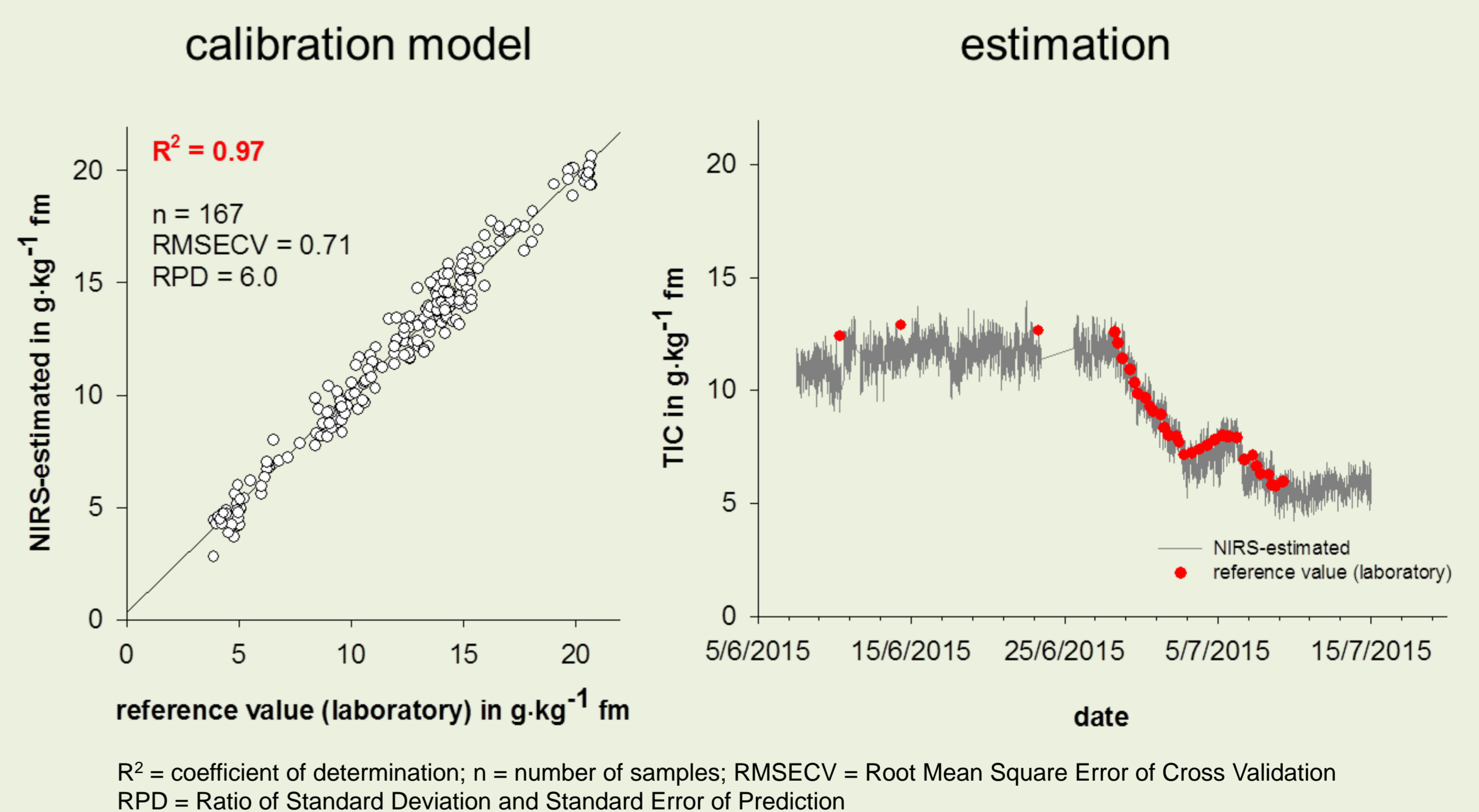
- Determination of volatile fatty acids titrated (VFA_{tit.}), acetic and propionic acid, the buffer capacity (TIC, total inorganic carbon) and organic dry matter in the digester

Results (calibration model and estimation of unknown samples)

volatile fatty acids titrated (VFA_{tit.})



buffer capacity (total inorganic carbon, TIC)



Possibilities of NIRS-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 NIRS-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.