

# Comparing on-line sensors: Application and critical review of the ISO standard 15839

2008 National  
Monitoring  
Conference

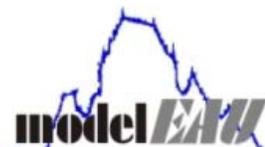
Atlantic City

20 05 2008

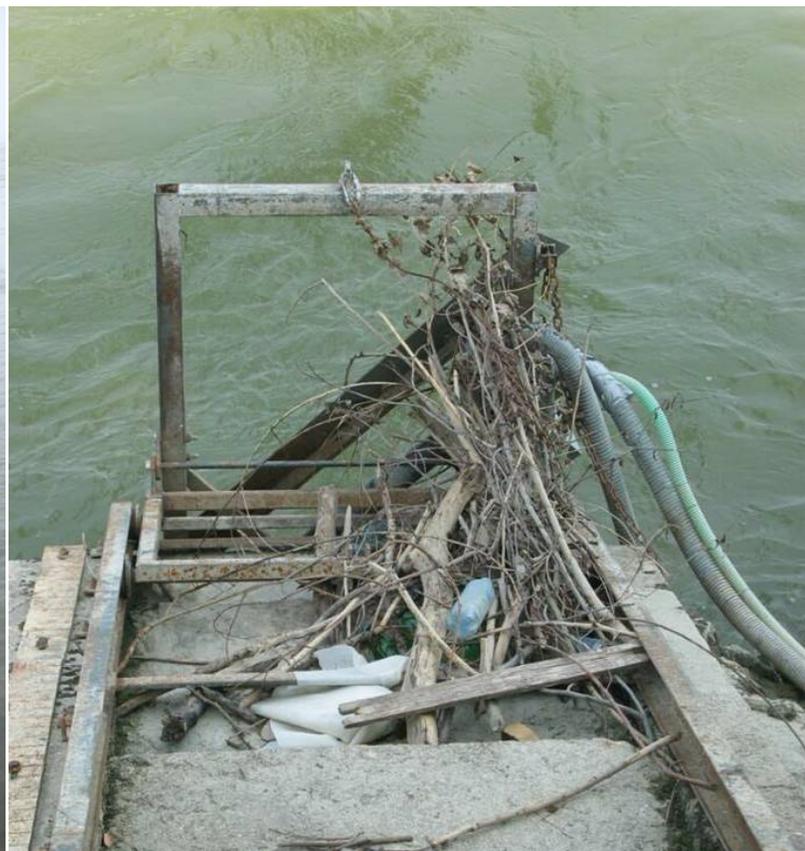
Peter A. Vanrolleghem, Mathieu Beaupré, Marie-Claude Boudreault,  
Karen Lévesque Cahill and Leiv Rieger



*Canada Research Chair  
in Water Quality Modeling*

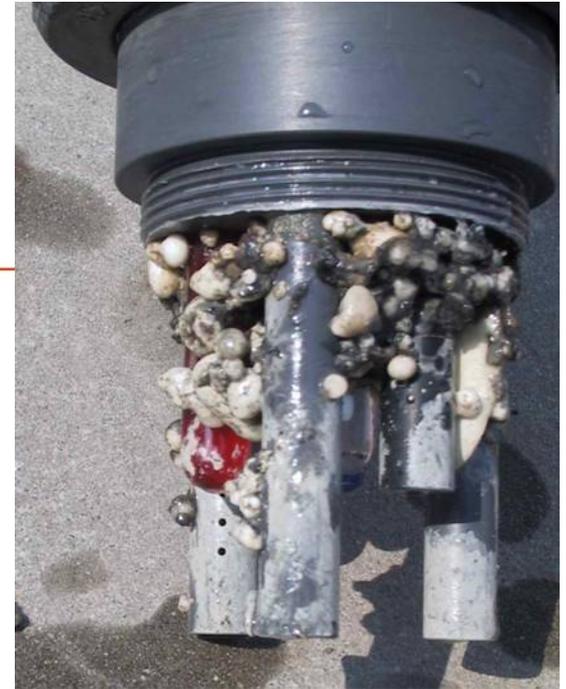


# Introduction



IMW-project – [www.imw.ac.at](http://www.imw.ac.at)

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# Introduction

- Check data quality of continuous monitoring



# Problem Statement

- What is the information one would need to buy the right sensor ?



# Problem Statement

- Rely on specifications of the manufacturers?

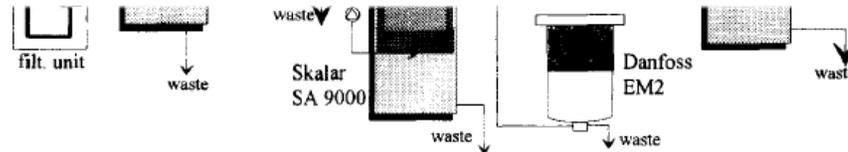
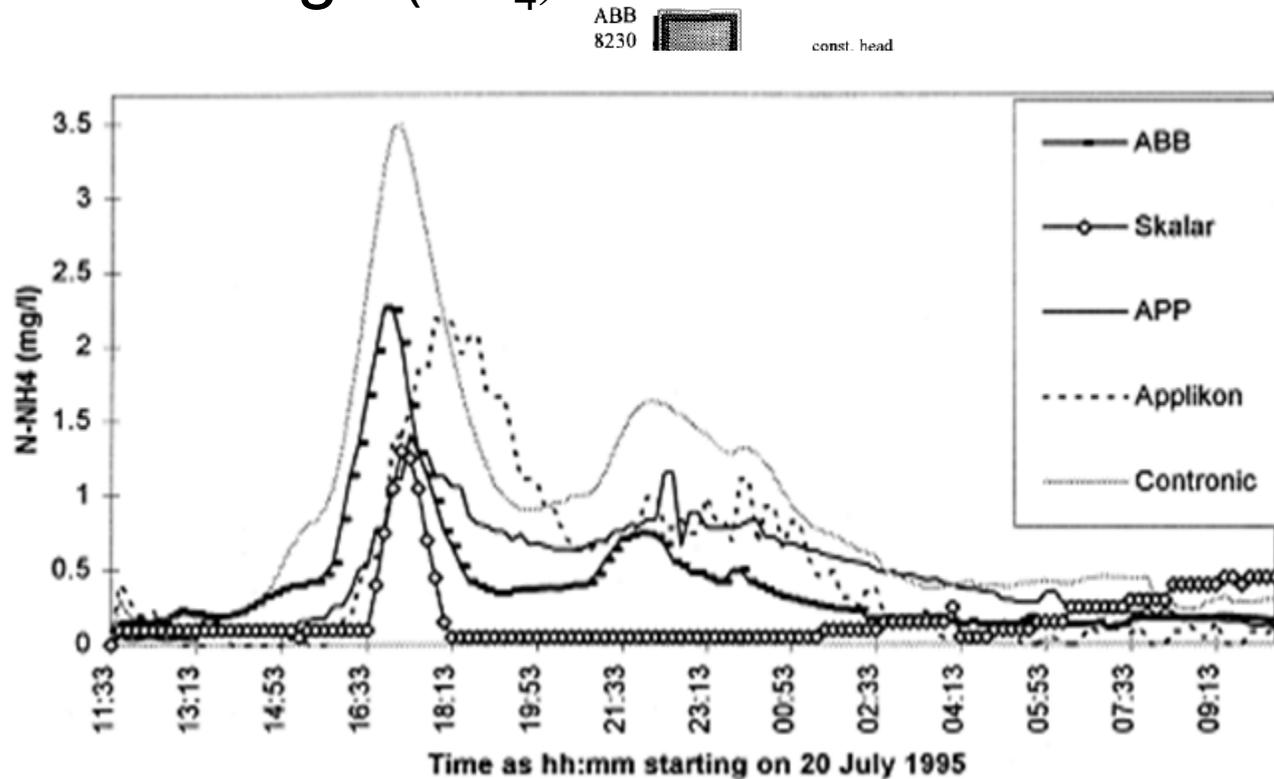
Dimensions & weight	Construction	Cable	Sensor	Detector	Filters	Sensitivity -Current	Sensitivity - Voltage	Working range	Linearity error
 34mm 65mm 200g (with 3m cable)	Anodised aluminum/ acetyl. Sealed to IP68	Screened cable 7-2-2C military specification	Cosine corrected head	Silicon, photocell	Dependant on sensor type	4-20mA	1,2,3,4, or 5 volts up to 10v full scale	See individual datasheets	<0.2%
Absolute calibration error (1)	Cosine error (2)	Azimuth error (3)	Temperature coefficient	Longterm stability (4)	Response time (5) - voltage output	Internal resistance - voltage output	Operating range	Power supply requirements	
type <3% max 5%	3%	<1%	+0.1%/°C	±2%	50mS	See individual datasheets	-20°C to +70°C 0-100% RH	Full Scale 1,2 & 3 volts 4 volts 5 volts 10 volts 4-20mA	Voltage 5-15volts 7-15volts 9-15volts 12-15volts 12-36 volts

### NOTES ON SPECIFICATIONS

- (1) Main source of this error is uncertainty of calibration of Reference Lamp. Skye calibration standards are directly traceable to N.P.L. standard references.
- (2) Cosine error to 80° is typically 5% max. Figures shown are for normal use sources, e.g., sun plus sky, diffuse sun, growth chambers, etc.
- (3) Measured at 45° elevation over 360°
- (4) Maximum change in one year. Calibration check recommended at least every two years. Experience has shown that changes are typically much less than figures

# Problem Statement

- Field-testing? ( $\text{NH}_4$ )

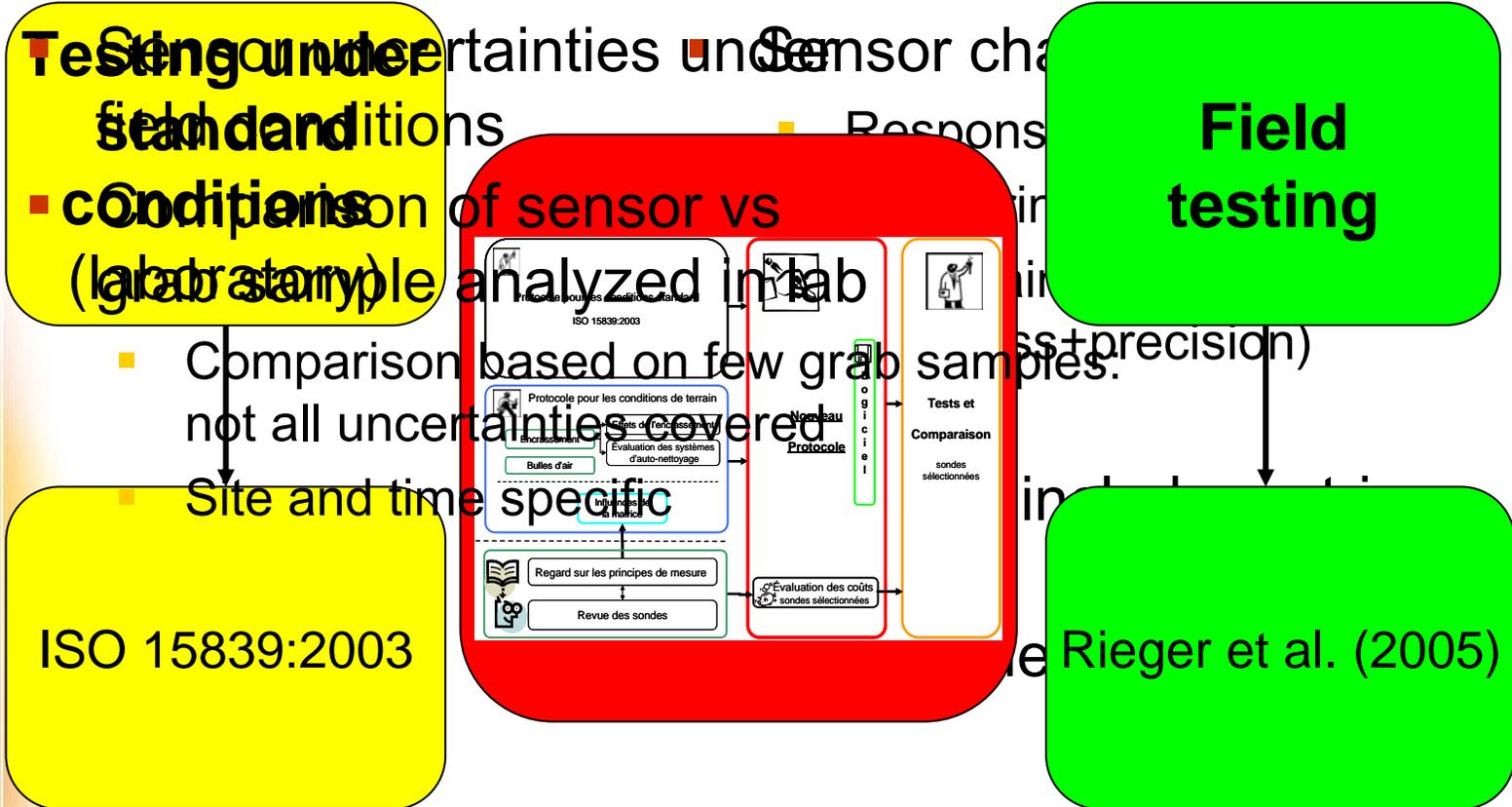


# Problem Statement

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- Field Testing? ( $\text{NO}_3$ )
- WERF 03-CTS-8 “On-Line Nitrogen Monitoring”
- Evaluates 5 different  $\text{NO}_3$  sensors parallel on DCWASA Blue Plains plant (12 w)

# Problem Statement



# Objectives

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- ISO 15834:2003 critical review
- To develop a standardized field conditions protocol to characterize sensors



Protocol for standard conditions  
ISO 15839:2003

**Critical review**



Protocol for standardized field conditions

Soluble matter	Air bubbles
Clogging	Turbidity

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Matrix effects



Review measuring principles

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Review of sensors



**New**  
**Protocol**

Software

Cost evaluation  
selected sensors



**Tests and  
Comparison**

of  
selected sensors

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# ISO 15839: Critical Review

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- Lessons learned from the sensor review:
  - The standard is out there since 2003, but:
  - Few sensor companies provide the ISO specs
  - Keep providing information using their own definitions of sensor characteristics

# ISO 15839: Critical Review

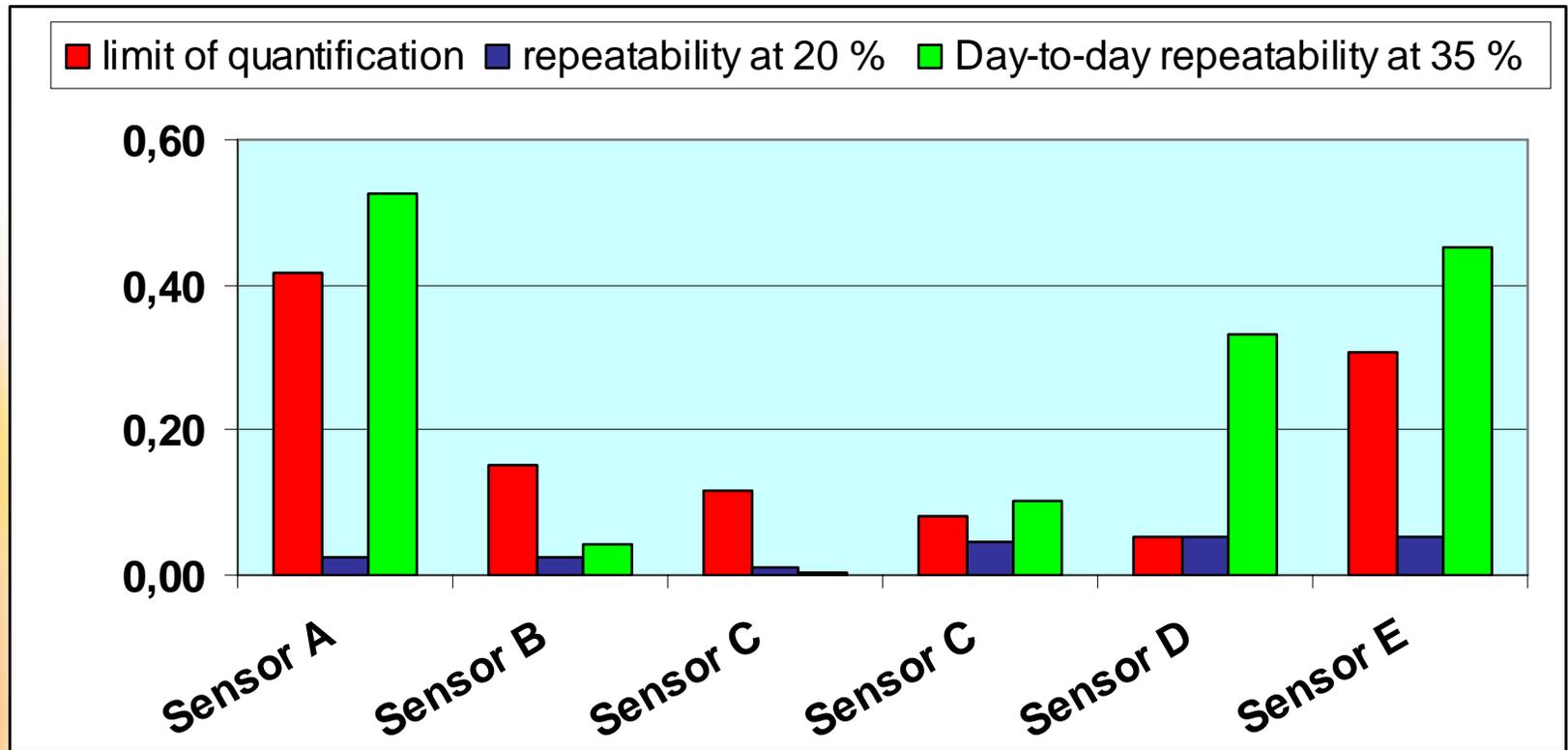
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- Determination of sensor characteristics under laboratory conditions (7 day test)
  - Response time
  - Linearity
  - Repeatability
  - Bias
  - Interferences
  - Limit of detection and quantification
  - ...

# ISO 15839: Critical review

Solution	Concentration (% of measuring range)	Output
1	5	LD, LQ
2	20	Bias, repeatability, LDC
3	35	Day-to-day repeatability
4	50	Short term drift
5	65	Day-to-day repeatability
6	80	Bias, repeatability, LDC
7	95	linearity

# ISO 15839: Critical Review





Protocol for standard conditions  
ISO 15839:2003

**Critical review**



Protocol for standardized field conditions

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**Neptune**  
FP6 Project



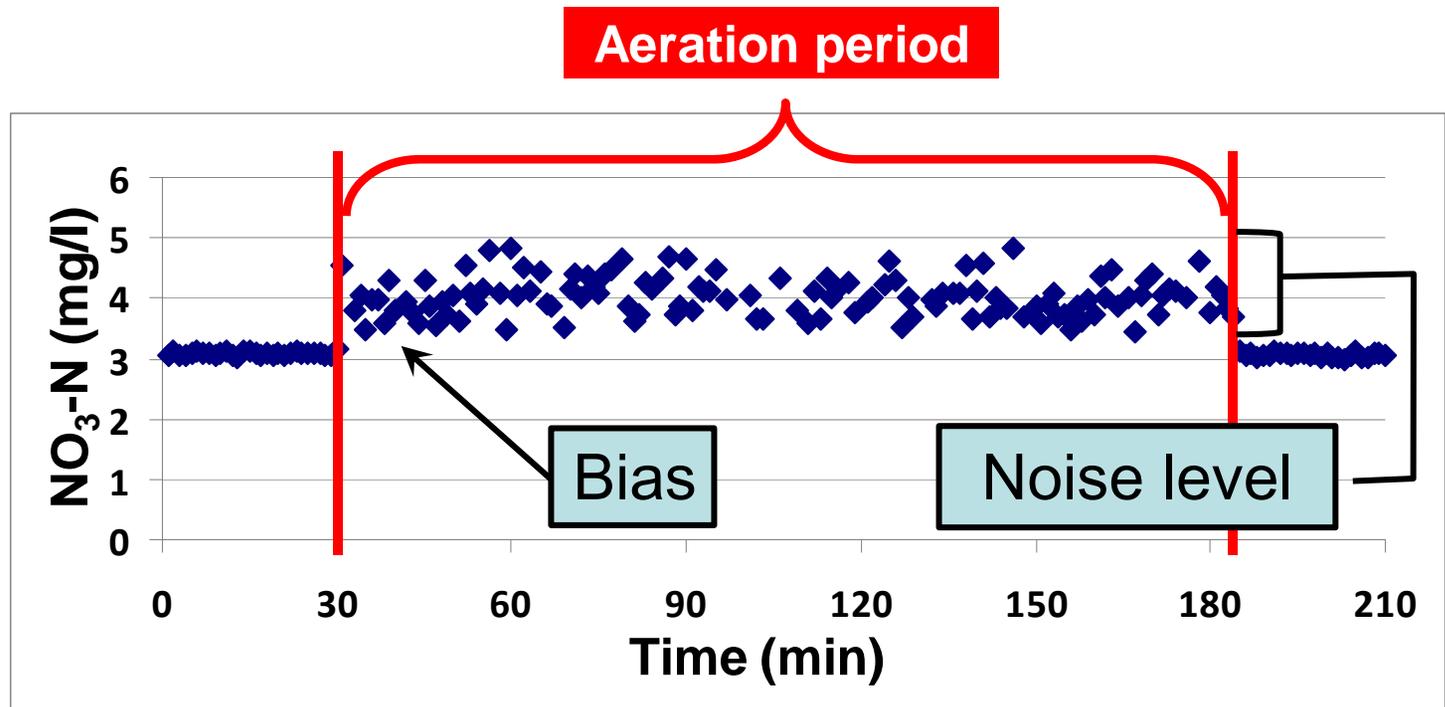
# Standardized field conditions

- Air bubble effects



# Standardized field conditions

- Air bubble effects

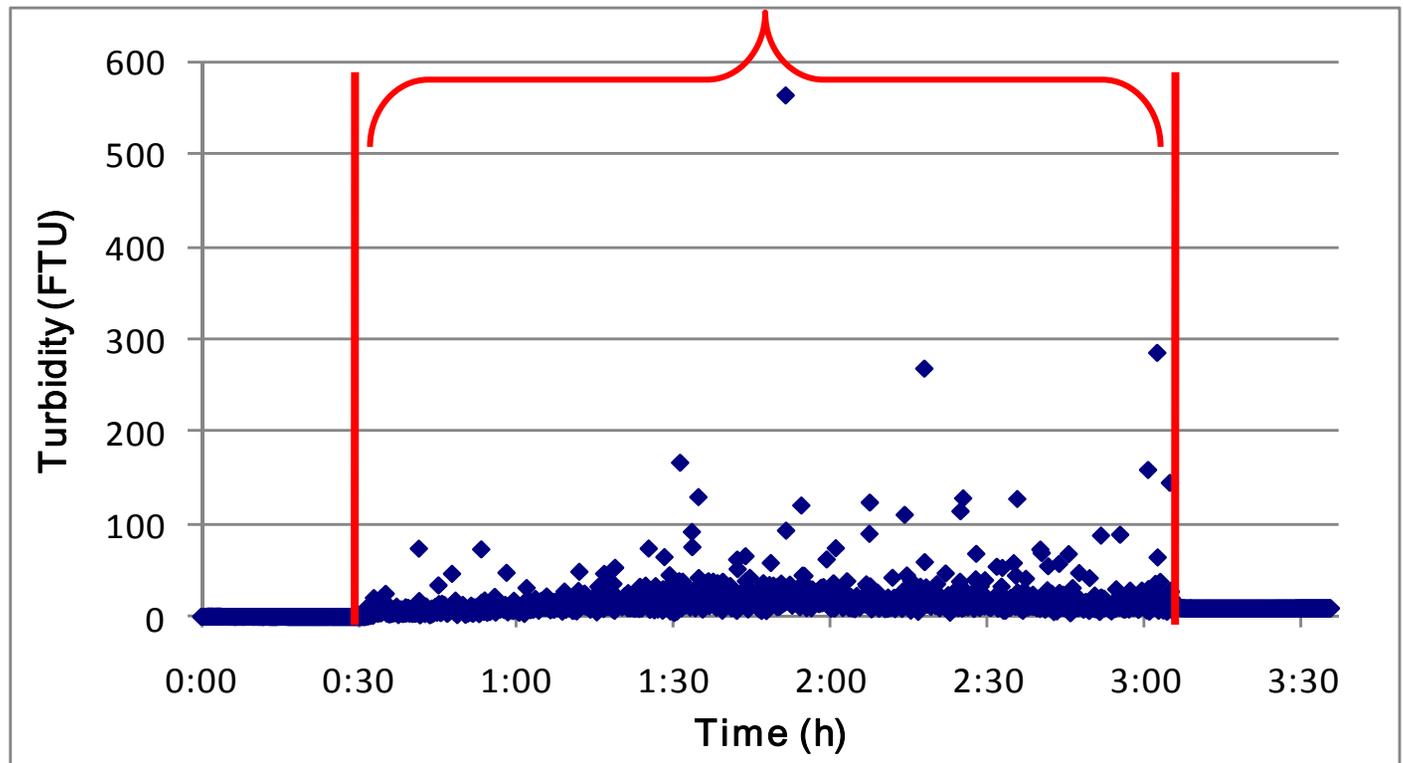


Nitrate concentration vs time for a spectrometer probe

# Standardized field conditions

- Air bubble effects

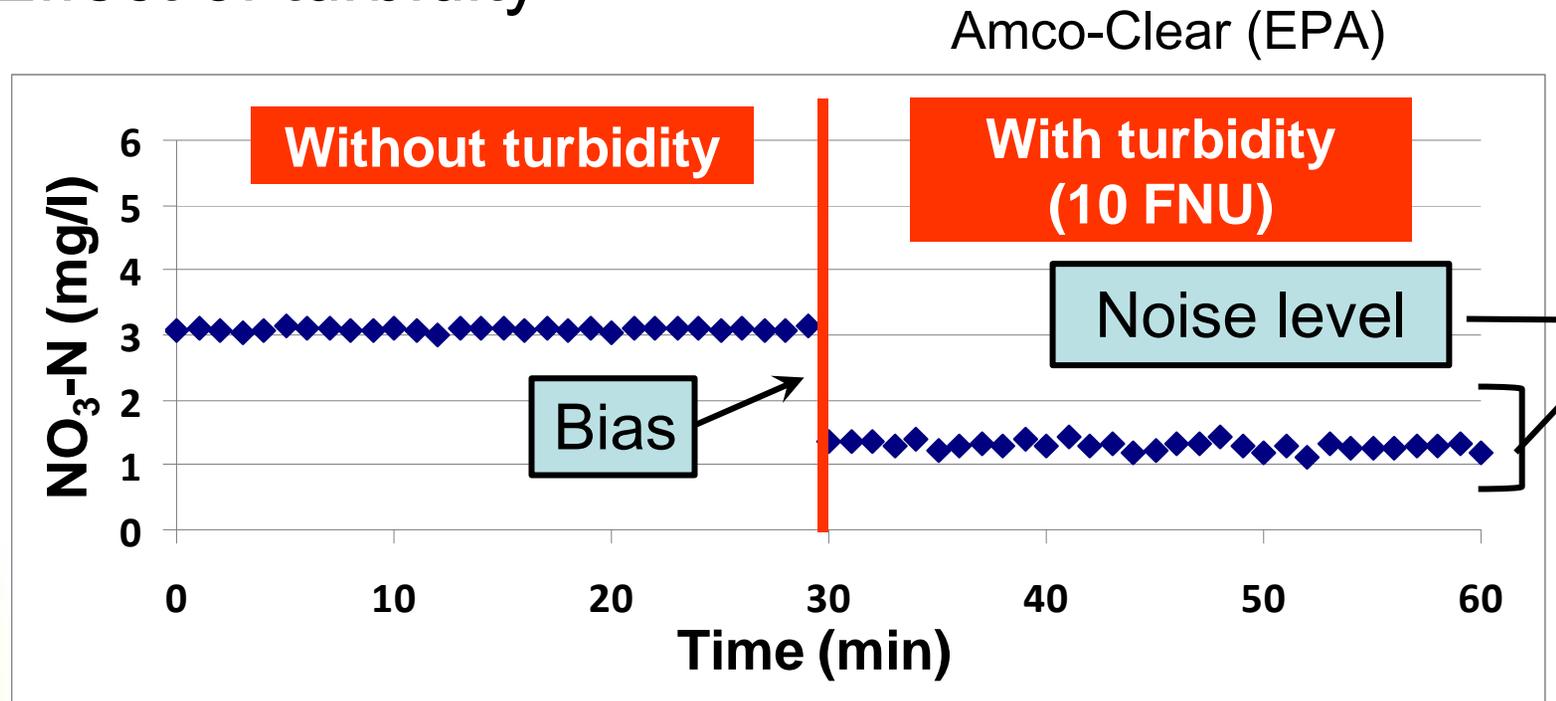
Aeration period



Turbidity versus time for a turbidity probe

# Standardized field conditions

- Effect of turbidity



Nitrate concentration vs time for a spectrometer probe



Protocol for standard conditions  
ISO 15839:2003

**Critical review**



Protocol for standardized field conditions

Soluble matter	Air bubbles
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Matrix effects



Review measuring principles

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**Tests and Comparison**

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**Neptune**  
FP6 Project



# Conclusions

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- ISO 15839:2003 is a good basis
  - Terms are clearly defined
  - Methodology is well described
- BUT!
  - Should be more end-user oriented  
e.g. visualisation should be improved
  - Standardised field conditions should be included

# Conclusions (cont'd)

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- A methodology was presented to test the effect of some field conditions on sensor performance
- Methodology should be applied to other:
  - Measuring principles (analyser, ISE, etc.)
  - Compounds (ammonium, phosphate, etc.)
- Methodology should be developed for other field conditions (fouling)

# Acknowledgement

- model *EAU* collaborators:
  - Mathieu Beaupré
  - Marie-Claude Boudreault
  - Karen Lévesque Cahill
  - Leiv Rieger



*Canada Research Chair  
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