BUNDESAMT FÜR
SEESCHIFFFAHRT
UND
HYDROGRAPHIE

Towards reliable in-situ real-time oxygen measurements

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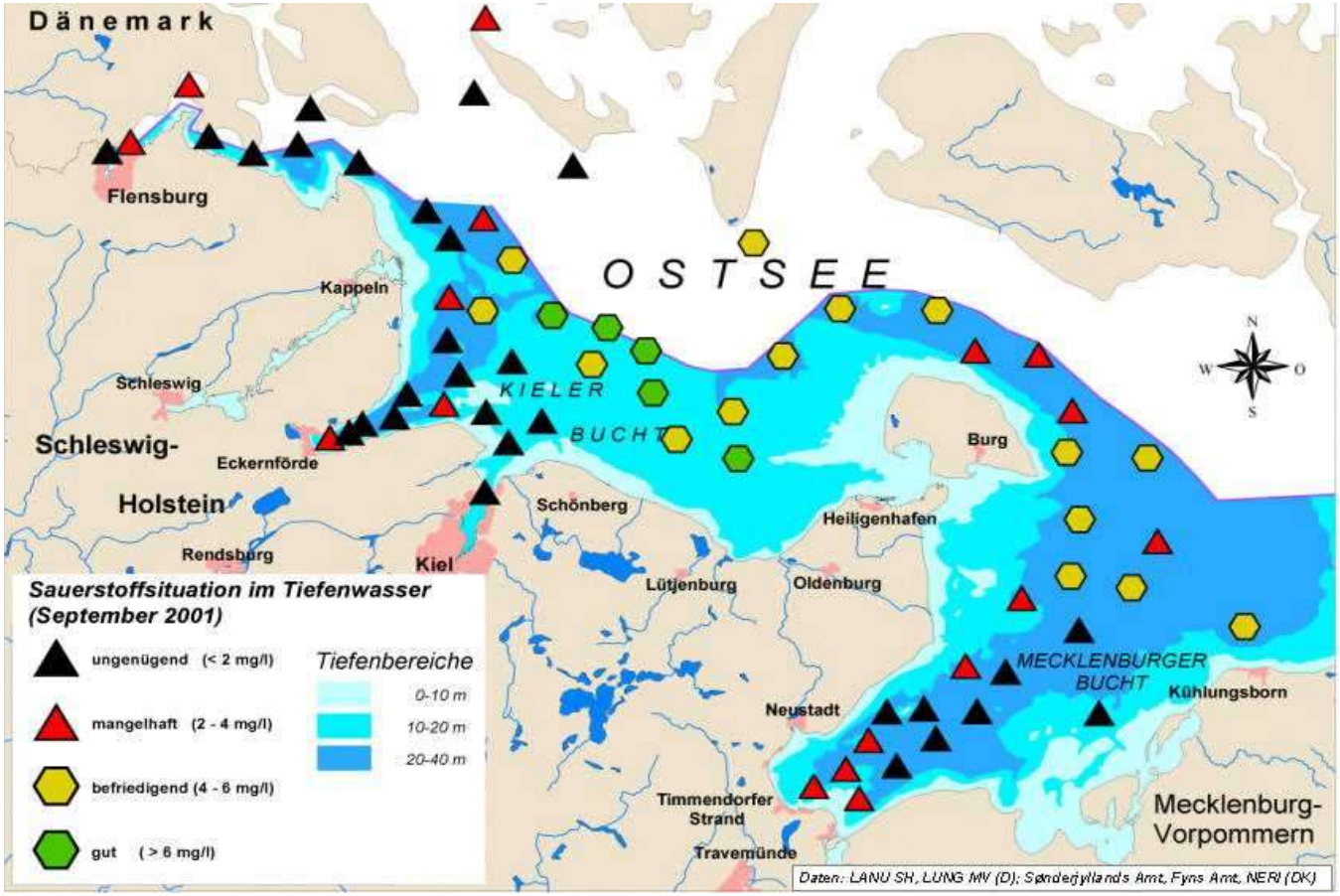
Oxygen measurements:

- deliver information about the biological status of the sea area
- deliver information about water exchange
- help to evaluate the environmental conditions for marine life
- indicate biological production/extinction

Oxygen measurements

Insufficient:
Poor:
Fair:
Good:



Oxygen distribution in the Western Baltic Sea, Sep. 2001

Ways of measuring oxygen:

- Winkler Titration
- Clark-cell Sensor (electrochemical, closed system)
- Züllig Sensor (galvanic, open system)
- Optode (chemo-optical system)

Oxygen measurements

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Winkler Titration:

Advantages:

- Standard measuring method
- High accuracy
- High resolution

Disadvantages:

- not usable for continuous measurements
- laboratory equipment is needed

Oxygen measurements

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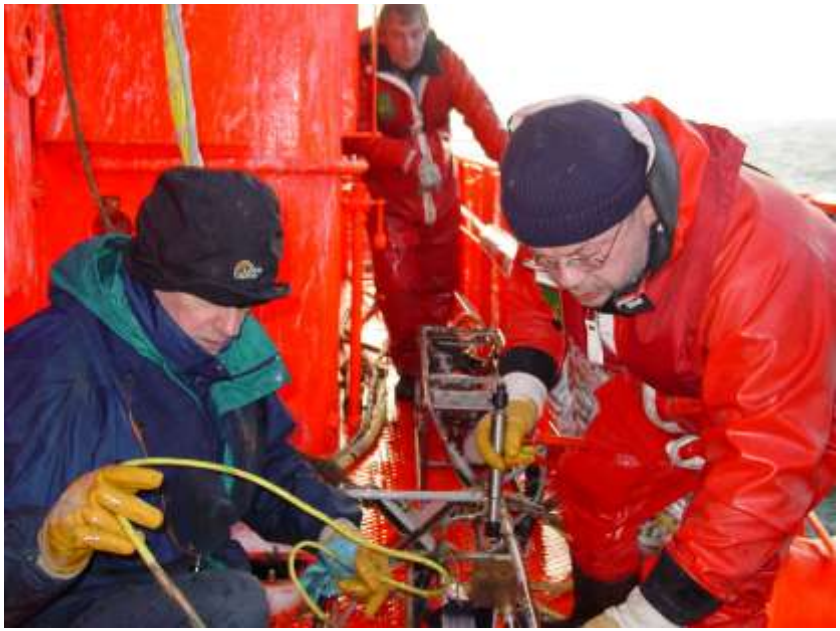
Clark-cell Sensor:



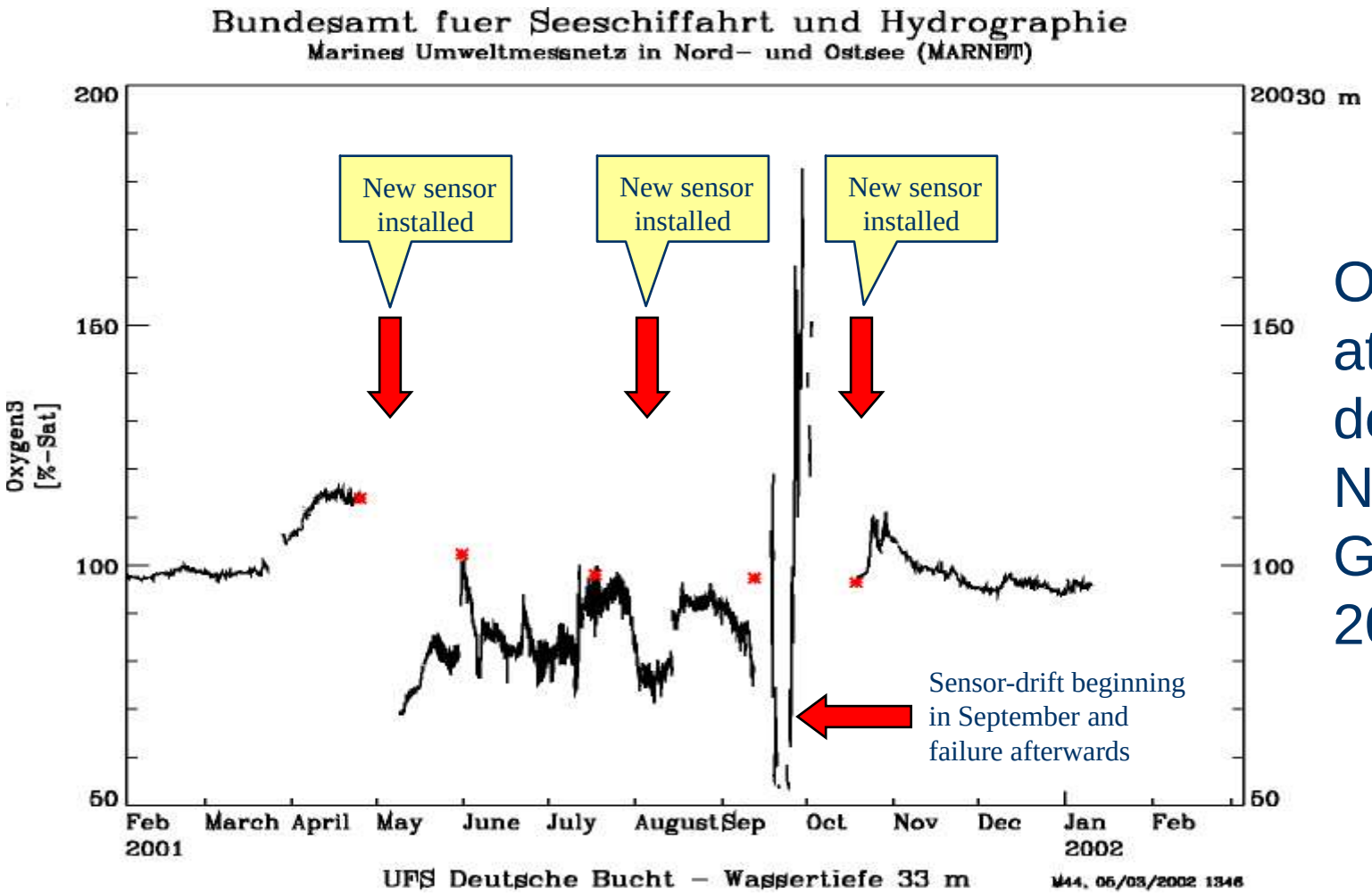
Advantages:

- automatic measuring system
- generating continously data
- acceptable resolution/accuracy

Disadvantages:

- extensive calibration/maintenance work before installation neccessary
- long-term stability is limited to the reaction of the electrolytical liquid
- susceptible to bio-fouling

Oxygen measurements



Oxygen saturation in 30 m depth at MARNET - station German Bight in 2001 (Clark-cell)

Oxygen measurements

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Züllig Sensor:

Advantages:

- automatic measuring system
- generating continously data
- acceptable resolution/accuracy
- not susceptible to bio-fouling
- little calibration/maintenance work before installation neccessary
- high long-term stability due to open system without electrolytical liquid

Disadvantages:

- whetstone has to be working continuously
- relatively high energy consumption
- mechanical instability
- small changes in the surface geometry of the electode create major changes in the oxygen values
- in-situ calibration necessary

Oxygen measurements

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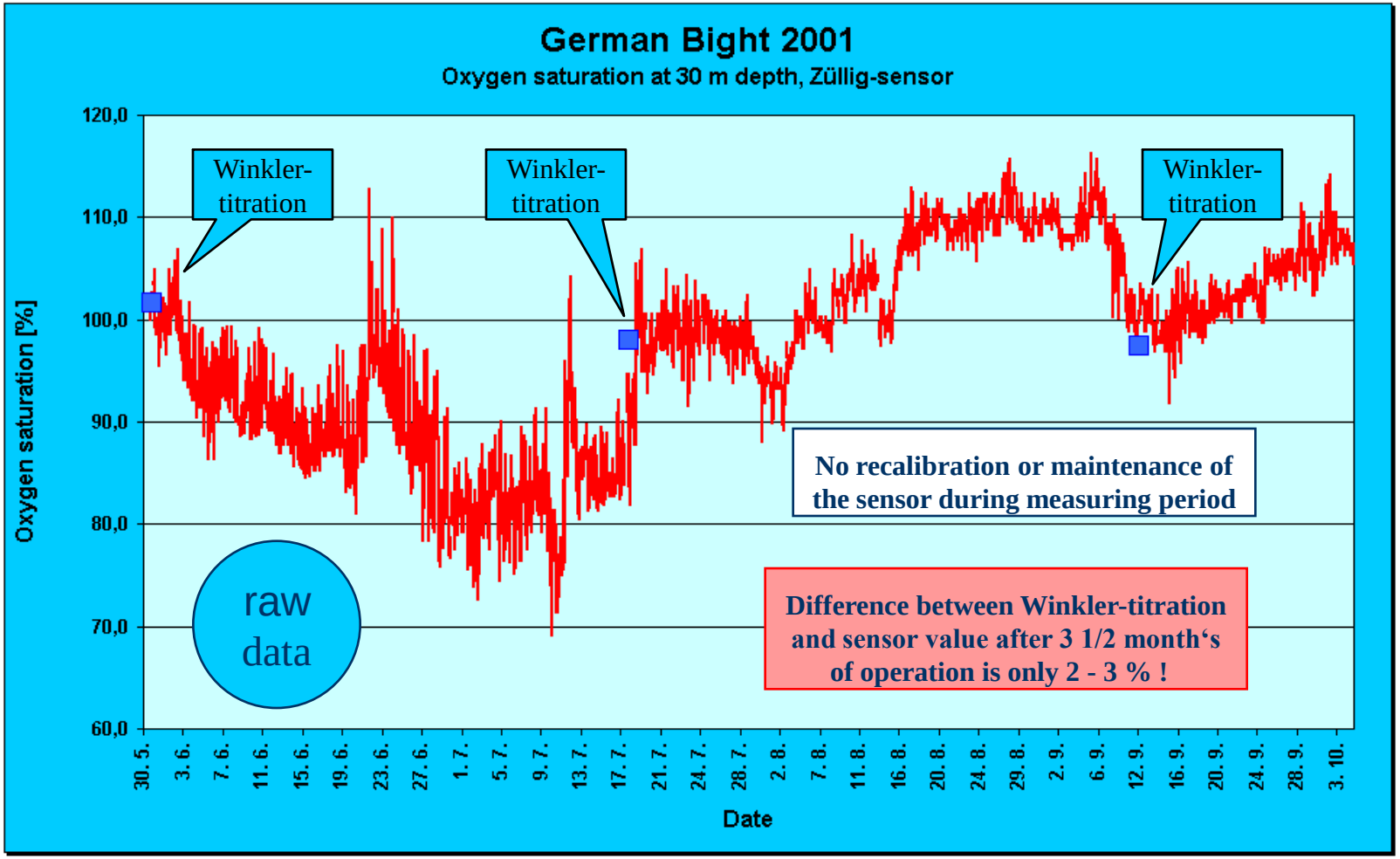

Oxygen measurements

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Optode:

Advantages:

- no movable parts
- easy to handle
- stable measurements up to one year
- comparatively low energy consumption

Disadvantages:

- foil cannot be treated by mechanical cleaning
- relative long response time, not suitable for profiling systems

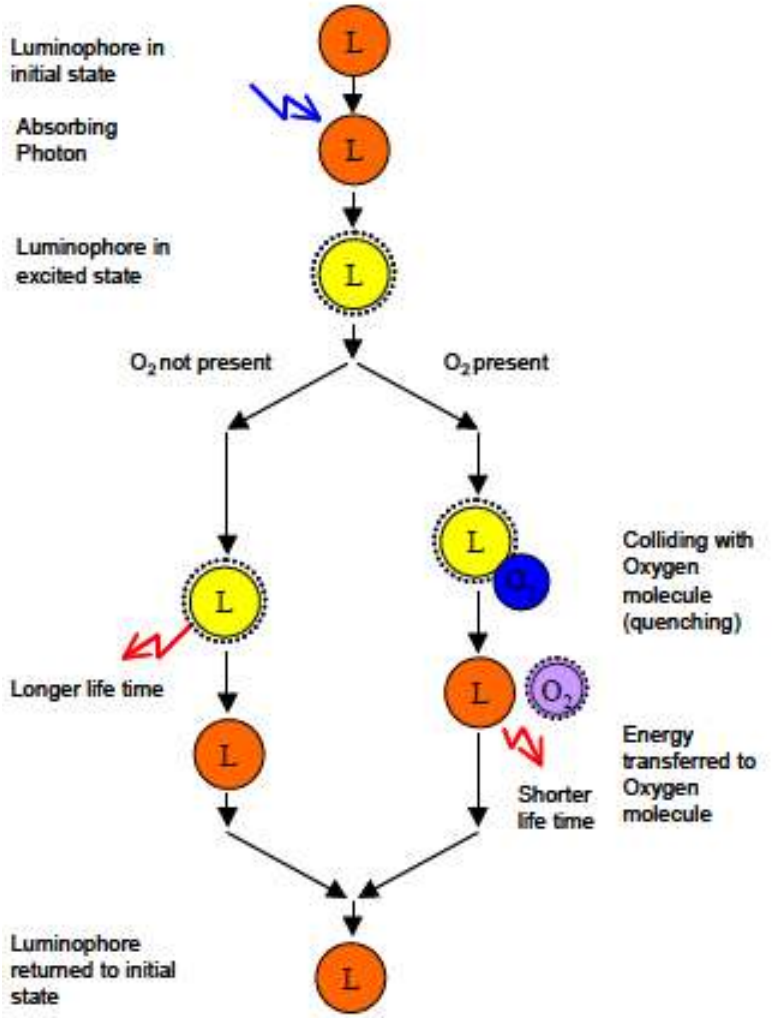
Oxygen measurements

Dynamic Luminescence Quenching:

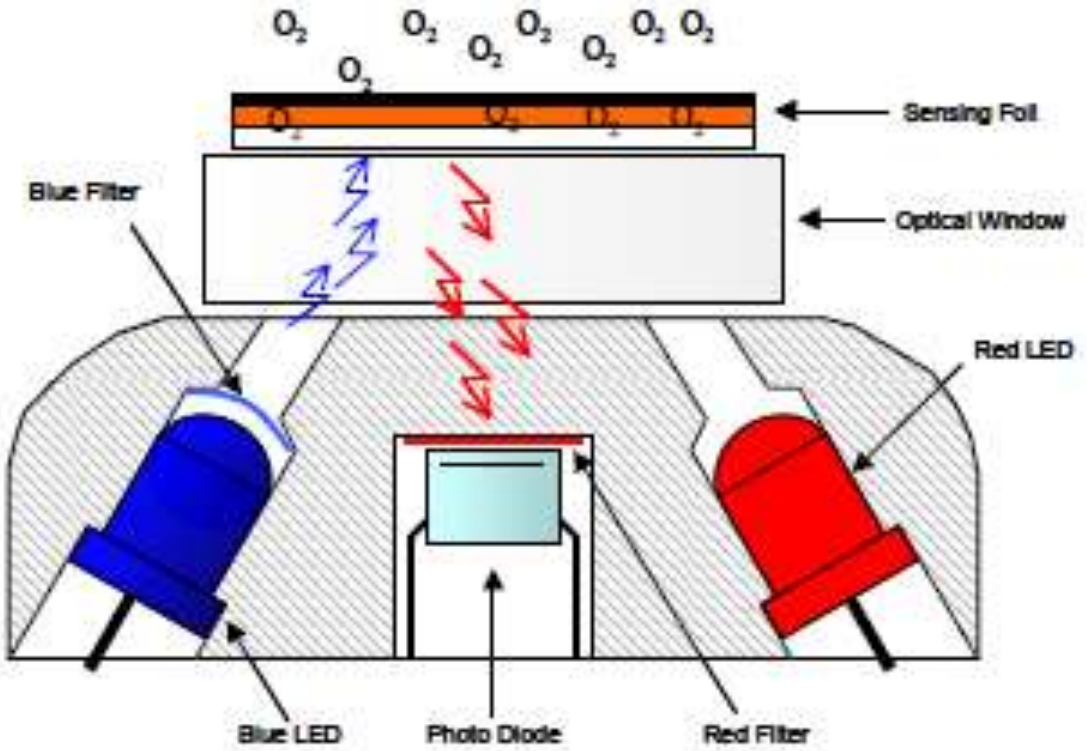
The Oxygen Optode is based on a principle called dynamic luminescence quenching.

This phenomenon is the ability of certain molecules to influence the fluorescence of other molecules. Fluorescence is the ability of a molecule to absorb light of a certain energy and later emit light with lower energy (longer wave length). Such a molecule, called a luminophore, will after absorbing a photon with high enough energy, enter an exited state.

After a while the luminophore will emit a photon of lower energy and return to its initial state. Some types of luminophores might also return to the initial state when colliding with certain other molecules.

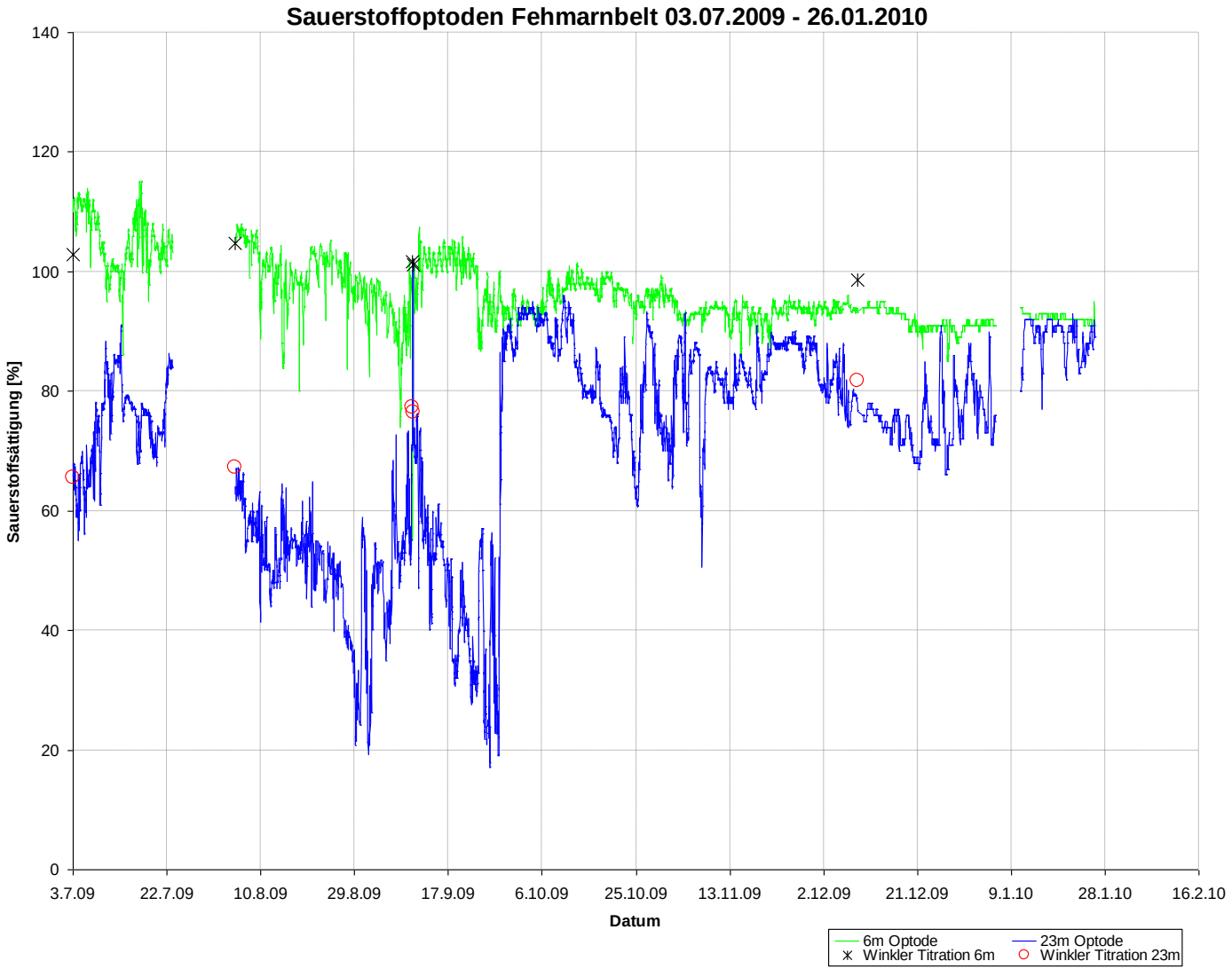


Oxygen measurements

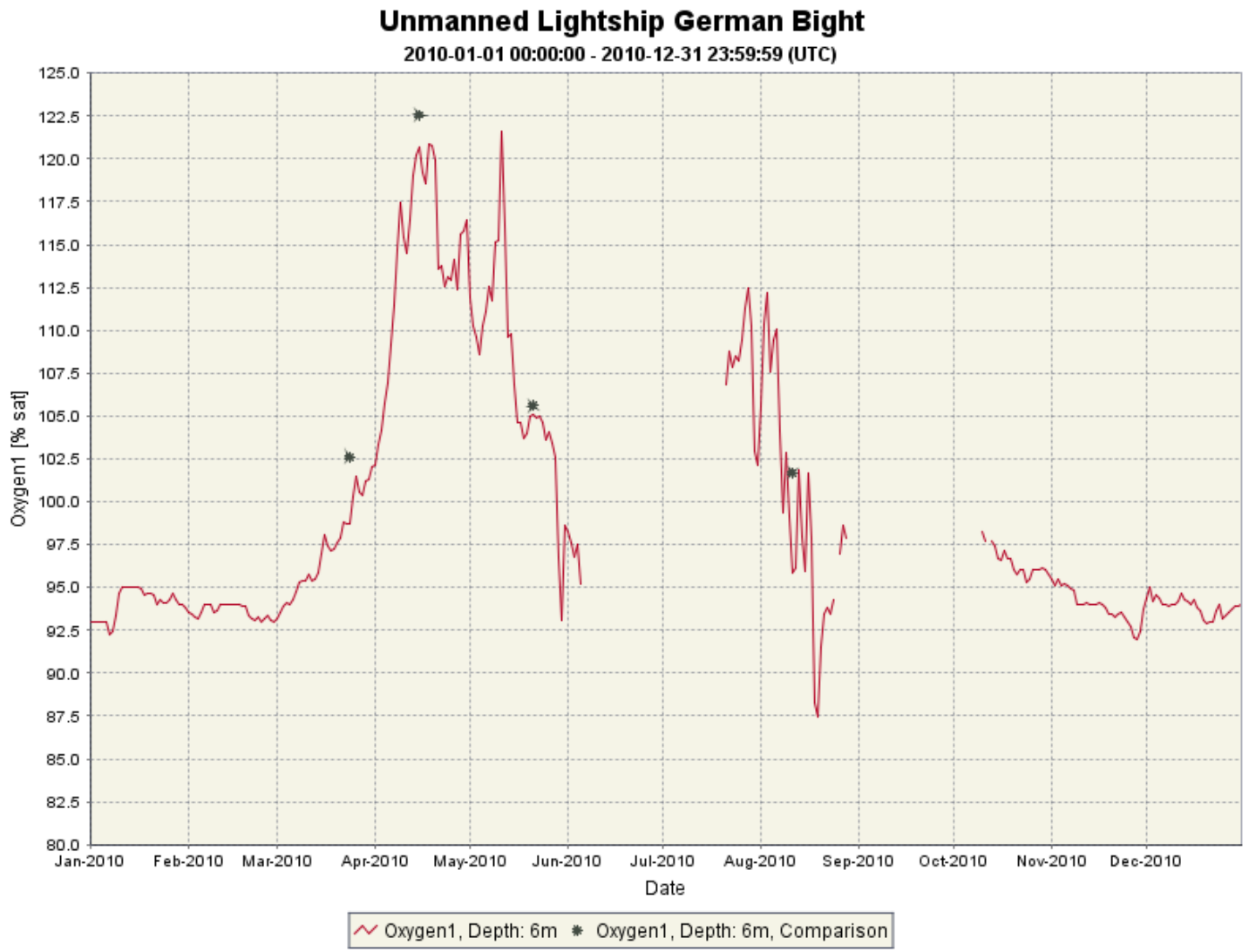


The optical design

Oxygen measurements



Oxygen measurements



Oxygen measurements

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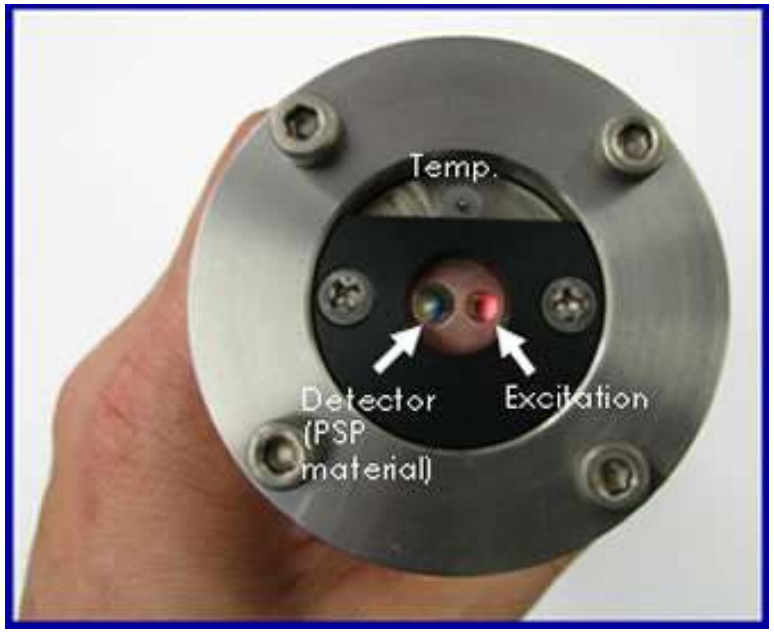
Fast response oxygen sensor:



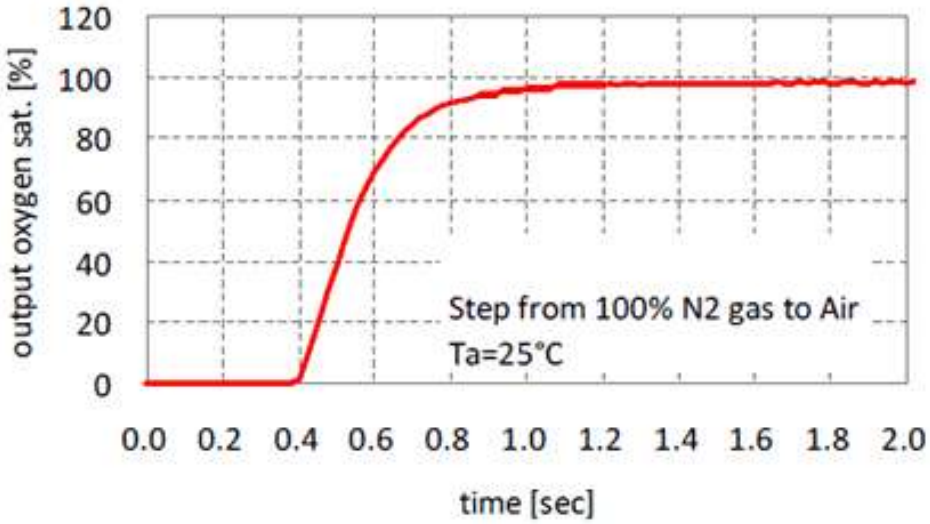


Fig.5 The response time of **RINKO**. This figure shows that the response time which reaches to 90% value of oxygen in air is within 1second.

Oxygen measurements

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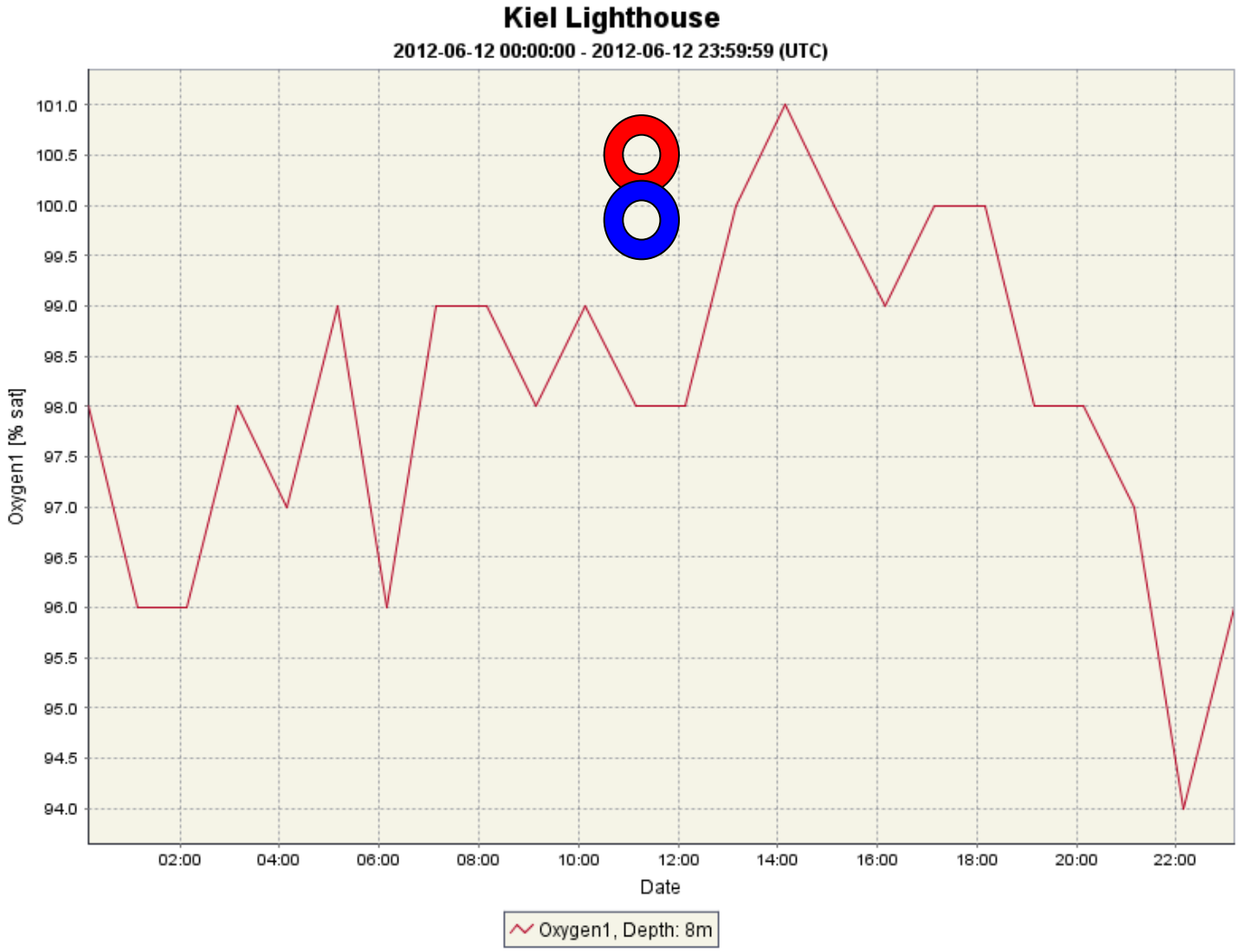
CTD

Winkler



Oxygen measurements

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Fast response oxygen sensor:

First results:

Calibration measurement 12. 06. 2012: CTD – Winkler-Tit.: 0.6 %

Calibration measurement 27. 09. 2012: CTD – Winkler-Tit.: 0.4 %

No calibration of the CTD – oxygen sensor between the two measurements!