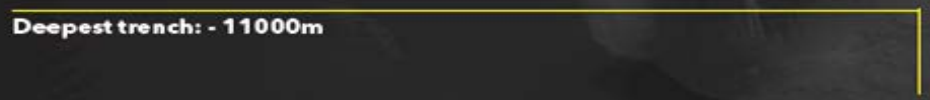
Glider Payload Sensors, Aanderaa

Plocan Glider School, Grand Canary, Spain, October, 2015



Dr. Anders Tengberg (anderste@chem.gu.se) Scientific Advisor/Product Manager, with Aanderaa since 1997. Associate Professor at the University of Gothenburg, Sweden

RELIABLE SOLUTIONS AANDERAA a xylem brand


xylem
Let's Solve Water
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YSI
a xylem brand
SonTek
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WATER LOG
a xylem brand
WTW
a xylem brand
O·I·Analytical
a xylem brand
Global Water
a xylem brand
ROYCE TECHNOLOGIES
a xylem brand
Bellingham + Stanley
a xylem brand
-ebro-
a xylem brand
SI Analytics
a xylem brand
mjk
a xylem brand
Standard Xchange
a xylem brand
Laing Thermotech
a xylem brand
rule
a xylem brand
GOULDS WATER TECHNOLOGY
a xylem brand
MIDLAND-ACS
a xylem brand
FLOJET
a xylem brand
Water Equipment Technologies
a xylem brand
McDonnell & Miller
a xylem brand
JABSCO
a xylem brand
SANITAIRE
a xylem brand
LOWARA
a xylem brand
godwin
a xylem brand
FLOWTRONEX
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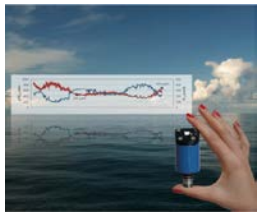
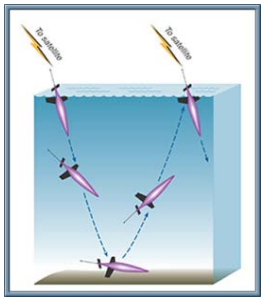
VOGEL PUMPEN
a xylem brand
WEDECO
a xylem brand
Hoffman SPECIALTY
LEOPOLD
a xylem brand
alcon SOLENOID VALVES
a xylem brand
rule Innovation
a xylem brand
Laing Thermotech
a xylem brand
essence OF LIFE
a xylem brand
FLYGT
a xylem brand
REDJACKET Water Products
a xylem brand
AC FIRE PUMP
a xylem brand
MARLOW
Bell & Gossett
a xylem brand
PCI MEMBRANES
a xylem brand
Domestic Pump

Content

Glider Payload Sensors





1. Aanderaa smart sensors
1. O2 quality control
2. Importance of combined measurements
3. Examples from moving platforms

Material to be distributed to participants:

- The presentation in pdf
- Multi-parameter platforms for coastal monitoring & research → pdf with links to info, on-line data & video clips
- Atamanchuk et al. (2015) Continuous long-term observations of the carbonate system dynamics in the water column of a temperate fjord. Journal of Marine Systems 148, 272–284

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Smart sensors

4330 frequent gliders/floats

New O2 for flush integration

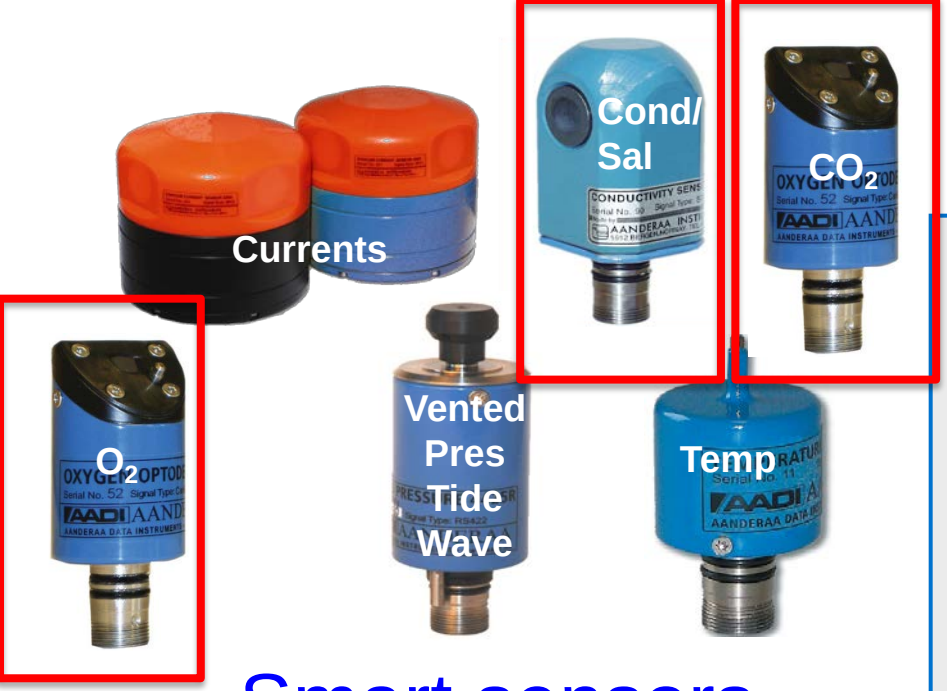
4831 frequent gliders/floats

Limited sales

On-going Glider evaluation

3830 frequent gliders/floats production stopped

Suitable for floats/gliders



Multiple Output:

- Cond: Cond,Sal,Temp,Sound speed,Raw
- Pres: Pres,Temp,Raw
- Oxygen: O_2,O_2%,Temp,Raw
- Wave & Tide: Wave,Tide,Temp,Raw
- Vented Wave & Tide: Wave, Tide, Pres, Temp, Raw
- Currents: Currents,Temp, Tilt, Signal, Strength,Raw
- CO2: pCO2 (microAtm), Temp, Raw

Smart sensors

Communication:

- AiCaP (CAN bus) XML format
- RS232/RS422 XML or various txt strings
- Analog 0-5 V, 4-20 mA

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Long term stable

Currents

Stand alone and high quality temp

Low power

Compact

e Output:

- **Cond: Cond,Sal,Temp,Sound speed,Raw**
- **Pres: Pres,Temp,Raw**
- **Oxygen: O_2,O_2%,Temp,**
- **Wave & Tide: Wave,Tide,Temp,Raw**
- **Vented Wave & Tide: Wave, Tide, Pres, Temp, Raw**
- **Currents: Currents Temp, Tilt, Signal, Strength,Raw**
- **n), Temp, Raw**

Robust

Smart s

Easy integration to different platforms

High accuracy & low noise

Communication:

- **AiCaP (CAN bus) XML format**
- **RS232/RS**
- **Analog 0-5 V, 4-20 mA**

300, 6000 and 12 000 m rated

Plug-and-Play sensor networks with AiCap

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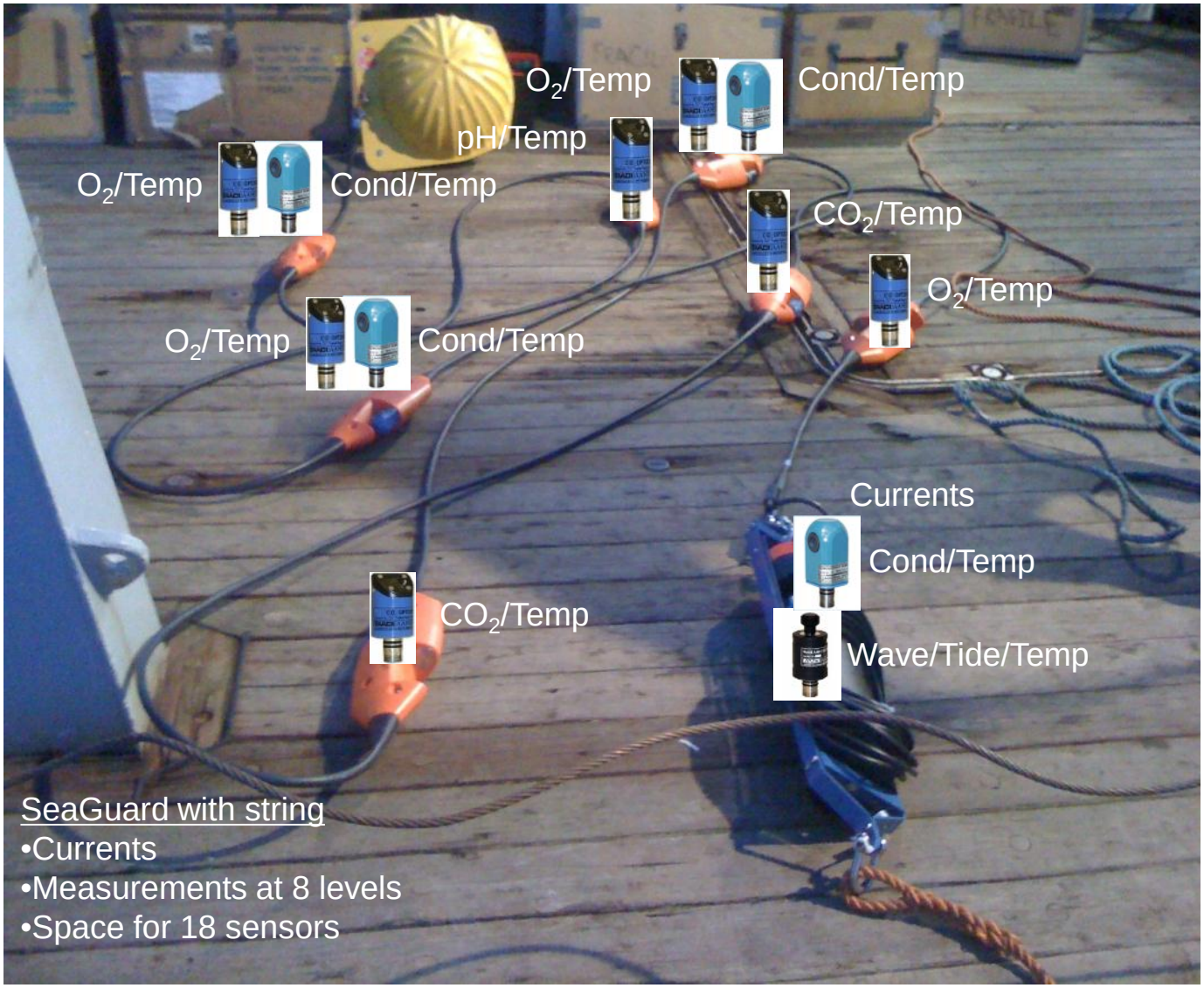
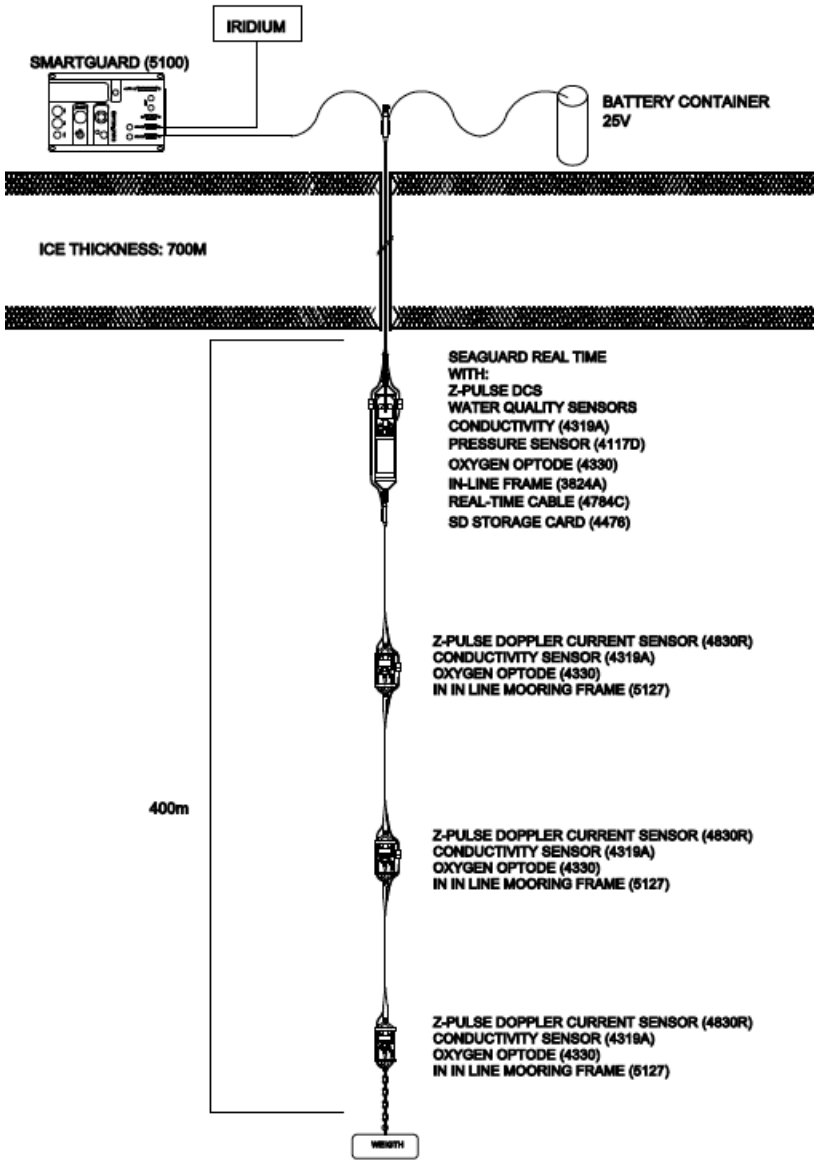
Example of plug-and-play sensor network: SeaGuard with string



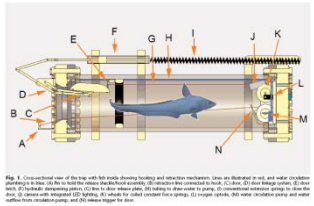
SeaGuard: Sensor String Solutions



Oxygen Optodes

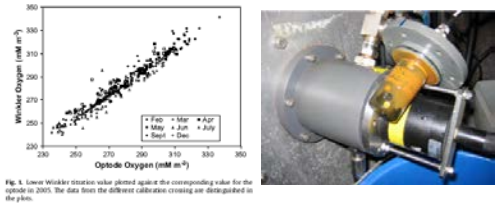
Examples of Scientific Papers more than 50

Incubators



Drazen et al (2005), Almroth et al (2012), Wikner et al (2013)

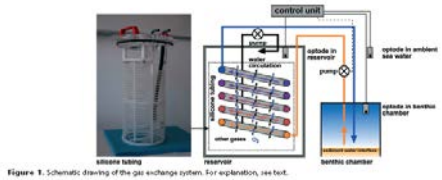
Ferry boxes



Hydes et al (2009)

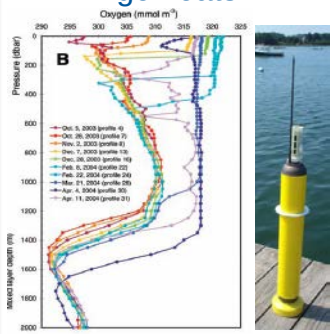
Tengberg et al (2006)

Gas Exchange Chamber



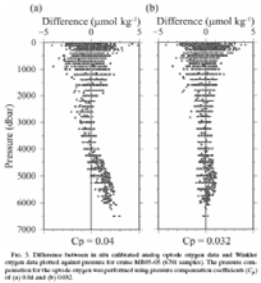
Sommer et al (2008)

Argo floats



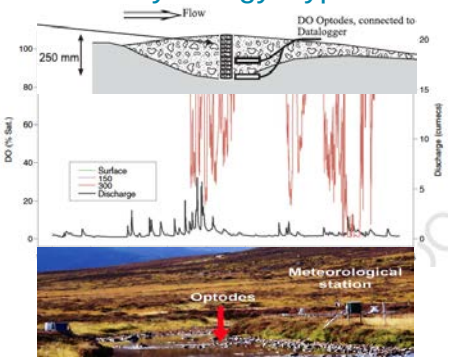
Körtzinger et al (2004, Nature)
Johnson et al (2010, Nature)
Fiedler et al (2013)
Takeshita et al (2013)
Bittig et al (2014)

Cabled CTD



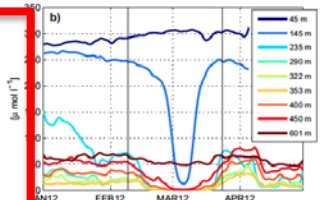
Uchida et al (2008)

Rivers/Hydrology/Hyporheic



Birkel et al (2013), Malcolm et al (2006, 2008, 2010), Soulsby et al (2008)

Moorings

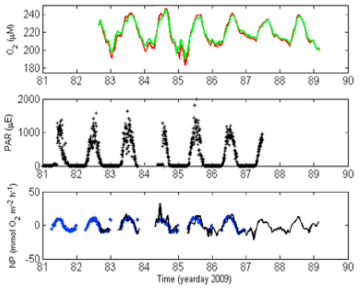


Stramma et al (2014), Viktorsson et al (2012)

Boys

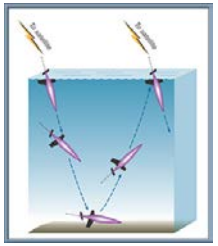
Jannash et al (2008), Bushinsky & Emerson (2013)

Gradients



McGillis et al (2011), Champenois and Borges (2012)

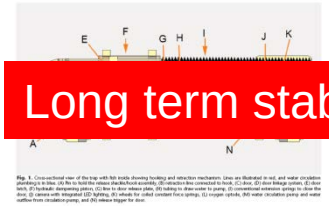
Gliders



Nicholson et al (2008)

Oxygen Optodes

Incubators



Long term stable

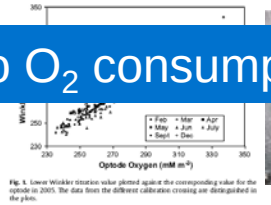
Examples of Scientific Paper
more than 50

Drazen et al (2005), Almroth et al (2012),
Wikner et al (2013

Not freezing sensitive

berg et al (2006)

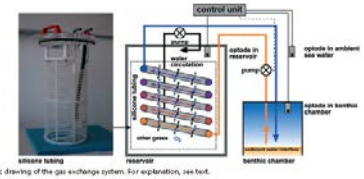
Ferry boxes



No O_2 consumption & Robust

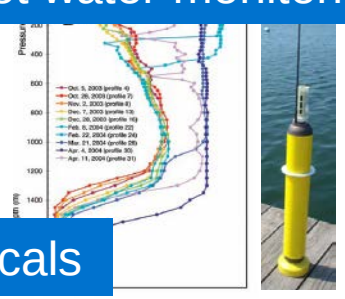
Hydes et al (2009)

Gas Exchange Chamber



Sommer et al (2008)

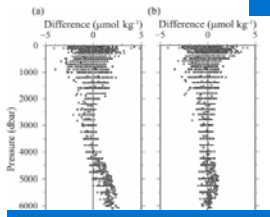
Good for hot water monitoring



zinger et al
(2004, Nature)
Johnson et al
(2010, Nature)
Fiedler et al (2013)
Takeshita et al
(2013)
Bittig et al (2014)

Not sensitive to H_2S and most other chemicals

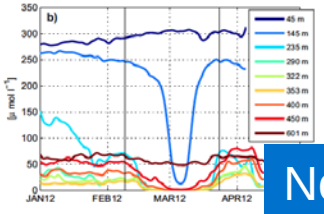
Cabled CTD



High accuracy & low noise

Uchida et al (2008)

Moorings



Stramma et al (2014),
Viktorsson et al (2012)

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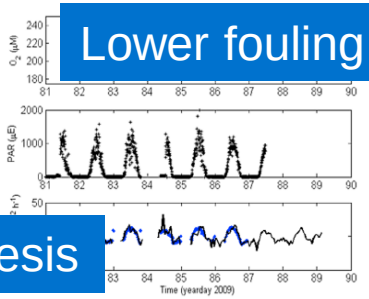
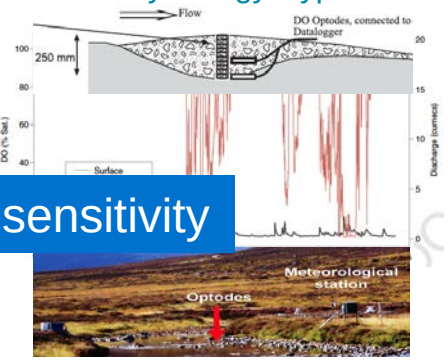
Gradients



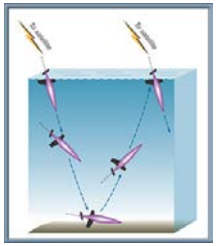
Lower fouling sensitivity

Rivers/Hydrology/Hyporheic



Birkel et al (2013),
Malcolm et al (2006, 2008,
2010), Soulsby et al
(2008)

Gliders



Nicholson et al (2008)

No pressure hysteresis

Jannasch et al (2008),
Bushinsky & Emerson
(2013)

McGillis et al (2011),
Champenois and
Borges (2012)

Sensor Development

MKI (2002)
Main models:
3830 & 3835

New O_2 for flush integration

- Better electronics
- Better optics (faster foils)
- Red reference LED
- Better temperature compensation
- Better formulas to calculate absolute oxygen (Uchida 2008)
- Multipoint calibrations with pre-treated foils

Aquaoptodes with new more stable/slower response foils

MKII (2012)
Main models:
4330, 4831 & 4835

Affordable, High quality, 100 m rated
Aquaoptode 4531 introduced in 2013

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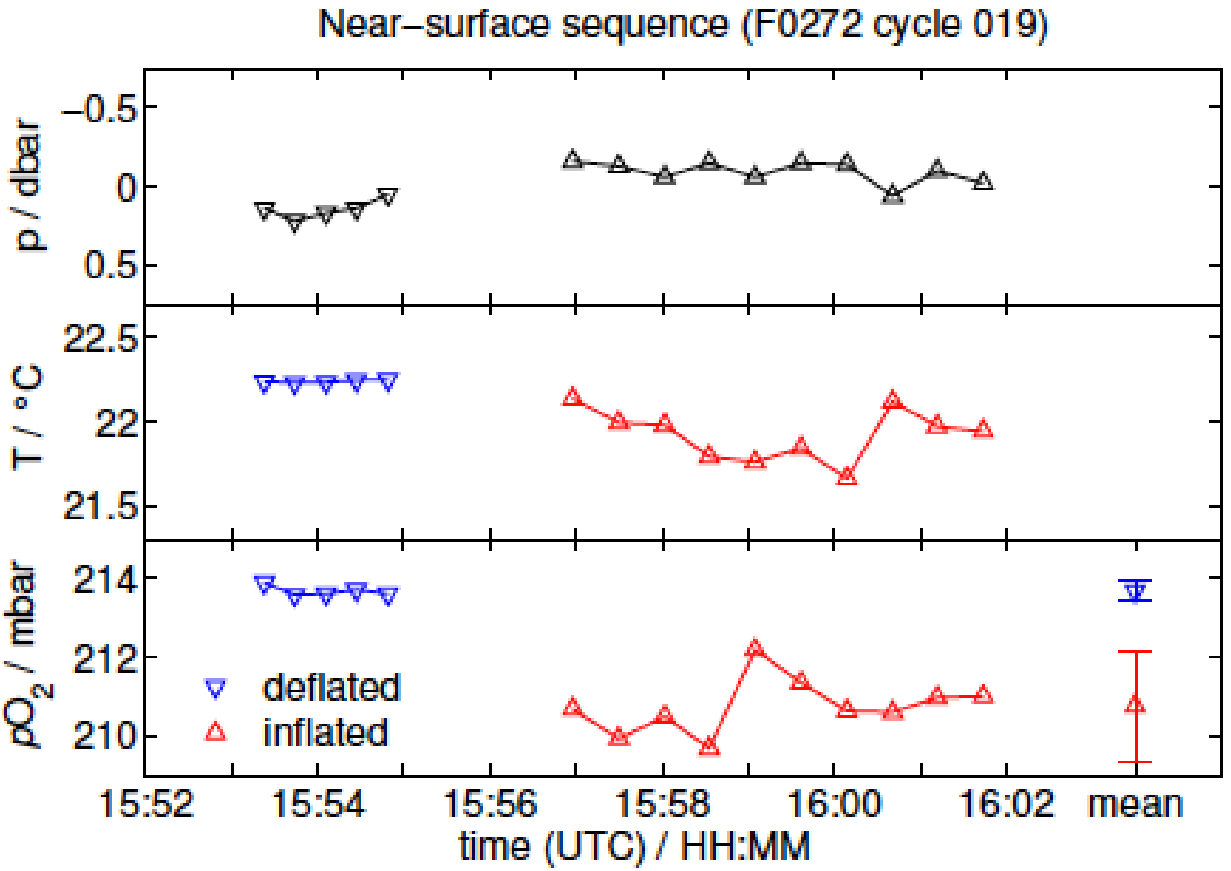
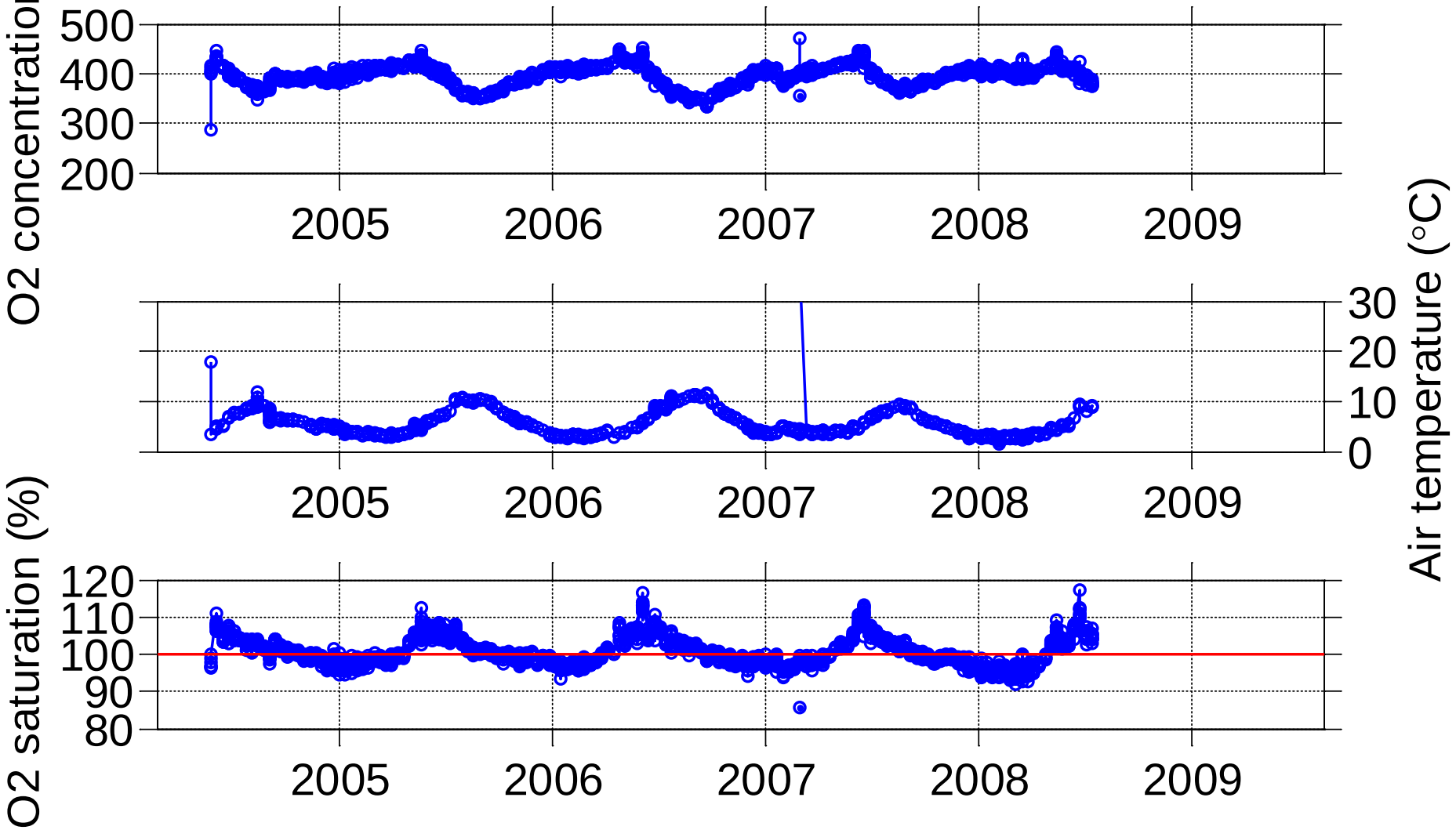
Henry C. Bittig and Arne Körtzinger, 2015: Tackling Oxygen Optode Drift: Near-Surface and In-Air Oxygen Optode Measurements on a Float Provide an Accurate in Situ Reference. J. Atmos. Oceanic Technol., 32, 1536–1543.

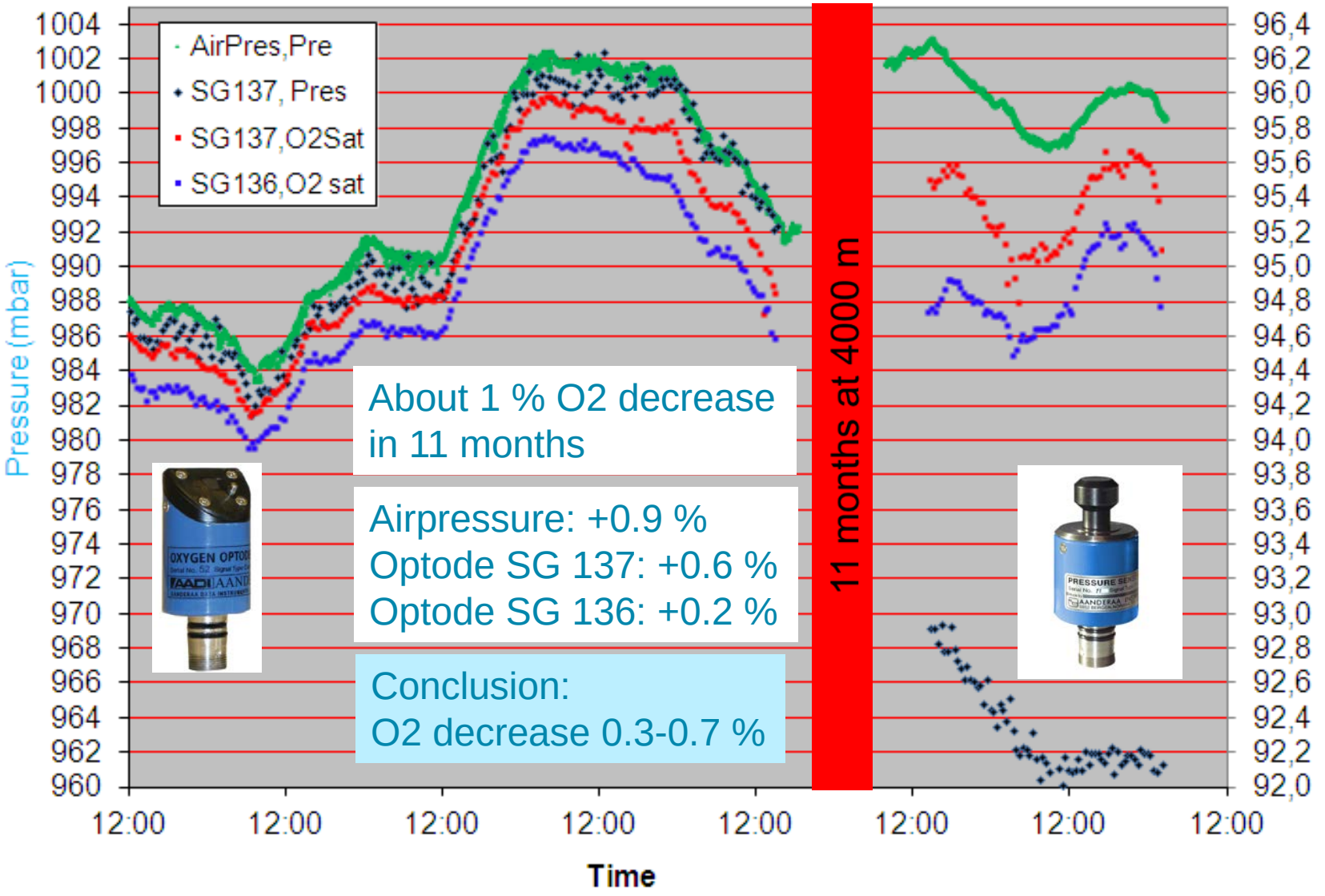


- Optode on 10-cm stick for in-air measurement
- Linear regression of measured in-air supersaturation against in-water supersaturation (using ancillary meteorological data to define the saturation level) provides a precise (0.2%) and accurate (1%) in situ correction that is available throughout the entire instrument's lifetime.

In air surface drift optode data from float 4900494

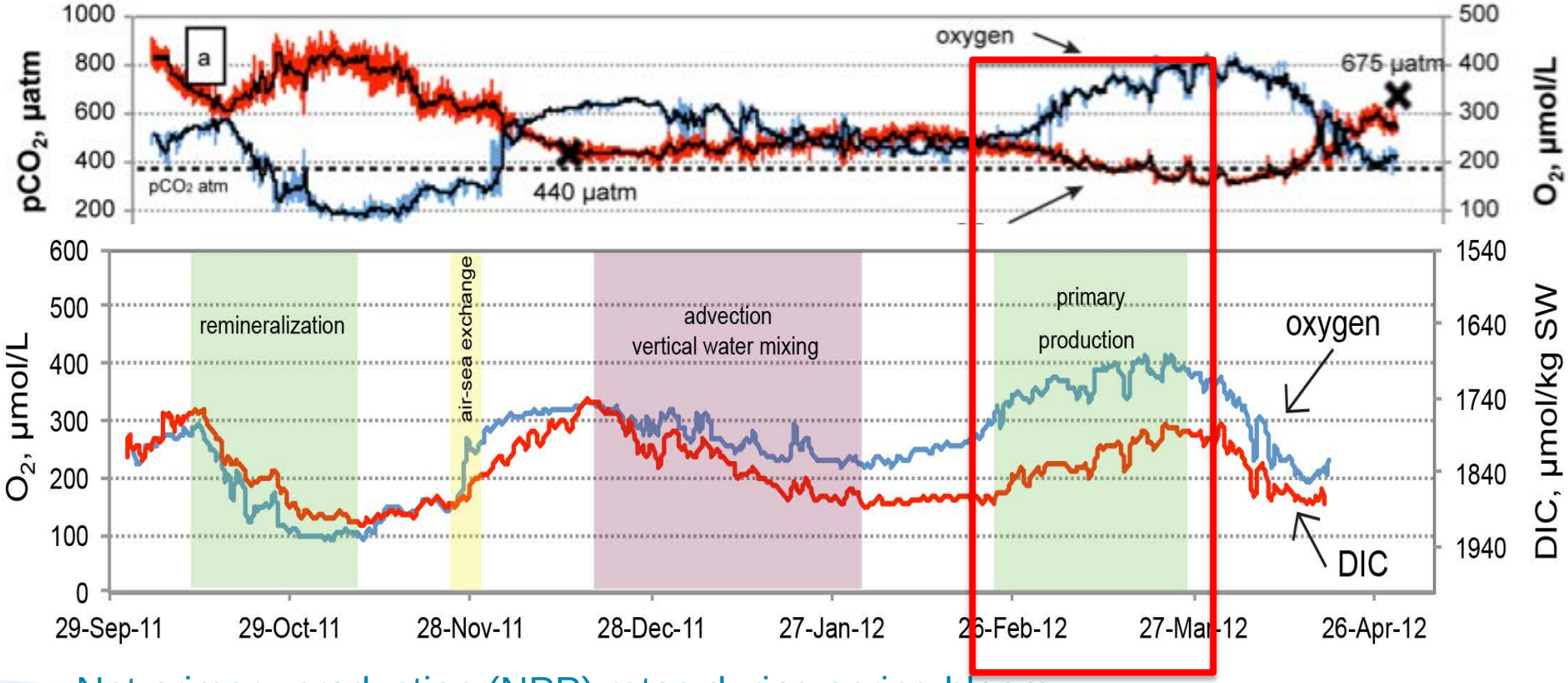


Pre & Post Deployment data. Air Pressure Ship + SG Pressure + Oxygen Saturation before and after deployment on two Seaguards



pCO_2 optode and O_2 optode at the depth of 12.6

Salinity derived Alkalinity



Net primary production (NPP) rates during spring bloom

- In 2012: 1.79 g C m-2
- In 2013: 2.10 g C m-2

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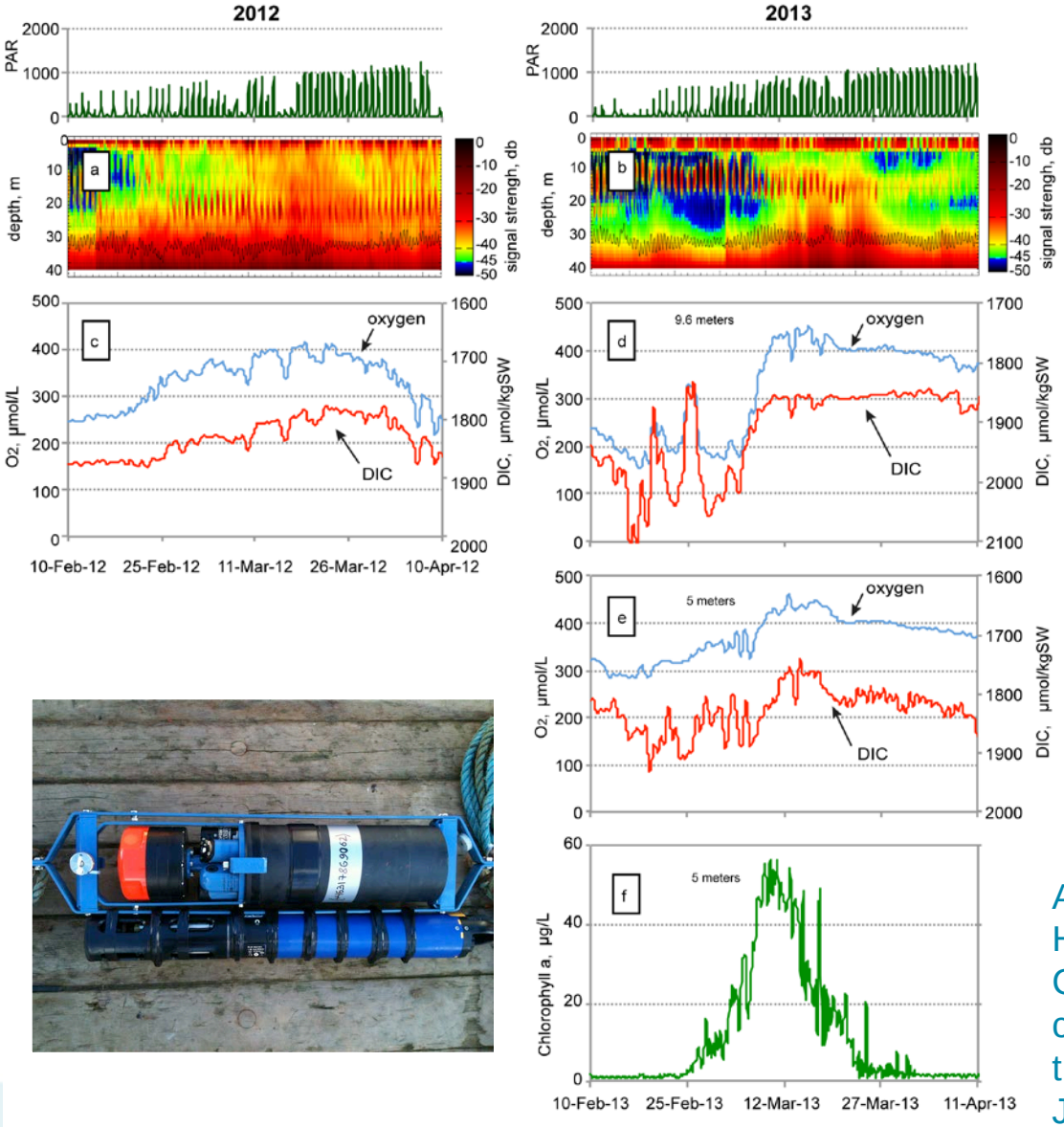
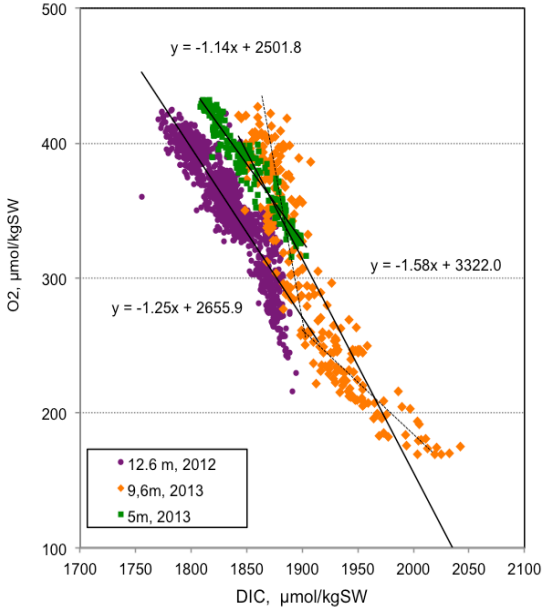
Combining sensors gives increased understanding



Redfield ratios
-C:O_2



Atamanchuk, Kononets, Thomas, Hovdenes, Tengberg and Hall (2015) Continuous long-term observations of the carbonate system dynamics in the water column of a temperate fjord. Journal of Marine Systems 148, 272–284

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SooGuard compact underway system. Environmental monitoring and research from ships of opportunity

AANDERAA Ambeon MSI

MS ROMANTIKA
TALLINK

Choose date 09-03-2014

Choose parameter Temperature [°C]

Sattelite overlay: -

View: datatable

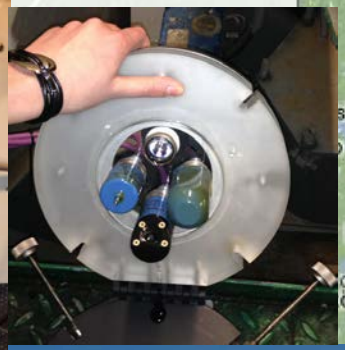
graph

SHIP'S LAST POSITION
1,1..1,9 °C
1,9..2,6 °C

Real-time: http://on-line.msi.ttu.ee/lvferry3/

MS ROMANTIKA

Time. 09-03-2014 23:52
Latitude: 57° 41.8382'
Longitude: 21° 58.6255'
Temperature: 1.82 °C
Conductivity: 6.39 mS/cm
Salinity: 6.33 psu
O2 Conc: 425.35 uM
O2 Air Satur: 96.92 %
Chlorophyll-a: 6.86 ug/l
Turbidity: 0.77 FTU
Phycocyanin: 3.29 ug/l
pCO2: 620.18 uatm
CalPhase: 32.74 deg
Signal strength: -59 dBm
Current GSM/GPRS provider: 24701
Battery voltage: 14.3 V



Sweden
Finland
Estonia
Latvia
Vaasa
Lapua
Seinäjoki
Sundsvall
Jyväskylä
Hudiksvall
Bollnäs
Gävle
Falun
Uppsala
Västerås
Täby
Södertälje
Norrköping
Nyköping
Lahti
Kouvola
Kotka
Mikkeli
Viljandi
Tartu
Valga
Võru
Ventspils
Alūksne
Liepāja

Offshore Sensing AS

O_2

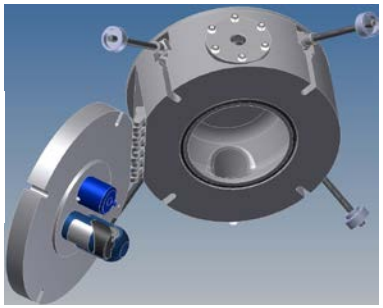
pCO_2

Temp

Hull Temp

Oil

CDOM



Sal

Turb

FDOM

ChlA

Phyco

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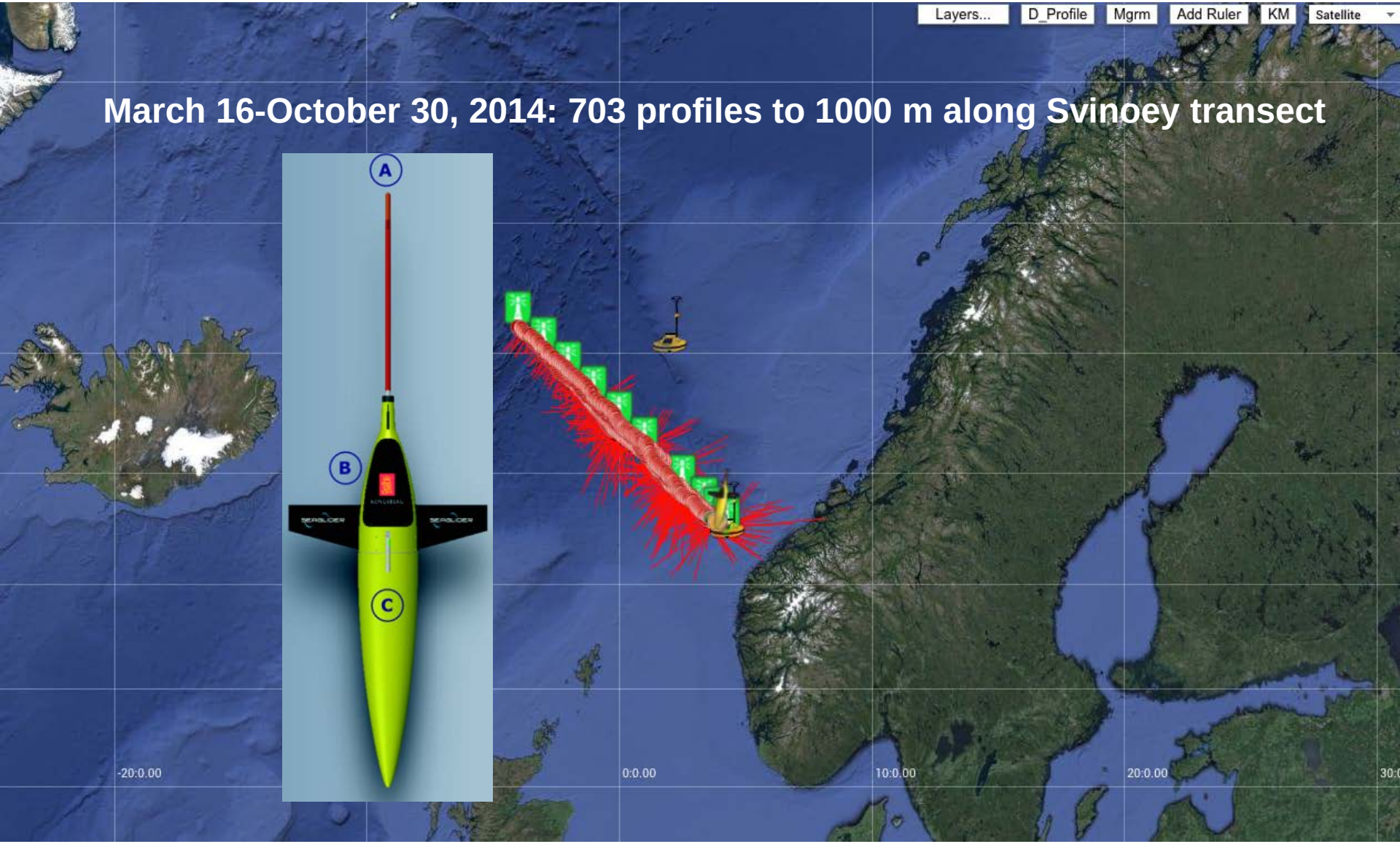
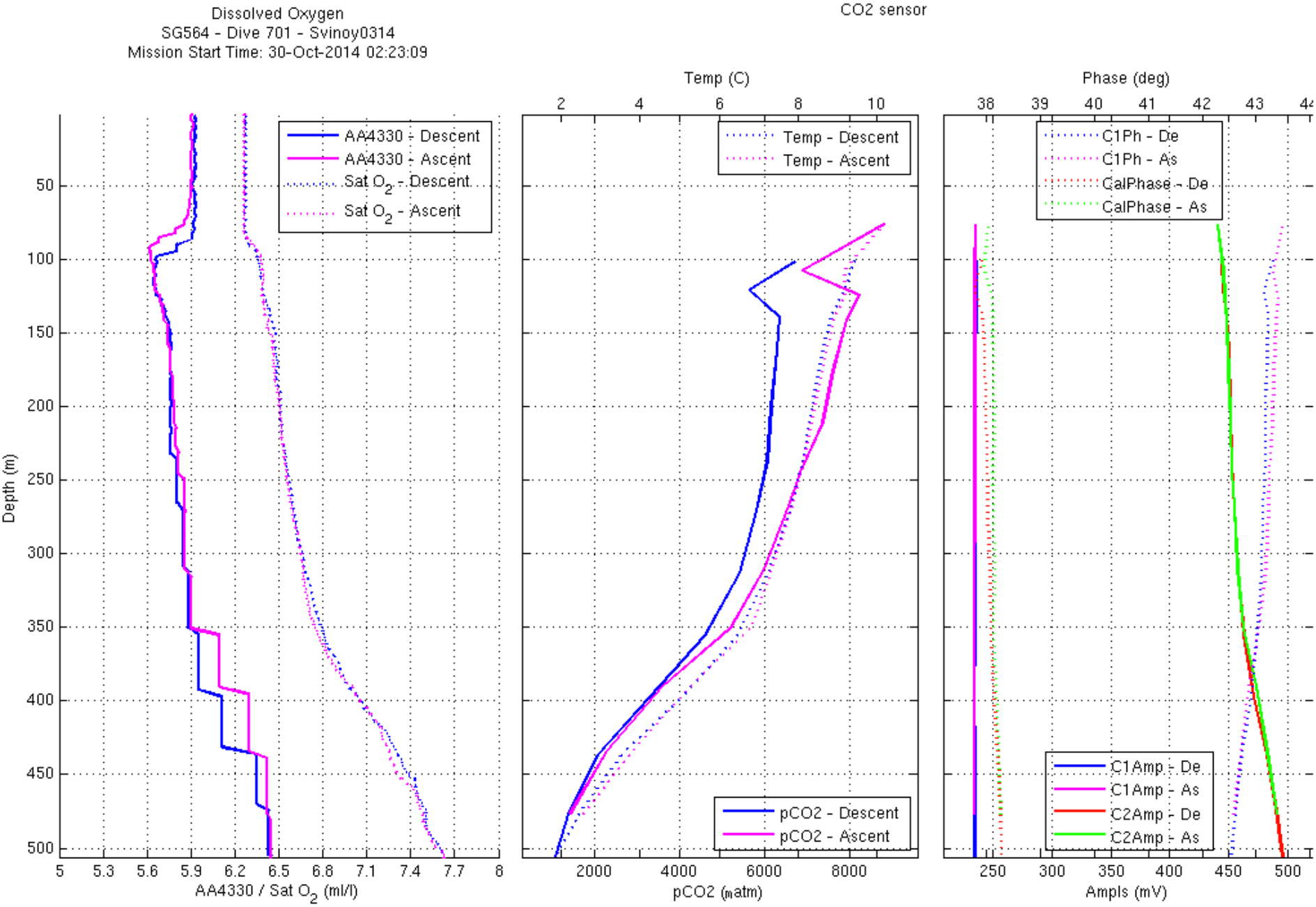
pCO2 and O2 optodes on IFM-Geomar wave glider during PhD course

Combining sensors, platforms and methods: Glider



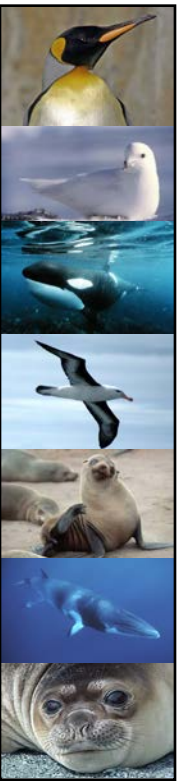
http://naco.gfi.uib.no/gp


Dissolved Oxygen
SG564 - Dive 701 - Svinoy0314
Mission Start Time: 30-Oct-2014 02:23:09
AA4330 - Descent
AA4330 - Ascent
Sat O2 - Descent
Sat O2 - Ascent
Depth (m)
AA4330 / Sat O2 (ml/l)
CO2 sensor
Temp (C)
Temp - Descent
Temp - Ascent
pCO2 - Descent
pCO2 - Ascent
pCO2 (matm)
Phase (deg)
C1Ph - De
C1Ph - As
CalPhase - De
CalPhase - As
C1Amp - De
C1Amp - As
C2Amp - De
C2Amp - As
Ampls (mV)

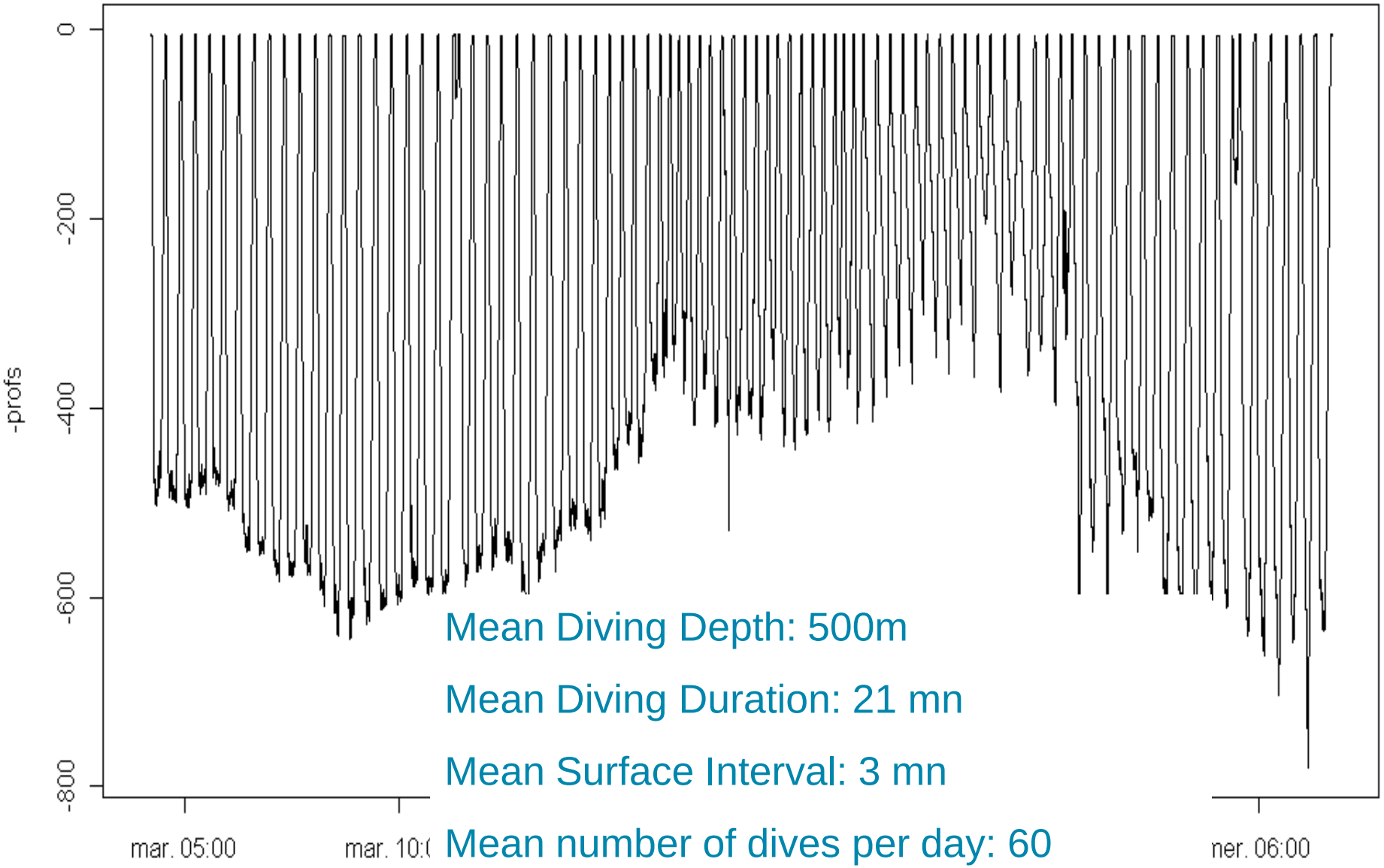
Marine Predators Team

Contribution of the Elephant Seal to monitor the oxygen content of the Southern Ocean

Christophe Guinet, CEBC-CNRS



ANR IPSOS-SEAL
Investigation of the vulnerability of the biological Productivity of the Southern Ocean Subsystems to climate change : the Southern Elephant seal Assessment from mid to high Latitudes



Mean Diving Depth: 500m

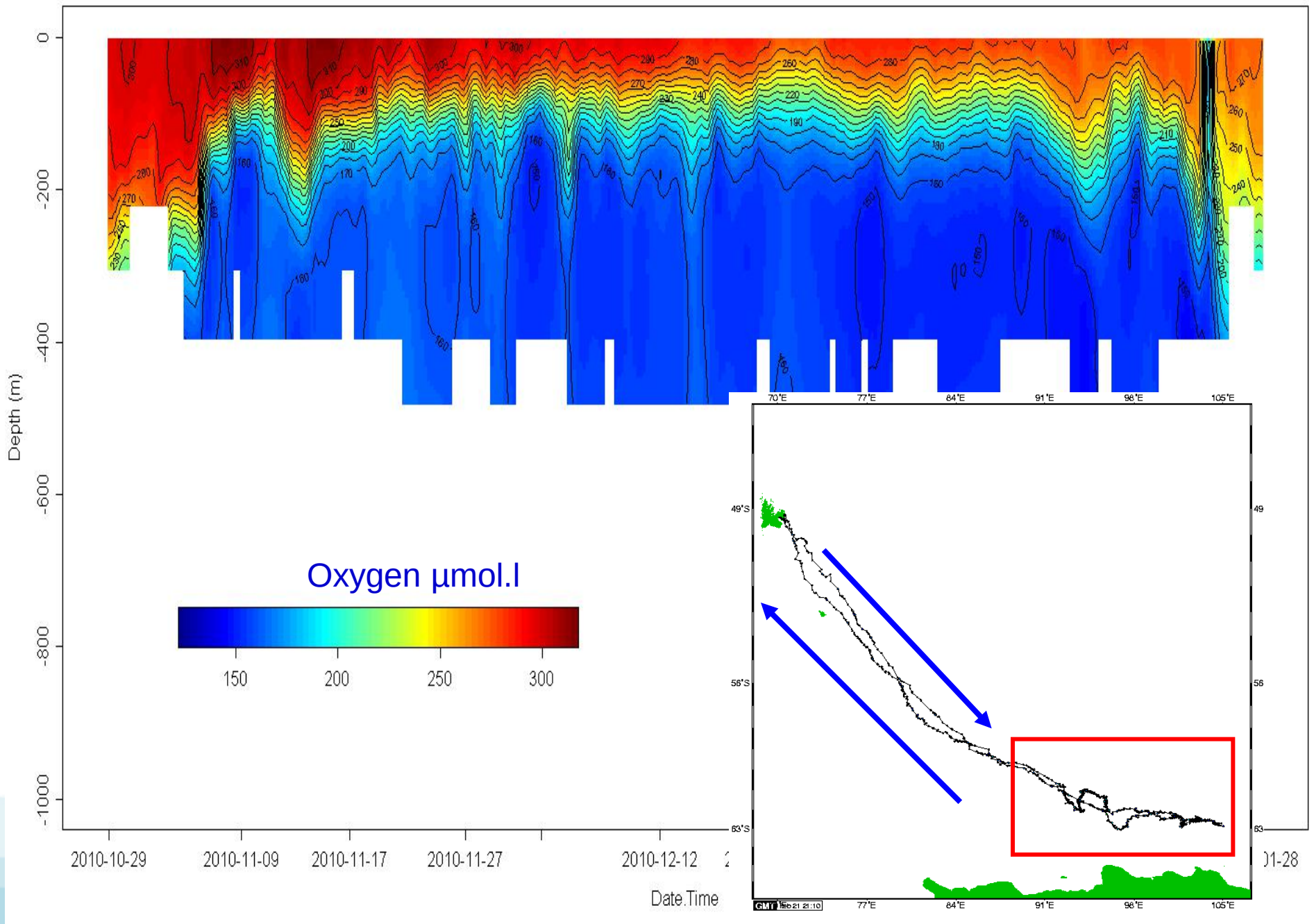
Mean Diving Duration: 21 mn

Mean Surface Interval: 3 mn

Mean number of dives per day: 60

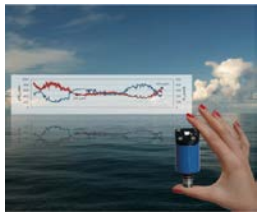
0-2 km between dives

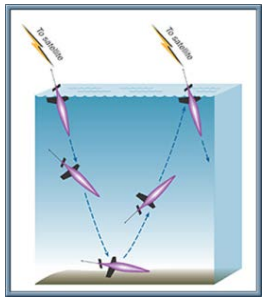
25 Oct -17 Nov 2010 | 17 Nov 2010 -10 Jan 2011 | 10 - 28 Jan 2011



Content

Glider Payload Sensors





Tank you!

1. Aanderaa smart sensors
1. O2 quality control
2. Importance of combined measurements
3. Examples from moving platforms

Material to be distributed to participants:

- The presentation in pdf
- Multi-parameter platforms for coastal monitoring & research → pdf with links to info, on-line data & video clips
- Atamanchuk et al. (2015) Continuous long-term observations of the carbonate system dynamics in the water column of a temperate fjord. Journal of Marine Systems 148, 272–284

AANDERAA a xylem brand