

Continuous measurements of atmospheric oxygen and carbon dioxide on a North Sea gas platform

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Outline

- Measurement site description
- Instrumental setup
- Measurement precision
- Initial results of continuous onsite measurements at F3 North Sea Platform

Measurement site: general information

F3 North Sea Platform

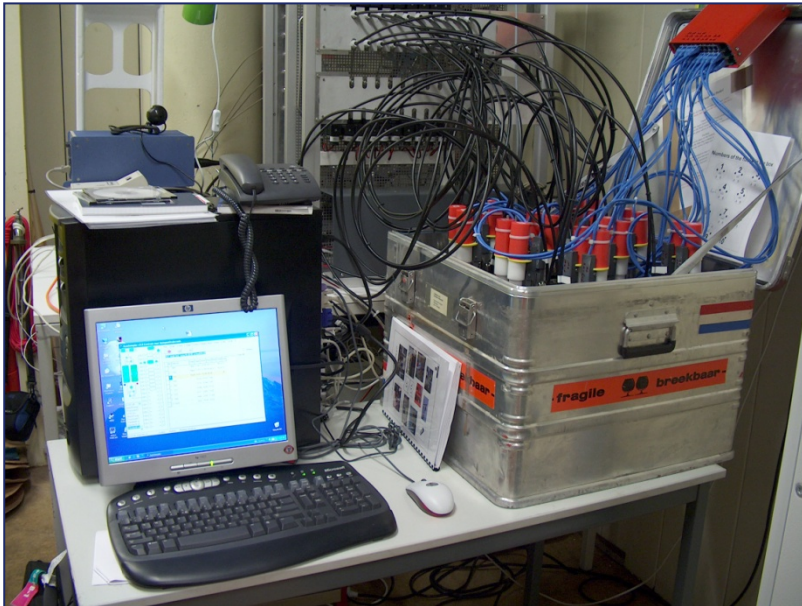
- 54°51'N, 4°44'E
- 200 km from land
- Oil and gas platform
- Air inlet on South-West corner, 46 meters above sea-level
- North Sea depth 44 meters



Measurement site: additional equipment

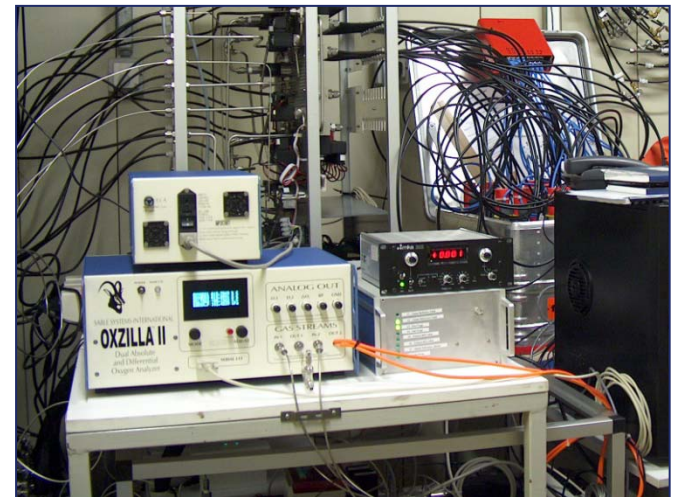


- Flask AutoSampler (Neubert et al., 2004)
- Meteorological facilities



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Instrumental setup O₂ and CO₂

- O₂: Oxzilla II similar to e.g. Stephens et al. (2007), Thompson et al. (2007) and Patecki & Manning (2007).

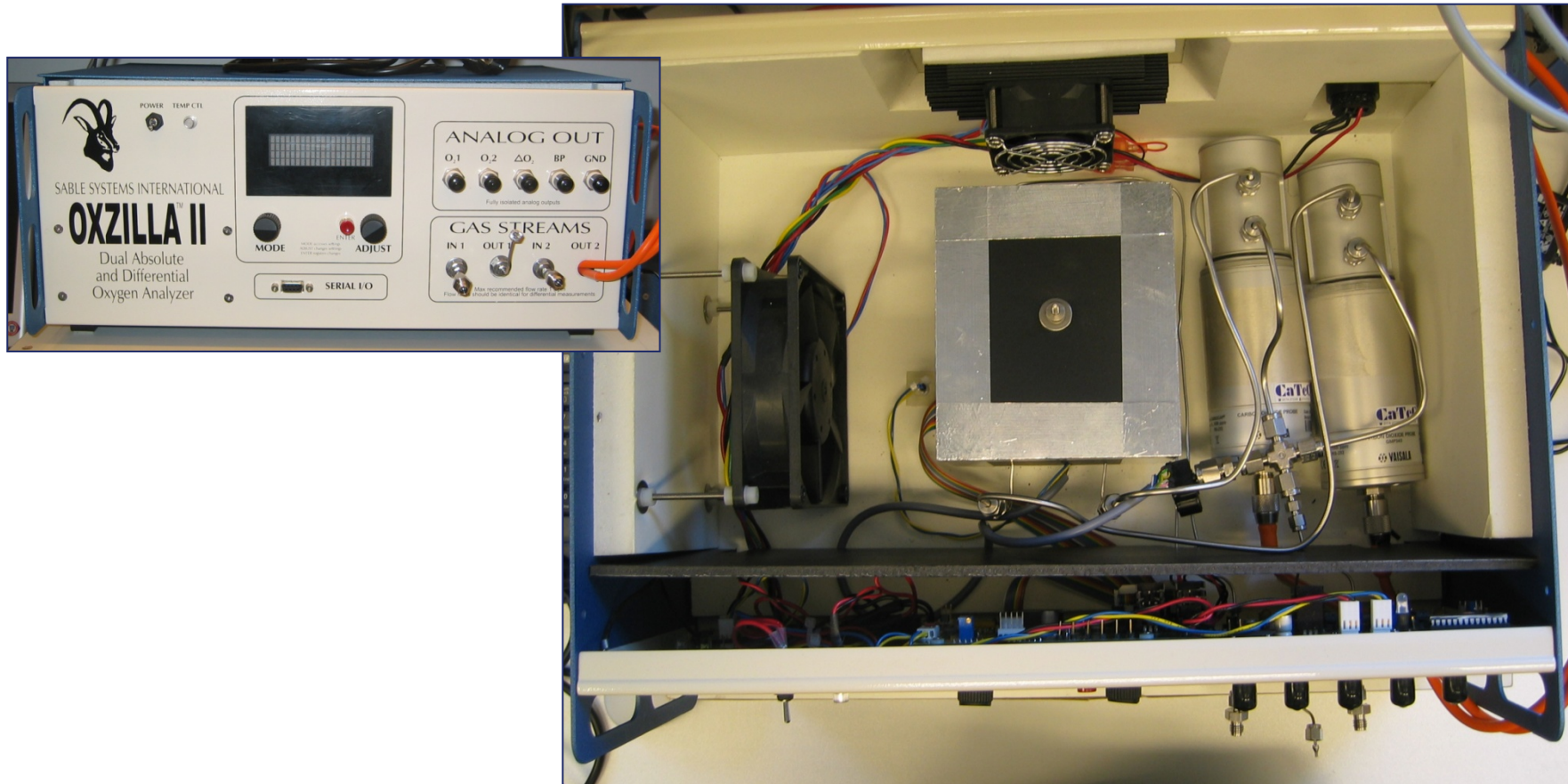


- CO₂: Vaisala CarboCap
Infrared absorption,
use two in differential
mode to increase accuracy

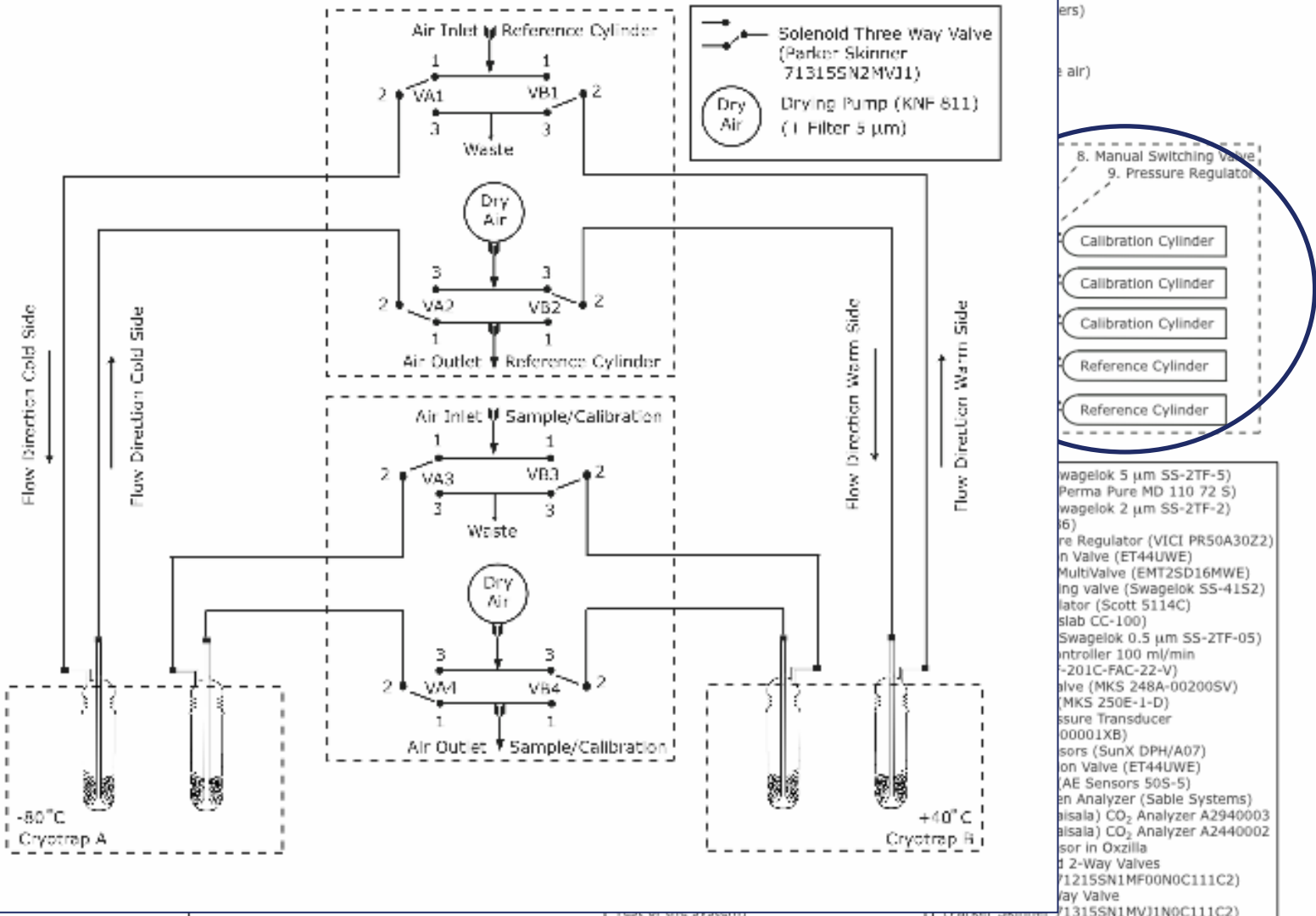


Instrumental setup O₂ and CO₂

Oxzilla + Vaisala = Oxzala



Instrumental setup O₂ and CO₂



Instrumental setup O₂ and CO₂

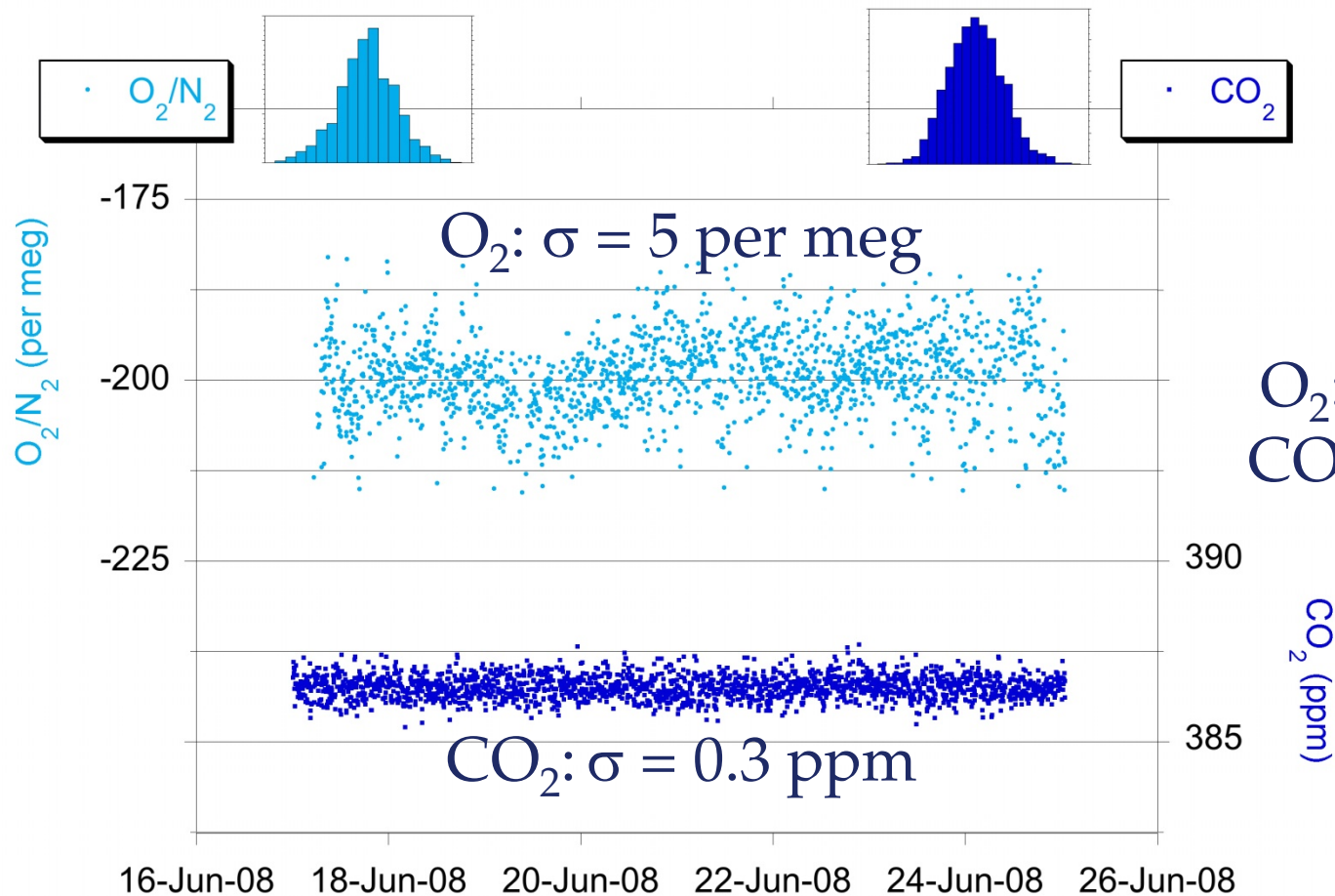
- Calibration of all working and reference cylinders is performed in our lab, using Air Optima.
- Until now local Groningen scale.
- The Air Optima measurements have recently been transferred to Scripps scale. F3 data in this presentation is however still on local scale.

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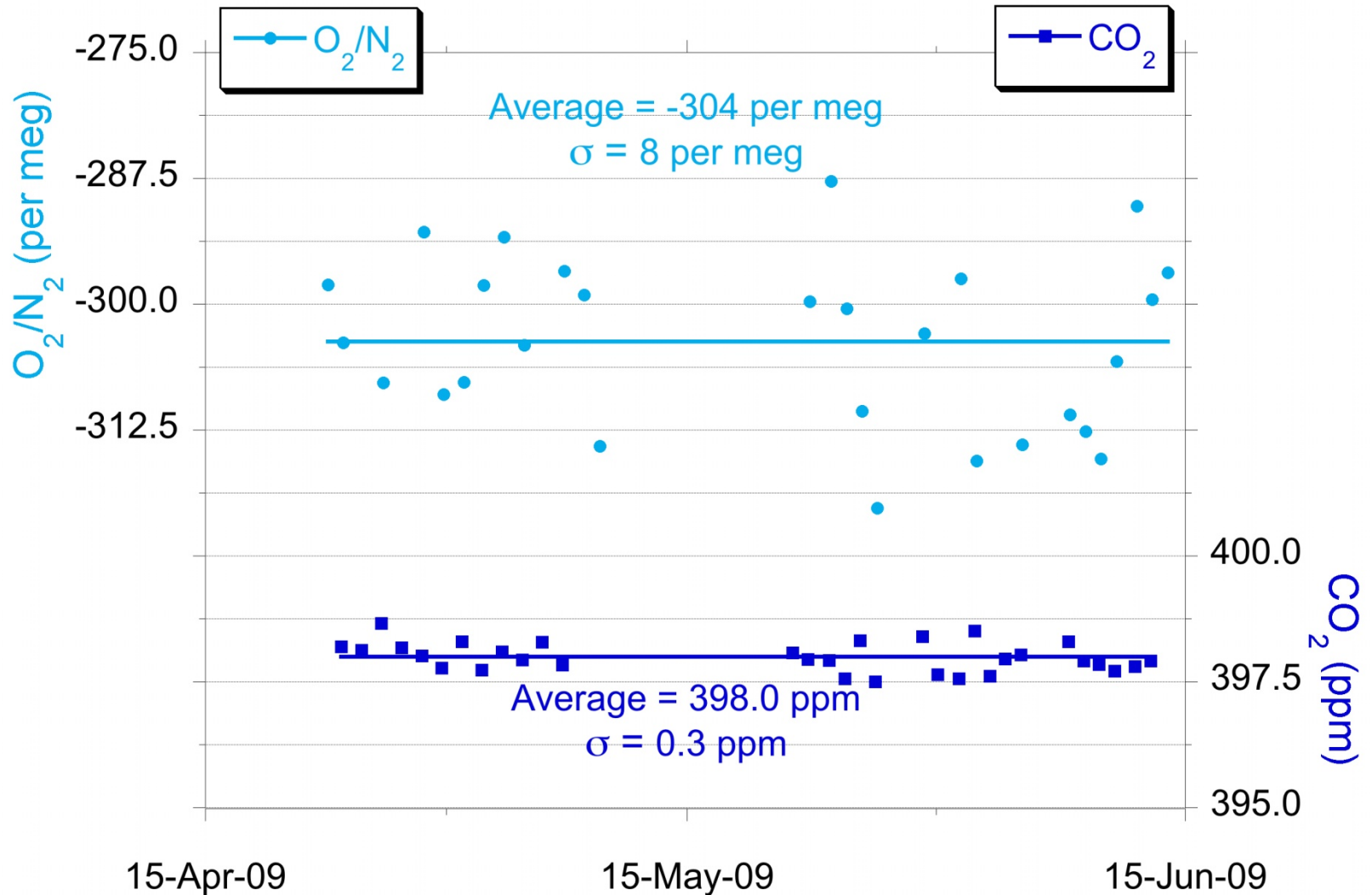
Measurement precision: Lab tests

Lab results have shown adequate stability (9 days):



Short term
(0.5 hour):
 $O_2: \sigma = 4$ per meg
 $CO_2: \sigma = 0.28$ ppm

Measurement precision: Target



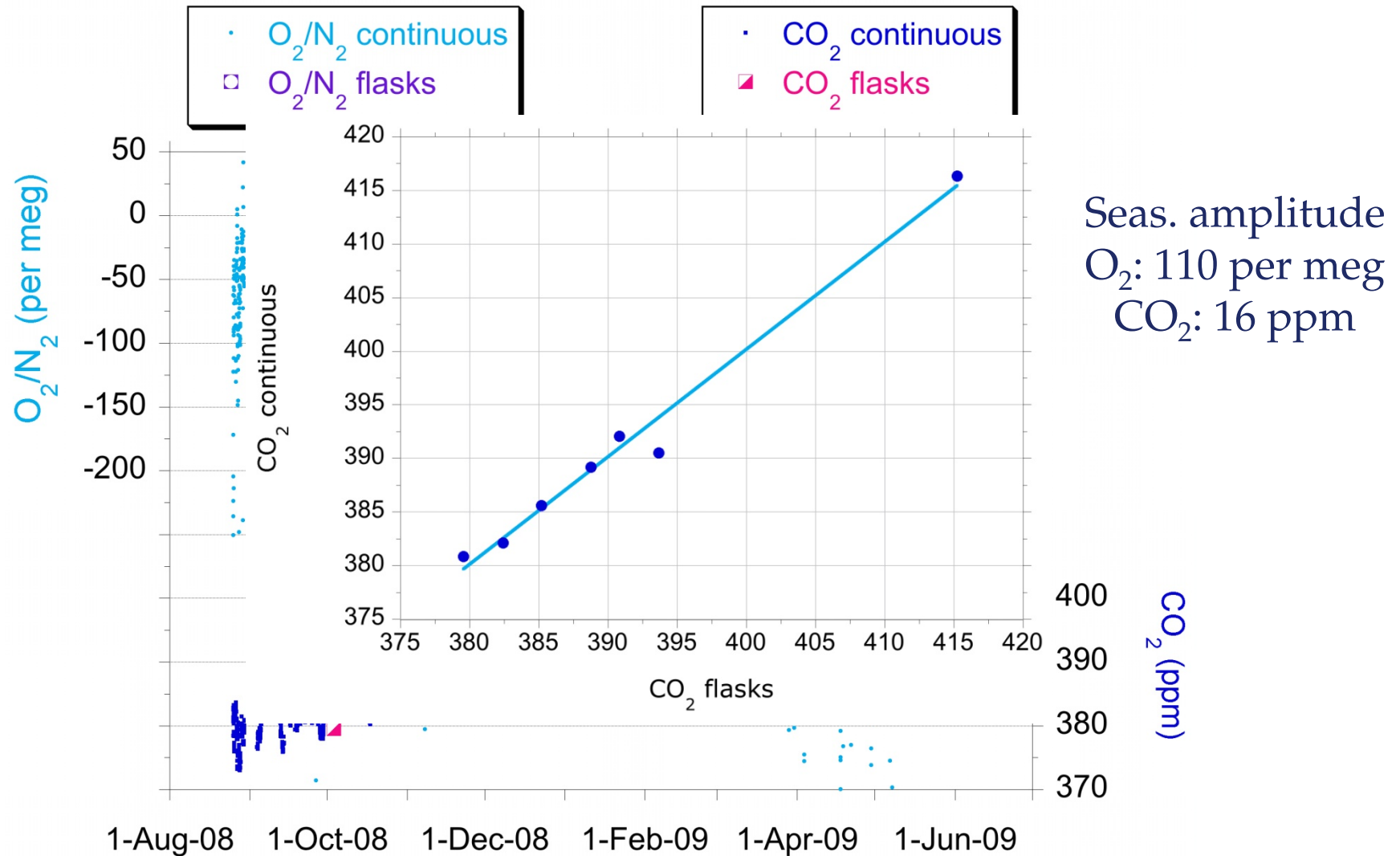
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Continuous observations from F3 platform

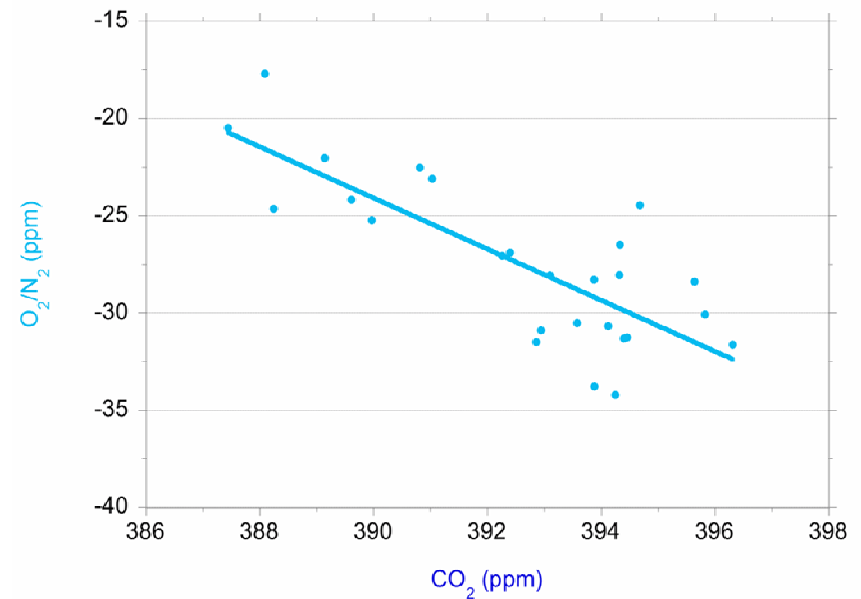
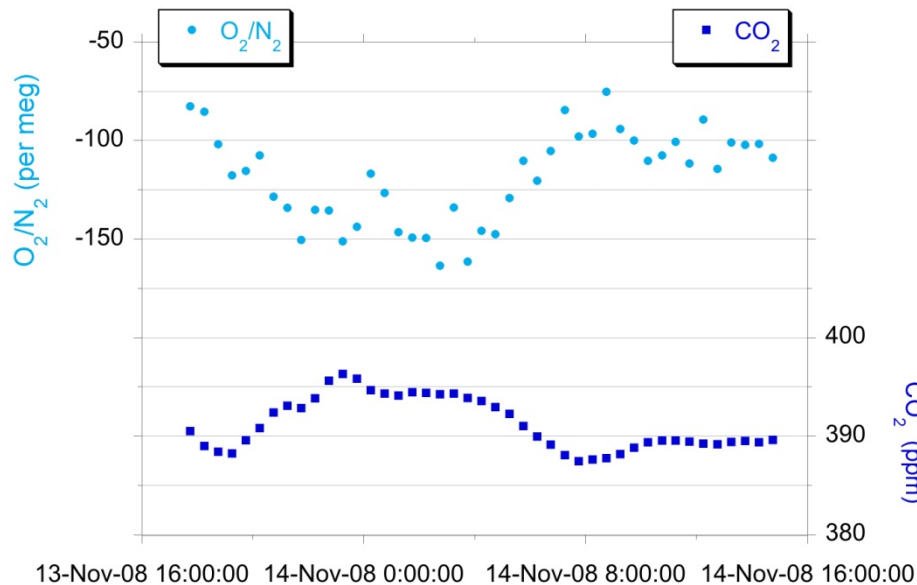
- Measurement system installed on F3 platform in August 2008.
- Continuous measurements at F3 platform started in September 2008.
- First preliminary results:

Continuous observations from F3 platform



Continuous observations from F3 platform

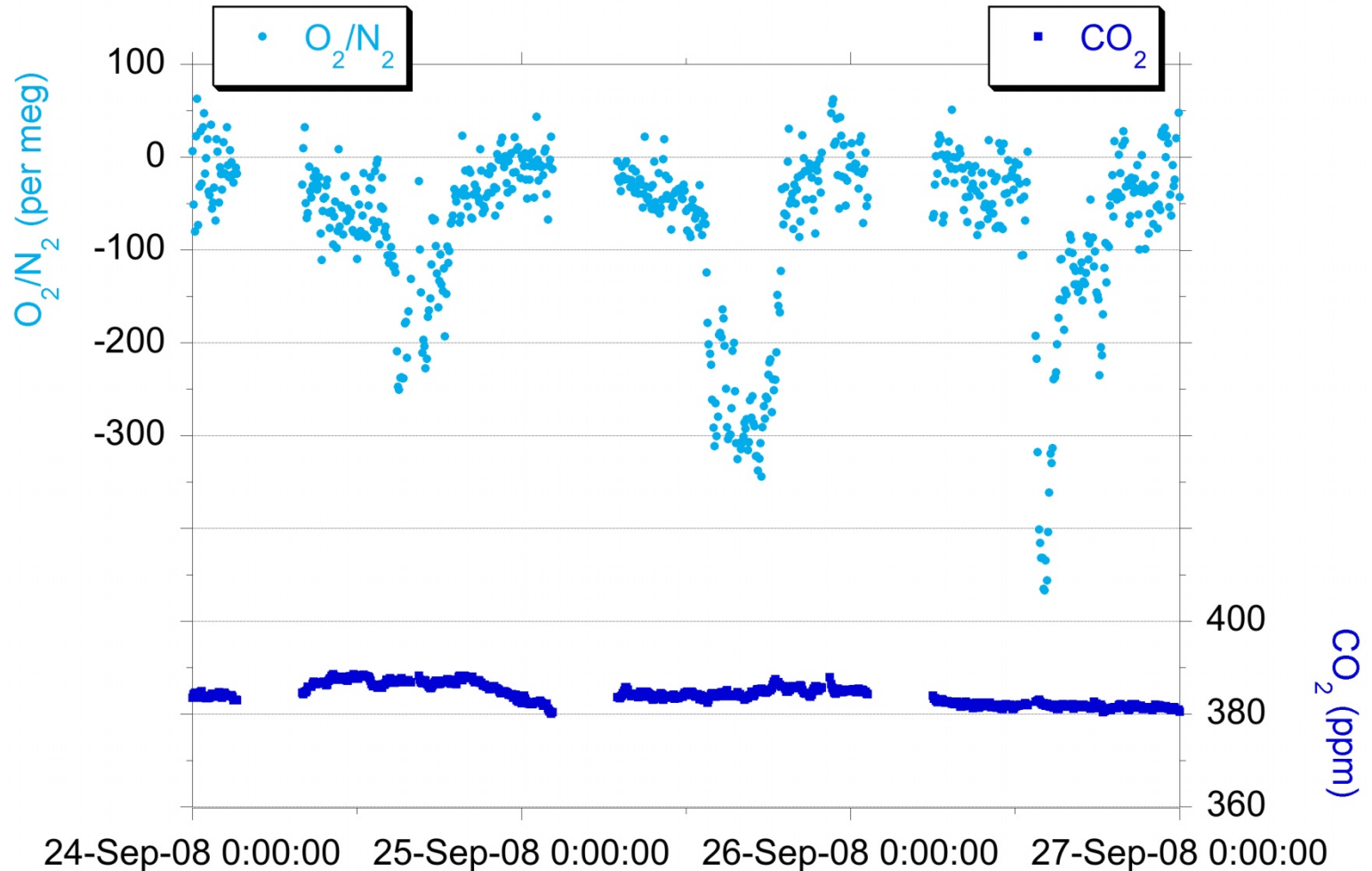
Small scale event:



Oxidative ratio
1 : -1.31 ± 0.09

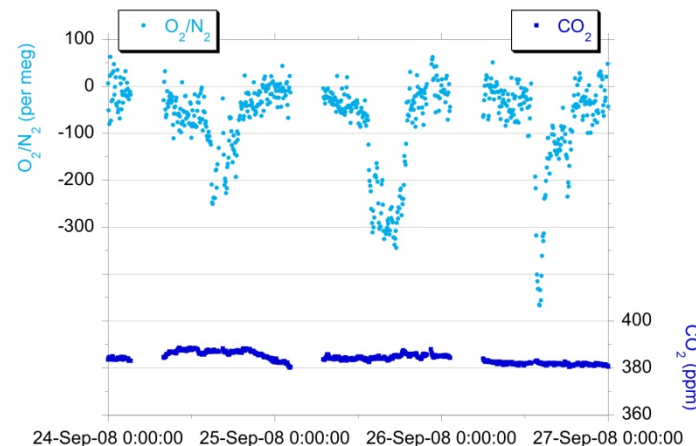
Continuous observations from F3 platform

Small scale events:



Continuous observations from F3 platform

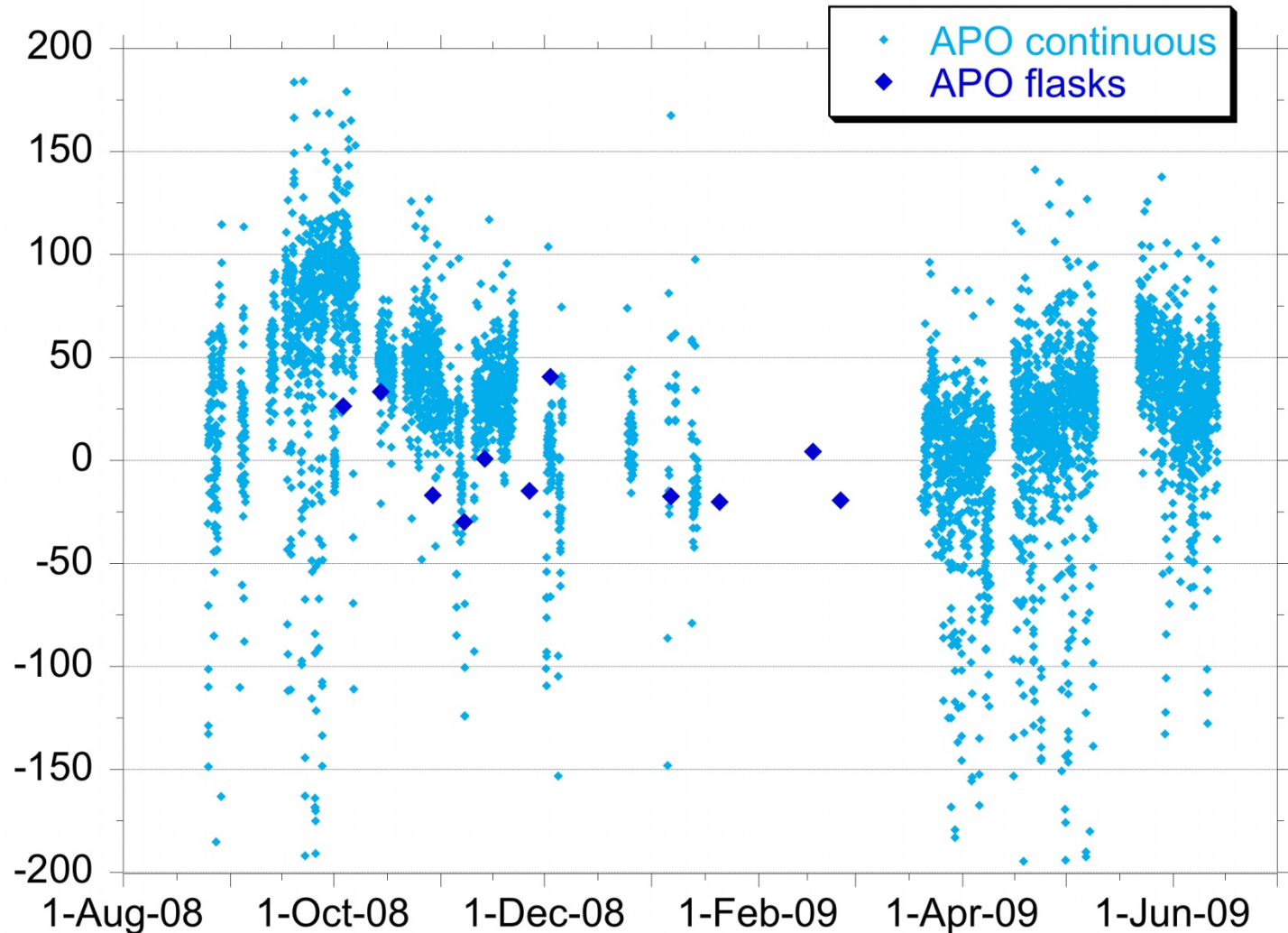
- Huge, fast changing O_2 signal
- Little cloud cover, high solar irradiance
- Since there is no concurrent CO_2 signal, most effects can be ruled out immediately
- No use of liquid N_2 and (thermal) fractionation is unlikely since signal does not fit temperature/cloud cover
- Signal does fit wave period measurements at F3
- Therefore likely marine O_2 uptake:
- Signal corresponds to a marine undersaturation of 10%



Continuous observations from F3 platform

APO:

APO (per meg)



Discussion

- The measurement system does yield important observations, but needs improvement in measurement precision
- Improvements can be achieved by: shorter flushing by minimizing volumes of e.g. air drying system and increasing the amount of working cylinders

Conclusion

- Continuous observations are available since one year.
- Flasks have been filled during 2006-2009, this data is presented at ICDC8, poster session T1-059.
- F3 is an ideal location for atmospheric observations in the North Sea area, since it is at the boundary of the shallower southern North Sea and the deeper northern part. The shallower part is a CO₂ source in summer whereas the deeper part is a sink for CO₂.

Thanks for your attention!



Questions?

Comments to AMTD can be submitted until 1 October

CIO is looking for PhD student to continue measurements at F3



References

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- Patecki, M. and Manning, A. C.: First results from shipboard atmospheric O₂ and CO₂ measurements over the North Atlantic Ocean, OCEANS 2007 – Europe, Aberdeen, UK, 18-21 June 2007, 2007.
- Stephens, B. B., Bakwin, P. S., Tans, P. P., Teclaw, R. M., and Baumann, D. D.: Application of a differential fuel-cell analyzer for measuring atmospheric oxygen variations, *J. Atmos. Ocean. Technol.*, 24, 82–94, doi:10.1175/JTECH1959.1, 2007.
- Thompson, R. L., Manning, A. C., Lowe, D. C., and Weatherburn, D. C.: A ship-based methodology for high precision atmospheric oxygen measurements and its application in the Southern Ocean region, *Tellus B*, 59, 643–653, 2007.