Hypoxia monitoring in aquatic ecosystems: a short introduction to target sites, scientific approach and first results (7 FP EU-project HYPOX)*

*In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies
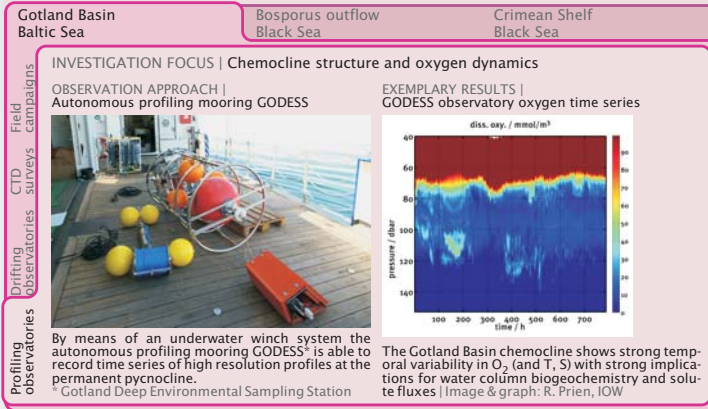
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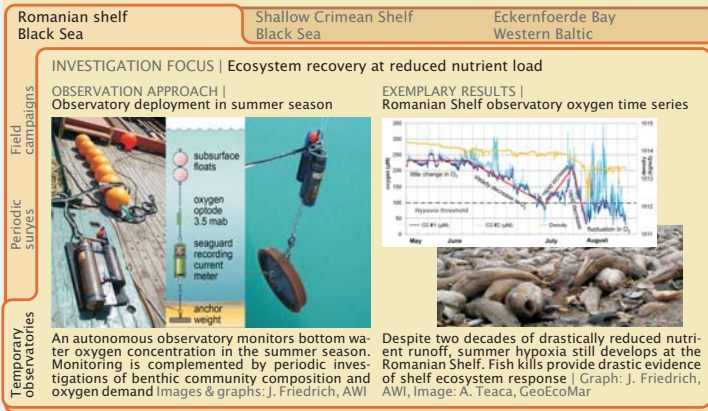
EXAMPLE 1 |
Observations in permanently stratified basins

SITE TYPE | Permanently stratified systems
HYPOXIA DRIVER SUSPECT | Restricted vertical exchange

Gotland Basin
Baltic Sea

Bosporus outflow
Black Sea

Crimean Shelf
Black Sea

INVESTIGATION FOCUS | Chemocline structure and oxygen dynamics

OBSERVATION APPROACH |
Autonomous profiling mooring GODESS

EXEMPLARY RESULTS |
GODESS observatory oxygen time series

By means of an underwater winch system the autonomous profiling mooring GODESS* is able to record time series of high resolution profiles at the permanent pycnocline.
* Gotland Deep Environmental Sampling Station

The Gotland Basin chemocline shows strong temporal variability in O₂ (and T, S) with strong implications for water column biogeochemistry and solute fluxes | Image & graph: R. Prien, IOW

EXAMPLE 2 |
Observations in shallow coastal systems

SITE TYPE | Eutrophied coastal systems
HYPOXIA DRIVER SUSPECT | Elevated Biological oxygen demand

Romanian shelf
Black Sea

Shallow Crimean Shelf
Black Sea

Eckernfoerde Bay
Western Baltic

INVESTIGATION FOCUS | Ecosystem recovery at reduced nutrient load

OBSERVATION APPROACH |
Observatory deployment in summer season

EXEMPLARY RESULTS |
Romanian Shelf observatory oxygen time series

An autonomous observatory monitors bottom water oxygen concentration in the summer season. Monitoring is complemented by periodic investigations of benthic community composition and oxygen demand Images & graphs: J. Friedrich, AWI

Despite two decades of drastically reduced nutrient runoff, summer hypoxia still develops at the Romanian Shelf. Fish kills provide drastic evidence of shelf ecosystem response | Graph: J. Friedrich, AWI, Image: A. Teaca, GeoEcoMar

INTRODUCTION

Hypoxic conditions are on the increase in water bodies worldwide due to eutrophication and global warming. By a combination of oxygen observatory deployments and dedicated field campaigns the EU-project HYPOX aims to better understand hypoxia causes and consequences. A variety of sites and monitoring approaches have been selected to cover all aspects of hypoxia and to maximize the knowlegde gained. This poster shows some examples of approaches and achievements.

For further information visit www.hypox.net

OBSERVATION TARGET SITES

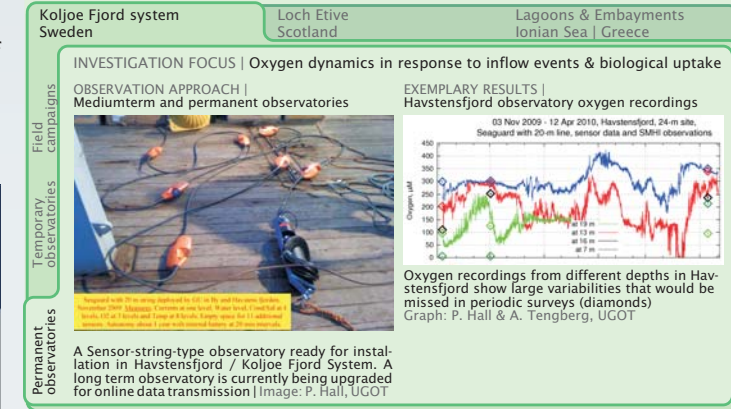Map: Sabine Luedeling | www.medieningenieure.de

SUMMARY

Sites investigated by the EU-project HYPOX cover a broad variety of drivers and consequences of hypoxia formation. Data are generalized by numerical modeling and disseminated in accordance with GEOSS principles. Knowledge gained on processes, monitoring approaches, and ecosystem responses is essential for decisions on adaequate hypoxia monitoring strategies in the future.

EXAMPLE 3 |
Observations in Fjord-like systems

SITE TYPE | Silled fjord-like systems
HYPOXIA DRIVER SUSPECT | Restricted lateral exchange

Koljoe Fjord system
Sweden

Loch Etive
Scotland

Lagoons & Embayments
Ionian Sea | Greece

INVESTIGATION FOCUS | Oxygen dynamics in response to inflow events & biological uptake

OBSERVATION APPROACH |
Mediumterm and permanent observatories

EXEMPLARY RESULTS |
Havstensfjord observatory oxygen recordings

Oxygen recordings from different depths in Havstensfjord show large variabilities that would be missed in periodic surveys (diamonds)
Graph: P. Hall & A. Tengberg, UGOT

A Sensor-string-type observatory ready for installation in Havstensfjord / Koljoe Fjord System. A long term observatory is currently being upgraded for online data transmission | Image: P. Hall, UGOT

EXAMPLE 4 |
HYPOX-modeling

TASK | Hypoxia modeling and data assimilation

Fjord mixing and Hypoxia
Scottish & Swiss Fjords

Hypoxia and benthic fluxes
Gotland Basin, Eckernfoerde Bay

Water column processes
Black Sea Basin

SIMULATION FOCUS | Tidally-driven lateral water exchange and effect on fjord mixing. Oxygen deficiency under sparse oxygen supply & strong biological demand

MODEL SETUP | Loch Etive modeling domain

EXEMPLARY RESULTS | Tidally-driven exchange

Shape and gridding of the Loch Etive modeling domain in FVCOM*. The red line refers to the vertical section shown in the right graph.
*Finite Volume Coastal Ocean Model with unstructured grid

Simulations of water column density structure under oscillating tidal forcing is the basis of hypoxia predictions in Loch Etive
Graphs: D. Aleynik, SAMS