KOB 2018 project

„Community level effects of sporadic upwelling in a warming climate“

Rationale:

Coastal upwelling transports deep water into shallow communities. When the water body is stratified, the deep water may differ substantially from the surface near water. Which abiotic variables vary by which amount and by which sign changes with season. With ocean warming water stratification will intensify. With ongoing eutrophication O2 consumption below the thermocline will intensify and hypoxia will become more prevalent.

Ocean warming, on the other hand, is a prime driver of ecological change in the age of global change. In Baltic macrophyte-dominated shallo habitats, the effect of warming changes with the seasons. In spring, warming favours gross primary production of macroalgae as well as theri reproductive activity. In early summer, warming enhances population growth and per-capita consumption of mesograzers. Their grazing activity, together with antifouling defenses of the macroalgae, is a major control mechanism of fouling on the thallus surfaces. In late summer, warming leads to a collaps of grazing activity and grazer populations and to a reduction in antifouling defenses of the macroalgae. In consequence, fouling intensifies on the surface of macroalgae leading to enhanced shading and nutrient depletion.

Various traits of upwelling deep water will affect the different components of the system differently. Macroalgae will benefit from the cooling and the nutrient enrichment. Grazers may succumb to hypoxia. Foulers may suffer from the cooling but benefit from nutrient enrichment.

While the net outcome of the upwelling can not be foreseen, we expect it to conspicuously modulate the direct impact of warming on an ecological important component of the Baltic benthic system.

Treatments

1. Upwelling. We will apply one 4 day upwelling late June and late August by pumping water from 16m through the KOB. Depending on season this may
   a. increase nutrients
   b. increase salinity
   c. increase pCO2
   d. decrease pO2
   e. decrease pH
   f. decrease temperature
2. Warming: We will apply warming a regression design with a 1°C increment over ambient, i.e. o-1-2-3-4-5 °C of warming

Responses assessed:

- Shifts in photosynthesis, growth, reproduction, carbon storage of the macrophytes
- Physiological responses of various invertebrate species (e.g. mussels, snails)
- Microbiom shifts
- Trophic interaction shifts
- Shifts in competitive interactions between native and invasive macroalgae
- Shifts in carbon use stratefies
- Shifts in the microbial communities assiciated with macrophytes
- Shifts in the autotroph/heterotroph balance in benthic communities
- Shifting prevalence of opportunists
- Shifts in the performance of epibiotic calcifiers

Target species

Natural benthic community composed of macroalgae, seagrass, mussels, seastars, isopods, gammarids, sticklebacks, random sediment fauna directly transplanted form Kiel Fjord into the KOB. In this process, natural proportion of species abundances will be repsected.

Participants supported by Aquacosm TA

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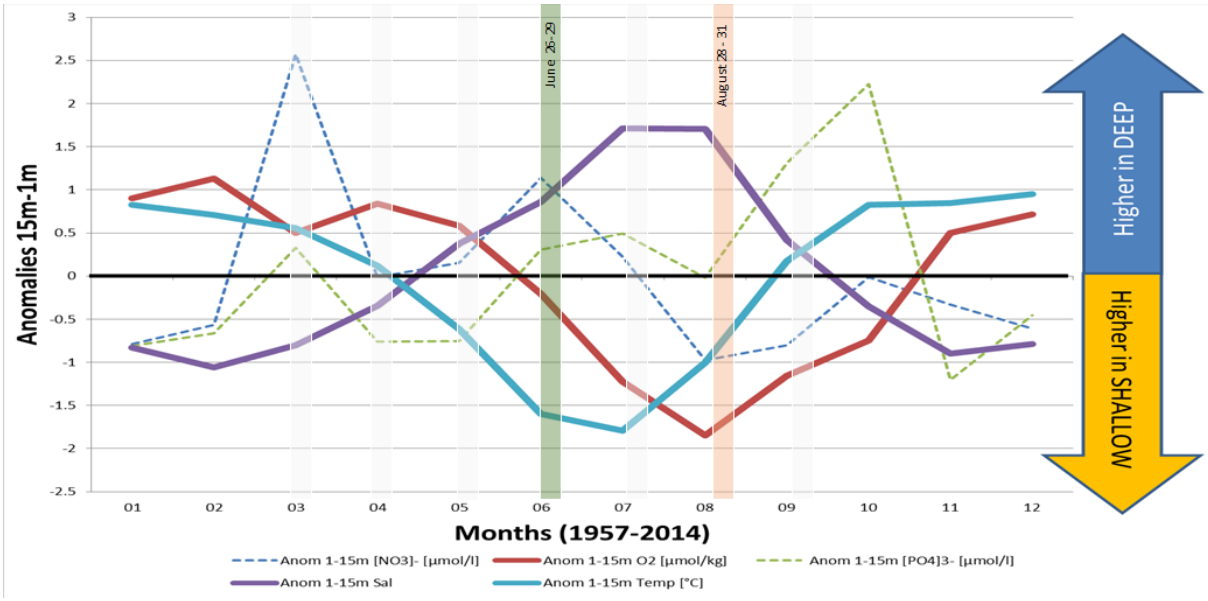
KOB


Anomalies 15m-1m
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
01
02
03
04
05
06
07
08
09
10
11
12
June 26-29
August 28 - 31
Higher in DEEP
Higher in SHALLOW
Months (1957-2014)
Anom 1-15m [NO3]- [µmol/l]
Anom 1-15m O2 [µmol/kg]
Anom 1-15m [PO4]3- [µmol/l]
Anom 1-15m Sal
Anom 1-15m Temp [°C]

Experimental design