

**Geofysisk institutt**  
Universitetet i Bergen

**Bjerknes Centre**  
for Climate Research



[WWW.BJERKNES.UIB.NO](http://WWW.BJERKNES.UIB.NO)

# CARBOOCEAN – Marine carbon sources and sinks assessment

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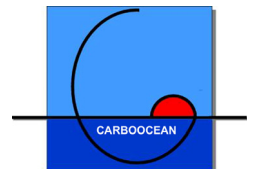
## 2.1 Overall goal and mission: (from Annex I)

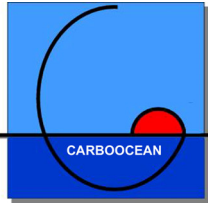
CARBOOCEAN IP (= CarboOcean Integrated Project) aims at an accurate scientific assessment of the marine carbon sources and sinks within space and time. It focuses on the Atlantic and Southern Oceans and a time interval of -200 to +200 years from now.

CARBOOCEAN will determine the ocean's quantitative role for uptake of atmospheric carbon dioxide (CO<sub>2</sub>), the most important manageable driving agent for climate change. **The ocean has the most significant overall potential as a sink for anthropogenic CO<sub>2</sub>.** The correct quantification of this sink is a fundamental necessary condition for all realistic prognostic climate simulations.

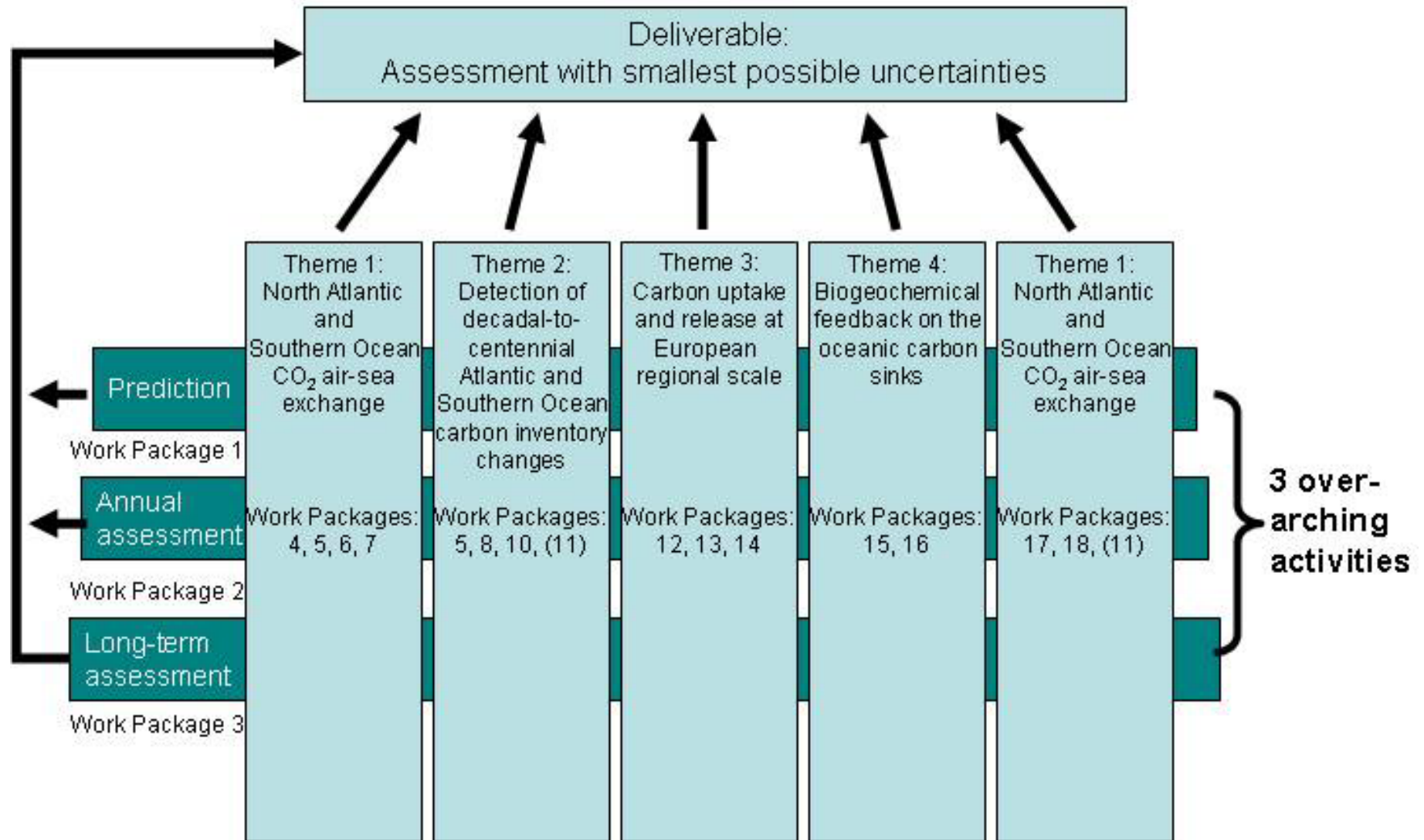
CARBOOCEAN will thus **create scientific knowledge, which is essential to a quantitative risk/uncertainty judgement** on the expected consequences of rising atmospheric CO<sub>2</sub> concentrations. Based on this judgement, it will be possible to **guide the development of appropriate mitigation actions**, such as management of CO<sub>2</sub> emission reductions within a global context (e.g., Kyoto Protocol, United Nations, 1997).

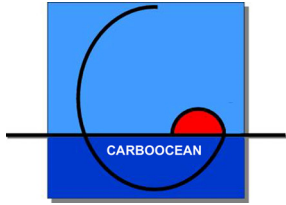
CARBOOCEAN combines the key European experts and scientific resources in the field through an integrated research effort. The **effort complements other major research programmes on oceanic, atmospheric, and terrestrial carbon cycling and is linked to these programmes.**



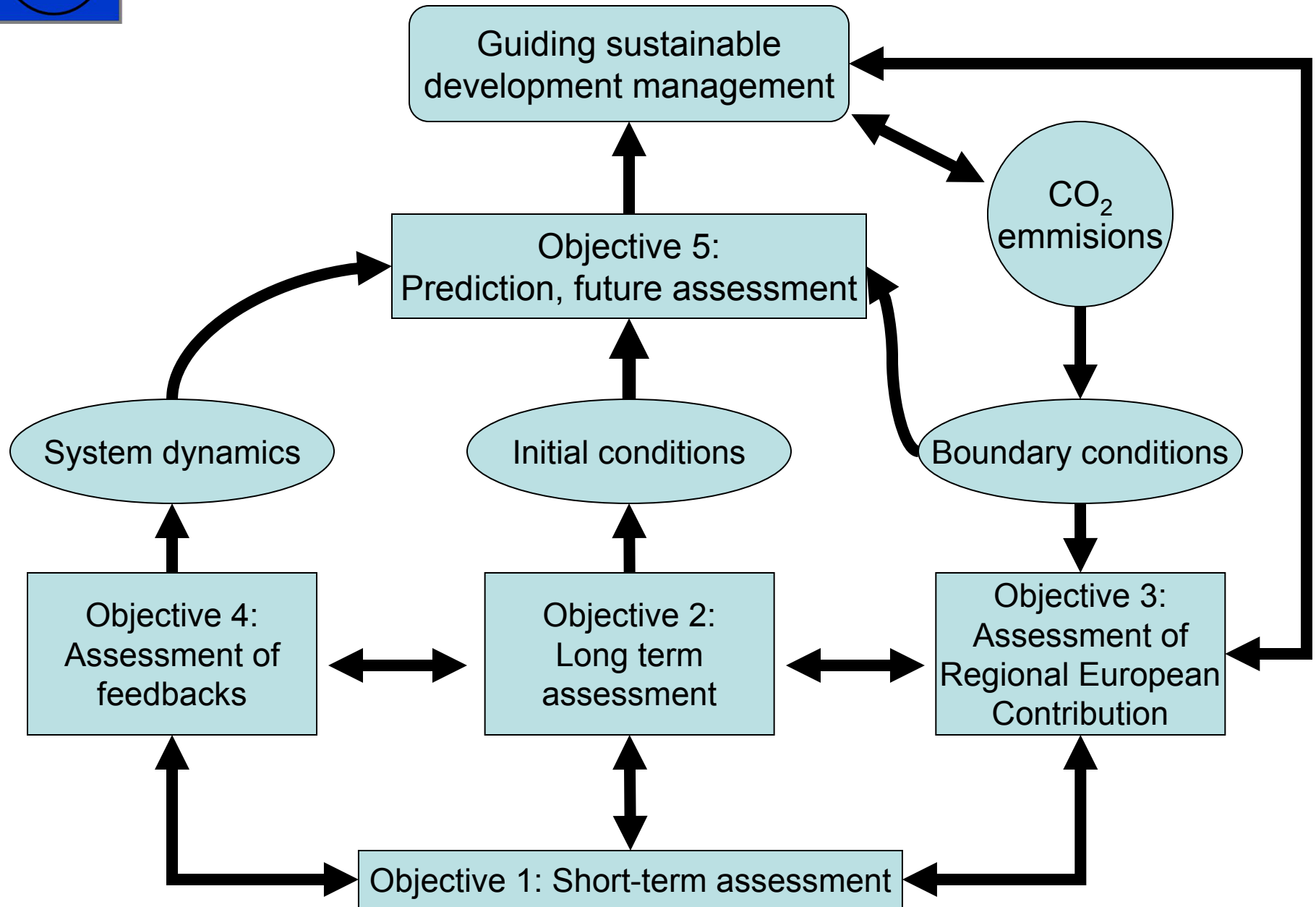


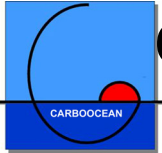
# Core Themes of CARBOOCEAN IP





# Objectives of CARBOOCEAN IP





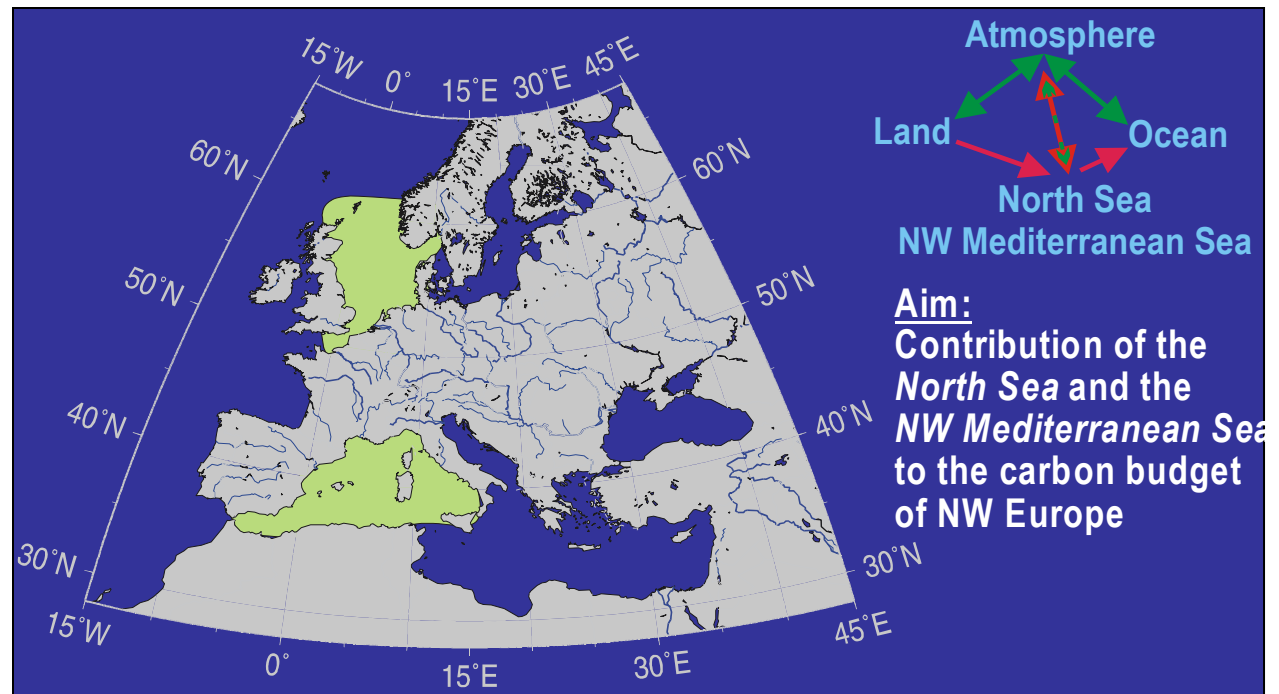
## Core theme III

### Core theme III:

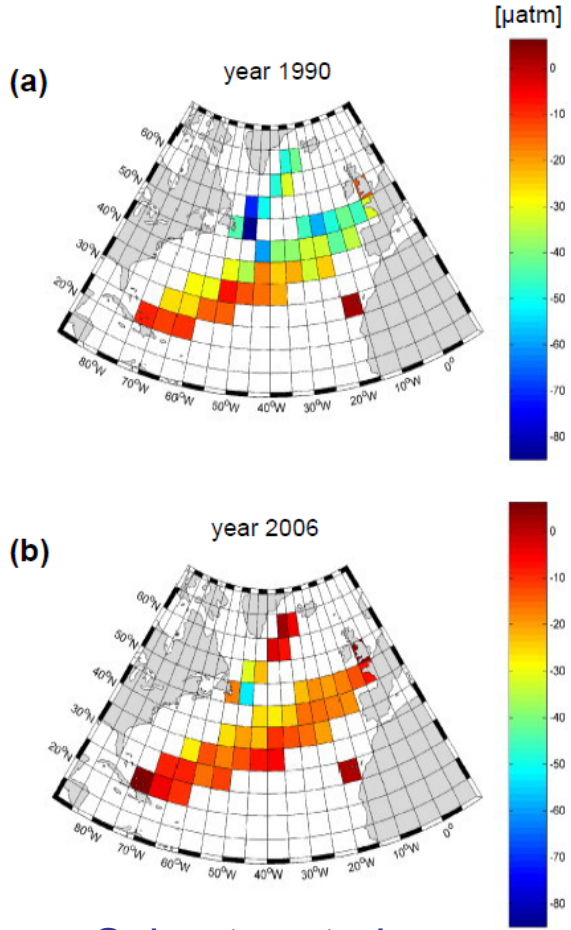
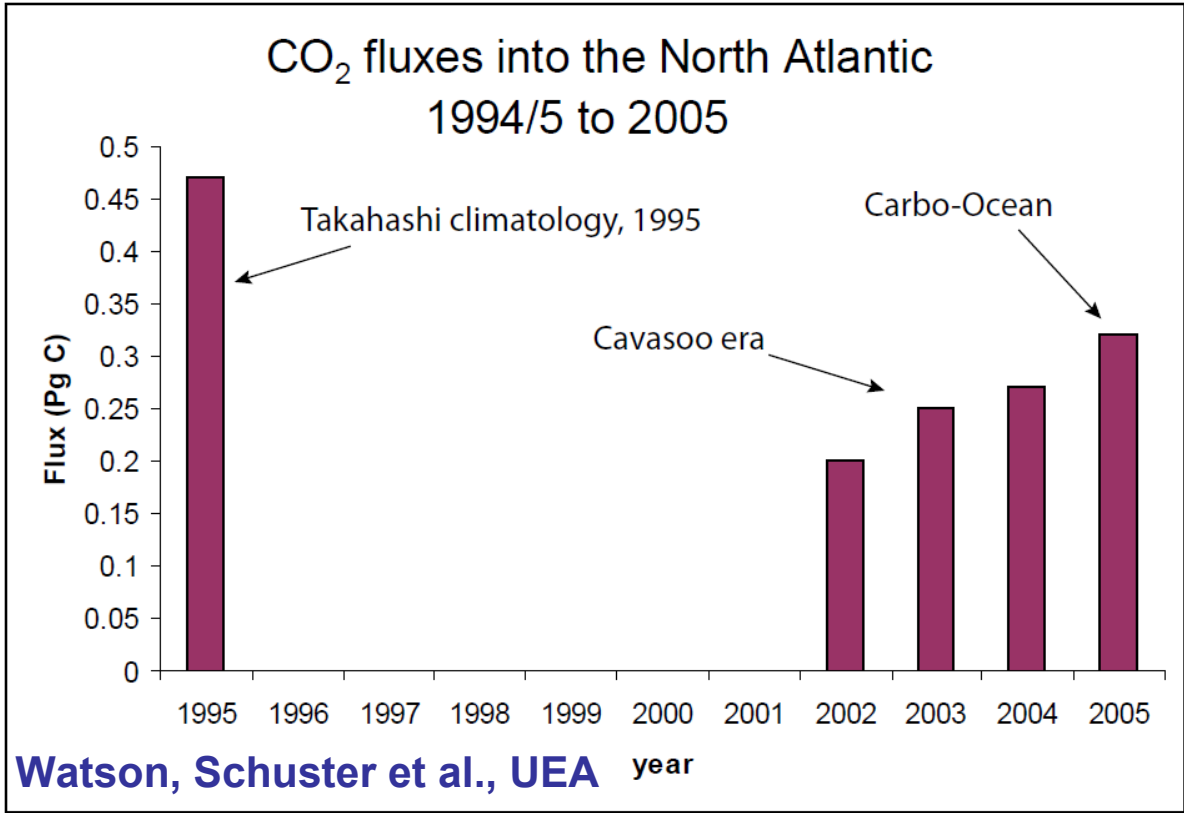
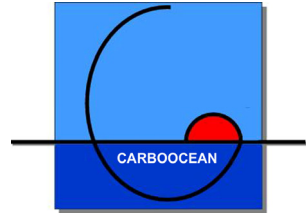
#### Carbon uptake and release at European regional scale

1. Variability of carbon exchange between marginal seas and atmosphere
2. C-Exchange between marginal seas and land and the role of shallow sediments
3. C-Exchange Marginal seas and the Atlantic Ocean
4. Carbon budget for Western Europe (marine, terrestrial, and atmospheric compartments; jointly with CarboEurope IP).

*(marginal seas / land / atmosphere / ocean CO<sub>2</sub> fluxes)*



# The ocean carbon sink is regionally more variable than previously thought!



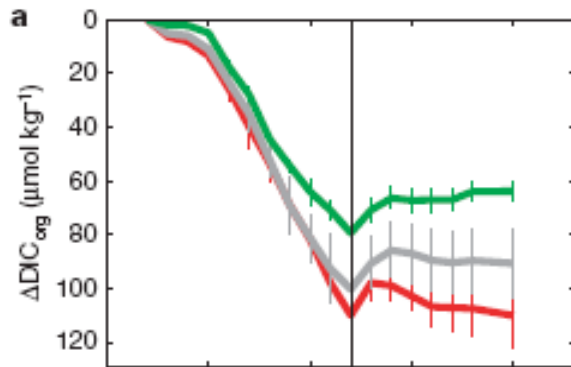
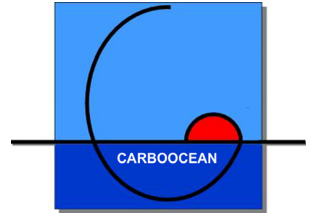
## Possible explanation:

NAO driven redistribution of North Atlantic CO<sub>2</sub> sink between subpolar and subtropical gyres (Thomas et al., 2008)  
European-North American Co-operation

Schuster et al. (2009) *DSR II*

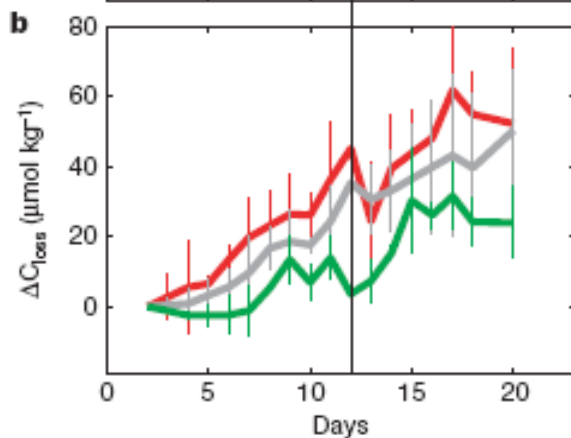


# Potential alterations in biological cycling of carbon with circulation and pCO<sub>2</sub> change:

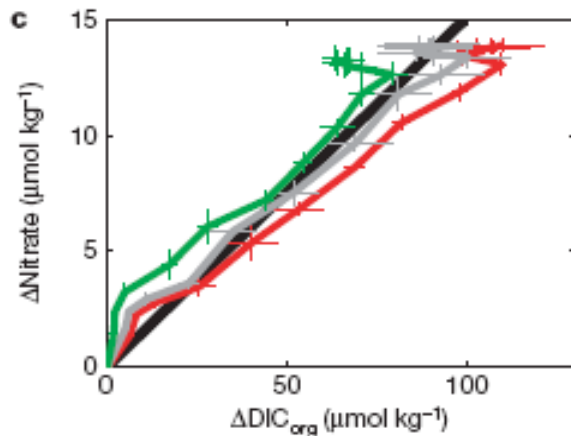


**350 μatm (green)**  
**700 μatm (grey)**  
**1050 μatm (red)**

**Apparent decrease of dissolved inorganic C with pCO<sub>2</sub>**



**Apparent increase of organically bound C with pCO<sub>2</sub>**



**Apparent increase of nutrient utilisation efficiency with pCO<sub>2</sub>**

**Mesocosm experiments at differing atmospheric pCO<sub>2</sub>:**  
*"Capturing natural ecosystem communities in plastic bags and watching their behavior for changes in forcing under controlled conditions"*

**Riebesell, Schulz, Bellerby, Botros, Fritsche, Meyerhöfer, Neill, Nondal, Oschlies, Wohlers & Zöllner, *Nature*, 2007**



**Mesocosm facilities at Espegrend, Bergen**

# CarboOcean's and CarboEurope's outreach project „CarboSchools“

60 European schools, 65 projects, 1450 pupils, x teachers, x scientists...



## Online resources

**CarboSchools website:**  
[www.carboschools.org](http://www.carboschools.org)

- materials
- publications
- SchoolCO2web

• **Regional websites**  
 (native languages)

## Publications

• **1. Educ. booklet:**

*What we have learned, What we still don't know and what we must do to combat climate change*

• **2. Educ. booklet:**

*What we have learned, what we still don't know and what we must do to combat climate change*

• **3. Educ. booklet:**

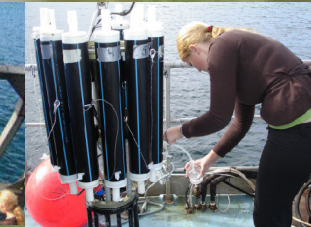
in prep.

• **CarboSchools regional operators' handbook**

• **Teacher/scientist partnership guide**

- Experimentation projects
- Processing scientific data
- Field trips and expeditions
- Observation and measurements

Volbers et al.







EUROPEAN  
COMMISSION

European  
Research Area

## Integrated assessment of the European and North Atlantic Carbon Balance

-key results, policy implications for post 2012 and research needs-



Brussels, 2009

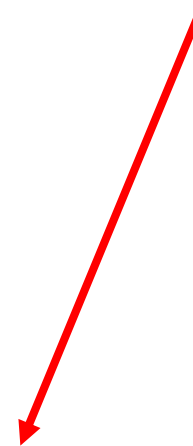


EU publication

Joint effort of marine and  
terrestrial carbon research  
community

Thanks to Anastasios  
Kentarchos, EU!!

*Web access available!*



[http://ec.europa.eu/research/environment/index\\_en.cfm?pg=publications](http://ec.europa.eu/research/environment/index_en.cfm?pg=publications)