

# Die Leistung der Sedimente in deutschen Küstenmeeren – Bewertung der Funktion mariner benthischer Systeme im Kontext menschlicher Nutzung – Leistungen der Ostsee (SECOS)

SECOS- Synthese Team



## SECOS Synthese Team:

### IOW

Helge Arz  
Ulrich Bathmann  
Michael E. Böttcher  
Dennis Bunke  
Bronwyn Cahill  
Mayya Gogina  
Anne Hiller  
Miguel Inacio  
Thomas Leipe  
Marko Lipka  
Bo Liu  
Daniel Neumann

Thomas Neumann  
Philipp Paysen  
Gregor Rehder  
Gerald Schernewski  
Johanna Schumacher  
Franz Tauber  
Jana Wölfel  
Michael L. Zettler

### CAU

Marion Kruse  
Felix Müller

### BSH

Stefan Schmolke  
Manfred Zeiler

### Uni-HRO

Stefan Forster  
Friederike Kunz  
Judith Renz

### Kontakt:

ulrich.bathmann@io-warnemuende.de  
friederike.kunz@uni-rostock.de

### Projektinformation:

<https://secos.deutsche-kuستنforschung.de/>

### Gefördert durch



### Affiliierungen:



[\(https://deutsche-kuستنforschung.de/\)](https://deutsche-kuستنforschung.de/)



[\(https://wissenschaftscampus-rostock.de/\)](https://wissenschaftscampus-rostock.de/)



[\(https://www.futureearthcoasts.org/\)](https://www.futureearthcoasts.org/)

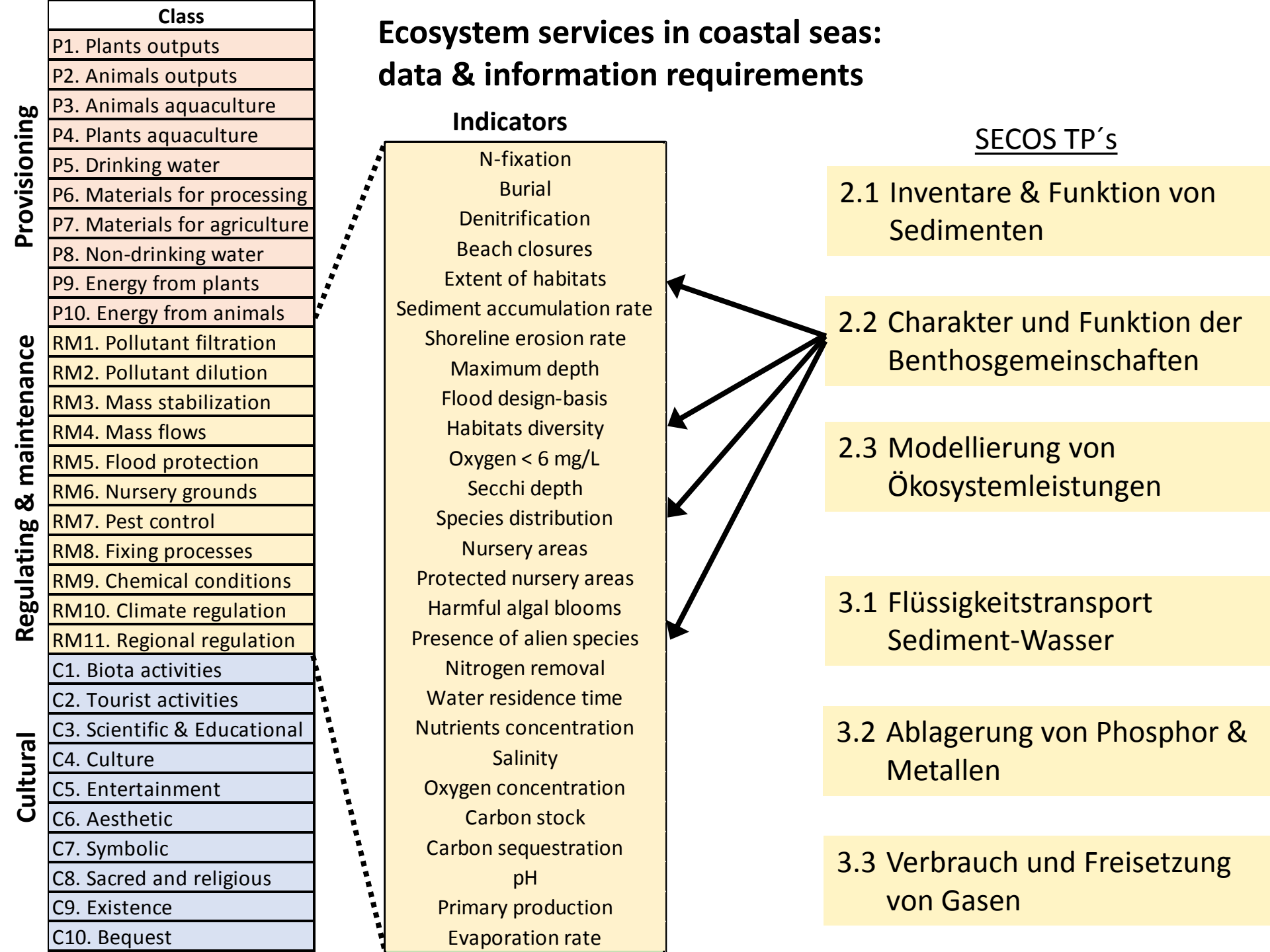
# Ecosystem services in coastal seas as a framework for marine research

## An ecosystem service assessment:

- Supports a **comprehensive understanding** of structures, processes and dependencies in coastal seas
- Allows the **reflection and visualization** of changes in ecosystems, resulting from anthropogenic impacts, measures or global changes
- Supports the **transfer** of complex messages to a broader public
- Supports the **implementation** of environmental policy, spatial planning and an ecosystem based management
- Provides a **justification** for protection or remediation measures
- Serves as **framework** and container for integrated and aggregated basic research results



# Ecosystem services in coastal seas: data & information requirements



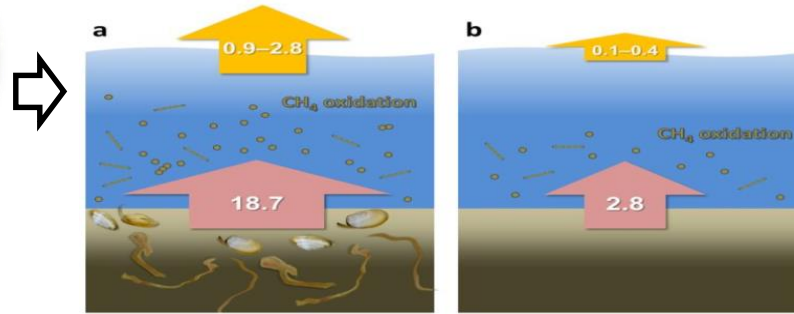
# How can society benefit from research on benthic organisms?

## 2.2 Charakter und Funktion der Benthosgemeinschaften



Seabed habitat

**Function:** *e.g. nutrients and exchange of greenhouse gases, burial of harmful substances*



Bongalia et al. 2017 Sci. Rep.

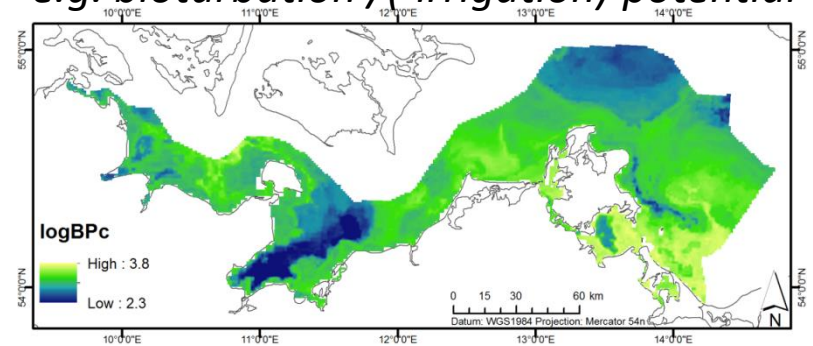
**Ecosystem services:**  
*e.g. food, climate regulation*

Balanced use with conservation of natural resources (*trade-offs, cost-effect*)



**Values & advantages:** *economic value, intangible human well-being*

On a wide range of spatial scales –  
for management & spatial planning  
*e.g. bioturbation /(-irrigation) potential*



Gogina et al. 2017; Renz et al. subm.

*e.g. Lohrer et al. 2015; Villnas et al. 2018*

# Bioirrigation potential of benthic communities (BIPc)

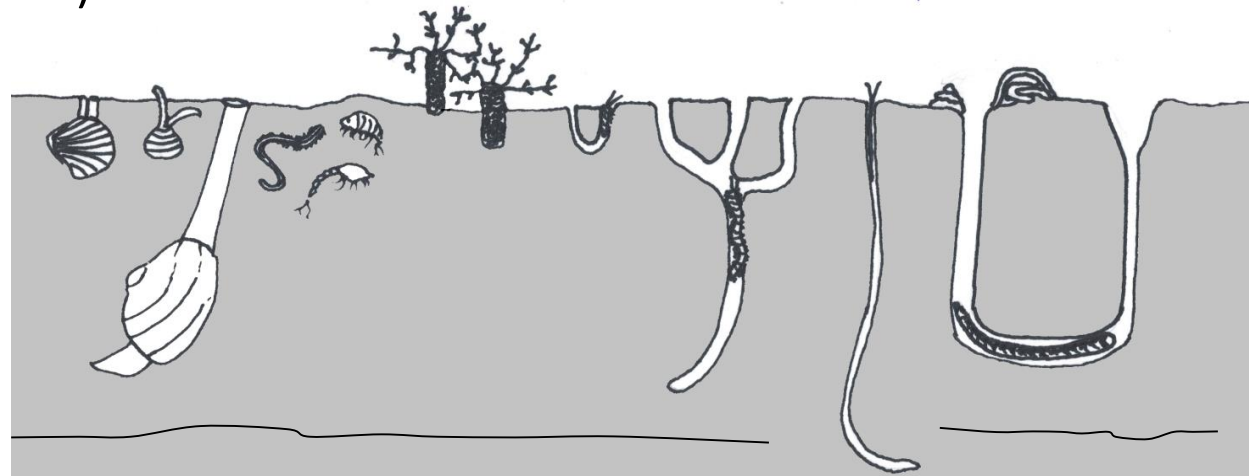
Marine Strategy Framework Directive: descriptor 6 (biodiversity & sea floor integrity)

- aiming to assess condition and function of benthic communities
- easily applicable descriptors are requested

## Development of an index to predict relative intensities of bioirrigation

- biomass and abundance weighted scoring system
- fundamental functional traits analogy to the particle related bioturbation potential (Solan et al. 2004)
- wide applicability:  
largely available  
macrofaunal data

- spatial full coverage
- estimates of the  
function of benthic  
communities



$$BIP_c = \sum_{i=1}^n \sqrt{\frac{B_i}{A_i}} \times A_i \times FT_i \times BT_i \times L_i$$

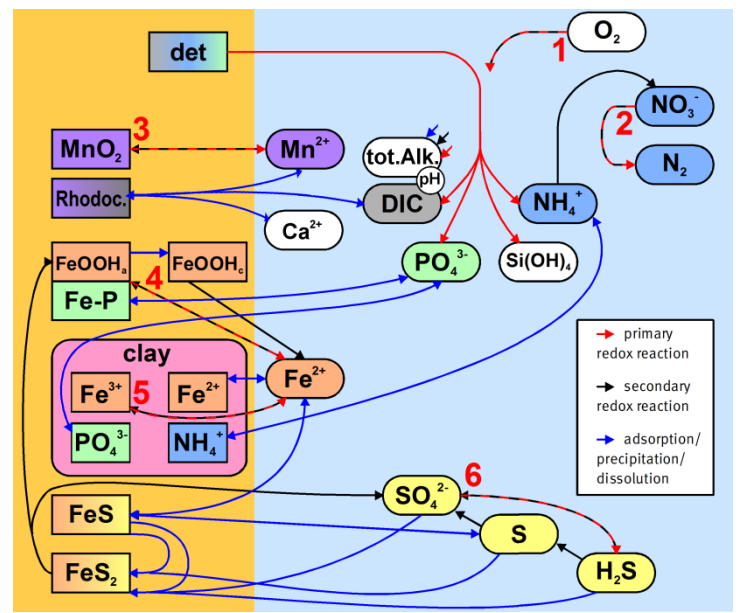
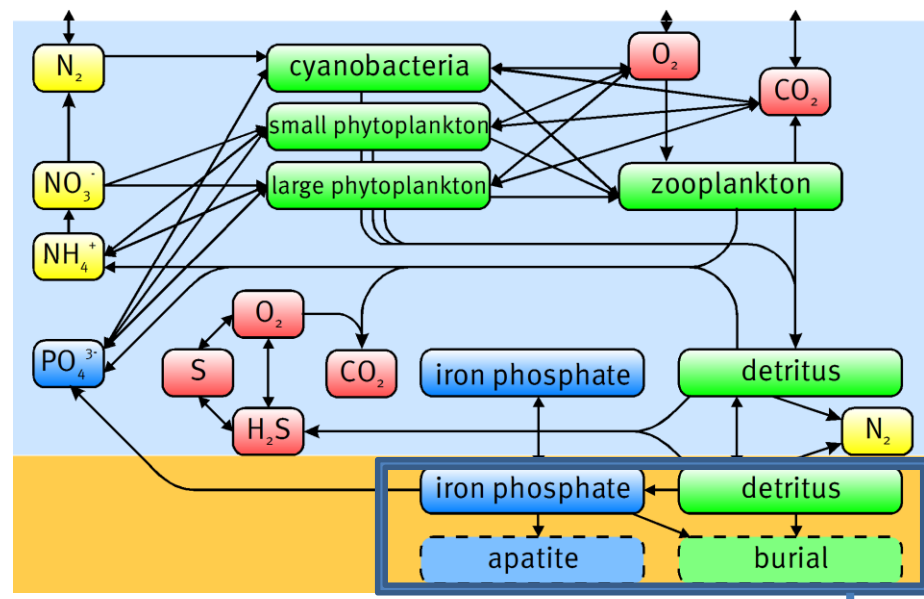
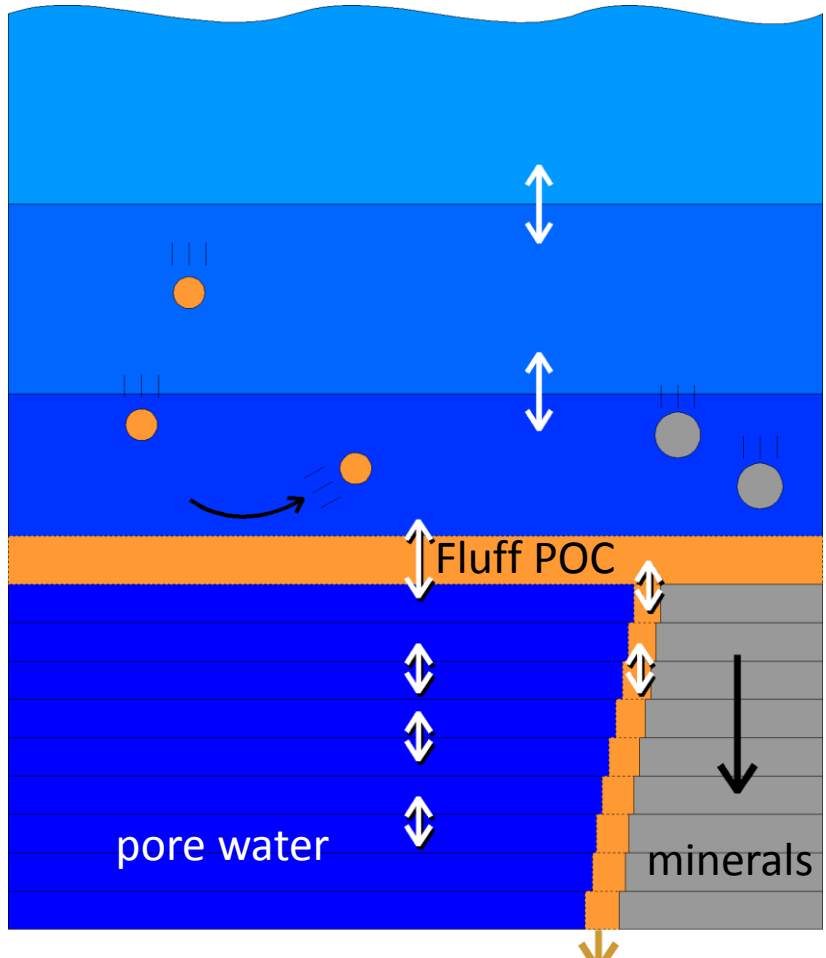
- $B_i$  – biomass (of species  $i$ )
- $A_i$  – abundance
- $FT_i$  – feeding type
- $BT_i$  – burrowing type
- $L_i$  – depth



# Ecological ReGional Ocean Model with vertically resolved sediments (ERGOM SED 1.0): Coupling benthic and pelagic biogeochemistry of the south-western Baltic Sea.

## 2.3 Modellierung von Ökosystemleistungen

Radtke, H, Lipka, M, Bunke, D, Morys, C, Cahill, B, Böttcher, ME, Forster, S, Leipe, T, Neumann, T, *Geosci. Model Dev. Discuss.*, 2018, 1–42



# Ecosystem services in coastal seas: transfer into spatial pattern

| Cultural     |               |                          | Regulating & maintenance |               |                   |             |                              | Provisioning           |                      |                           |                          |                          |                       |                   |                      |                       |                 |                         |                         |                           |                          |                        |                        |                               |                              |                    |                        |                         |                     |                    |       |
|--------------|---------------|--------------------------|--------------------------|---------------|-------------------|-------------|------------------------------|------------------------|----------------------|---------------------------|--------------------------|--------------------------|-----------------------|-------------------|----------------------|-----------------------|-----------------|-------------------------|-------------------------|---------------------------|--------------------------|------------------------|------------------------|-------------------------------|------------------------------|--------------------|------------------------|-------------------------|---------------------|--------------------|-------|
| C10. Bequest | C9. Existence | C8. Sacred and religious | C7. Symbolic             | C6. Aesthetic | C5. Entertainment | C4. Culture | C3. Scientific & Educational | C2. Tourist activities | C1. Biota activities | RM11. Regional regulation | RM10. Climate regulation | RM9. Chemical conditions | RM8. Fixing processes | RM7. Pest control | RM6. Nursery grounds | RM5. Flood protection | RM4. Mass flows | RM3. Mass stabilization | RM2. Pollutant dilution | RM1. Pollutant filtration | P10. Energy from animals | P9. Energy from plants | P8. Non-drinking water | P7. Materials for agriculture | P6. Materials for processing | P5. Drinking water | P4. Plants aquaculture | P3. Animals aquaculture | P2. Animals outputs | P1. Plants outputs | Class |

Data and spatial information

3D Ecosystem model data

4.2 Spatial typology, integration & usability

4.1 Integrated ES assessment approach

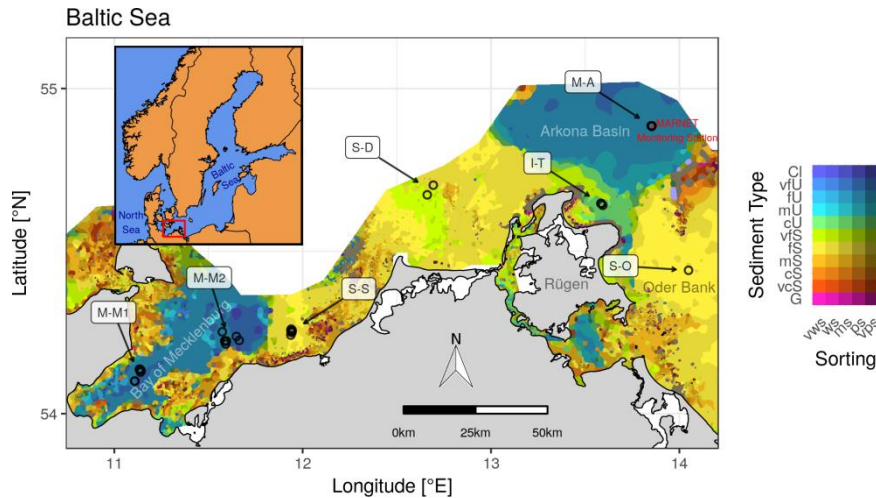
1.2 Baltic Sea Atlas (Geo-Information System)

Ecosystem service map for the German Baltic coastal sea





## WP 3: Basic research: mineralisation/accumulation processes- release and consumption



- Lipka, 2018; PhD-thesis
- Lipka M, Woelfel J, Gogina M, Kallmeyer J, Liu B, Morys C, Forster S, Böttcher ME; *Spatiotemporal dynamics in solute reservoirs of temperate brackish surface sediments*
- Gogina M, Lipka M, Woelfel J, Liu B, Böttcher ME, Zettler ML; *On the hunt for a field-based relationship between benthic macrofauna and biogeochemistry in a modern brackish coastal sea*  
-> submitted to Marine Frontiers (special issue BSSC)

### ORGANIC MATTER MINERALIZATION RATES...

- ▶ ... are **similar** in sandy and muddy sediments.
- ▶ ... are **higher** in the mud of the Mecklenburg Bight than in the deeper Arkona Basin.
- ▶ Differences between muds can be attributed to **varying organic matter supply**.
- ▶ **Seasonal variability** and **salinity dynamics** in the bottom waters show minor or no effects.

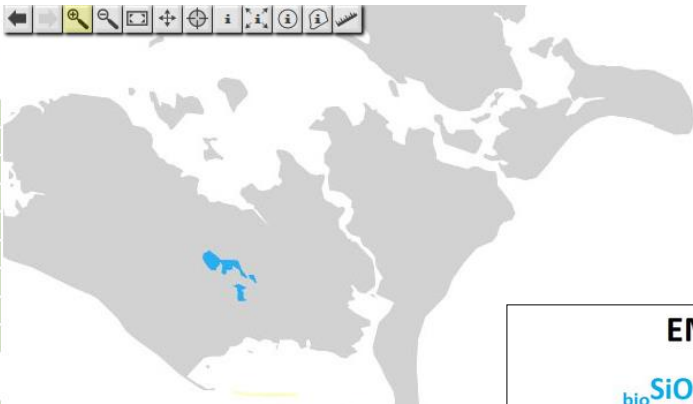
### ADVECTIVE TRANSPORT due to currents, bioturbation/-irrigation, human impact...

- ▶ ... are the main force for **solute fluxes** across the sediment-water interface in sands and muds.
- ▶ ... affect **metal oxide contents** near the sediment surface, which can delay benthic nutrient fluxes after a shift to hypoxic bottom water conditions.

# Baltic Sea Atlas – structure & function

LEIBNIZ-INSTITUT FÜR OSTSEEFORSCHUNG WARMEMÜNDE

Logout  
Optionen  
Übersicht  
Administratorfunktionen  
Karte  
Zwischenablage  
Suchen  
Stellenverwaltung  
Nutzerverwaltung  
Nutzer anlegen  
Nutzer anzeigen

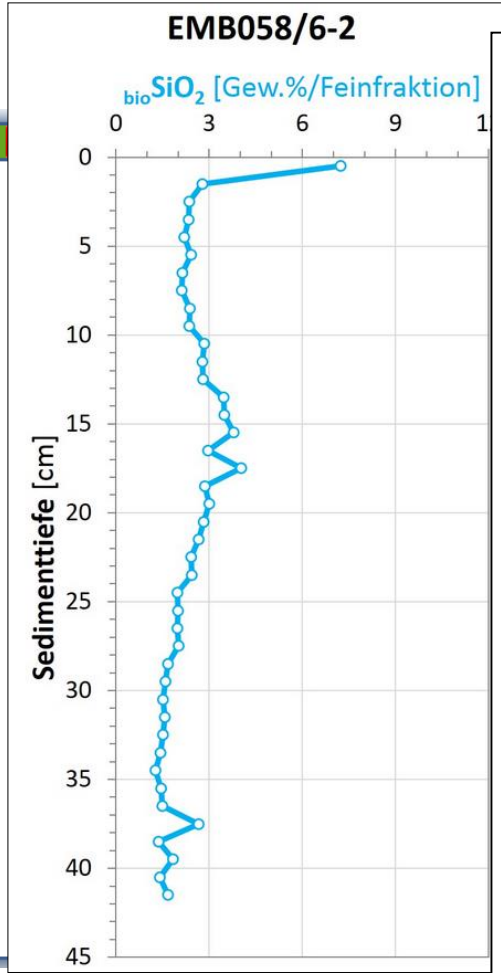


## Geochemical profiles

Verfügbare Themen:

Neu Laden

- Geochemie
- alle
- Test-Lotta
- Probenlokation
- As Feinfraktion
- As Gesamtfraktion
- Biogensilikat Feinfraktion - Profil
- Probenlokation
- Biogensilikat Feinfraktion
- Biogensilikat Gesamtfraktion



| EMB058/6-2                          |                            |
|-------------------------------------|----------------------------|
| Sediment depth / Sedimenttiefe [cm] | bioSiO <sub>2</sub> [wt.%] |
| 0,50                                | 6,34                       |
| 1,50                                | 2,45                       |
| 2,50                                | 2,13                       |
| 3,50                                | 2,04                       |
| 4,50                                | 1,91                       |
| 5,50                                | 2,11                       |
| 6,50                                | 1,85                       |
| 7,50                                | 1,85                       |
| 8,50                                | 2,11                       |
| 9,50                                | 2,10                       |
| 10,50                               | 2,55                       |
| 11,50                               | 2,54                       |
| 12,50                               | 2,50                       |
| 13,50                               | 3,21                       |
| 14,50                               | 3,17                       |
| 15,50                               | 3,32                       |
| 16,50                               | 2,48                       |
| 17,50                               | 3,78                       |
| 18,50                               | 2,57                       |
| 19,50                               | 2,57                       |
| 20,50                               | 2,40                       |
| 21,50                               | 2,28                       |
| 22,50                               | 2,02                       |
| 23,50                               | 1,96                       |
| 24,50                               | 1,59                       |
| 25,50                               | 1,59                       |
| 26,50                               | 1,56                       |
| 27,50                               | 1,50                       |
| 28,50                               | 1,27                       |

### Biogensilikat Feinfraktion - Profil

Datensatz auswählen

|                 |                            |
|-----------------|----------------------------|
| Kern            | EMB058/6-2                 |
| Gerät           | Vierrohr-Multicorer        |
| Region          | Arkonabecken               |
| Sedimenttyp     | Schlack <del>Schlack</del> |
| Wassertiefe (m) | 42                         |
| Profil          | link                       |
| Tabelle         | link                       |

Biogensilikat Feinfraktion - Profil: alle auswählen

ausgewählte Datensätze:

klassifiziert nach:

Sachdatenanzeige drucken

# Baltic Sea Atlas – access to metadata & data

**IOWMeta**  
LEHRGEBIET FÜR OZEANFORSCHUNG WISMAR  
Start Suche Karte

Zurück zur Suche

### Geochemical depth profiles of modern sediments in the south-western Baltic Sea

Räumliche Ausdehnung

Kontinuierliche Aktualisierung 3 months ago

Vertical distribution of environmentally relevant elements and compounds in the sediments of the south-western Baltic Sea. More informations in the link Methods or Methoden.

Linked to KüNO-Data portal and MDI-DE

**KüNO-Portal** Suchen Karte Anleitung Impressum Anmelden Deutsch

cookieWarning moreOnCookie acceptCookie oder rejectCookie

Zurück zur Suche < Zurück Nächster >

### Geochemical depth profiles of modern sediments in the south-western Baltic Sea

Räumliche Ausdehnung

Kontinuierliche Aktualisierung 3 months ago

Vertical distribution of environmentally relevant elements and compounds in the sediments of the south-western Baltic Sea. More informations in the link Methods or Methoden.

Completed

Notice: KüNO is now harvesting IOWMeta

**Download and links**

- Caesium-137  
Baltic Sea Atlas
- Caesium-137/TOC  
Baltic Sea Atlas
- Biogenic silica in total fraction  
Baltic Sea Atlas
- Biogenic silica in fine fraction  
Baltic Sea Atlas

**MDI-DE** AufMod

Was möchten Sie tun?

Ergebniscenter

Suche einschränken

- Sprache
- Typ
- Herausgeber
- Hauptthema
- Format
- Katalog

Geochemical depth profiles of modern sediments in the south-western Baltic Sea

Herausgeber: Department of Marine Geology, IOW, Department of Marine Geology, IOW/IOW  
Katalog: MDI-DE Catalog  
Typ: Datensatz  
Zusammenfassung: Vertical distribution of environmentally relevant elements and compounds in the sediments of the south-western Baltic Sea. More informations in the link Methods or Methoden.

| Beschreibung           | Kategorien  | Zugriff | Vertrieb | Qualität | Metadaten |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
|------------------------|---|---------|----------|----------|-----------|---|---|---|--------------|-----------------------------------|--|-----------------|------------------|--|---------------|--|--|-----------|--|--|----------|----------|--|-------|--|--|------|--|--|
| <b>Titel</b>           | Geochemical depth profiles of modern sediments in the south-western Baltic Sea  |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| <b>Kurztitel</b>       |   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| <b>Zeitstempel</b>     | Erzeugungsdatum:<br>Publikationsdatum:<br>Revisionsdatum: 2018-02-06  |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| <b>Zusammenfassung</b> | Vertical distribution of environmentally relevant elements and compounds in the sediments of the south-western Baltic Sea. More informations in the link Methods or Methoden.   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| <b>Bezeichner</b>      |   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| <b>Kontakt</b>         | <table border="1"><thead><tr><th>1</th><th>2</th><th>3</th></tr></thead><tbody><tr><td>Organisation</td><td colspan="2">Department of Marine Geology, IOW</td></tr><tr><td>Name der Person</td><td colspan="2">Dr. Dennis Bunke</td></tr><tr><td>Telefonnummer</td><td colspan="2"></td></tr><tr><td>Faxnummer</td><td colspan="2"></td></tr><tr><td>Funktion</td><td colspan="2">Erzeuger</td></tr><tr><td>Stadt</td><td colspan="2"></td></tr><tr><td>Land</td><td colspan="2"></td></tr></tbody></table> |         |          |          |           | 1 | 2 | 3 | Organisation | Department of Marine Geology, IOW |  | Name der Person | Dr. Dennis Bunke |  | Telefonnummer |  |  | Faxnummer |  |  | Funktion | Erzeuger |  | Stadt |  |  | Land |  |  |
| 1                      | 2   | 3       |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Organisation           | Department of Marine Geology, IOW   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Name der Person        | Dr. Dennis Bunke  |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Telefonnummer          |   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Faxnummer              |   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Funktion               | Erzeuger  |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Stadt                  |   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |
| Land                   |   |         |          |          |           |   |   |   |              |                                   |  |                 |                  |  |               |  |  |           |  |  |          |          |  |       |  |  |      |  |  |

Keine verwandten Metadatenätze verfügbar

Notice: IOW-Metadata also available via MDI-DE (since April 2018)



## **IOW MESAT:**

# **Marine Ecosystem Service Assessment Tool**

### **Objective:**

Support of environmental policy implementation

### **Method/Approach:**

- Adaptation of the Common International Classification on Ecosystem Services (CICES, version 5.1) (Haines-Young and Potschin 2018)
- Comparative, non-monetary assessments (time, space, state)
- Definition of spatial units according to the Water Framework Directive: characterization of types by major physico-chemical parameters, like depth, tidal range, salinity, temperature, turbidity, residence time, wave exposure and current velocities (Coast 2003)

# Background

- For several EU-Directives (Marine Strategy Framework Directive (MSFD), Water Framework Directive (WFD), Maritime Spatial Planning (MSP) Directive, Habitat-Directive) and strategies (Integrated Coastal Zone Management (ICZM), Biodiversity) an Ecosystem Service Assessment is recommended.
- Usually it is expected that Ecosystem Service assessments provide a comprehensive understanding of structures and dependencies and support the required „Ecosystem Approach to Management“.
- However, ideas and recommendations about concrete aims, where and when in the policy implementation process and how to use the results are either lacking or remain vague.

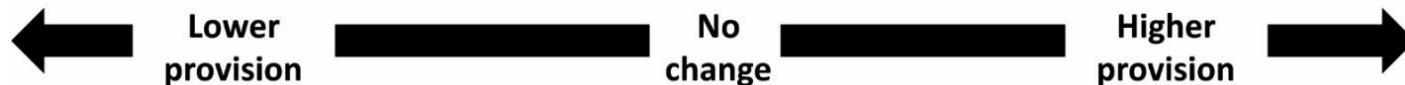




# Methodology for comparative ecosystem service assessments

| Division  | Group                          | Class  | S1. Mussel farm | Class | Group | Division | Section |
|-----------|--------------------------------|--|-----------------|-------|-------|----------|---------|
| Nutrition | Biomass                        | P1. Wild plants, algae and their outputs   |                 |       | 2     | 2        | 2       |
|           |                                | P2. Wild animals and their outputs   | 1               | -1    |       |          |         |
|           |                                | P3. Animals from in situ aquaculture   | 5               | 5     |       |          |         |
|           |                                | P4. Plants and algae from in situ aquaculture  |                 |       |       |          |         |
|           | Water                          | P5. Surface water for drinking purposes  |                 |       |       |          |         |
| Materials | Biomass                        | P6. Fibres and other materials from plants, algae and animals for direct use or processing | 3               | 3     | 3     | 2        |         |
|           |                                | P7. Materials from plants, algae and animals for agriculture                               | 3               | 3     |       |          |         |
|           | Water                          | P8. Surface water for non-drinking purposes  | 1               | 1     |       |          |         |
| Energy    | Biomass-based energy resources | P9. Plant based resources  |                 | 1     | 1     | 1        |         |
|           |                                | P10. Animal based resources  | 1               | 1     |       |          |         |

|         |                     |                     |                     |                     |                |                 |                 |                 |                 |       |
|---------|---------------------|---------------------|---------------------|---------------------|----------------|-----------------|-----------------|-----------------|-----------------|-------|
| < 1/4.1 | 1/2.5<br>-<br>1/4.1 | 1/1.7<br>-<br>1/2.5 | 1/1.3<br>-<br>1/1.7 | 1/1.1<br>-<br>1/1.3 | Initial Status | 1.1<br>-<br>1.3 | 1.3<br>-<br>1.7 | 1.7<br>-<br>2.5 | 2.5<br>-<br>4.1 | > 4.1 |
| -5      | -4                  | -3                  | -2                  | -1                  | 0              | 1               | 2               | 3               | 4               | 5     |

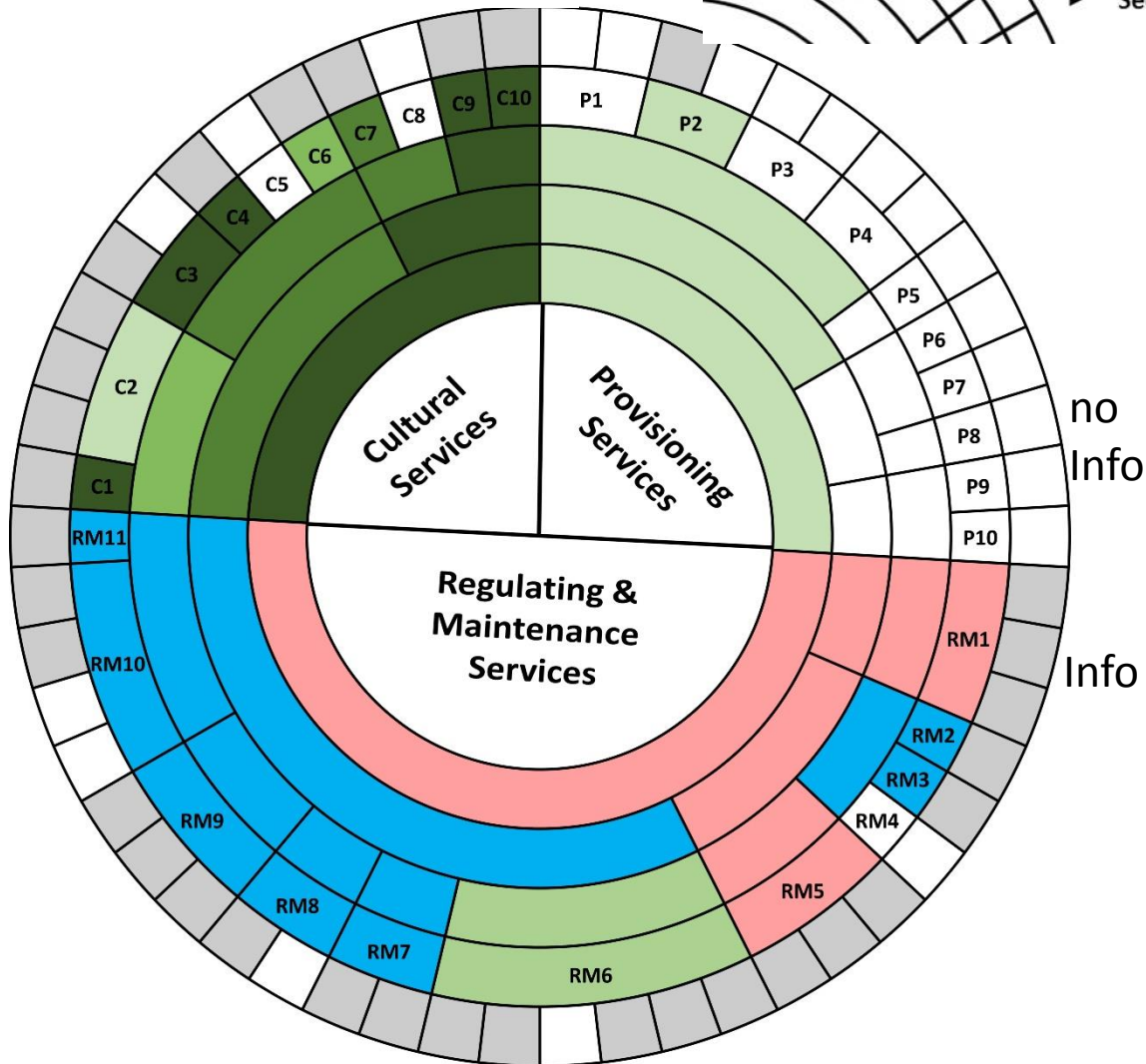
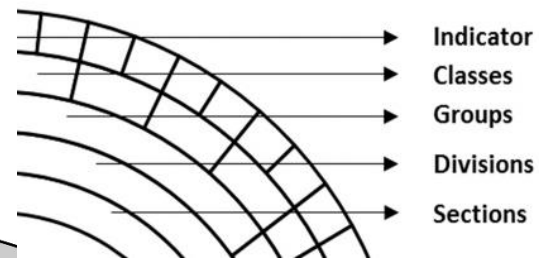




# Ecosystem services of coastal seas:

## Pomeranian Bay

A comparative assessment between 1960 and today



Inácio, Schernewski et al (in prep.)

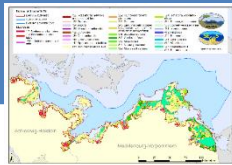


# Alternative assessment and mapping approach

Definition of spatial setting

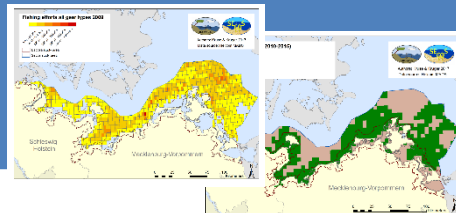
German Baltic Coast & Sea

and focus areas for detailed analysis



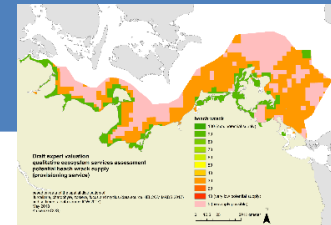
Data examples

e.g. sediment and key species distribution; literature; model results



Results

Maps for  
-Regulating  
-Provisioning  
-Cultural ecosystem services



- Aims are to test the applicability of an integrative terrestrial-coastal-marine approach (Kiel Matrix approach) and
- To visualize past, current and possible future states of ecosystem service supply (and demand) with spatially explicit maps for the case study area (cooperation with BACOSA II)