

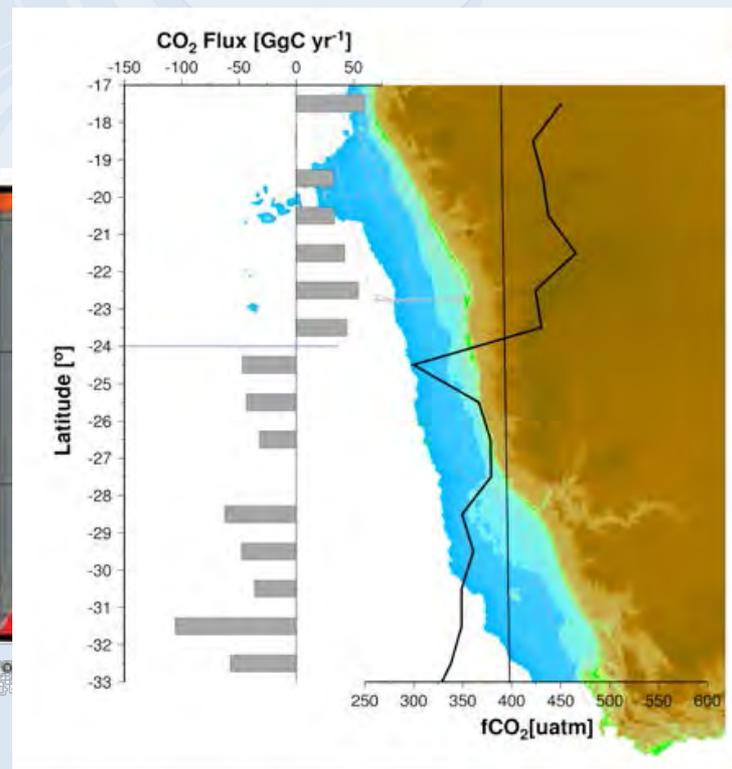
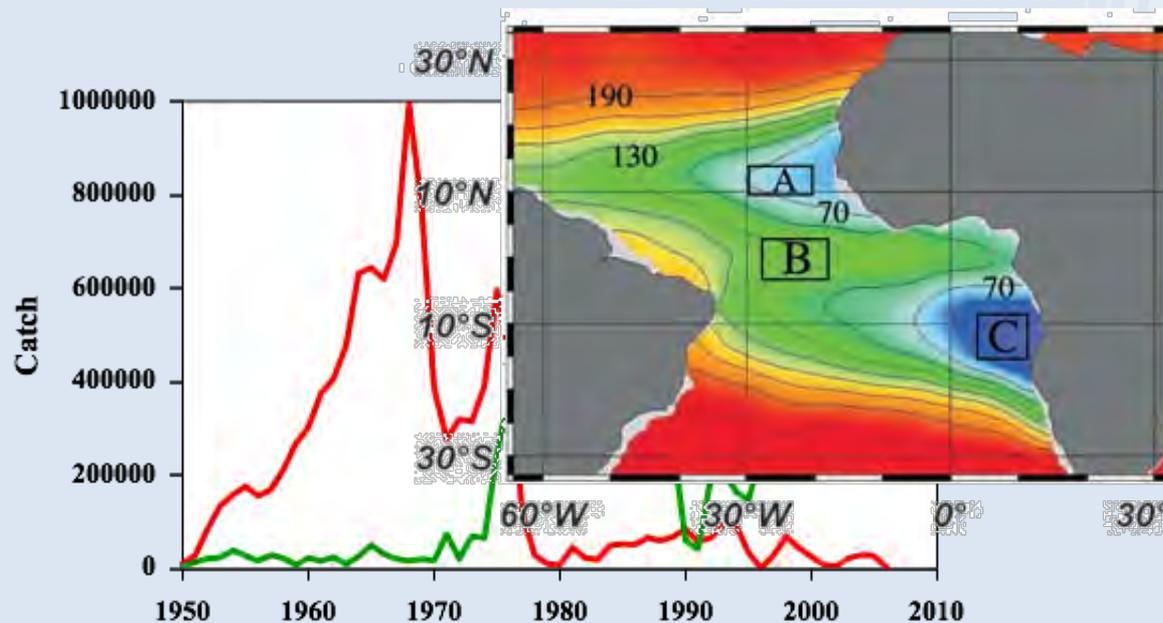
Geochemistry and Ecology of the Namibia Upwelling System (GENUS)

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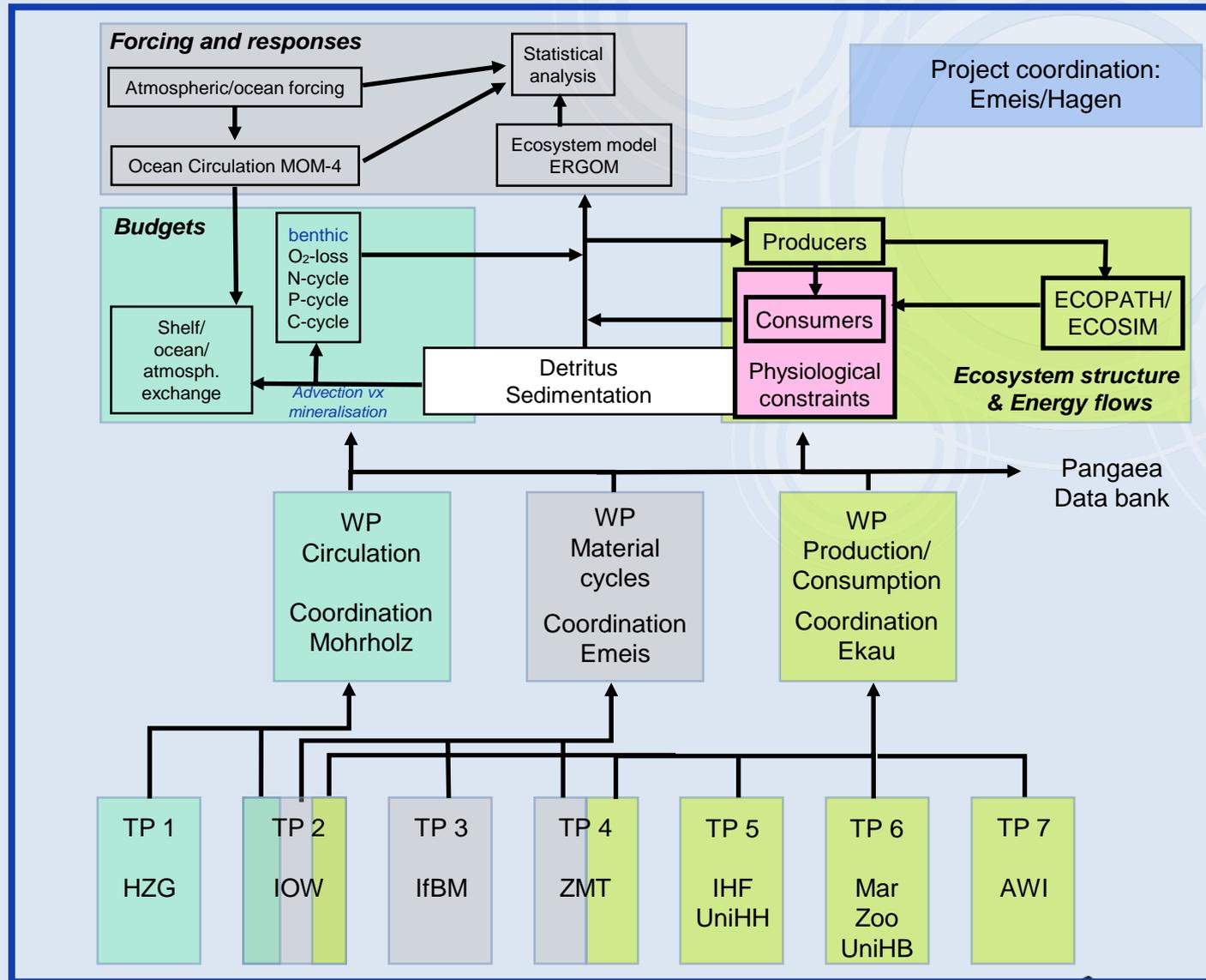
Scientific goals of GENUS

(Geochemistry and Ecology of the Namibian Upwelling System)

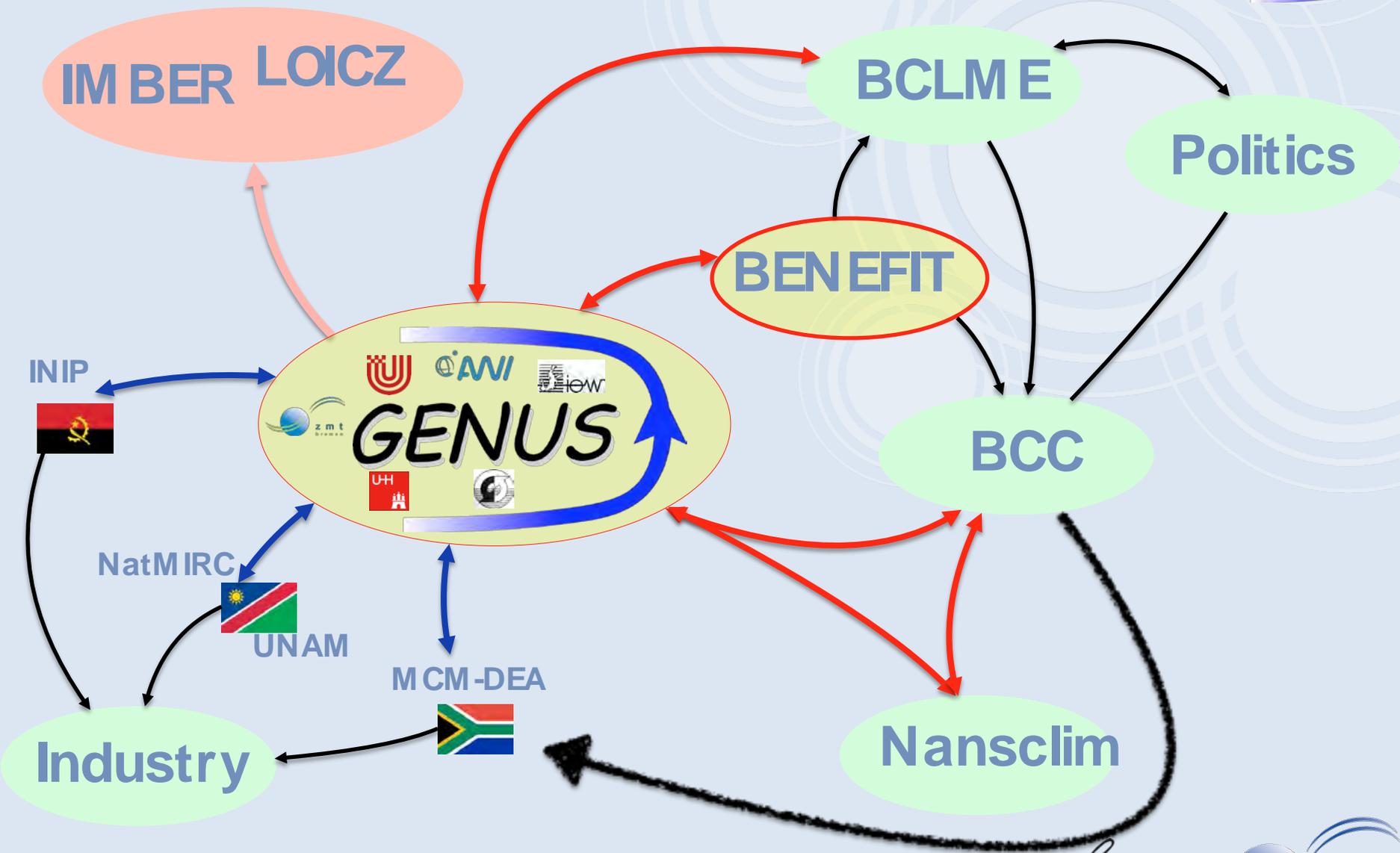
- Analyse interrelationships between climate change, oceanic nutrients and greenhouse gases and the structure of ecosystems in the coastal upwelling area off Namibia.



Project structure



Role of GENUS within the BC region

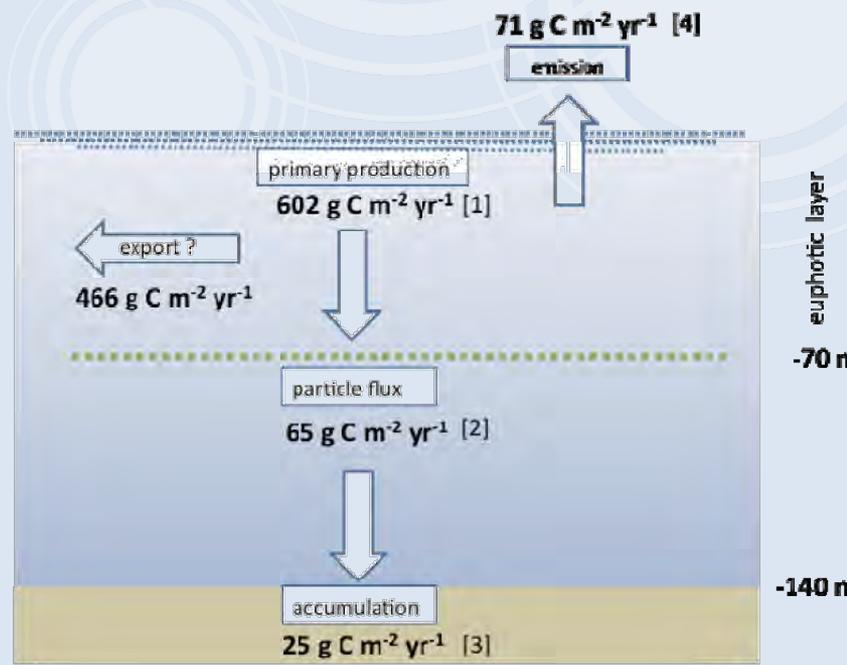


Results

- WP 1: Retrospective Analysis of changes in physical conditions and reaction of biogeochemical cycles
 - Simulation with GENUS (MOM/ERGOM) over 12 years (1999-2012) and STORM (ECHAM6-OM, w/o Biogeochemistry)-model over 60 years (1950-2010) to model the distribution of dominating water masses ESACW and SACW and oxygen concentrations.
 - Model results used as basis for explaining temporal and spatial variabilities and energy budgets in other sub-projects.

Results

- WP 2: Key processes and rates in physical, biogeochemical and biological processes
 - Dynamics of water masses and oxygen supply to the Northern Benguela shelf
 - Quantification of C, N and P cycles
 - Green house gases CO₂ and CH₄ : Northern Benguela system as source for CO₂, southern Benguela system as sink for CO₂.

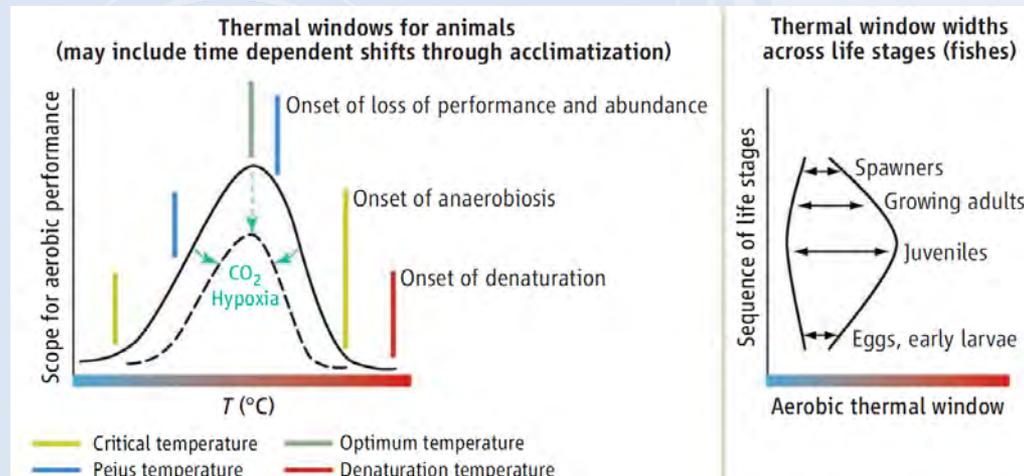


Results

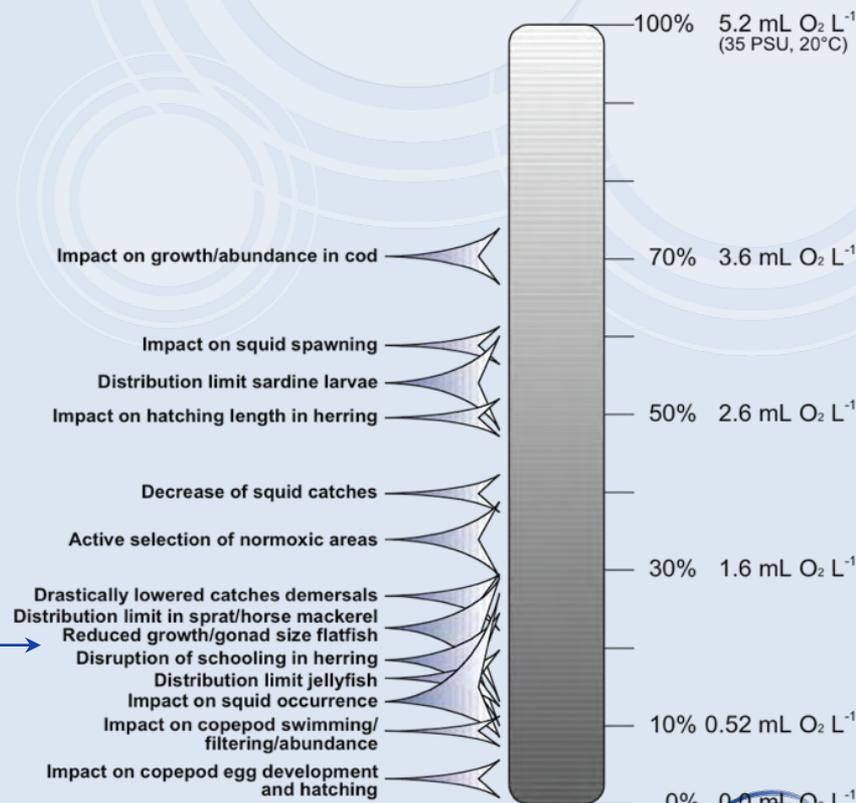
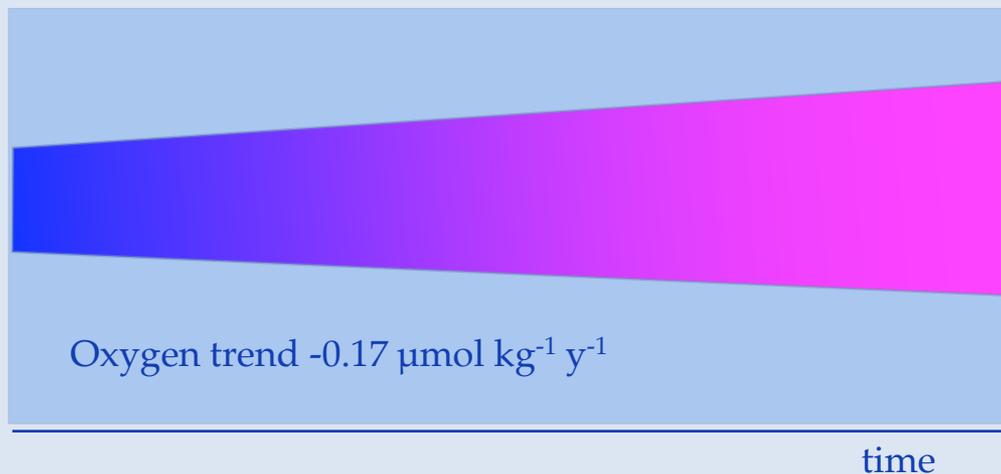
- WP3: Processes, Interactions and Mechanismen der Regelung trophischer Beziehungen im Auftriebs-Ökosystem**
 - Mesozooplankton : High variability in abundance and composition of species.**
 - Many fish species (Hake; Horse mackerel) avoid areas of high upwelling but prefer medium strengths**
 - Declining trend in mean abundance of copepods (*Calanoides carinatus*) from 2002 to 2011**
 - Southward shift of distribution of several zoo- and ichthyoplankton species. Very prominent in *Trachurus capensis* and *Sardinella aurita*.**
 - Copepods and decapods contribute significantly to vertical transport of organic material (biological pump)**

Temperature and oxygen

- Respiration &
- Hypoxia tolerance



Temperature trend: + 0.002 °C y⁻¹



Ekau et al. 2010
Pörtner & Farrel 2008
Stramma et al. 2008

H2020-MSCA-ITN-2015

VOYAGE - Variability of OxYGen in marine Ecosystems and climate change

- Scientific topics
 - Deoxygenation in marine ecosystems over continental margins (Black Sea, Benguela/Namibia upwelling System and Humboldt System).
 - Selection of systems exhibiting various degrees of deoxygenation and responses under present climate change and probably under future climate change.
 - Interconnections between aerosols, clouds and marine ecosystems are one of the largest uncertainty in the projection of the climate system.
 - Regional climatic projections with selection of CMIP5 scenarios for all domains and an Integrative modeling approach from the atmosphere to the ocean to fisheries and to humans.
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- Corresponding four overarching work packages:
 - WP1: Aerosols, clouds, circulation, climate variability and change
 - WP2: Climatic and anthropogenic impacts on marine ecosystems
 - WP3: Fisheries: recruitment, productivity and links to biogeochemistry and physics
 - WP4: From end to end: integrative studies (a synergy between WP1, 2 and 3)

VOYAGE - ITN

Increased deoxygenation state →

GENUS

SOUTHERN BENGUELA

NORTHERN BENGUELA

HUMBOLDT

BLACK SEA

W
P
1

4
Mesoscale O-A coupling

1
Aerosols-SST-PP-O2

12
SST bias & O-A coupling

5
Denitrification-PP-O2

13
Equatorial connection-O2

W
P
2

2
DMS-PP-O2

3
Fish niche habitats-O2

6
Pelagic fish body conditions

8
O2 season /episode

11
Benthic-pelagic coupling

10
O2 Benthic-pelagic coupling

W
P
3

7
Hypoxia simulation

14
Spatial shifts fish species

9
Otoliths-O2 Trophic pathways

3
Fish niche habitats-O2

Increased E2E integration ↓