GENUS – Geochemistry and Ecology of the Namibian Upwelling System

Subprojects and Field Work

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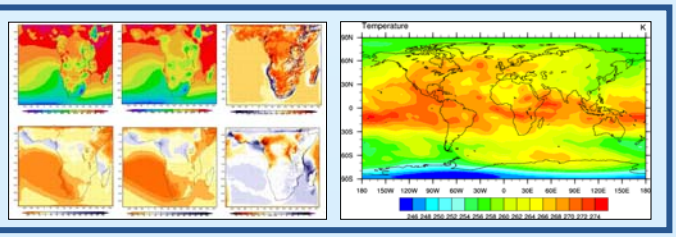
Subproject 1

Max Planck Institute for Meteorology, Hamburg, Germany

Daniela Jacob, Susanne Pfeifer

Highly resolved Simulations of Atmospheric Circulation over the SE Atlantic Ocean: 1960 - 2008 AD, Little Ice Age, Medieval Warm Period

- REMO simulations using ERA40 Reanalyses/Analyses
- Report on the evaluation of the model
- Transfer of atmosphere data to MOM4/ERGOM from REMO simulations for 1960 to 2008
- REMO simulations for LIA and MWP using ECHAM5/MPI-OM Millennium simulations
- Statistical Analyses of atmospheric flow conditions for all simulations
- Report of changes in flow pattern between the 3 simulation periods



Subproject 2

Institute for Baltic Research Warnemünde, Germany

Wolfgang Fennel, Volker Mohrholz, Martin Schmidt, Norbert Wasmund, Anja Eggert, Annethea Muller

Modelling and Observation of Hydrographical and Biogeochemical Key processes in the Benguela-Upwelling System

- Hydrographical changes of the eastern boundary current affect the dynamics of oxygen and what are the consequences for the lower part of the food web? How are fluctuations of the eastern boundary current driven by atmospheric variations?
- What are the quantitative figures of the mass fluxes between the Benguela upwelling system and the open ocean? What is the relationship between vertical fluxes in the bottom boundary layer and the turbulent exchanges on the shelf and how can these processes be parameterized?
- How large is the primary production in the upwelling area and which species are responsible for nitrogen fixation and the re-establishment of the Redfield-ratio at aerobic conditions?
- How can we quantify the ecosystem responses to climate signals with the help of the current stage as well as the medieval warm period and the little ice age?

Subproject 3

Institute of Biogeochemistry and Marine Chemistry, University of Hamburg, Germany

Kay-Christian Emeis, Niko Lahajnar, Birgit Nagel

Regulation of Nutrient Fluxes and Reconstruction of Past Nutrient Status in the Shelf Upwelling System – Geochemical and Isotopic Tracers

- Synoptic patterns of nutrient ratios in relation to oxygen conditions and their temporal variability
- Quantification of denitrification and nitrification by analyses of the isotopic compositions of dissolved nitrate and ammonia, as well as dissolved organic nitrogen
- Quantification of trophic and diagenetic offsets between $\delta^{15}N$ in DIN, chlorophyll-degradation products, suspended matter and sediments
- Quantification pCO_2 and pCH_4 in shelf waters
- Construction of validation data sets for simulations of past ecosystem states (1960-2008; Little Ice Age and Medieval Warm Period) from sedimentary archives

Subproject 4

Center for Tropical Marine Ecology, Bremen, Germany

Werner Ekau, Tim Rixen, Andreas Kunzmann, Anita Flohr, Simon Geist

Impact of climate related environmental changes on the biological pump and on the fluxes in the higher trophic levels: Ichthyoplankton and mikronekton

- Estimation of CO_2-emission in the Benguela region. Understanding of processes leading to an uptake of CO_2 by older upwelling water off Namibia
- Impact of pH on growth of foraminifera; characterisation of a situation fostering nitrogen fixation
- Assessment of Redfield (C/N/P) and rain ratios in the water column
- Estimation of key species and quantification of their role in the food web
- Assessment of the consumption rates of the key species and their importance for energy fluxes in the system.
- Quantification of the productivity of important species based on growth estimation. Quantification of oxygen uptake related to activity and stress
- Differentiation of physiological performance into basal and activity metabolism by long culturing periods.

Subproject 5

Institute of Hydriobiology and Fisheries Science, University of Hamburg, Germany

Rolf Koppelmann, Bettina Martin, Bernd Christiansen, Karolina Bohata

Meso- and macrozooplankton dynamics in the southwest African Upwelling region: Shelf sea - open ocean interactions

- Determination and quantification of vertical migrating organisms; contribution to assess the lateral transport of zooplankton
- Determination of carbon consumption rates of zooplankton and key taxa
- Determination of the trophic position of main taxa and their food sources by means of stable isotope analyses (N = trophic position, C = food source)
- Assessment of the predation pressure by gelatinous organism
- How do atmospheric and hydrodynamic changes influence the structure, production, and diversity of pelagic ecosystems?
- How are higher trophic levels affected by changes at the base of the food web?
- Do changes in structure, production, and diversity of pelagic ecosystems feed back on biogeochemical cycles?

Subproject 6

Marine Zoology, University of Bremen, Germany

Wilhelm Hagen, Holger Auel, Anna Schukat, Lena Teuber

Quantification and modelling of trophic interactions of important meso- and macrozooplankton – the contribution of calanoid copepods and decapods to carbon flux in the Benguela Current coastal upwelling system

- Composition and structure of calanoid copepod and decapod communities in terms of abundance, biomass, regional and vertical distribution
- Data on trophic biomarkers (fatty acid and fatty alcohol compositions)
- Data on stable isotope ratios (nitrogen, carbon)
- Data on metabolic activity and ingestion rates of dominant species derived from respiration measurements
- Data integration and development of an ECOPATH/ECOSIM model for trophic interactions

Subproject 7

Alfred-Wegener-Institut, Bremerhaven, Germany

Friedrich Buchholz, Thorsten Werner

The trophic position of euphausiids (krill) in the upwelling areas of the Southwest African shelf in changing climatic conditions

- Which position do the krill species, particularly *Euphausia hanseni,* hold in the food web and in material fluxes?
- How does the omnivorous krill adapt food aquisition, growth, reproduction, and energy metabolism to the steep gradients in temperature, oxygen and food supply?
- Which kind of influence does the strongly pulsed upwelling system exert on these adaptations?
- In which way is the pronounced vertical migration behaviour tuned to those factors?
- What would be the consequences of climatically induced fluctuations of the krill population to the ecosystem of the shelf?

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