ECOSUPPORT

(Advanced modeling tool for scenarios of the Baltic Sea ECOsystem to SUPPORT decision making)

Cyanobacteria bloom 2005

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4. Jonathan Havenhand, Tjärnö Marine Biological Laboratory (TMBL), Göteborg University, Sweden
5. Brian MacKenzie, Technical University of Denmark, Danish Institute for Fishery Research (DTU), Denmark
6. Thomas Neumann, Baltic Sea Research Institute Warnemünde (IOW), Germany
7. Jan-Marcin Weslawski, Institute of Oceanology Polish Academy of Sciences (IOPAS), Poland
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Objectives

1. to calculate the **combined effects** of changing *climate* and changing *human activity* (nutrient load reductions [runoff and airborne], coastal management, fisheries) on the BS ecosystem,

2. to assess the resulting **socioeconomic** impacts,

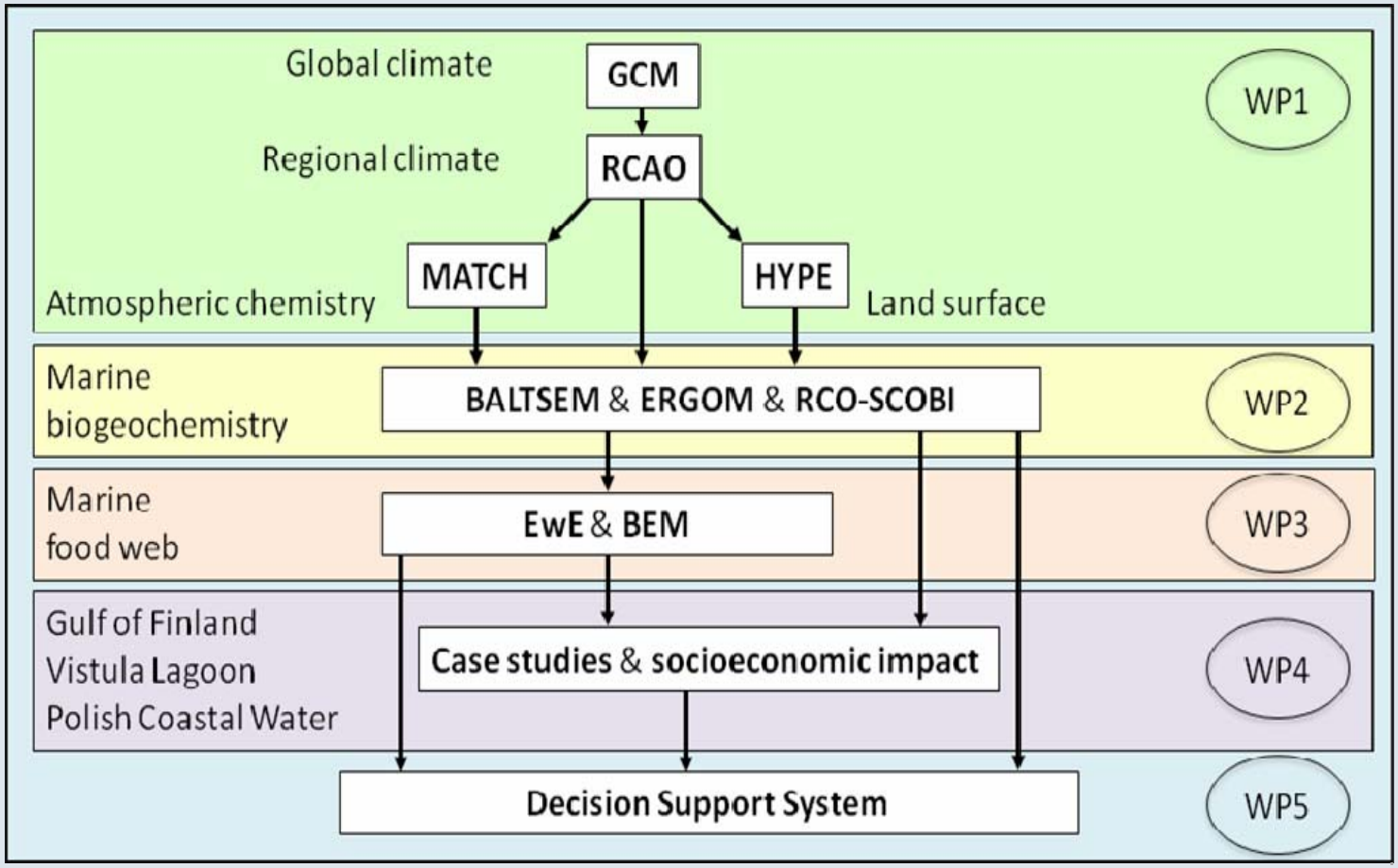
3. to perform **time-dependent scenario** simulations from present climate until 2100, and quantify the **uncertainties** around these future projections,

4. to support decision makers and stakeholders with **a tool** providing them with relevant and readily accessible information that will help to raise wider public awareness,

5. to conduct focused assessments of local-scale impacts of changing climate on **coastal areas** (with focus on the Gulf of Finland, Vistula Lagoon, and the Polish coastal waters).

Model hierarchy in ECOSUPPORT

(Advanced modeling tool for scenarios of the Baltic Sea ECOsystem to SUPPORT decision making)



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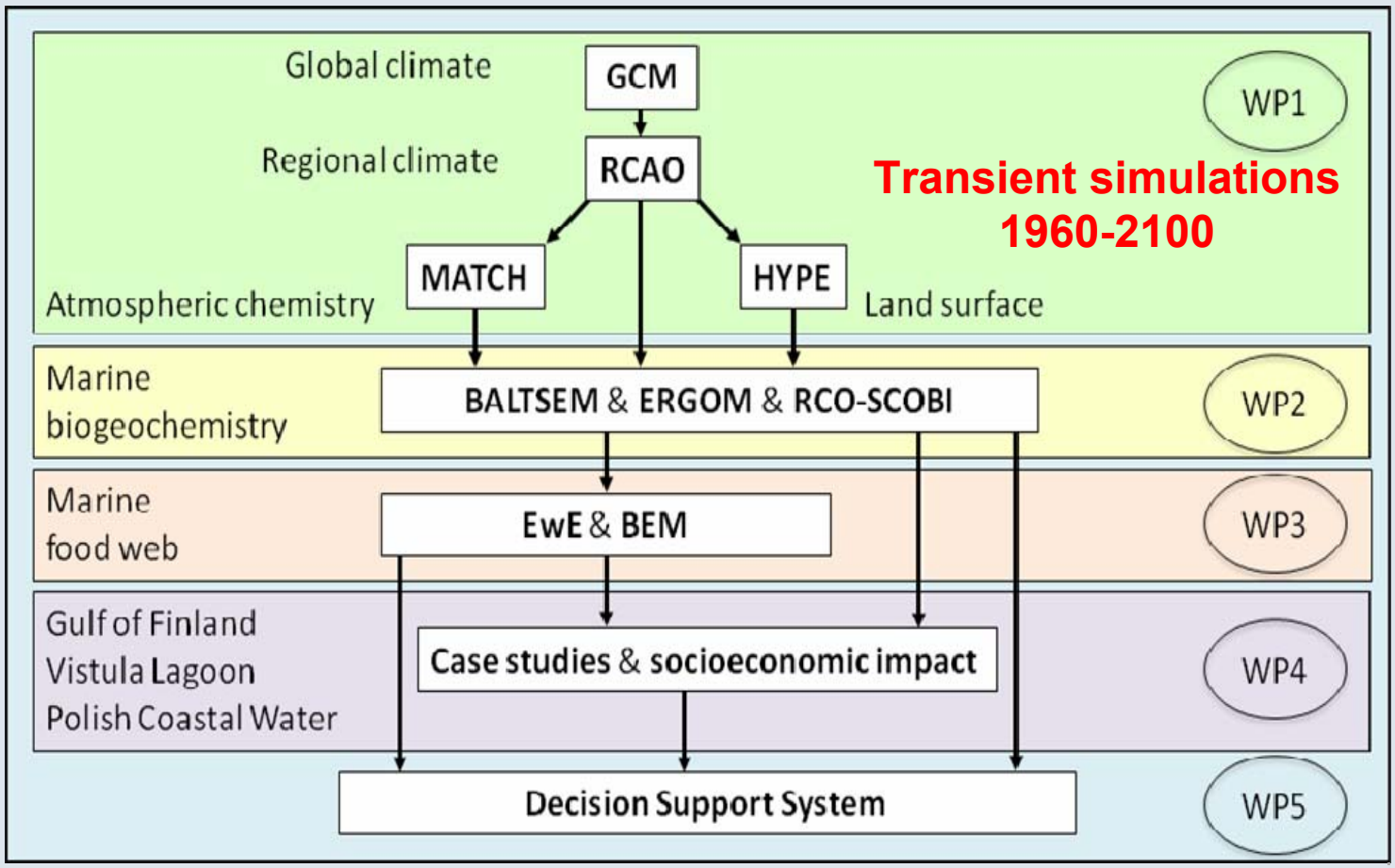
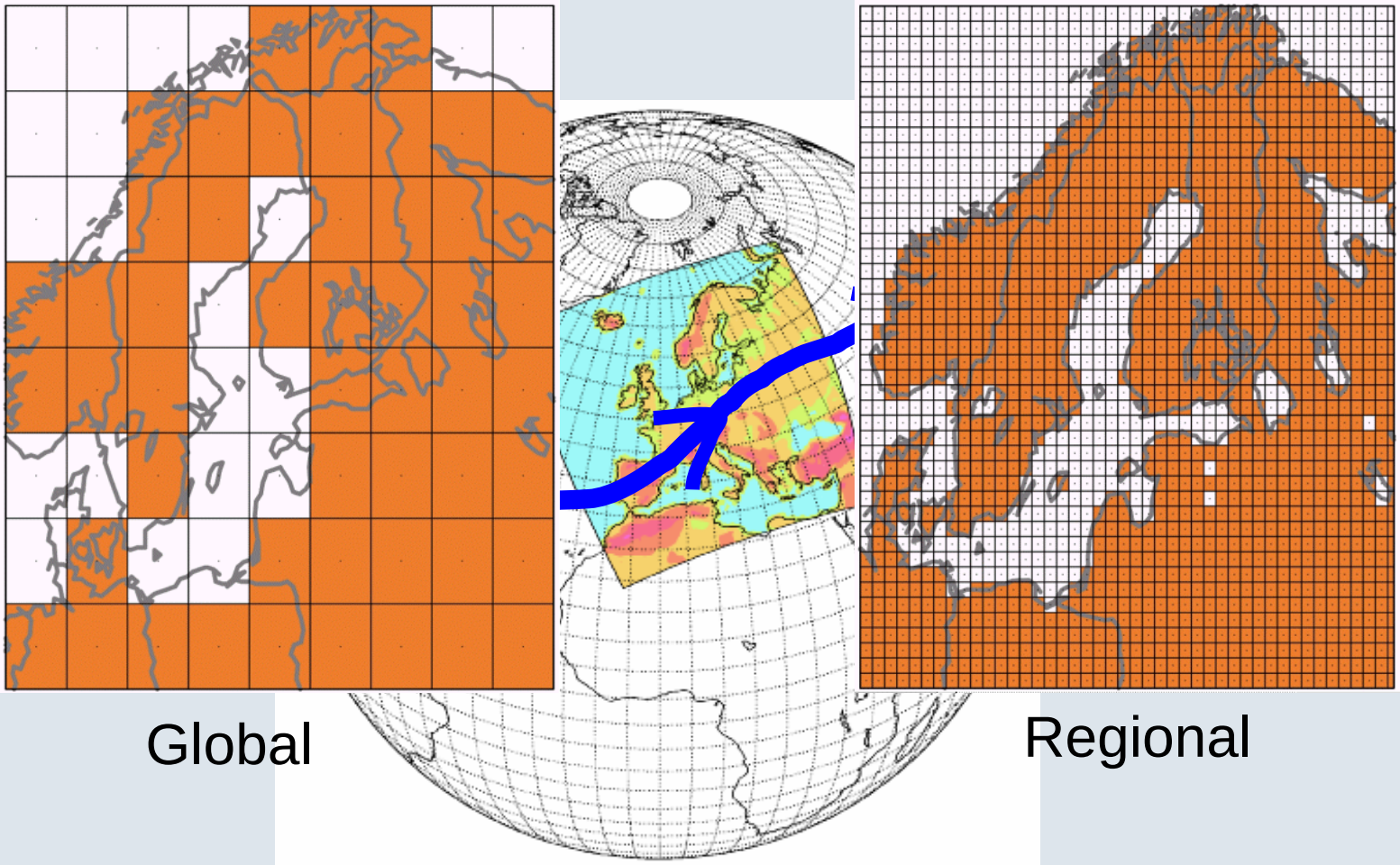


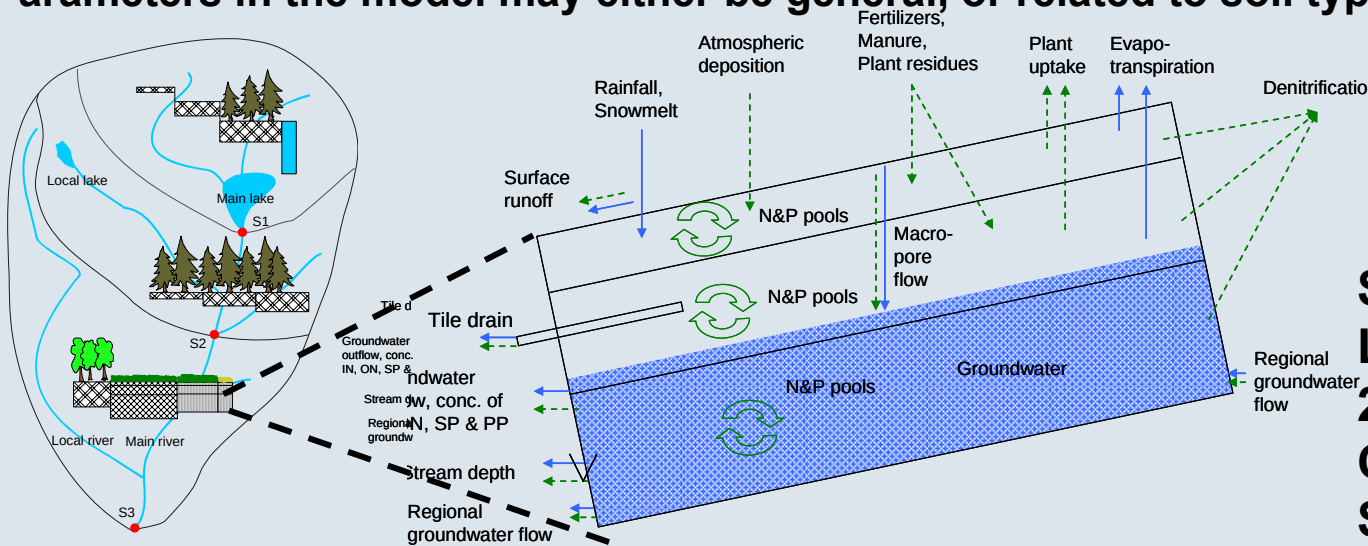
Regional climate modeling at SMHI/Rossby Centre using RCAO



The HYPE model

(**HY**drological **P**redictions for the **E**nvironment)

- **A new, daily time-stepping hydrological model for small and large-scale assessments of water resources and water quality,**
- **Landscape is divided into classes according to soil type, vegetation and altitude.**
- **Soils are divided into 1-3 layers and**
- **The model simulates e.g. snow melt, surface runoff, macropore flow, tile drainage, groundwater outflow from the individual soil layers, nutrient turnover, and transport/transformation in rivers and lakes.**
- **Flow is routed within and between subareas to calculate discharge of water, nitrogen, phosphorus, (TOC).**
- **Parameters in the model may either be general, or related to soil type or land use.**



Source: Lindström et al., 2009.
Chantal Donnelly, SMHI

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Methods

(1) assessing the **predictive skills** of the models by comparing observed and simulated past climate variability (i.e. quantification of model uncertainties) and analyzing causes of observed variations

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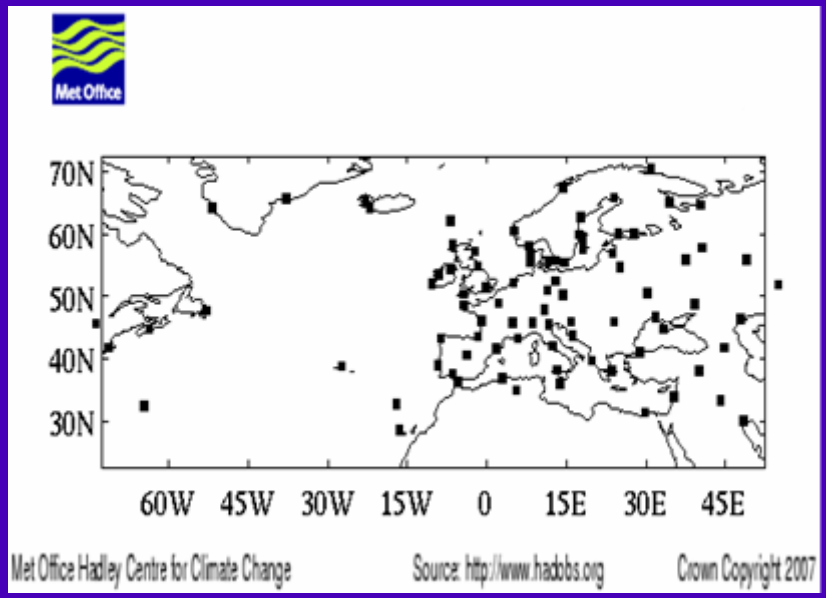
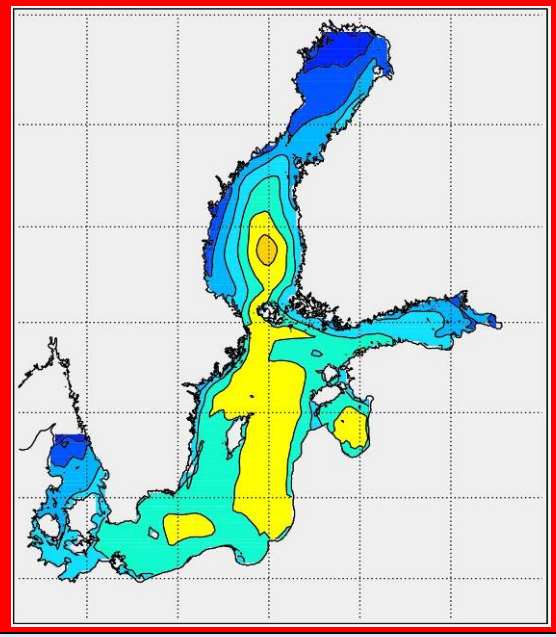
Reconstruction of past atmospheric forcing on the Baltic Sea, 1850 to present

Daily sea-level-pressure and temperature station data should contain enough information to approximately reconstruct wind-stress, air-temperature, precipitation on a high-resolution grid over the Baltic Sea,

Data 1850-present from the EMULATE project: daily station data over Western Europe



Gridded data from regional model simulations driven by large-scale meteorological reanalysis



(Source: Eduardo Zorita, GKSS)

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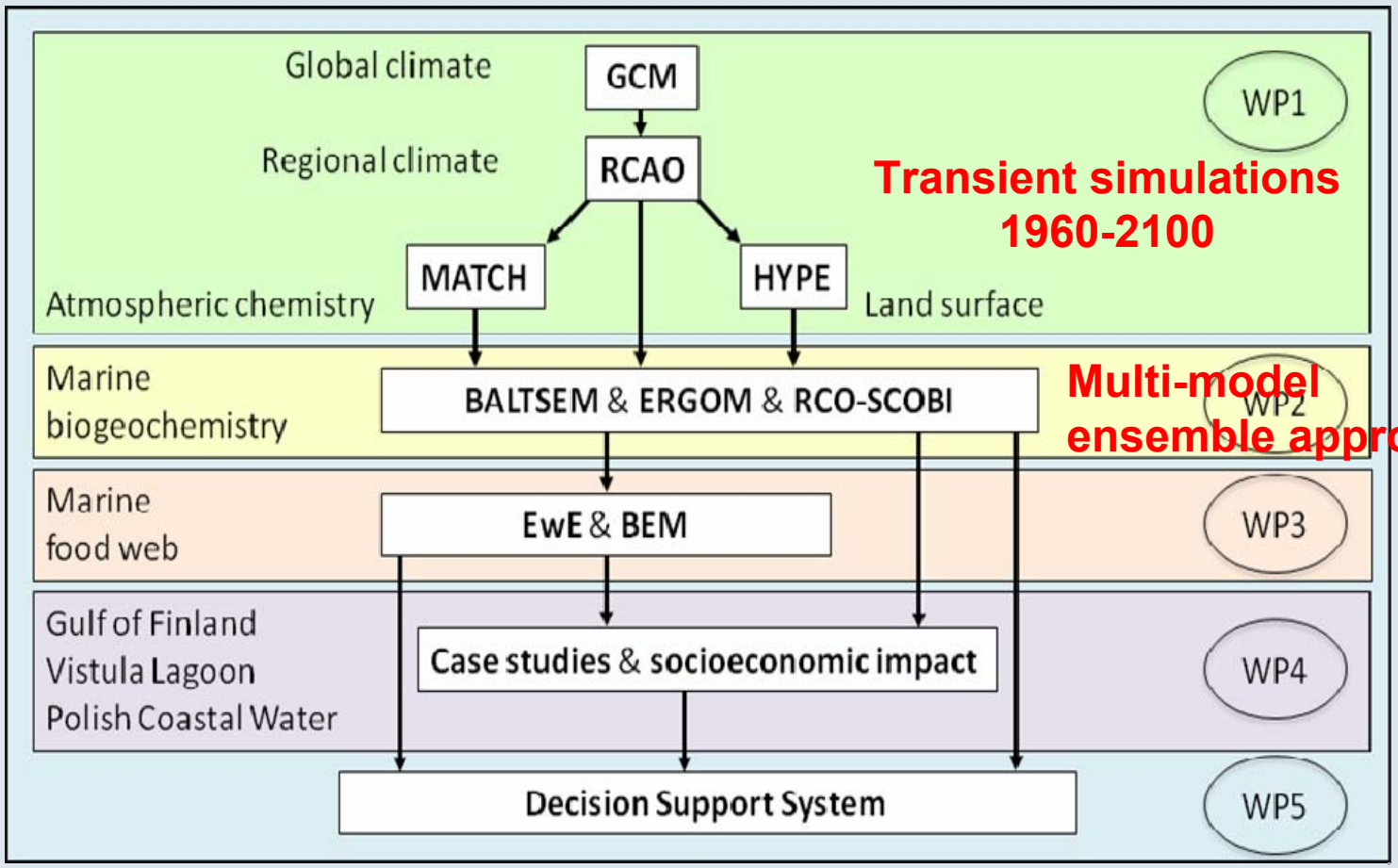
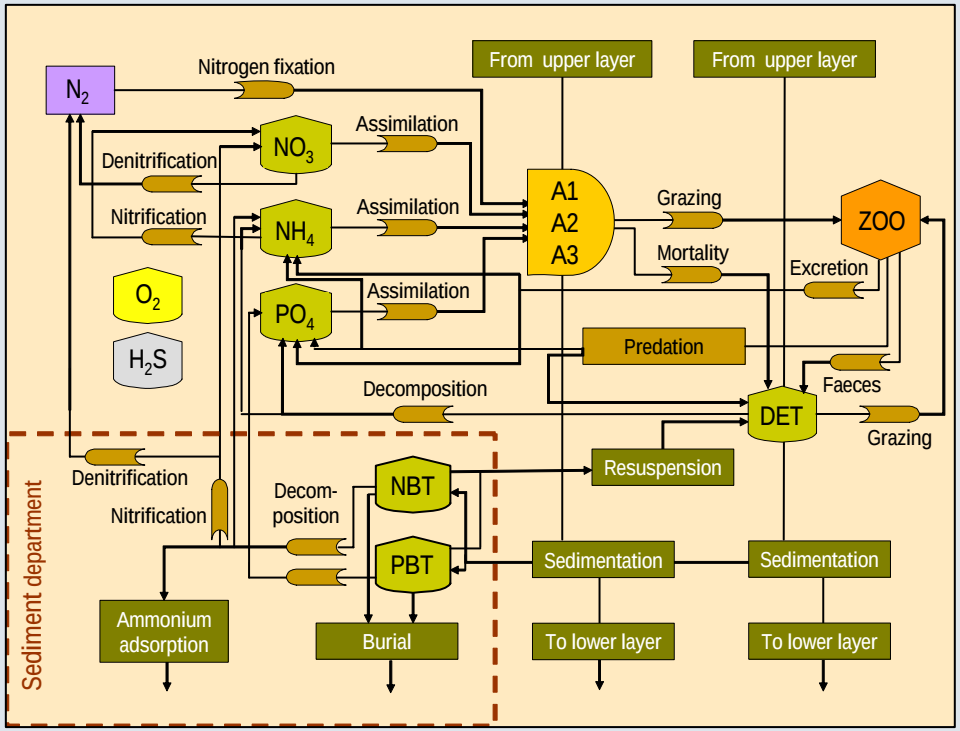


RCO-SCOBI

a high-resolution 3-D coupled physical-biogeochemical model for climate and process studies



Pelagic variables:

- ***nitrate*** ***(NO3)***
- ***ammonium*** ***(NH4)***
- ***phosphate*** ***(PO4)***
- ***autotrophs*** ***(A1,A2,A3)***

(diatoms, flagellates etc., cyanobacteria)

- ***zooplankton*** ***(ZOO)***
- ***detritus*** ***(DET)***
- ***oxygen*** ***(O2)***
- ***Hydrogen sulfide*** ***(H2S) is included as negative oxygen.***

- **The sediment contains nutrients in the form of benthic nitrogen (NBT) and phosphorus (PBT)**
- **Improvement of re-suspension by implementing a wave model and dissolved organic matter (carbon, nitrogen, phosphorus)**
- **Two versions of the sediment model (runs 30 and 45)**
- **Reference: Eilola, K., H.E.M. Meier and E. Almroth (2009)**

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Methods

(2) performing **multi-model ensemble simulations** of the marine ecosystem for **1850-2100** forced by reconstructions of past climate and by various future greenhouse gas emission and air- and riverborne nutrient load scenarios (ranging from a pessimistic *business-as-usual* to the *most optimistic case*)

(3) analyzing projections of the future BS ecosystem using a probabilistic approach accounting for **uncertainties** caused by biases of regional and global climate models (RCMs and GCMs), lack of process description in state-of-the-art ecosystem models, unknown greenhouse gas emissions and nutrient loadings, and natural variability

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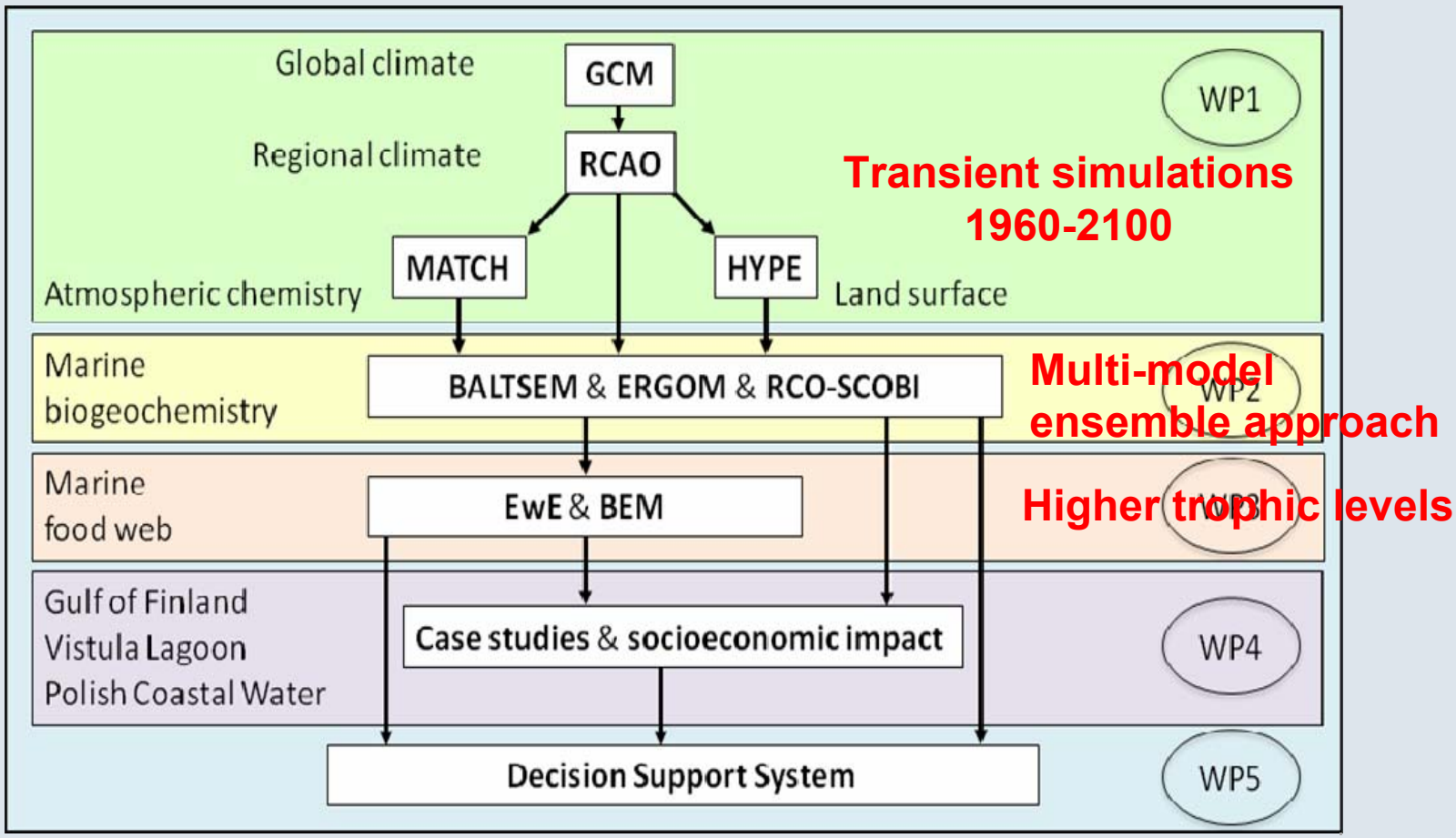

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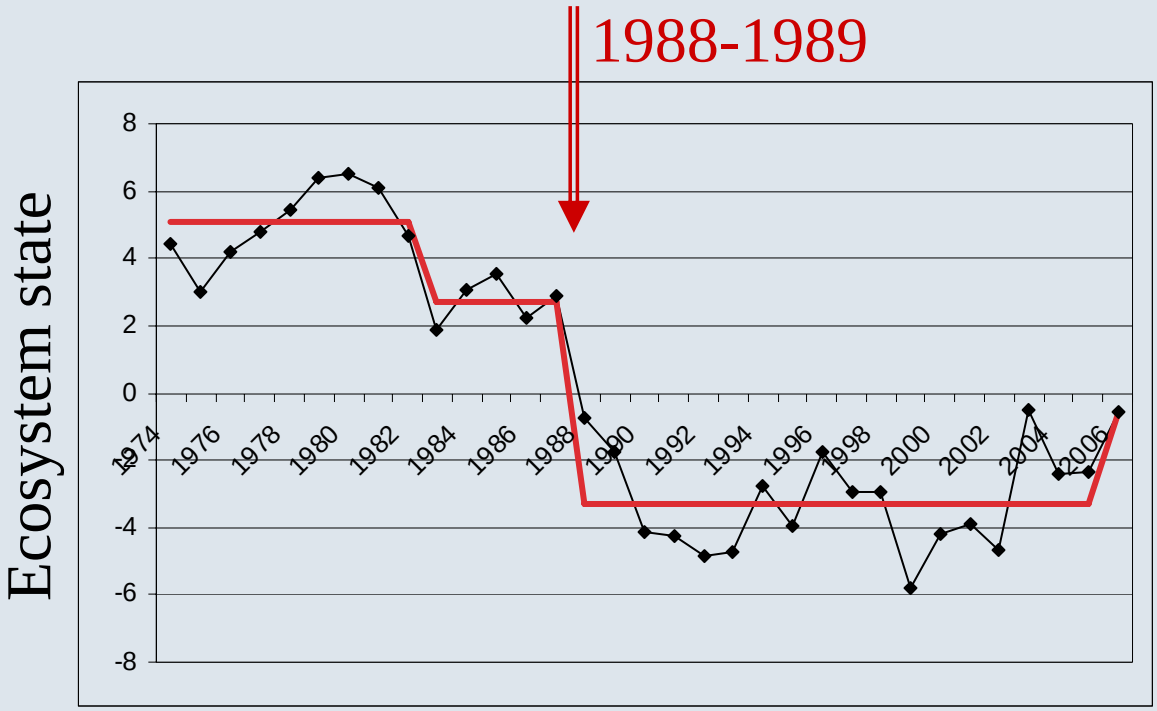
Methods

(4) assessing impacts of climate change on the **marine biota** (e.g. effects of ocean acidification), **biodiversity** and **fish populations** (with focus on cod, sprat and herring)

Baltic Proper- Regime Shift

based on long-term monitoring

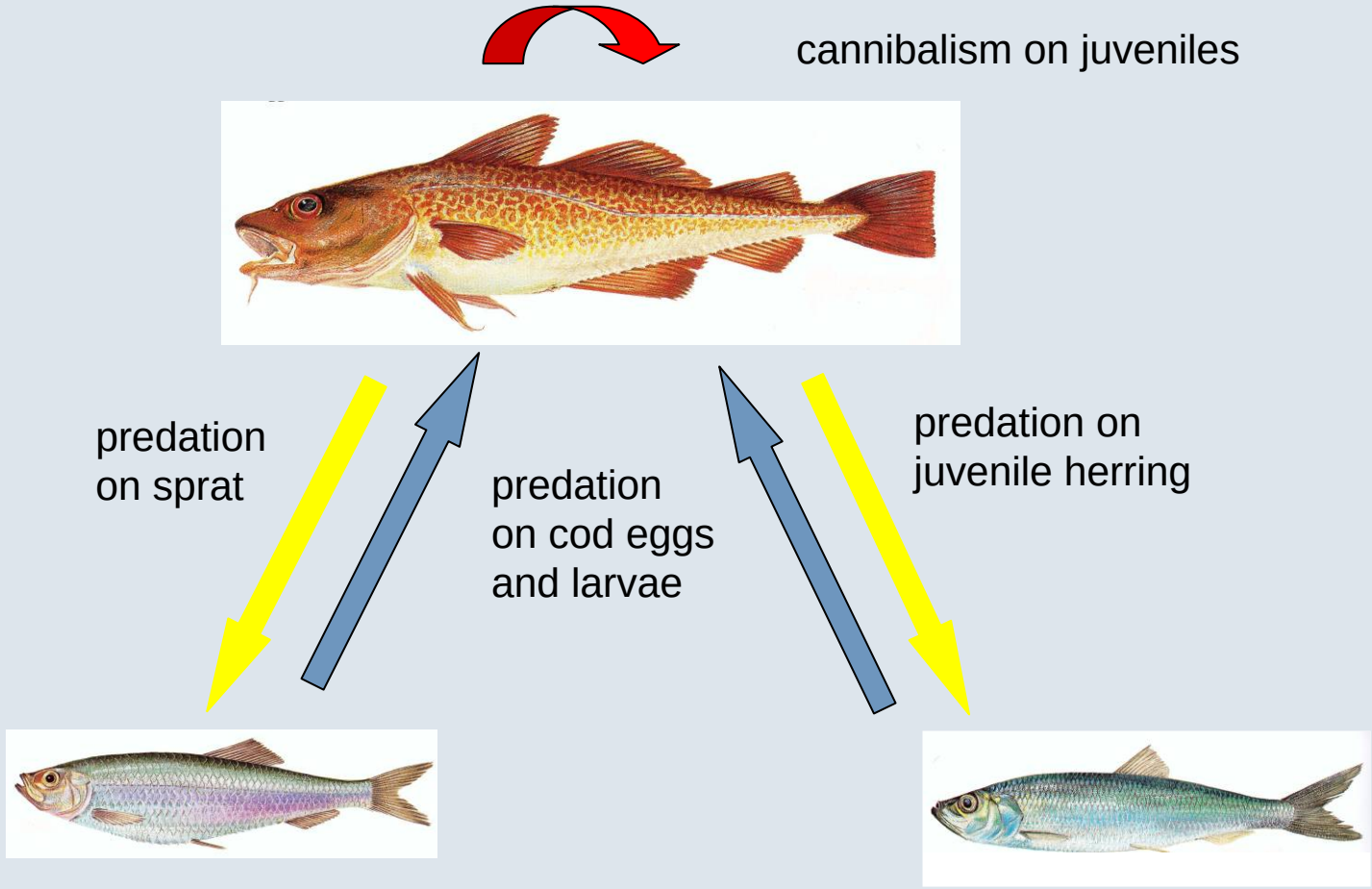


ICES WGIAB 2008

Regime shifts are climate related and may lead to severe changes in food-webs lower food quality of prey (junk-food)

(Source: Blenckner et al., in prep.)

Species Interactions: Cod & Clupeids in the Baltic



(Source: Köster, Uzars, Plikshs, Möllmann, Neuenfeldt et al.)

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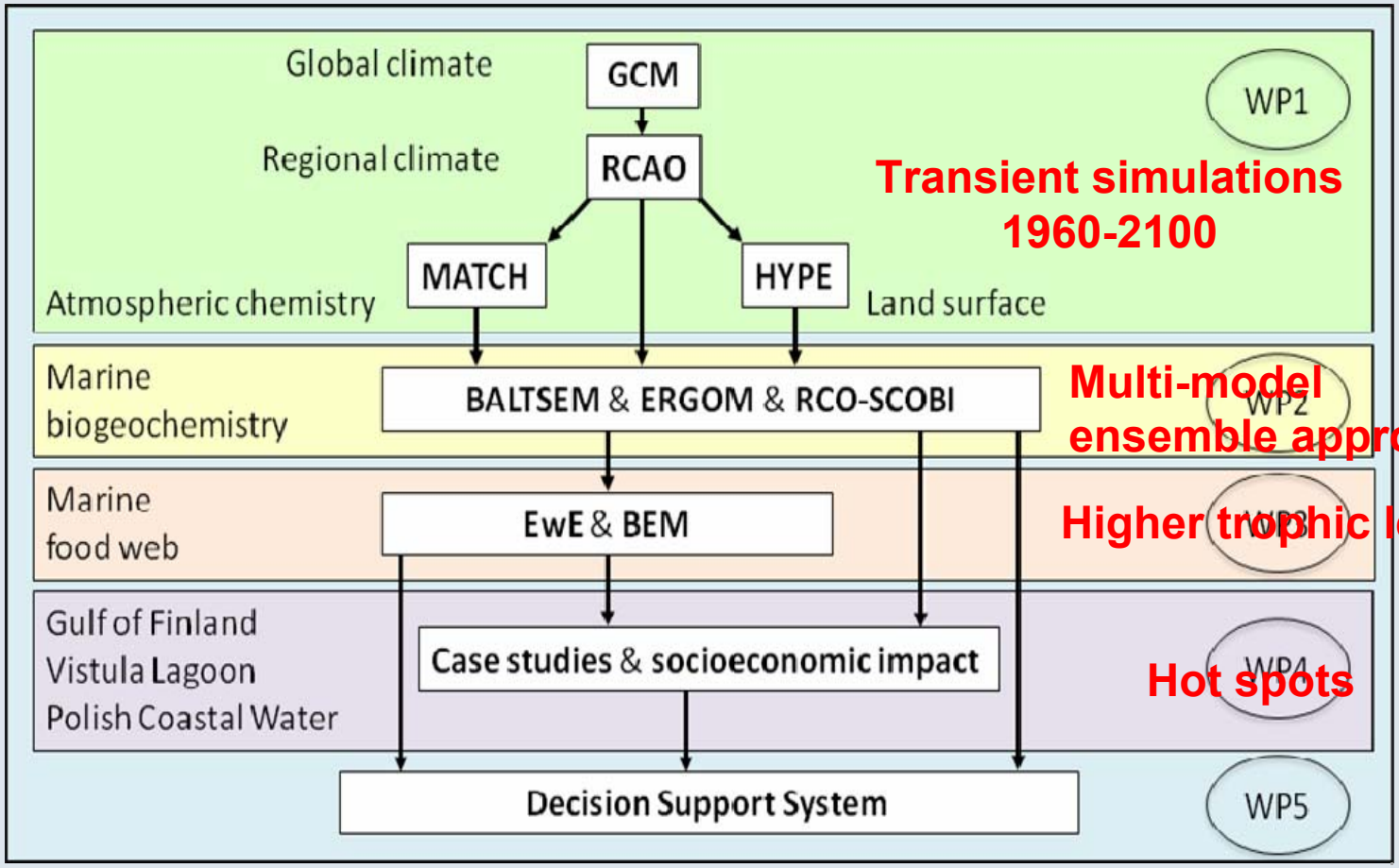

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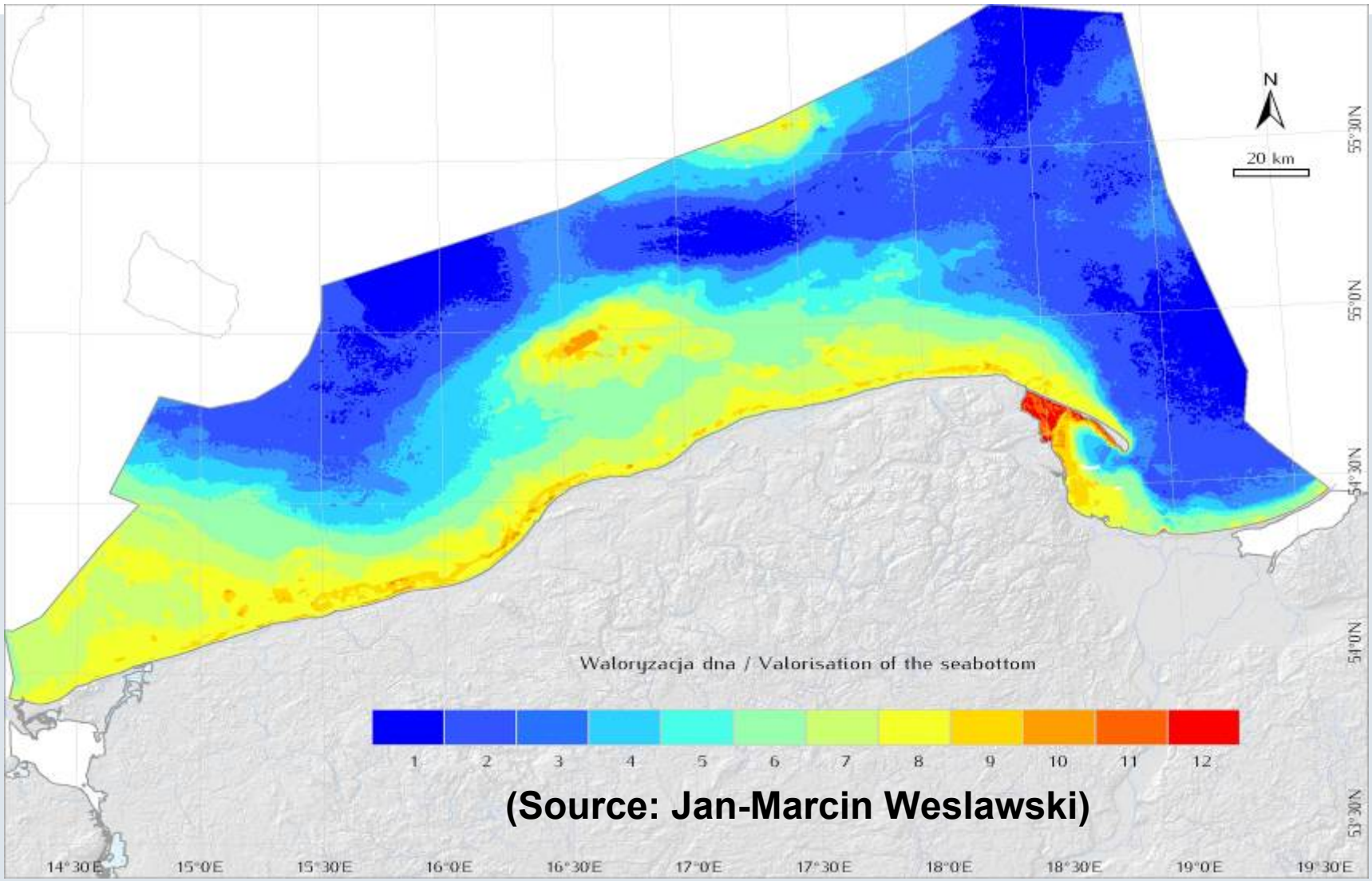
Biological valuation

- ”the intrinsic value of marine biodiversity without reference to anthropogenic use”
- Criteria: rarity, aggregation, fitness, naturalness, proportional importance

(Source: Weslawski et al.)

Biological valorisation of Polish Marine Areas



(Source: Jan-Marcin Weslawski)

Methods

(5) calculating the **costs** of climate change

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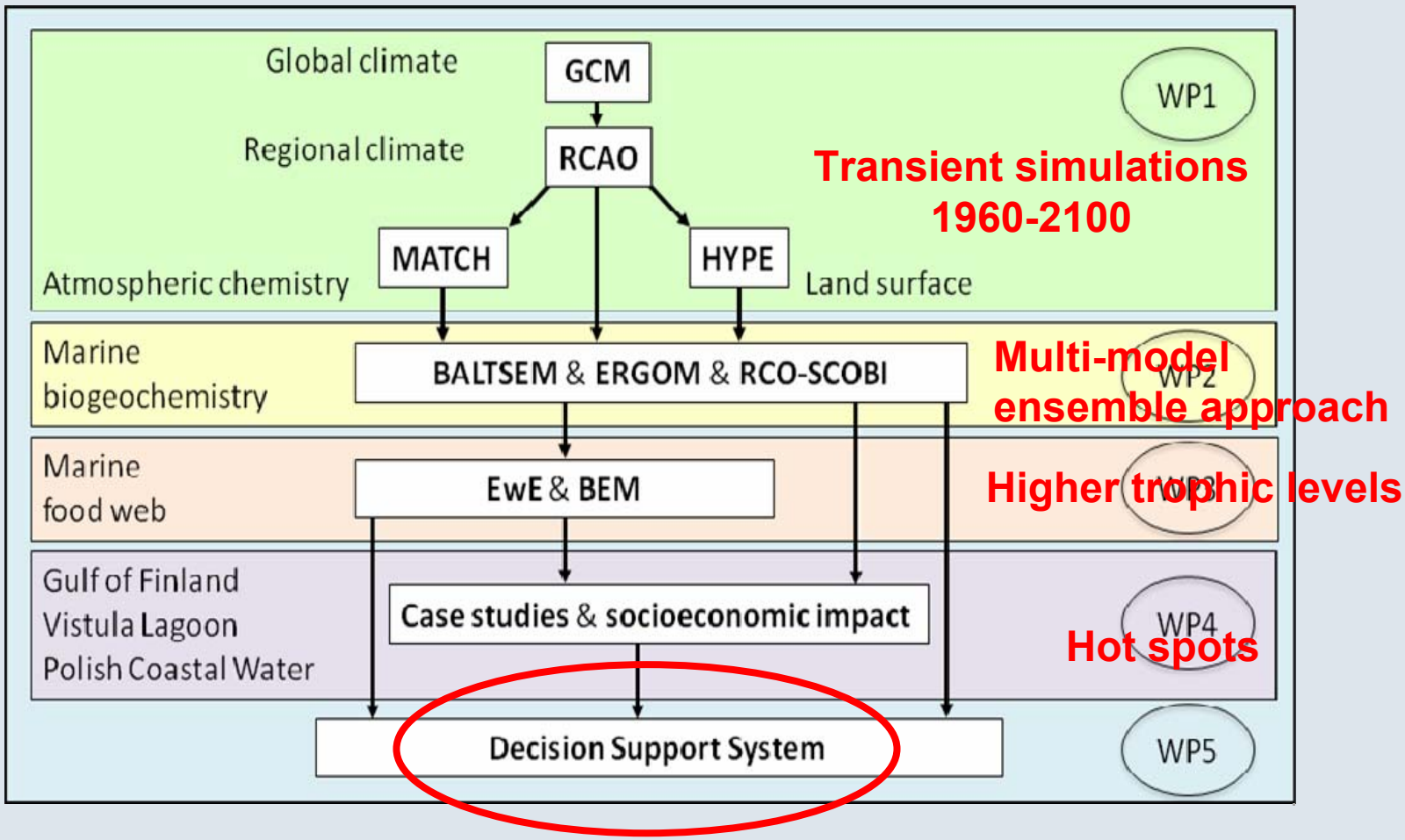

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Methods

(6) disseminating the project results to stakeholders, decision makers (e.g. via the Helsinki Commission - HELCOM) and the public (webpage, newsletters, seminars, conferences, etc.).

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Thank you for your attention!

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