

Future projections of the Baltic Sea ecosystem

Water quality and lower trophic levels perspective

Presentation: Elin Almroth Rosell

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“The goal of working with scenarios is:

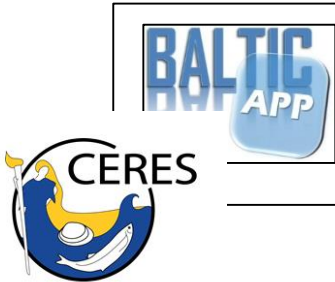
1. Not to predict the future, but
2. to better understand uncertainties and alternative futures, ‘
3. in order to consider how robust different decisions or options may be
4. under a wide range of possible futures.”



No crystal ball.

Design assumptions, hypothesis, scenarios and experiments to support decisions and new research





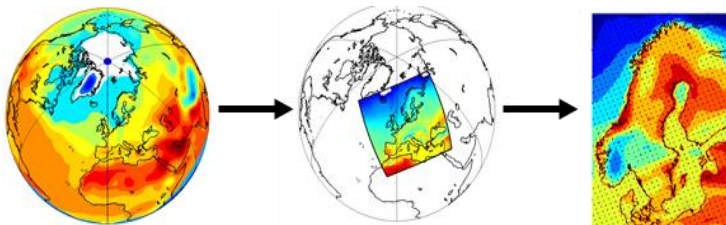
BalticAPP project studies marine ecosystem services across the Baltic Sea region in the 21st century.

SMHI

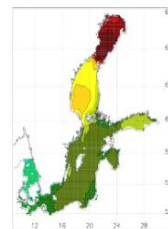
Projections of water quality and lower trophic levels for the Baltic Sea

Downscaling for studies of ecosystem services

From global to regional climate change



Baltic Sea climate



Water quality

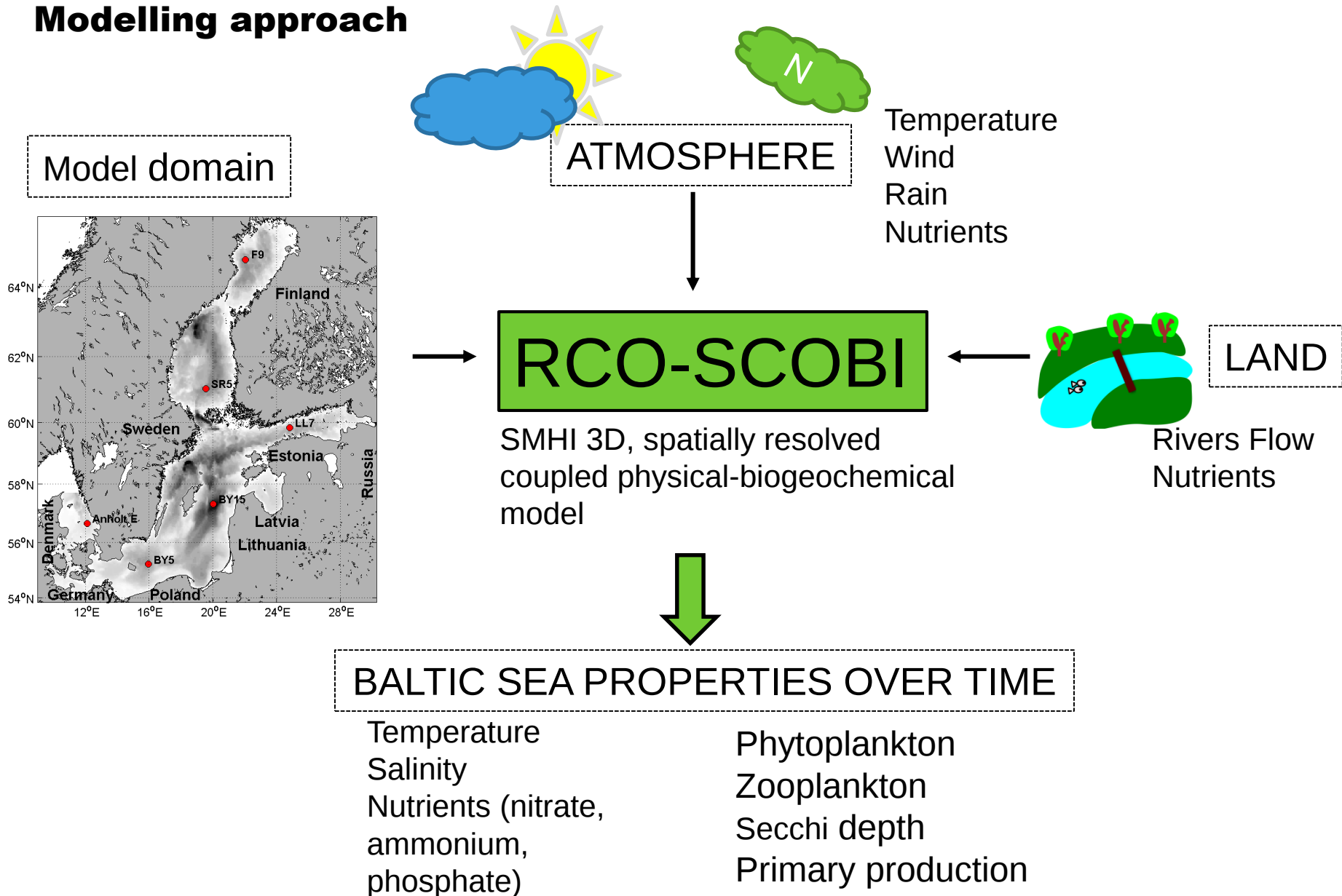


Ecosystem changes

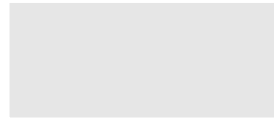
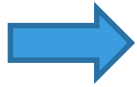


Projections of water quality and lower trophic levels

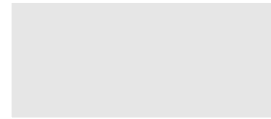
Modelling approach



Regionalized scenarios



RCP4.5

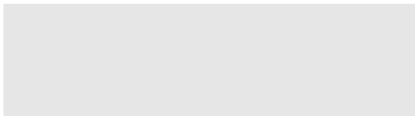


RCP8.5

Downscaled models

A MPI-ESM-LR
<http://www.mpimet.mpg.de>

B EC-EARTH
<https://www.knmi.nl>



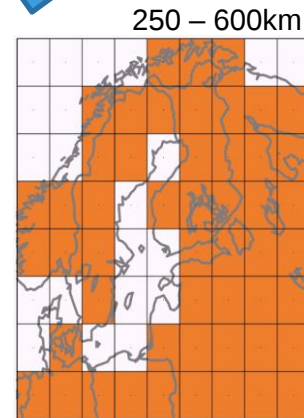
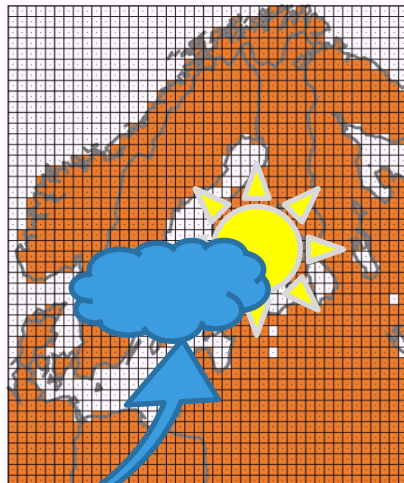
D HadGEM2-ES
<http://www.metoffice.gov.uk2>

E IPSL-CM5A-MR
<http://www.gfdl.noaa.gov>

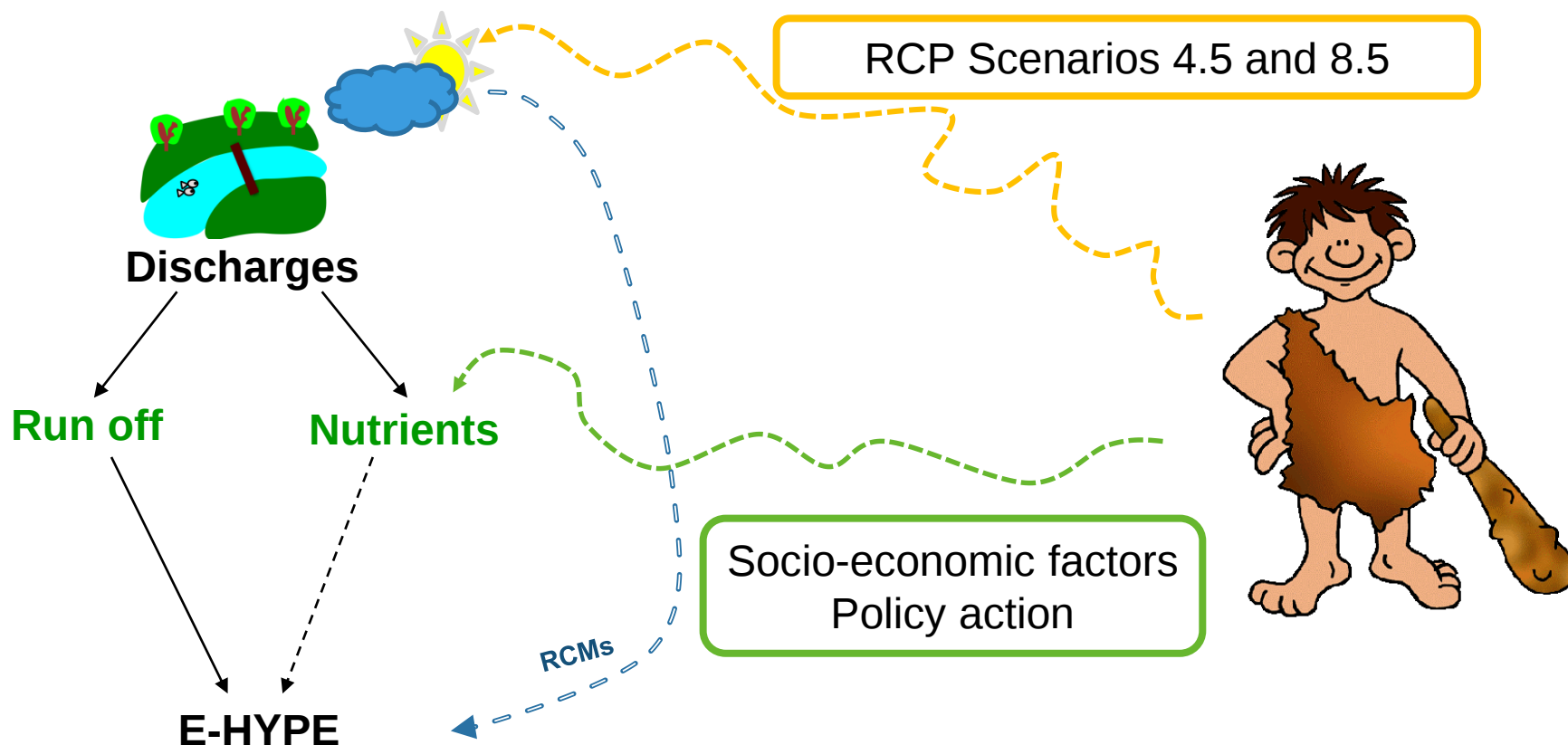
Global Climate Models
GCM



Regional Coupled
Climate Model
RCA4-NEMO



- 0.22 degree, atmosphere
 - about 3.7 km, sea
- Wang et al. 2015

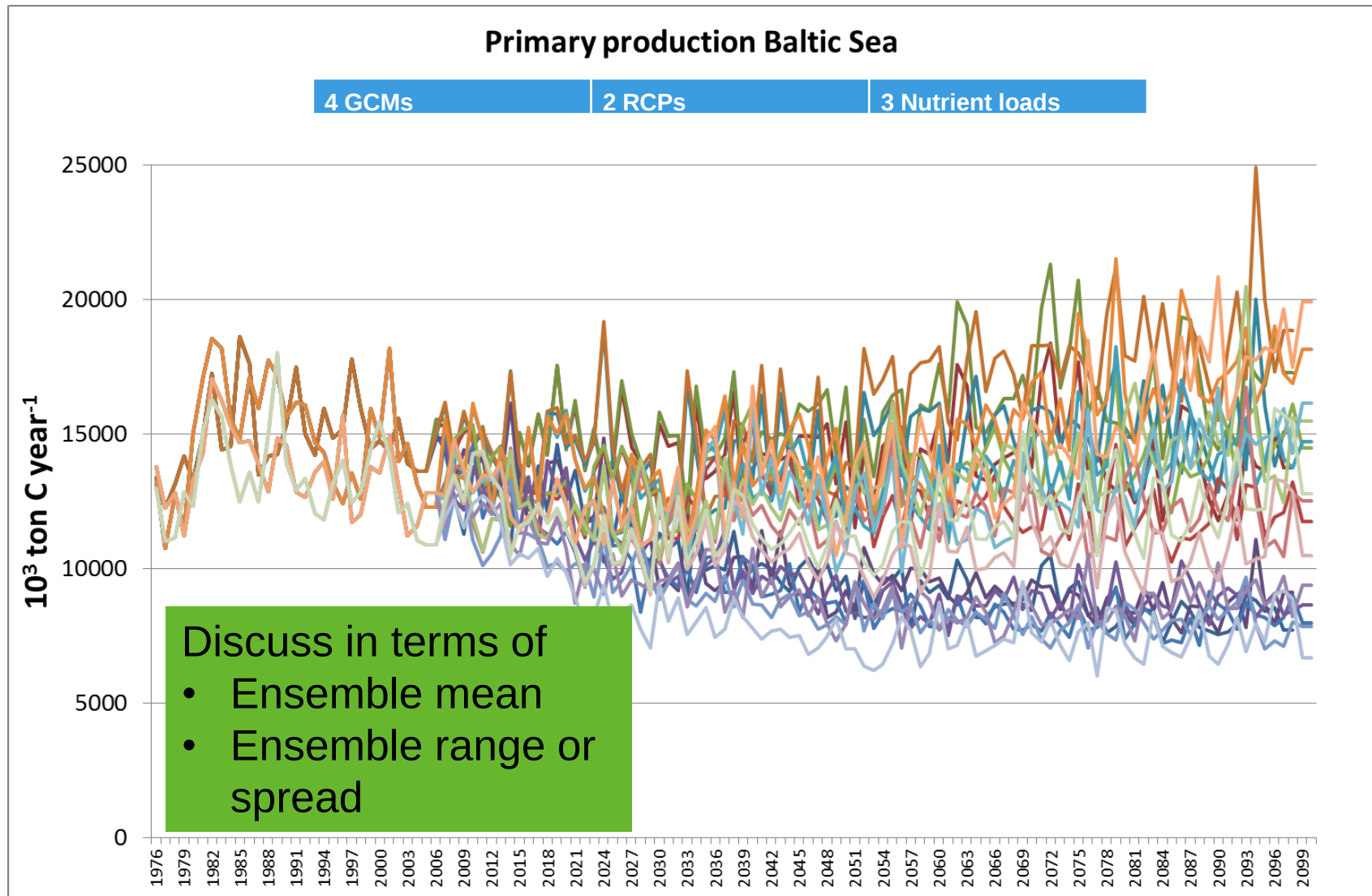


BSAP: Baltic Sea Action Plan (SSP1, Sustainability)

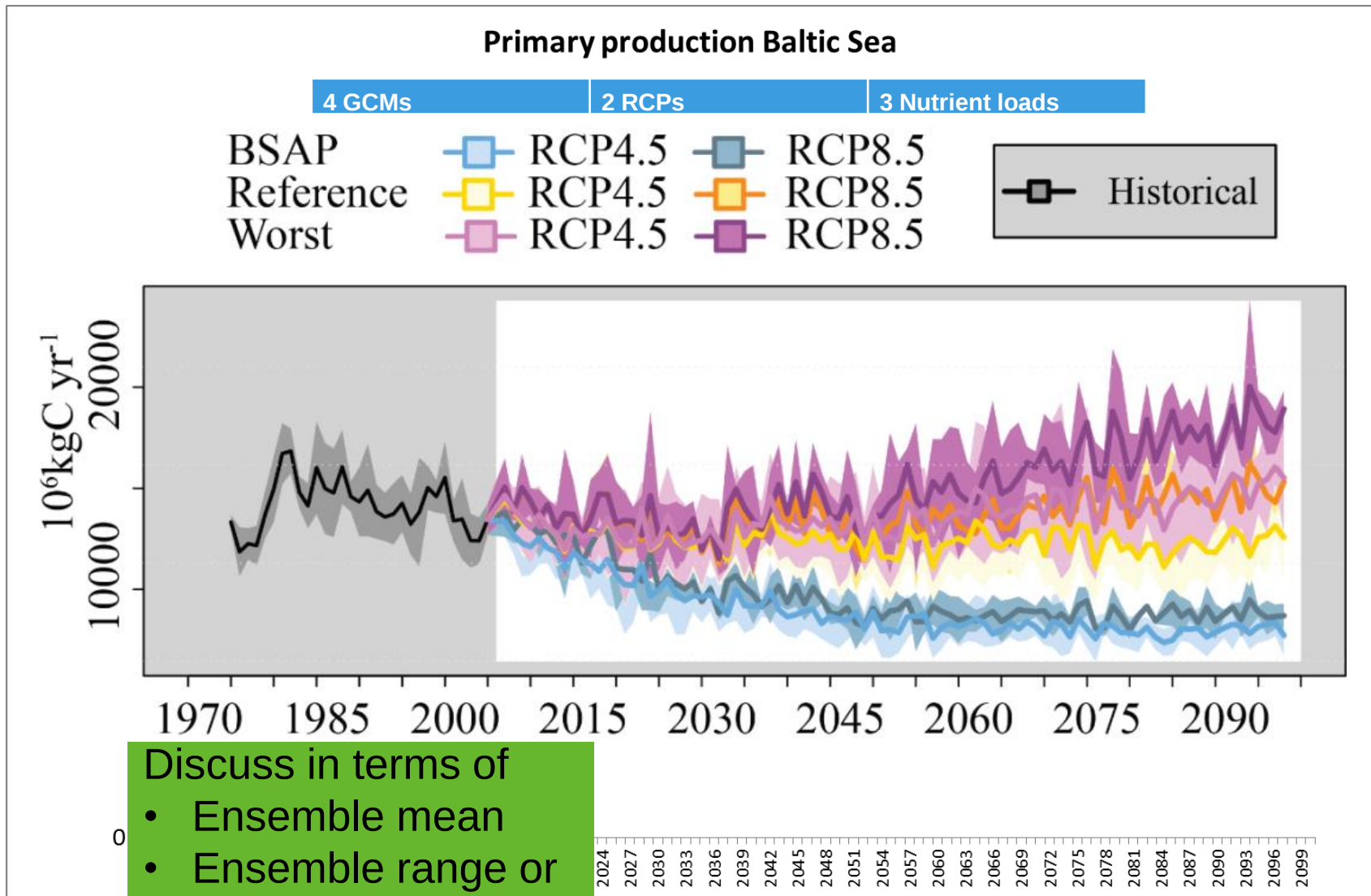
REF: Reference case (Only climate change effect)

Worst: Worst Scenario (SSP5, Fossil fuel development)

Example of model runs



Example of model runs

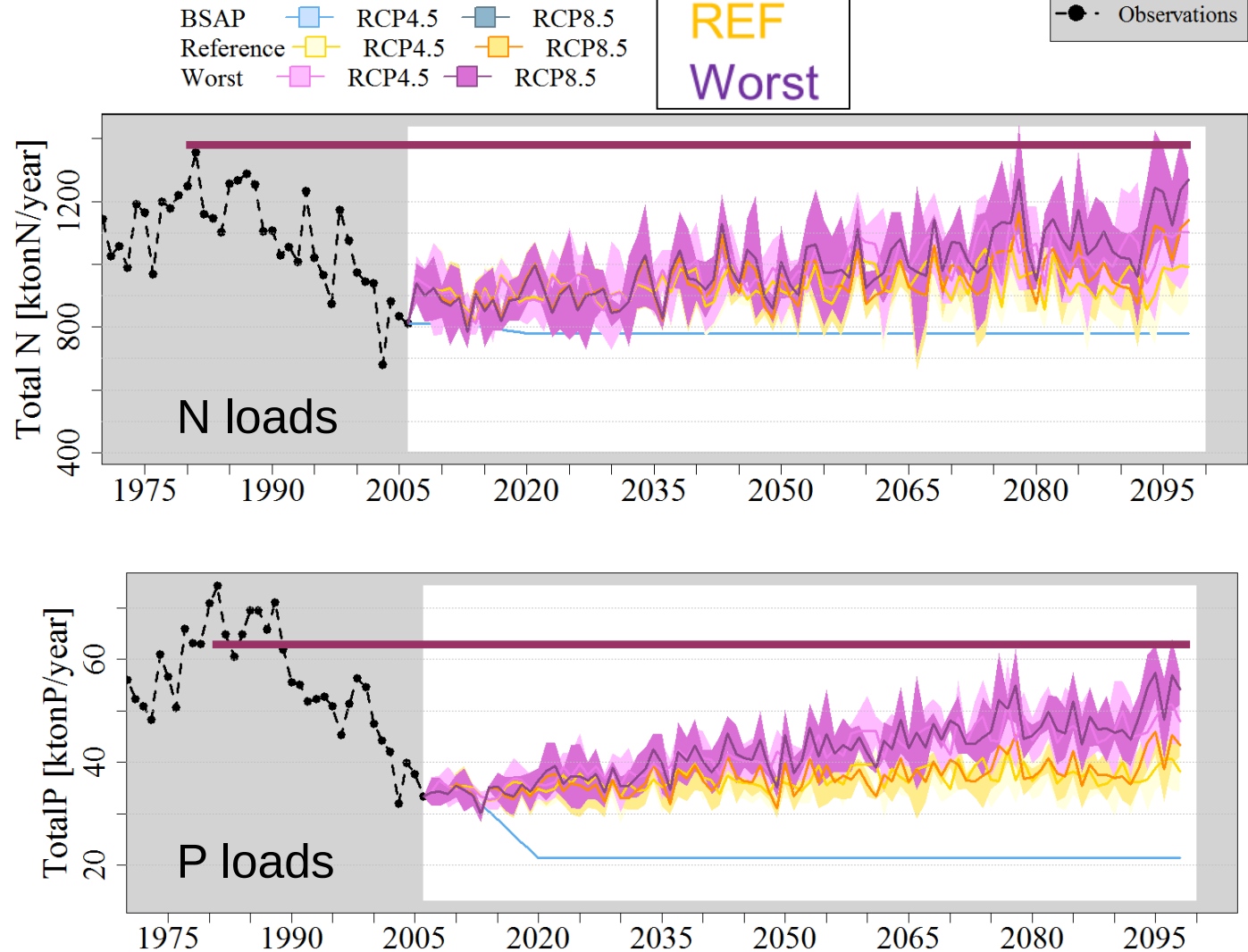
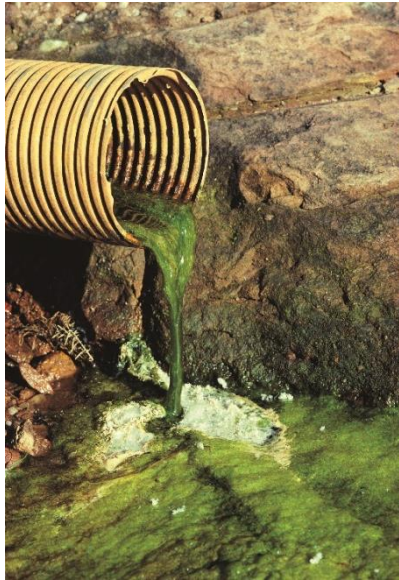


Discuss in terms of

- Ensemble mean
- Ensemble range or spread

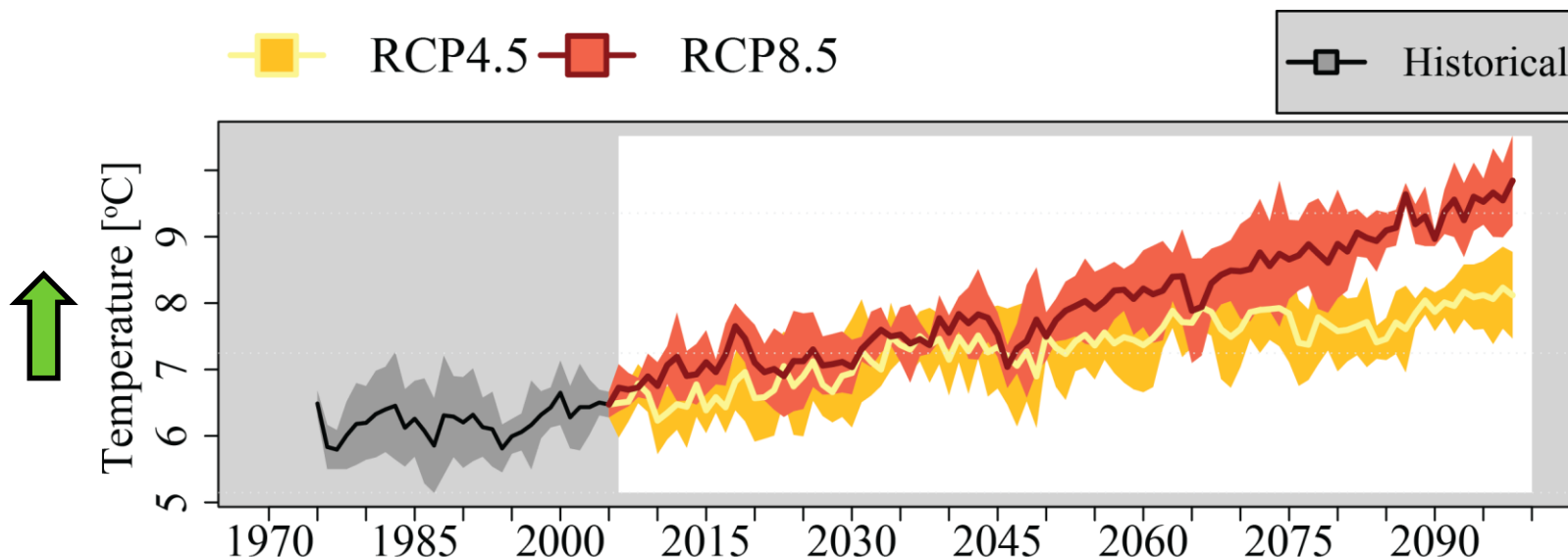
Nutrient load scenarios

SMHI



Source: Saraiva et al.,
2019 (SMHI)



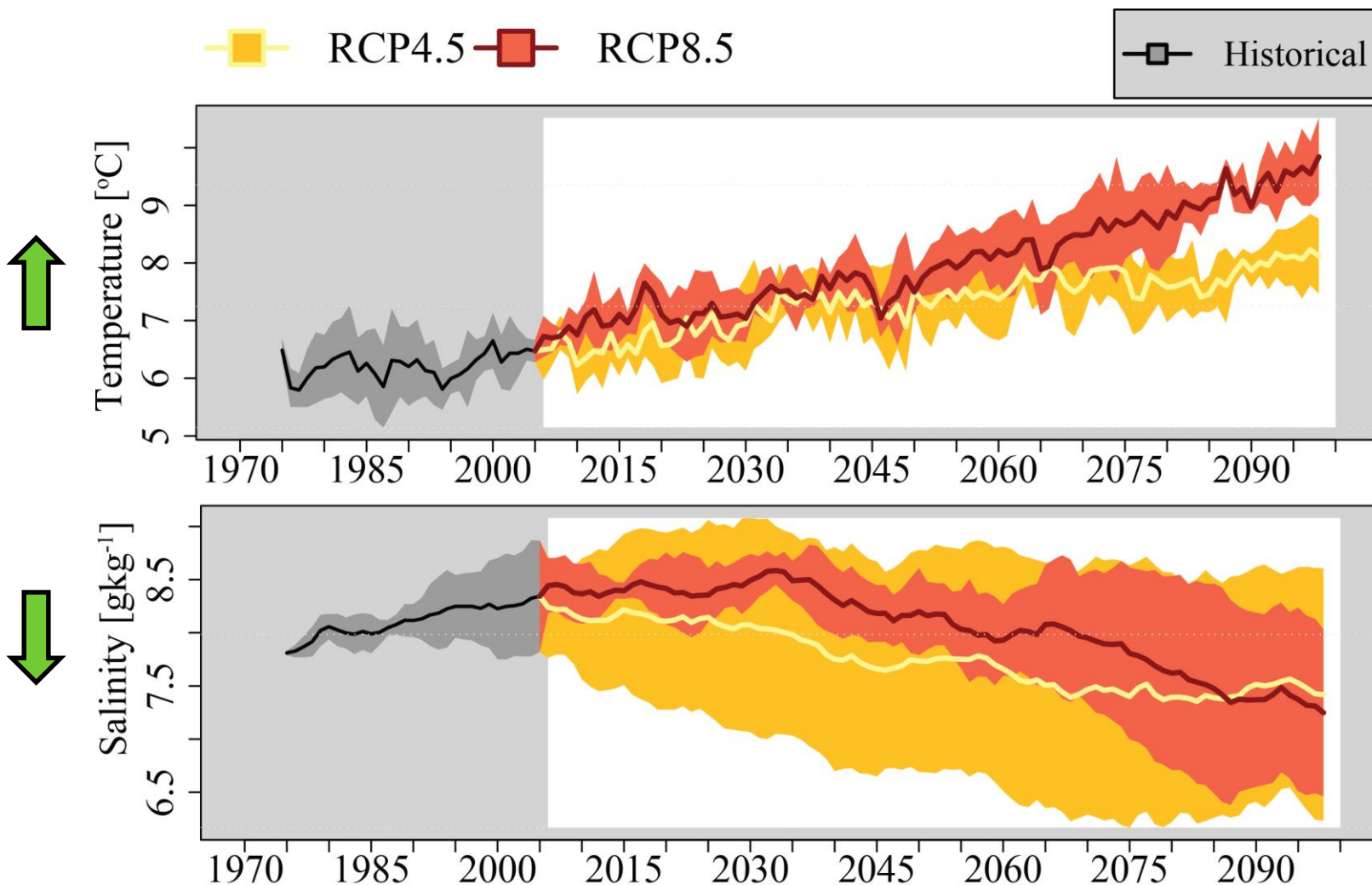


Source: Saraiva et al.,
2019 (SMHI)

- **Volume averaged** Baltic Sea temperature (in °C) as a function of time.
- Ensemble **mean** and ensemble spread (**standard deviation**, shaded area) among ensemble members.

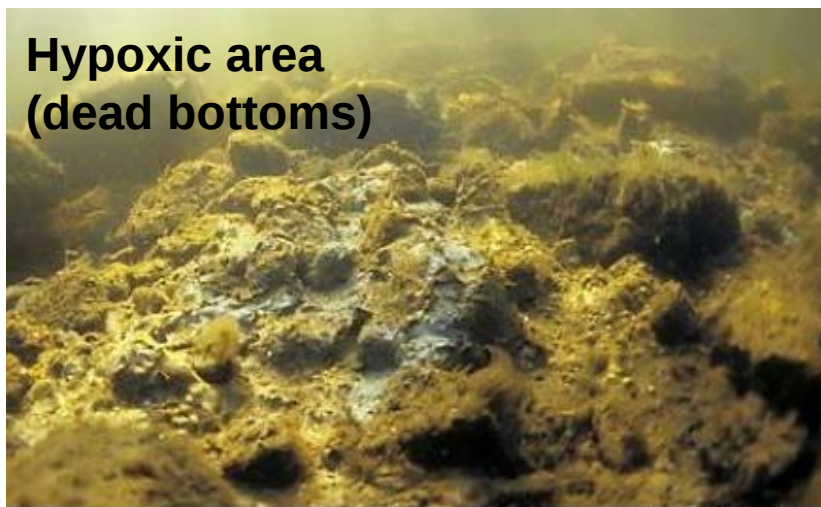
Projected physical conditions

SMHI

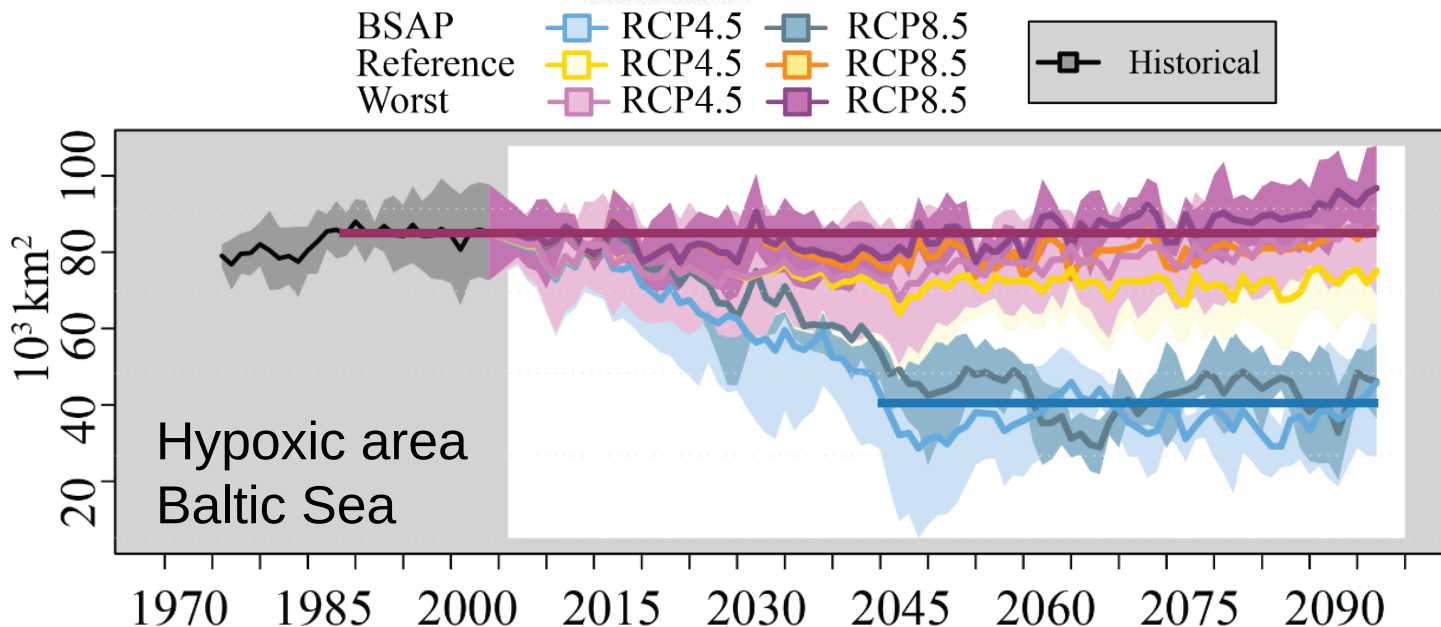
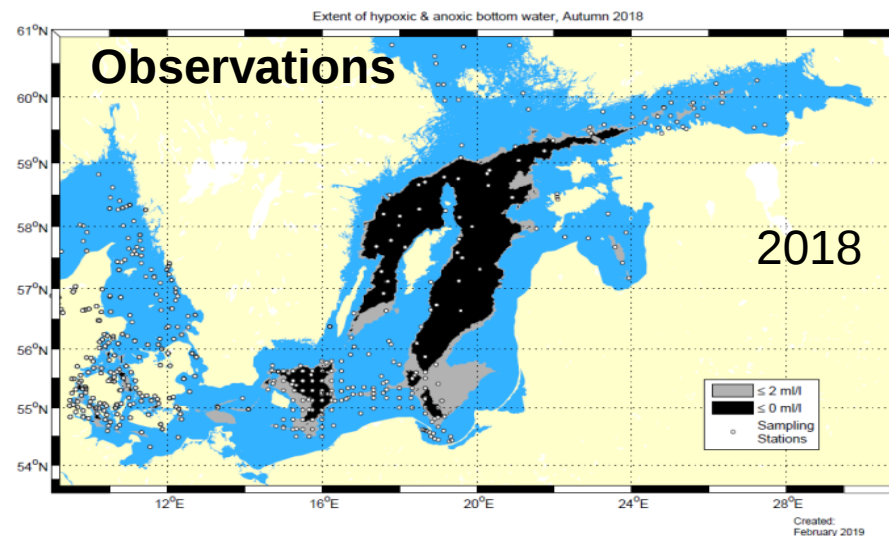


Source: Saraiva et al.,
submitted manuscript
(SMHI)

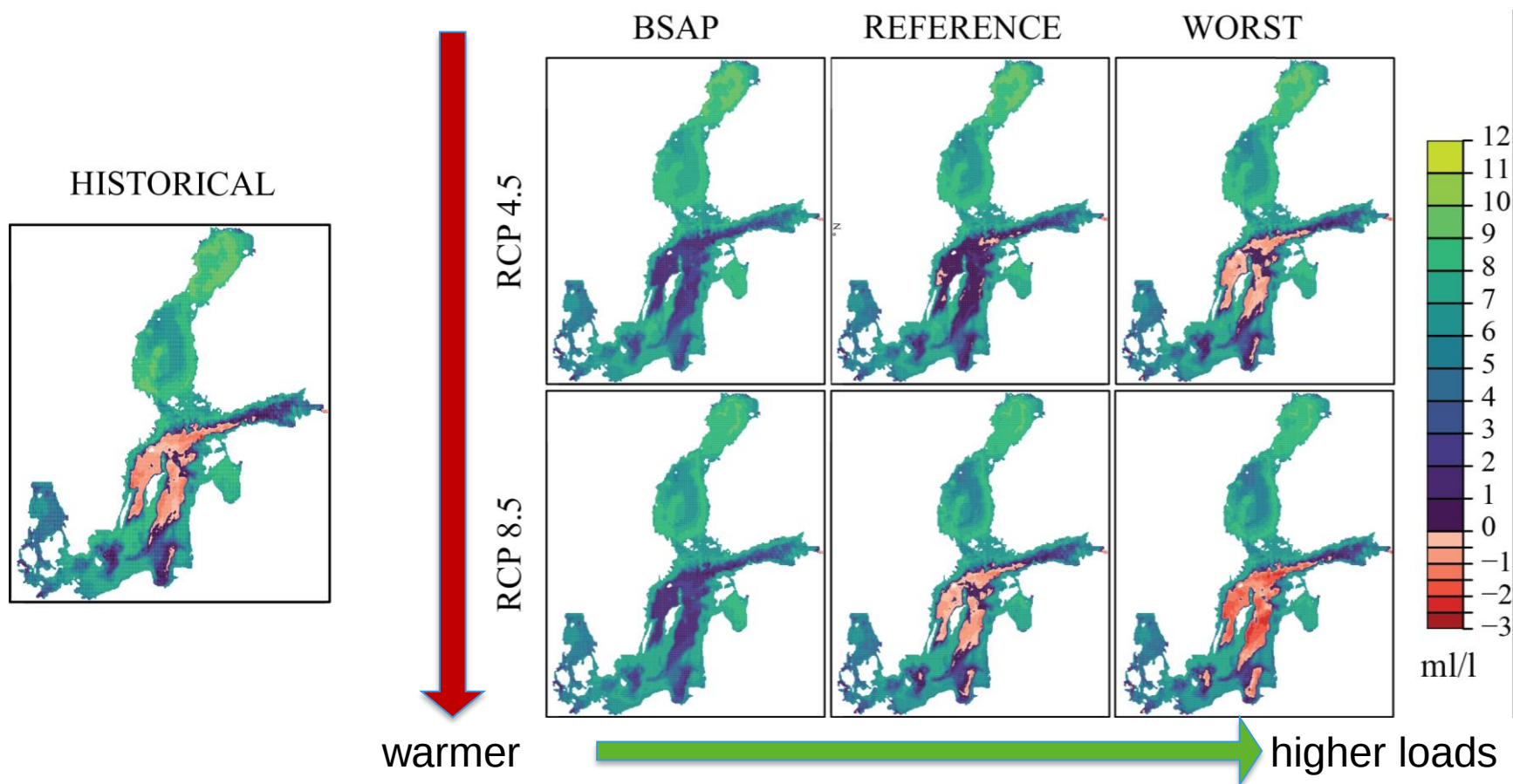
Bottom oxygen conditions – hypoxic area



J. Lokrantz/Azote



Source: Saraiva et al.,
2019 (SMHI)



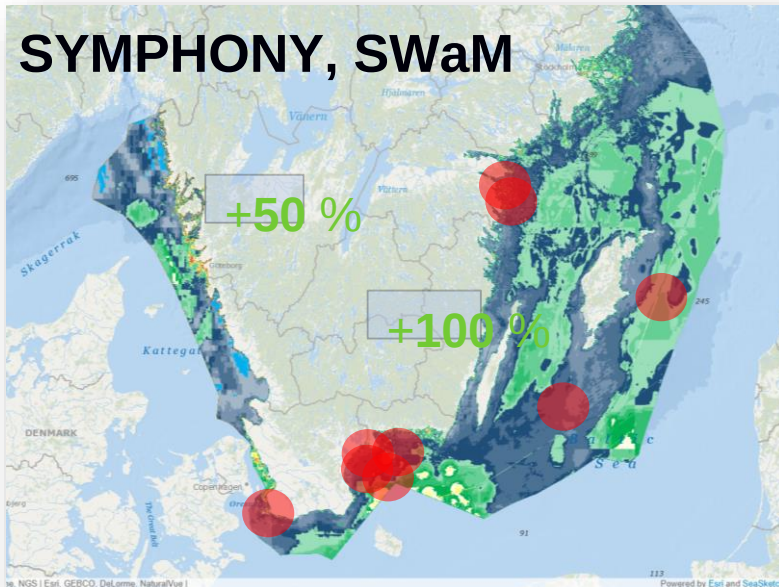
Historical (1976–2005) and projected future (2069–2098) ensemble mean summer bottom oxygen concentrations (in mL L⁻¹) in three nutrient load (BSAP, Reference and Worst Case) and two greenhouse gas concentration scenarios (RCP 4.5 and 8.5). Hydrogen sulfide concentrations are represented by negative oxygen concentrations (1 mL H₂S L⁻¹ = -2 mL O₂ L⁻¹).

- (1) External nutrient loads are the main driver of oxygen depletion.
- (2) Future climate change will amplify oxygen depletion. The impact of climate change is larger in case of higher nutrient loads.
- (3) Hence, the implementation of the BSAP is needed. The BSAP will lead to a significantly improved marine ecosystem.
- (4) The response of the Baltic Sea to nutrient load changes is slow.
- (5) There are substantial uncertainties in future projections for the Baltic Sea. In particular for salinity.



How to use these kind of results?

The model data are used as forcing/input to other models,



Kumulativ miljöpåverkan när tidigare modell över förändrad ytemperatur och havsförurening lagts till analysen

Röda cirklar anger områden som i preliminär analys visats kunna bli viktiga klimatrefugier för nyckelarter i Östersjön, baserat på tidigare modell över salthaltsförändringar



Management



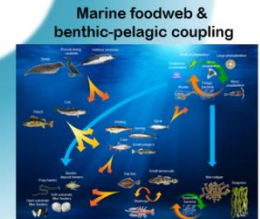
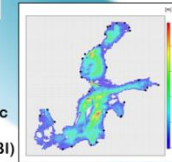
Socio-economics & fleet-based bio-economics

Baltic Atlantis model



Model domain

Physical hydrodynamic & bio-geochemical conditions (RCO-SCOB)



Marine foodweb & benthic-pelagic coupling

as boundary conditions in e.g. the project SmartSea. The scenarios is also used in projects such as ClimSea and CoClime.



Thank you for your attention!

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