Spatially resolved impact of temperature change on recruitment of sprat ~~and cod~~ in the Baltic Sea:

From observation to bio-economic modeling

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C | A | U Kiel University: Sustainable Fishery

future ocean
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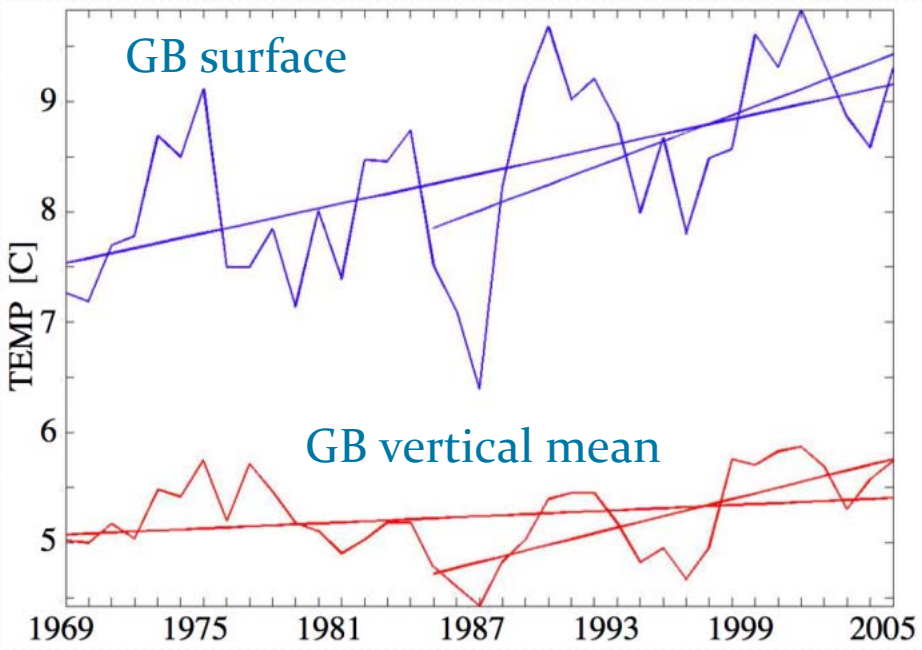
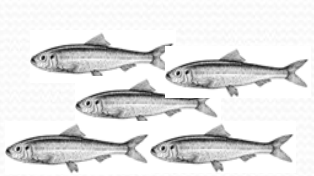
IFM-GEOMAR

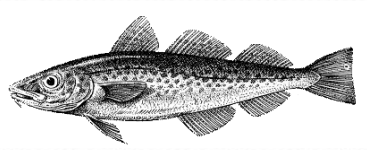
Motivation

- General global warming trend
- Since mid-80s accelerated to ca. 0.4°C / decade
- Also obvious in the Baltic



- Are there spatial / seasonal differences?
- How are fish early life stages affected?





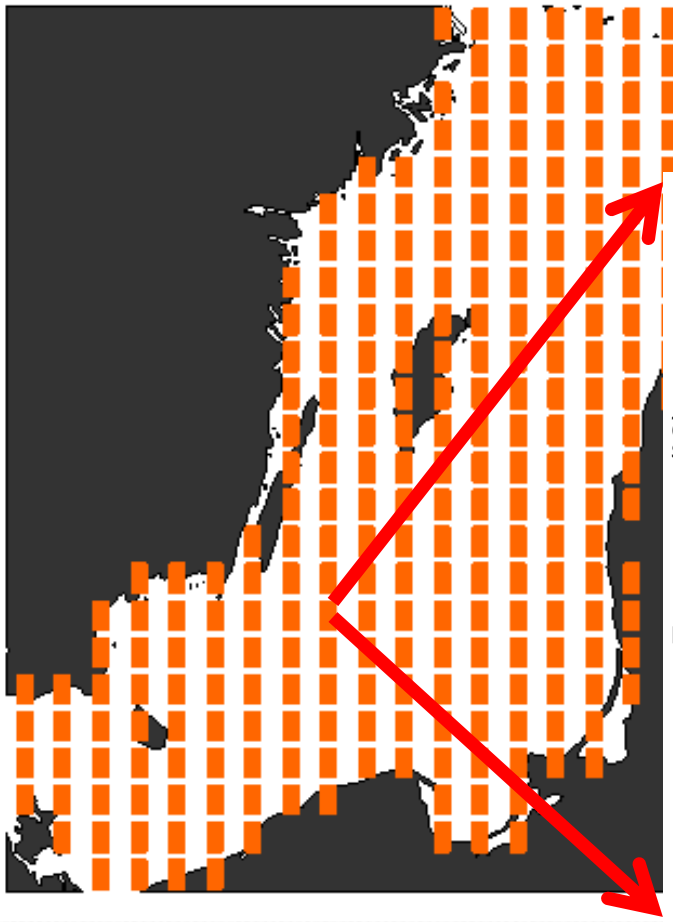
Methods

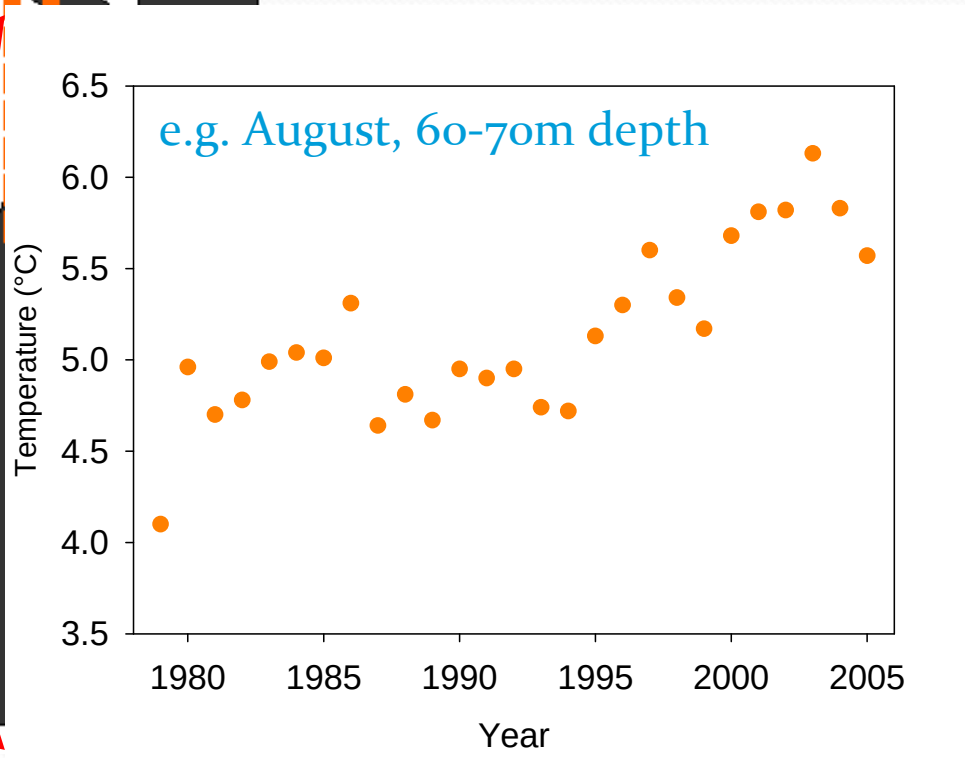
- 3-D hydrodynamic model
- Period 1979-2005
- Resolution 5x5 km, 42 vertical levels
- Forced by real wind field & river runoff
- Validated against field data

Data analysed

- ¼ ICES rectangle (15x15 nm)
- Monthly basis
- 10 m depth strata

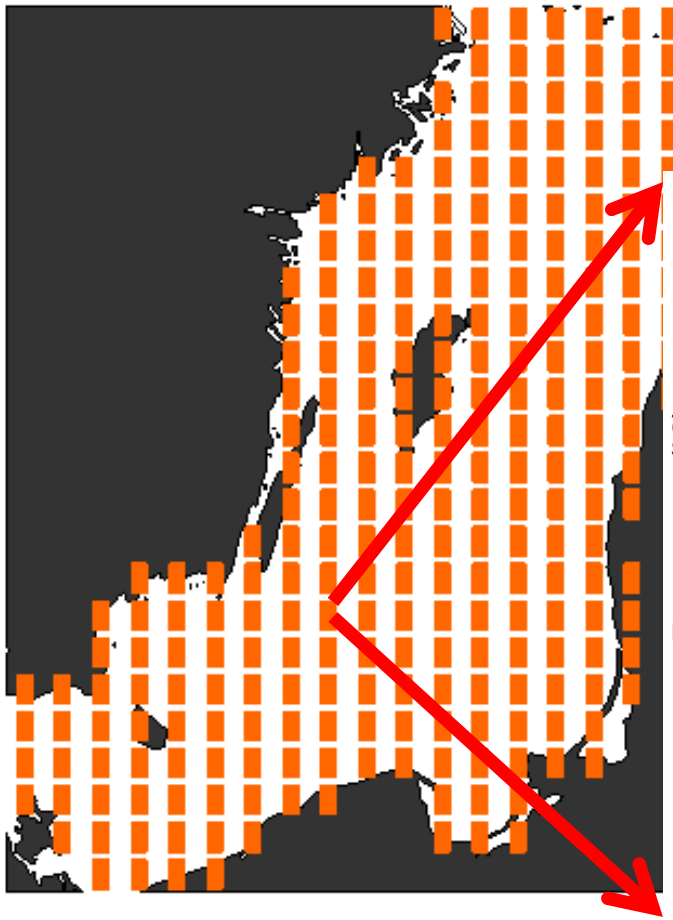
Methods

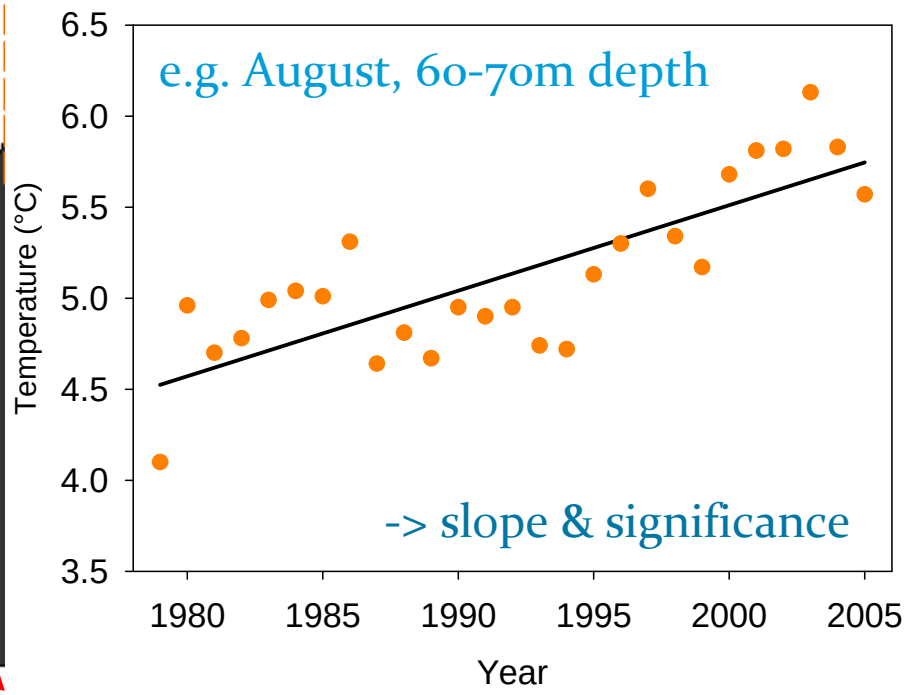




- For each cell/month/depth stratum: linear regression

Methods





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Fish early life stages: Baltic Sea is highly stratified

Sprat larvae

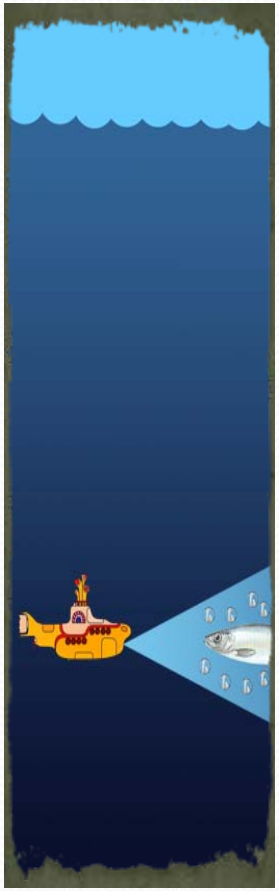
Cod larvae

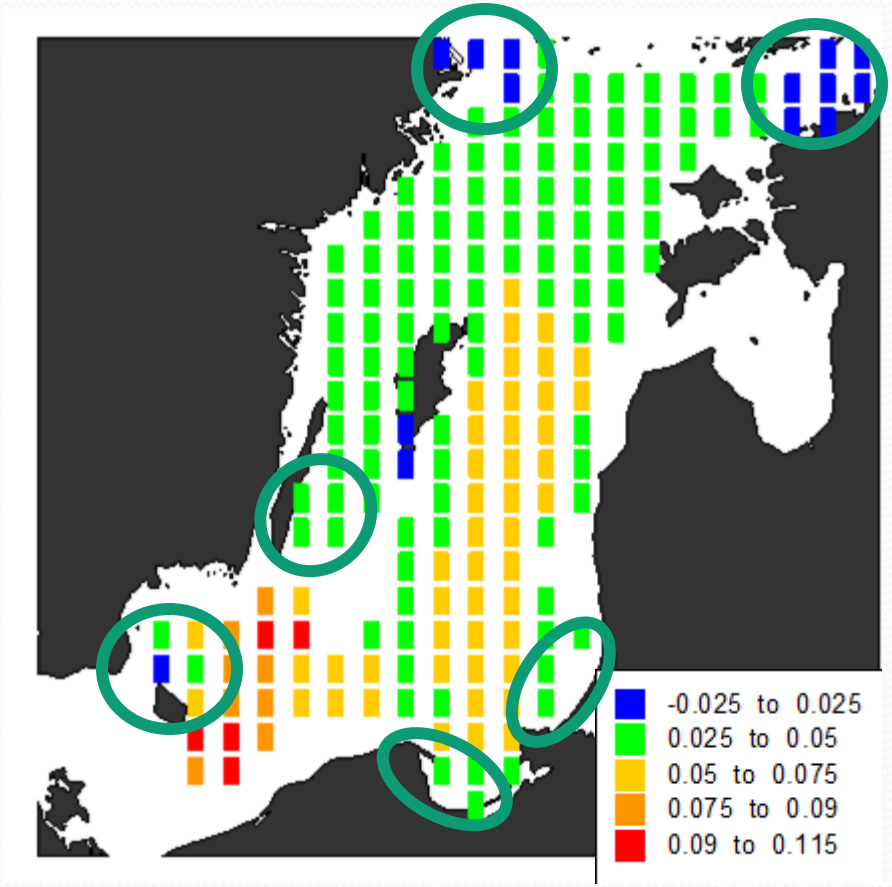
Sprat eggs

Cod eggs

- Concentration on depth strata and month, which are relevant for cod & sprat ELHS

Temperature trend 1979-2005
May, 50-60m





- North-south gradient
- Highest values in Bornholm Basin
- Up to >1°C/decade
- Some areas not sign.

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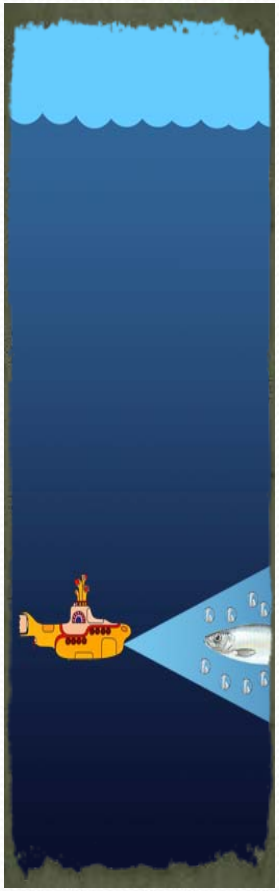

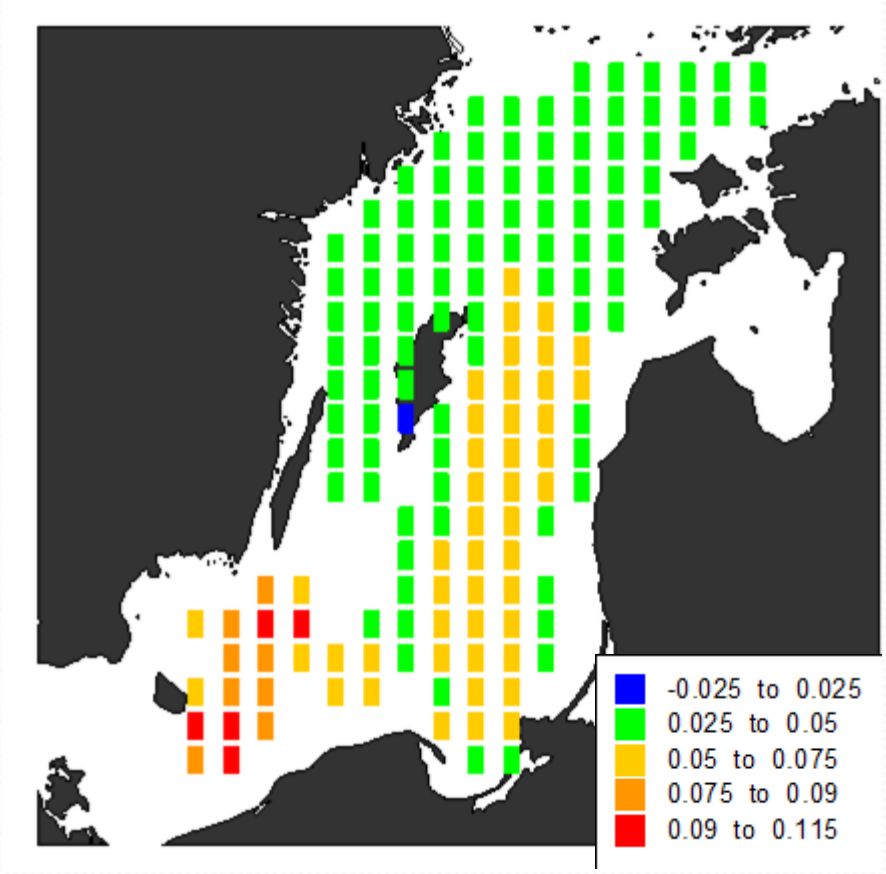

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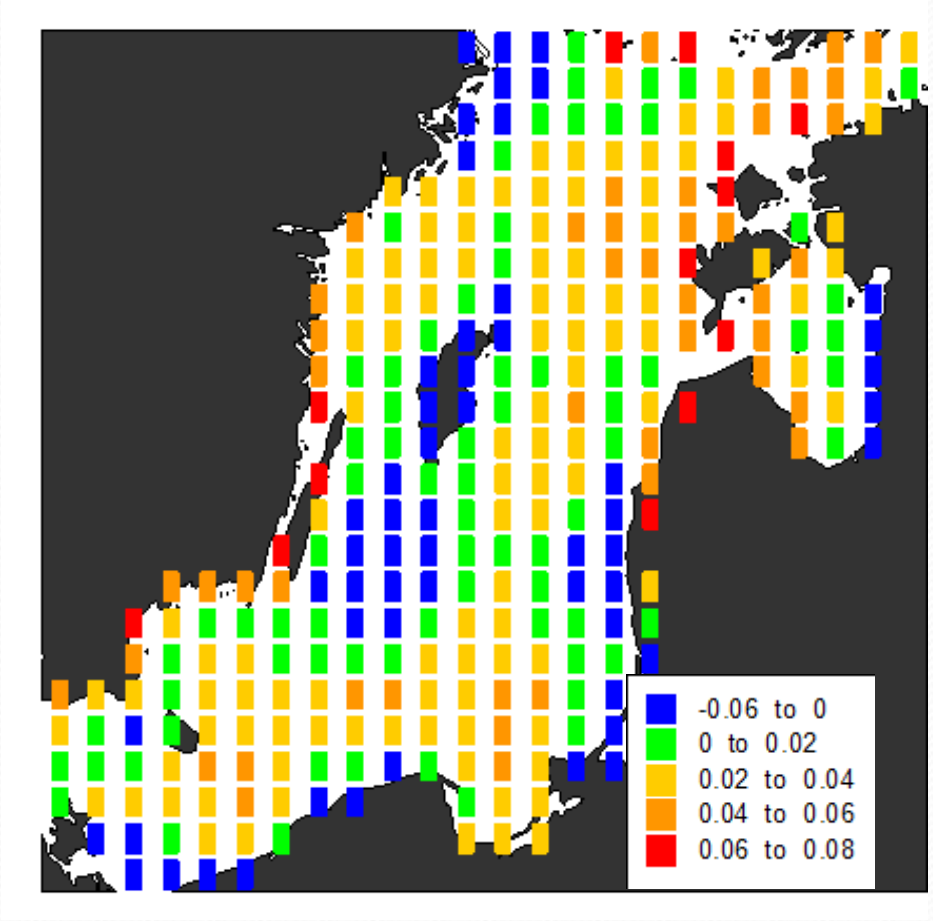
August, 0-10m



- Coast-basin gradient
- Moderate increase; 0.3°C/decade
- Important coastal areas with negative trend!
- Large areas (mainly coastal) not significant

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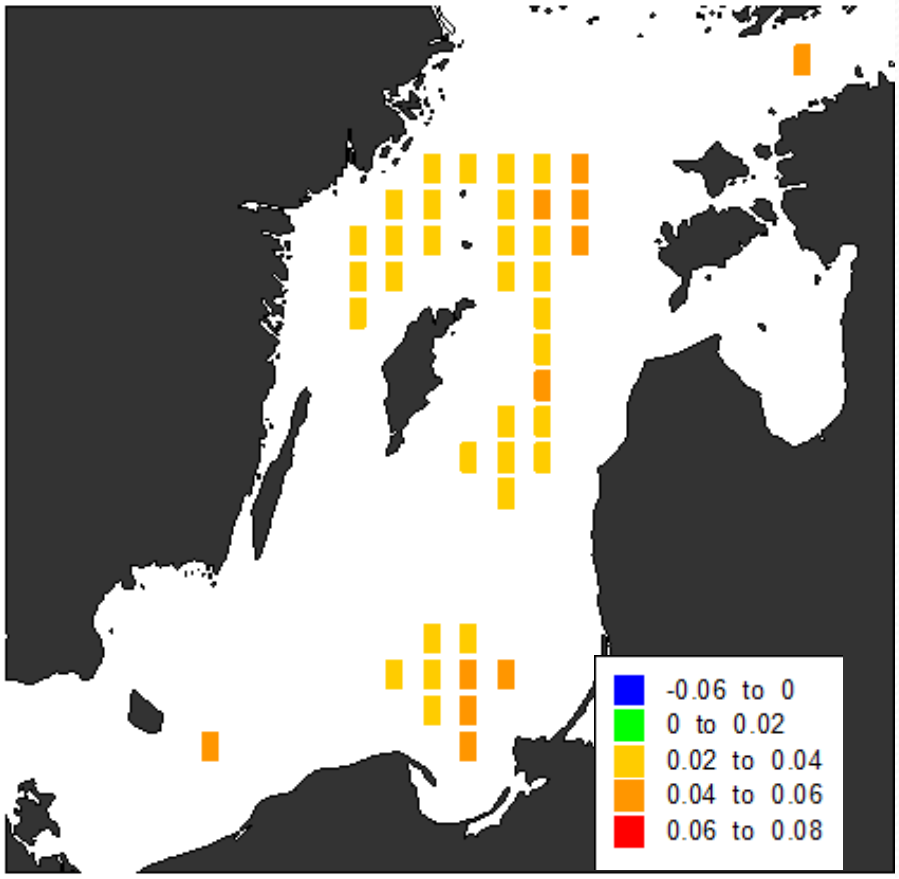

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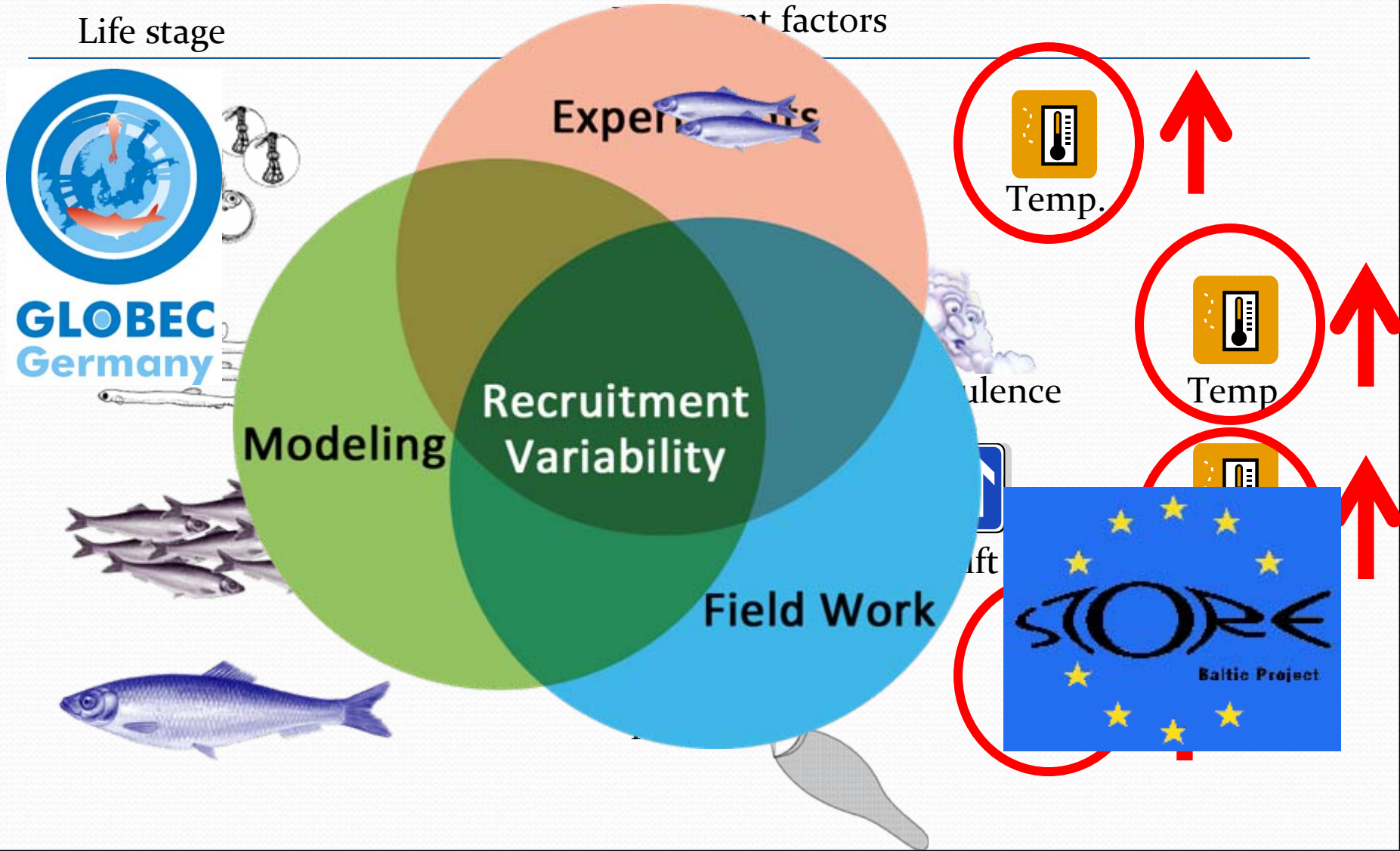
Sprat Recruitment variability



Economic implications

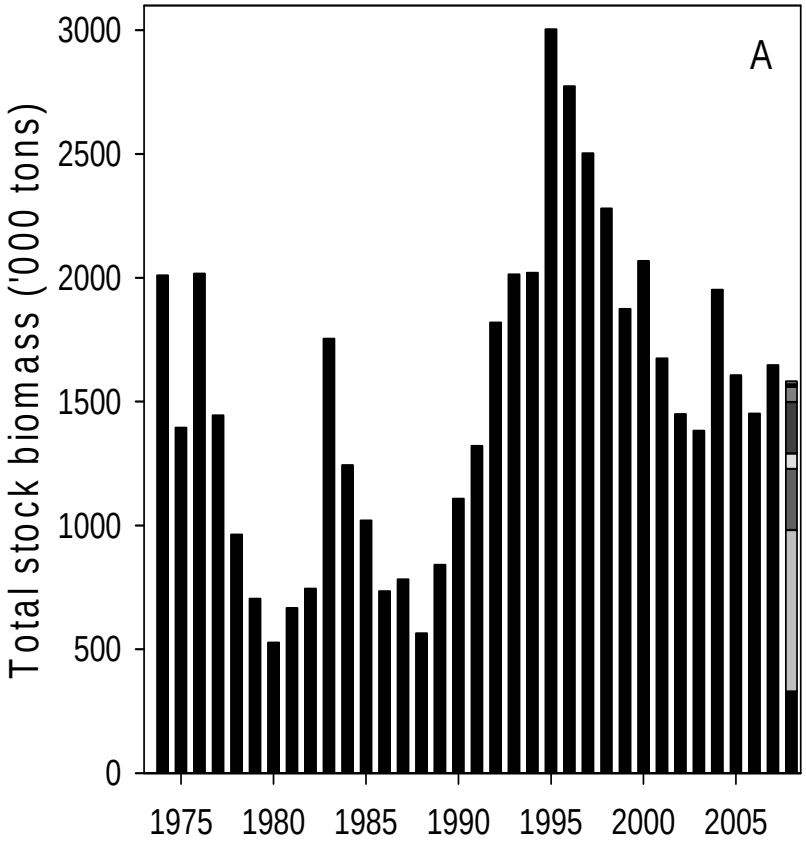
- Example: Sprat management
- Economic-ecological model
- Age-structured (8 age-classes)
- Harvest costs independant of stock size
- Constant price
- Maximise biomass yield (no discounting)

Impact of climate change & species interaction on optimal management?

- Temp.-dependant stock-recruitment functions
- Variable natural predation mortality (M2)

Economic implications

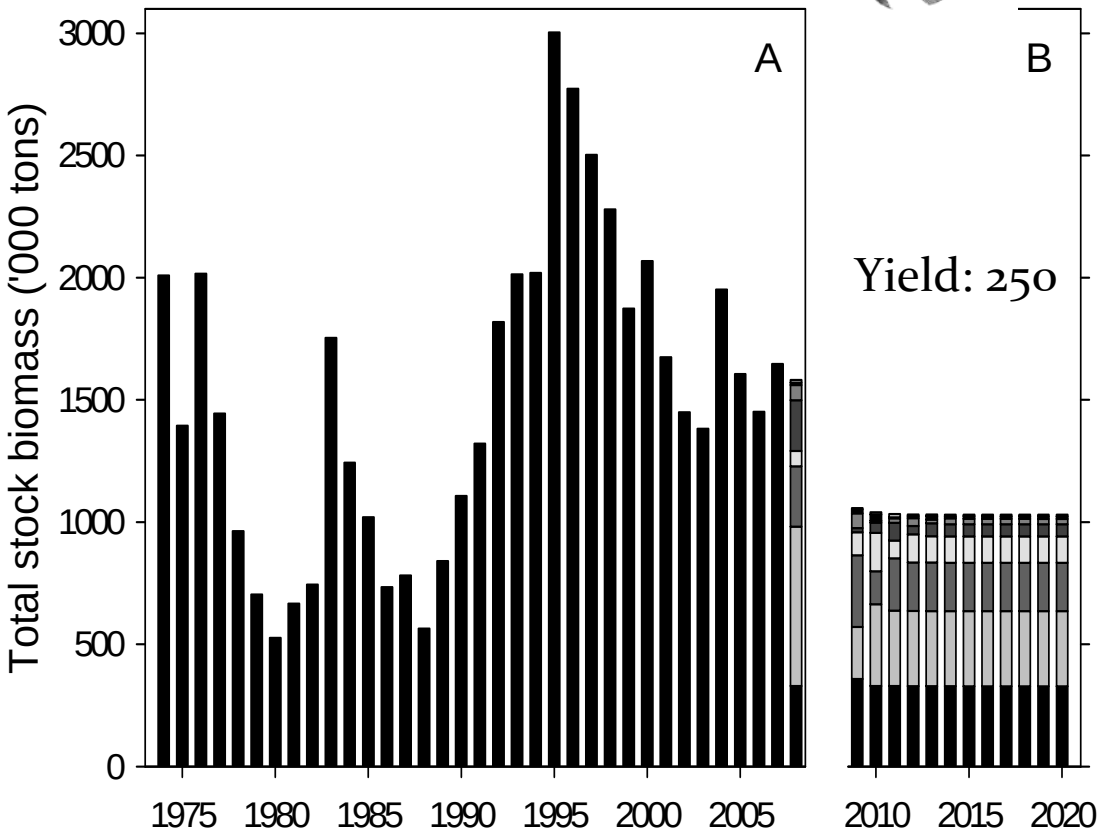
Climate change



Economic implications

Variable predation mortality

Reference



Conclusion

- Temperature trends are not spatially homogen
- Coastal, shallow areas are less predictable, with less temperature increase
- Temperature increase will favour sprat recruitment
- Species-interaction as well as temperature change will strongly influence optimal fisheries management