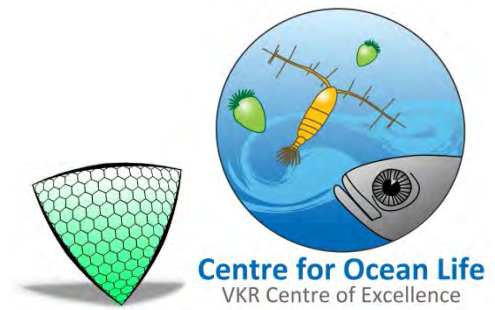




Technical University of Denmark



THE PREDICTIVE POTENTIAL OF SPECIES DISTRIBUTION MODELS FOR PLANKTON

Philipp Brun (pgrbr@aqua.dtu.dk)

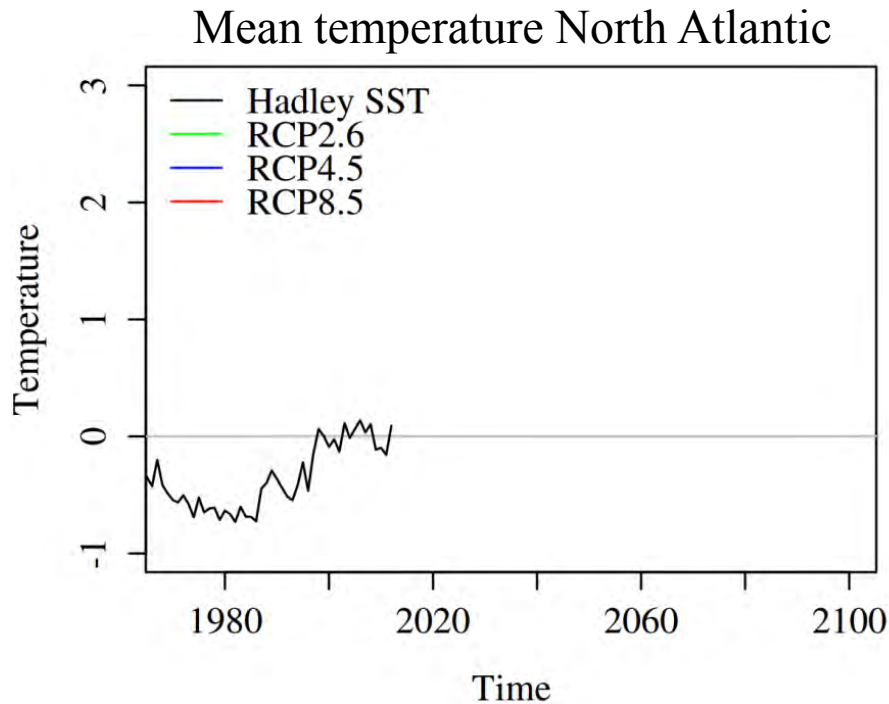
Thomas Kiørboe

Priscilla Licandro

Mark Payne (mpay@aqua.dtu.dk)

Santos, 26th of March 2015

Climate change and future predictions



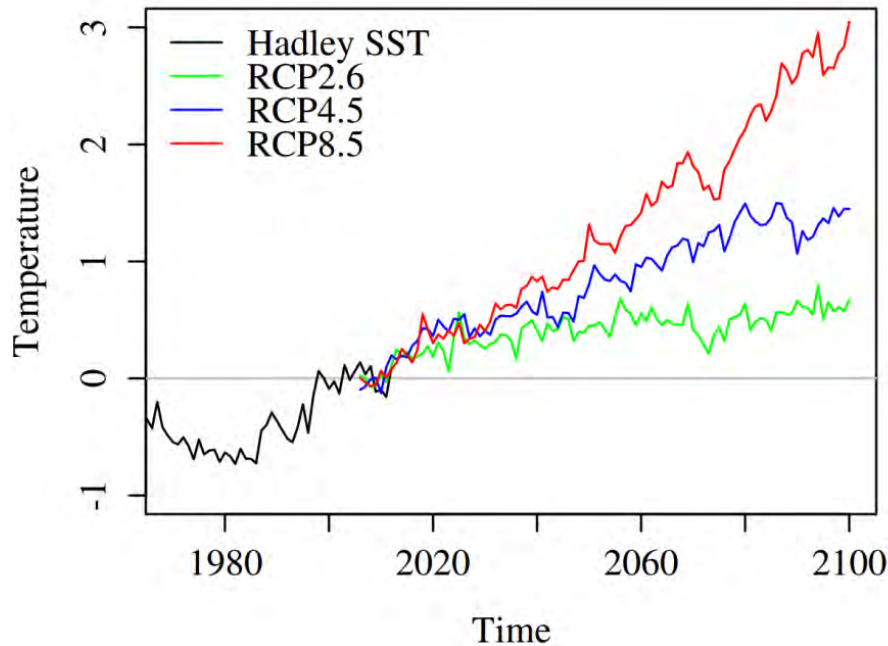
Leading edge range expansions:

- Phytoplankton: 470 km dec⁻¹
- Zooplankton: 142 km dec⁻¹
- Bony fish: 278 km dec⁻¹

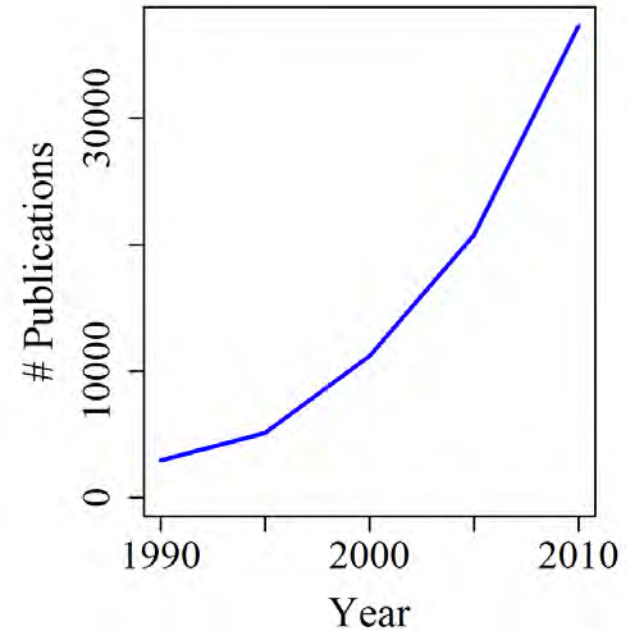


Climate change and future predictions

Mean temperature North Atlantic



Studies on climate change impact



Brander et al. 2013

Leading edge range expansions:

- Phytoplankton: 470 km dec⁻¹
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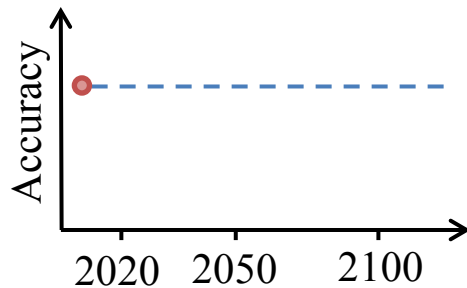
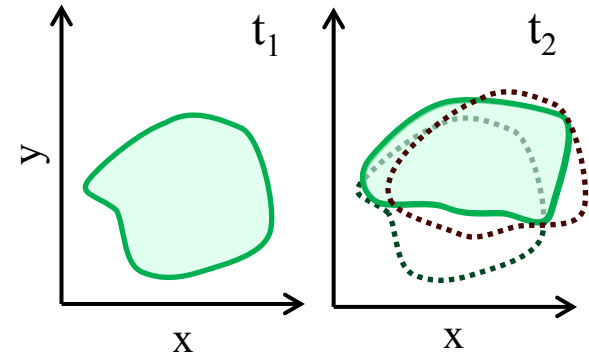
- Predictions are inherently risky
- May gain large public attention
- **Need to be carefully validated!**



Aim

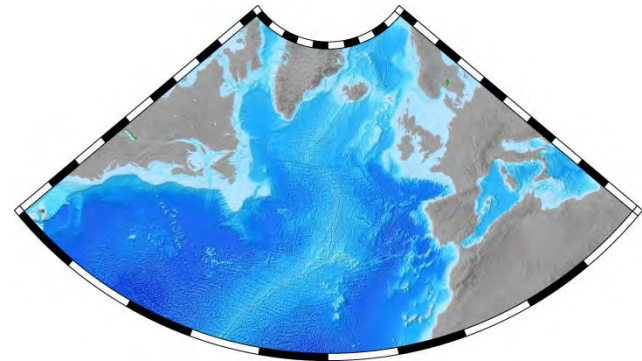
Real-world test of species distribution model (SDM) predictions for plankton in the North Atlantic

1 Are SDM predictions about changes in biogeography useful?

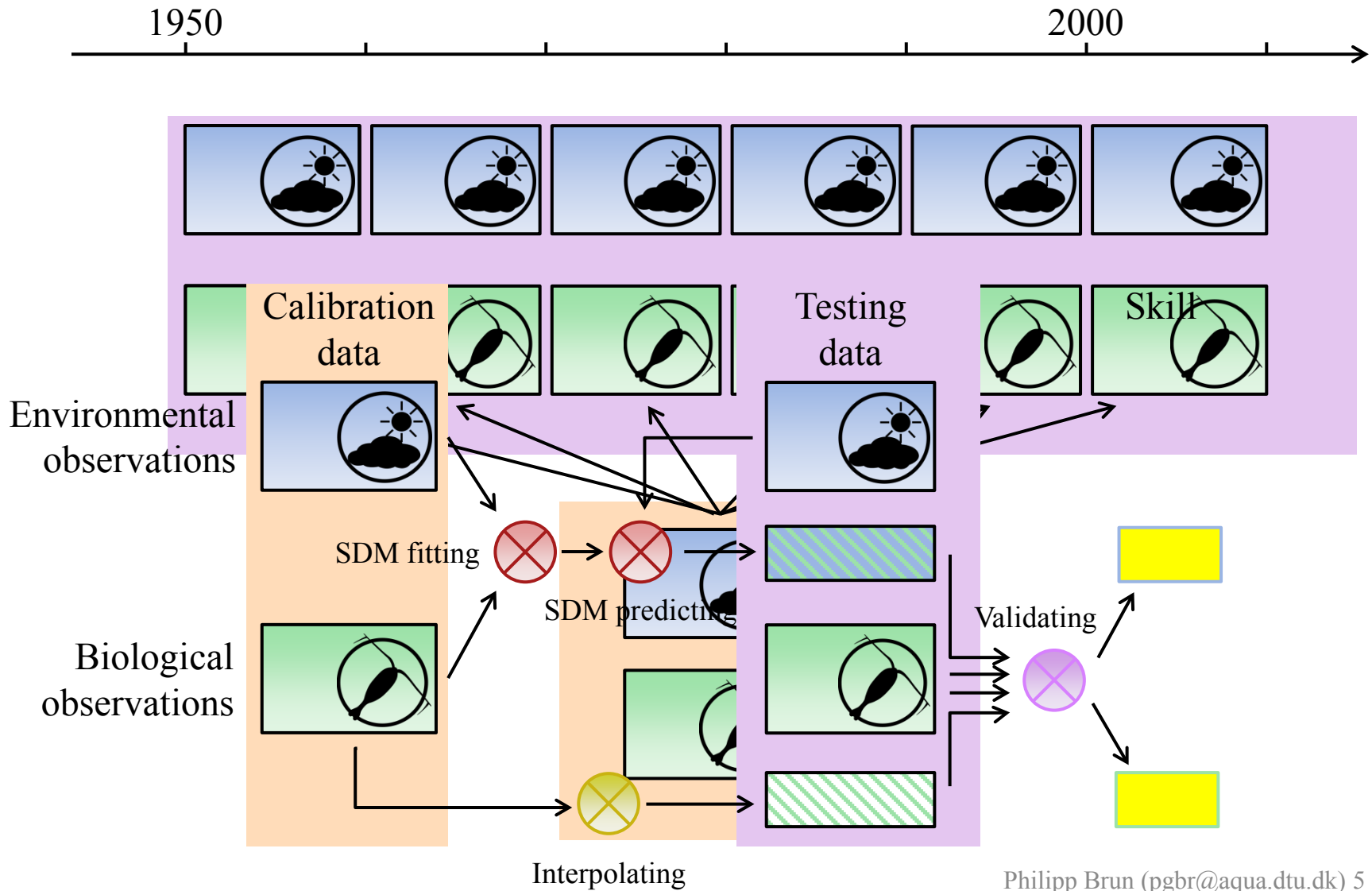


2 Does model performance stay constant when models are projected into more distant times?

3 Is model performance spatially homogenous?



Concept

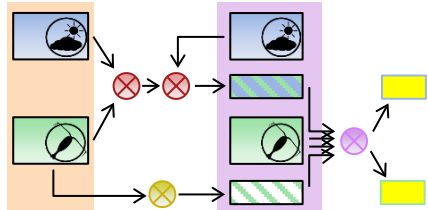
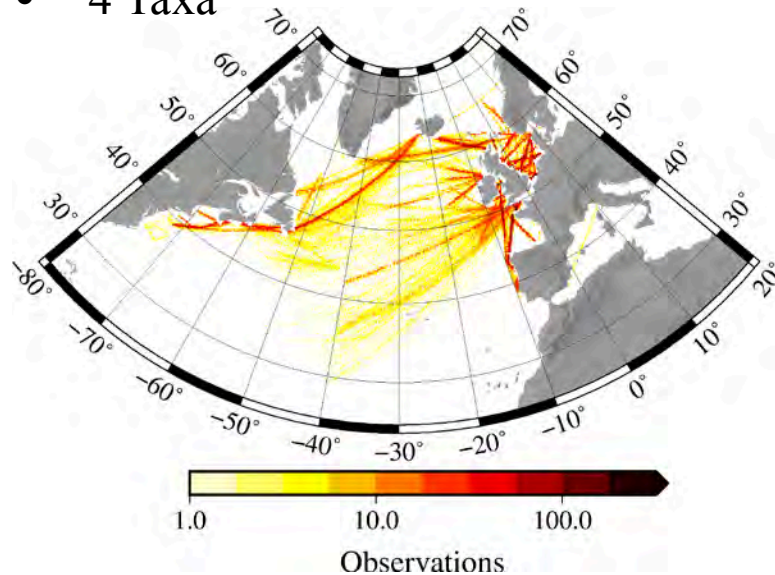


Data

Biological



- Continuous Plankton Recorder
- > 200 000 observations
- 1958-2012
- 4 Taxa



Taxonomic Group

Observed prevalence

Calanus finmarchicus

Copepods

37 %



Pseudocalanus spp.

Copepods

12 %



Ceratium tripos

Dinoflagellates

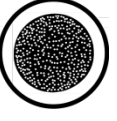
16 %



Coscinodiscus wailesii

Diatoms

1 %



Environmental



- Temperature
- Salinity
- Depth
- Day length
- Daytime



Methods



SDMs

- MaxEnt (presence-only)
- Generalized additive models (GAM) (presence/absence)
- Random forest (presence/absence)



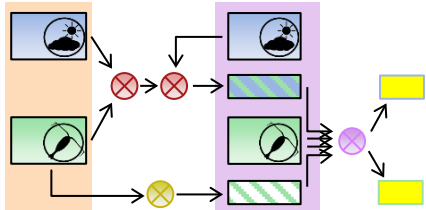
Spatial interpolations

- Inverse distance



Model-validation metrics

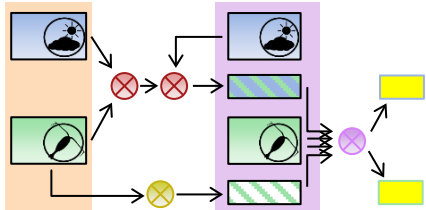
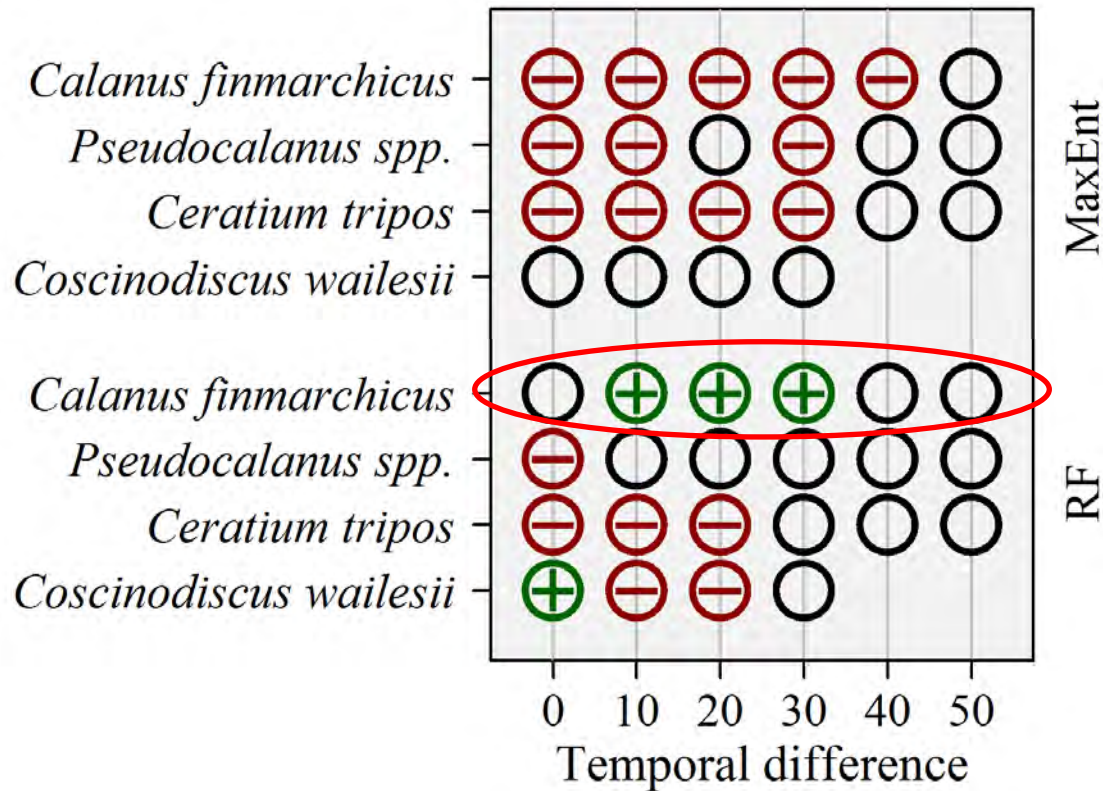
- Precision of presence predictions (PPV)
- Overall performance (TSS)
- Prevalence error



Comparative performance

SDM predictions versus assuming constant distribution

Two-sided, paired t -tests ($p \leq 0.05$) of overall performance (TSS)



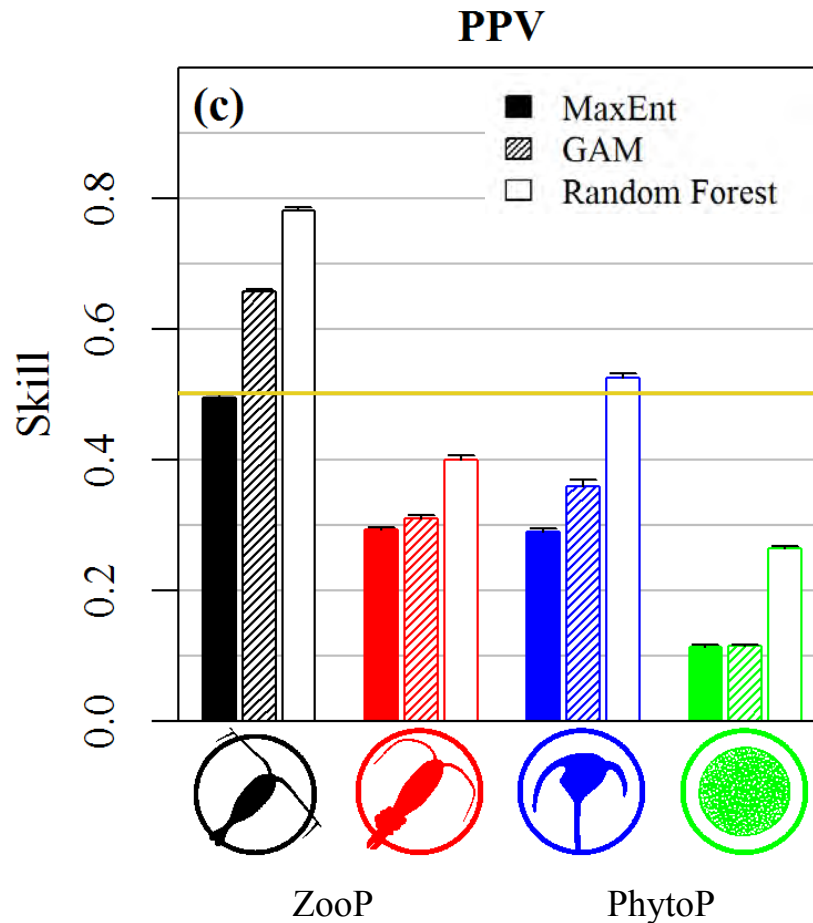
- **Most SDM-predictions perform equally or worse than «no-change» scenarios**



Potential precision

for SDMs with full training data 1958-2012

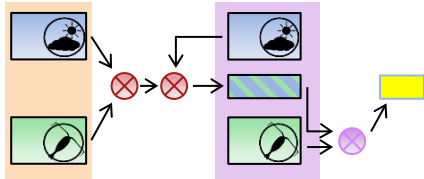
PPV: Probability of correctly predicting presences



➤ Relatively low precision of presence predictions



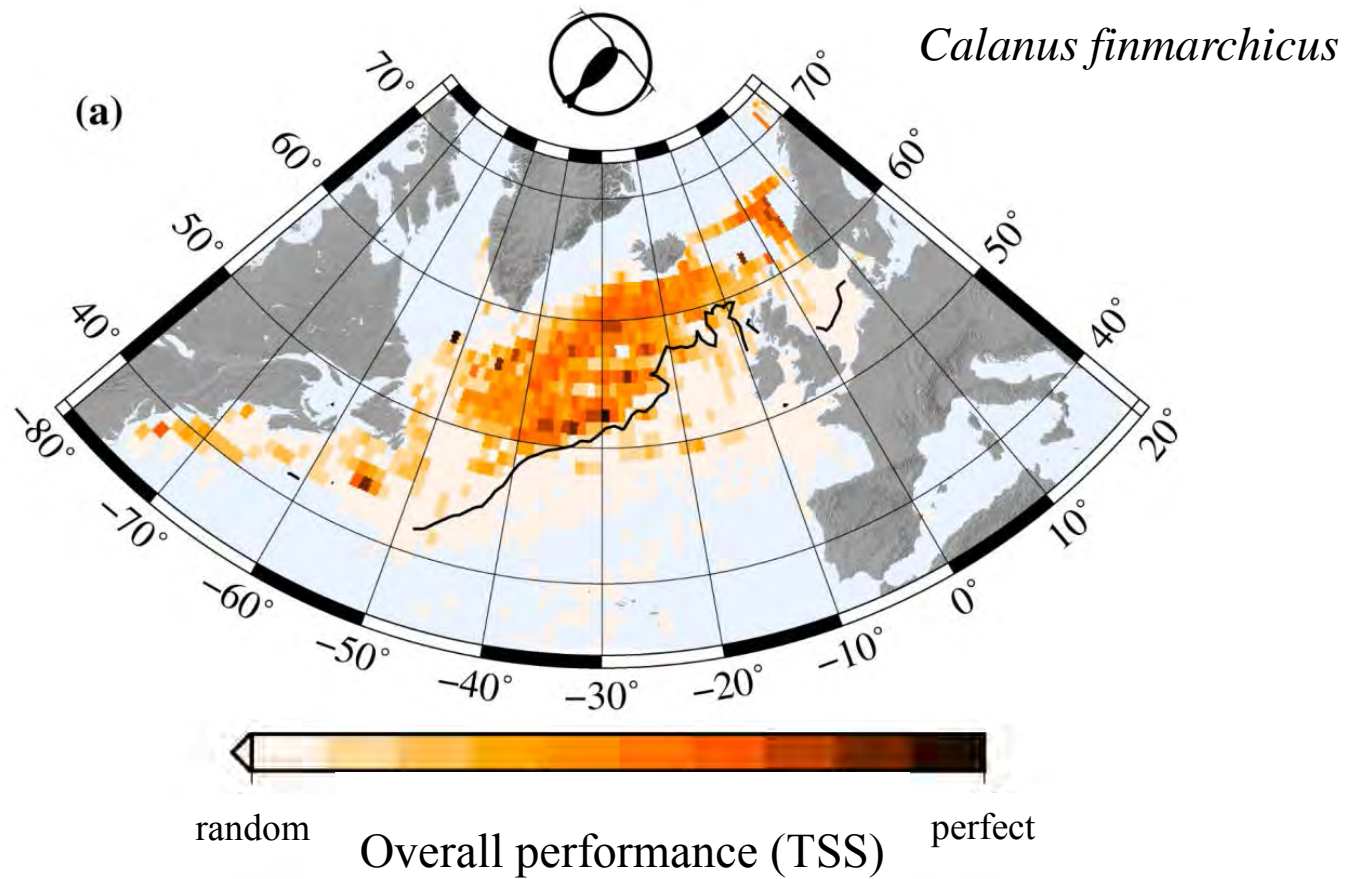
Temporal extrapolations



- **Prevalence error increases for extrapolations with more temporal distance**



Spatial variations



➤ **Strong spatial variations in model performance**



Reasons for low performance

Methodological

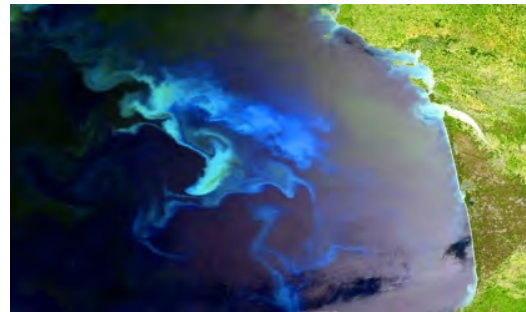
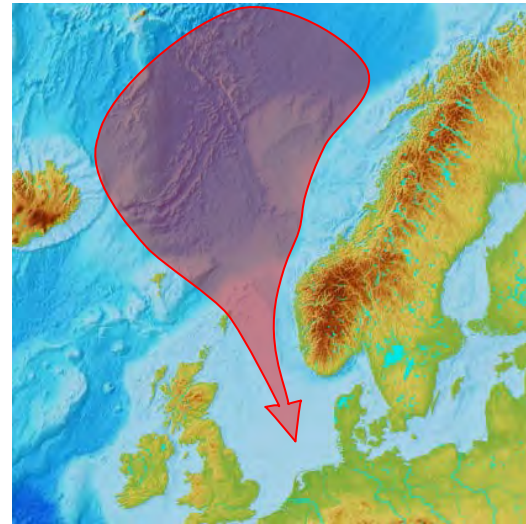
- Single overall performance metrics promote optimistic conclusions

Ecological

- Short generation times
- Neglect of biotic interactions
- *Calanus finmarchicus* depends on spring population

Physical

- Lateral dispersal



Summary

1. Most SDM-predictions perform equally or worse than «no-change» scenarios
2. The difference between predicted and observed prevalence increased for predictions with more temporal distance from their training dataset
3. Distinct spatial patterns in model performance

- **Model validation against independent data sets is essential to assess future predictions of change...**
- **...but also a complex, multidimensional problem that needs to be approached from several angles**

