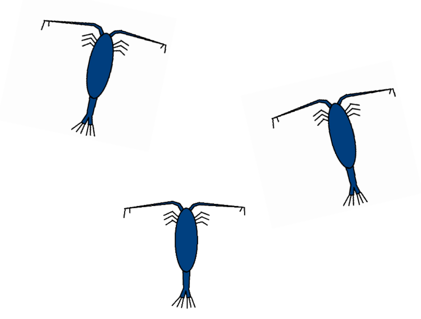
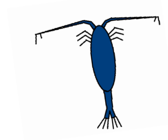
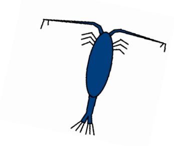
# Modeling the fate of *Calanus glacialis* and *C. finmarchicus* in the Barents Sea in a rising temperature scenario





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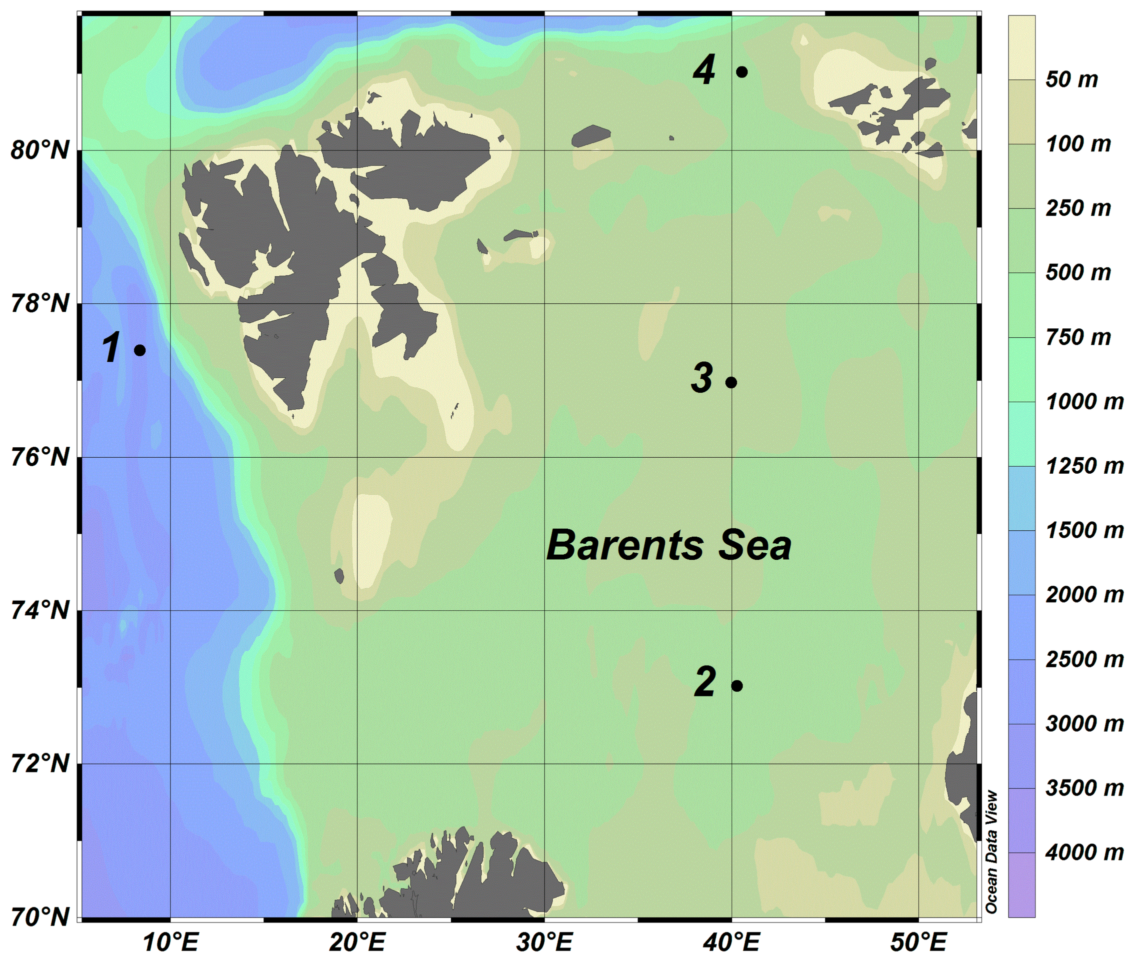
## / BACKGROUND

The calanoid copepods *Calanus glacialis* and *C. finmarchicus* represent important links between primary producers and higher-trophic level organisms in the shallow Arctic shelf seas and the north Atlantic, respectively.
As key species of their respective food webs, it is of high importance to understand and predict how increasing sea water temperatures affect their population dynamics and respective distributions.
Recently published experimental results of temperature responses of feeding and respiration suggest unimodal responses for both *Calanus* sp. (1, 2, 3), rather then an exponential increase with temperature. We therefore incorporated these results into the well-established population models of the coupled physical-biological SINMOD model.



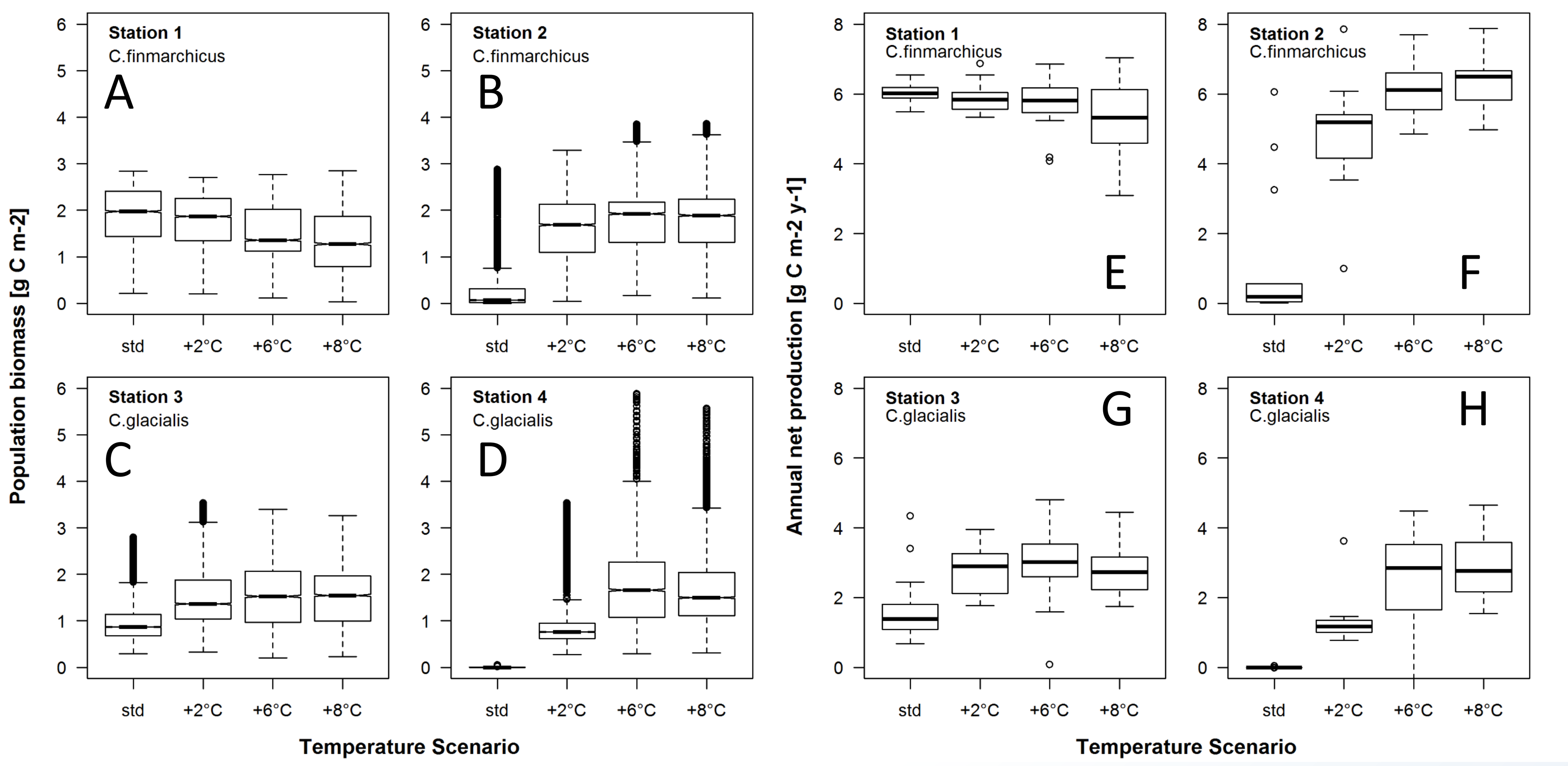

**Locations of the 1D simulations**

(**1**) Station 1 – West Spitsbergen, *C. finmarchicus*
(**2**) Station 2 – Southern Barents Sea, *C. finmarchicus*
(**3**) Station 3 – Northern Barents Sea, *C. glacialis*
(**4**) Station 4 – North-East Spitsbergen, *C. glacialis*

## / METHODS

The SINMOD model is a coupled physical-biological numerical ocean circulation model (4) of the Arctic Ocean with 20km grid cell distance. The biological part of the model was run in 1D at four different stations (see map) with physical forcing data from the 3D model (5), which was forced with atmospheric data from the European Centre for Medium-Range Weather Forecasts (ECMWF).
We compared four different temperature scenarios. A standard scenario (no temperature increase), a +2 °C scenario (2 °C increase in air temperature at the North Pole), a +6 °C scenario, and +8 °C scenario, each run from 1995-2007.

## / RESULTS




For *C. finmarchicus* (station 1 and 2) the effect of increasing temperature depended on the station. While at station 1 (Atlantic water masses) an increase in temperature would lead to a decrease in biomass (Fig. A, I) and net production (Fig. E, I), at station 2 increasing temperatures lead to a pronounced increase in biomass (Fig. B, J) and net production (Fig F, J).

For *C. glacialis* (station 3 and 4) increasing temperatures generally lead to increasing population biomasses (Fig. C, D, K) and net production (Fig. G, H, K) with most pronounced changes at station 4 (Fig D, H, L).

For both species, changes are generally most pronounced at the highest temperature scenario (+8 °C) but already the lowest temperature scenario (+2 °C) results in substantial changes in biomass and net production at the more intermediate stations 2 and 3.

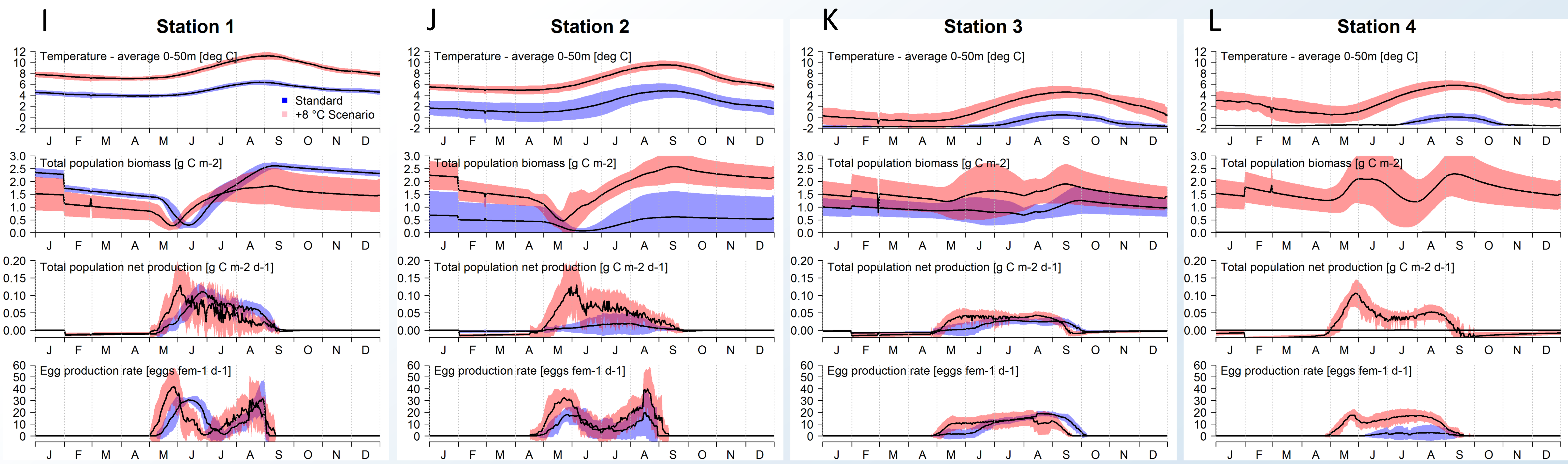



Fig. I-J. Annual mean temperature (average 0-50m depth), population biomass (g C m-2), population net production (g C m-2 d-1), egg production rate (eggs fem-1 d-1) at four different stations and for two different copepods (*C. fin* station 1 and 2, *C. gla* station 3 and 4).

## / DISCUSSION

The modeling results of the present study indicate that the two *Calanus* sp. modeled, *C. glacialis* and *C. finmarchicus* respond differently to increasing sea water temperatures, depending on the location. While *C. finmarchicus* might experience a decrease in biomass and net production in its current area of distribution (station 1), its population is likely to increase in areas with currently low biomass and net production (station 2).
*C. glacialis* on the other hand is likely to increase at its northern range of distribution (station 4), as well as in its current area of distribution (station 3). However, the current modeling approach does not include its southernmost range of distribution and how increasing temperatures may affect *C. glacialis* there.


References:
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