Will ocean warming save the day and protect Arctic copepods from heatwaves ?

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I. Context

- Metabolic rate is the most fundamental rate of life; it is influenced by mass and temperature[1,2]
- Temperature determines invertebrates' geographical distribution; as a result of both climate and species' physiological limits, which are shaped in part by evolutionary mechanisms[3,4]
- As the planetary climate changes, temperatures in the Arctic Ocean are rising at speeds amongst the fastest on Earth. Concomittantly, weather variability is also increasing, with more frequent and intense extreme events such as heatwaves (HW)[5] (Figure 1)
- Changes in temperature regimes in the Arctic Ocean might affect *Calanus glacialis*, a keystone large copepod species of the continental shelf ecosystem[6], unless a longterm acclimation to heat by ocean warming (OW) provides protection when facing marine HW

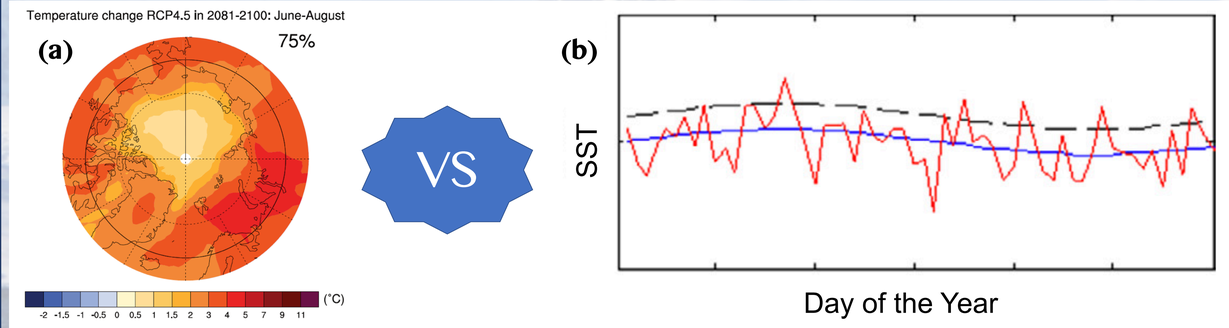


Figure 1. Climate Change will induce an increase in both mean temperature and weather variability, (a) shows the predicted longterm increase in mean temperature in the summer around the Arctic as opposed to (b), where weather variability as defined by the frequency and the intensity of extreme temperatures.

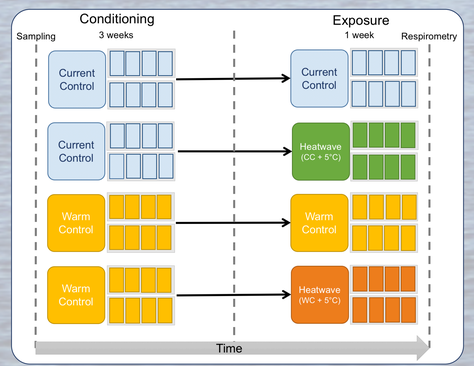
II. Aim

To determine the metabolic response of *Calanus glacialis* to the cumulative effect of ocean warming and marine heatwaves

- Marine HW occur when temperatures reach the 90th percentile for at least 5 d[7]
- Integrative approach: metabolic rate AND metabolomics
- Individual approach: inter-individual variability ?

OW 2100: +3 °C

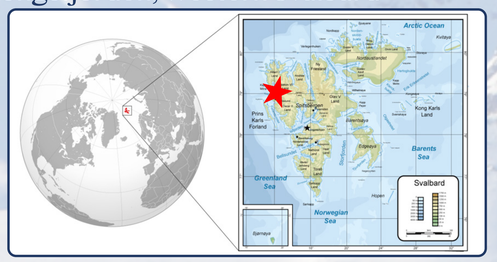
HW: +5 °C



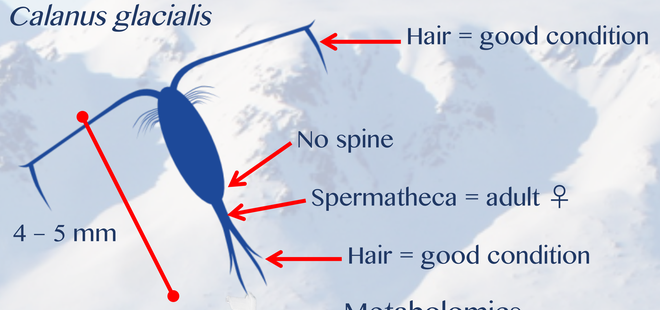
III. Methods

Sampling in Kongsfjorden, Svalbard → Handling and Sorting → Experiment → Metabolic Rate (Respirometry) → Metabolomics

Kongsfjorden, Western Svalbard



Calanus glacialis



Respirometry

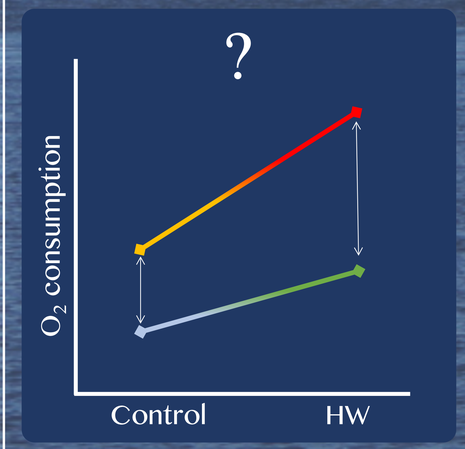
- Non-invasive optode

- Flash frozen in liquid N

Metabolomics

- LC MS

IV. Next Steps...



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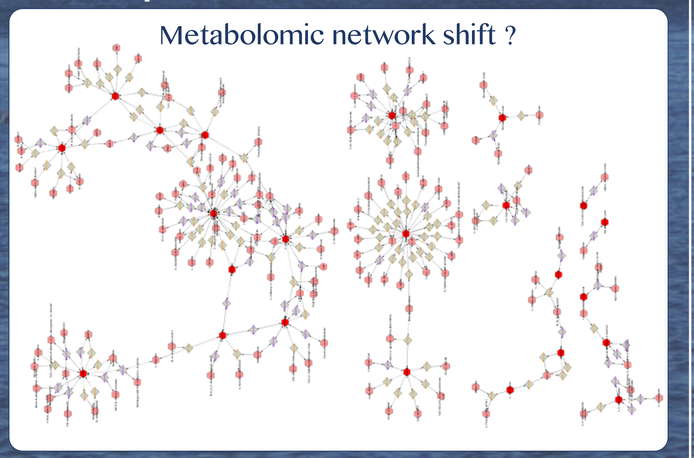
Metabolomic network shift ?



Cellular damage caused by high temperatures *may* decrease the amount of energy allocated towards survival, growth, and reproduction, i.e. **overall performance**.

Deleterious effects of high temperature *may* force *C. glacialis* to avoid the newly inauspicious environment; **their response will likely affect the whole ecosystem**.

Cited references : (1) Brown et *al.* 2004, *Ecology* **85** (7): 1771-1789 ; (2) Gillooly et *al.* 2001, *Science* **293**: 2048-2051 ; (3) Bozinovic et *al.* 2011, *Annu Rev Ecol Evol Syst* **42**: 155-179 ; (4) Clarke 2004, *Funct Ecol* **18**: 252-256 (5) IPCC 2014 ; (6) Slagstad & Tande 1990, *Mar Ecol Prog Ser* **63**: 189-199 ; (7) Hobday et al. 2016, *Prog Oceanogr* **141**: 227-238.