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Projecting the potential phenological responses of North Sea small copepods to climate warming with a modelling approach

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Energy transfer from the first trophical level (phytoplankton) to second trophical level (zooplankton) relies on temporal match between the seasonal cycle (phenology) of phytoplankton and zooplankton. The phenology of zooplankton and phytoplankton are sensitive to climate change. Concerns are thus raised that future climate warming may disturb the the phenology of phytoplankton and zooplankton, and cause a mismatch between them. When the mismatch happens, zooplankton abundance will decrease and the energy transfer from the first trophical level to higher trophical level will be blocked.

Here, I study the impacts of climate warming on phytoplankton and zooplankton with a focuse on phenological changes with a modelling approach. I choose Acartia clausi, a key zooplankton species in the North Sea as a representative for zooplankton and develop a life cycle model for this species. The developed model is then coupled to different warming scenarios. The model results show that when the sea temperature is increased by 1.2°C from current level, the seasonal cycle of Acartia clausi and phytoplankton match more closely and Acartia clausi becomes more abundant compared to now. When temperature is increased by more than 2°C from current level, the seasonal cycle of Acartia clausi mismatch with the seasonal cycle of phytoplankton, which induces a sharp decrease in Acartia clausi abundance.

The uncertainty of my study is that I only consider the direct effects of climate warming on the biological processes of zooplankton. Climate warming can influence zooplankton indirectly e.g. through changing the ocean current and enhance the stability of water column. It is possible that the indirect effects are more important than the direct effects.