

Spawning fish maintain trophic synchrony across time and space beyond thermal drivers



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1 BACKGROUND AND OBJECTIVE

With climate warming, a general expectation is that fish spawning time will become decoupled to the timing of the offspring's food resources, referred to as **trophic asynchrony**.

Here, we test this expectation by comparing spawning time for **Northeast Arctic cod** to a proxy for offspring food resource, the onset of the phytoplankton spring bloom.

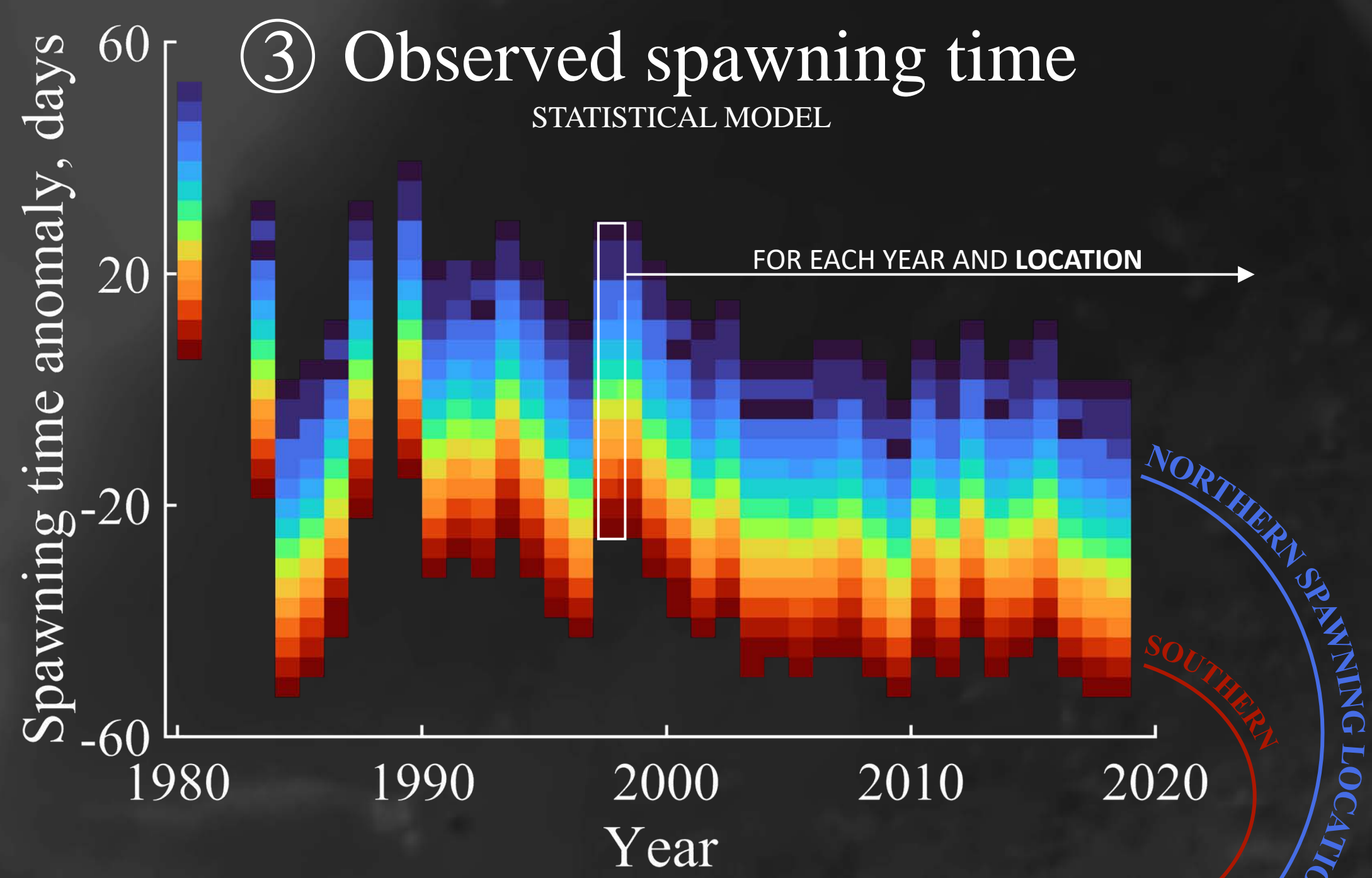
We can also disentangle the effect of temperature vs. food availability on spatiotemporal variation in spawning time.

2 DATA AND METHODS

For cod spawning time, we use individually resolved catch data (see map) to construct a statistical model for spawning time across years (1980-2019) and space (3000 km, 58 – 71 °N).

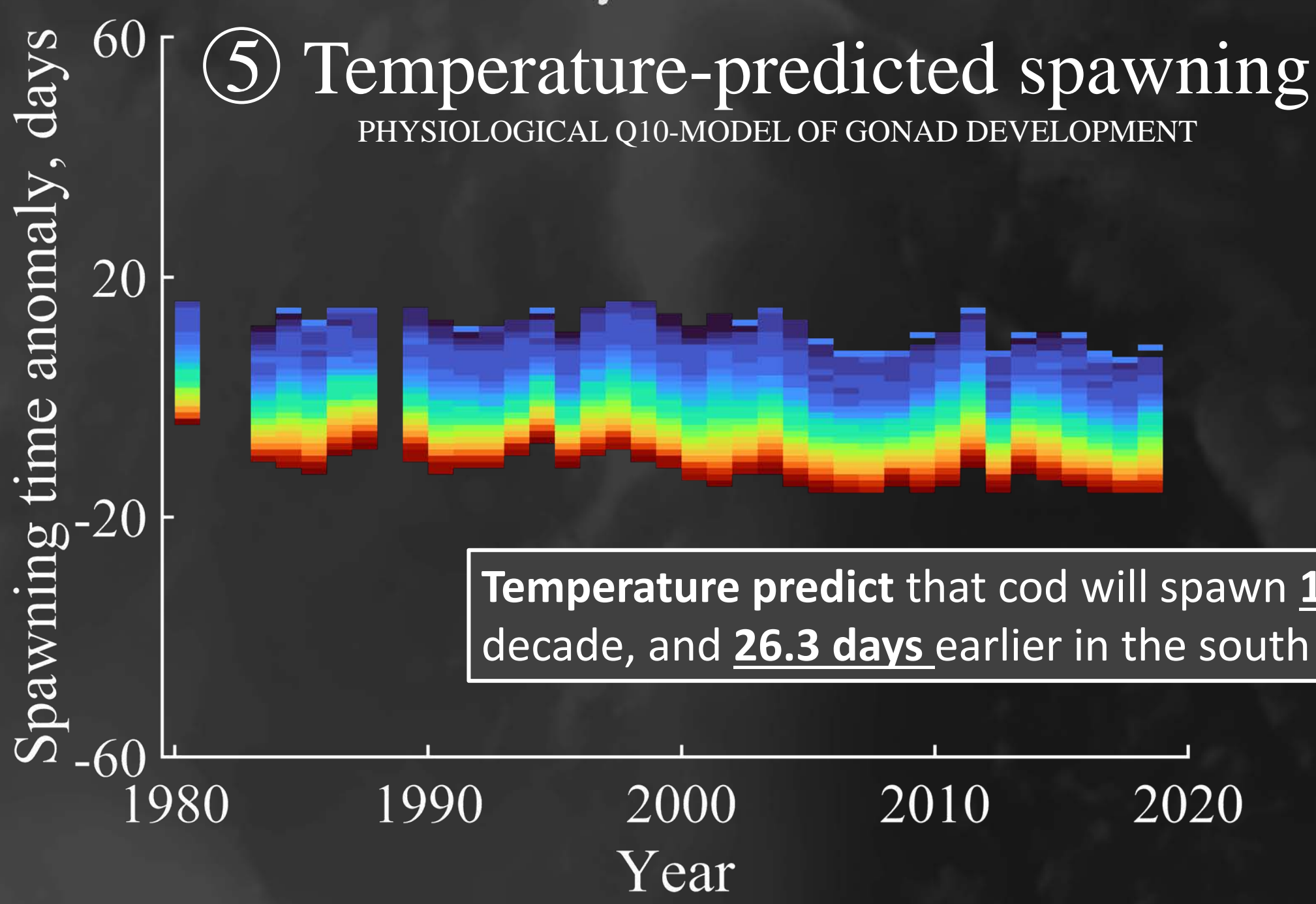
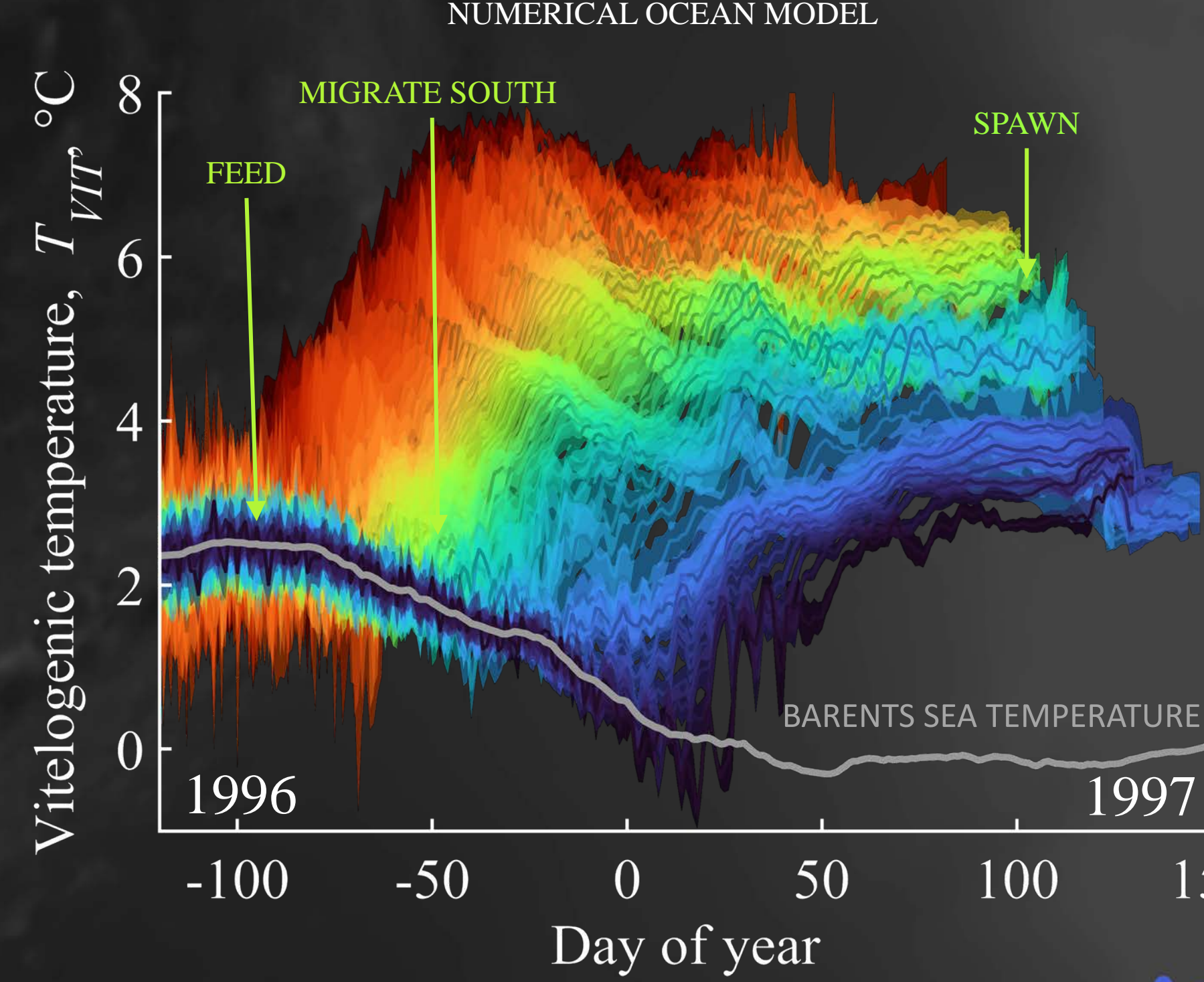
We also estimate the **ambient temperature** during gonad development and spawning migration (vitellogenic temperature), and calculate the theoretical temperature-driven change in spawning time.

For the resource availability, we use satellite images to estimate the time of the phytoplankton spring bloom.



Cod spawn on average **7.8 days** earlier per decade, and **53.5 days** earlier in the **south** compared to the **north**.

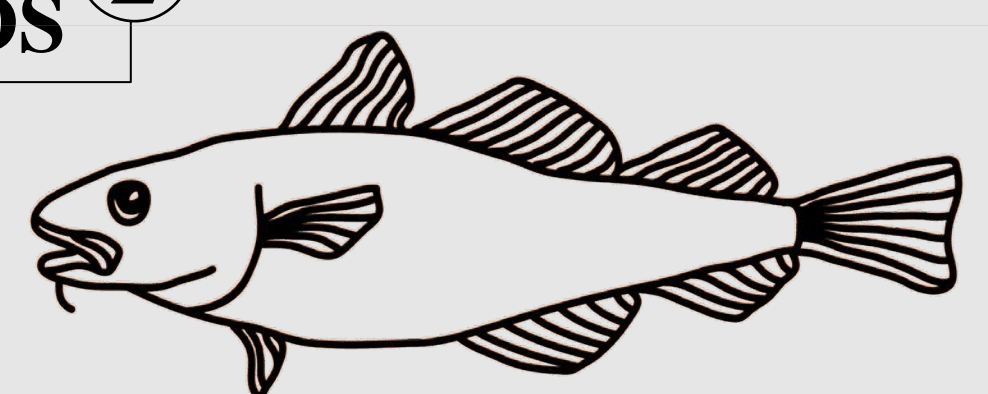
4 Estimate ambient temperature



Temperature predict that cod will spawn **1.8 days** earlier per decade, and **26.3 days** earlier in the south compared to the north.

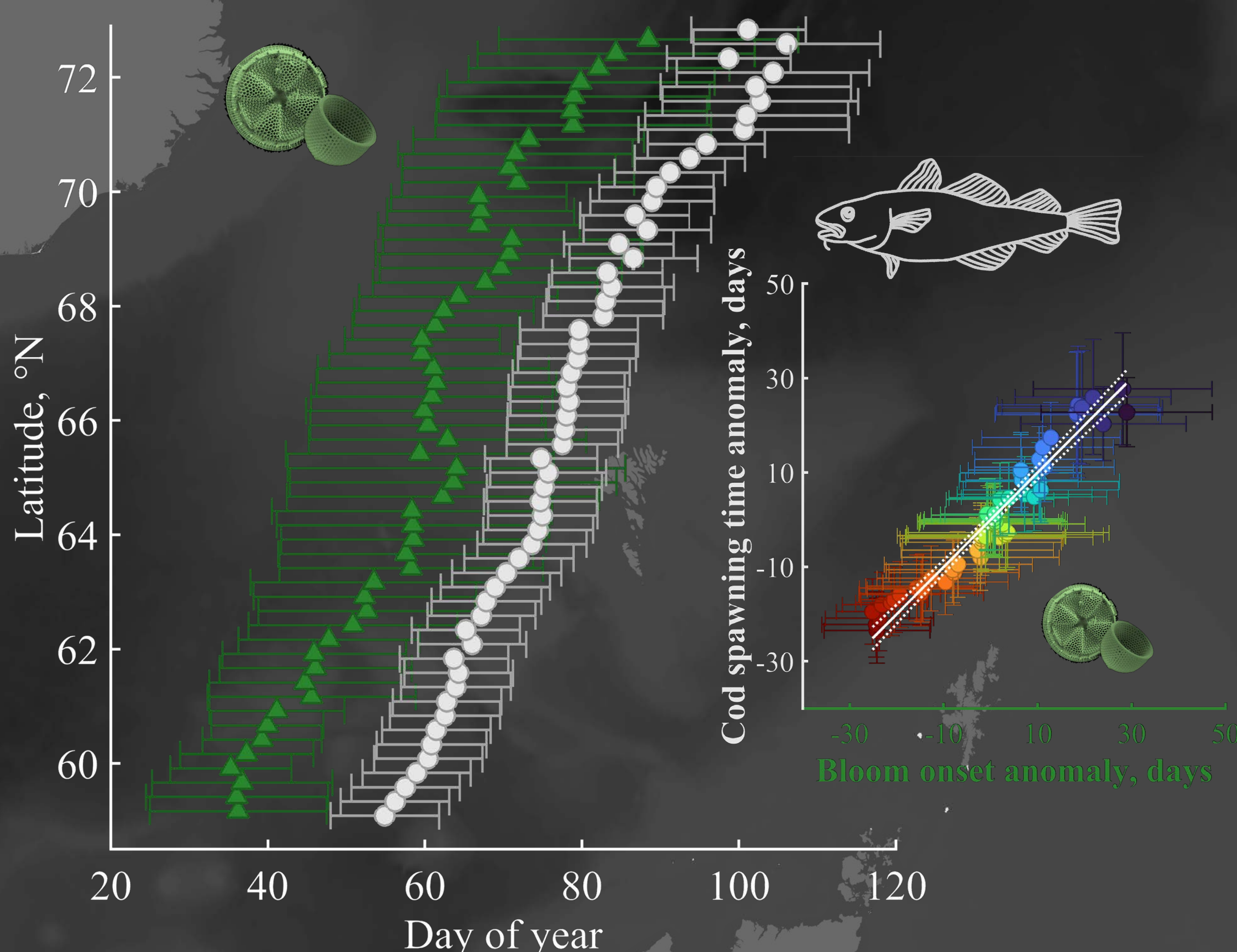
DATA AND METHODS

Time: 1980 to 2019
Sampled: 126 000 individual cod
Measured: sex, age, length, and gonad stage



6 Phytoplankton spring bloom

SATELLITE IMAGES, 1998-2019



The phytoplankton spring bloom onset is **7.9 days** earlier per decade, and **49.1 days** earlier in the south compared to the north. Thus, **cod spawning is synchronous** with bloom onset in space and time

7 SUMMARY

Northeast Arctic cod **spawn progressively earlier**

Individuals delay or advance spawning time depending on year and choice of spawning location.

Variation in spawning time is largely independent of temperature, but is **synchronous to the local phytoplankton** spring bloom onset.

This finding highlights a new dimension for trophic match-mismatch and should be an **important consideration in models** used to predict phenology dynamics in a warmer climate

