

The bivalve *Angulus benedeni benedeni* as a climate archive for Pliocene seasonality

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A well-established climate archive: fossil bivalves



Figure 2 in *de Winter et al. (2018)*

A well-established climate archive: fossil bivalves

Growth
increments

Seasonality
reconstructions

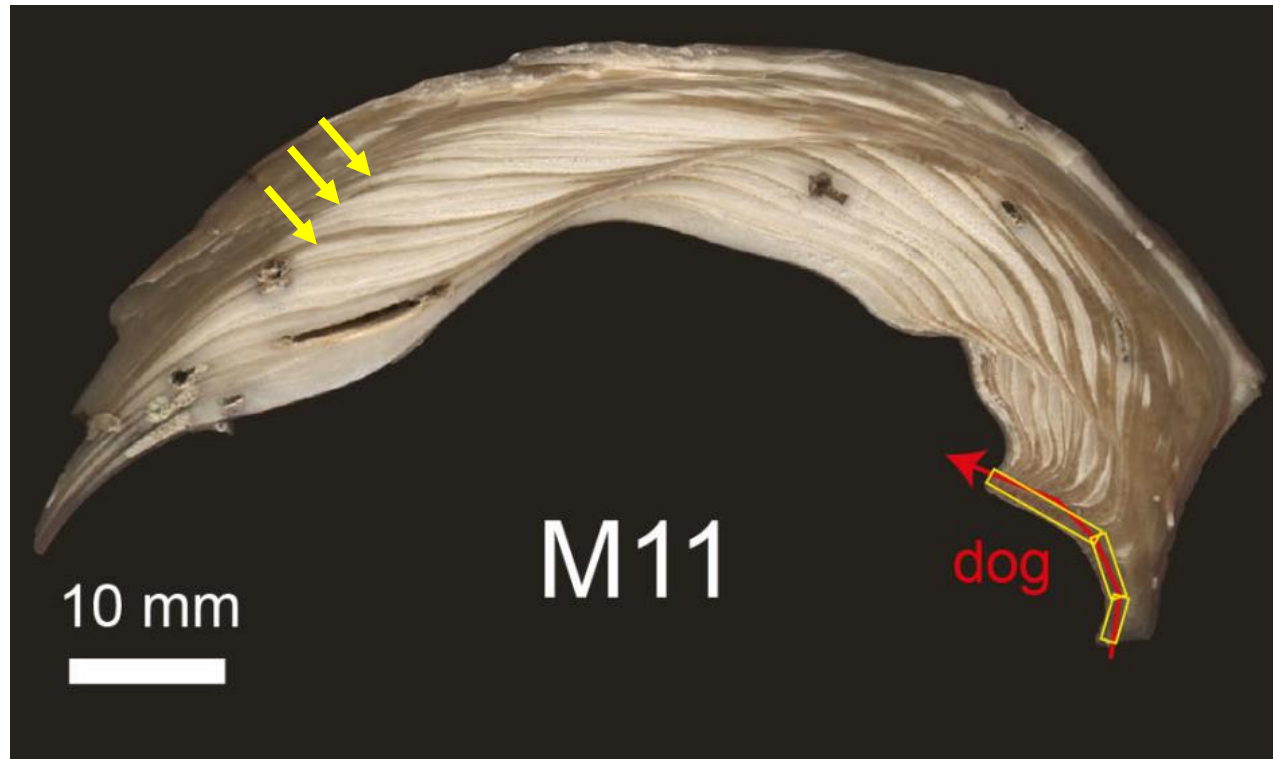


Figure 2 in *de Winter et al. (2018)*

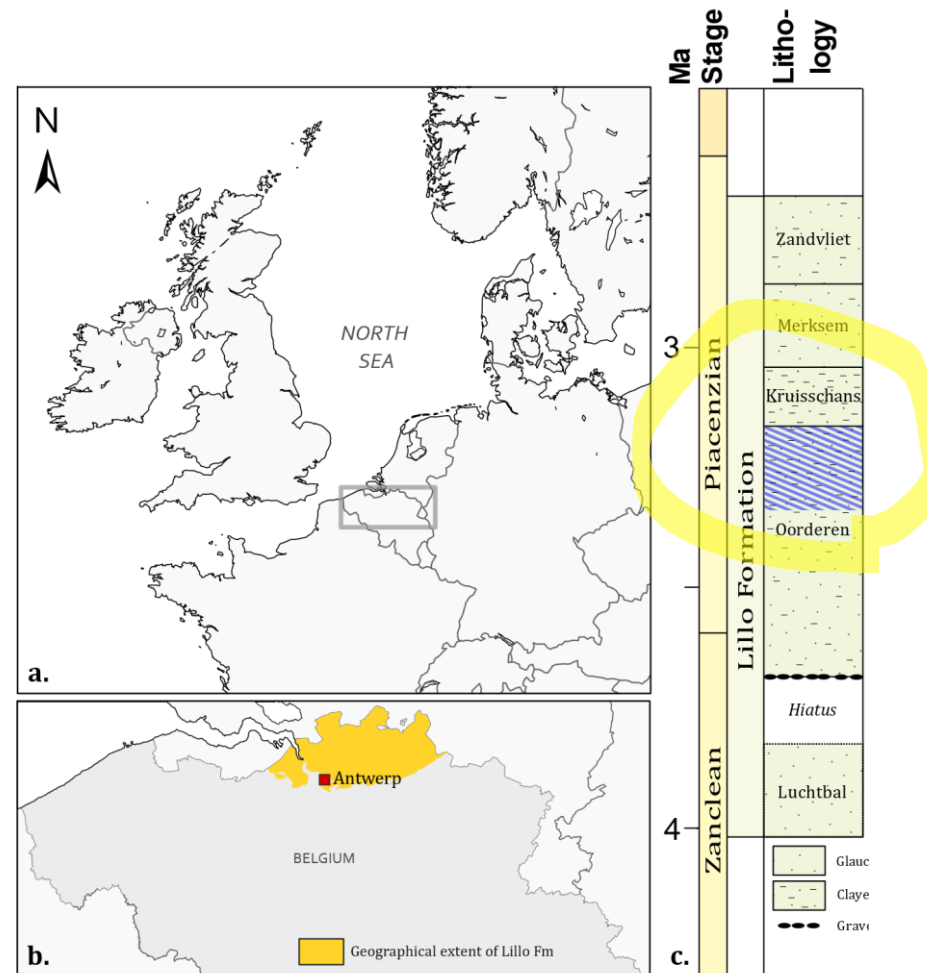
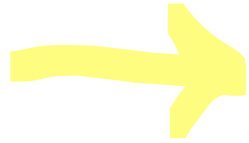
...less well-established: this specific species, *A. benedeni benedeni*. Can it be used as a proxy?



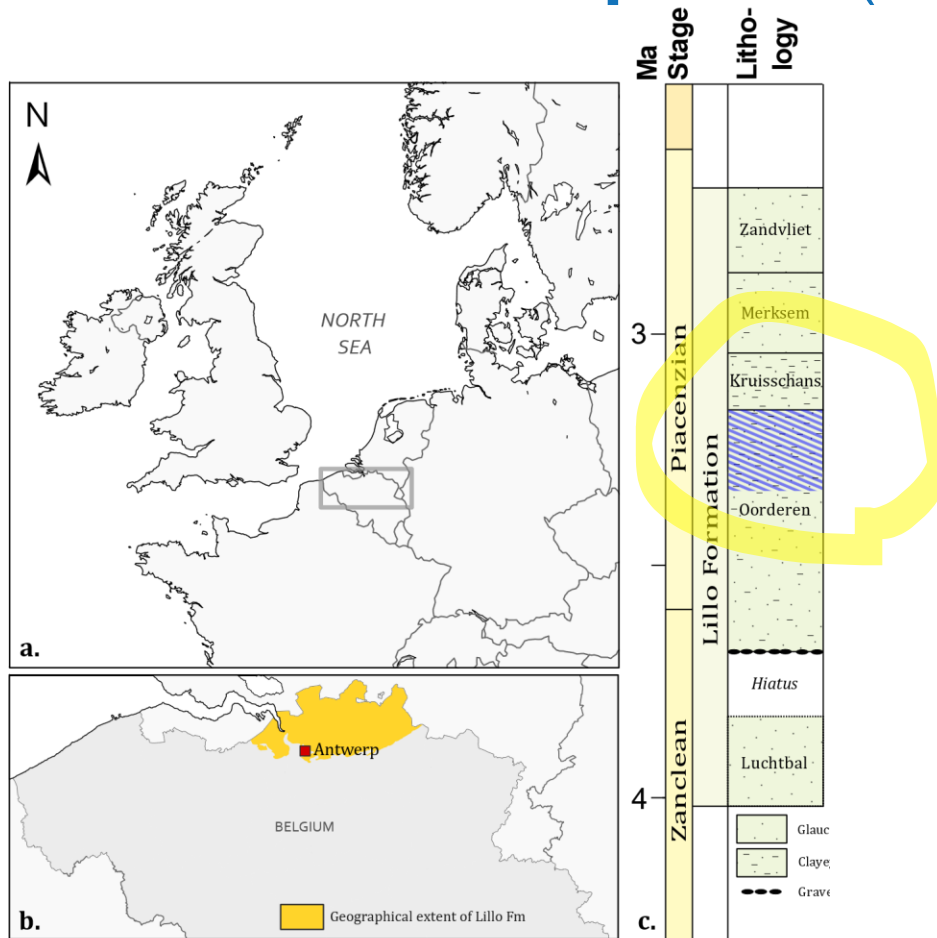
- Family Tellinidae
- Pliocene
- North Sea Basin

- Stable isotopes approach

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A. benedeni benedeni is a potential climate archive for the mid-Piacenzian warm period (mPWP, 3.264-3.025 Ma)



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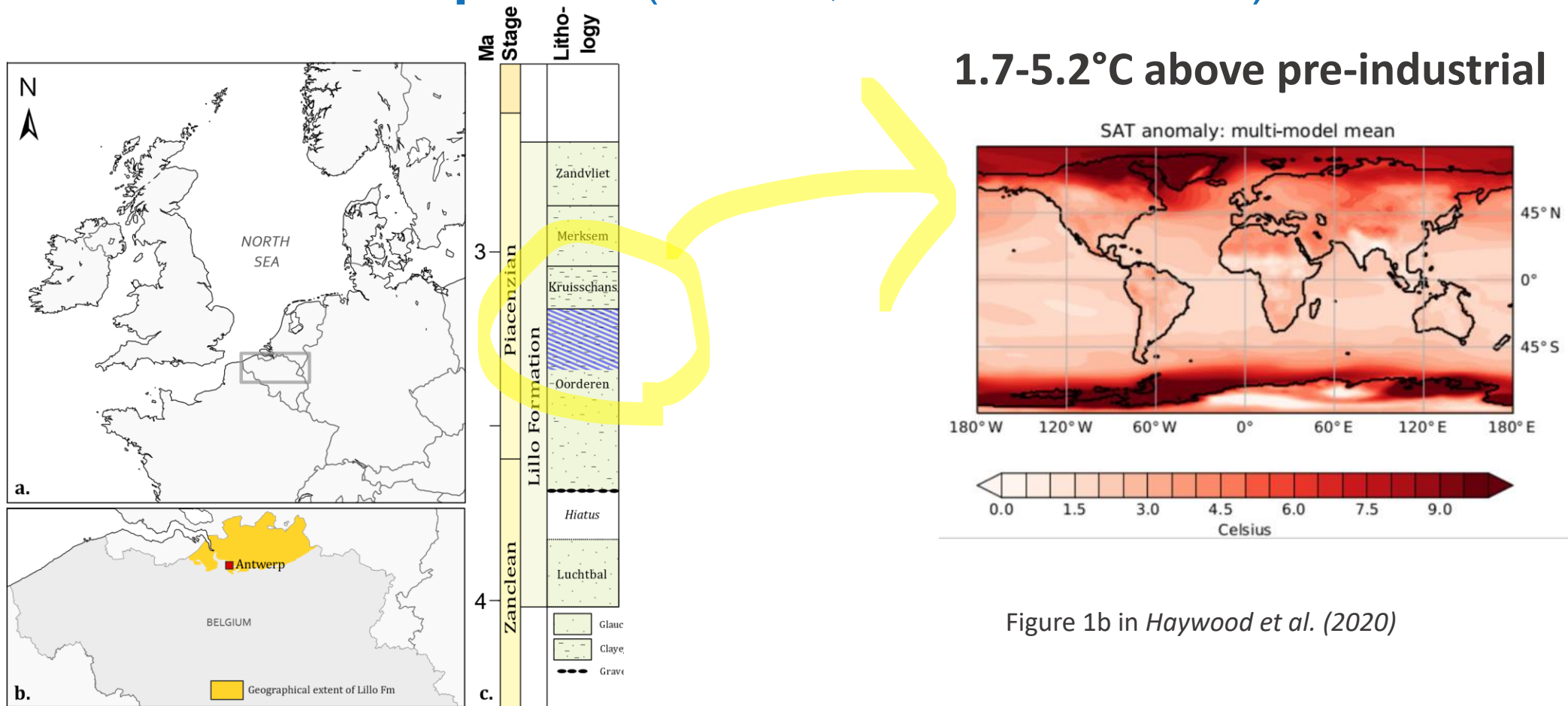


Figure 1b in *Haywood et al. (2020)*

The mPWP (3.264-3.025 Ma) is an important source of information for future warming

1.7-5.2°C above pre-industrial

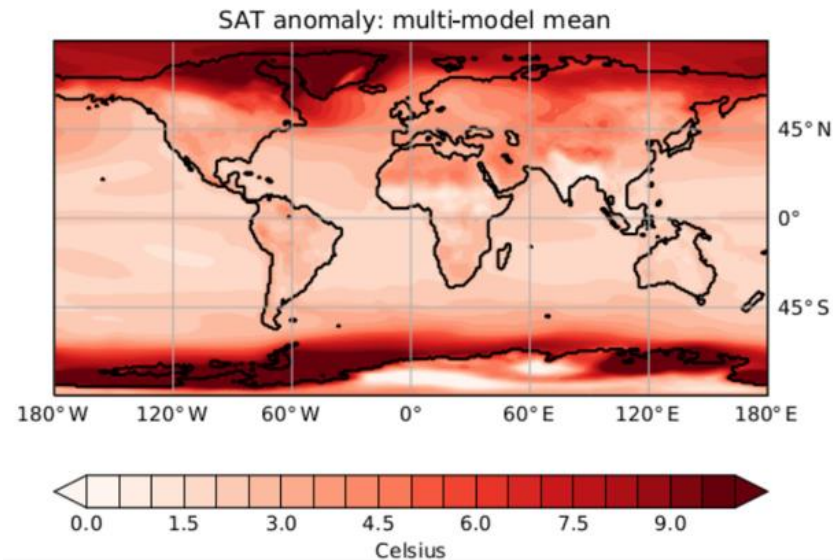


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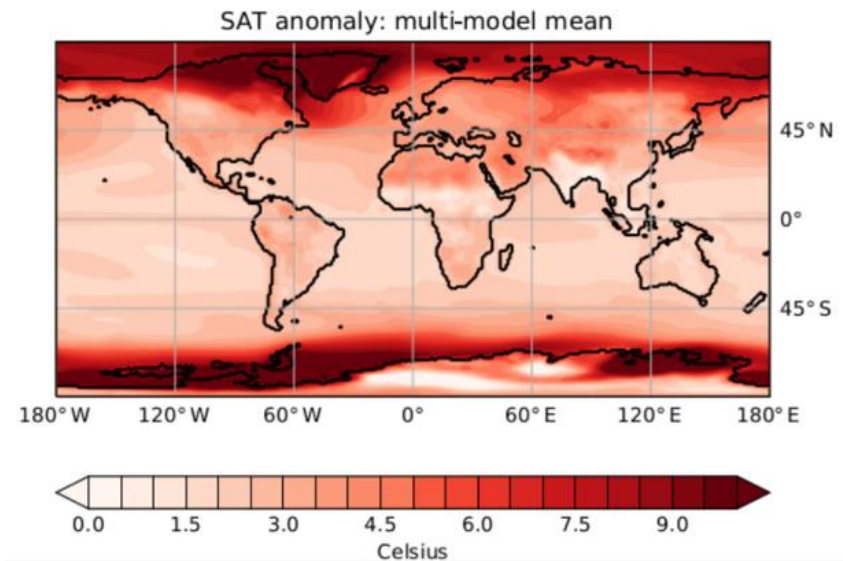


Figure 1b in Haywood et al. (2020)

1-4°C above pre-industrial

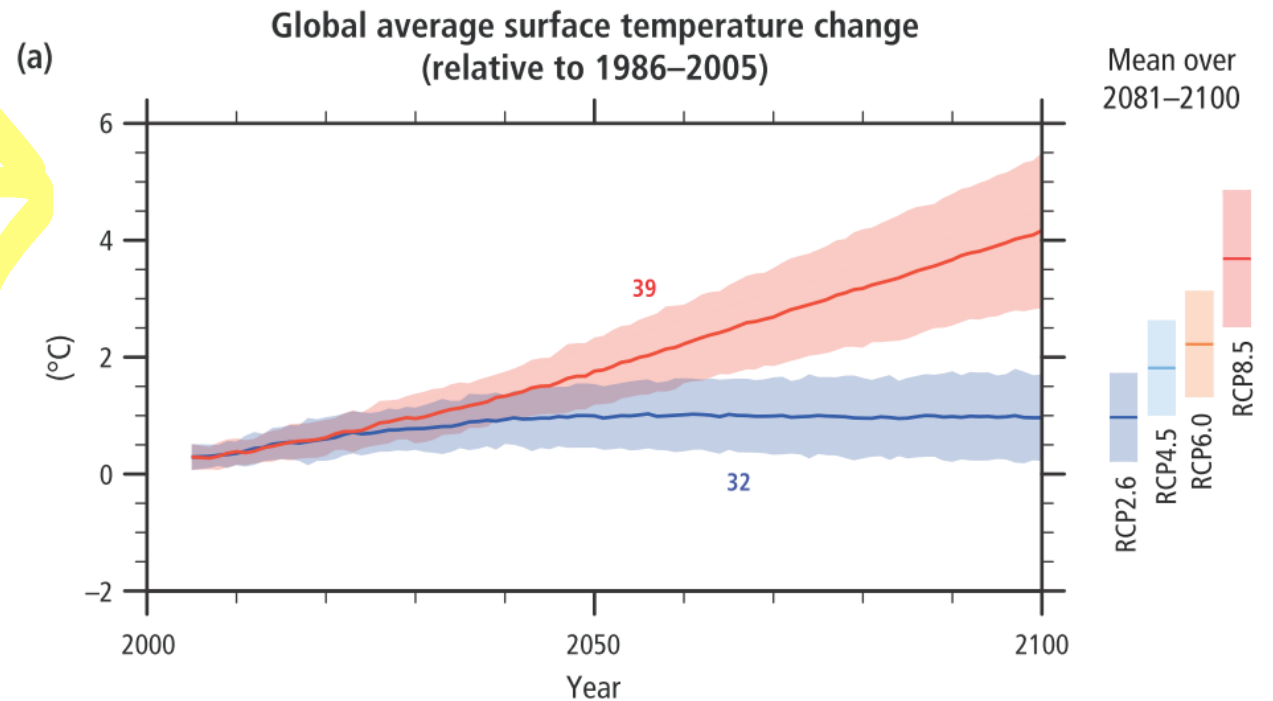
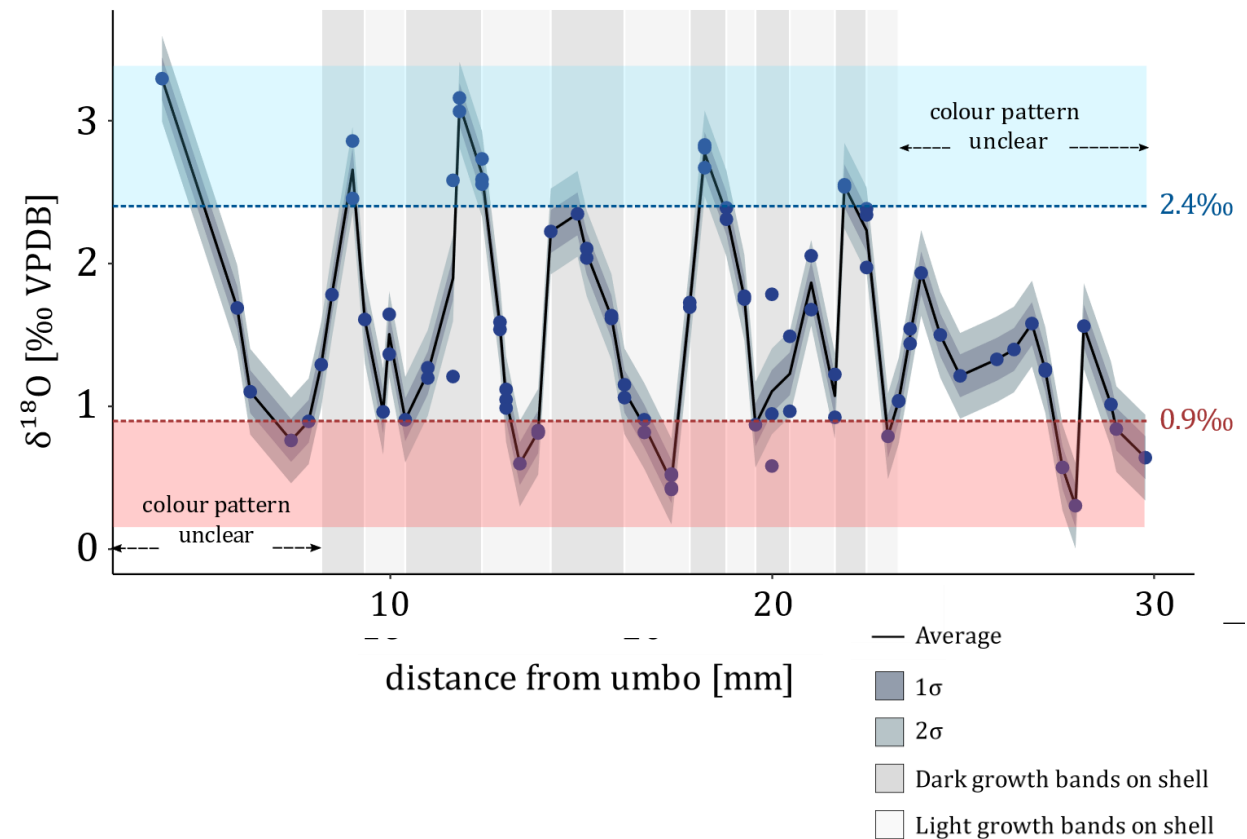
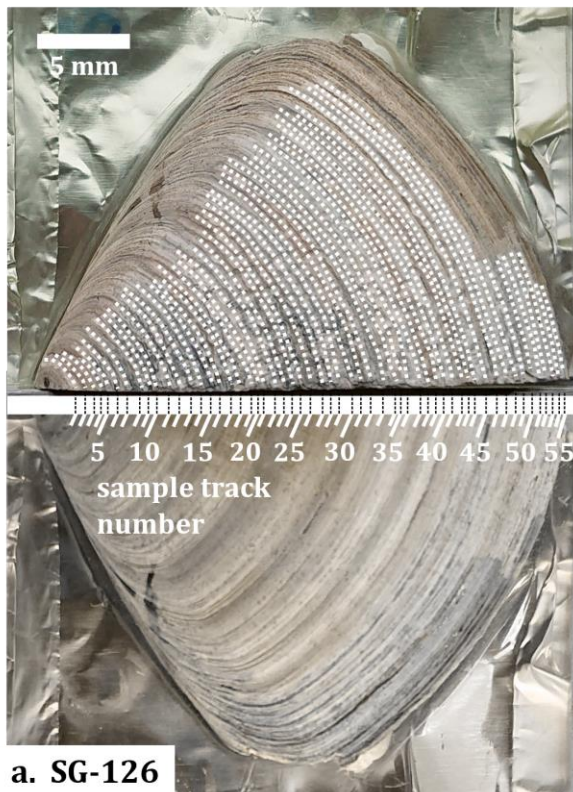
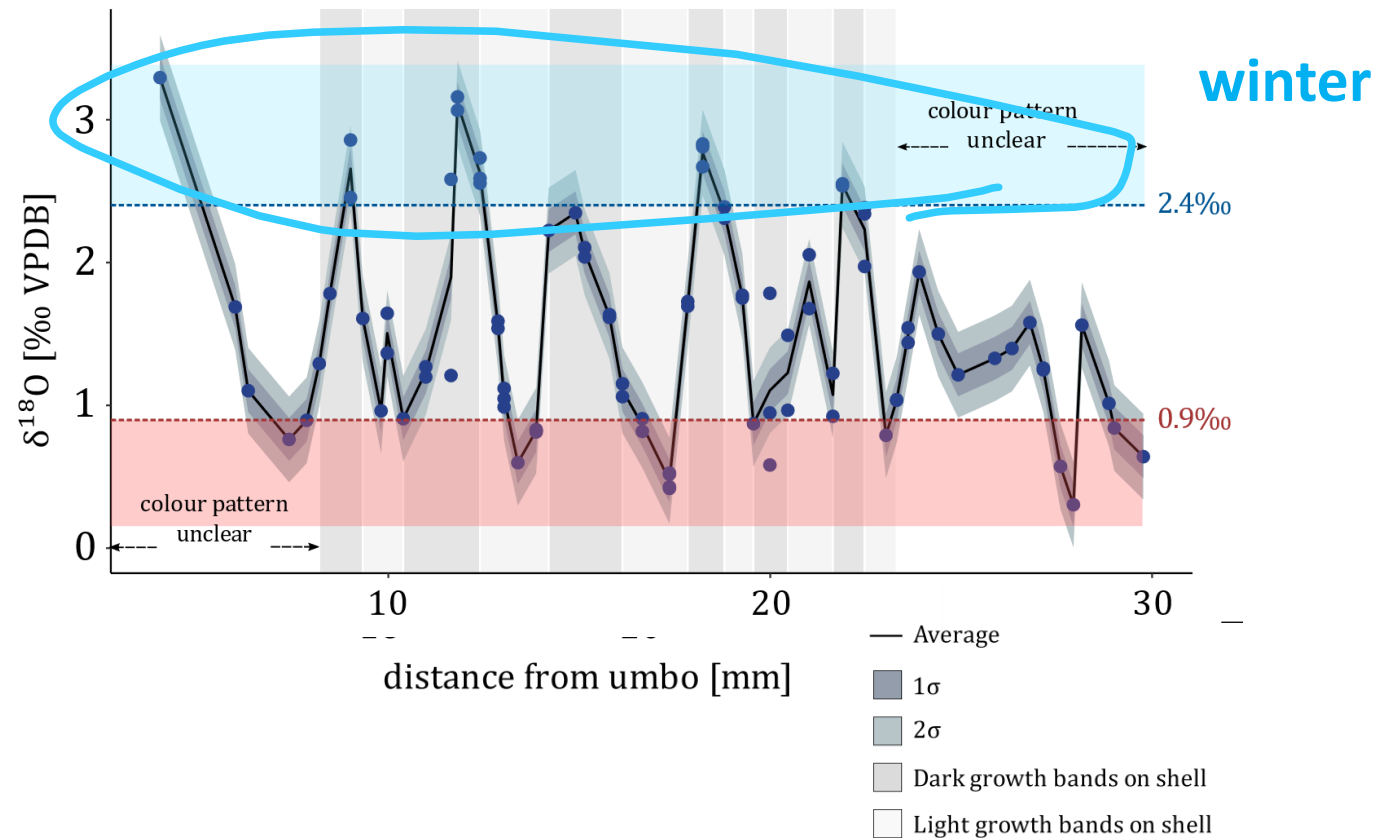
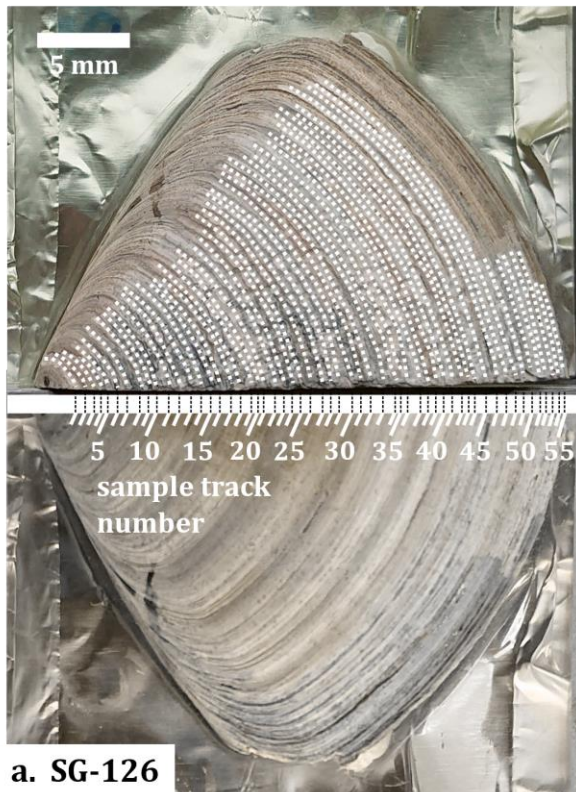


Figure 2.1 in IPCC, 2014: Climate Change 2014: Synthesis Report.

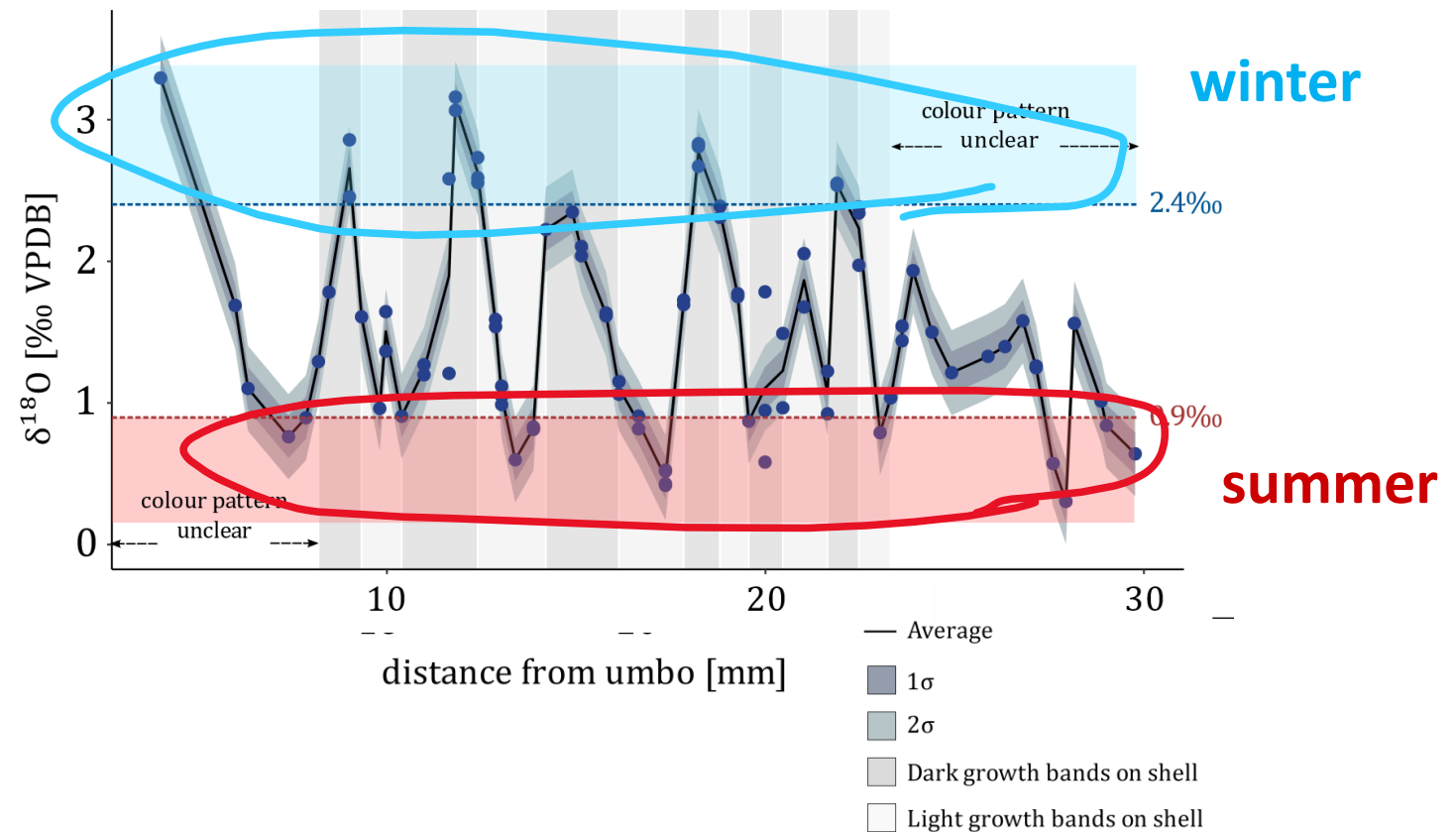
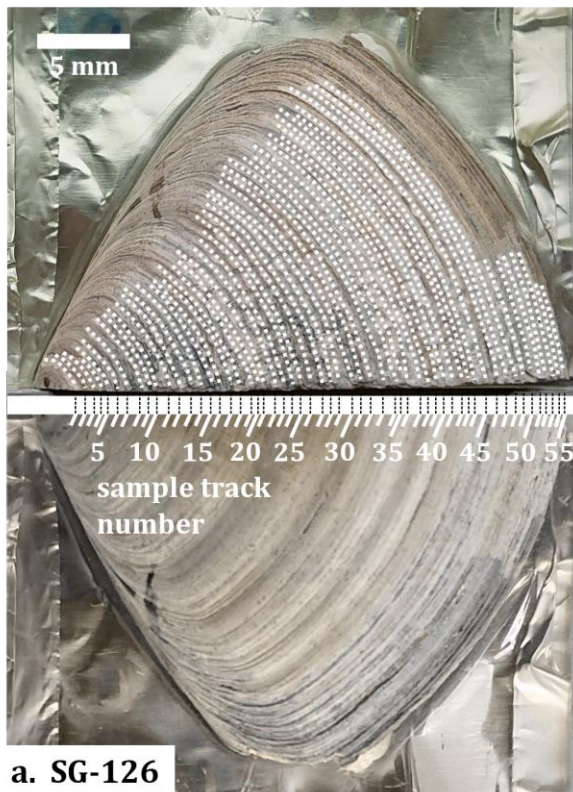
Oxygen isotope data reveals multiannual record with summers and winters



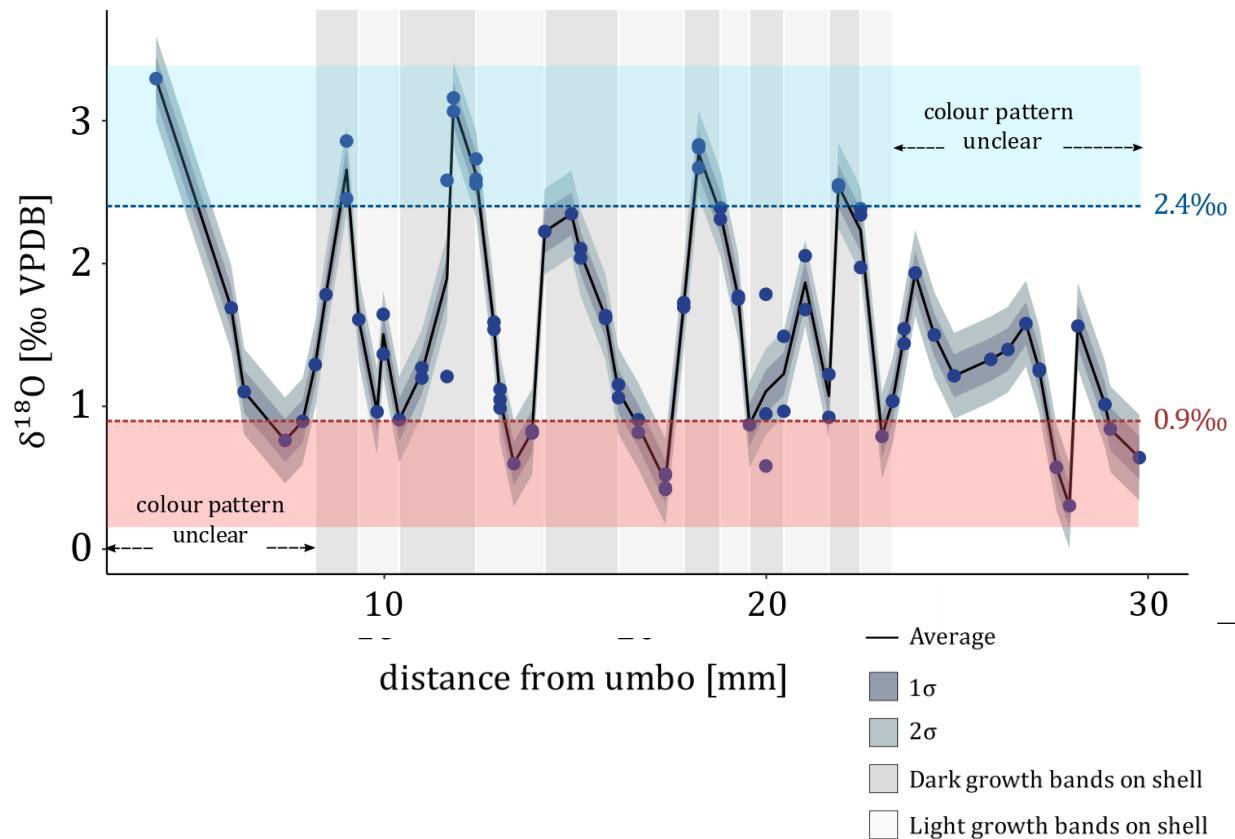
Oxygen isotope data reveals multiannual record with summers and winters



Oxygen isotope data reveals multiannual record with summers and winters



Clumped isotopes can be used to reconstruct a **mean annual temperature** from *A. benedeni benedeni*'s shell

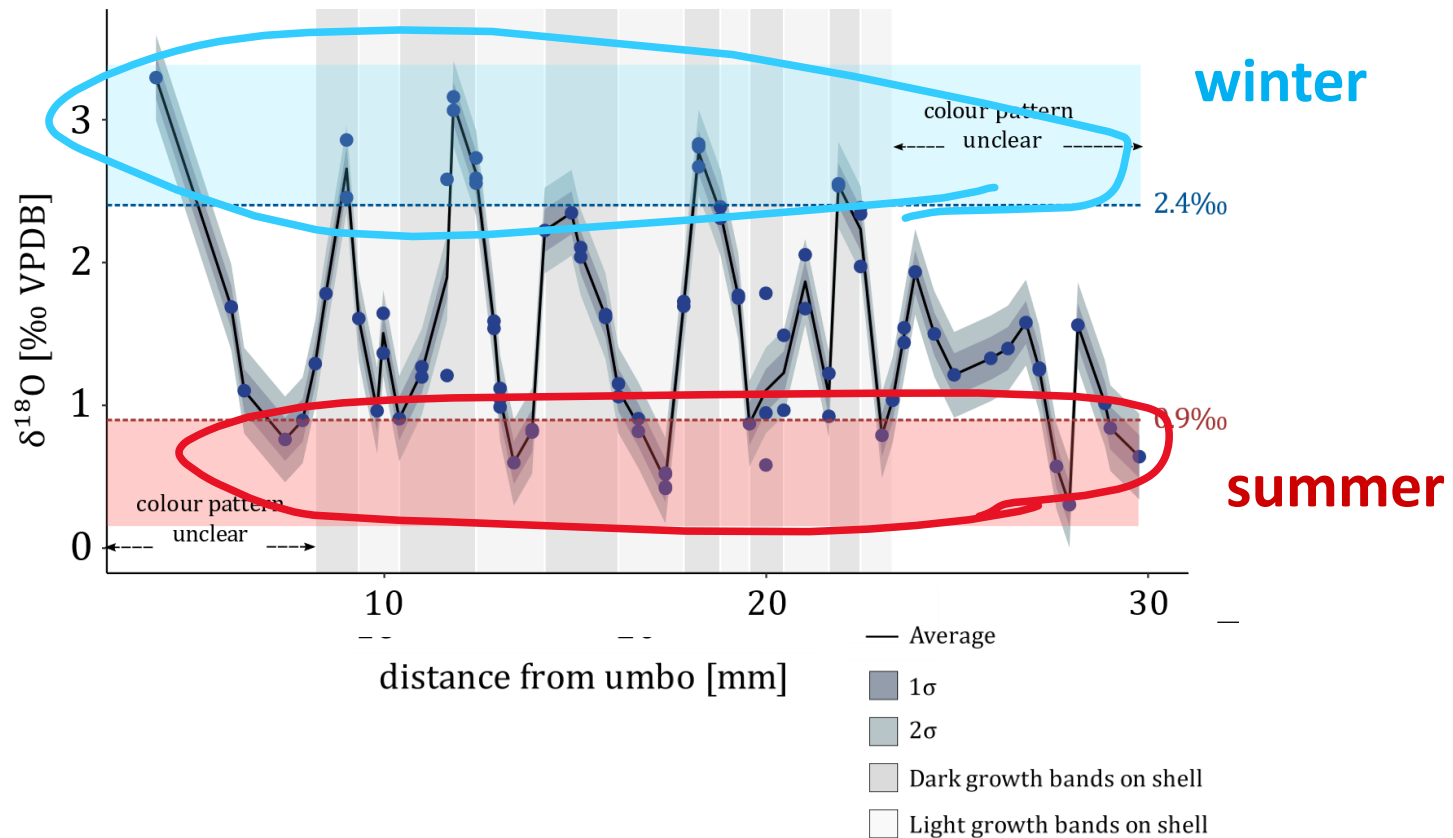


**Combine all:
MAT of $13.5 \pm 3.8^\circ\text{C}^*$
(N=103)**

today: 11°C
pre-industrial: 10°C

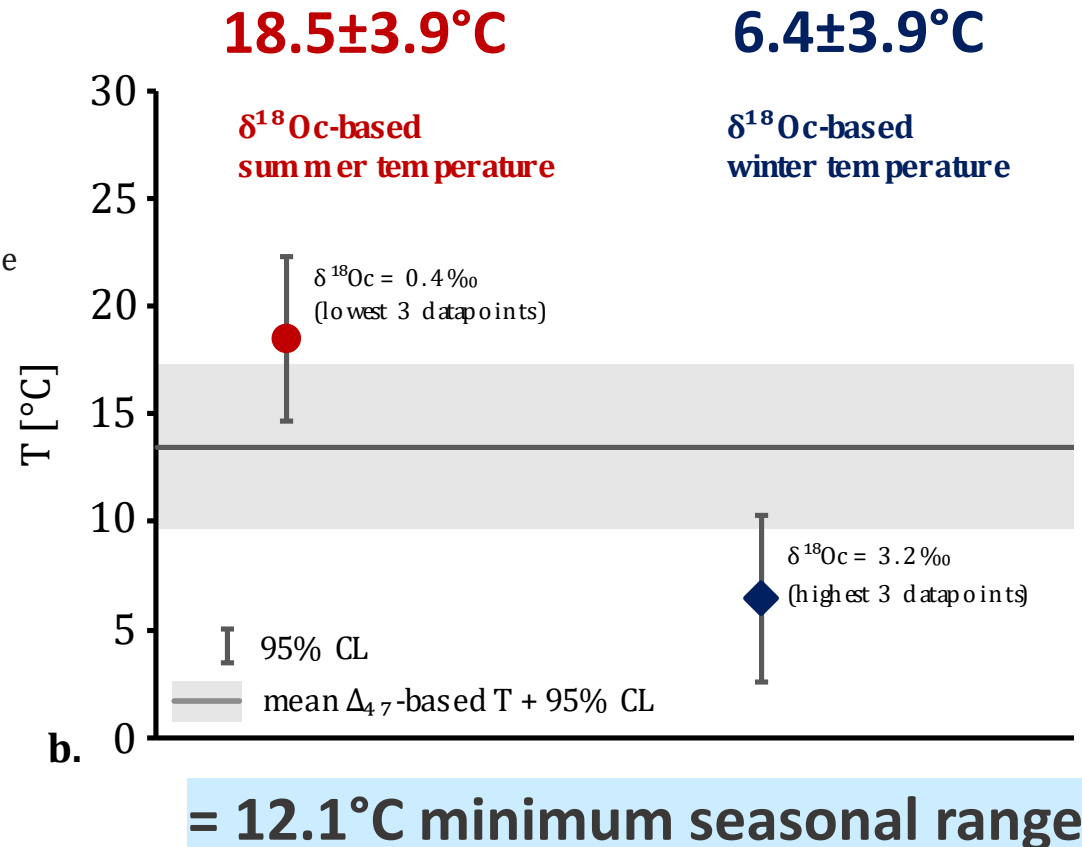
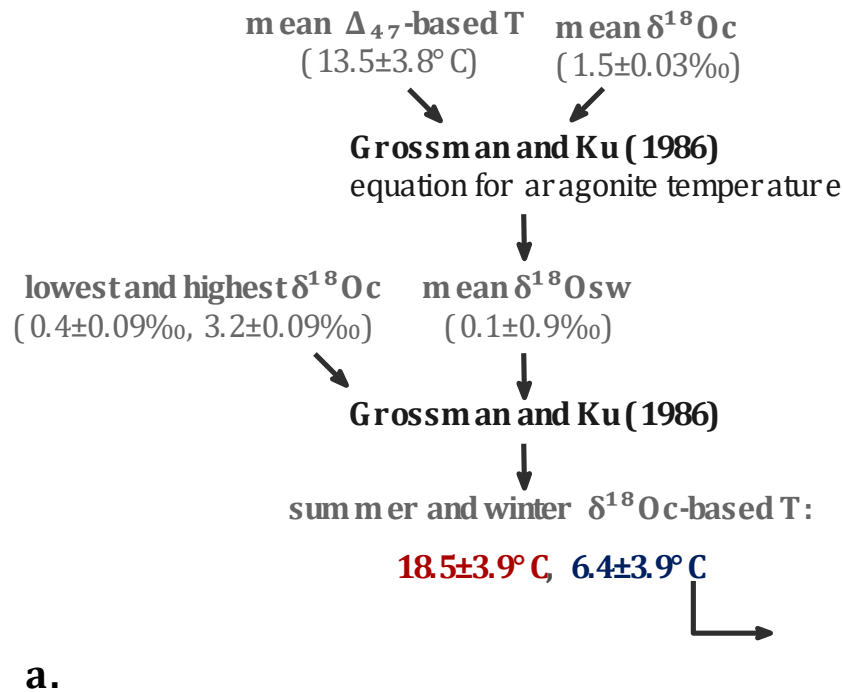
* *MAT in abstract: less appropriate calibration*

Clumped isotopes can be used to reconstruct seasonality from *A. benedeni benedeni*'s shell...



...if enough measurements are available (2-4 shells)

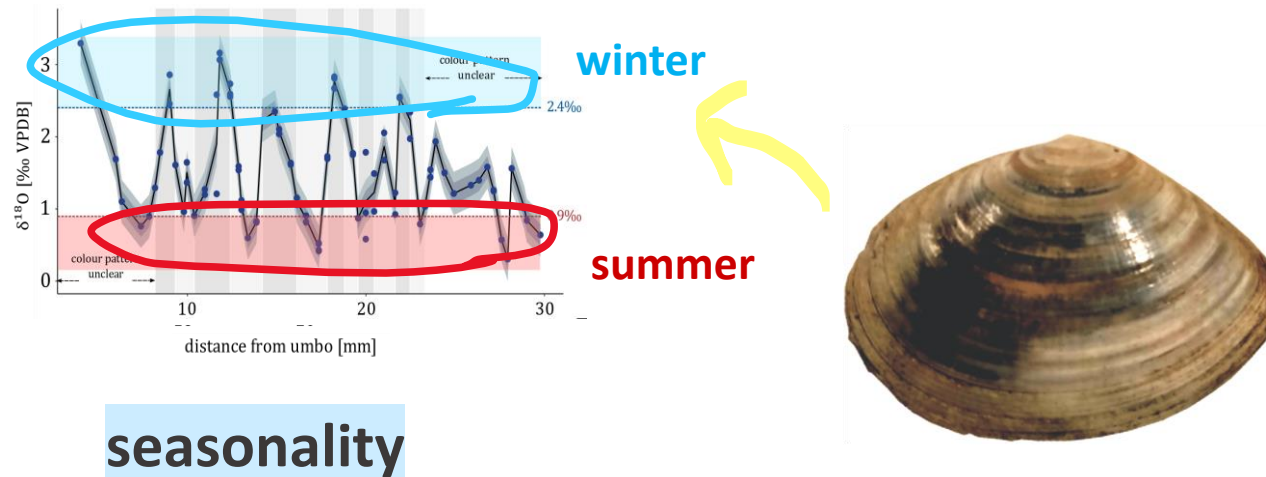
Clumped and oxygen isotopes can be combined to reconstruct seasonality



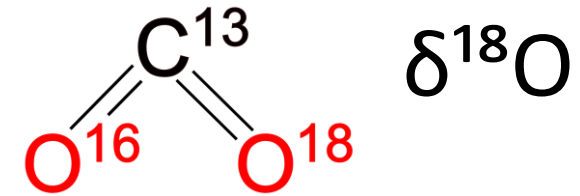
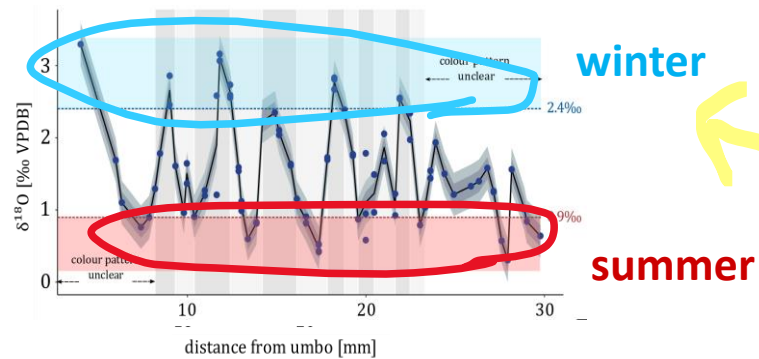
A. benedeni benedeni can be used as a stable-isotope-based climate archive to reconstruct Pliocene seasonality



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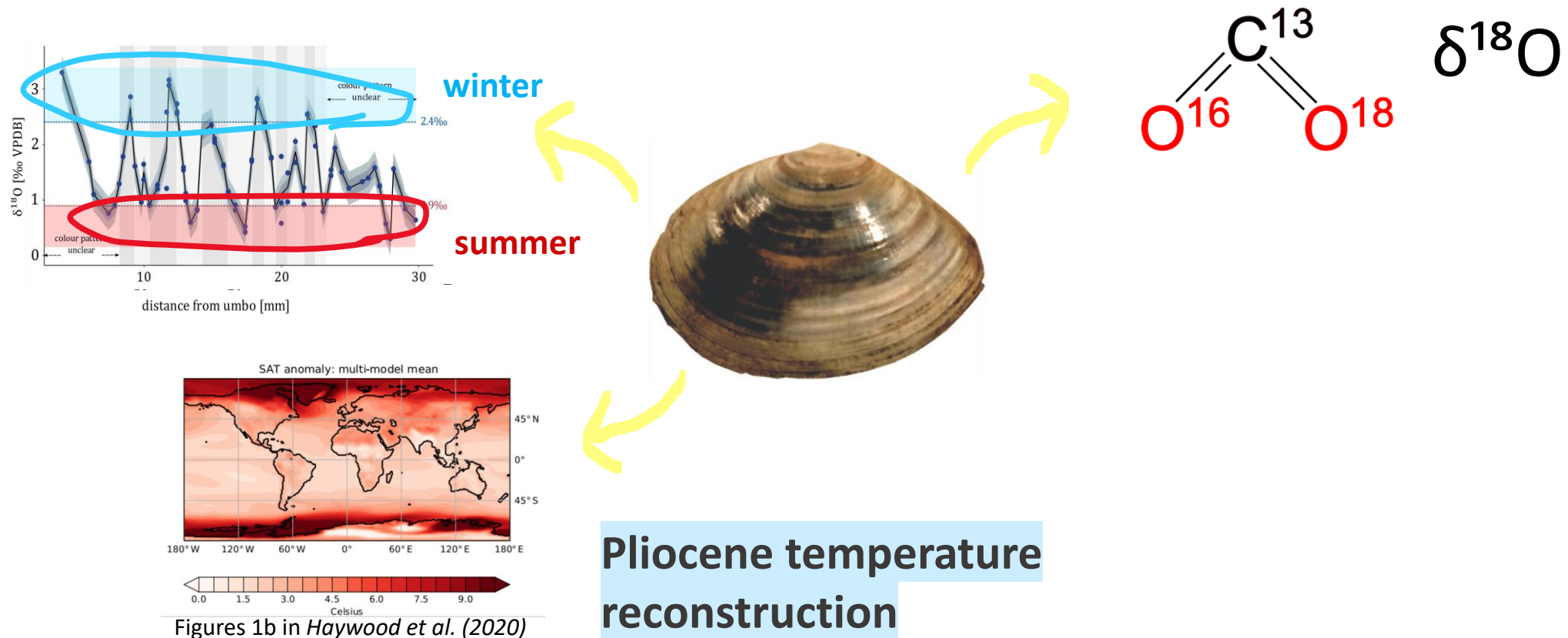


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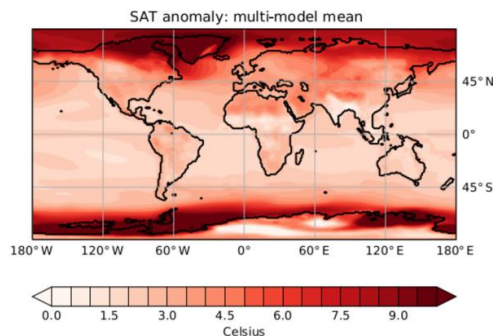
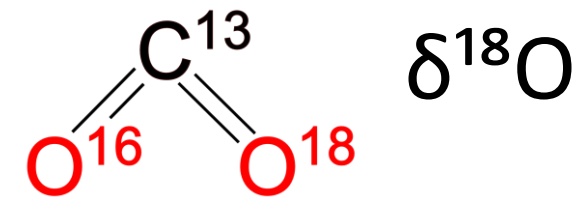


oxygen & clumped isotopes

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Figures 1b in Haywood et al. (2020)

Future climate
modelling

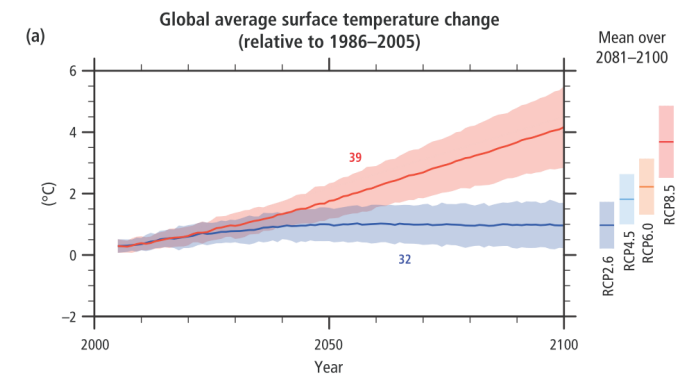
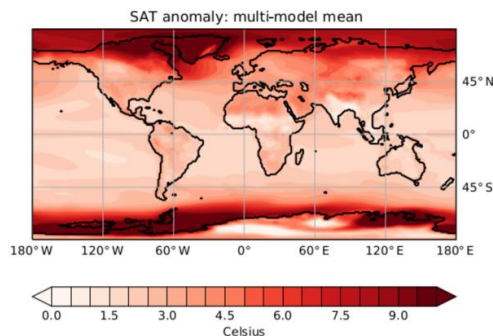
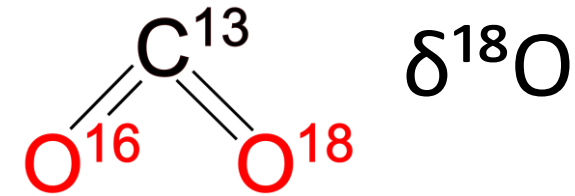
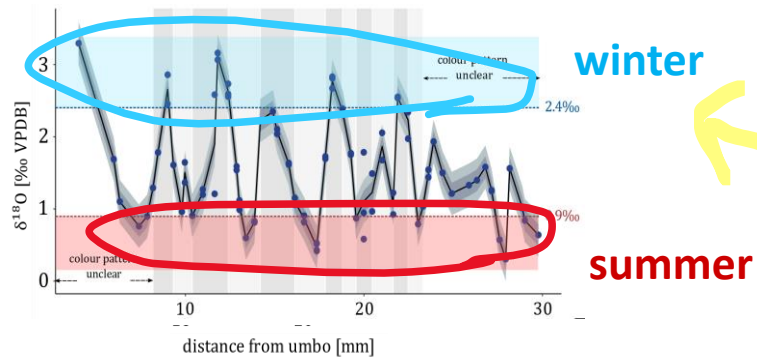


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long presentation available
on EGU website!



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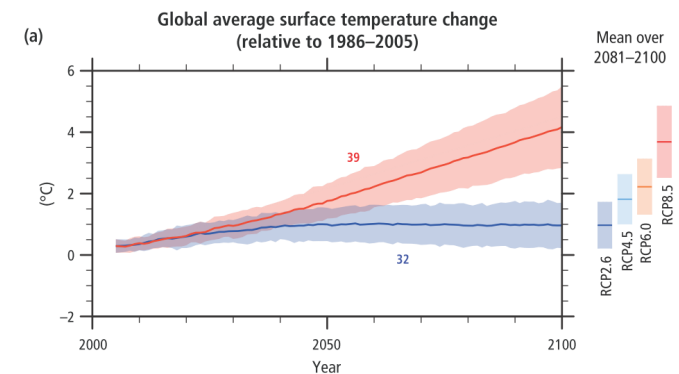


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