Institute of Earth Environment

Beijing Normal University

Sea surface temperature seasonality in the northern South China Sea during the middle Holocene derived from high resolution Sr/Ca ratios of *Tridacna*

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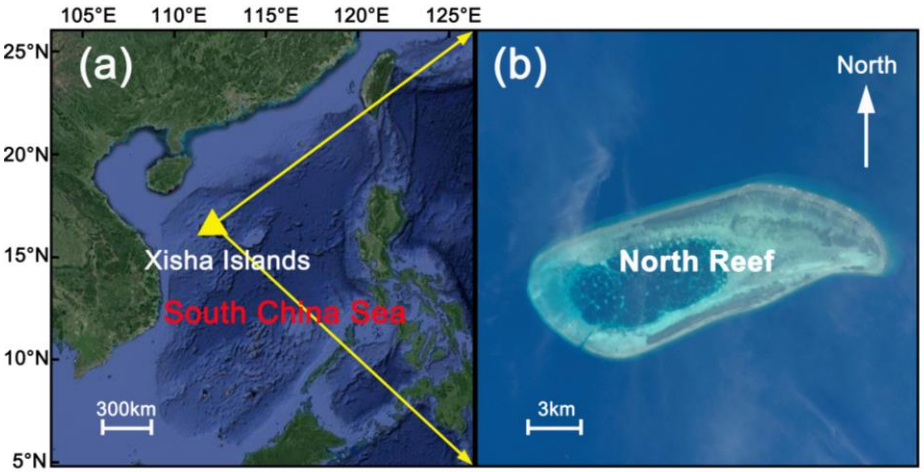
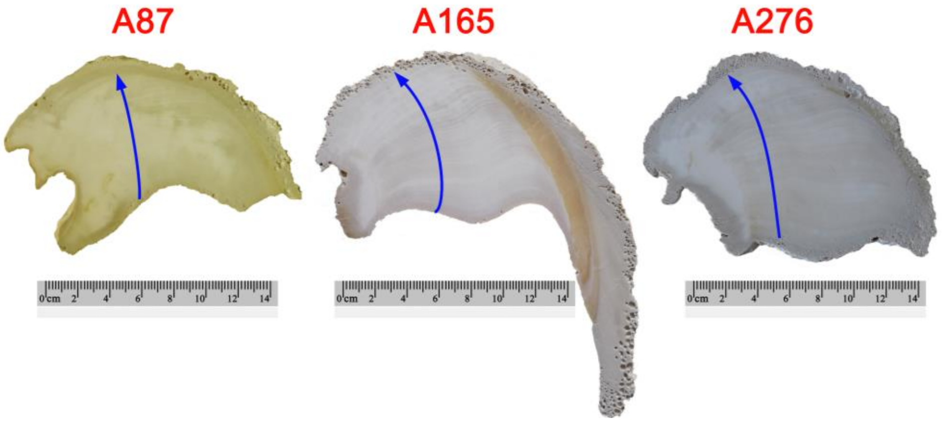
Samples and proxy

- **Three subfossil *Tridacna* were collected from the north SCS;**
- **Three time-windows (3118yr B.P., 4069yr B.P., 4860yr B.P.);**
- **Sub-samples for Sr/Ca analysis**

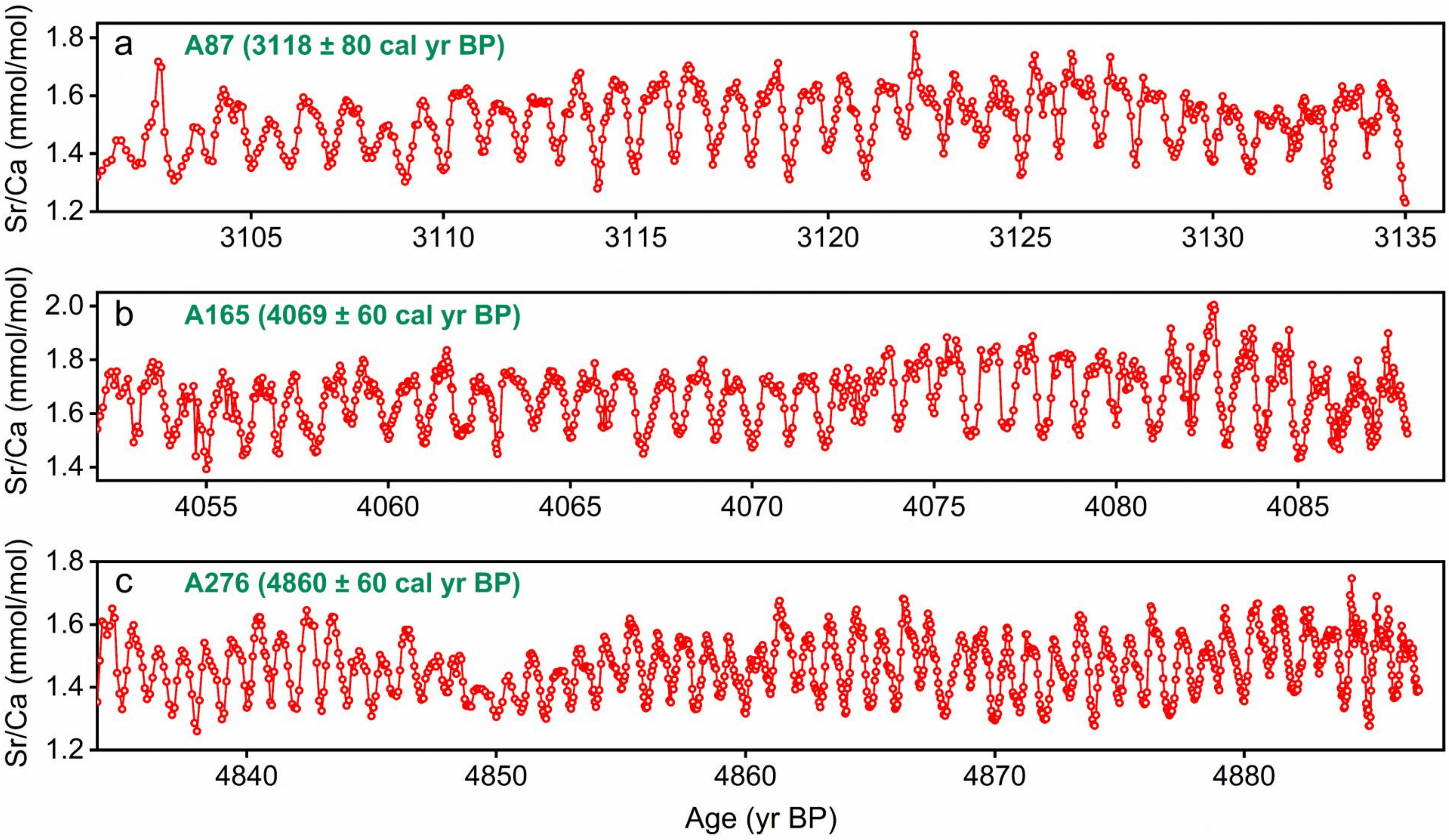


SCS and North Reef

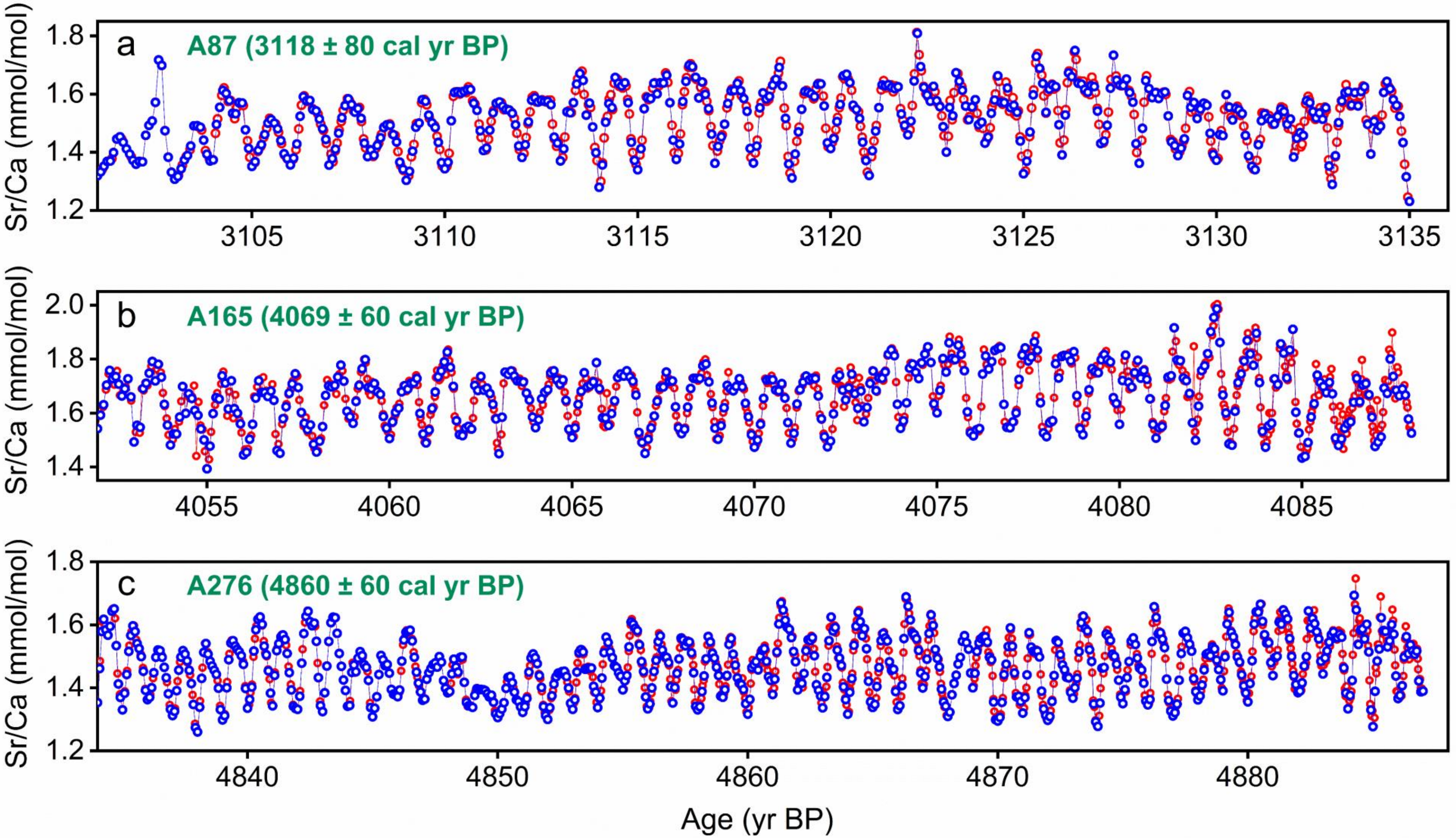


Three subfossil *Tridacna*

Sr/Ca profiles for A87, A165 and A276

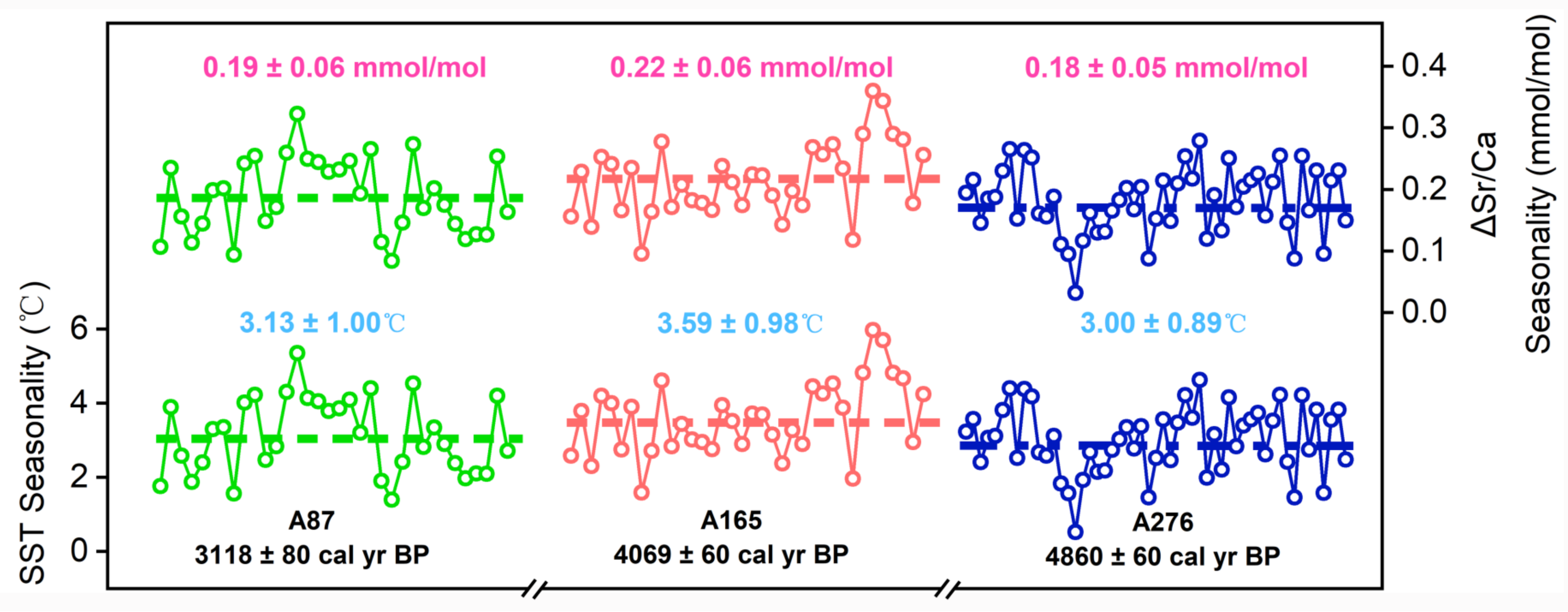


Sr/Ca profiles for 12-point resampling



Calculating SST seasonality

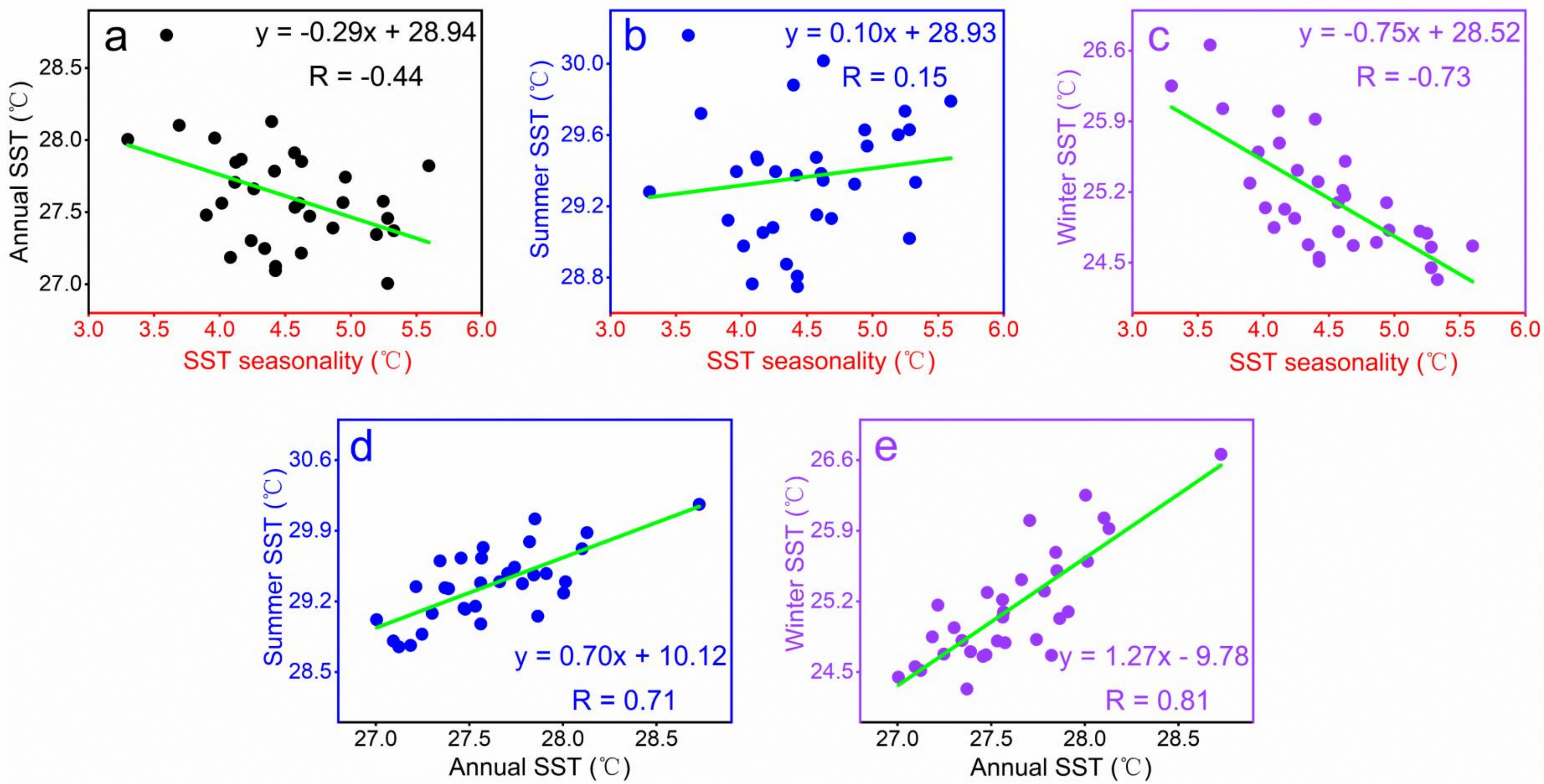
SST seasonality ΔT(°C)=proxy seasonality ΔSr/Ca×16.60



The mean SST seasonality of specimens A87, A165, and A276 were 3.13±1.00 ℃, 3.59±0.98 ℃ and 3.00±0.89 ℃

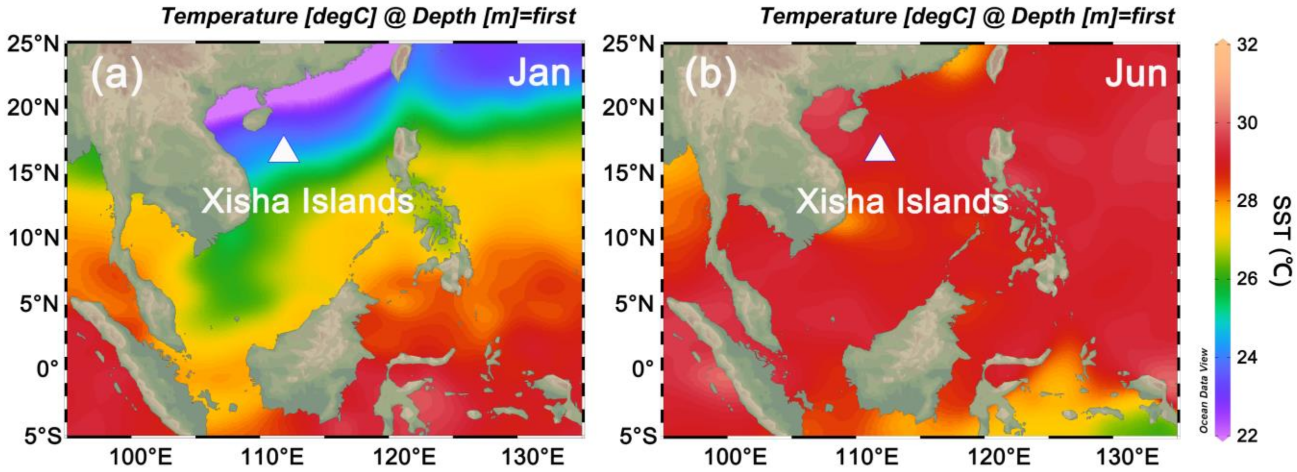
Recent decadal variations and dynamics of SST seasonality

- The SST seasonality in the northern SCS was **negatively** correlated with annual SST
- the SST seasonality in the northern SCS was probably driven by **winter SST**
- Winter SST increased/decreased **more than** that in summer



Recent decadal variations and dynamics of SST seasonality

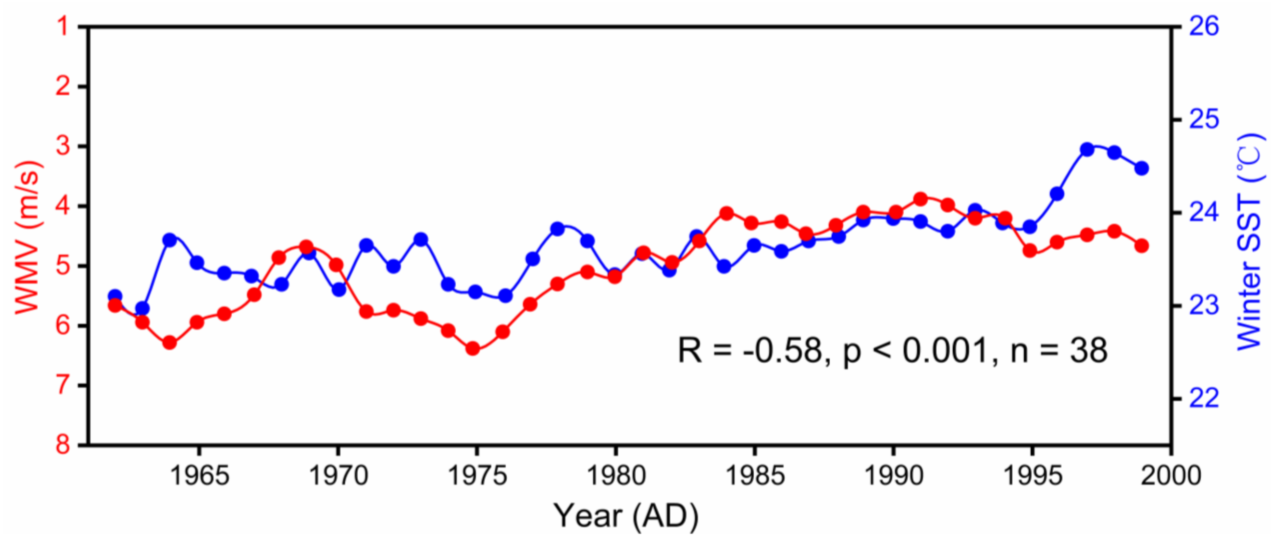
Different climate system impacts:



During summer: the WPWP

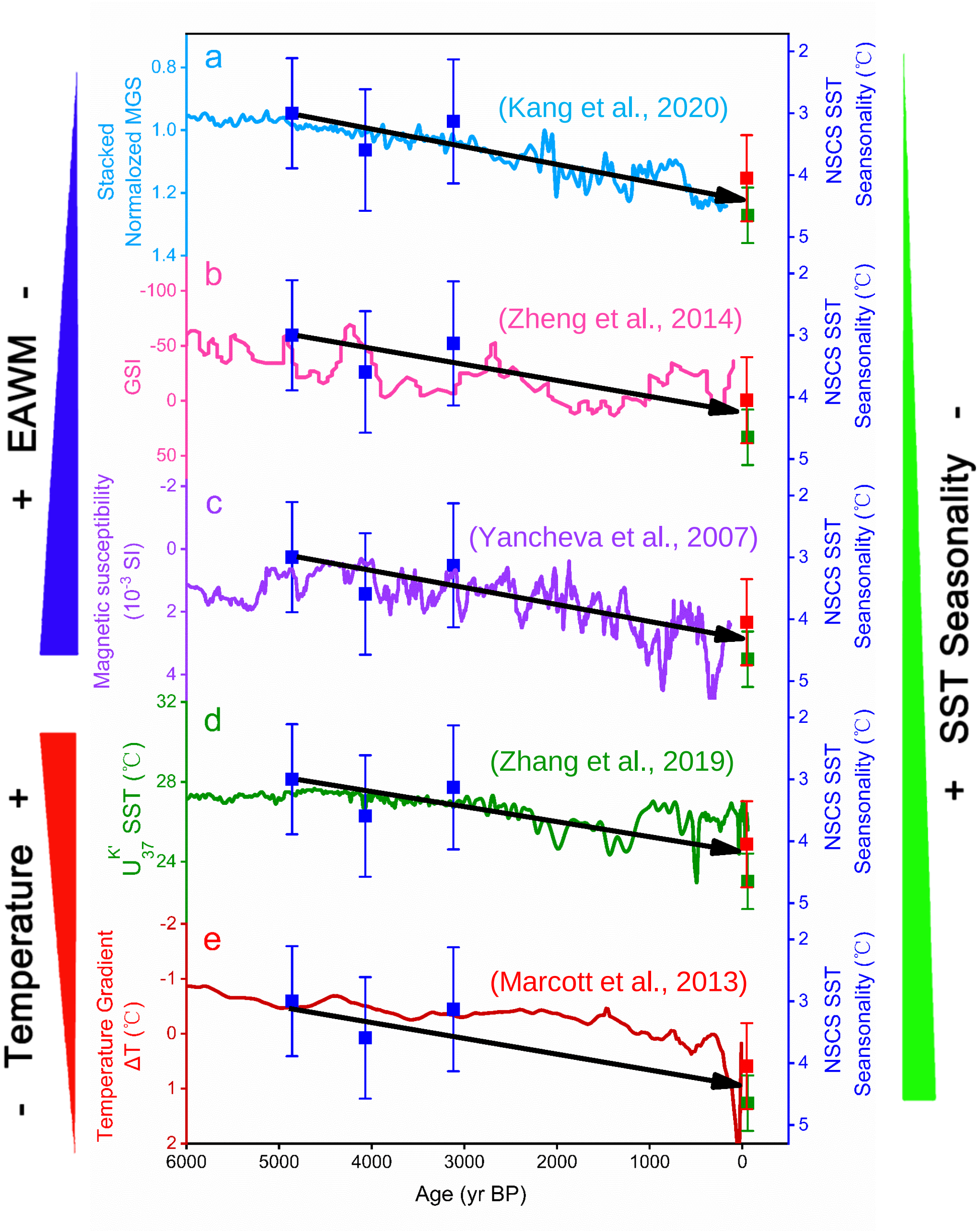
During winter: the EAWM

EAWM and winter STT（AD 1961-1999）:



Negatively

Reconstructed SST seasonality



- **a,b,c:EAWM records**
- **d:long-chain unsaturated alkenones $U_{37}^{K'}$**
- **e:temperature gradient between the low and high latitudes of Northern Hemisphere**

Sea surface temperature seasonality in the northern South China Sea during the middle Holocene derived from high resolution Sr/Ca ratios of *Tridacna* shells

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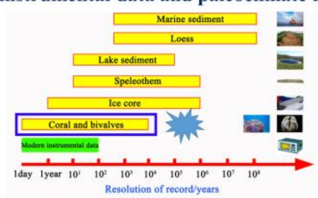
Extreme seasonal climate events

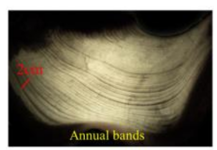

Seasonal changes in climate, such as temperature seasonality (temperature contrast between summer and winter) and extreme seasonal climate events, have important impacts on natural and human systems. Therefore, understanding the dynamics of the seasonal climate changes and predicting its future trends under expected future global warming should be one of the most important priorities in the climate sciences.

Modern instrumental data and paleoclimate records



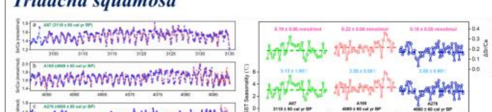
However, the time span of high-resolution modern instrumental data is usually less than two hundred years, limiting our understanding of seasonal climate variations within the long-term climate background. Paleoclimate proxy records, such as ice cores, loess, lake sediments, and tree rings, are important supplements for modern instrumental data, but most of these proxies cannot be used to study past seasonal climate changes because of their relatively low temporal resolution.

Tridacna shells have the potential to be used as an ideal material for past seasonal climate variability



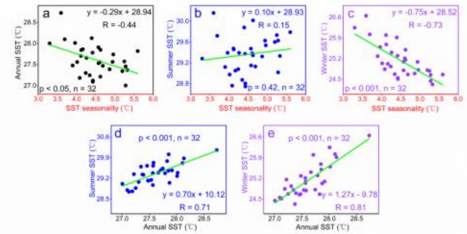
- *Tridacna* spp. may live over 100 years, and their shells are the largest bivalve shells in the world, measuring up to 1m in diameter.
- Since the Eocene (ca. 50 million years ago), *Tridacna* spp. has been a key component of coral reefs in the tropical Indian-Pacific Ocean.
- *Tridacna* shells are sedentary, record environments at a fixed point in space.
- Hard and dense aragonite shells with visible annual growth lines even daily growth line in their inner shell layer.

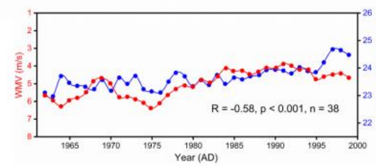
Sr/Ca ratios and SST seasonality (ΔT) for three *Tridacna squamosa*



ΔT (°C) = proxy seasonalityΔSr/Ca × 16.60

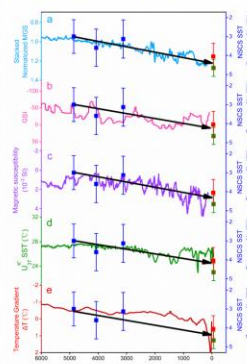
Recent decadal variations and dynamics of SST seasonality in the northern SCS





High-resolution modern instrumental data suggested that the SST seasonality in the northern SCS was negatively correlated with annual SST in the SCS. When annual SST increased, SST seasonality generally decreased, and vice versa. The negative correlation between annual SST and SST seasonality was mainly caused by asynchronicity of SST variations in winter and summer. When the northern SCS mean climate condition warmed, winter SST increased more than that in summer, resulting in a reduction of the amplitude of SST seasonality. When the northern SCS mean climate conditions cooled, the decreased amplitude of SST in winter was larger than that in summer, resulting in an increased SST seasonality. Therefore, the SST seasonality in the northern SCS was probably driven by winter SST. The variation of winter SST in the northern SCS was deeply influenced by the intensity of East Asian winter monsoon (EAWM).

Reconstructed SST seasonality in the northern SCS during the middle Holocene



Comparing sea surface temperature (SST) seasonality records (squares) in the northern South China Sea (NSCS) during the middle to late Holocene with other published paleoclimate records. Holocene EAWM records derived from (a) mean grain size (MGS) of Chinese loess sediment, (b) grain-size index (GSI) from core Oki02 in the northwestern Pacific Ocean, and (c) magnetic susceptibility of a sediment core from Lake Huguang Maar. (d) Reconstruction of Holocene mean annual SST in the northern SCS derived from long-chain unsaturated alkenones $U_{37}^{K'}$. (e) Temperature gradient between the low and high latitudes of Northern Hemisphere.

Blue squares indicate the average SST seasonality derived from the Sr/Ca ratio of middle Holocene *Tridacna squamosa* specimens (A87, A165, and A276), red squares indicate the Sr/Ca ratio of a modern *Tridacna gigas* specimen (YX1), and green squares indicate modern instrumental SST data (AD 1994–2004).

Thank you