

# AMOC多百年振荡调制了吐蕃王朝的兴衰

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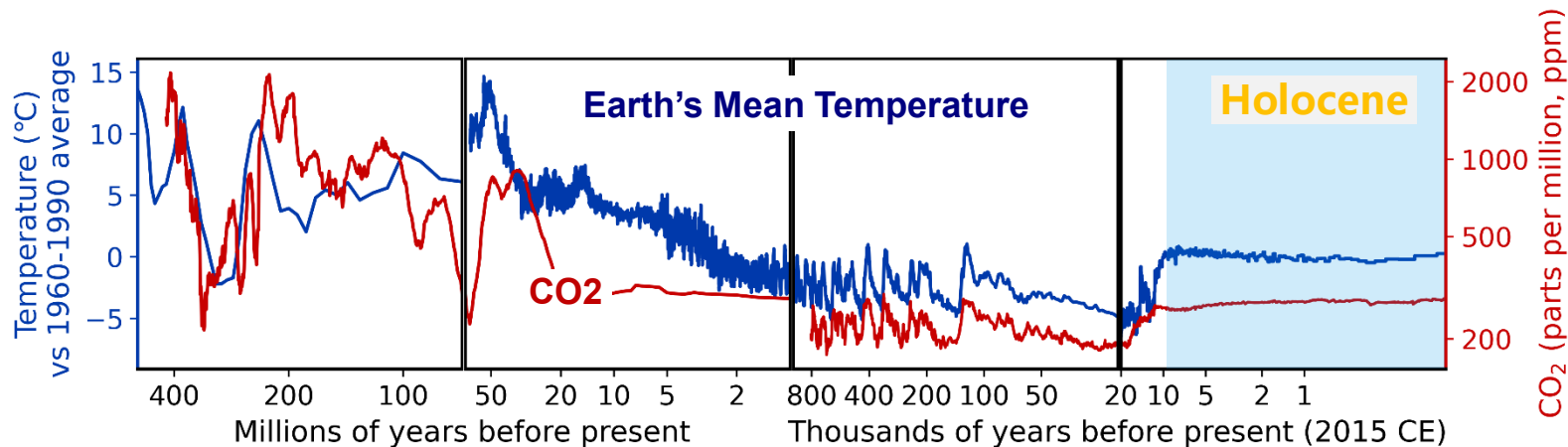
# Questions

## 500±300 Years

1. *Natural Centennial-Millennial oscillation* in Holocene climate?  
地球气候系统是否存在百年-千年尺度自然振荡? (Yes!)
2. *What component* can provide multicentennial timescale?  
地球气候系统哪个分量能够提供千年振荡的时间尺度? (AMOC)
3. Connection to the *evolution of human civilization*?  
这种振荡与人类文明演化是否有关系?

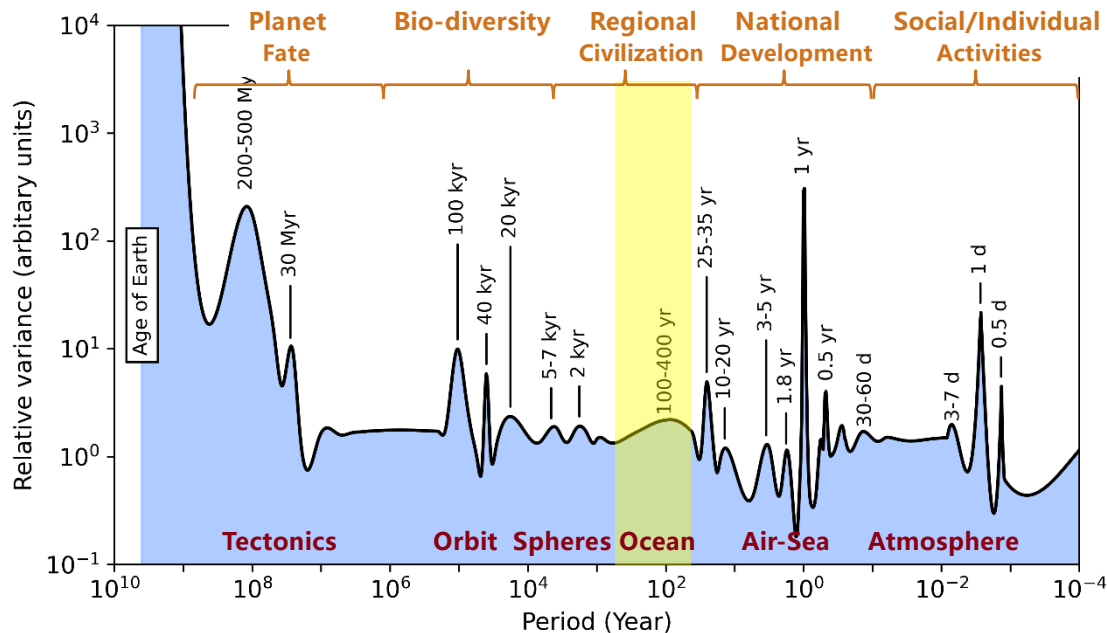
# Background: Stable Holocene Climate

Holocene: Since 10ka / Stable external forcing / *Natural* variability ( $500 \pm 300$ ) (?) years



[https://earth.org/data\\_visualization/a-brief-history-of-co2/](https://earth.org/data_visualization/a-brief-history-of-co2/)

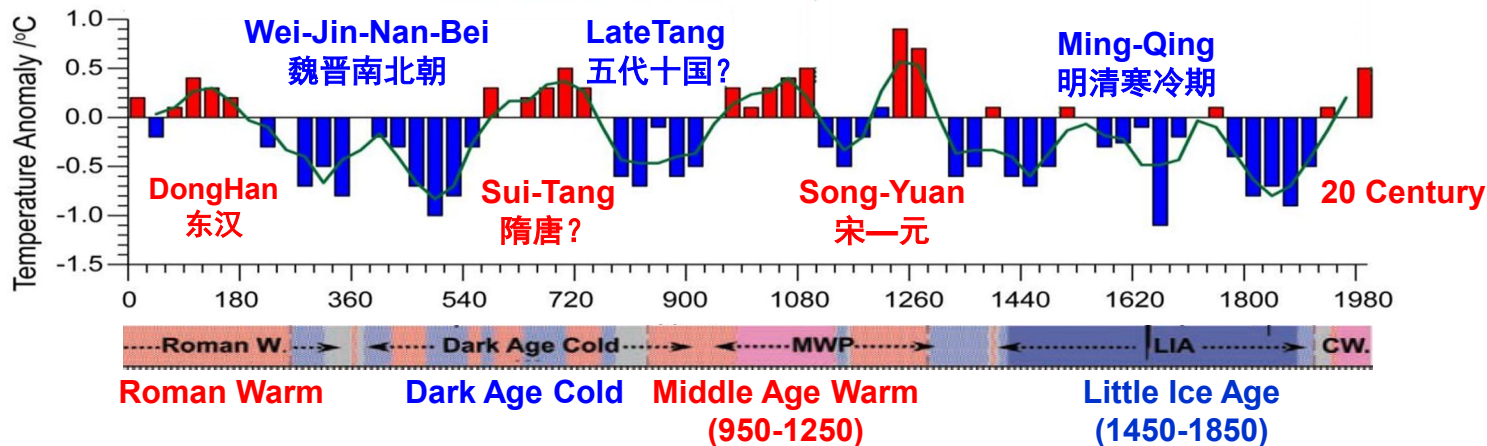
## Spectrum of Earth's Climate Variability



Based on multiply sources of “prewhitened” temperature records

Mitchell, 1976; Stocker and Mysak, 1992; Ghil, 2001; Heydt, 2021;

## Chinese Scientists' contribution: Temperature evolution in eastern China in wintertime of the past 2000 years

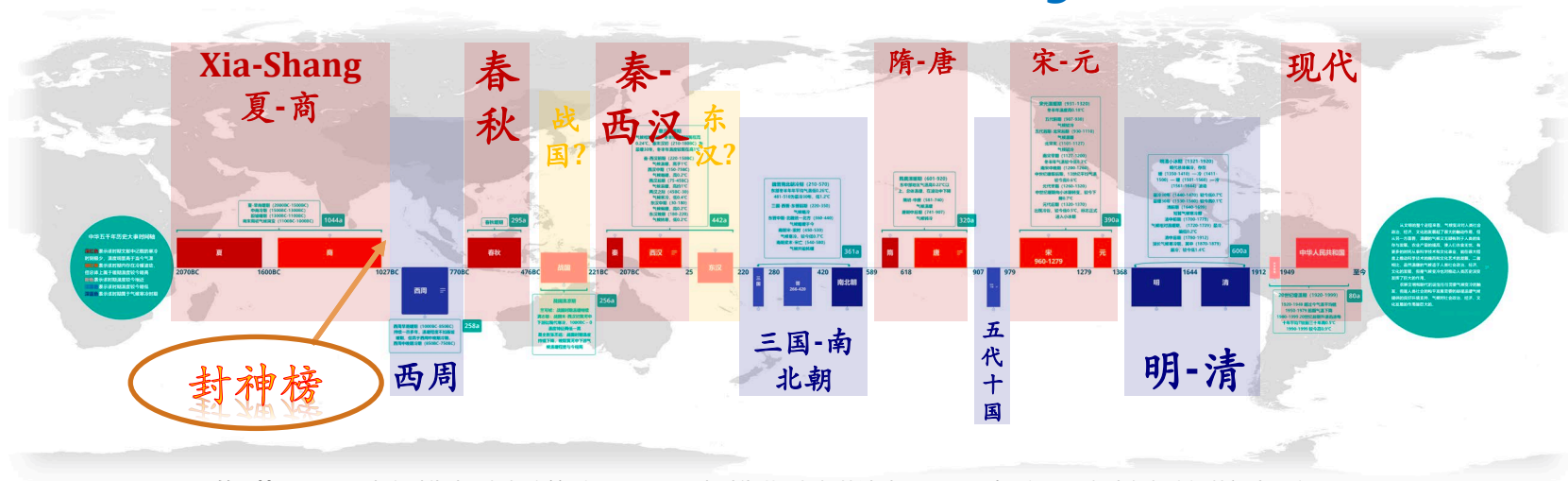


葛全胜, 郑景云, 满志敏, 方修琦, 张丕远, 2002: 过去2000a中国东部冬半年温度变化序列重建及初步分析. 地学前沿, 9(1), 169-181.

郑景云等, 2010; 葛全胜等, 2014

# Documentary records in China: 200-300 or 600 (?) Years

## Warm and Cold period during the past 5000 years in the evolution of civilization over greater China



竺可桢, 1925: 南宋时代我国气候之揣测; 1961: 历史时代世界气候的波动; 1972: 中国近五千年来气候变迁的初步研究  
 吴祥定等, 1990: 树木年轮与气候变化; 张丕远等, 1996: 中国历史气候变化; 牟重行, 1996: 中国五千年气候变迁的再考证  
 张德二等, 2004: 中国三千年气象记录总集; 满志敏, 2009: 中国历史时期气候变化研究

# What We Have Done

MCO theory  
established

2-D Ocean Model ✓ *Verified*

3-D Simple Ocean Model ✓

3-D Ocean GCM ✓

Coupled Earth System Model ✓

Apply to

Tubo Dynasty (600-900 AD)

Tang Dynasty and others .....



LaCOAS  
北京大学气候与海-气实验室

Thanks