**Variations in the Climate**

**气候变化**

One of the most difficult aspects of deciding whether current climatic events reveal evidence of the impact of human activities is that it is hard to get a measure of what constitutes the natural variability of the climate. We know that over the past millennia the climate has undergone major changes without any significant human intervention. We also know that the global climate system is immensely complicated and that everything is in some way connected, and so the system is capable of fluctuating in unexpected ways. We need therefore to know how much the climate can vary of its own accord in order to interpret with confidence the extent to which recent changes are natural as opposed to being the result of human activities.

确定现在的气候事件是否证明人类活动影响的最大困难之一在于很难找到一种

方法来确定是什么构成了气候的自然可变性。我们知道在过去的几千年里，气候

在没有重大人类干预下也经历了主要变化。我们还知道全球气候系统是非常复杂

的，所有因素都在某些方面互相联系，因此这个系统以意想不到的方法变化着。

因此，我们需要知道气候在多大程度上是自然变化的，以便于确切解释出最近的

变化在多大程度上是自然的，或相反是人类活动的结果。

Instrumental records do not go back far enough to provide us with reliable measurements of global climatic variability on timescales longer than a century. What we do know is that as we include longer time intervals, the record shows increasing evidence of slow swings in climate between different regimes. To build up a better picture of fluctuations appreciably further back in time requires us to use proxy records.

仪器记录不能追溯回那么久远以提供给我们长于一个世纪的时间标准下的全球

气候可变性的可信测量方法。我们所确知的就是当我们想包括更长久的时间跨度，

记录揭示了在不同制度中缓慢的摇摆的更多的证据。为了建立一个略久远变化的

更好的变化描述，需要我们使用替代记录。

Over long periods of time, substances whose physical and chemical properties change with the ambient climate at the time can be deposited in a systematic way to provide a continuous record of changes in those properties overtime, sometimes for hundreds or thousands of years. Generally, the layering occurs on an annual basis, hence the observed changes in the records can be dated. Information on temperature, rainfall, and other aspects of the climate that can be inferred from the systematic changes in properties is usually referred to as proxy data. Proxy temperature records have been reconstructed from ice core drilled out of the central Greenland ice cap, calcite shells embedded in layered lake sediments in Western Europe, ocean floor sediment cores from the tropical Atlantic Ocean, ice cores from Peruvian glaciers, and ice cores from eastern Antarctica. While these records provide broadly consistent indications that temperature variations can occur on a global scale, there are nonetheless some intriguing differences, which suggest that the pattern of temperature variations in regional climates can also differ significantly from each other.

经过很长一段时间，物理和化学特征随着当时周围的气候变化的物质将会以系统

的方法沉淀，这可以提供那些特征在超长时间里变化的连续记录, 这个超长时间

有时可达几百年或几千年。通常，分层堆积是每年发生的，因此在记录中可观察

的变化可以用来确定日期。 关于温度，降雨和气候的其他方面的信息通常都是

指替代数据，这些信息可以从这种特征的系统变化中推断出来。替代温度记录已

被重建通过：钻取自格陵兰冰帽中部的冰核，西欧深嵌在分层湖底沉积物中的方

解石壳，取自热带大西洋的海底沉积物核，取自秘鲁冰河的冰核,和取自东南极

洲的冰核。尽管这新记录提供了广范一致的迹象指出温度变化可在全球范围内发

生，但仍存在引人发问的差异，这些差异表示区域性气候的温度变化方式可以如

此不同。

What the proxy records make abundantly clear is that there have been significant natural changes in the climate over timescales longer than a few thousand years. Equally striking, however, is the relative stability of the climate in the past 10, 000 years (the Holocene period).

代理记录所充分解释的是在长于几千年的时间跨度里存在着显著的自然气候变

化。但同样令人惊讶的是在过去的一万年（全新世）中气候的相对稳定。【\*全新

世：在地质年表上第四纪后两世从更新世结束一直到现在岩石时期的泥沙时

期——译者】

To the extent that the coverage of the global climate from these records can provide a measure of its true variability, it should at least indicate how all the natural causes of climate change have combined. These include the chaotic fluctuations of the atmosphere, the slower but equally erratic behavior of the oceans, changes in the land surfaces, and the extent of ice and snow. Also included will be any variations that have arisen from volcanic activity, solar activity, and, possibly, human activities.

这些记录中对全球气候的覆盖度已经达到了可以提供气候可变性的方法的程度，它应该至少揭示所有引起气候变化的自然原因是怎样结合的。这些原因包括混乱的大气波动，相对较慢但相当混乱的海洋活动，地表变化和冰雪的覆盖度。还包括任何火山活动、太阳活动将会引起的变化。或许也包括人类活动引起的变化。

One way to estimate how all the various processes leading to climate variability will combine is by using computer models of the global climate. They can do only so much to represent the full complexity of the global climate and hence may give only limited information about natural variability. Studies suggest that to date the variability in computer simulations is considerably smaller than in data obtained from the proxy records.

一种可估计所有这些导致气候变化的不同过程是如何结合的方法就是使用计算机全球气候模型。它们可以做的只有这么多来描绘全球气候的全部复杂性，因此

只能提供自然变化的有限信息。研究表明迄今为止计算机模拟的可变性比取自代

理记录的数据少得多。

In addition to the internal variability of the global climate system itself, there is the added factor of external influences, such as volcanoes and solar activity .There is a growing body of opinion that both these physical variations have a measurable impact on the climate. Thus we need to be able to include these in our deliberations. Some current analyses conclude that volcanoes and solar activity explain quite a considerable amount of the observed variability in the period from the seventeenth to the early twentieth century’s, but that they cannot be invoked to explain the rapid warming in recent decades.

除全球气候系统本身的内部变化之外，还存在其他外部影响的因素，如火山或太

阳活动。有越来越多的观点认为这两种物理变化对气候有着可测量的影响。因此

我们需要能够考虑到这些。一些现在的分析断定火山和太阳活动解释了自 17 世

纪到 20 世纪早期的相当多的可观察到的变化但他们不能用以揭示最近几十年的迅速变暖。