



Global Monsoon and Civilization

WANG Pinxian

School of Ocean and Earth Sciences, Tongji University, Shanghai 200092 China

FIRST PARAGRAPH: Six monsoon systems are recognized in the modern world, the Asian, North and South African, Australian, North and South American, and their changes are affecting billions of people. The regional monsoon systems are driven by the same annual cycle of solar heating, yet differ from each other in their geographic position and orographic features. For over 300 years, the monsoon has been considered as a gigantic land-sea breeze of regional scale, but now it is considered as a global system over all continents but Antarctica.

全球季风与人类文明

汪品先

同济大学 海洋与地球科学学院, 上海 200092

首节: 当今世界上有六大季风系统: 亚洲季风, 北非和南非季风, 澳洲季风, 南美和北美季风。不同区域的季风, 都由太阳辐射加热的季节周期所驱动, 但是又因为地理位置和地形特征不同而互有差别。三百多年来, 季风一直被看成一种巨型的“海陆风”, 属于区域性现象; 现在方才意识到这是一个全球系统, 为南极以外各个大陆所共有。

The global monsoon exists through all geological history and covaries with various geological cycles including those caused by the geometric changes of the Earth's orbits. The 20,000-year precessional cycle of the global monsoon, for example, is responsible for the collapse of several Asian and African ancient cultures about 4,000 years ago. The same cyclicity is seen in the chemical composition of the air, such as methane concentration and oxygen isotope composition of air-bubbles captured in ice cores. There is evidence that the long-term cycles in the oceanic carbon reservoir also has a global monsoon origin. This 400,000-year cyclicity related to “long eccentricity” of the Earth's orbit, and the rhythmic changes in oceanic carbon reservoir were likened to “heartbeat” of the Earth system. This cyclicity becomes longer since 1.6 million years ago, displaying a kind of “arrhythmia” in the Earth system, probably resulting from the growth of the polar ice sheets.

Large-scale changes in climate were discovered in the 19th century, but in two different aspects: Historians and archeologists saw deluges, while geologists saw glaciations. The focus in modern climatology lies on

hydrological cycles, on dry vs humid variations, whereas paleoclimatologists emphasize glacial cycles, changes between warm and cold, and the difference has been maintained until the present day. In the global scale, however, monsoon and ice-sheets are the two major components in the climate system related to low- vs high-latitude processes, respectively. The human and its civilization originated in low-middle latitudes and, hence, have been sensitive to variations in the global monsoon system.

The presentation will review the recent progress in paleo-monsoon records with a perspective of its human dimension. Emphasis will be laid on variations in precipitation and related disasters, illustrated with examples from ancient civilizations in Asia, Africa and America.

全球季风贯穿着整个的地质历史, 并且随着各种地质旋回而变化, 包括地球运行的轨道周期。正是全球季风的两万年岁差周期, 导致了大约四千年前亚洲和非洲一系列古文明的衰亡。同样的周期性变化也影响着大气的化学成分, 极地冰芯气泡中的甲烷浓度和氧同位素值, 都随着岁差周期而发生变化。

有证据表明：全球季风还造成了大洋碳储库变化的长周期。大洋碳储库在地质历史上呈现出 40 万年的变化韵律，来源于偏心率的长周期，被喻为地球系统的“心跳”。这种韵律反映的是全球季风和低纬过程的长周期，在“正常”状态下的气候系统里扮演着主角。160 万年前极地冰盖的大幅度增长打破了这种状态，大洋碳储库的 40 万年周期“拉长”，地球系统进入“心律不齐”的状态。

19 世纪才发现气候有过巨大的变化，不过从考古和历史角度看到的是大洪水，从地

质记录角度看到的是大冰期。现代气候学更重视干、湿，古气候学更重视冷、热，两者之间的差异一直延续至今。然而从全球的尺度看，冰盖和季风无非是气候系统分别由高、低纬过程所驱动的两大部分。人类和人类文化是在中-低纬度区演化产生的，因而对于季风演变是敏感的。

本文将从人类的角度对于古季风研究的进展进行评述，并且通过亚洲、非洲和美洲的实例，重点讨论降水的变化和灾害。