The global monsoon across time scales: Mechanisms and outstanding issues

Pin Xian Wang, Bin Wang, Hai Cheng, John Fasullo, Zhengtang Guo, Thorsten Kiefer, ZhengYu Liu

PII: S0012-8252(16)30207-0
DOI: doi: 10.1016/j.earscirev.2017.07.006
Reference: EARTH 2454

To appear in: *Earth-Science Reviews*

Received date: 28 July 2016
Revised date: 13 July 2017
Accepted date: 13 July 2017

Please cite this article as: Pin Xian Wang, Bin Wang, Hai Cheng, John Fasullo, Zhengtang Guo, Thorsten Kiefer, ZhengYu Liu , The global monsoon across time scales: Mechanisms and outstanding issues, *Earth-Science Reviews* (2017), doi: 10.1016/j.earscirev.2017.07.006

The Global Monsoon across Time Scales：

Mechanisms and Outstanding Issues

Pin Xian Wang[1], Bin Wang[2,3], Hai Cheng[4,5], John Fasullo[6], Zhengtang Guo[7], Thorsten Kiefer[8], and ZhengYu. Liu[9,10]

[1] State Key Laboratory of Mar. Geol., Tongji University, Shanghai 200092, China

[2] Department of Atmospheric Sciences, School of Ocean and Earth Science and Technology,, University of Hawaii at Manoa, Honolulu, HI 96825, USA

[3]Earth System Modeling Center, Nanjing University of Information Science and Technology, Nanjing, 210044, China.

[4]Institute of Global Environmental Change, Xi'an Jiaotong University, Xi'an 710049, China

[5] Department of Earth Sciences, University of Minnesota, Minneapolis, MN 55455, USA

[6] CAS/NCAR, National Center for Atmospheric Research, 3090 Center Green Dr., Boulder, CO 80301, USA

[7] Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, P.O. Box 9825, Beijing 100029, China

[8] Future Earth, Global Hub Paris, 4 Place Jussieu, UPMC-CNRS, 75005 Paris, Franc

[9] Laboratory Climate, Ocean and Atmospheric Studies, School of Physics, Peking University, Beijing 100871, China

[9] Center for Climatic Research, University of Wisconsin Madison, Madison, WI 53706, USA

Correspondence to: P. X. Wang (pxwang@tongji.edu.cn) and B. Wang (wangbin@hawaii.edu)

Abstract

The present paper addresses driving mechanisms of global monsoon (GM) variability and outstanding issues in GM science. This is the second synthesis of the PAGES GM Working Group following the first synthesis "The Global Monsoon across Time Scales: coherent variability of regional monsoons" published in 2014 (Climate of the Past, 10, 2007-2052). Here we introduce the GM as a planetary scale circulation system and give a brief accounting of why it exhibits regional structure. The primary driver of the GM is solar insolation, and the specific features in the underlying surface, such as land-sea distribution, topography, and oceanic circulations, are mainly responsible for the differences among regional monsoon systems. We then analyze the monsoon formation mechanisms, together with the major processes that drive monsoon variations at various timescales, including external forcings and internal feedbacks. On long time scales external forcings often induce variability on a global scale, whereas short-term variability in regional monsoon systems is usually caused by internal feedbacks within the climate system. Finally, a number