

MONSOON RAINS, GREAT RIVERS, AND THE DEVELOPMENT OF FARMING CIVILIZATIONS IN ASIA

The Asian monsoon and associated river systems supply the water that sustains a large portion of humanity and have enabled Asia to become home to some of the oldest and most productive farming systems on Earth. This book uses climate data and environmental models to provide a detailed review of variations in the Asian monsoon since the mid-Holocene and their impact on farming systems and human settlement. Future changes to the monsoon due to anthropogenically driven global warming are also discussed. Faced with greater rainfall and more cyclones in South Asia, as well as drying in North China and regional rising sea levels, understanding how humans developed resilient strategies to past climate variations is critical. Containing important implications for the large populations and booming economies in the Indo-Pacific region, this book is an important resource for researchers and graduate students studying the climate, environmental history, agronomy, and archeology of Asia.

Peter D. Clift is the Charles T. McCord Chair in Petroleum Geology at Louisiana State University. He is an affiliate faculty at the Massachusetts Institute of Technology and Yunnan University, China, and a fellow of the Geological Society of America. In 2008, he coauthored *The Asian Monsoon: Causes, History and Effects* (Cambridge University Press).

Jade d'Alpoim Guedes is an associate professor at the Department of Anthropology, Scripps Institution of Oceanography, University of California, San Diego. She is an environmental archeologist and ethnobiologist who employs an interdisciplinary research program to understand how humans adapted their foraging practices and agricultural strategies to new environments and have developed resilience in the face of climatic and social changes.





MONSOON RAINS, GREAT RIVERS,
AND THE DEVELOPMENT
OF FARMING CIVILIZATIONS IN ASIA

PETER D. CLIFT

Louisiana State University

JADE D'ALPOIM GUEDES

University of California, San Diego





CAMBRIDGEUNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom
One Liberty Plaza, 20th Floor, New York, NY 10006, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India
79 Anson Road, #06–04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9781107030084
DOI: 10.1017/9781139342889

© Peter D. Clift and Jade d'Alpoim Guedes 2021

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2021

A catalogue record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data Names: Clift, P. D. (Peter D.), author.

Title: Monsoon rains, great rivers and the development of farming civilisations in Asia / Peter D. Clift, Louisiana State University, Jade d'Alpoim Guedes, Scripps Institution of Oceanography, University of California, San Diego.

Description: Cambridge, UK: New York, NY: Cambridge University Press, 2021

Description: Cambridge, UK; New York, NY: Cambridge University Press, 2021. | Includes bibliographical references and index.

Identifiers: LCCN 2020028436 (print) | LCCN 2020028437 (ebook) | ISBN 9781107030084 (hardback) | ISBN 9781139342889 (ebook)

Subjects: LCSH: Meteorology, Agricultural – Asia. | Rain and rainfall – Asia. |
Monsoons – Asia. | Crops and climate – Asia.

Classification: LCC S600.7.R35 C55 2021 (print) | LCC S600.7.R35 (ebook) | DDC 630.2/515095-dc23

LC record available at https://lccn.loc.gov/2020028436 LC ebook record available at https://lccn.loc.gov/2020028437

ISBN 978-1-107-03008-4 Hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.



Contents

Acknowledgments				
1	Intro	duction	1	
	1.1	Climate and Farming Societies in Asia	1	
	1.2	The Monsoon in Asia	4	
	1.3	Environmental Impact of the Monsoon	6	
	1.4	Past Monsoon Environments	9	
	1.5	Niche Construction and Plant-Human Coevolution	15	
	1.6	Connecting Changes in the Monsoon to Changes in Human Society	17	
	1.7	Human Farming Strategies	26	
	1.8	The 8.2 ka Event as a Global Warming Analogue	31	
	1.9	Summary	35	
2	Tem	poral Variations in the Asian Monsoon	37	
	2.1	Introduction	37	
	2.2	Annual to Decadal Timescales	42	
	2.3	Intra-seasonal Variations in the Monsoon	45	
	2.4	Links to Australian-Indonesian Monsoon	46	
	2.5	Measuring the Monsoon	48	
	2.6	Reconstructing the Prehistoric Monsoon	51	
	2.7	Chemical Weathering and the Monsoon	55	
	2.8	Cave Records as Climate Proxies	56	
	2.9	Lake Records	59	
	2.10	Swamp Deposits	60	
	2.11	Organic Geochemistry	61	
	2.12	Tree Rings	62	
	2.13	Temperature Proxies	64	
	2.14	Monsoon during the Little Ice Age	66	

V



Vİ	Contents				
	2.15	Historical Records	67		
	2.16	Synthesis and Summary	69		
3	Monsoon and Societies in Southwest Asia				
	3.1	Monsoonal Weather Patterns in South Asia	76		
		Crops and Farming in South Asia	77		
	3.3	Paleoclimate Proxy Records in South Asia	77		
	3.4	Rivers in South Asia: Morphology and Mythology	87		
	3.5	Early Farmers in the Indus Valley	89		
	3.6	The Historic Period	105		
	3.7	Synthesis and Summary	110		
4	Origins of a Uniquely Adaptive Farming System: Rice Farming				
	-	ems in Monsoon Asia	112		
		Introduction	112		
		Rice Ecology	115		
	4.3	The Background to Rice Domestication: Transformations			
		during the Late Upper Paleolithic in China	120		
	4.4	Broad Spectrum Foraging, Early Exploitation of Rice and			
		Holocene Climate	122		
		Development of Rice Cultivation Technology	128		
	4.6	Climate Change and the Development of New Varieties of			
		Rice during the Establishment and Early Spread of Rice			
		Farming in East Asia	130		
	4.7	Niche Construction, Geographic and Climatic Barriers			
		in the Spread of Rice to Southwest and Southeast China	134		
	4.8	Great Rivers, Niche Construction, and Rice Irrigation on the			
		Chengdu Plain	138		
	4.9				
		Historic Period	141		
	4.10	Synthesis and Summary	147		
5	Dryland Farming in the Northern Monsoon Frontier				
	5.1	Paleoclimate in Northern Monsoon Area from MIS3 to the LGM	149		
	5.2	Late Pleistocene Foragers in the Northern Monsoon Area	150		
	5.3	Intensification during the Bølling-Allerød and Younger Dryas	156		
	5.4	The Origins of Millet Farming in North China	160		
	5.5	Consolidation and Expansion during the Climatic Optimum	166		



More Information

	Contents	vii
5.	6 The 4 ka Event, Collapses of Millet Agriculture on the Margins of the Tibetan Plateau and Northeast China, and	
	Changes in Jōmon Japan	169
5.	7 Adaptations and Resilience: A New Economic Model	173
5.	8 Changes in the Monsoon during the Historic Period	179
5.	9 The Impact of Changing Climate on Pastoralism in the Steppe	182
5.1	0 Synthesis and Summary	184
6 Re	cent Changes in Monsoon Climate	186
6.1	Transformations in Farming during the Twentieth Century	186
6.2	Precipitation Changes in the Twentieth Century	191
6.3	Evolution of Tropical Cyclones	200
6.4	Rainfall in South Asia	203
6.5	River Drainage Evolution	208
6.6	Damming on the Yangtze	218
6.7	Sediment in the Yellow River	220
6.8	Impacts on Farming Systems in South Asia	222
6.9	Synthesis and Summary	231
7 Fut	ture Monsoon Predictions	233
7.1	Monsoon and Global Climate Change	233
7.2	Hydrologic Response to Warming	239
7.3	Modeling Future Monsoon Intensity	247
7.4	Typhoons and Cyclones	257
7.5	Changes in River Runoff	265
7.6	Predictions of Future Sea Level Rise	268
7.7	Synthesis and Summary	275
References		
Index		



Acknowledgments

Peter Clift (PC) wishes to thank support from Louisiana State University during the writing of this book. Much of the material was put together during a fellowship at the Hanse-Wissenschaftskolleg (HWK) in Delmenhorst, Germany. PC especially thanks Doris Meyerdierks at the HWK and Heiner Villinger at the University of Bremen for their help. The final phases of the work were made possible by time spent at Yunnan University, the University of Texas at Austin, and the University of Hong Kong. PC also wishes to thank Sophie Vincent and Erinn Buhyoff for their help with various manuscript preparation tasks. He dedicates his work on this book to the memory of his mother, Margaret Teresa Clift, without whose help and love none of this would have been possible, as well as that of his father Donald William Clift, who first introduced him to Asia.

Jade d'Alpoim Guedes is grateful to the University of California, San Diego, for support during the writing of this book. She is grateful to Kyle R. Bocinsky and to Jacqueline Austermann, who assisted with making figures. She dedicates this book to her daughter, Anwen Else d'Alpoim-Zhang, who was patient while she worked on this book during her very first year on earth and to her family, most notably her husband, Chunbai Zhang who supported her throughout the writing process.

We wish to thank Sarah Lambert and Susan Francis at Cambridge University Press for their encouragement and patience during the writing of this work and to the comments of reviewers who helped improve this manuscript.

viii