

Christian Pfister, Heinz Wanner

**Climate and Society
in Europe –
the Last Thousand
Years**

Haupt Verlag

1st edition 2021

Graphic design: Katarina Lang with Nikolaj Jaberg

Front cover painting: Hendrick Avercamp. Winter Landscape with Ice Skaters c. 1608.
Rijksmuseum Amsterdam, purchased with support of the Vereniging Rembrandt.
Public Domain; www.rijksmuseum.nl/collectie/SK-A-1718

Translation and editing: Angela Wade

The German National Library lists this publication in the Deutsche Nationalbibliografie;
Detailed bibliographic data are available at: dnb.dnb.de

Haupt Publisher is supported by the Swiss Federal Office of Culture with a financial
contribution for the years 2021-2024.

ISBN 978-3-258-08234-9 (eBook: 978-3-258-48234-7)

All rights reserved.

Copyright © 2021 Haupt Berne

Any kind of reproduction without permission of the copyright owner is not allowed.

The authors and the publisher have made every effort to locate all copyright holders.
In case of discrepancies, please contact the publisher.

Printed in Austria

Also available as German edition: 978-3-258-08182-3, 978-3-258-48182-1 eBook

www.haupt.ch

Table of contents

Preface	8
Abbreviations	10
1. Introduction	13
1.1 The switch to rapid warming – a new comparative basis in climate history	14
1.2 Two scientific cultures	15
1.3 Common ground	20
1.4 The climate system	23
1.5 The global energy balance – driver of the climate system	26
1.6 What determined the Holocene energy and temperature fluctuations?	27
1.7 Circulation, energy and mass exchange – basic elements of climate dynamics	29
1.8 Forcing disturbances and internal variability generate climate change	33
1.9 The structure of the book	38
2. Ötzi's wake-up call	41
2.1 Introduction	42
2.2 Facing a Neolithic mummy	42
<i>Insert 2A: The most thoroughly investigated body in the world</i>	
2.3 Ötzi's last hike	44
<i>Insert 2B: The longer-term climatic background</i>	
2.4 Ötzi and the mid-Holocene transition to cooler climate	51
2.5 Conclusion	55
3. The long arm of Tambora	57
3.1 Introduction	58
3.2 Dark night at midday	58
3.3 A global weather chaos	60
<i>Insert 3A: Disaster alert in a mountain valley</i>	
3.4 Europe's last subsistence crisis	65
3.5 Contrasting vulnerabilities	68
3.6 Too many hunger refugees	73
<i>Insert 3B: The birth of Frankenstein and Dracula</i>	
3.7 Conclusion	77
4. From weather narratives to climate science	79
4.1 Introduction	80
4.2 An animated environment	81
4.3 Developing weather chronicles	83
4.3.1 The Graeco-Arabic legacy	
4.3.2 The 12th-century Renaissance	
4.3.3 Reporting under clerical control	
4.3.4 Outstanding weather chroniclers	
4.4 Systematic weather reporting	90
4.4.1 The significance of astrometeorology	
4.4.2 Weather reports from the world's oceans	
4.4.3 Outstanding weather diarists	
4.5 The instrumental measurement of the weather	98
4.5.1 A breeding ground for innovations	
4.5.2 The establishment of meteorological networks	
4.6 A fundamental break	103
4.6.1 The rise of scientific meteorology and climatology	
4.6.2 The exclusion of extreme events	
4.7 Summary and conclusion	107
5. Reconstructing past climate	109
5.1 Introduction	110
5.2 Evidence from archives of nature	110
5.2.1 Signal detection and dating	
5.2.2 Trees never forget	
5.2.3 Mud with a long-term memory	
5.2.4 Ice cores – long frozen climate calendars	
5.2.5 Stalagmites – an archive growing drop by drop	
5.2.6 Glaciers and treelines – synthetic integrators of climate change	
5.3 Evidence from archives of societies	122
5.3.1 A puzzle with missing pieces	
5.3.2 How glaciers became pictures	
5.3.3 The blessings of historical administrations	
5.3.4 The summer half-year in the light of vine growing	
5.3.5 Cultural responses to climatic stress	
5.4 Numbers out of words – the concept of indices	133
5.5 Outlook to Chapters 6 to 8	136
6. European climate – present and past	137
6.1 The European topography at a glance	138
6.2 Spatial overview of current European climate	139
6.3 A 1000-year long overview	144
6.4 A 1000 year-long simulation	149
7. The High Medieval Period 1000 to 1300 AD.....	151
7.1 Introduction and guide to source references	152
7.2 A warm peak around 1000 AD	153
<i>Insert 7A: Vikings on a voyage of discovery – from Iceland to the New World</i>	
7.3 The 11th century	156
7.3.1 Winters from 1000 to 1099	
<i>Insert 7B: The Road to Canossa – pure fiction?</i>	
7.3.2 Summers from 1000 to 1099	
7.3.3 General climatic conditions in the 11th century	
7.4 The 12th century	160
7.4.1 Winters from 1100 to 1199	
7.4.2 Summers from 1100 to 1199	
7.4.3 General climatic conditions in the 12th century	

7.5	The 13th century	164		
7.5.1	Winters from 1200 to 1299			
7.5.2	Springs from 1200 to 1299			
7.5.3	Summers from 1200 to 1299			
	<i>Insert 7C: Olive trees in Cologne</i>			
7.5.4	General climatic conditions in the 13th century			
8.	The Boreal Little Ice Age and the Short Twentieth Century	171		
8.1	Introduction	172		
8.2	The fateful 14th century	173		
8.2.1	Winters from 1300 to 1399			
8.2.2	Springs from 1300 to 1399			
8.2.3	Summers from 1300 to 1399			
	<i>Insert 8A: The millennium flood of July 1342</i>			
8.2.4	General climatic conditions in the 14th century			
	<i>Insert 8B: The Flowered Alp Saga</i>			
8.3	The frosty 15th century	182		
8.3.1	Winters from 1400 to 1499			
8.3.2	Springs from 1400 to 1499			
	<i>Insert 8C: Wolves in Paris</i>			
8.3.3	The 14-month-long heat and drought in 1473 to 1474			
	<i>Insert 8D: Characteristics of outstanding hot and dry European summers</i>			
8.3.4	Summers from 1400 to 1499			
8.3.5	Autumns from 1400 to 1499			
8.3.6	General climatic conditions in the 15th century			
8.4	The two-faced 16th century	193		
8.4.1	Winters from 1500 to 1599			
8.4.2	Springs from 1500 to 1599			
8.4.3	Summers from 1500 to 1599			
8.4.4	The 11-month-long heat and drought in 1540			
8.4.5	Autumns from 1500 to 1599			
	<i>Insert 8E: The fate of the Spanish Armada</i>			
8.4.6	Annual temperatures from 1500 to 1599			
8.4.7	General climatic conditions in the 16th century			
8.5	The volatile 17th century	207		
8.5.1	Winters from 1600 to 1699			
8.5.2	Springs from 1600 to 1699			
8.5.3	Summers from 1600 to 1699			
	<i>Insert 8F: The most devastating inferno in peacetime</i>			
8.5.4	Autumns from 1600 to 1699			
8.5.5	Annual temperatures from 1600 to 1699			
8.5.6	General climatic conditions in the 17th century			
	<i>Insert 8G: Why the Greenland whales survived</i>			
8.6	The quiet 18th century	219		
8.6.1	Winters from 1700 to 1799			
	<i>Insert 8H: Sudden Stratospheric Warming and the Big Chill of 1709</i>			
8.6.2	Springs from 1700 to 1799			
8.6.3	Summers from 1700 to 1799			
	<i>Insert 8I: Five months of volcanic haze over Europe</i>			
8.6.4	Autumns from 1700 to 1799			
8.6.5	Annual temperatures from 1700 to 1799			
8.6.6	General climatic conditions in the 18th century			
8.7	The record-breaking cold 19th century	230		
8.7.1	Introduction			
8.7.2	Winters from 1800 to 1899			
	<i>Insert 8J: Events and sporting activities on the ice</i>			
8.7.3	Springs from 1800 to 1899			
8.7.4	Summers from 1800 to 1899			
8.7.5	Autumns from 1800 to 1899			
8.7.6	Annual temperatures from 1800 to 1899			
8.7.7	General climatic conditions in the 19th century			
8.8	The slow-warming 20th century	238		
8.8.1	Winters from 1900 to 1999			
	<i>Insert 8K: Winter 1963 - the last memory of the Little Ice Age</i>			
8.8.2	Springs from 1900 to 1999			
8.8.3	Summers from 1900 to 1999			
8.8.4	Autumns from 1900 to 1999			
8.8.5	Annual temperatures from 1900 to 1999			
8.8.6	General climatic conditions in the Short Twentieth Century			
8.9	Annual temperatures from 1500 to 1999	246		
9.	Weather, climate, and the human world	247		
9.1	Introduction	248		
9.2	Population size as a new focus	250		
9.3	The medieval demographic greenhouse	254		
9.4	Setback and stagnation	263		
	<i>Insert 9A: Biological warfare and the Black Death</i>			
	<i>Insert 9B: Forging the Hammer of Witches</i>			
9.5	The two-faced 16th century	271		
	<i>Insert 9C: The age of witch hunts 1570-1630</i>			
9.6	A cornucopia of innovations	277		
9.6.1	A new momentum in demographic growth			
9.6.2	Enforcing quarantine			
9.6.3	Modernising agriculture			
9.7	Severe famines and overcoming them	281		
9.7.1	Hunger and climate variability			
9.7.2	Impacts of climate variability			
9.7.3	The millennium famine of 1195 to 1197			
9.7.4	13th-century famines			
9.7.5	The Great European Famine of 1315-17			
9.7.6	The deadly frost famine of 1437-38			
9.7.7	The Malthusian Famine of 1569-74			
9.7.8	The perennial crisis of 1585-1601			
9.7.9	Famines during the 17th and early 18th centuries			
9.7.10	Subsistence crises and famines in the late 18th and 19th centuries			
9.8	Summary and conclusion	294		

10. European climate over the last millennium ... 297

- 10.1 The seasonally resolved climate of the period 1000 to 1989 AD **298**
 - 10.1.1 Introduction
 - 10.1.2 The evolution of seasonal temperatures prior to the Recent Warming Period (RWP)
 - 10.1.3 Forcing factors and the longer-term picture
 - 10.1.4 Seasonal overview of past millennium climate
 - 10.1.5 The transitions from the HMP to the BLIA and from the STC to the RWP
- 10.2 Glacier fluctuations **309**
- 10.3 Tree line fluctuations **314**
- 10.4 Climate and human affairs **315**

11. From slow-going to rapid warming 319

- 11.1 Trapped in the greenhouse: From early detection to full manifestation **320**
 - 11.1.1 Introduction
 - 11.1.2 Scientific pioneers and early alerters
 - 11.1.3 The greenhouse debate reaches the international level
 - 11.1.4 The greenhouse controversy
- 11.2 The “1950s Syndrome” **328**
- 11.3 The sudden transition to sustained warming **334**
 - 11.3.1 The Recent Warm Period (RWP)
 - 11.3.2 Future climate scenarios
- 11.4 The return of vulnerability **340**

Annex 349
Endnotes 350
References 369
Sources 387
Index 389
Figure credits 392
Thanks to the sponsors 397

Online Appendix

- Pfister, Christian; Wanner, Heinz (2021). Climate and Society in Europe – the Last Thousand Years.
doi: 10.7892/boris.148155
or <https://boris.unibe.ch/id/eprint/148155>
Table 1 Sources for Winter
Table 2 Sources for Spring
Table 3 Sources for Summer
List of Sources for Table 1 to 3
Table 4 Centennial sums of Pfister-Indices 1000–1999