SPRINGER BRIEFS IN ENVIRONMENTAL SCIENCE

Winfried Schröder
Gunther Schmidt

Modelling Potential Malaria Spread in Germany by Use of Climate Change Projections

A Risk Assessment Approach Coupling Epidemiologic and Geostatistical Measures

Springer

SpringerBriefs in Environmental Science

For further volumes:
http://www.springer.com/series/8868

Winfried Schröder · Gunther Schmidt

Modelling Potential Malaria Spread in Germany by Use of Climate Change Projections

A Risk Assessment Approach Coupling Epidemiologic and Geostatistical Measures

Springer

Winfried Schröder
Gunther Schmidt
Lehrstuhl für Landschaftsökologie
Universität Vechta
Vechta
Germany

ISSN 2191-5547 ISSN 2191-5555 (electronic)
ISBN 978-3-319-03822-3 ISBN 978-3-319-03823-0 (eBook)
DOI 10.1007/978-3-319-03823-0
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013955558

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Contents

Abstract

According to estimated future temperature rise of the Intergovernmental Panel on Climate Change (IPCC), it has to be expected that the spatial and temporal extent for malaria transmission in Germany will increase as well. Climate warming can affect the distribution and the intensity of parasitic diseases that are carried by insects and animals (vector-borne diseases). This is because the parasites that cause the disease usually flourish in increased temperatures where they benefit from accelerated rates of reproduction and development. Malaria is usually thought to be restricted to the tropics and developing countries, but climate change could bring it back to Europe, especially into countries where it was present until the middle of the last century, such as, for example, Germany: tertian malaria or vivax malaria, a rather severe form of malaria, was prevalent in north-western parts of Germany until the 1950s before it was eradicated. The vector itself (the mosquito) is still present and infected people from malarial regions could introduce a new onset of malaria.

The study at hand comprises two case studies: in *case study 1* areas at risk of a malaria outbreak in the German federal state Lower Saxony, a former endemic malaria region until the 1950s, were mapped. Subsequently, the study was broadened to the whole territory of Germany (*case study 2*). *Case study 1* was based on measured (1947–1960, 1961–1990, 1985–2004) and predicted (2020, 2060, 2100, each best case and worst case scenario) air temperatures. In *case study 2*, the potential spread of tertian malaria by anopheles mosquitoes was modelled for the periods 1991–2020, 2021–2050, and 2051–2080 using the IPCC A1 and B1 emission scenarios. Both studies rely on data from the relevant literature defining the reproduction and development of the mosquito (*Anopheles atroparvus*) and the malarial parasite as considered in the basic reproduction rate (R_0) formula.

The results from *case study 1* indicated that the gate of potential tertian malaria transmissions with regard to R_0 could be expected to increase from 2 months in the past to 6 months in the future in Lower Saxony. Past and recent findings of *Anopheles atroparvus* coincide with those regions where the potential malaria transmission gate was projected lasting for 4 months in 2060 (best case scenario)