When Dutch astronomer Prof. dr. Kees de Jager returned to his isle of birth Texel, he was asked by the former director of the Royal Dutch Institute for Sea Research, Prof. dr. Jan de Leeuw, to investigate the relationship between solar activity and our climate. During this research he cooperated with Silvia Duhau, Ad Nieuwenhuizen, Hans Nieuwenhuijzen, and many other researchers. That research, done over a period of 15 years, has generated about ten papers with remarkable new insights. All the papers are compiled together here and they provide the common thread for this book.

This book covers the equatorial and poloidal magnetic fields, and the recently discovered granular scale magnetic fields. Further, a prediction method is described for the *sunspot maxima* until 2130, and the notions *phase diagram*, *Transition Point* and *grand episode* are explained. The start of modern heating (1920), and the concept of solar variability *as part of* the modern heating curve (≈ 0.15 °C), have statistically been determined by the same method which has been applied to study the influence of the solar variability on the climate. Another aspect of our study is the non-linear time difference between the solar magnetic increase and terrestrial warming, which has some parallelism with the glacier lengths. This time difference has almost become zero in the last decades of the 20th century.

ISBN 978-94-92114-14-3
9 789492 114143

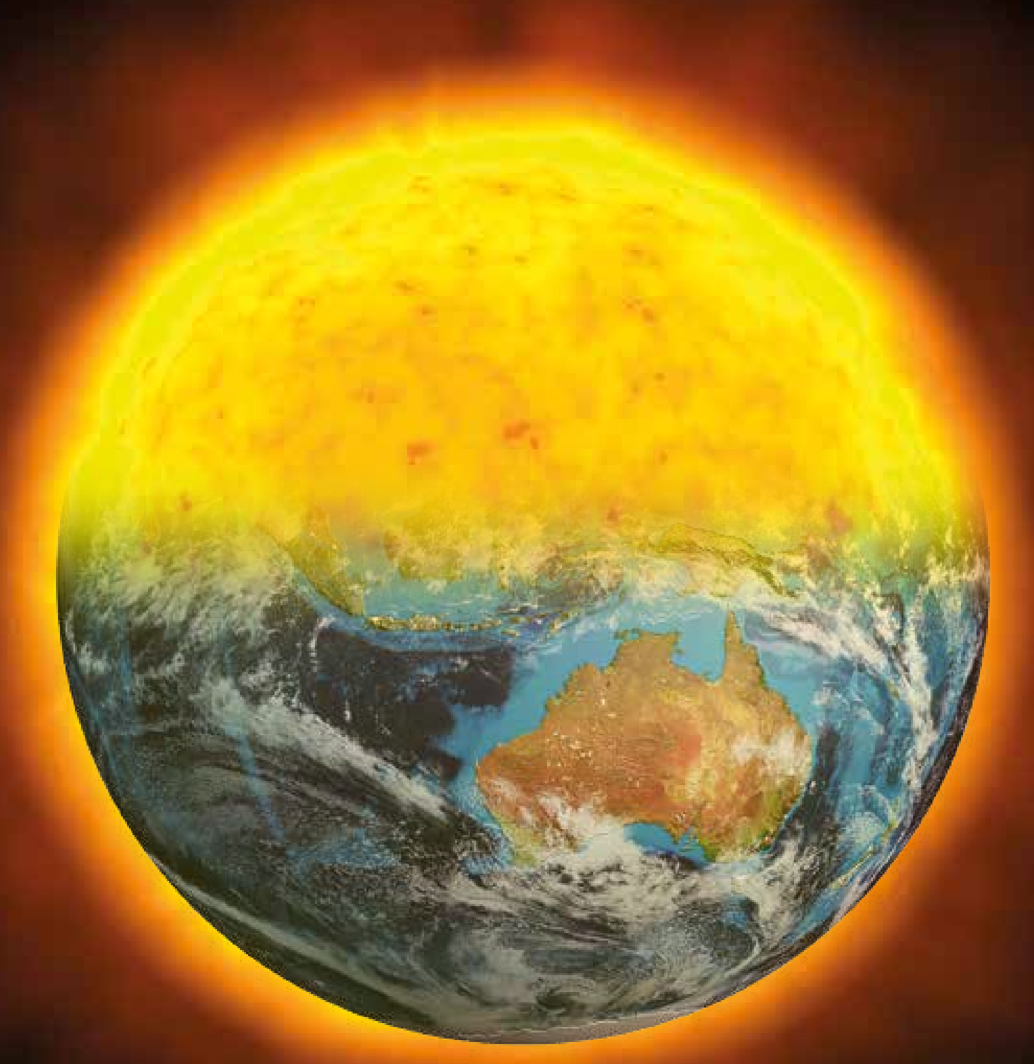
stip•media

SOLAR MAGNETIC VARIABILITY AND CLIMATE - C. de Jager, S. Duhau, A.C.T. Nieuwenhuizen

stip•media

SOLAR MAGNETIC VARIABILITY AND CLIMATE

C. de Jager, S.Duhau,
A.C.T. Nieuwenhuizen



stip•media

Uitgever: Stip Media, Alkmaar
Eerste druk: december 2020
ISBN: 978-94-92114-14-3
NUR: 000

SOLAR MAGNETIC VARIABILITY AND CLIMATE

by

C. de Jager, S. Duhau and A. C. T. Nieuwenhuizen

stip media

2020

CONTENTS

INTRODUCTION AND SUMMARY

Some time ago one of the authors (CdeJ) was invited by Prof. dr. Jan de Leeuw, at that time director of the Royal Netherlands Institute for Sea Research, to investigate the relationship between solar activity and our climate. In the subsequent studies good cooperation was found with the two other authors (Silvia Duhau and Ad Nieuwenhuizen) while at some time we also profited greatly from the cooperation with Rob Rutten, Bas van Geel, Ilya Usoskin, Hans Nieuwenhuijzen and Rob Hammerschlag. We are also obliged to Frédéric Clette and Leif Svalgaard for their help in matters of sunspot and group sunspot counting. Their fine cooperation is thankfully mentioned here.

This book deals with the problem of the influence of the various solar magnetic field components on the Earth' s average Northern hemisphere ground temperature. While most previous studies of this topic by other authors were restricted to the equatorial magnetic fields we found it necessary also to include the polar magnetism which was hitherto not yet discussed. Yet, it is found (Ch. 8) that it contributes considerably to the terrestrial warming, nearly half as much as the equatorial magnetic fields do. And, next to these two fields we had to deal with a recently noted third solar magnetic component that also seems to influence the earth's climate, to the considerable degree of about 25% before 1920.

In the first three Chapters of this book (Ch. 1, 2 and 3) the three magnetic field components are described. Their proxies and variability is dealt with. The main aspects of the solar dynamo are discussed in Chapter 4. We find (Chs. 5 and 6) that the recently started fairly low level of solar activity (since about 2000) will stay that low during a few coming solar undecennial cycles and that it may even stay that low during the forthcoming millennium. The last four chapters deal with the Earth's climate and its variation due to solar magnetic influence. We limit ourselves to the climate of the Northern Hemispheric continents (it is only for these regions of the Earth that sufficiently reliable observational data are available). It then appears that during the past few centuries, up to the first two decades of the 20th century, the average Northern Hemisphere ground temperature is fully correlated with solar activity. But after 1920 an additional component becomes more and more important (Ch. 8). It consists of additional heating that already reached a value of close to one degree centigrade around the year 2000. In addition we find (Chs. 9 and 10) a variable delay with an average value of some 16 years between the times of solar increase of magnetic activity and that of terrestrial warming. The duration of this delay decreased steadily from ~1600 till present. The main results of this book are summarized in Figs. 9.13 and 10.7 and 10.8.

Summarizing, the main new results described here are:

-- we investigate the dependence of the average (smoothed) Northern Hemisphere ground temperature on three components of the solar magnetic fields and determine their relative contributions to the Earth's average temperature variation.

-- up to ~ 1920 the variation of the smoothed average NH ground temperature is mainly determined by the three solar magnetic fields; after that an extra non-solar component becomes more and more important, to reach a value close to one degree centigrade around the year 2000.

-- the notions Transition Point and Grand Episodes of the solar dynamo are introduced.

-- the beginning of an episode of increased atmospheric warming occurs on the average about 16 years after the start of a period of increased solar magnetic activity, but that delay decreased in the course of time: it was longest some 500 years ago and became gradually shorter. Some parallelism with glacier lengths is noted.

C. de Jager, *R. Netherlands Institute for Sea Research, Texel, formerly SRON Space Research Organisation of the Netherlands, Laboratory for Space Research , Utrecht, The Netherlands*

S. Duhau, *Departemento de Fisica, Universidad de Buenos Aires, Argentina*

A.C.T. Nieuwenhuizen, *SRON Netherlands Institute for Space Research, SRON Utrecht, Utrecht, The Netherlands*