Preface

The topical issue of “Variability of the Sun and Sun-Like Stars: From Astero-seismology to Space Weather” is based on contributions presented at the first International Conference on Solar Physics which was organized in Baku, Azerbaijan in July 06–08, 2015.

The primary goals were to highlight all aspects of modern solar physics research, including observation and theory that span from the interior of the Sun out into the wider heliosphere, as well as solar-terrestrial physics and particularly, sun-like stars.

Around 120 people were gathered in Baku (both from domestic and abroad) to share the findings of their research in solar and solar-terrestrial physics. All international scientists appreciated to live a while in this beautiful capital and largest city of Azerbaijan, housing many scientific and cultural headquarters, including the Science Development Foundation under the President of the Republic of Azerbaijan. This foundation hosted and financed the Conference, for which one of the sessions has been held at the Shamakhy Astrophysical Observatory of the Azerbaijan National Academy of Sciences, a delightful place in the Caucasian mountains.

This book does not cover all issues addressed in the Conference but tackled some of them to pinpoint the best of international research in the field of the Solar Variability and Space Weather.

It is clear today that the Sun is a variable star. However, we are still far from fully understanding what and how causes this variability. Why does the Sun continue to go on, on a rhythmic scale, the so-called solar cycle, without damping? How to better understand the complicated relationships between the Sun, the heliosphere and the many proxies of long-term solar activity? How the data could be fully exploited for a better understanding of solar changes on the longest possible time scales? How our knowledge on the Sun can be transferred to other stars?

These questions shape the architecture of the book.

- The first seven chapters in Section 1 “Solar Physics” focus on the Physics of the Sun. In the recent years helioseismology provided us with important information about the interior of the Sun. After recalling briefly the principles of helioseismology, Chapter 1 by S. Ehgamberdiev describes the scientific results obtained at the Ulugh Beg Astronomical Institute (UBAI) in the framework of an International Research on the Interior of the Sun. In a comprehensive review, A. Kosovichev et al. study in Chapter 2 the development of local helioseismology which provides a unique opportunity to investigate the subsurface structure and dynamics of active regions and their effect on the largescale flows and global circulation of the Sun. The two next Chapters (3 and 4) by Alan

A. Wray et al. and I. Kitashvili focus on realistic numerical simulations, i.e., those that make minimal use of ad hoc modeling, which are essential for understanding the complex turbulent dynamics of the interiors and atmospheres of the Sun (and other stars) and the basic mechanisms of their magnetic activity and variability.

Chapter 5 is a general up-to date history of the measurements of the solar diameter viewed from a critical quality assessment of the existing data. From an astrophysical point of view, this topic is closely link with the study of the solar Near Sub-Surface Layer (NSSL or “leptocline”) and therefore directly understood through mechanisms explained in Chapter 2.

In the scope of the study of the solar cyclicity characteristics, V.N. Ishkov develops in Chapter 6 statistics leading to different scenarios of the regular changes of magnetic field in the solar convection zone generation regime, in accordance with the epoch of low or high activity.

Lastly, Chapter 7 in this Section, by N.S. Dzhililov, focuses on the wave instabilities in an anisotropic magnetized space plasma whose results are of importance for the description of wave processes in the solar corona and solar wind. Thus, this Chapter constitutes a good transition with Section (3) dedicated to space weather.

- The next Section 2 is devoted to “recent developments from helioseismology to asteroseismology” and are presented by J. Christensen-Dalsgaard. Transposing the results obtained from helioseismology to asteroseismology has already been very profitable. In the last decade extensive observations of stellar oscillations, in particular from space photometry, have provided very detailed information about the global and internal properties of stars. As explained in this Chapter 8, remarkable insight has been obtained on the properties of evolved stars, and many new results are expected in the near future.
- Section 3 is dedicated to peculiar aspects of “Space Weather”. This concept was launched some 15 years ago to describe the short-term variations in the different forms of solar activity, and their effects in the near-Earth environment and technoculture. The ultimate goal is to get a better understanding of the full chain of effects from the Sun to the Earth. Here the focus is put on the influence of cosmic rays.

In Chapter 9 by L. Dorman and E.S.Babayev, the authors deal with the issue of whether there is an appropriate role of Cosmic Rays on Satellites Operation, Technologies, Biosphere and People Health.

By contrast, L. Dorman et al. focus in Chapter 10 on how to forecast exactly dangerous phenomena from space on the Earth’s civilization and propose steps for founding a cosmic ray warning system.

Chapter 11 is dedicated to Space Weather effects on human health. S. Dimitrova and E.S.Babayev reviews here collaborative investigations performed at middle Earth latitudes and at different geographical

places in order to study the potential effects of space weather on human physiological and psycho-physiological state and acute cardio-vascular incidences.

- Section 4 develops some “Impacts of the Sun on Earth climatology”, and is divided in three chapters. The first one (Chapter 12) by L. Dorman examines the Cosmic Rays and other Space Phenomena that influenced the Earth’s Climate and evidence inter alia that very big changes in climate could have been caused by some rarely phenomena as impacts of asteroids and nearby supernova explosions. Discussing issues on forecasting global climate change that could be important for saving present civilization from great climate catastrophes introduce Chapter 13. This Chapter by J.P. Rozelot and Z. Fazel explores the effects of drastic climate change on society vulnerabilities, such as the collapse of the Akkadian Empire, those of the Classical Mayan civilization or the Greenland colonies, to revisit the linked questions of the history of solar output, the history of the Earth’s climate and the history of past disasters. Lastly Chapter 14 by V. A. Dergachev focuses on the Influence of orbital forcing and solar activity on climate change in the past. In considering the question on the evolution of global surface temperature during the Holocene, it is addressed that the models have tendencies to suppress the variabilities of regional level fixed in the data from natural archives.

The audience targeted by this book consists of researchers, PhD students, post-docs, and also all scientists seeking a complementary culture or evolving toward new research topics.

The editors sincerely thanks the authors for the great quality of the lectures given in Baku and of the resulting papers published here. They hope that this Book will help to a better knowledge of our Star.

J.-P. ROZELOT

Université de la Côte d’Azur (F)
77, Ch. Des Basses Moulrières
F-06130 Grasse, France

E.S. BABAYEV

Science Development Foundation under the President of the Republic of Azerbaijan
AZ-1025, Yusif Safarov street-27, Baku, Azerbaijan

Science Development Foundation under the President of the Republic of Azerbaijan

SDF (Science Development Foundation under the President of the Republic of Azerbaijan), is a government non-profit organization, established in October 2009 within the National Strategy on Development of Science in Azerbaijan.

SDF supports scientists and specialists from academic, education, ministerial, NGO structures, as well as employed and unemployed physical scientists/persons through research grants. Types of grant competitions are: so called “Classic Annual grant competition” covering all of branches and directions of science; Young scientists and specialists’ grant competition, up to 35 years old; “Shusha grant” competition, covering Karabakh studies; “Mobility grant” competition, full support of participation at scientific conferences and short-term trainings abroad; targeted grant competitions such as ICT, Industry grant, Science-Education Integration grant, University grant competitions, so on. Types of projects supported by SDF are: Fundamental; Applied; Innovative; Mega projects (more than 500 000 manats up to several millions and up to 500 000 manats) – so called “pilot projects” and “complex multidisciplinary program projects” aimed in equipping of scientific organizations with super-modern scientific devices, equipment etc. and creating new labs, as well as preparation and training staff abroad to work with these technologies; Material-technical support (scientific devices, equipment etc.) of labs, researchers; Support of publishing of monographs, books, atlases etc.; Support of organization of scientific conferences in Azerbaijan; support of participation at scientific conferences abroad; support of participation at short-term trainings abroad. International collaboration: HORIZON-2020 (BSH and EaP PLUS), BS ERA-NET; BSEC, UNECE; UNESCO; CNRS (France); Belarusian Republican Foundation of Basic Studies; Russian Republican Foundation of Basic Studies, TUBITAK (Turkey), Georgian Shota Rustaveli National Science Foundation, Kyiv National Technical University, Ukraine; “Science Foundation”, Kazakhstan; US “Karabakh Foundation”; Elsevier; Thomson Reuters; Springer, etc.

Advantages are: scientific priorities are changed for each year taking into account trends in world science and collaboration; All branches and directions of science are covered; Preparation of young professionals through trainings abroad; No limitation to scientific degree and title – only scientific content is major merit; Non dependence on sex, nationality and age; Grant budget directly goes to project leader’s bank account; they get additional salaries, they have ability to travel (business trips), to get ICT facilities, special scientific equipment, so on; SDF buys (dealing with custom, tax and other authorities itself saving time for scientists) and supplies all of scientific devices, equipment, materials directly to scientists; SDF prefers so called “temporary scientific collectives” at grant project application which brings scientists from different organizations (academic, university, NGO, so on) together and stimulate their collaboration; Special weekly tutorial seminars, including those of outside Baku (capital city), how to prepare applications. SDF each year organizes different international and domestic conferences, seminars, trainings, so on.