

Preface

12th International Symposium on Equatorial Aeronomy (ISEA-12)

The International Symposia on Equatorial Aeronomy (ISEA) is an historic conference series, initiated by ionospheric scientists in the early sixties soon after the Jicamarca Radio Observatory started its operation near Lima, Peru. This series has become an important event for scientists interested in the physics of the low- and mid-latitude upper atmosphere and ionosphere. Since the first symposium in Huaychulo, Peru nearly five decades ago, ISEA has been held regularly every 3 to 5 years in different locations around the globe. It represents an opportunity for researchers in the aeronomic community to review and evaluate their scientific achievements over the period since the previous ISEA, share their most recent results and ideas, and discuss possibilities for new directions in research, joint experiments and observing campaigns.

The 12th International Symposium on Equatorial Aeronomy (ISEA-12) was hosted by the Ionospheric Physics Lab, Physics Department, University of Crete. It was held from 18 to 24 May 2008 at the Royal Knossos Conference Hotel to the east of Heraklion on the island of Crete, Greece. The symposium was attended by 175 participants from 25 countries. A total of 250 papers (about 150 oral and 100 posters) were presented by invited and contributing authors during 11 scientific sessions. The topics covered a wide range of research areas, reflecting the need to study the Earth's ionosphere/atmosphere system in a coupled sense. ISEA-12 comprised sessions on the dynamics of the middle atmosphere, mesosphere and thermosphere, *E*- and *F*-region ionospheric plasma physics and electrodynamics, including large scale ionospheric modeling and simulation, atmosphere-ionosphere coupling processes and phenomena, magnetic storm and space weather effects, and a session on new experimental techniques and instruments. In addition, and for the first time in its long history, ISEA-12 started with a full day of tutorials on key topics and ended with a session of invited talks on future research trends and unresolved problems. The works of the symposium are included in the ISEA-12 Book of Abstracts, which is available for download at the symposium's web page <http://isea12.physics.uoc.gr>.

The ISEA-12 Organizers have also produced a Book of Tutorials, a quality publication volume of 150 pages that was offered to all the symposium participants. Its scope was to allow the reader to gain a wider perspective on fundamental scientific aspects of low- and middle-latitude aeronomy, as they have evolved over the past five decades of research since the first ISEA meeting. Its tutorials constitute comprehensive reviews of the present state of knowledge on key research areas of ionospheric and upper atmospheric science. The contents include: upper atmosphere waves and dynamics, equatorial *E*- and *F*-region plasma irregularities and instabilities, mid-latitude electrodynamics and plasma physics, internal and external influences on ionospheric electrodynamics at low and middle latitudes, as well as lower and middle atmosphere electrical phenomena and electrodynamics. The emphasis is on the observational characteristics of the various aeronomic phenomena at low and middle latitudes and the governing physical principles, theories and mechanisms. The goal of this book is to allow the members of the community to appreciate the recent developments in research and thus obtain a clearer picture of the current state of understanding concerning low- and middle-latitude aeronomy. With the approval of the authors, the Organizing Committee made the ISEA-12 Book of Tutorials available to everyone interested, who can download its pdf version from the symposium's web page <http://isea12.physics.uoc.gr>.

Participants felt that the symposium had been a great success, both scientifically and socially, and that the low- and mid-latitude aeronomic community has gained new momentum for future work. The ISEA-12 organizers wish to cordially thank everyone for their attendance and scientific contributions. Many thanks are also extended to the national (Greek) and international sponsors (<http://isea12.physics.uoc.gr>) for providing funds which made the participation of many colleagues, mostly young scientists and PhD students, possible.

This *Annales Geophysicae* Special Issue contains 33 papers that were presented in ISEA-12. The Guest editors wish to thank all the authors and also the referees (see list of names below) for their efforts. In particular, the Guest editors are grateful to Dr. Kirsti Kauristie, the *Annales Geophysicae* Special Issue Editor, who did the editorial work with great efficiency and cooperation.

Last but not least, the organizers and guest editors, acting on behalf of the entire ISEA community, wish to dedicate the ISEA-12 Special Issue to the memory of Tor Hagfors, an outstanding scientist and a prominent member of the ionospheric community, and for many a dear colleague and friend, who suddenly passed away on 17 January 2007.

The Guest Editors

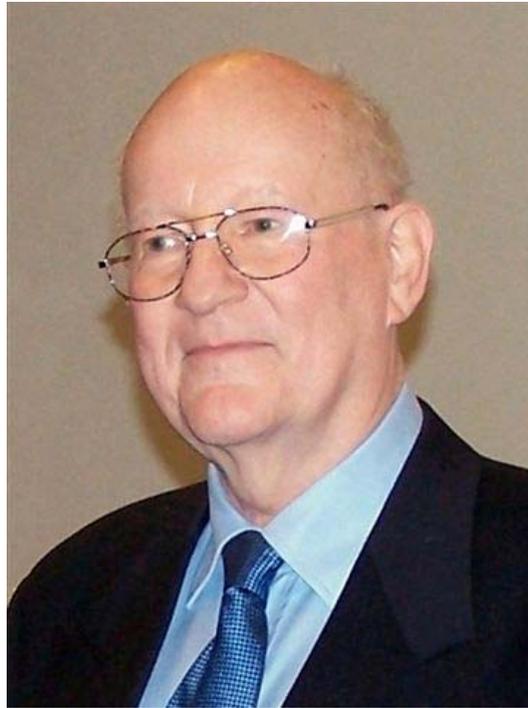
Christos Haldoupis, ISEA-12 Chair, University of Crete, Greece
 Jonathan Makela and Erhan Kudeki, University of Illinois at Urbana-Champaign, USA
 Jorge Chau, Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Peru
 Dora Pancheva, Geophysical Institute, Academy of Sciences, Bulgaria
 David Hysell, Cornell University, USA

List of ISEA-12 Special Issue referees

Alfonsi Lucilla	Haerendel Gerhard	Meriwether John	Singer Werner
Alken Patrick	Haeusler Kathrin	Miller Ethan	Smith Anne
Amata Ermanno	Haldoupis Christos (2)	Millward George	Snively Jonathan
Aveiro Henrique	Harris Matthew	Nicolls Michael	Sofieva Victoria
Bankov Ludmil	Hysell David (2)	Nygren Tuomo	Sulzer Michael
Belehaki Anna	Jacobi Christoph (2)	Oberheide Jens (2)	Swartz Wesley
Bourdillon Alain	Kumar Kishore Karanam	Otsuka Yuichi	Swenson Gary (2)
Bowman Bruce	Kauristie Kirsti (2)	Paluri VS Ramarao	Tsugava Takuya
Bruinsma Sean	Kelley Michael	Pancheva Dora	Tsunoda Roland
Brunini Claudio	Kherani Esfhan	Patra Amit Kumar	Urbina Julio
Chau Jorge (2)	Kil Hyosub	Pellinen-Wannberg Asta	Uspensky Mikhail
Cilliers Pierre	Kofman Wlodek	Pirjola Risto	Vadas Sharon
Coker Clayton	Kudeki Erhan	Retterer John	van de Kamp Max
Correia Emilia	Lastivicka Jan	Röttger Jürgen	Wang Wenbin
Dimant Yakov	Li Feng	Richmond Art	Wernik Andrzej
Earle Gregory	Lopez-Gonzalez Maria	Saha Yogeshwar	Wu Dong
Eresmaa Reima	Makela, Jonathan (3)	Sahr John	Yahnin Alexander
Farley Donald	Malhotra Akshay	Shalimov Sergey (2)	Yeoman Timothy
Fentzke Jonathan	Maria Antonita	Shiokawa Kazuo (2)	

The ISEA-12 Special Issue is dedicated to the memory of Tor Hagfors.

In Memoriam



Tor Hagfors

8 December 1930–17 January 2007

Biography

Tor Hagfors was born in 1930 in Oslo, Norway. He received his education in Oslo and Trondheim, finishing his studies with a PhD in Physics from the University of Oslo in 1959. His first employment, with the Norwegian Defense Research Establishment from 1955 to 1963, was interrupted by a position as Research Associate at Stanford University in 1959/60. From 1963 to 1967 and again from 1969 to 1971, he was a staff member of the MIT Lincoln Laboratory. From 1967–1969, he served as Director of the Jicamarca Radio Observatory near Lima, Peru, and from 1971 to 1973, as Director of Operations of the Arecibo Observatory in Puerto Rico. He subsequently went back to Norway, accepting a position as Professor of Electrical Engineering at the Norwegian University of Science and Technology in Trondheim, where he stayed until 1982. During this time, from 1976 until 1982, he was also the founding Director of the European Incoherent Scatter Association (EISCAT) in Kiruna, Sweden. Next he was a Professor of both Astronomy and Electrical Engineering at Cornell University in Ithaca, New York, until 1992, and was simultaneously Director of the National Astronomy and Ionosphere Center (NAIC), which manages the Arecibo Observatory. In addition, during this period (1989–

1990) he was awarded a senior Humboldt Fellowship, which he spent at the Max-Planck-Institut für Aeronomie in Lindau, Germany. Having already served as a member of the Scientific Advisory Committee of this institute since 1976, in 1992 he accepted a call to be a Director of the Max-Planck-Institut für Aeronomie, where he stayed until his retirement at the end of 1998. Simultaneously, he was a Professor at the University of Oslo. After his retirement, he kept scientifically active not only at the renamed Max-Planck-Institut für Sonnensystemforschung (Solar System Research), but also as a Guest Professor at the University of Tromsø, Norway, at the University of Nagoya, Japan, and at the University of Lancaster, UK.

His scientific interests focused from the very beginning on the scattering of radio waves from magnetised plasmas, and also from random rough surfaces, including polarisation effects. His results on the latter topic, published in an often-cited paper in 1964, have come to be known as the “Hagfors scattering laws” laying the foundations for radio-astronomical studies of the surfaces of the moon and the planets. His plasma physics research covered a wide range of ionospheric topics, such as the foundations of incoherent scatter theory; radar scattering from irregularities in the au-

roral and the equatorial electrojet; the theory and practice of modification of the ionosphere by powerful radio waves, including the application of a novel chirp technique; the observation of Langmuir waves in natural and HF-modified plasmas; advanced riometer techniques; and observations of optical emissions from aurora. Among his achievements in radio astronomy were the determination of the effective dielectric constant of the surface of the moon at 50 MHz, radar observations of the surface of Venus, the mapping of rapidly rotating planetary bodies, the application of lunar reflections for very-long-baseline interferometry, studies of the scattering from the Galilean satellites of Jupiter, studies of the interior of comets and asteroids by radio methods, and, recently, the search for water on Mars by means of a long-wavelength radar on the Mars Express spacecraft. His success as a radio scientist was based not only on his profound knowledge of the underlying physics, but also on his engineering skills and experience. His numerous scientific achievements were published in 170 papers.

Besides being a brilliant and ingenious scientist, he was also an inspiring and gifted teacher, lecturing on information theory, plasma physics, radio astronomy, and also on technical subjects such as radio techniques and antenna design. In his various directorships, he displayed exceptional organizational and diplomatic skills. As the founding Director of EISCAT, he raised the necessary funds for the construction and operation of the facility, and he established the framework of rules necessary to operate the organisation with six European

research councils. As NAIC Director, he developed the concepts for upgrading the Arecibo antenna with a new and complex Gregorian feed system and a noise-reducing fence that shields the antenna from thermal radiation from the ground, and he obtained the funds for this major upgrade from the US National Science Foundation and NASA. During his time at the MPI für Aeronomie he developed concepts that ensured the survival of the Institute in the face of threats of closure due to the need for the Max-Planck-Society to establish new institutes in the re-united East Germany.

His scientific honours are numerous and cannot all be listed here. Among the most prestigious are the URSI Van der Pol Gold Medal, received in 1987; the Humboldt Society Senior Scientist Award, 1989; membership in the Royal Norwegian Academy of Science and Letters, 1996; Associate Membership in the Royal Astronomical Society, 1998; the EISCAT Sir Granville Beynon Medal, 2002; and the Doctor Honoris Causa of the University of Oulu, 2002, and of the University of Tromsø, 2003. The asteroid 1985 VDI was named "Hagfors" in 2000.

Tor Hagfors, although he was a highly acclaimed scientist, remained always a modest, unselfish, and friendly person; everyone was at ease with him. He liked gatherings, social contacts and discussions, and he was a terrific host. Parties at the various institutions where he served were often memorable. We have lost an outstanding scientist, an admirable colleague, and a sincere friend of many of us.