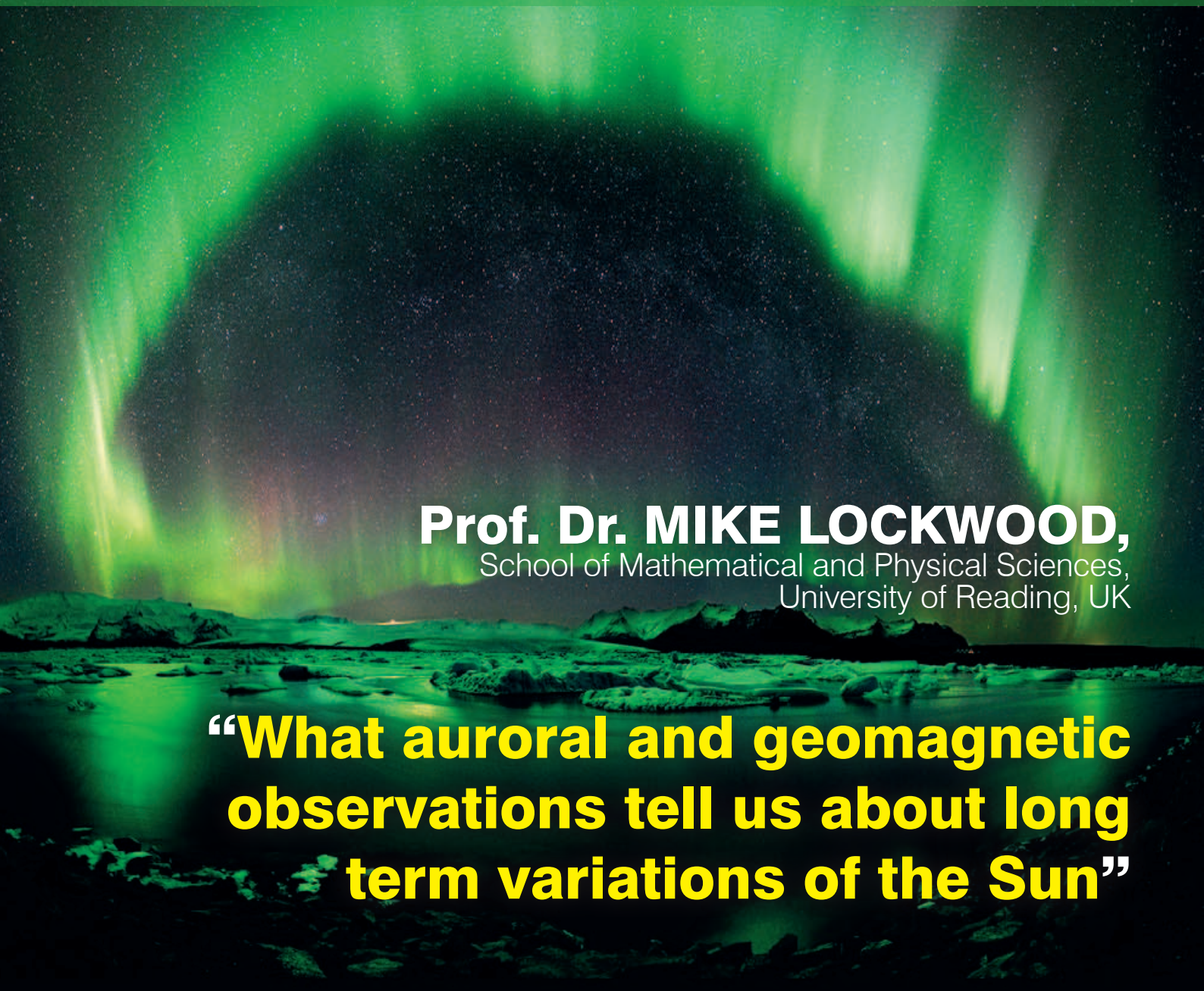
THE NORWEGIAN ACADEMY
OF SCIENCE AND LETTERS

DRAMMENSVEIEN 78, OSLO
THURSDAY, SEPTEMBER 26, 17:30

THE BIRKELAND LECTURE 2013



Prof. Dr. MIKE LOCKWOOD,
School of Mathematical and Physical Sciences,
University of Reading, UK

"What auroral and geomagnetic observations tell us about long term variations of the Sun"

No registration necessary. Free admission

This portrait of Professor Kristian Birkeland was painted by Asta Nørregaard in 1906.

A list of former Birkeland lecturers is found on http://www.dnva.no/artikkel/vis.html?tid=44857

Yara's Birkeland Prize in Physics and Chemistry

In 1905, Kristian Birkeland's research formed an important basis for the foundation of the world's first company to manufacture fertilizer on an industrial scale, Norsk Hydro.

Birkeland was a visionary scientist with the ability and commitment to carry out large scale projects in the laboratory and the field, to follow up with theoretical studies, and to see the application of his results. Today Yara carries this heritage forward and takes great pride in being part of the effort to improve food security. A company's continued success depends upon its ability to innovate. To honor the innovative spirit of its co-founder, Yara established the Birkeland Prize in Physics and Chemistry in 2009.

Yara's Birkeland Prize will be awarded to a Ph. D. candidate from a Norwegian university who has carried out a scientific study that is in accordance with the innovative mind of Kristian Birkeland. The prize has an emphasis on the environment and technology, and encourage research across traditional borders. The prize will alternate between physics and chemistry, with chemistry in odd-numbered years and physics in even-numbered years. The award ceremony will take place in connection with the Birkeland lecture.

The Birkeland Lecture

The first Birkeland Lecture was given in Oslo in 1987 by the Nobel Laureate Hannes Alfvén. The lecture was a joint venture by the University of Oslo, the Norwegian Academy of Science and Letters and the Norwegian company Norsk Hydro. In 2004 Yara ASA took the place of Norsk Hydro and since 2005 the Norwegian Space Centre has been a partner in this cooperation. The Birkeland Lecture is above all an endeavor to honor the great Norwegian scientist and entrepreneur Kristian Birkeland. However, it has also given the organizers an opportunity to invite to Oslo many outstanding scientists within the field of geophysical and space research, areas which were central in Kristian Birkeland's own research.

Except for the year 1993, when the lecture was presented in Tokyo, and in 1998, when a mini-seminar was organized at the Norwegian Embassy in Tokyo, the lectures have been given in Norway, most of them at the Academy's premises in Oslo. Some years seminars have been arranged in connection with the lectures, e.g. in 1993 when the lecture was a part of a "Joint Japanese – Norwegian Workshop on Arctic Research", in 1995 when the lecture was a part of a seminar on Norwegian environmental research, and in 2001 when the lecture was given in connection with a workshop on Norwegian space research, with emphasis on the Cluster satellite programme.

Science and Innovation

In 2012 a new section was added to the traditional Birkeland Lecture: an introductory lecture under the thematic umbrella "Science and Innovation". This year's introductory lecture will be given by Rolf Skatteboe, President / CEO Kongsberg Satellite Services (KSAT).

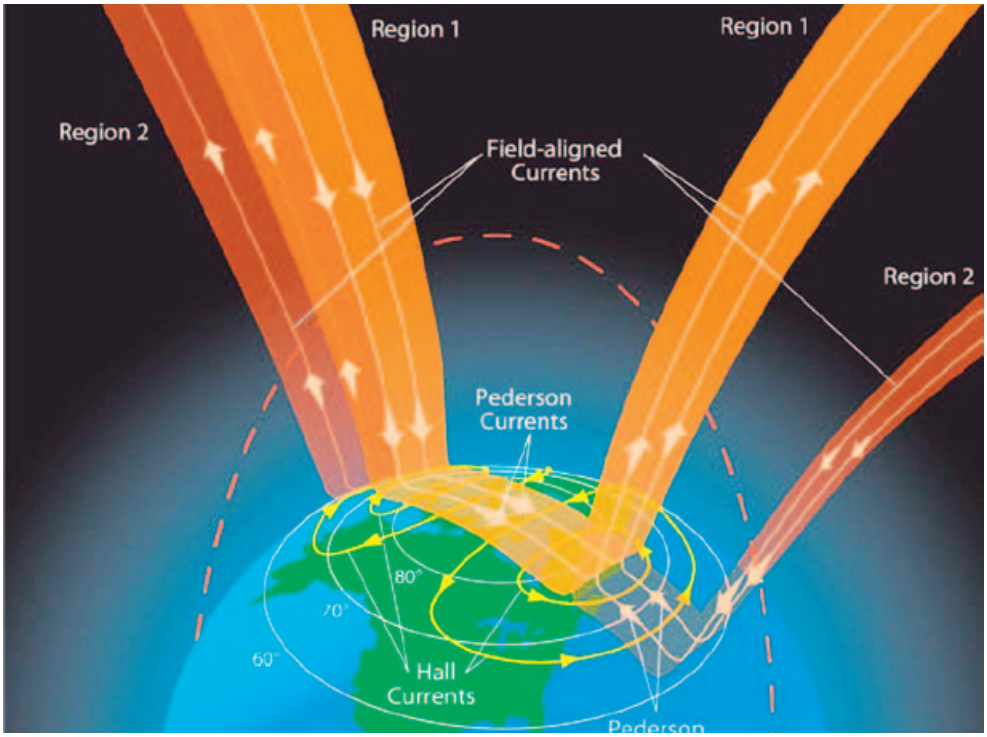
The topic of the talk is: Satellite based marine monitoring. From early concepts till world class services.

KSAT is a commercial Norwegian company, providing ground station and earth observation services using polar orbiting satellites. KSAT has more than 60 antennas installed at various locations around the globe, and is the world leading provider of services related to satellite data reception and control.

Norwegian institutions pioneered the field of marine monitoring using radar imagery from satellites. Coordinated data reception capabilities, computer and algorithm as well as processor developments have put Norway in the forefront for such services world wide.

This activity has opened for an industrial success story, including development of the world's largest ground station for monitoring and control of satellites in polar orbit, located at Svalbard Norway.

This presentation will introduce marine situational awareness and the activities related to satellite monitoring and control in Norway.



One of Galileo's sketches of sunspots, as he observed them in the summer of 1612 using his development of the telescope. We now understand them to be regions where the solar magnetic field threads the surface and inhibits the upflow of energy from below. This cools the surface from about 6500 degrees (Kelvin) to about 4000 degrees which makes the spots appear dark compared to the rest of the visible disc of the Sun.

Geomagnetic activity is caused by variability in large-scale currents that flow in near-Earth space driven by the solar wind and the solar magnetic field embedded within it. Birkeland currents that flow along field lines are a key part in those current systems, causing currents to flow in the upper atmosphere at high latitudes which are detected by magnetometers in space and on the ground. Reliable observations of geomagnetic activity began in 1835 and these provide us with another insight into how the solar wind and the Sun's magnetic field have changed.

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Aurorae have been reported throughout history and the associated fluctuations in the Earth's magnetic field were first detected in 1701. Both are linked to currents flowing in near-Earth space, including the Birkeland currents, driven by the variable solar wind. Using spacecraft in concert with ground-based radars, auroral imagers and magnetometers, we have gained considerable understanding of these currents and how they vary with the solar wind flow and the weak magnetic field in interplanetary space that is carried with it.

A major challenge has been to interpret century-scale variations in the Sun's behaviour using our modern understanding with four sources of information that are available to us: sunspot observations, geomagnetic activity data, auroral sightings and the abundances of "cosmogenic isotopes".

Naked-eye sunspot observations are rare and depend on specific meteorological conditions such as dust storms. However, the telescope made regular observations possible, starting with the measurements made by Galileo in 1612. The first reliable magnetometer was developed by Gauss in 1835 and a worldwide network was established soon after. Auroral sightings need careful verification but a good dataset is available from northern Europe from about 1780. The fourth source of information is different as it is stored not by human observers but in layered reservoirs such as ice sheets and tree trunks, into which we can drill cores and make measurements that go back in time as we drill deeper. Cosmic rays are accelerated to close to the speed of light in explosive events such as super-novae. On impacting Earth's atmosphere they generate cosmogenic isotopes, such as Berillium-10 or Carbon-14, which are stored in the reservoirs where their abundance is measured using drilled cores. They tell us about the Sun because the interplanetary magnetic field shields Earth from cosmic rays such that the abundances fall when solar activity is high. By removing other influences, we can gain a record of solar variability that extends back over millennia.

Using these four sources and our space-age understanding, a coherent picture of past variations is emerging from which we can make analogue forecasts of how the Sun is likely to behave in the future and what consequences are for modern technology. It may even give us better forecasts of cold European winters. All this is based on the work of the great innovators in the study of space, such as Kristian Birkeland who once wrote: "A very few lonely pioneers make their way to high places never before visited . . . they create the living conditions of mankind and the majority are living on their work".

Professor Dr. MIKE LOCKWOOD
School of Mathematical and Physical Sciences, University of Reading, UK

Mike Lockwood is the Director of Research of the School of Mathematical and Physical Sciences of the University of Reading, UK where he is a Professor of Space Environment Physics. He has been researching space, aurora and the Sun for over 30 years, having gained his PhD from Exeter University in 1980. He has worked at Auckland University, the Royal Aircraft Establishment, NASA's Marshall Space Flight Centre, Rutherford Appleton Laboratory and Southampton University. He has served on a great many national and international committees, including Chair of the EISCAT Council, President of Solar-Terrestrial sciences of the European Geophysical Society and Chair of Division 3 (Magnetospheres) of the International Association of Geomagnetism and Aeronomy.

He is the author of over 300 journal publications and one book. His research has covered a great many aspects of solar-terrestrial science including: how the solar wind excites flow in Earth's magnetosphere and ionosphere; non-thermal plasmas; ion upflows from the ionosphere; transient magnetic reconnection; solar wind particle entry into the magnetosphere in the cusp; and how the Sun's magnetic field has varied on centennial timescales. In recent years he has become interested in how solar irradiance varies and how it may modulate the northern hemisphere jetstream and hence the severity of European winters. He has successfully supervised 12 PhD students and follows their subsequent achievements with great pride.

He has won international awards for his work. In 1990 he was awarded the Zel'dovich Award for Commission C (Ionospheric Physics) by COSPAR (The Committee on Space Research of the International Council of Scientific Unions) and the Issac Koga Gold Medal by URSI (The International Union of Radio Science). He also received the Chapman Medal from the Royal Astronomical Society of London (1998) the Charles Chree (now renamed the Appleton) Award and Prize from the Institute of Physics, London (2003) and the Julius Bartels Medal from the European Geosciences Union (2012). In 2006 he was elected as a Fellow of the Royal Society of London.

Organizing committee:

Professor Jan A. Holtet, Department of Physics, University of Oslo
Professor Alv Egeland, Department of Physics, University of Oslo
Øyvind Sørensen, Chief Executive, the Norwegian Academy of Science and Letters
Bernhard Stormyr, Director Corporate Communications, Yara International ASA
Pål Brekke, Senior Advisor, Norwegian Space Centre

The Birkeland Lecture is open for everybody. There is no registration. Free admission.

For more information about the Birkeland Lecture 2013:
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