ABSTRACTS

(Abstracts are in alphabetical order of the first author's surname.)

EISCAT and CHAMP satellite comparison of the poleward boundary of the auroral oval

A.T. Aikio(1), T. Pitkänen(1), P. Ritter(2), H. Lühr(2)

(1) Dept of Physics, University of Oulu, 90014 Oulu, Finland
(2) GFZ German Research Centre for Geosciences, Potsdam, Germany

We study EISCAT low-elevation VHF and ESR radar measurements from selected events during near-conjugate CHAMP satellite passes. Using EISCAT data, we determine the polar cap boundaries and make comparisons to electron temperature and field-aligned current structures measured by CHAMP.

Overview of optical auroral observations and research

C.-F. Enell(1), K. Kaila(2), N. Partamies(3), L. Sangalli(3), B. Gustavsson(4), U. Brändström(5), T. Sergienko(5), I. Sandahl(5), T. Aslaksen(6)

(1) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland
(2) Dept of Physics, University of Oulu, 90014 Oulu, Finland
(3) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland
(4) University of Southampton, UK
(5) Swedish Institute of Space Physics, Kiruna, Sweden
(6) TACO Scientific, Tromsø, Norja

In this talk we give an overview of recent activities in the field of optical auroral observations: Status of the SGO auroral imagers, current activities of the NordAuropt network, development of analysis tools and calibration in collaboration with FMI and Björn Gustavsson, and tomography-like quantitative auroral volume emission estimates.

Electron density determination based on CAA WHISPER spectra

G. Facsko(1,2) and the WHISPER Team(3)

(1) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland
(2) HAS Geodetic and Geophysical Research Institute, P.O. Box 5, 9401 Sopron, Hungary
(3) Laboratoire de Physique et Chimie de l'Environnement et de l'Espace/CNRS, 3A, Avenue de la Recherche Scientifique, 45071 Orléans cedex 2, France

The measurements of Waves of HIgh frequency and Sounder for Probing of Electron density by Relaxation (WHISPER) instrument onboard Cluster are available on the Cluster Active Archive (CAA) servers. The open access electron densities were determined by software tool after manual preprocessing. The density files do not have full coverage region and unfortunately gaps can be found very often in the most interesting regions because of the restrictions of the software and the limited capacity and speed of the manual processing. Fortunately using the available WHISPER spectra the density can be produced applying basic space physics laws. Examples and methods are presented for automatically and manually generated electron densities and compared with CAA open access electron densities.

Correlation functions of small-scale fluctuations of the Interplanetary Magnetic Field

G. Facsko(1,2), Z. Nemeth(3), E.A. Lucek(4)

(1) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland
(2) HAS Geodetic and Geophysical Research Institute, P.O. Box 5, 9401 Sopron, Hungary
(3) KFKI Research Institute for Particle and Nuclear Physics, P.O. Box 49, 1525 Budapest, Hungary
(4) The Blackett Laboratory, Imperial College London, Prince Consort Road, London SW7 2BW, UK

The Interplanetary Magnetic Field shows complex spatial and temporal variations. Single spacecraft measurements reveal only a one-dimensional section of this rich four-dimensional phenomenon. Multi-point measurements of the four Cluster spacecraft provide a unique tool to study the spatiotemporal structure of the field. Using Cluster data we determined three-dimensional correlation functions of the fluctuations. By means of the correlation function one can describe and measure field variations. Our results can be used to verify theoretical predictions, to understand the formation and nature of solar wind turbulence. We found that the correlation length varies over almost six orders of magnitude. The IMF turbulence shows significant anisotropy with two distinct populations. In certain time intervals the ratio of the three axes of the correlation ellipse is 1/2.2/6 while in the remaining time we found extremely high correlation along one axis. We found favoured directions in the orientation of the correlation ellipsoids.

Optical measurements during December 2010 campaign

K. Kaila

Dept of Physics, University of Oulu, 90014 Oulu, Finland

Experiences during the measurement campaign on Dec 2010.

Electrodynamics of an omega-band as deduced from optical and magnetometer data

H. Vanhamäki(1), K. Kauristie(1), O. Amm(1), A. Senior(2), D. Lummerzheim(3), S. Milan(4)

(1) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland
(2) Lancaster University, UK
(3) University of Alaska, USA
(4) University of Leicester, UK

We investigate an omega-band event that took place above northern Scandinavia around 02:00-02:30 UT on 9.3.1999. In our analysis we use ground based magnetometer, optical and riometer measurements together with satellite based optical images. The optical and riometer data are used to estimate the ionospheric Hall and Pedersen conductances, while ionospheric equivalent currents are obtained from the magnetometer measurements. These data sets are used as input in a local KRM calculation, which gives the ionospheric potential electric field as output, thus giving us a complete picture of the ionospheric electrodynamic state during the omega-band event.

Usage of the multi-purpose codes in CP experiments

A. Kero(1), Ilkka Virtanen(2)

(1) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland
(2) Dept of Physics, University of Oulu, 90014 Oulu, Finland

Measuring the properties of energetic particle precipitation is one of the key problems in the studies of solar activity impacts in the atmosphere. In principle, the EISCAT radars provide a unique tool for monitoring the precipitation in high precision, but the lack of D-region in most of the CP programs limits the usage of the EISCAT data for the purpose.

This is only one example of numerous scientific fields which would benefit from usage of the multipurpose codes covering the whole ionosphere. We would like to open a discussion on possible ways for lobbying the multipurpose approach into the present EISCAT CP experiments, as a pathway to the future 3D experiments.

Summary of the Finnish EISCAT Campaign 2010

A. Kero(1), J. Vierinen(1), A. T. Aikio(2), I. Virtanen(2), K. Kaila(2), A. Kozlovsky(2), K. Kauristie(3)

(1) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland
(2) Dept of Physics, University of Oulu, 90014 Oulu, Finland
(3) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland

Annual Finnish EISCAT campaign was carried out successfully in Nov-Dec 2010. The range of the experiments were scientifically multidisciplinary, including auroral measurements, rocket campaigns, space object monitoring, active heating experiments etc. Some preliminary results are presented by the PIs of the experiments.

On the spectral width of SuperDARN echoes in a vicinity of the polar cap boundary

A. Kozlovsky

Sodankylä Geophysical Observatory (Oulu Unit), Linnanmaa, 90570 Oulu, Finland

We consider data of joint ESR and SuperDARN observations and show that the spectral width of HF echoes tends to increase with the electric field. This relationship is explained in terms of non-linear evolution of the ExB gradient drift instability with energy cascade from hundred of metres wavelengths to metre wavelengths.

New findings of ELF-VLF events recorded 2005-2008 at Sodankylä

J. Manninen, T. Turunen

Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

All ELF-VLF data recorded during campaigns in 2005-2008 has been rechecked systematically. Some new and interesting findings will be shown.

An EISCAT satellite tracking campaign for ESA

J. Markkanen(1), J. Vierinen(2)

(1) EISCAT Sodankylä, Tähteläntie 50, 99600 Sodankylä, Finland
(2) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

In December 2010, we run the first-ever satellite tracking campaign at EISCAT UHF system in Tromsø, as part of the European SSA Preparatory Phase Programme. The final purpose is to build a capability at EISCAT for determining precision orbits of satellites and space debris. Altogether 39 passages of six different functional satellites were observed. Data were recorded both with the Finnish USRP-based receiver and the EISCAT standard receiver. All the data taken with the standard receiver has been analysed for time,range and velocity observations and sent over to an ESA subcontractor for orbit analysis. Range accuracy of about 50 m and velocity accuracy of about 1 m/s was achieved in the standard analysis. The challenge now is to develop the analysis further, better optimised for the extremely high signal-to-noise situation of coherent targets. Our preliminary results suggest that a range accuracy of about a metre and velocity accuracy of a few cm/s should be attainable.

Testing Kalman filter methods for defining solar quiet variations from hourly mean geomagnetic data

D. Martini(1,2), M. Orispää(3), Th. Ulich(3), M. Lehtinen(3), K. Mursula(2)

(1) School of Space Research, Kyung Hee University, Gyeonggi-Do, 446-701 Yongin, Korea
(2) Dept of Physics, University of Oulu, 90014 Oulu, Finland
(3) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

We test the recursive Kalman filter method to obtain the regular solar variation curve of the geomagnetic field. Using a simple algorithm we demonstrate how different approaches affect the daily curve estimate. Using our best estimate we derive a digital counterpart, AhK, of the analog range index Ak at the sub-auroral Sodankylä station, and compare it to the earlier digital estimate Ah and the local Ak index. We find that the new method outperforms the former estimate in every aspect studied, and provide a robust, straightforward manner to estimate and verify the manually scaled Ak index.

LOFAR

D. McKay-Bukowski

Rutherford Appleton Laboratory, STFC, Didcot, UK

LOFAR (Low Frequency Array) is a new pan-European radio telescope, developed and administered by the Netherlands Foundation for Research in Astronomy. This presentation, in addition to giving a status update, provides a compact overview of the technical project, explains the scientific rationale and describes the international collaboration which makes it all possible. In particular, it will cover the relevance of this new endeavour to atmospheric and space research in the Arctic.

Latest news about the Bashful Ballerina: What do hemispheric and longitudinal asymmetries imply about the Sun and why are they important for the Earth's space environment?

K. Mursula(1), I. Virtanen(1), L. Zhang(1,2), I. Usoskin(3)

(1) Dept of Physics, University of Oulu, 90014 Oulu, Finland
(2) Key Laboratory of Solar Activity, NAO, CAS, Beijing, China
(3) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

It is known since long that solar activity is unevenly distributed over the solar surface, both along the solar longitude and between the two solar hemispheres. Related studies of hemispheric and longitudinal asymmetries have been pursued for long, using different methods and different activity parameters. Unfortunately, these studies have so far remained at a rather marginal status due to the rather inconclusive and sporadic occurrence of the asymmetries.

However, it is known since recently that the solar hemispheric asymmetries depict a systematic long-term patterns that have prevailed for more than a century. Also, using a dynamic reference frame, more significant longitudinal asymmetries have been found that are quite similar for different solar parameters. Also, solar longitudinal asymmetries depict systematic long-term patterns that seem to be common for all cool stars.

We review here these recent developments on solar hemispheric and longitudinal asymmetries and their role in improving our understanding solar activity and solar magnetic field generation. We also note that solar asymmetries affect the Earth's space environment and that the newly found patterns allow the possibility to make better long-term forecasts of solar related disturbances in near-Earth space.

Electric fields and neutral winds from monostatic incoherent scatter measurements by means of stochastic inversion

T. Nygrén(1), A.T. Aikio(1), R. Kuula(1), M. Voiculescu(2)

(1) Dept of Physics, University of Oulu, 90014 Oulu, Finland
(2) Dept of Physics, Dunarea de Jos University of Galati, Romania

A new method utilising stochastic inversion in determining the electric field and neutral wind from monostatic beam swing incoherent scatter measurements is described. The method consists of two stages. In the first stage, the electric field is determined from F region velocity measurements. In the second stage, E region velocity measurements and electric field results are combined to a single measurement vector, and the three neutral wind velocity components are determined. This gives a possibility to have different temporal resolutions for electric field and neutral wind. The method is tested using EISCAT UHF data.

The role of local weather on near-surface Beryllium-7 variations in Rio de Janeiro, Brazil.

A.A. Pacini(1,2), I.G. Usoskin(2), H. Evangelista(3), E. Echer(4), R. de Paula(3)

(1) University of Vale do Paraíba (UniVap), São José dos Campos, Brazil
(2) Sodankylä Geophysical Observatory (Oulu Unit), Linnanmaa, 90570 Oulu, Finland
(3) University of Rio de Janeiro State (UERJ), Brazil
(4) National Institute for Space Research (INPE), São José dos Campos, Brazil

We present a study of the atmospheric 7Be variability measured at Rio de Janeiro state (Brazil) and its relation to solar activity cycle, local weather and regional air mass dynamics. This investigation is based on the analysis of two 7Be concentration time series collected in air samples at Rio de Janeiro: a long one, covering the period from 1987 to 2009 with 3-month time resolution, took around the Angra Nuclear Power Stations (23°00'S 44°19'W; Pc=11.6 GV); and a short one, which was obtained by our team through nearly continuous weekly air sampling since August 2008 in Rio de Janeiro city (22°33'S 43°18'W; Pc=11.2 GV). These isotopic data were analysed using spectral tools (WAVELET and ARIST) and compared with the local climatic indices (temperature, pressure and precipitation). Moreover, a reliable conceptual approach, which includes the CRAC:7BE production model, was applied to understand the seasonal behaviour of our series. The results suggest that the regional precipitation pattern is a dominant forcing to the 7Be seasonal modulation at the studied site, while the local cosmogenic production has a minor effect on its variability. Furthermore, there is an indication that the anomalous events of tropospheric dynamic may also imprint information about air masses 3-D movement in the near-ground air 7Be data, making it a useful tracer of the atmospheric dynamics.

GPS tomography for ionospheric research

D. Pokhotelov, O. Amm

Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland

Ionospheric plasma content can be deduced from the characteristics of microwave signals acquired by ground-based networks of GNSS receivers as well as GNSS receivers on-board LEO satellites. The tomographic inversion of these data in a three-dimensional algorithm can reveal spatial and temporal distributions of the ionospheric plasma anomalies induced by various magnetosphere-ionosphere coupling processes. Dense networks of GNSS receivers in Fennoscandia open an opportunity for the high-resolution ionospheric tomography with the existing network of other instruments (IS radars, magnetometers, etc.) providing a characterisation of the ionospheric processes.

A LOFAR remote station will be constructed in Lapland 2011

M. Postila

Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

Sodankylä Geophysical Observatory together with the Department of Physics of the University of Oulu received a grant for the construction of an EISCAT_3D receiving station. The plan is to purchase a LOFAR remote station and install it in Lapland. In the presentation, the status of the Finnish LOFAR station project is told.

Periodic stationary stochastic processes on bounded finite domains

L. Roininen

Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

In our recent papers we have considered the convergence of systems of stochastic partial difference equations to systems of partial differential equations on unbounded infinite domains. In this talk we consider the processes on tori in dimensions one and two. This is the case with bounded finite domain with periodic boundary conditions. We use finite difference and element methods for the constructions of priors and consider the convergence of the discrete setting to the continuous one.

Latest results from IMAGE team in Finland

E.I. Tanskanen(1, 2), A. Viljanen (1), T. Raita (3), L. Häkkinen (1), K. Pajunpää (1)

(1) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland
(2) University of Bergen, Norway
(3) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

The high-resolution magnetic field measurements provided by IMAGE magnetometers give an excellent opportunity to examine the high-latitude magnetospheric-ionospheric physics. The homogeneous good quality measurements together with continuous data since 1982 enable variety of space weather and space climate studies. The westward electrojet index in the IMAGE UT-sector, the IL index, is formed and used for the auroral oval studies from 1993 to 2010. Seasonal and inter-annual variations were found in substorm occurrence rate, substorm strength and in dH/dt activity (1 nT/s fluctuations).

Current status of EISCAT and EISCAT_3D

E. Turunen

EISCAT Scientific Association, Kiruna, Sweden

This talk reviews the status of the current EISCAT facilities and EISCAT operations, as well as the status of the ESFRI Roadmap project EISCAT_3D, which is now in preparatory phase funded by EU.

Variations of high-latitude D region as seen by the 1-year ESR experiment during IPY

E. Turunen(1), I. Häggström(1), A. Kero(2)

(1) EISCAT Scientific Association, Kiruna, Sweden
(2) Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

The EISCAT Svalbard Radar was operated in a continuous type mode during the entire first year of the International Polar Year (IPY), starting on 1 March 2007 and ending on 29 February 2008. The ISR experiment used a specially written IPY mode, which was optimised to ensure also a good coverage in the ionospheric lower E and D regions, in addition to covering the more standard experiment target, the ionospheric F peak and reaching into the topside ionosphere. We present preliminary analysis of the ionospheric D-region data, where backscattered power measurements, with 3 km range resolution and 2.25 km steps, start from the altitude of 45 km. We demonstrate how using a detailed coupled neutral and ion-chemistry model, one can deduce the effect of neutral atmospheric variability in the backscattered power data.

SMILE-II balloon campaign

E. Turunen(1), T. Tanimori(2), S. Arvelius(3)

(1) EISCAT Scientific Association, Kiruna, Sweden
(2) Kyoto University, Japan
(3) Luleå University of Technology, Sweden

In Japan, JAXA ha s recently approved funding for the construction of the SMILE-II balloon-borne low-energy gamma ray detector, a new large Electron Tracking Compton Camera (ETCC), proposed by Prof Tanimori and his group in Kyoto University. Kyoto University already observed in 2006 celestial sub-MeV gamma rays using small balloon-borne ETCC called SMILE (Sub-MeV gamma ray Imaging Loaded-on-balloon Experiment). Now the group is constructing a larger ETCC with a size of 40x40x40cm: the main purpose is a long-duration experiment to catch gamma-rays from the Crab Nebula. The energy range of the SMILE-II detector is suitable for observing bremsstrahlung from relativistic electrons precipitating into atmosphere, making a quantitative estimate of the flux of the precipitating electrons possible within the field of view of the ETCC. We propose a longer ground-based measurement campaign, including the EISCAT radars, all-sky cameras and photometers, as well as suitably located VLF receivers in support of the SMILE-II balloon, which will be launched from Esrange in 2012.

Results from the first performance tests of the new SGO pulsation magnetometer

T. Turunen

Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

A new 3-component pulsation magnetometer has been designed and built in Sodankylä Geophysical Observatory and the first field tests started in November 2010. The design goal was to reach sensitivity, which allows monitoring of Alfvén resonances on routine basis, improved sensitivity at the lowest frequencies of interest, and essentially improved dynamic range. The design utilises the existing sensors of the present pulsation magnetometers. The solutions are based on the tests done using a simpler prototype device, which was taken in use already in 2007. The front end solution is differential thermally shielded 16+16 FET input parallel amplifiers followed by 10-pole analog linear phase filters having corner frequency at 12.5 Hz. This allows 35 Hz usable measuring bandwidth. The wide band noise level from about 10 mHz to 35 Hz is less than 100 nVpp and above a few Hz the noise level is of the order of 1.5 nV/sqrtHz or less. Dynamic range has been obtained by using 24 bit AD-converters and low gain. Timing is GPS controlled and data contains timing information in every sample. This allows construction of phase coherent networks. Sampling frequency is 250 Hz. Extensive program package allows effective data analysis. The first tests are presented and show that the instrument fulfils the design goals in all respect.

Ionisation effect of solar particle GLE events in low and middle atmosphere

I.G. Usoskin(1), G.A. Kovaltsov(2), I.A. Mironova(3), A.J. Tylka(4), W.F. Dietrich(5)

(1) Sodankylä Geophysical Observatory (Oulu Unit), University of Oulu, Linnanmaa, 90570 Oulu, Finland
(2) Ioffe Physical-Technical Institute, St. Petersburg, Russia
(3) Institute of Physics, St.Petersburg State University, St.Petersburg, Russia
(4) Space Science Division, Naval Research Laboratory, Washington, DC, USA
(5) Praxis, Inc., Alexandria, VA, USA

Using a new reconstruction of the solar proton energy spectra for Ground Level Enhancement (GLE) events, based on fits to measurements from ground-based and satellite-borne instruments covering a wide energy range, we quantitatively evaluate the possible ionisation effects in the low and middle atmosphere for 58 out of the 66 GLE events recorded by the world-wide neutron monitor network since 1956. The ionisation computations are based on the numerical 3D CRAC:CRII model. A table of the ionisation effect caused by the GLE events at different atmospheric heights is provided. It is shown that the direct ionisation effect is negligible or even negative, due to the accompanying Forbush decreases, in all low- and mid-latitude regions. The ionisation effect is important only in the polar atmosphere, where it can be dramatic in the middle and upper atmosphere (above 30 km) during major GLE events.

Faraday rotation lag-profile inversion at Jicamarca

J Vierinen

Sodankylä Geophysical Observatory, Tähteläntie 62, 99600 Sodankylä, Finland

We present a novel dual-polarisation incoherent scatter radar analysis method called Faraday rotation lag-profile inversion. In addition to estimating the plasma backscatter autocorrelation function at each height, the propagation delay between the two different characteristic modes of propagation can be measured, which allows the absolute electron density to be measured independently of the target backscatter mechanism. The method has recently been demonstrated a Jicamarca as a part of a general purpose experiment, which allows the simultaneous measurement of the full atmospheric profile, including everything between the MST-region and the exosphere.

Stratospheric dynamics and atmospheric coupling research at Russian State Hydrometeorological University

A. Vlasov(1,2), E. Savenkova(2), A. Kanukhina(2), A. Pogoreltsev(2)

(1) Finnish Meteorological Institute, P.O. Box 503, FIN-00101 Helsinki, Finland
(2) Russian State Hydrometeorological University, Saint-Petersburg, Russia

The presentation will give the overview of ongoing and planned studies of stratospheric dynamics and planetary wave activity at Russian State Hydrometeorological University. The data used includes atmospheric reanalysis results and data from global GPS radio-occultation experiment COSMIC. The main topics are Sudden Stratospheric Warming events and investigation of their connection with processes in lower atmosphere. There is also a minor study aiming to find possible connection of Planetary Wave activity in stratosphere with activity of Atmospheric Gravity Waves observed with EISCAT.