

Vuosikertomus 1999 (Annual Report 1999)

- IAG-Report 1999 (Edited by Prof. S.-E. Hjelt)

One important output of the associations of the IUGG are the number of scientific publications. A [graph](#) is attached here showing the annual number (since 1995) of reviewed scientific papers produced by scientists of the Finnish national IUGG associations.

INTERNATIONAL ASSOCIATION OF GEODESY ([IAG](#))

REPORTER: R. Kuittinen

1. GEODETIC ACTIVITIES

FINNISH GEODETIC INSTITUTE

1. The permanent GPS network FinnRef

The routine operations of the FinnRef continued. Twelve stations covering the territory of Finland collect GPS data at 30 seconds interval, and every night 24 hours' worth of data is transferred by dial-up modem line to the FGI headquarters in Masala. The procedure is in principle automatic, but requires extensive human supervision and intervention. During 1999, ensuring smooth operation consumed significant manpower resources. The data is archived and transferred to the international computing centres. It is also used for local studies on crustal movements and atmospheric effects on signal propagation. During 1999, Vaisala meteorological sensors were put into operation at all permanent GPS sites. Exploitation of this data has not yet started. The FGI also has permanent GPS stations in Suurupi, Estonia, and in Xi'an, China.

2. The Third Precise Levelling of Finland

During 1999, 402 km of double-run precise levelling was measured along and near the Finnish-Swedish border. Several links across the border were established in collaboration with Swedish colleagues.

3. The EUREF densification projects

During 1999, the second half of the second phase of the Finnish EUREF densification "EUREF-FIN", the so-called points for practical use, was completed, producing some 150 GPS points in easily accessible places mainly by the sides of roads. This second half, covering the North of Finland, complements the measurements of 1998 covering the Southern half of the country.

The results of the first phase of EUREF-FIN, 100 high precision points mainly located at primary triangulation sites, were completed. 7 of these, as well as all 12 FinnRef sites, were submitted to the EUREF Subcommittee for certification as Class B points, and certified. A report on this project was completed and appears during 2000.

4. The airborne gravimetric survey of the Baltic Sea

In the framework of a Nordic co-operation, most of the Baltic Sea proper, and a large part of the Gulf of Finland, was gravity surveyed from the air. This was a highly successful project in which the permanent GPS stations were productively used as references for the GPS receivers on-board the aircraft.

5. Väisälä white-light interferometric baseline work

During autumn, the baseline in Gödöllő, Hungary, was re-measured by researchers Jokela and Poutanen. Results -- to be published 2000 -- were excellent on the 432 m long half of the baseline, which was extended to the full 864 m by cleverly combining interferometric and Mekometer-produced range measurements.

During 1999, the Finnish Centre for Metrology and Accreditation (MIKES) succeeded in performing absolute calibrations of the one metre quartz gauges used in the Väisälä interferometric method. This will make it unnecessary to transport them to the Physikalisch-Technische Bundesanstalt in Braunschweig, Germany, where absolute calibration was done earlier.

Relative calibrations are done, as before, at the Tuorla Observatory of Turku University. The report on the Väisälä baseline measurement at Chengdu, China, which was performed in 1998, came closer to completion.

6. Maintenance of Finnish primary triangulation sites

During 1999, 25 triangulation points were checked and refurbished and the local geometry re-measured. For the first time, GPS was used on 8 points earlier measured to determine the local control network's absolute orientation.

7. Absolute gravimetric work

In January, absolute gravimetric measurements were performed in Wettzell and Moxe (Germany). The measurement in Wettzell completed the COPERNICUS UNIGRACE campaign started in 1998.

During November and December, absolute gravimetric measurements were performed on the sites Virolahti and Joensuu and on both absolute points in Vaasa. Control measurements were made in Metsähovi as well.

8. Relative gravimetric work

The densification of the national gravimetric survey's base network was continued in the Lempäälä and Vesilahti area. The points measured were positioned by GPS, using the permanent FinnRef station Tuorla as reference station. 550 points were measured in total.

9. Metsähovi work

During 1999, the new satellite laser continued its routine operations and underwent technical improvements.

10. Superconducting gravimeter studies

The instrument has worked very reliably in spite of some short breaks caused by the compressor. Helium re-filling took place in July, and a second time in November. A registering rain meter was installed.

The gravity effect local hydrology, including snow -- and sweeping the snow -- on local gravity has been observed and studied. The measurements obtained by the instrument have been made available to the international community on a monthly basis in the framework of the GGP (Global Geodynamics Project).

11. Land uplift gravimetric profiles

In September the profile at 65 degrees latitude was re-measured, for the first time in a long time. Some unexpected results were found, and a re-measurement is planned for 2000.

Because instruments happened to be available, also the Finnish half of the 63 degrees profile was re-measured, in October, one year after the previous measurement.

12. Levelling staff comparator

The work to automate the levelling staff comparator was brought to completion and a report on the work written. The instrument has been used for the staffs of the Third Precise levelling as well as for international collaboration (Latvia, Lithuania).

13 Other

Metsähovi participated in the IGEX98 GPS/GLONASS campaign.

The Posiva Oy sites under review for nuclear waste disposal, Olkiluoto, Romuvaara and Kivetty, were targeted by two local precision GPS surveys aimed at detecting possible crustal movements.

14. HELSINKI UNIVERSITY OF TECHNOLOGY

Research project on the utilisation of GPS in traversing, mapping and setting out measurements has been continued. For this purpose a test net in Otaniemi, Espoo, was established, measured and computed. The test net was used in studying the validity of Real Time Kinematic GPS (RTKGPS) in urban environment and in testing communication modems and data storing and handling in a rugged field computer under natural, open air, conditions. Several transformations of coordinates were carried out between different coordinate systems.

The IGC again carried out studies, measurements and analyses for renovation of local coordinate systems; Jyväskylä town was the case this year. The basic control net existing was first analysed, then

enlarged net was measured with static GPS and tacheometers. The network was computed in three different plane coordinate systems: Jyväskylä local coordinate system, National Grid Coordinate System and EUREF-FIN -system. 3-D transformations were carried out and geoid model FIN95 was applied. Multi-theodolite system (Spatial Intersection Method) for 3-D optical precision measurements was further developed, updated and tested. Work on automation in precise height determination was continued and data transfer telematically was further tested.

IAGA-Report 1999

INTERNATIONAL ASSOCIATION OF GEOMAGNETISM and AERONOMY (IAGA)

REPORTER: H. Nevanlinna

The following report contains summaries of the activities of the Finnish organizations within the field of geomagnetism, aeronomy and space physics during 1999.

1.1 THE FINNISH METEOROLOGICAL INSTITUTE

1.1.1 Geophysical Research Division (Space Physics and Geomagnetism)

The Geophysical Research Division's year began impressively with hardware developed by the Division being launched into space onboard four different space probes. The SWAN instrument onboard the SOHO spacecraft continued the solar wind measurements which had been interrupted the previous autumn due to problems with the spacecraft. The Cassini/Huygens probe made its last planetary acceleration manoeuvre inside the earth's gravity field in August at an altitude of 1000 km above the Pacific Ocean and headed towards Saturn and its satellite Titan, whose atmosphere the probe will enter in 2004.

The Mars Polar Lander, launched towards Mars in January, reached its destination according to plan in December, but contact with the craft could not be re-established after its landing. The Stardust comet probe was also successfully launched towards the Wild 2 comet, from which it is to obtain samples for analysis back on earth. The Geophysical Research Division is involved in this project, making a contribution to the dust analysis apparatus which, surprisingly, found large 'macro-molecules' in outer space, something that had not previously been discovered in interplanetary space.

Two new space programmes were started during the year. Following a strict selection process the FMI's SPEDE instrument was chosen for the European Space Agency's (ESA) lunar probe, which utilizes an electric propulsion engine. The device will record altitudinal variations in electron concentration in near-earth space, the dust and plasma environment of the moon and the electrical disturbances around the probe caused by the particle accelerator. The electric propulsion engine test is the first of its kind and will help develop faster and more efficient ways of travel in the solar system.

The second project, NetLander, focuses on Mars research. The programme involves constructing a network of four surface stations in cooperation with France and Germany. The stations will then be taken to the surface of Mars in 2005. Project planning was carried out in Finland, and the main responsibility for implementation is shared between France and Finland.

Instrument deliveries for the ESA's ongoing Rosetta comet programme and for the Mars Express programme progressed on schedule. The main construction stage for the six units in the comet programme took place during the year and the busiest stage of the work on the equipment unit for the Mars Express programme began.

Preparations for the launch of the Odin and ENVISAT satellites for a research project on the earth's atmosphere were continued by putting the finishing touches to the data processing facilities at the Sodankylä processing centre. The deliveries of the ozone measuring equipment for NASA's EOS-CHEM satellite progressed according to schedule. Planning of the satellite receiver station to be located in Sodankylä was also begun as part of the programme.

1.1.2 Magnetic surveys and records

The instrument network monitoring the state of the near-Earth space above Finland, Northern Scandinavia and xxx was completed. Data from this network were transmitted worldwide over the Internet practically in real-time. The arrangements concerning the Cluster satellites to be launched in summer 2000 were finalized. Several new international projects were set up under the research programme on space weather, and the first ESA pilot study was completed.

The magnetic survey of Estonia reached its mid point and processing of historical magnetic data records was completed, more than 100 years after the observations were first made. A calibration coil-system developed at the Nurmijärvi Observatory was installed in Canberra (Australia) as a co-operation between FMI and Australian Geological Survey.

The publishing targets set for the year were achieved. 34 peer-reviewed articles were published. One doctoral degree was completed and two graduate students received licentiates. Turnover for the Division exceeded FIM 40 million, more than half of which was related to major industrial contracts.

1.2 THE UNIVERSITY OF OULU

1.2.1 Ionospheric and Magnetospheric physics

The space physics group in Oulu has an extensive research program in ionospheric and magnetospheric physics, including observations from both ground-based and satellite instruments. The program is conducted mostly in national and international collaboration. The chain of search-coil magnetometers was further enlarged by installing a new magnetometer at a low-latitude station in Crete in May 1999 for continuous observations of magnetic pulsations and magnetic background noise. Preparations for an instrument measuring the vertical electric component of the Schumann field were initiated. Optical instruments were further developed and operated in campaigns. Two or three photometers with real speed video cameras were used to measure auroral emissions through the northern winter period in Northern Scandinavia, and the photometer in the Chinese Zhong Shan base in Antarctica was successfully operating during the southern winter. Amplitude scintillation of satellite radio signals were used to determine the anisotropy parameters of F-region small-scale irregularities. The orientation of perpendicular isotropy was compared with F region plasma drift observed by the incoherent scatter radar. The effect of ionospheric heating on the background F region electron density as well as heating-induced irregularities were also investigated. Moreover, coherent and incoherent scatter radar techniques were developed and used in auroral and airglow studies.

The high-sensitivity magnetic and optical measurements, together with simultaneous satellite observations, have given several interesting results on auroras, waves and the magnetosphere-ionosphere coupling. Action of the ionospheric Alfvén resonator at auroral latitudes was experimentally verified and the possibility of artificial excitation of the resonator by periodic HF heating of the ionospheric electron gas could be demonstrated. Electromagnetic ion cyclotron (EMIC) waves were studied using both ground-based and satellite (in particular the Polar satellite) observations, and evidence was given for an alternative model of structured (pearl) Pc1 pulsations. Also, new general constraints were presented for theories of pearl formation. A number of studies on auroras and substorms were published. By studying pseudobreakups from ground, ionosphere, geosynchronous orbit and mid-tail, it was shown that pseudo-breakups are associated with particle injections, current disruptions and magnetic reconnection in the magnetotail.

The group is involved in a number of satellite instrument projects, e.g., the EFW (Electric Field and Waves) and RAPID (Research with Adaptive Particle Imaging Detectors) instruments for the CLUSTER-II multi-satellite project. All the remaining parts for the EFW instrument were prepared and tested for CLUSTER-II under the supervision of the Production Technology Laboratory. The group participated in system level tests both for EFW and RAPID. Astrid-2 microsatellite was operating successfully until July 1999.

1.2.2 Heliospheric physics

Heliospheric physics is also an important research field in the space physics group of Oulu. Heliospheric research includes ground-based cosmic ray measurements, long-term satellite measurements of solar wind and IMF and satellite missions. The cosmic ray nucleon component has been measured continuously at Oulu cosmic ray station since 1964. Collaboration with the CUPP project was continued in order to establish a multi-layer muon detector in the Pyhäsalmi mine. Effects of the Earth's magnetic field on the asymptotic directions of cosmic rays were calculated according to the modern models of the magnetic field. Solar neutrons were studied using an extensive network of cosmic rays stations at different latitudes. Heliospheric structure and its changes over the solar cycle were analysed using the long-term measurements of the solar wind and IMF obtained from various spacecraft.

The group is also participating as a co-investigator in the CAPS instrument project of the Cassini mission to Saturn, with the main responsibility in the ion beam sensor (IBS). Calibration beam runs for the IBS-instrument were simulated and analyzed in order to determine the instrument performance. Measurements by the instrument were obtained from the asteroid belt for analysis and instrument calibration and testing. The Cassini probe will reach its destination in 2004.

1.2.3 Institute of Geosciences

The Department of Geophysics at the Institute of Geosciences, University of Oulu continued research towards understanding the structure composition, dynamics and evolution of the lithosphere using e.g. electromagnetic deep sounding techniques. During 1999 the following major activities were:

1. The analysis of the BEAR (Baltic Electromagnetic Array Research) data measured in 1998. BEAR is a subproject of the EUROPROBE / SVEKALAPKO project.

2. The NOIGEM project of the TIETO programme of the Academy of Finland finalized studies of the electromagnetic joint inversion problem and modelling. The co-operation with the group of prof. L. Päiväranta (Department of Mathematics, University of Oulu) and scientists from the Universities of Delaware, Göttingen, Helsinki (Nevanlinna Inst.), Karlsruhe, Utah and Washington (Seattle) and the NGRI (Hyderabad, India). The project continues as IGEM (Inversion of Geophysical EM data) with slightly modified aims.
3. A new formulation of joint inversion of EM and seismic data was presented by E. Kozlovskaja. A fractal model parametrization makes the approach feasible in regions of the crust and upper mantle, where fractures or other anisotropic features affect both electrical conductivity and seismic velocities.
4. New experiments with GPR on glaciers were performed in co-operation with prof. M. Leppäranta and his group. (Department of Geophysics, University of Helsinki) under the guidance of doc. John Moore (Arctic Centre, Univ. Lapland). The most exotic ones were made on blue ice fields in Antarctica by John Moore and Anna Sinisalo.
5. Experiments were continued at Kilpisjärvi for studying the feasibility of onshore recording of electromagnetic signals from ocean water movements in the Norwegian Sea.
6. In the project MARATON teaching material on the structure and dynamics of the Earth, based on the Earth System Science concept was prepared and tested both in University and Secondary School environment.

1.2.3 SODANKYLÄ GEOPHYSICAL OBSERVATORY

The activities of SGO continued normally. Observatory is divided into seven divisions: Administration, Aeronomy, Geomagnetism, Computing, Technical, EISCAT station and Oulu division. The most important projects funded by external sources were EISCAT program, GUISDAP as a Finnish in-kind contribution to EISCAT, Inversion project, the Barents- Interegg II project "Investigation of the near-space and atmosphere in the Barents region", the Meteor Radar Project and the Svekalapko project. The Finnish Graduate School in Astronomy and Space Physics is lead by SGO.

Several scientific meetings and seminars were organized in 1999 in Sodankylä. The most important of them were the "Arctic UV Research - Workshop" on March 25-26, the "First Arctic Workshop on Cosmic Ray Muons" on April 24-29 and the "XIX Meeting of the Finnish Geophysical Society" on June 14-15.

1.3 GEOLOGICAL SURVEY OF FINLAND

Aerogeophysical surveys was performed in Germany, England and Finland in all 80 000 line-km.

The upper crustal evolution, geology and structure of the Finnish bedrock was approached and modelled by interpreting and correlating geophysical, petrophysical and geological data. The petrophysical database is continuously updated. Updated versions of the aeromagnetic and Bouguer gravity maps of North Finland - Kola was compiled as a joint project between the GSF and the PGE (Petersburg Geophysical Expedition). New versions of aeromagnetic and Bouguer gravity maps of

Central Finland - Karelia were compiled. The project of geological, aeromagnetic and gravity maps and petrophysical data base for the whole Fennoscandian Shield was continued as a joint venture between Geological Surveys of Finland, Norway and Sweden, the Finnish Geodetic Institute, the National Land Survey of Sweden, the Norwegian Mapping Authority and the Regional Geological Centre of Northwest Russia. The maps are ready for printing.

The laboratory for Palaeomagnetism participated in several international projects, such as EUROPROBE/SVEKALAPKO, GGT, IGCP, ESF-network on Impact Craters and IUGG/IAGA data bases. Based on the palaeomagnetic data bases, reconstructions of Baltica with other continents were built and their geological interpretations investigated.

Geophysical modelling of several impact craters in Finland is carried out. Magnetic properties of the Popigai structure (Siberia) were investigated. Projects on the geophysical modelling of the Bosumtwi impact structure in Ghana and comparison of the Lappajärvi structure (Finland) and the Jänisjärvi (Russia) were continued.

1.4 THE UNIVERSITY OF HELSINKI

1.4.1 Space Physics

The space physics group at the Department of Physics of the University of Helsinki is a small unit consisting of a professor (Hannu Koskinen) and presently of 8 active graduate students, most of whom are located at the Geophysical Research Division of the Finnish Meteorological Institute (FMI/GEO). The professorship is funded jointly by the University and the Finnish Meteorological Institute and the scientific research is conducted in close co-operation with the space physics group at FMI/GEO.

In 1999 the first ESA contract study on space weather was completed with the final report "Space Weather and Interactions with Spacecraft" was published in FMI's report series (Reports 1999:4, 191 pages). This activity is a part in the process which has made the FMI-HU collaboration one of the leading contributors to the European space weather activity. Another major achievement was the completion of book "Magnetospheric Plasma Sources and Losses" by the International Space Science Institute, with significant contribution from the FMI-HU collaboration.

The scientific work was mainly in the field of solar-terrestrial physics where a new direction was initiated in the research of coronal mass ejections and their role in the magnetospheric storms. Now the FMI-HU collaboration covers practically all major research areas which contribute to space weather.

As one of the main purposes of founding the joint professorship in space physics was to improve the space physics education, the development of courses at the university has continued. Two new special courses were lectured during the spring term of 1999: Solar Physics and Space Weather. The interest of students to space physics courses has remained high and 6 Master's Theses were completed in space physics in 1999.

IAHS-Report 1999

INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES (IAHS)

REPORTER: Pertti Seuna

1. ACTIVITIES

1.1 FINNISH ENVIRONMENT INSTITUTE (FEI)

Hydrological monitoring was continued by the Finnish Environment Institute and the 13 Regional Environment centres according to the Environmental Monitoring Programme 1997-1999. The national hydrometric monitoring comprised the following programmes: areal precipitation, areal snow water equivalent, evaporation (Class A pan), surface water level, river discharge, ice thickness in lakes and rivers, surface water temperature, vertical temperature profiles in lakes - a total of 1300 observation stations. In 1999, the bathymetric mapping of lakes covered some 200 km². By now about 65 % of the total lake area, or 20000 km² are completed. Two large development projects were under production: (1) a new, a hydrometric database that will be completely available through a www server, and (2) a quality assurance system for hydrometric monitoring.

The monitoring of integrated hydrology comprised the networks of small hydrological catchments and groundwater stations, both including water quantity and quality. Small catchments, 46 at the moment, serve mostly as research basins. Some of the catchments are included in the UNESCO FRIEND project and to the ERB (European Research Basins network). Human impacts and the separation of event and pre-event water have been under investigation. Groundwater stations, 54 together, have the main objective of studying groundwater formation and the quality of groundwater affected by various geologic conditions and other factors.

Hydrological models covered about 90 % of the country including all the important river basins. The HBV-based model was used mainly for flood forecasting, but also for producing information to complete field measurements, such as snowpack data. The model information is available from the Internet on the space information basis. On the contract basis the users themselves can also run the models using their own input data, i.e. weather forecast. During 1999 the service of the hydrological data was improved by introducing new, near real-time www-pages. A new monthly hydrological review was also served on the www.

1.2 UNIVERSITY OF HELSINKI, DEPARTMENT OF GEOPHYSICS

The general theme of the activities was geophysics of snow and ice. This included ice mechanics, lake ice impurities, snow, and sea ice dynamics. A new graduate school titled "Geophysics of Snow and Ice" was opened in the beginning of 1999 with direct funding of 6 PhD students and with about 5 students funded by various research projects.

1) Study of the effects of climate and morphology on temperature conditions of lakes. Long series of physical and meteorological data have been used to study the modelling of the temperature of the lakes. The study has been concentrated on Finnish lakes. American lakes have been studied for comparison. During 1999 data and studies from Central European lakes have also been used in comparison studies.

1.3 HELSINKI UNIVERSITY OF TECHNOLOGY

The Laboratory of Water Resources of the Helsinki University of Technology gives higher education and carries out research on the following topics: applied hydrology, hydraulics, water resources planning, limnology, environmental impact assessment, water constructions, as well as irrigation and soil drainage. The ongoing research projects include inflow forecasting, harmful substances in soil, decision support systems, scale models, environmental river engineering, global changes and water resources, and environmental impact assessment.

1.4 FINNISH GEODETIC INSTITUTE

Snowmelt investigations using satellite information has formed the most important project in hydrological studies. Up-to-date information on the extent and properties of snow cover is needed e.g. for hydrological purposes and hydropower production., especially during the snowmelt season in spring. A method was developed that uses NOAA/AVHRR and ERS/SAR images as well as daily air temperature, precipitation and snow depth measurements from weather stations. A rule-based approach was used to combine information from the multisource input data. Use of the SAR data in the method was based on the results from an algorithm developed at the Helsinki University of Technology.

IAMAS-Report

INTERNATIONAL ASSOCIATION OF METEOROLOGY AND ATMOSPHERIC SCIENCES
(IAMAS)

REPORTER: M. Alestalo

1. ACTIVITIES

1.1. UNIVERSITY OF HELSINKI, DEPARTMENT OF METEOROLOGY

In 1999, research was carried out mainly on three subareas:

Studies on climate dynamics included especially the effect of the upper boundary condition on the linear simulation of stationary waves, and the effect of a single mountain on an aquaplanet.

In development and application of numerical models and schemes, methods for parameterisation of radiation were further developed. The department's mesoscale model was applied in case studies of e.g. several EU projects, and compared with various observations. Simulation and comparison was also made to Mars Pathfinder observations.

In radar meteorology, mesometeorology and cloud physics application to environmental issues were studied.

1.2. FINNISH METEOROLOGICAL INSTITUTE (FMI)

The main research areas in 1999 were atmospheric modelling, climate change, ozone and air quality.

The development of the HIRLAM-model (High Resolution Limited Area Models) continued with the goals on the improvement of short-range forecasting and regional accuracy in northern conditions. Forecasting methods for marine wind, ocean waves and ice were developed in co-operation with the Finnish Marine Research Institute. Development of the dispersion model for airborne radioactive substances was continued.

For the better understanding of the linkage between the man-made emissions of greenhouse gases and their impact to the atmosphere, the measurements were continued in Pallas GAW Station located in boreal forest belt. Extensive data series of observations are used for monitoring the climate change and for analysing its causes. Impact studies on traffic conditions were computed using the climate change model data.

The research on Ozone and UV-radiation was composed of several international projects. In the Antarctic ozone soundings were continued in co-operation between Finland and Argentina. The EUMETSAT Satellite Application Project continued focusing on Ozone profiles and support to UV radiation forecasting.

In air quality one of the emphases of the research was on measurements and modelling of ozone dry deposition in relation to the representative ecosystems. In air chemistry laboratory the research was focussed on analysing of light hydrocarbons and terpenes from air samples in order to get more information on their impact in the environment. Research on tropospheric aerosols continued on development and application of methods for size-resolved chemical character of tropospheric particles and investigation of the processes associated with the formation and subsequent evolution of these particles in the atmosphere. These activities were carried out in international projects involving laboratory tests, field experiments, and modelling.

IAPSO-Report

INTERNATIONAL ASSOCIATION FOR THE PHYSICAL SCIENCES OF THE OCEAN (IAPSO)

REPORTER: Pentti Mälkki

1. ACTIVITIES

FINNISH INSTITUTE OF MARINE RESEARCH

The studies focused on dynamics, hydrography, waves and ice studies of the Baltic Sea and on air-sea interaction and dynamics of the polar seas.

The project Sea currents in the Baltic Sea had a major field experiments in 1999. The data analysis system development has been continued. Gulf of Finland data from 1994-1996 has been analysed. Experimental and modelling studies of the physical processes of the Baltic Sea were especially devoted to 3D-modelling and verifications of the model results using measurements of hydrographical parameters and currents in the Baltic Sea.

Within BALTEX/DIAMIX project the data from the previous field experiments was analyzed. For the BALTEX Oceanographic Data Base, a world wide web home page has been under construction. An expedition in the East Gotland Basin of the Baltic Sea was arranged and the data analysis carried out.

Wave studies were made in co-operation with University of Miami and University of Uppsala. These studies have showed that in presence of high swells outrunning weak wind the Monin-Obukhov similarity theory and classical logarithmic boundary layers are no longer valid.

In EU-funded Arctic Radiation and Turbulence Interaction Study, FIMR scientist developed a method of optimizing flight patterns in airborne meteorological measurements was developed and accepted for publication. Modelling work is going on to study the warm-air advection over sea ice, and the surface energy balance and now thermodynamics in Spitsbergen.

Studies were conducted for further development of numerical sea ice forecasting models. Special attention was given to ice thermodynamics and coupling of an ocean- and sea ice model with the high resolution atmospheric model (European HIRLAM). Together with the Finnish Meteorological Institute a project of the coupled atmospheric and marine models was continued. The aim of the project is an improved forecasting of marine weather (wind, temperature,...) and wind waves and sea ice conditions. Verification of the HIRLAM model is going on with the R/V Aranda rawinsonde soundings as a reference. Analyses of the Aranda weather station data from the Baltic Sea in 1991-1999 is under work.

Air-ice- sea process studies and process modelling were conducted in BALTEX-BASIS (Baltic Air-Sea- Ice Study of BALTEX/GEWEX program), the EC funded study of which is coordinated by FIMR. A BASIS data archive was established. A 9-day-long field experiment was made in the Gulf of Bothnia in March. Most of the basic data analyses from this and the previous year's experiment were made. Process studies and model simulations are going on.

Air-Sea Interaction studies in the Weddell Sea (project included in FINNARP-1995/1996) focused on the sea ice dynamics and heat exchange between the ocean, sea ice, and atmosphere. A manuscript on ice dynamics was accepted for publication. Ice dynamics studies and air-sea interaction investigations based on the Finnish Antarctic FINNARP-95/96 Weddell Sea marine expedition data were finished.

The EC funded project VEINS (Variability of Exchanges in the Nordic Seas) was continued. The work conducted within the EU Mast III programme VEINS and has been concentrated to studies of transports, water mass formation, and mixing in the Nordic Seas and the Arctic Ocean, especially to the conditions in the East Greenland Current, Denmark Strait and Fram Strait.

Global Change related sea level variation and marine weather studies were carried out under the Finnish Global Change program FIGARE.

Under shared-cost CEC project IMSI -Integrated use of new microwave satellite data for improved sea ice observation (1997-1999), the FIMR has developed automatic RADARSAT SAR classifier. The classifier is based on Pulse-Coupled Neural Network and Segmentation Network methods. The classification classes are: open water/ice, thin ice, thick ice, slightly deformed ice, and deformed ice. In the ice season of 1998-1999 the results were used operationally at the Finnish ice service and sent in digital format to the Finnish ice breakers and some merchant vessels.

The Commission of European Communities under the CEC/Joint Research Centre/CEO Programme financed training project- Training in Use of Satellite Data for Sea Ice Monitoring (1998-1999). The FIMR in co-operation with NERCs, Norway, arranged training courses and commany demonstartions in Finland, Norway, Iceland and Russia. The course material is available at:
http://www.nrsc.no/CEO_Training.

UNIVERSITY OF HELSINKI, DEPARTMENT OF GEOPHYSICS.

The BASYS project which aimed for a development work of the advanced coupled ice-ocean model for the Baltic Sea has been finalized. The modelling work have done in cllaboration with the groups from the Institute of the Marine Research of the University of Kiel and the Swedish Meteorological and Hydrological Institute and it was supported by the European Commission MAST-III program. The high resolution model developed in Kiel has been compared to the moderate ice climatology model developed in Helsinki. The climatological ice model has been used also for the estimation of effect of the climate change for the Baltic Sea ice conditions. The project was done in collaboration with the Finnish Meteorological Institute and the Rossby Center (Sweden). Two ten years numerical simulations were made in order to estimate the pre-industrial and the future ice conditions in the Baltic.

The research topic of Prof. Leppäranta is geophysics of sea ice. This has included sea ice dynamics, structure and properties of sea ice, and sea ice thermodynamics. The sea ice investigations are focused on coastal processes including the fast ice zone, the boundary of fast ice and drift ice, and the dynamic boundary zone of drift ice at the fast ice boundary. Field work has been carried through in the coastal ice at Hanko peninsula in the Baltic Sea. Modeling work has focused on coastal ice dynamics in the Baltic and sea ice grwoth and decay in Saroma-ko lagoon on the northern coast of Hokkaido.

IAPSO-Report 1999

INTERNATIONAL ASSOCIATION OF SEISMOLOGY AND PHYSICS OF THE EARTH'S INTERIOR (IASPEI)

REPORTER: P. Heikkinen

1. ACTIVITIES

Research of the subcommision in 1999 focused on the deep seismic refraction, reflection and tomographic studies, on the methods detecting the underground nuclear tests, on studies of local eartquakes, as well as lithospheric thermal modelling and geothermal measurements including studies of palaeoclimatic and hydrogeological effects and heat production of rocks.

Researchers at the Institute of Seismology of the University of Helsinki and at the Geophysical Oservatory and Department of Geophysics of the University of Oulu took part in the seismic tomographic measurements of the SVEKALAPKO research project in Finland (EUROPROBE program) They also participated in interpretation of the DSS data from the EUROPROBE/EUROBRIDGE profile running from the Baltic Sea through Lithuania and Belarussia to Ukraine as well as in interpretation of the large international seismic experiments POLONAISE and TTZ in Poland.

The researchers of Oulu University interpreted data of DSS profiles in the Barents Sea and in one line of the BABEL experiment as Finnish-Russian co-operative works. They also made integrative interpretations of the seismic data and potential fields along the EUROBRIDGE, the TTZ and the LT7 (in Poland), and along the SVEKA profile.

At the Institute of Seismology the lithospheric structure and dynamics were studied using seismic and geologic interpretation of the BABEL marine deep reflection data, deep seismic sounding data from the profiles SVEKA81, SVEKA91 and FENNIA. Studies on the attenuation of the crust in the Baltic shield were continued with the Russian Academy of Sciences. Studies on local seismicity, seismotectonics and seismic hazard were carried out as postgraduate studies at the Institute of Seismology.

As the Finnish contribution to the study and development of effective seismic verification methods for nuclear test ban, the Finnish Research Project on Seismological Verification of Nuclear Tests was run at the Institute of Seismology.

In 1999 many of the activities in geothermal research were related to EUROPROBE project 'Svekalapko'. Geothermal measurements measured in 1996-97 in the central Kola Peninsula area were processed in co-operation with the Kola Science Centre of the Russian Academy of Sciences. Stochastic Monte Carlo techniques were developed and applied in forward and inverse thermal modelling of the lithosphere.

Thermobarometric data on kimberlite-hosted mantle xenoliths which were combined already earlier with numerical thermal modellings of the lithosphere in eastern Finland close to the Proterozoic-Archaean boundary, were further applied in a study of a rheological models of the lithosphere combined with deep electromagnetic data. The results have general implications on models of thick lithosphere in the area, and particularly on the volatile content of the upper mantle. The PT-data from xenoliths was also applied geothermal inversion modelling of the thick lithosphere in the central Fennoscandian Shield.

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1. GENERAL ACTIVITIES

In the Geological Survey of Finland, tectonic, petrological and geochemical studies of the Proterozoic and Archaean volcanic belts (especially komatiite-bearing) have been conducted as part of the general geological mapping and more thematic tectonic-petrological studies and exploration work. Results have been synthesized in general geological and thematic maps, and related articles. The studies on the tectonic setting, geochemistry and petrogenesis of the Palaeoproterozoic mafic dyke swarms in northern and eastern Finland and in adjacent areas in Russia have been continued in international

context. The Palaeoproterozoic ophiolites and associated ore-forming processes have been another subject of systematic detailed studies.

At the Department of Geology, University of Helsinki, petrogenetic and tectono-magmatic studies of the Mesozoic basalts of Queen Maud's Land, Antarctica, have been completed and submitted for printing. The geotectonic setting, origin and metallogeny of the rapakivi granites and related rocks have been studied in Finland and abroad (southwestern USA, Namibia, Brazil). Researchers of the Department have studied the magmatic evolution and crystallization of the Finnish rapakivi granites in the laboratories of GeoForschungsZentrum, Potsdam (melt inclusions in minerals) and Department of Mineralogy, University of Hannover (experimental petrological studies). Petrological and geochemical studies of the Palaeoproterozoic metavolcanites of the Tampere schist belt have been continued.

At the Department of Geology, University of Turku, a project studying the volcanic evolution and ore potential (Ni, Cu, Au) of the Archaean komatiites of the Kuhmo and Suomussalmi greenstone belts in northern Finland has been completed and reported. The hydrothermal alteration related to gold mineralization has been one topic of detailed studies. An international field excursion and workshop was arranged in September 11-16, 1999, to the Archaean and Palaeoproterozoic greenstone belts of northern Finland. Studies on postorogenic granites and anorogenic rapakivi granites have continued.

The research projects of the Department of Geology, Åbo Akademi University, have studied the granitic magmatism - especially the postorogenic granites and the anorogenic bimodal rapakivi magmatism - of southern Finland and the Palaeoproterozoic metavolcanites of southwestern Finland.

The department of Geography, University of Turku, has studied the eruptive history of lava flow fields in northern Iceland, as well as soil and tephra layers in the same area.

At the Nordic Volcanological Institute, Reykjavik, one Finnish stipendiate has studied recent volcanism of Iceland. Geology students from Helsinki University had 10 days' volcanological excursion to Sicily, and those of Åbo Akademi University to Santorini.

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