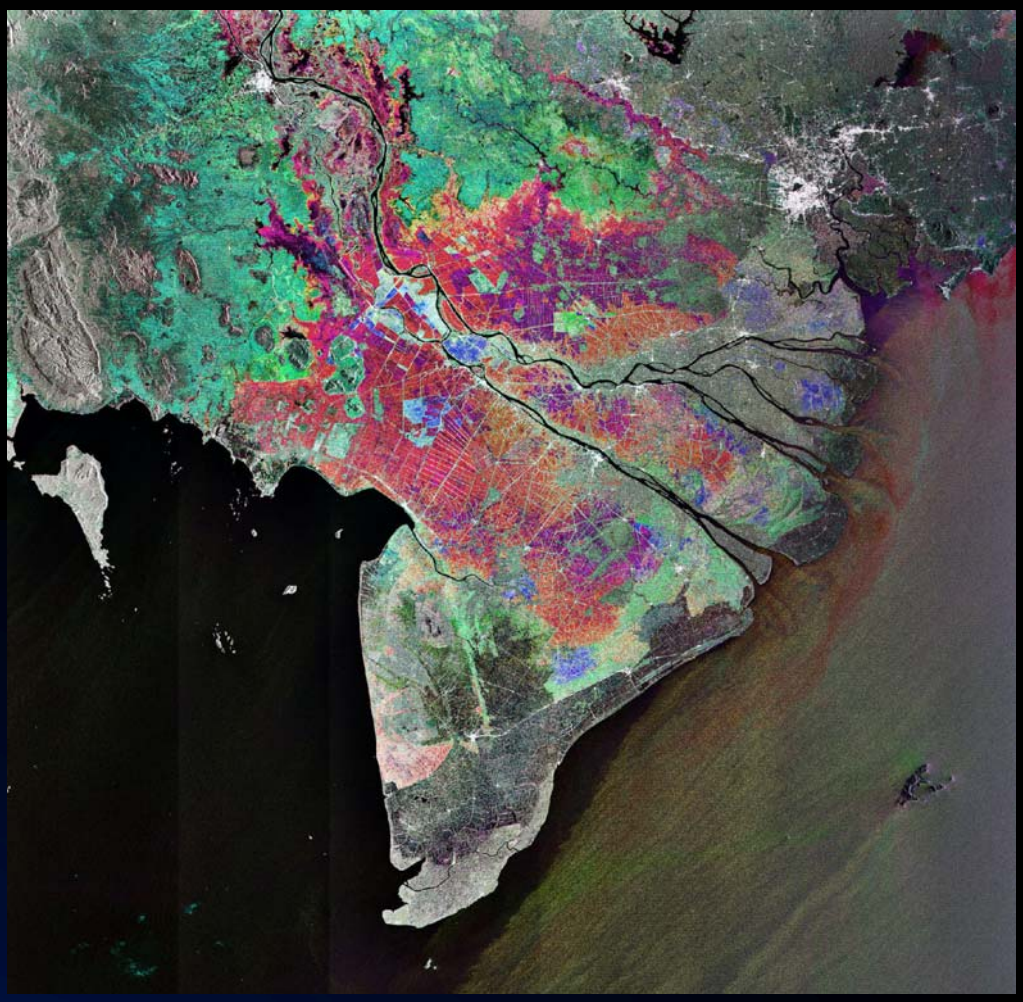
# EARSeL



# NEWSLETTER

June 2009
No 78

EARSeL

European Association of Remote Sensing Laboratories

Front Cover – This radar image features Vietnam's Mekong Delta where the Mekong, the world's twelfth longest river, fans out into tributaries and empties into the South China Sea in Southeast Asia. Ho Chi Minh (formerly known as Saigon), Vietnam's largest city and chief port, is visible as white in the upper right corner. The image was obtained by combining three Envisat's Advanced Synthetic Aperture Radar (ASAR) acquisitions (9 January 2007, 13 February 2007 and 20 November 2007) taken over the same area. The colours in the image result from variations in the surface that occurred between acquisitions. Source: ESA

# EARSeL Newsletter

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| Individual observer | 330€ |
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### CONTENTS

# 1. EDITORIAL

Dear members,

Another academic year is nearly over and the period of meetings, workshops and symposia is beginning. By the time you read this the 29th EARSeL symposium will have already taken place. We hope you have enjoyed the presentations as well as our beautiful island.

In this issue you will find some information about two organisations that have recently joined the EARSeL community, the University of Education in Heidelberg and the Space Research institute of the Bulgarian Academy of Sciences. In addition you can also find a short report on the activities of the Special Interest Group on Urban Remote Sensing. Last, but certainly not least, this issue includes an obituary to R.A.G. Savigear, one of the founding members of EARSeL, back in 1976.

In the news, we have a number of articles that present the information that is collected from the analysis of radar data, with applications on arctic ice, seismology and volcanic behaviour. In addition there is an extensive article on the GOCE mission, launched by ESA, which will map the Earth's gravity field in high detail. This information will be very useful in a range of applications.

Finally, a number of conferences and workshops are announced and added to the list at the end of the issue. Some of them are announced up to a year in advance. If you happen to know of any relevant conferences or workshops, please let us know so we can inform the rest of the community

We hope you have a pleasant and relaxing summer.

Sincerely,

The Editorial Team

# 2.NEWS FROM EARSeL

## 2.1 OBITUARY: R. A. G. SAVIGEAR

Ronnie Savigear, one of the founding members of EARSeL, died on 4th December 2008. He was elected the National Representative for the UK at a meeting in Lyngby in 1976 at which the decision was taken to create officially a European Association (see "EARSeL's History – the first 30 years" page 18).

As a university lecturer, Ronnie appreciated the role of education, and stressed the importance of educating the young generation of students in the new and exciting discipline of remote sensing. He originally had the idea that EARSeL should promote education and training at university level and set up an Education and Training Working Group, WG3, becoming its first chairman. The basis for a European programme was set out at a European Workshop convened by the Council of Europe in Enschede in 1979. The proceedings, "A European Workshop to design the development of postgraduate training modules in remote sensing" was edited by Ronnie and it was he who proposed the idea of a programme of such modules to EARSeL. This led to the very successful series of Dundee Summer Schools ( Vaughan and Cracknell, 1990).

He originally lectured at the University of Sheffield where he specialised in geomorphology. After two years teaching in Pakistan, he returned to Sheffield where he became interested in geomorphological mapping, from which emerged his enthusiasm for promoting the use of the new remote sensing systems. He set up an MSc course in Applied Geomorphology and helped to establish the British Society for Geomorphology. In 1969 he was appointed Professor of Physical Geography at the University of Reading. During the 1970s he was involved in the setting up of the Remote Sensing Society (RSS) in the UK (now the Remote Sensing and Photogrammetric Society (RSPSoc)), and became its first Chairman. He continued developing a team of researchers in remote sensing in Reading before moving to JRC in Ispra in 1979 where he continued to be involved in running training courses. He retired back to Reading where he continued in his research interests, working on a geomorphological map of Southern Africa. He became the first recipient of the Society's highest award, the Gold Medal, in 1984.

Robin Vaughan and Gunnar Østrem

Godefroy, M, G Østrem and R A Vaughan, 2008. *EARSeL's History – the first 30 years*. EARSeL, Hannover.

Savigear, R A G (ed), 1979. *European Workshop to Design the Development of Postgraduate Training Modules in Remote Sensing*. Council of Europe, Strasbourg DEC/ESR Mod A (79).

Vaughan, R A and A P Cracknell, 1990. The Dundee Summer Schools. In *Proceedings of the 9th EARSeL Symposium*, Helsinki, June 1989, ESA Publications, pp19 – 34.

## 2.2 SIG ON URBAN REMOTE SENSING: "DETECTION AND VALUATION OF POTENTIAL AREAS FOR SMART GROWTH USING REMOTE SENSING AND GIS"

**Smart growth to avoid urban sprawl**

The spreading of a city and its suburbs over rural land at the fringe of an urban area is termed as *urban sprawl*. Residents of sprawling neighbourhoods tend to live in single-family houses and commute by automobile to work. Urban planners emphasize the qualitative aspects of sprawl such as the lack of transportation options and pedestrian friendly neighbourhoods. Conservationists tend to focus on the actual amount of land that has been urbanized by sprawl. The term urban sprawl with low population density as an indicator generally has negative connotations due to the health and environmental issues that sprawl creates. Residents of sprawling neighbourhoods tend to emit more pollution per person and suffer more traffic fatalities. Sprawl is controversial, with supporters claiming that consumers prefer lower density neighbourhoods and that sprawl does not necessarily increase traffic. Sprawl is also linked with increased

obesity since walking and bicycling are not viable commuting options.

Conversely, *smart growth*, a coalition promoting a better way to grow, is an urban planning and transportation theory that concentrates growth in the centre of a city to avoid urban sprawl protecting farmland and open space; and advocates compact, transit-oriented, walkable, bicycle-friendly land use, including neighbourhood schools, complete streets, mixed-use development with a range of housing choices. To summarize, smart growth is growth that helps to achieve the following goals: neighbourhood livability, better access, less traffic, thriving cities, suburbs and towns, shared benefits, lower costs, lower taxes, and keeping open space open.

It is forecasted that in 15 years two thirds and in 40 years 80% of the world's population will be living in cities and towns. According to scenario analyses the number of megacities will increase from 5 (1975) to 26 (2015) with all problems but also potentials for a sustainable urban development. In addition there is a huge and also increasing number of large cities and mega-urban regions. Residential, commercial and transportational areas in Germany have increased noticeably over the past 50 years. Currently, land consumption amounts to about 100 ha/day. Predominantly, the land newly designated for building comprises farmland. This suggests a process of suburbanisation and an expansion of settlement areas mainly along the fringe zones of conurbations. Similar processes can be observed in countries like Turkey, where the ongoing economic growth leads to an increasing migration of people from Anatolia to urban areas and an increasing rate of urbanisation. These developments can be shown on higher level especially at megacities like *Berlin*, *Istanbul* and the *Ruhr Region* as metropolitan areas. The continuing demand for settlement areas as well as the striving for a "city of short distances" lead to a demand for urban consolidation. Thus, city and regional planning have to take into consideration not only the adequate supply of their population with space, but also the protection and sustainable use of the finite resource land. In this context, smart growth and area economic planning are important, following the principle "spare the urban fringe, develop the inner suburbs first". This aim, however, presents challenging tasks to the responsible institutions in densely populated areas, fringe zones and rural communities – tasks which cannot be mastered with traditional planning methods, but require differentiated instruments allowing for quantitative and qualitative appraisals of current building potentials, such as remote sensing and GIS.

**Research project**

In the framework of an intensified cooperation program (Inten-C) a bilateral project in cooperation of the University of Education Heidelberg (UEH), Istanbul Technical University (ITU) and the Ruhr University-Bochum (RUB) started in March 2009 funded by the Federal Ministry of Education and Research (BMBF) and the Turkish Scientific and Technological Research Council of Turkey (TÜBİTAK). The project is lead by Prof. Dr. Alexander Siegmund (Geography Dept., UEH), Prof. Dr. Derya Maktav (Remote Sensing Dept., ITU) and Prof. Dr. Carsten Jürgens (Geography Dept., RUB). The objective of the project GAUS (Gaining Additional Urban Space) is the development of a technology-based instrument for supporting the municipal area management authorities with regard to urban consolidation and smart growth. Very high resolution earth observation satellite images constitute the basis for an up-to-date and partly automated detection of potentially usable areas. Within a GIS, high spatial resolution satellite data, such as Ikonos, Quickbird, Worldview-1 or Geoeye-1 offer opportunities for adequately identifying even the smallest potential building areas with their exact extent and location.

The partly automated detection of inner suburb potential areas and underused areas is based on high-resolution RS data. With the help of an object-oriented classification procedure the images are heuristically divided into homogeneous segments. Spectral features of the real objects as well as textural and geometric parameters, such as shape and size, are used to demarcate the segments. In the next step, a classification is carried out drawing on a knowledge based decision tree, whereby fuzzy logic based membership functions and/or nearest-neighbour functions can be used. The segmentation and object-orientated classification allow the registration and designation of areas with different structures.

Intersecting these detected areas with additional geodata, such as implementation maps, topographic maps etc is the basis for formulating a *valuation catalogue*. The regulations, through integration into a GIS with the help of a multi-criteria decision procedure, are modifiable according to local needs. The assessment of the suitability of detected plots regarding specific construction projects can be adapted to individual requirements for base data through graded analyses functions. In the framework of urban development and consolidation, using such a modular approach can assure an effective valuation of potential building areas with regard to their specific possible usages as well as a reduction of the resource intensive in situ surveying, mapping and inspection tasks.

The designation, classification and qualitative valuation of building potentials in terms of their suitability of urban consolidation employ analytical intersection functions within a GIS. The proposed modular system allows an adaptation of the valuation and decision rules depending on available base data and quality as well as local appraisal criteria. Besides the obligatory RS data, a variety of optional data such as transportation infrastructure, lithology or topography can be included into the planning process as available to increase the accuracy of the classification of urban areas with different potential for an inner city development.

The suitability of individual plots can be assessed with geometric and thematic parameters. Size and shape, slope, infrastructure, type of adjacent land use etc. are thus integrated into the classification and valuation process as central variables with individually settable weighting. Information concerning the availability of the plots from the perspective of the owners can be included as additional variables into the analyses.

The RS and GIS supported instrument to be developed in the research project hence offers city and regional planners a chance for a timely and economic detection, classification and especially valuation of building areas in the course of urban redevelopment.

In the last few years, previous projects and programs for the reduction of land “consumption” due to settlement have had some success. Nevertheless, demands on the resource land and the dispersing settlement pattern increased further. Major reasons could be a on the one hand lack of transferability of the employed methods to other regions and on the other hand lack of appropriate planning instruments for appraising size, position and usage of potential building plots. The demand of urban area in megacities like Berlin or Istanbul is rapidly increasing, so that traditional planning tools often take too long and are often too work-intensive. These circumstances cause higher urban expansion. A large scale implementation of urban consolidation thus can only occur based on new, work extensive and partly automated instruments that are easily adaptable to local requirements.

Smart growth of settlement areas has to be supported, based on an inventory of the status quo, by innovative tools which facilitate future planning. These tools have to include a valuation scheme for the availiable building land. Implementation of such an valuation scheme can be achieved through multi-criteria decision support procedures in terms of a weighting of various parameters within a GIS. Apart from classified RS data, additional geodata which is relevant for the local planning situation can be included.

The adaptability of the rules within the multi-criteria decision support system (MDSS) to individual requirements is a main objective in the research project. To verify the adaptability the system will be employed with a third case study area within Germany (Ruhr Region). The project can be regarded as a first step towards developing practical, adaptive, transferable and thus sustainable tools for regional planning to combat urban sprawl in Europe.

The proposed research could also serve as basis for standardized image processing chains and subsequent rule-based decision making procedures. These could be integrated into a standardized planning directive for the detection and development of underdeveloped areas within cities across the EU.

Simone Naumann, University of Education, Heidelberg, Geography Dept., Germany

Alexander Siegmund, University of Education, Heidelberg, Geography Dept., Germany

Carsten Jürgens, Chair of EARSeL SIG Urban Remote Sensing, Geography Dept., Ruhr University, Bochum, Germany

Derya Maktav, Co-chair of EARSeL SIG Urban Remote Sensing, Remote Sensing Dept., Istanbul Technical University, Turkey

## 2.3 NEW EARSeL MEMBER: UNIVERSITY OF EDUCATION, HEIDELBERG

We would like to welcome a new member to the EARSeL family, the University of Heidelberg in Germany, and specifically its Department of Physical Geography and its Didactics. The department is directed by Prof. Dr. Alexander Siegmund and is also represented in EARSeL by Prof. Dr. Ulrich Michel and Dr. Simone Naumann.

Learning how to "read" the earth – the Department has contributed to this. Through the application of modern geographic work methods the team looks at current subject-related, methodical, and didactic research questions in different projects world wide, from the analysis of environmental changes through satellite images, to environmental didactic training concepts.

Here are some chosen running projects:

**Vulnerability and Degradation Analysis of semiarid Island ecosystems in the marginal tropics of Fogo (Cape Verde Islands), the chosen specimen – a study based on Remote Sensing and GIS**

Through the use of multi-temporal and multi-scale airborne and satellite data, the processes of ecological vulnerability in relation to the global climatic changes and locally initiated processes of land use changes and land degradation can be analyzed and modelled using the island of Fogo as an example.

With this background, an object orientated land use and land cover classification can be generated, detecting all parts of the heterogeneous land cover segments and degradation phenomena. This is an important part of geo-ecological spatial pattern analysis and planned change detection analysis over the last three decades.

**Gaining additional urban space (GAUS) – Detection and valuation of potential areas for inner urban development with remote sensing and GIS**

Currently, land consumption amounts to about 100 ha per day. These developments can be seen on a higher level, especially in mega cities like Berlin, Istanbul, the Ruhr region, and metropolitan areas. The continuous demand for settlement areas and the strife for a „city of short distances" has lead to a demand for urban consolidation. Satellite images are used to detect potentially usable areas through partial automation. Within a GIS, remote sensing data with a spatial resolution of just below one metre offers opportunities for the adequate registration of even the smallest potential building areas with their exact extent and location. In order to formulate an evaluation catalogue, the detected areas must be intersected with additional geo data. The regulations, through integration into a GIS with the help of a multi-criteria decision procedure, are modifiable according to local needs. In the framework of urban development and consolidation, using such a modular approach can assure an effective evaluation of potential building areas with regard to their specific possible usages as well as a reduction of the resource intensive in situ surveying, mapping and inspection tasks (See previous article).

**BLIF: a web- based remote sensing software for schools**

The project "Blickpunkt Fernerkundung (BLIF)" provides a way to implement remote sensing more frequently in school as a digital kind of modern learning.

To establish the 'new way of learning' into school with the chance of success, it is necessary to have an appropriate software solution for pupils. Characteristic of this application, developed on the newest didactical achievements of remote sensing and technical standards, is its intuitive usability according to the pupils' age. It is possible to have several special settings, depending on what kind of geographical question pupils want to explore and, depending on their knowledge, using remote sensing systems. Because of that, the software can be used by a wide range of users. The technical features range from normal basic features (like importing and exporting files, zoom function, the changing of vector to image files and vice-versa), to the possibilities of image improvement (e.g. regulation of brightness,

contrast settings, and stretching) up to several kinds of supervised classifications and geo-referencing.

**"Science Education through Earth Observation for High Schools" (SEOS)**

Within the European funded project 'Science Education through Earth Observation for High Schools' (Activity Code AERO-2005-2.3.2.1e) online based learning modules and teacher manuals have been developed for the application of remote sensing in different subjects. The Department of Physical Geography and its Didactics at the University of Education, Heidelberg is responsible for the overall didactical concept of the learning modules, a methodological introduction to remote sensing and for a module about land use, land use change, and land consumption.

The aim of the module is to build awareness for the problems of land cover and land use change in example areas with the help of satellite images in different landscape zones. This objective is realised in four chapters about global land use changes, urbanisation, syndromes of global change and mass tourism, focusing on the island of Tenerife.

***"Glokal Change"*- Evaluating global environmental alterations locally**

The project "Glokal Change – Evaluating global environmental alterations locally (German: lokal)" offers a web-based learning management system (LMS) for students in lower secondary school levels that can be used in curricular as well as in an informal education environment. The application of satellite images should visualize the environmental change in different spatial scales, e.g., on a global, regional and local level. Beside the modules and mapserver, where the satellite images are hosted, another focus of the project is a didactically suitable concept for combining interactive learning methods with instructions for an action-oriented fieldwork, e.g., mapping instructions and interview guidelines. From our understanding, it is important to extend the students' knowledge from the interactive learning to their individual experiences in the field.

The project is founded by the Deutsche Bundesstiftung Umwelt (DBU).

## 2.4 NEW EARSeL MEMBER: SPACE RESEARCH INSTITUTE, BULGARIAN ACADEMY OF SCIENCES

The registration of Space Research Institute in the Bulgarian Academy of Sciences with EARSeL was announced in the previous issue, however we are now able to give you a bit more information on the newly registered member.

The major and most intensive work in the field of Remote Sensing of the Earth in the Republic of Bulgaria has been carried out since 1974 in the Central Laboratory for Space Research at the Bulgarian Academy of Sciences (nowadays' Space Research Institute). In the beginning of 2009, nine scientists from our institute became EARSeL members with group membership. They are mainly young scholars working in the field of development and transfer of Remote Sensing of the Earth technologies. They feature various qualifications: geologists, geographers, landscape ecologists, ecologists and engineers. During the past three years they have been participating in several scientific projects:

- *Development of Human Resources: Improving the qualification and preserving of young scientific staff in the field of aerospace technologies as a precondition for monitoring and conservation of the environment and prevention of damages from natural hazards* on the scheme of Operative Programme Support for Development and Improvement of PhD students, Post Docs, postgraduate students and young scientists, 2008–2010.
- A methodology has been developed and a national database has been created for the NDVI, EVI, NPP and LAI based on satellite data from NOAA AVHR and MODIS; 2008 was completed successfully, supported by the firm Kontrax EAD, having as its end user the Aerospace Monitoring Centre at the Ministry of Emergency Situations, Bulgaria.
- In a consortium of 12 partners from 9 countries from the Mediterranean region, the project *Scenarios for Hazard-Induced Emergencies Management - SCHEMA. Sixth Framework Programme EC 2007–2010* is being implemented.

- In a consortium of 6 partners from 4 countries from the Western Balkan region, the project *Development of Strategy and Methods for Monitoring of Electromagnetic Pollution in the Environment of the Western Balkans. EU Programme, SEE-ERA.NET, INTAS.2007-2008* 2008 was completed successfully.
- The project *Establishment of a Scientific-Information Complex for Aerospace Polygons on the Territory of the Republic of Bulgaria* (Fig. 1.), 2007–2008, was completed successfully; funded by the Scientific Research Fund at the Ministry of Education and Science.

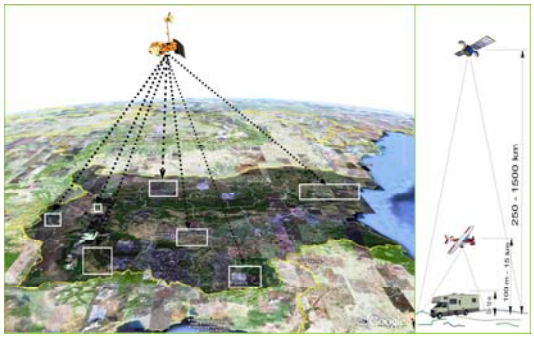
During this period, the members of the EARSeL have also participated in the following projects funded by the municipal authorities:

- A Pilot Monitoring Study of Forests and Agricultural Lands on the Territory of the Municipality of Kurdzhali Based on Satellite and GPS Data;
- A Pilot Monitoring Study of the Municipality of Toundzha Reservoirs Based on Satellite and GPS Data;
- Web-based Monitoring of Fires on the Territory of the Balkan Peninsula (http://sz.space.bas.bg/BG-Fires/index.html);
- Web-based Monitoring of Air Pollution in the Region of the Municipalities of: Bourgas (http://brg.space.bas.bg/), Kurdzhali (http://kr.space.bas.bg/), Stara Zagora (http://sz.space.bas.bg/).

Members from the SRI-BAS (http://www.space.bas.bg/):

*Department of Remote Sensing of the Earth:* Sen. Res. E .Roumenina, PhD; Res. Fell. L. Filchev, PhD student; Res. Fell. V. Naydenova, PhD student; Res. Fell. Geol. Eng. G. Jelev, PhD student; Res. Fell. P. Dimitrov, PhD student; Specialist Vassil Vassilev, MSc.

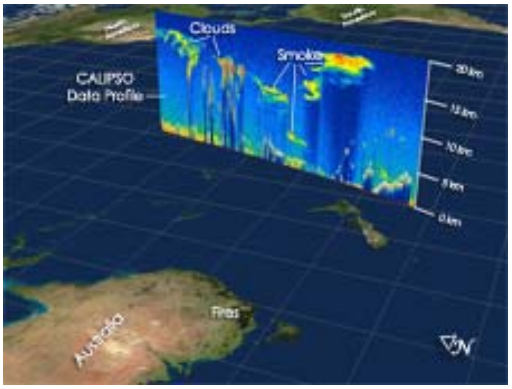
*Aerospace Information Centre:* Sen. Res. Dipl. Eng. R. Nedkov, PhD; Res. Fell. I. Ivanova; Specialist D. Panayotova, MSc.



The aerospace polygons on the territory of Bulgaria

# 3. NEWS ITEMS

## 3.1 CALIPSO FINDS SMOKE AT HIGH ALTITUDES DOWN UNDER




*As CALIPSO passed over the smoke plumes accumulating over Australia on February 10, 2009, its lidar technology took a vertical "slice" of the atmosphere to see the distribution of clouds and aerosols. In this photo, the CALIPSO data reveals that the smoke reached an abnormal altitude of 20 km, a detail that planar images are not able to detect. Credit: Chieko Kittaka, NASA's Langley Research Centre.*

As smoke plumes from powerful bushfires clouded the Australian skies in early February, satellites orbiting the Earth captured the rapid dispersal of smoke in real-time. One particular satellite, however, saw the occurrence from a different perspective than the rest and uncovered a rare phenomenon.

The NASA Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO), using its active lidar system, traced vertically through the layers of the atmosphere to find that the Australian bushfire smoke was lofting, or rising, to an astonishing 12 miles, an unusually high altitude that penetrates the lower part of the stratosphere.

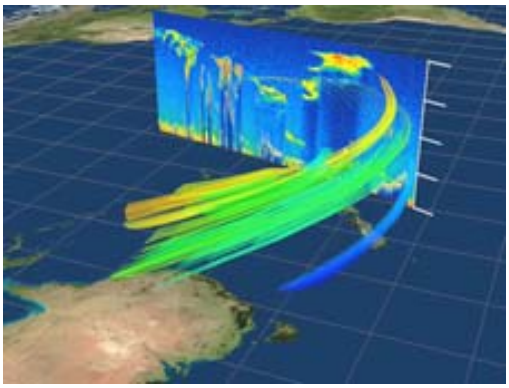
"Typically, the altitude of the smoke from wildfires is emitted to the lower troposphere, and occasionally, the smoke can get as high as tropopause heights," explains Chieko Kittaka, a research scientist at NASA Langley Research Centre in Hampton, Va., who is working on analysing the satellite data.


*In this photo, taken by the Moderate Resolution Imaging Spectroradiometer (MODIS), smoke from the fires in Australia is seen travelling across the Pacific Ocean toward New Zealand. As it mixes with the clouds, the smoke is distinguished by its tan colour. Credit: MODIS Rapid Response Team, NASA Goddard Space Flight Centre.*

CALIPSO has the ability to see the vertical distribution of smoke particles in the atmosphere. While most other satellites saw the smoke as a flat image that portrayed the horizontal direction of the distribution, CALIPSO was able to see the altitude of the lofting smoke. The satellite is not only unique for its ability to make vertical measurements of the atmosphere, but it can also see aerosol layers and plumes that are often invisible to most other instruments. At first glance, another satellite may have thought that the smoke was a low-level cloud, but CALIPSO is able to look deeper.

"For the most part, smoke particles are smaller than cloud particles, and they have a shape that differs from ice crystals and water droplets. CALIPSO recognizes this and is able to distinguish smoke from clouds," explains Mike Fromm, a researcher from the U.S. Naval Research Laboratory in Washington, who has been investigating these fires with CALIPSO scientists at NASA Langley.

Determining where smoke layers are found and their location is important to better understand how tiny ash particles can possibly affect climate. "If smoke particles reach the upper troposphere or lower stratosphere, they can persist for weeks and travel long distances," explains Chip Trepte, the project scientist for CALIPSO. And at these altitudes they can also influence the formation and lifetime of clouds as well as their brightness. All of these effects can alter the way sunlight is reflected and absorbed in the atmosphere.



*This visualization, which joins a single CALIPSO data profile with a back-trajectory, portrays the estimated movement of smoke over an 80-hour period. The varying colours of the trajectory represent the altitude of the travelling smoke, with blue depicting 5 km of height, and red representing 20 km. Credit: Analysis by Chieko Kittaka; visualization by Kurt Severance.*

Because so many different aspects of the atmosphere are affected by the smoke particles, it is important to understand what caused their abnormal presence in the stratosphere. Fromm explains that as the heat from the fire rises, a convective weather system is created. Within this, a severe thunderstorm, known as the pyro-cumulonimbus (pyroCb), develops. As the fire increases in strength, it acts like a chimney as it sucks the smoke from the flames up into the convective column. The smoke is then injected into the atmosphere at abnormally high altitudes – a side effect similar to volcanic eruptions. The abundant smoke fuels the storm's updrafts by serving as the nuclei for cloud particles, seeding so many that little-to-no precipitation forms, and taking away a storm-killing drag force.

While the elements of the fires in Australia are becoming clearer, there is still quite a bit of uncertainty surrounding the pyro-convection process. Satellite missions like CALIPSO have been supporting field campaigns to get a better handle on the meteorological, chemical, physical anomalies that forest fires create. This support in turn helps scientists learn more about other pyroCbs that have occurred.

"PyroCbs, such as the ones in Victoria, are historically rare," explains Fromm, who has been studying pyroconvection for over a decade. "Preliminary data from CALIPSO show that the smoke from these storms has gotten to altitudes never observed before."

Source: NASA Homepage on 5 March 2009

## 3.2 ESA LAUNCHES EARTH EXPLORER MISSION GOCE

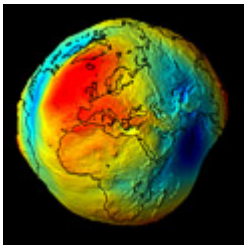
On the 17th of March 2009, the Gravity field and steady-state Ocean Circulation Explorer (GOCE) satellite developed by the European Space Agency (ESA) was lofted into a near-Sun-synchronous, low Earth orbit by a Rockot launcher lifting off from the Plesetsk cosmodrome in northern Russia.

With this launch, a new chapter in the history of Earth observation in Europe begun. GOCE is the first of a new family of ESA satellites designed to study our planet and its environment in order to enhance our knowledge and understanding of Earth-system processes and their evolution, to enable us to address the challenges of global climate change. In particular, GOCE will measure the minute differences in the Earth's gravity field around the globe.

The Russian Rockot launcher, derived from a converted ballistic missile, lifted off at 15:21 CET (14:21 GMT) and flew northward over the Arctic. About 90 minutes later, after one orbital revolution and two Breeze-KM upper-stage burns, the 1052 kg spacecraft was successfully released into a circular polar orbit at 280 km altitude with 96.7º inclination to the Equator. The launch was procured from Eurockot Launch Services, a German/Russian company based in Bremen, Germany.

"GOCE is ESA's first science satellite dedicated to Earth observation since Envisat in 2002. The size has changed, but the rationale remains the same: to provide the best science our technology can deliver for the maximum benefit of the science community and ultimately the citizens of Europe and the world," said Jean-Jacques Dordain, ESA Director General.

GOCE was selected in 1999 as the first Earth Explorer Core Mission under ESA's Living Planet Programme. The satellite was developed by an industrial team led by Thales Alenia Space in Turin, Italy. EADS Astrium Space in Friedrichshafen, Germany, provided the platform. Thales



*The geoid*

Alenia Space in Cannes, France, developed and integrated the main instrument using ultra-precise sensors developed by Onera of France. A total of 45 European firms have contributed to the building of the satellite.

For 24 months, GOCE will collect three-dimensional gravity data all over the globe. The raw data will be processed on the ground to produce the most accurate map of the Earth's gravitational field to date and to refine the geoid: the actual reference shape of our planet. Precise knowledge of the geoid, which can be considered as the surface of an ideal global ocean at rest, will play a very important role in further study of our planet, its oceans and atmosphere. It will serve as the reference model for our measurement and modelling of sea-level change, ocean circulation and polar ice cap dynamics.

**A unique payload onboard a unique spacecraft**

The main payload instrument is a state-of-the-art Electrostatic Gravity Gradiometer incorporating six highly sensitive accelerometers, mounted in pairs along three perpendicular axes on an ultra-stable carbon-carbon structure. The mission will measure not gravity itself but the tiny differences in gravity between the accelerometer pairs 50 cm apart.

The data collected by GOCE will yield accuracy of 1 to 2 cm in the geoid altitude and 1 mGal for the detection of gravity-field anomalies (mountains, for instance, usually cause local gravitational variations ranging from tens of milligals to approximately one hundred). The spatial resolution will be improved from several hundreds or thousands of kilometres on previous missions to 100 km with GOCE.

In order to get the maximum performance from the Gradiometer, GOCE is designed to provide a highly stable and undisturbed environment, despite its low-altitude orbit which forces the spacecraft to endure slight but significant drag from the uppermost layers of the atmosphere. This is the main reason for its slender 5 metre-long arrowhead aerodynamic shape design.

The spacecraft also incorporates two low-power xenon ion engines, one primary and one backup, each able to deliver 1 to 20 milli-Newtons of thrust (the force equivalent to our exhaling). These thrusters will be used to make real-time compensation for atmospheric drag, based on the mean acceleration detected by the two accelerometers mounted along the velocity axis.

The spacecraft's structure and design were also optimised to filter out all kinds of disturbance, by using ultra-stable materials to limit thermal cycling effects, without any deployable or moving parts.

**One mission, many benefits**

*Understanding ocean circulation*

The satellite is currently going through the commissioning phase. Mission operations are scheduled to start in summer 2009.

The mapping of the Earth's gravity field with such precision will benefit all branches of Earth science.

For geodesy, it will provide a unified reference model for height measurements worldwide, eliminating discontinuities between height systems for the various landmasses, countries and continents. This will enable better surveying of sea-level change, allowing scope to revisit a 200 year-plus history of recorded sea levels around the globe.

For oceanography, a better knowledge of the gravity field will significantly reduce current uncertainties regarding ocean heat and mass transfer, which will translate into tremendous improvements to global ocean-circulation and climate-forecasting models. GOCE will also improve our knowledge of the polar cap bedrock in Greenland and Antarctica. The precise geoid map will enable better orbit determination for satellites monitoring the ice sheet and thus increased measurement accuracy.

For geophysics, combining GOCE's results with magnetism, topography and seismology data will help produce detailed 3D mapping of density variations in the Earth's crust and upper mantle. This will be a major contribution to the improvement of all modelling of sedimentary basins, rifts, tectonic movement and sea/land vertical change, enhancing our under-

standing of the processes responsible for natural hazards.

**One Earth Explorer up, more to come**

*Understanding the Earth system*

"This launch success marks the dawn of a new generation of Earth sciences satellites in Europe," said Volker Liebig, Director of Earth Observation Programmes at ESA. "It is the first of a new generation of small, dedicated science satellites and it paves the way for more Earth Explorer missions. The scientists are urgently awaiting the data sets from these missions. We have four more launches due over the next two years; this means that we are in for a very busy time."

*Mt. Etna eruption in 2006*

GOCE is the first Earth Explorer Core Mission under ESA's Living Planet Programme which was initiated in 1999 to foster research on the Earth's atmosphere, biosphere, hydrosphere, cryosphere and interior, their interaction and the impact of human activities on these natural processes. Two more Core Missions, selected to address specific topics of major public concern, are already under development: ADM-Aeolus for atmospheric dynamics (2011), and EarthCARE to investigate the Earth's radiative balance (2013). Three smaller Earth Explorer Opportunity Missions are also under preparation: Cryosat 2 to measure ice-sheet thickness (2009), SMOS to study soil moisture and ocean salinity (2009) and Swarm to survey the evolution of the magnetic field (2011).

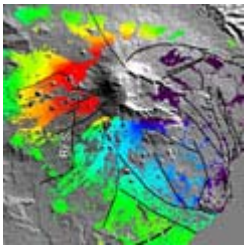
Source: ESA Homepage on 17 March 2009

## 3.3 HOT STUFF – 15 YEARS OF SATELLITE DATA OVER MOUNT ETNA

Using radar images acquired by ESA satellites from 1992 to 2006, scientists have for the first time been able to monitor the long-term behaviour of Mt. Etna, Europe's highest and most active volcano.

This unprecedented time series of Synthetic Aperture Radar (SAR) observations from ESA's ERS-1, ERS-2 and Envisat satellites provided crucial information for understanding how the volcano's surface deformed during the rise, storage and eruption of magma.

Changes in surface deformation, such as sinking, bulging and rising, are indicators of different stages of volcanic activity, which may result in eruptions. Thus, precise monitoring of a volcano's surface deformation, or 'breathing', could lead to predictions of eruptions.



*Cumulative deformation maps*

Using advanced SAR Interferometry (InSAR) techniques, the team was able to determine the deformation of Mt. Etna's surface over a long period on a scale of centimetres. InSAR involves mathematically combining different radar images acquired from the same point in space at different times to reveal changes that have occurred on the ground between recordings.

Based on the deformation measurements retrieved from their InSAR analysis during the 1992-2006 time interval and on the recorded volcanic data, the team distinguished two volcano-tectonic behaviours.

"Between 1993 and 2000, Etna inflated with a deformation rate of about 1 cm per year that progressively reduced with time, nearly vanishing between 1998 and 2000. Moreover, several eruptions took place with the lava being erupted (at a relatively low rate) exclusively from the top of the volcano," said Riccardo Lanari from the Istituto per il Rilevamento Elettromagnetico dell' Ambiente (IREA-CNR) in Naples, Italy.

"Between 2001 and 2005, Etna deflated while erupting lava at a higher rate from its flanks; this occurred along with large displacements of the entire east-flank. We suggest that these two behaviours result from the higher rate of magma stored between 1993 and June 2001, which triggered the emplacement of the dike responsible for the 2001 and 2002-2003 eruptions, destabilising the volcano."

The results of the study show how surface deformation relates to eruptive behaviour over a time span much larger than that of a single eruption. Consequently, the continuity of satellite data is essential for studying and possibly predicting future volcanic eruptions.

ESA remains committed to providing continuity to its SAR missions. As part of its Global Monitoring for Environment and Security (GMES) programme, ESA will launch five Sentinel satellites. Sentinel-1, expected to be launched in 2011, will ensure the continuity of SAR data with ERS-2 and Envisat.

Source: ESA Homepage on 27 March 2009

## 3.4 SATELLITES SHOW ARCTIC LITERALLY ON THIN ICE

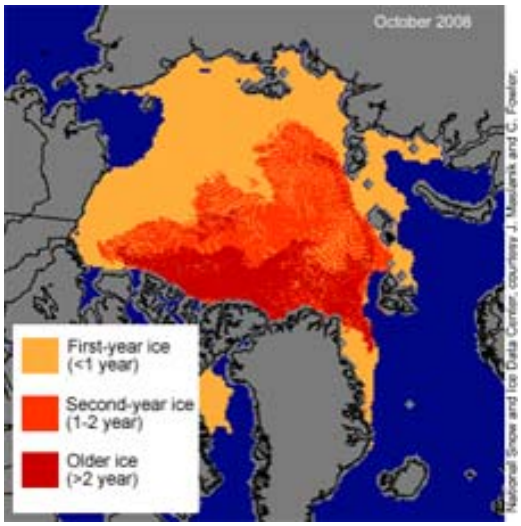
*This data visualization from the AMSR-E instrument on the Aqua satellite show the maximum sea ice extent for 2008-09, which occurred on Feb. 28, 2009.* ***Credit:*** *NASA Goddard's Scientific Visualization Studio*

The latest Arctic sea ice data from NASA and the National Snow and Ice Data Centre show that the decade-long trend of shrinking sea ice cover is continuing. New evidence from satellite observations also shows that the ice cap is thinning as well.

Arctic sea ice works like an air conditioner for the global climate system. Ice naturally cools air and water masses, plays a key role in ocean circulation, and reflects solar radiation back into space. In recent years, Arctic sea ice has been declining at a surprising rate.

Scientists who track Arctic sea ice cover from space announced today that this winter had the fifth lowest maximum ice extent on record. The six lowest maximum events since satellite monitoring began in 1979 have all occurred in the past six years (2004-2009).

Until recently, the majority of Arctic sea ice survived at least one summer and often several. But things have changed dramatically, according to a team of University of Colorado, Boulder, scientists led by Charles Fowler. Thin seasonal ice -- ice that melts and re-freezes every year -- makes up about 70 percent of the Arctic sea ice in wintertime, up from 40 to 50 percent in the 1980s and 1990s. Thicker ice, which survives two or more years, now comprises just 10 percent of wintertime ice cover, down from 30 to 40 percent.




*During the winter, winds and currents push some of the thick, multi-year ice out of the Arctic Ocean. In the past, that thicker ice was replenished by new ice that survived several summer melt seasons.* ***Credit:*** *Chuck Fowler and Jim Maslanik, University of Colorado, and NSIDC*

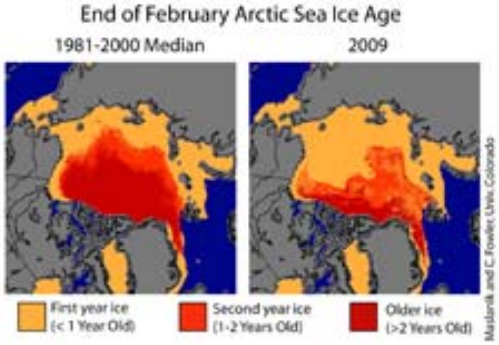
According to researchers from the National Snow and Ice Data Center in Boulder, Colo., the maximum sea ice extent for 2008-09, reached on Feb. 28, was 5.85 million square miles. That is 278,000

square miles less than the average extent for 1979 to 2000.

"Ice extent is an important measure of the health of the Arctic, but it only gives us a two-dimensional view of the ice cover," said Walter Meier, research scientist at the center and the University of Colorado, Boulder. "Thickness is important, especially in the winter, because it is the best overall indicator of the health of the ice cover. As the ice cover in the Arctic grows thinner, it grows more vulnerable to melting in the summer."

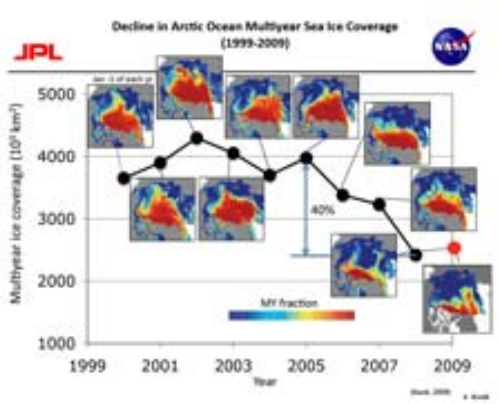
The Arctic ice cap grows each winter as the sun sets for several months and intense cold sets in. Some of that ice is naturally pushed out of the Arctic by winds, while much of it melts in place during summer. The thicker, older ice that survives one or more summers is more likely to persist through the next summer.

Sea ice thickness has been hard to measure directly, so scientists have typically used estimates of ice age to approximate its thickness. But last year a team of researchers led by Ron Kwok of NASA's Jet Propulsion Laboratory in Pasadena, Calif., produced the first map of sea ice thickness over the entire Arctic basin.




*Maps show the relative age of Arctic sea ice at the end of February 2009 and over time. Thin, first-year ice is the predominant type covering the Arctic Ocean this winter.* ***Credit:*** *Chuck Fowler and Jim Maslanik, University of Colorado, and NSIDC*

Using two years of data from NASA's Ice, Cloud, and land Elevation Satellite (ICESat), Kwok's team estimated thickness and volume of the Arctic Ocean ice cover for 2005 and 2006. They found that the average winter volume of Arctic sea ice contained enough water to fill Lake Michigan and Lake Superior combined.




*The decline in multiyear (including second-year ice) sea ice coverage has also been measured by NASA's QuikScat satellite from 1999 to 2009. Each field shows the coverage on January 1 of that year. There is a 40 percent drop in coverage between 2005 and 2007.* ***Credit:*** *Ron Kwok, NASA/JPL*

The older, thicker sea ice is declining and is being replaced with newer, thinner ice that is more vulnerable to summer melt, according to Kwok. His team found that seasonal sea ice averages about 6 feet in thickness, while ice that had lasted through more than one summer averages about 9 feet, though it can grow much thicker in some locations near the coast.

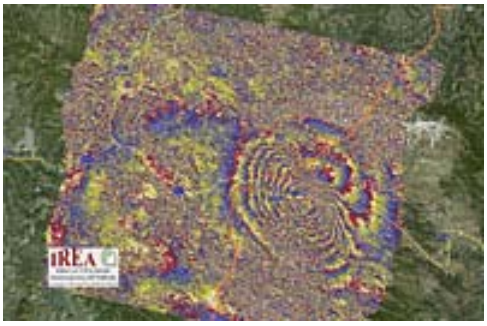
Kwok is currently working to extend the ICESat estimate further, from 2003 to 2008, to see how the recent decline in the area covered by sea ice is mirrored in changes in its volume.

"With these new data on both the area and thickness of Arctic sea ice, we will be able to better understand the sensitivity and vulnerability of the ice cover to changes in climate," Kwok said.

Source: NASA Homepage on 6 April 2009

## 3.5 SATELLITES SHOW HOW EARTH MOVED DURING ITALY QUAKE

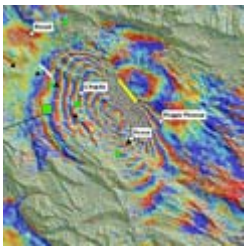
Studying satellite radar data from ESA's Envisat and the Italian Space Agency's COSMO-SkyMed, scientists have begun analysing the movement of Earth during and after the 6.3 earthquake that shook the medieval town of L'Aquila in central Italy on 6 April 2009.




*Envisat interferogram over the L'Aquila area*

Scientists from Italy's Istituto per il Rilevamento Elettromagnetico dell' Ambiente (IREA-CNR) and the Istituto Nazionale di Geofisica e Vulcanologia (INGV) are studying Synthetic Aperture Radar (SAR) data from these satellites to map surface deformations after the earthquake and the numerous aftershocks that have followed.

The scientists are using a technique known as SAR Interferometry (InSAR), a sophisticated version of 'spot the difference'. InSAR involves combining two or more radar images of the same ground location in such a way that very precise measurements – down to a scale of a few millimetres – can be made of any ground motion taking place between image acquisitions.



*Interpreted Envisat interferogram*

*A damaged church in L'Aquila*

The InSAR technique merges data acquired before and after the earthquake to generate 'interferogram' images that appear as rainbow-coloured interference patterns. A complete set of coloured bands, called 'fringes', represents ground movement relative to the spacecraft of half a wavelength, which is 2.8 cm in the case of Envisat's ASAR.

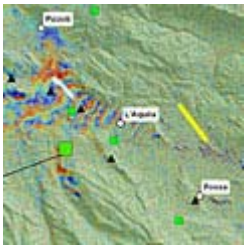
The first Envisat data, acquired after the earthquake on 12 April, were made immediately available to the scientists.

"We produced an interferogram just a few hours after the Envisat acquisition by combining these data with data acquired before the earthquake on 1 February. We were pleased that we were able to immediately see the pattern of the earthquake," said Riccardo Lanari of IREA-CNR in Naples, Italy.

The Envisat interferogram, as explained by Stefano Salvi from INGV's Earthquake Remote Sensing Group, shows nine fringes surrounding a maximum displacement area located midway between L'Aquila and Fossa, where the ground moved as much as 25 cm (along a line between the satellite's orbital position and the earthquake area).

"By using available 3D ground displacements from five GPS location sites around the affected area, we were able to confirm the preliminary results obtained with Envisat data," Salvi said.

The COSMO-SkyMed constellation, which is currently made up of three satellites, allows for frequent data. This means new interferograms can be calculated every few days.



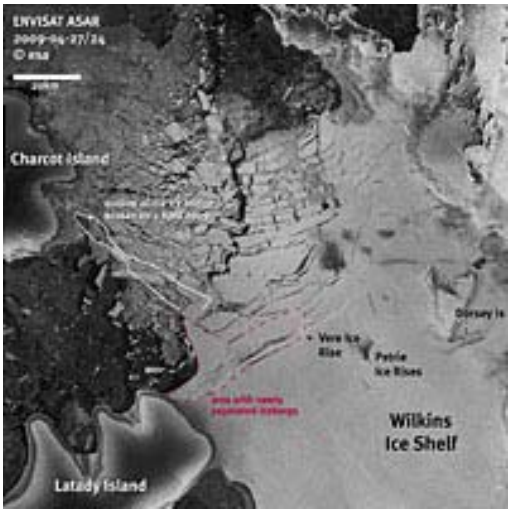
*COSMO-SkyMed interferogram over the L'Aquila area*

The COSMO-SkyMed data together with the Envisat data and possibly SAR data from other satellites will ensure a dense sampling of the ground deformation around the L'Aquila area in the next months, which could make this earthquake one of the most covered by SAR Interferometry measurements.

To ensure all scientists are able to contribute to the analysis of the earthquake, ESA is making its Earth observation dataset collected over the L'Aquila area freely accessible with an innovative fast data download mechanism (http://earth.esa.int/ew/earthquakes/Italy_April09/). The dataset will be continuously updated with the newest Envisat acquisitions.

Source: ESA Homepage on 15 April 2009

## 3.6 SATELLITE IMAGERY SHOWS FRAGILE WILKINS ICE SHELF DESTABILISED




Superimposed Envisat images show margins of the collapsed ice bridge

Satellite images show that icebergs have begun to calve from the northern front of the Wilkins Ice Shelf – indicating that the huge shelf has become unstable. This follows the collapse three weeks ago of the ice bridge that had previously linked the Antarctic mainland to Charcot Island.

The ice bridge, which effectively formed a barrier pinning back the northern ice front of the central Wilkins Ice Shelf, collapsed on 5 April removing about 330 sq km of ice. As a consequence of the collapse, the rifts, which had already featured along the northern ice front, widened and new cracks formed as the ice adjusted in the days that followed.

Dr Angelika Humbert from the Institute of Geophysics, Münster University and Dr Matthias Braun from the Center for Remote Sensing, University of Bonn have been monitoring the ice shelf using a combination of radar images from ESA's Envisat satellite and the German Aerospace Centre's TerraSAR-X satellite.

On 24 April, the satellite data showed that the first icebergs had started to break away from the fragile ice shelf. A very rough estimate suggests that, so far, about 700 sq km of ice has been lost from the Wilkins Ice Shelf.

In contrast to the ice bridge, which shattered very quickly, it is expected that the discharge of ice will continue for some weeks. The icebergs are calving as a result of fracture zones that have formed


TerraSAR-X image over Wilkins Ice Shelf from 23 April

over the last 15 years and which turned Wilkins into a fragile and vulnerable ice shelf.

"The retreat of Wilkins Ice Shelf is the latest and the largest of its kind. Eight separate ice shelves along the Antarctic Peninsula have shown signs of retreat over the last few decades. There is little doubt that these changes are the result of atmospheric warming on the Antarctic Peninsula, which has been the most rapid in the Southern Hemisphere," explained David Vaughan from the British Antarctic Survey.

"The changes to Wilkins Ice Shelf provide a fabulous natural laboratory that will allow us to understand how ice shelves respond to climate change and what the future will hold for the rest of Antarctica," Vaughan commented. "The quality and frequency of images acquired by ESA satellites mean that the break-up of Wilkins Ice Shelf can be analysed far more effectively than any previous event. For the first time, I think, we can really begin to see the processes that have brought about the demise of the ice shelf."

However, it is still unclear how the situation will evolve. Humbert noted that, "We are not sure if a new stable ice front will now form between Latady Island, Petrie Ice Rises and Dorsey Island. If the connection to Latady Island is lost, the projected loss of 3370 sq km of ice might be greater – though we have no indication that this will happen in the near future."

The combination of high resolution TerraSAR-X images and the more frequently acquired Envisat images, increases the understanding of ice shelf break-up more than ever before.

Source: ESA Homepage on 28 April 2009

# 4. FUTURE EVENTS

## 4.1 CONFERENCES AND SYMPOSIA

| | |
|---|---|
| **1 – 9 July 2009** | 9th Conference on Optical 3-D Measurement Techniques<br>Vienna, Austria<br>http://info.tuwien.ac.at/ingeo/optical3d/ |
| **5 – 8 July 2009** | 6th International Symposium on Spatial Data Quality (ISSDQ 2009)<br>St. John's (Newfoundland), Canada<br>http://www.mun.ca/issdq2009 |
| **6 – 10 July 2009** | The VII Hotine-Marussi Symposium<br>Rome, Italy<br>http://w3.uniroma1.it/Hotine-Marussi_Symposium_2009/homepage.asp |
| **24 – 28 August 2009** | ICA Symposium "True-3D in Cartography"<br>Dresden, Germany<br>http://kartographie.geo.tu-dresden.de/true3Dincartography09/ |
| **31 August – 3 September 2009** | SPIE Europe Remote Sensing<br>Berlin, Germany<br>http://spie.org/x6262.xml |
| **31 August – 4 September 2009** | Geodesy for Planet Earth (IAG2009)<br>Buenos Aires, Argentina<br>http://www.iag2009.com.ar/ |
| **8 – 11 September 2009** | RSPSoc 2009 Annual Conference<br>Leicester, UK<br>http://www.rspsoc.org/events/info/rspsoc-annual-conference-2009-leicester/ |
| **9 – 12 September 2009** | 6th International Symposium on Digital Earth (ISDE6)<br>Beijing, China<br>http://www.isde6.org/ |
| **5 – 8 October 2009** | IXth International Scientific & Technical Conference ″From Imagery to Map: Digital Photogrammetric Technologies″<br>Attica, Greece<br>www.racurs.ru/Greece2009/ |
| **18 – 23 October 2009** | 30th Asian Conference on Remote Sensing (ACRS2009) ″Asia Onward Space Age″<br>Beijing, China<br>www.acrs2009.org/ |
| **18 – 20 November 2009** | 18 – 20 November 2009<br>EGU Topical Conference on Earth Observation and Water Cycle Science<br>Frascati, Italy<br>http://www.congrex.nl/09c16/ |
| **1 – 3 December 2009** | 4th International Conference "Earth from Space – The Most Effective Solutions"<br>Moscow, Russia<br>http://www.transparentworld.ru/conference/2009/en/ |

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| **7 – 9 December 2009** | Global Space Technology Forum<br>Abu Dhabi, UAE<br>www.smg-conferences.com/gstf/ |
| **22 – 24 June 2010** | OCOSS 2010, Ocean & Coastal Observation and forecast: Sensors and observing Systems, numerical models & information systems<br>Brest, France<br>http://www.see.asso.fr/htdocs/main.php/congresJourneesFutures.php/1520/ |
| **18 – 25 July 2010** | 38th Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events "COSPAR 2010"<br>Bremen, Germany<br>http://www.cospar2010.org/ |

## 4.2 WORKSHOPS, TRAINING COURSES AND EVENTS

| | |
|---|---|
| **28 June – 3 July 2009** | ESA Advanced Training Course on Land Remote Sensing<br>Prague, Czech Republic<br>http://earth.esa.int/landtraining09/ |
| **26 – 28 August 2009** | 1st IEEE GRSS Workshop on "Hyperspectral Image and Signal Processing: Evolution in Remote Sensing"<br>Grenoble, France<br>http://www.ieee-whispers.com/2009/ |
| **2 – 5 September 2009** | EARSeL 7th SIG International Workshop on Forest Fires: "Advances in RS and GIS applications in Forest Fire Management". Towards an operational use of remote sensing in forest fire management<br>Matera, Italy<br>http://www.forestfire.imaa.cnr.it/ |
| **8 – 11 September 2009** | RSPSoc2009 Annual Conference "New Dimensions in Earth Observation"<br>University of Leicester, Leicester, UK<br>http://www.rspsoc2009.org |
| **8 – 11 September 2009** | 3rd HYPER-I-NET Summer School: "Hyperspectral Data: from Images to Information"<br>Pavia, Italy<br>http://www.hyperinet.eu |
| **20 – 21 October 2009** | ISPRS ICWG I/V 3rd International Workshop "The Future of Remote Sensing"<br>Antwerp, Belgium<br>http://isprs.vgt.vito.be/cms/ |
| **21 – 23 October 2009** | 3rd United Nations International UN-SPIDER Workshop: "Disaster Management and Space Technology – From Concepts to Application"<br>Bonn, Germany<br>Information: joerg.szarzynski@unoosa.org |
| **26 – 27 October 2009** | NATO Specialists' meeting on Thermal hyperspectral Imagery<br>Royal Military Academy (RMA), Brussels, Belgium<br>http://www.sic.rma.ac.be/ThIS/ |
| **25 – 27 November 2009** | 3rd Workshop of EARSeL SIG Remote Sensing of Land Use and Land Cover<br>Bonn, Germany<br>http://www.zfl.uni-bonn.de/earsel/earsel.html |

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|---|---|
| **30 November – 11 December 2009** | 30 November – 11 December 2009<br>'COP15', United Nations Climate Change Conference - ESA exhibition<br>Copenhagen, Denmark<br>http://www.cop15.dk/en |
| **3 – 4 December 2009** | WG II/2+3+4 Workshop on Quality, Scale & Analysis Aspects of Urban City Models<br>Lund, Sweden<br>http://www.commission2.isprs.org/wg2/ |

Back Cover – This Envisat image highlights Buenos Aires, the coastal capital of Argentina. Home to 12 million people, the large conurbation of Buenos Aires is seen as a distinct grey area on the southern bank of the River Plate, with the smaller purpose-built provincial capital of La Plata just to its east. The Uruguayan capital of Montevideo is another smaller grey mass on the north side, on the mouth of the River Plate.

The image was acquired on 5 April 2009 by Envisat's Medium Resolution Imaging Spectrometer (MERIS). Source: ESA

EARSeL Sponsoring Agencies:

Council of Europe  European Space Agency

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