



Earth Observation Center (EOC)

German Remote
Sensing Data Center
(DFD)



EOC's German Remote Sensing Data Center

The German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum – DFD) and the Remote Sensing Technology Institute (Institut für Methodik der Fernerkundung – IMF) together form the Earth Observation Center (EOC). This association of two institutes within the German Aerospace Center (Deutsches Zentrum für Luft und Raumfahrt - DLR) is Germany's leading research and development organization in the field of earth observation.

Whereas IMF focuses on basic development work more directly related to the earth observation sensors, DFD concentrates on generating geoinformation products and services based on sensor data and on customizing methodologies for specific applications.

At DFD data from national, European and many international satellite missions are received, processed, archived and made available to the public. For this purpose the institute operates receiving stations in Germany, the Antarctic and Canada in cooperation with international organizations and companies. The raw satellite data are then processed to yield data products which are made available over the Internet and safeguarded long term for retrospective analyses.

DFD develops methodologies and information systems which address such urgent social challenges as the preservation of the environment, global change, disaster relief and early warning. DFD offers advice, services and data products to scientists, public authorities and the public via Web interfaces. In addition, DFD assumes sovereign obligations as operator of the German Satellite Data Archive and in the context of DLR membership in the International Charter Space and Major Disasters.

DFD assists the next generation of scientists. An endowed chair at Würzburg University and lectureships at other institutions promote close interactions with academia. DFD cooperates with universities in Augsburg and Munich (TUM) as well as with numerous research institutions worldwide, industry, and international organizations. As a partner of public authorities and commercial customers, DFD links the science sector with end users.

Earth observation can expedite the solution of important social concerns. As part of the Earth Observation Center, the German Remote Sensing Data Center makes the relevant information available.

The German Remote Sensing Data Center is certified in accordance with ISO9001.



The Earth Observation Center – EOC – in Oberpfaffenhofen near Munich

Current Fields of Research

Global Change

Temperatures rise, perpetual ice melts, fertile landscapes turn into deserts, animals and plants become extinct, megacities proliferate. Global change has many aspects. Earth observation satellites measure ice thickness and the flow velocity of glaciers. They register how the chemistry of the atmosphere is changing and monitor worldwide how humans overrun natural environments.

Only remote sensing offers the view from space which makes it possible to record and comprehend the dimensions of global change and provide information vital for planning and decision making as well as input data for climate modeling. For example, earth observation data are being used to analyze complex ecological and hydrological interactions in the Mekong Delta. The satellite data are integrated in an environmental information system that was established in a German-Vietnamese joint project (WISDOM) with the support of DFD, so that water resources can be used sustainably and precautions taken against flooding. Another example: satellites are employed to map ecologically valuable habitats and to monitor their development for biodiversity research.

Emergency Mapping and Crisis Management

High resolution satellite data provide a precise image of a given situation, also in remote and inaccessible disaster areas. Within a short time large areas can be recorded and analyzed, even if they are hidden under a thick layer of clouds, smoke or fog. DFD has concentrated the relevant experience in its Center for Satellite Based Crisis Information (ZKI).

Satellite image maps for disaster management after natural catastrophes and for humanitarian emergencies are provided by ZKI to national crisis response teams, European relief services and international organizations. On behalf of DLR, DFD assumes responsibility for routine operations associated with the International Charter Space and Major Disasters. It additionally supports the United Nations information platform for disaster aid, UN-SPIDER. DFD also provides continuous monitoring services based on satellite data, such as fire monitoring for Europe and neighboring regions.

Information Systems for Decision Support

Human receptiveness quickly reaches its limit if many different kinds of information have to be processed simultaneously. This is particularly the case if the data are rapidly changing temporally and spatially, which is precisely the case in crisis situations.

Here, intelligent information technology can ease the burden on those responsible. DFD has put to use its experience in the field of data and information management systems to develop a decision support system (DSS) as part of the German-Indonesian GITEWS project. It is part of an innovative tsunami early warning system for Indonesia developed and established by a consortium of German research institutions.

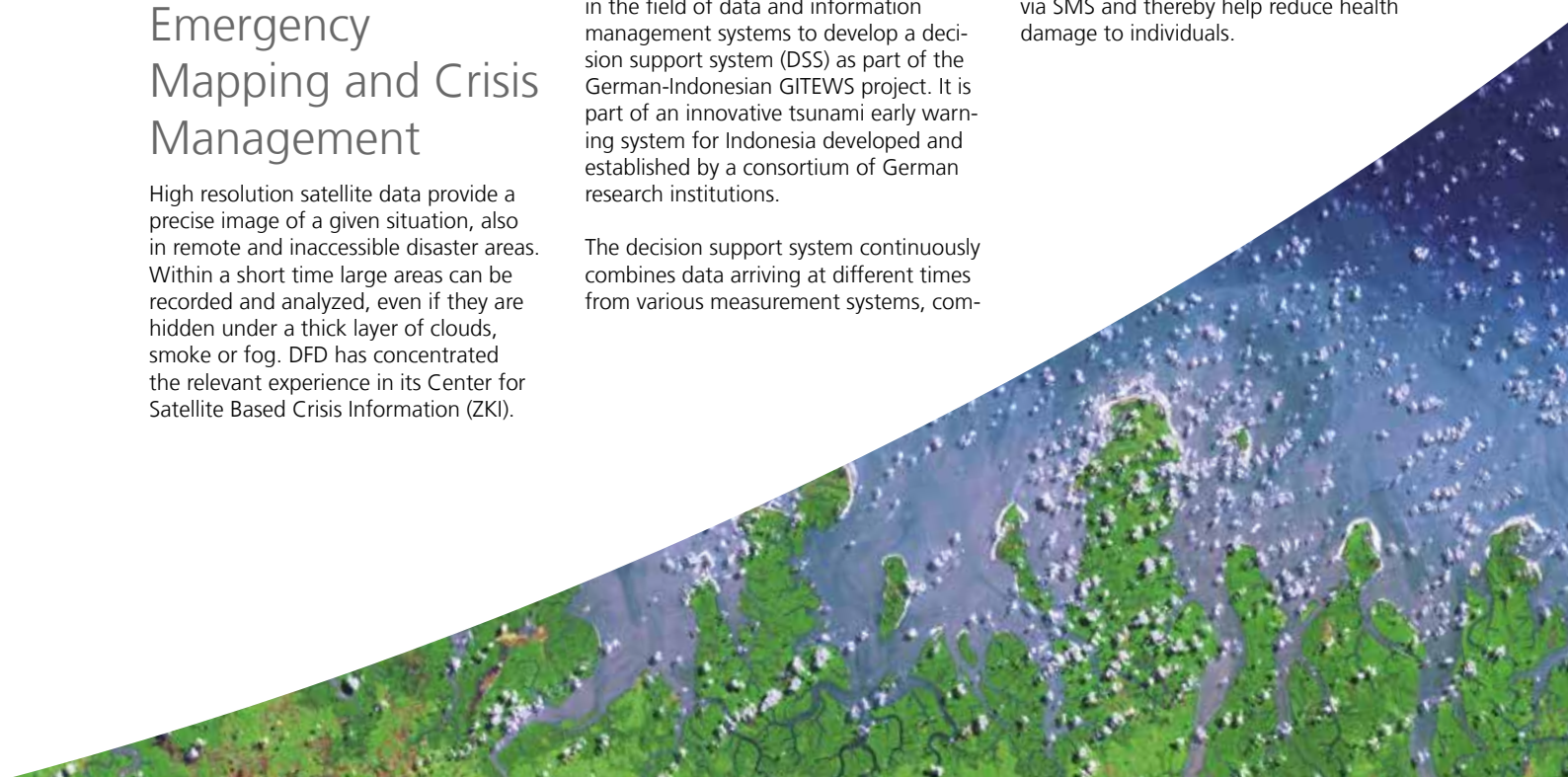
The decision support system continuously combines data arriving at different times from various measurement systems, com-

pares them with simulations and then provides the heads of situation centers with a precise and comprehensive overview of the momentary situation. These leaders can then decide within minutes whether and for which region a tsunami warning must be given and the population evacuated. DFD's system will be expanded so that early warning can be provided for other types of catastrophes.

Health Care and Environmental Pollution

Satellites not only monitor the atmosphere to provide weather forecasts. Information about trace gases in the upper layers of the atmosphere or on air pollutants can be derived from remote sensing data.

Every day, DFD provides up-to-date information on air quality for all of Europe, and uses modern communication and navigation technology to facilitate easy access for users. Local and timely information on environmental hazards such as the level of ultraviolet radiation can be conveyed to any interested person via SMS and thereby help reduce health damage to individuals.



Data Reception and Processing



DFD Receiving Antenna in Inuvik, Canada

Payload Ground Segment for Earth Observation Missions

Worldwide, DFD receives data from numerous satellite missions. The payload ground segment required for data reception includes, in addition to antenna facilities in Neustrelitz and Oberpfaffenhofen, an international network of receiving stations which in some cases are managed in cooperation with public and commercial partners. These stations are equipped for multimission operation and are also available for scheduled campaigns as well as routine assignments for European and international missions. Important partners and customers are the European Space Agency (ESA), Europe's operator of weather satellites (EUMETSAT) and commercial data distributors.

DFD's processing and archiving centers (PAC) process the received data to generate standard products which can be easily integrated into various applications. Increasingly, geoinformation is also being directly derived and offered as an information service by DFD. Examples are data on air quality, ultraviolet radiation hazards, vegetation indices and fire monitoring. For time-critical applications the data are processed into information products already at the receiving stations and are accordingly available soon after acquisition.

Data Management and Information Technology

More and more satellites are providing images in ever greater detail. Therefore, the amount of data which must be automatically received, processed, archived and made available to users is rapidly increasing: an information-technology challenge. Now with the TanDEM-X radar mission the data volume safeguarded in DFD archives already surpasses two billion megabytes.

Together with industrial partners DFD has developed a Data Information Management System (DIMS) to handle this amount of data. This system can be flexibly adapted to meet the various requirements of different ground segment. Currently, DIMS technology is not only being used at DFD, but also by ESA and international partners.

The earth observation data managed at DFD by DIMS are safeguarded long-term in the German Satellite Data Archive (D-SDA). Via Web interfaces this collection can be searched and data ordered. Robots access the entire archive and process orders automatically. The DFD data archive adheres to European standards and contributes to the creation of a joint European geodatabase. DFD contributes its experience in data management also to the development of decision support systems.

Analysis and Applications

Atmosphere

With the help of satellite earth observation, climate change and variations in the atmosphere can be continuously monitored and adherence to international environmental conventions verified. For this purpose DFD measures the distribution of such atmospheric constituents as ozone, greenhouse gases, aerosols, clouds and pollutants on global, continental and regional scales.

Mathematical processes combine the measurement data with complex models of the atmosphere and biosphere. This kind of data assimilation makes it possible to obtain information which the satellite cannot measure directly and to supply forecasts to warn people about problematic levels of pollutants such as fine dust, ground-level ozone and pollen.

These data are available from the World Data Center for Remote Sensing of the Atmosphere (WDC-RSAT). This center is operated by DFD under a mandate from the United Nations' World Meteorological Organization (WMO) and the International Council for Science (ICSU).

But there is more to be learned about the atmosphere. Temperature fluctuations at 87 km altitude not only reveal climate signals but could in the future also warn of approaching tsunamis. This possibility is being investigated by DFD as a member of the virtual institute Schneefernerhaus Environmental Research Station (UFS) on the Zugspitze, Germany's highest mountain.

Terrestrial Ecosystems and Environment

People are exploiting Earth's natural resources at an increasing pace. With the help of satellites it is possible to monitor the consequences for terrestrial ecosystems relating to land use, mining operations, biodiversity, carbon capture by vegetation, and the water cycle.

These observations in combination with geodata from other sources are analyzed in geographic information systems (GIS). With help from mathematical models, trends and future threats resulting from climate change, natural catastrophes and pressures from high-density human settlements such as megacities can be anticipated, providing a basis for effective environmental management and a sustainable economy.

In addition to "classic" multispectral recordings, radar and hyperspectral data are also employed for these purposes. Hyperspectral analysis provides highly precise information about the quality of soil and water as well as the health of vegetation. Radar approaches enable to assess slope collapse or volcanic eruptions, and make it possible to monitor worldwide the melting of global ice masses also during polar night. The methodologies are being experimentally tested and in some cases readied for routine application.

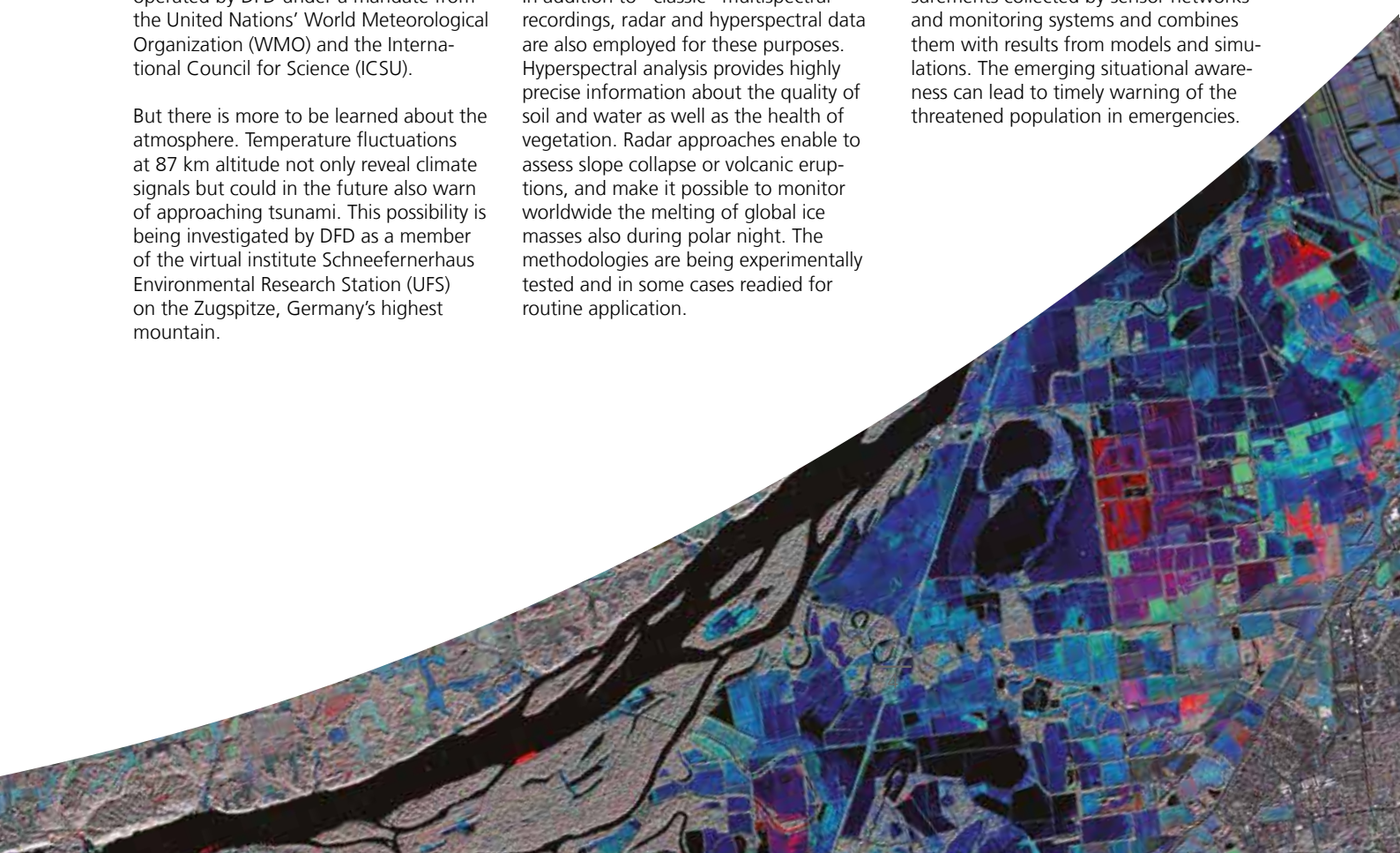
Civil Crisis Information and Geo Risks

Natural and environmental disasters, humanitarian emergencies and technology accidents demand coordinated action by all participants. Geoinformation provides an important basis for planning this response.

But earth observation data is not only suitable for rapidly mapping seriously damaged areas as part of crisis management. They are above all also used to plan and implement preventive measures.

Risk and vulnerability analyses can be used to draw up evacuation scenarios and to prepare the population for impending disasters.

The early warning system developed at DFD integrates such analyses with measurements collected by sensor networks and monitoring systems and combines them with results from models and simulations. The emerging situational awareness can lead to timely warning of the threatened population in emergencies.





User Services

DFD develops earth observation methodologies and encourages their use in science, industry, and society in general. Therefore, in addition to research activities it offers products and solutions via specialized services tailored to the needs of particular user groups.

Center for Satellite Based Crisis Information (ZKI)

ZKI offers crisis reaction teams satellite mapping services at short notice for use during natural catastrophes and humanitarian emergencies. Particularly within the framework of the "International Charter Space and Major Disaster," satellite data is rapidly recorded, analyzed and processed to yield customized and easy-to-use thematic maps and visualizations. ZKI is integrated into national and international networks and staff members are also involved in the United Nations disaster management initiative SPIDER.



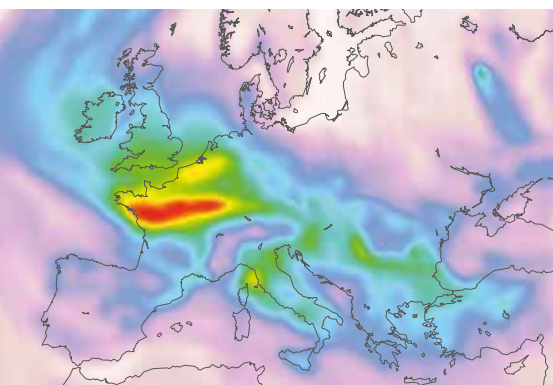
World Data Center for Remote Sensing of the Atmosphere (WDC-RSAT)

WDC-RSAT is one of the World Data Centers of the International Council for Science (ICSU) and the World Meteorological Organization (WMO). It processes and archives satellite data on the atmosphere from a variety of sources and makes available data and derived products free of charge to scientists and other users via Web interfaces.



Optical Airborne Remote Sensing and Calibration Facility (OpAIRS)

The "Optical Airborne Remote Sensing and Calibration Facility" brings together the relevant experience and infrastructure available at the Earth Observation Center from IMF and DFD. In this laboratory, hyperspectral sensors are calibrated and operated, and customized data products are generated on request.



DFD Structure

Institute Director

Prof. Dr. Stefan Dech

Staff Function
Business Development and GMES:
Dipl.-Geophys. Gunter Schreier

Departments

National Ground Segment

Neustrelitz
Head: Dipl.-Ing. Holger Maass

International Ground Segment

Oberpfaffenhofen
Head: Dr. Erhard Diedrich

Information Technology

Oberpfaffenhofen
Head: Dipl.-Inf. Eberhard Mikusch

Atmosphere

Oberpfaffenhofen
Head: Prof. Dr. Michael Bittner

Land Surface

Oberpfaffenhofen
Head: PD. Dr. Claudia Künzer

Civil Crisis Information and Geo Risks

Oberpfaffenhofen
Head: Prof. Dr. Günter Strunz

Science Communication and Visualization

Oberpfaffenhofen
Head: Dipl.-Geogr. Nils Sparwasser

Endowed Chair in Remote Sensing

Julius Maximilian University Würzburg
Director: Prof. Dr. Stefan Dech

EOC Central Functions
(shared with DLR-IMF)

Controlling

Oberpfaffenhofen and Neustrelitz
Head: Dipl.-Forstw. Hans-Henning Voß

Addresses and Contacts

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www.code-de.org

ZKI: www.zki.dlr.de

WDC: www.wdc.dlr.de

DLR at a Glance

DLR is Germany's national research centre for aeronautics and space. Its extensive research and development work in Aeronautics, Space, Energy, Transport and Security is integrated into national and international cooperative ventures. As Germany's space agency, DLR has been given responsibility for the forward planning and the implementation of the German space programme by the German federal government as well as for the international representation of German interests. Furthermore, Germany's largest project-management agency is also part of DLR.

Approximately 6,900 people are employed at fifteen locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also operates offices in Brussels, Paris, and Washington D.C.

DLR's mission comprises the exploration of the Earth and the Solar System, research for protecting the environment, for environmentally-compatible technologies, and for promoting mobility, communication, and security. DLR's research portfolio ranges from basic research to innovative applications and products of tomorrow. In that way DLR contributes the scientific and technical know-how that it has gained to enhancing Germany's industrial and technological reputation. DLR operates large-scale research facilities for DLR's own projects and as a service provider for its clients and partners. It also promotes the next generation of scientists, provides competent advisory services to government, and is a driving force in the local regions of its field centers.



**Deutsches Zentrum
für Luft- und Raumfahrt e.V.**
in der Helmholtz-Gemeinschaft

Deutsches Fernerkundungsdatenzentrum
Oberpfaffenhofen

www.DLR.de