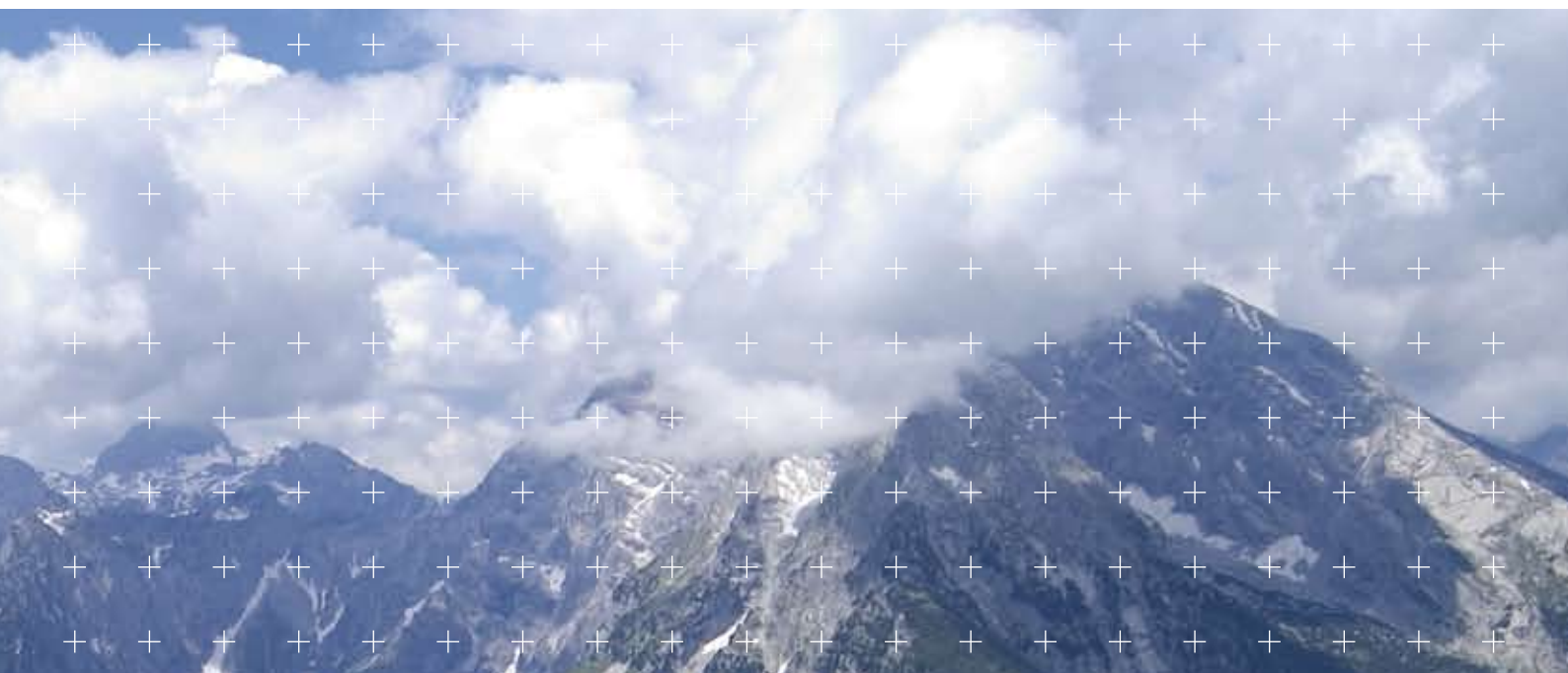


Monitoring for environment and security – Bavaria's capabilities in GMES



Bavarian Ministry of
Economy Affairs, Infrastructure,
Transport and Technology



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Greetings

The Global Monitoring for Environment and Security (GMES) project, brought together by the EU and ESA, promises to achieve the same degree of significance as the Galileo project. Bavaria, the biggest location for aeronautics in Germany, not only has outstanding capabilities in the field of satellite technology, but also in the fields of data acquisition, processing, archiving and utilisation, which are particularly relevant for GMES. Universities, institutes and companies from Bavaria are prepared to contribute these capabilities to the European GMES project.

Bavaria's excellent research infrastructure at the DLR, universities, technical colleges and non-university institutions is complemented by a high concentration

of companies in the IT or ICT industries, and the GIS and geo sectors. It is our aim to continue to develop this strong, local network in Bavaria, and introduce Bavarian know-how to national and international networks for the benefit of all partners.

This brochure gives a brief overview of Bavaria's potential and current GMES activities. It aims to increase interest in and knowledge about the forward-looking GMES-program, and provide inspiration for further thoughts on the shaping of partnerships.



*Erwin Huber,
Bavarian Minister of
Economic Affairs, Infrastructure,
Transport and Technology*

Monitoring for the environment and security – Bavaria's capabilities in GMES

The GMES initiative (Global Monitoring for Environment and Security) was established in 1998 to improve the environment and security for the civilian population in Europe by providing access to global information. Regions such as Bavaria will benefit enormously from GMES.

Firstly, the information provided by means of GMES contributes to an improved understanding of our environment. Examples are the forecasting of atmospheric pollution levels in urban and industrial areas, better flood forecasts during the spring thaw or during high-water periods in summer, better regional planning for infrastructure projects or more purposeful reforestation programmes domestically and abroad.

Secondly, GMES will also be able to make a contribution towards increased safety, for example, better operations management in the case of disasters, more effective border security on Europe's external frontiers and an improved warning system against landslides.

At the same time, GMES will create new prospects for regional industries in both space and information technology. Bavaria's industry has attained worldwide reputation in many areas, for example, in the management of ESA ground segments at the DLR in Oberpfaffenhofen, in the building of innovative satellite sensors by industry or through involvement in international application projects in the above-mentioned specialist fields. In all areas the small and medium-sized businesses in Bavaria are also playing a crucial role.

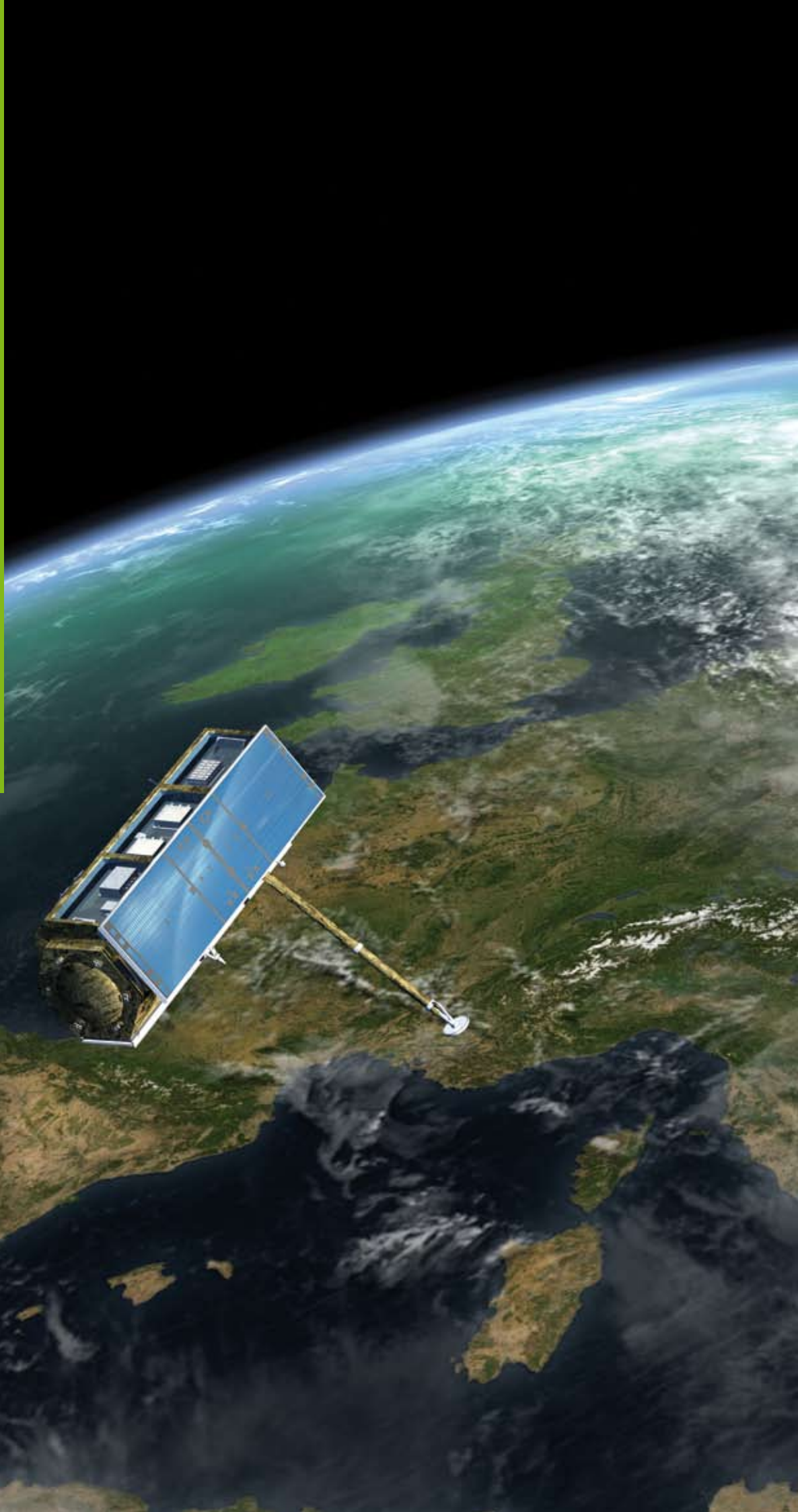
I am, therefore, genuinely pleased that the Free State of Bavaria sees GMES as an opportunity for foresighted action.



*Dr. Volker Liebig
Director of Earth Observation
Programmes, European Space
Agency, ESA, Frascati, Italy*

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GMES – Environment and Security

Global Monitoring for the Environment and Security: Geographic information services and space technologies for safeguarding our quality of life. Services and technologies also supported by the experience and innovative strengths of Bavarian institutes and companies.

Like the Galileo satellite navigation system, the programme for Global Monitoring for Environment and Security (GMES) also contributes towards European independence and systems leadership in space technologies of the future. Space technologies that benefit the people on earth. Technologies that enable sustainable creation of industrial value.

The GMES space fleet will continue the successful line of European Space Agency (ESA) and EUMETSAT satellites with their emphasis on environment, weather and climate monitoring. The European systems are complemented by national satellites with an emphasis on mapping and tasks relevant to security. They include the German satellites TerraSAR, RapidEye, TanDEM-X and EnMAP. Bavarian companies and institutes are involved in all of these systems.

The control of the satellites, the acquisition, the archiving and, finally, the distribution of their data require operational control and data centres. Centres located in Bavaria that have already proved their capability in European missions and are now preparing for duties in GMES.

The data for these satellites are fed to geographic information services. Services that help us to use our living space better, to avoid disasters, to detect environmental damage and to protect us against security risks.

Digital maps, permanent monitoring of ground measuring stations, and air-based photography also contribute towards understanding space data better and utilising the necessary information for making decisions that affect politics, society and the economy.

The GMES pilot services are to deliver from the year 2008 onwards reliable information concerning land, ocean, security and atmosphere. Bavarian companies and institutes – in part, as European consortium managers – are already acquiring a pioneering role in the establishment of such GMES services. The setup of these services is initially being financed by the European Commission and the European Space Agency.

On a sustainable basis, however, GMES will be supported by the need of the public, government and industry for information on our environment and on the safeguarding of our security. As a large European region with great innovative and industrial strength, Bavaria will not only be very much involved in the setup and operational processes, but also in the sustained use of GMES services.



Monitoring the land surface

Bavarian companies and research institutions have been among the pioneers and leading authorities in the field of Earth Observation (EO) applications in land monitoring for more than 20 years, both in Germany and worldwide. Innovations, technical excellence and customer orientation form the core focal points for services enabling sustainable land surface, agricultural and forest management.

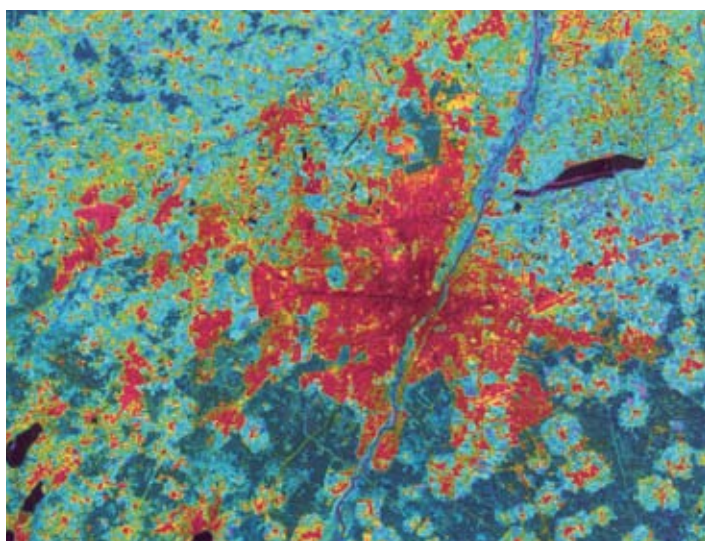
Earth observation data help people to manage their environment and the resources of the land surface. The satellite technology existing today offers unique and cost-efficient possibilities for this. The application range is almost unlimited and the possibilities are still far from being exhausted. For example, severe storm damage, drought, forest fires and floods can be recorded quickly and reliably for large areas from outer space. High-accuracy images of cities can be produced such that individual pedestrians on the streets could be detected. For almost every question posed, there is a corresponding sensor technology with the appropriate satellites in orbit. Monitoring the land surface is one of the pilot topics of the European GMES. Bavarian companies possess more than 20 years of experience in this complex market.

The GMES forest monitoring project (GSE-FM) has been supported by the European Space Agency since 2003 and is managed by GAF AG, Munich. With more than 50 partners from all over Europe, it is one of the mainstays

of the European GMES initiative (www.gmes-forest.info). On the basis of satellite data, urgently required products and services for sustainable forest management are already being delivered to users and will also continue to be developed and refined up to 2008. They enable state authorities to fulfil their policy-related duties for international reporting on environmental and climate protection on national, regional and community levels.

The EU budget allocation for the agricultural industry is quite significant and impressive. Almost half of the Commission's annual spending flows into the agricultural industry and rural areas as compensation payments or restructuring aids through development programmes. The correct allocation of these agricultural subsidies in Europe is facilitated extensively every year with the aid of agricultural information systems and remote sensing data. Only the best and most up-to-date aerial images and satellite recordings are used. Bavarian companies such as GAF AG also play an important role in training and advising farmers and political decision makers as well as in research and applications development.

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Munich – an urban heat island: distribution of surface temperature on a hot summer's day

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Companies

- ☞ Definiens AG, Munich
- ☞ ESRI, Kranzberg
- ☞ GAFAG, Munich
- ☞ IABG mbH, Ottobrunn
- ☞ Remote Sensing Solutions GmbH, Munich
- ☞ Vista Geowissenschaftliche Fernerkundung GmbH, Wessling

Institutions

- ☞ German Remote Sensing Data Center, Oberpfaffenhofen
- ☞ Institute for Remote Sensing Technology, Oberpfaffenhofen
- ☞ Julius-Maximilians University, Würzburg
- ☞ Ludwig-Maximilians University, Munich
- ☞ Technical University, Munich

Up-to-date and high-precision land use data today are indispensable also in areas other than the agricultural industry. They are needed by mobile communication providers for setting up and extending their telecommunications networks, as well as by government authorities, or environmental protection and research institutions, which use such data for traffic and regional planning, climate model calculations and other ecological issues. These clients are served by value adding and consulting companies. Using satellite data and additional knowledge from Geographical Information Systems (GIS), Bavarian companies offer sophisticated and technically sound solutions that meet the clients' requirements – worldwide and always up-to-date. This includes products that are related to land use, resources exploration and management, road networks, public infrastructure and much more. Research institutions and universities play a leading role in creating innovations both in data processing and data interpretation.



Both agricultural industry and forest management benefit from the latest developments



Protecting the atmosphere

Bavarian research institutes have long-term experience in climate and atmospheric research and satellite validation. By intensive cross-linking of science and economics, optimum conditions are given in Bavaria for global environmental monitoring and therefore a significant contribution to GMES.



Environmental research station Schneefernerhaus on the Zugspitze



Air chemical laboratory of the German Weather Service on the Hohenpeissenberg

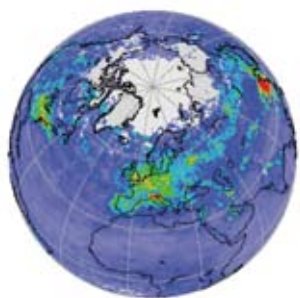
Satellites are successfully used for climate and atmospheric monitoring. Only satellites provide the kind of global and area-wide information which is indispensable for atmospheric research and monitoring, climate protection, and control of international environmental agreements like the Kyoto or Montreal protocol.

Acceptance and use of satellite data for environmental policy decisions requires that the data are subject to extensive and continuous quality assurance. Directly measured quantities must be confirmed, long-term instrument drifts detected, continuity with follow-up missions ensured, and evaluation algorithms tested over and over again. Only this will guarantee consistent data streams from satellite missions over at least one decade. To achieve these goals, permanent ground measuring stations are needed, where satellite measurements have to be checked by classic in-situ

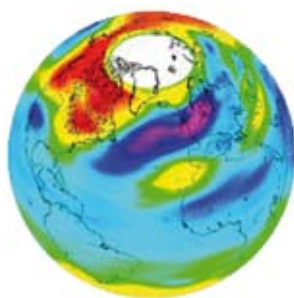
techniques and ground-based remote sensing methods, both with highest precision and constant availability.

The internationally renowned research institutes in Bavaria look back on many years of experience in climate and atmospheric research as well as in satellite validation. Close networking with Bavarian companies guarantees innovative product development in the areas of measuring techniques and data application. Therefore, optimum conditions are given in Bavaria for an important contribution to global environmental monitoring in GMES.

For example, the "Schneefernerhaus", the Centre for High-altitude and Climate Research in Bavaria at a height of 2650 m on the northern edge of the Alps, represents a fascinating platform for long-term measurements as well as for basic research, case studies and experiments.



Nitrogen dioxide distribution derived from satellite measurements



Ozone distribution derived from satellite measurements

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Companies

- ☞ InnoLas GmbH – Innovative Laser Technology, Krailling
- ☞ Kayser-Threde GmbH, Munich

Institutes

- ☞ Bavarian State Agency for the Environment, Augsburg
- ☞ Centre for High-altitude and Climate Research in Bavaria, Schneefernerhaus, Zugspitze
- ☞ Federal Environment Agency, GAW station "Zugspitze/Hohenpeissenberg"

- ☞ German Remote Sensing Data Center, Oberpfaffenhofen
- ☞ German Weather Service, Meteorological Observatory Hohenpeissenberg
- ☞ Institute for Atmospheric Physics, Oberpfaffenhofen
- ☞ Institute for Meteorology and Climate Research, Garmisch-Partenkirchen
- ☞ Institutes of the University of Munich and Technical University Munich
- ☞ National Research Center for Environment & Health, Neuherberg
- ☞ Remote Sensing Technology Institute, Oberpfaffenhofen

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The German Weather Service (DWD) and the Federal Environment Office (UBA) jointly operate the station "Zugspitze/Hohenpeissenberg", one of 23 main stations worldwide in the "Global Atmosphere Watch" programme of the World Meteorological Organisation. The station consists of the platforms Hohenpeissenberg (988 m), Schneefernerhaus (2650 m) and Zugspitze summit (2964 m), and produces one of the most comprehensive data sets worldwide on meteorological parameters, radio nuclides, radiation, ozone, reactive and greenhouse gases, aerosols, and chemical composition of rainfall.

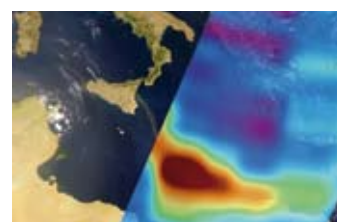
The Institute for Meteorology and Climate Research of the Karlsruhe Research Centre is also active on Germany's highest mountain, which in combination with the institute's nearby stations Mt. Wank (1800 m) and Garmisch-Partenkirchen (750 m) forms a worldwide

unique vertical station-chain. As part of the NASA global environmental monitoring network these stations have extensively contributed to the validation of satellites like ENVISAT, ACE, and EUMETSAT.

In combination with other Bavarian and European institutes and companies, the German Remote Sensing Data Center is leading the European GMES consortium PROMOTE (www.gse-promote.org). As a GMES pilot project for monitoring the atmosphere, PROMOTE aims to contribute to the health protection of the population in Europe by measuring air quality, greenhouse gas concentrations, and solar UV radiation.



Satellite view of an eruption of Mt. Etna, Sicily



Sulphur dioxide concentration in the atmosphere after the 2002 Mt. Etna eruption

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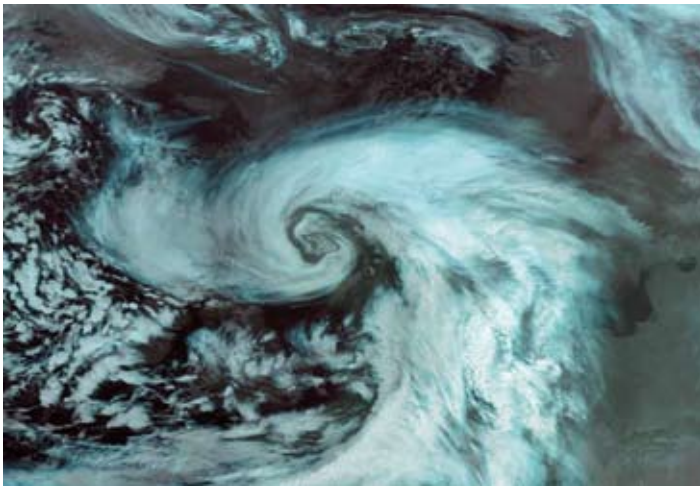
Management of natural disasters

Satellites provide valuable information for warning against disasters, to estimate the degree of damage and to coordinate humanitarian aid. Institutes and companies in Bavaria are actively involved in the utilisation of satellite data for the management of natural disasters.

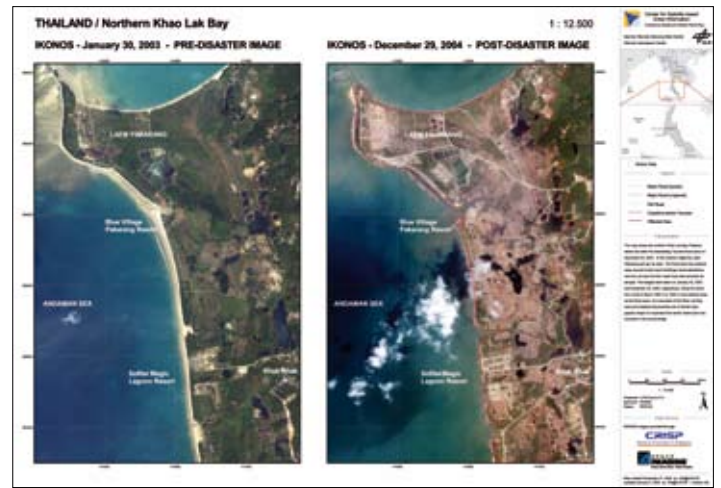
The view from outer space used for forecasting the weather over the next few days is quite familiar to us from the daily weather report. Along with the weather satellites already available, new satellite technologies enable us to make even better forecasts of extreme weather situations and other natural disasters hostile to nature and mankind. Being able to offer precautions and warnings about natural disasters and the ability to estimate their effects as a tool for the optimum deployment of aid workers represents a social and economic aspect of considerable importance.

Although Europe has experienced river flooding, damage created by storms and spring tides, as well as forest fires after long periods of drought, it has only rarely been ravaged by earthquakes and volcanic eruptions. In other parts of the world, however, catastrophes like these cause damage of enormous proportions. The direct effects of catastrophes – such as tsunamis – have cost the lives of thousands of people.

Accordingly, GMES is focussing its projects on the deployment of new geographic information and satellite technologies for natural disasters in Europe. These technologies can, however, also be useful for other regions



The storm Lothar as seen in a satellite image



The destruction of Indonesia's coast following the 2004 tsunami, as seen with satellite data

Companies

- ⇒ ESG GmbH, Munich
- ⇒ ESRI, Kranzberg
- ⇒ GAF AG, Munich
- ⇒ IABG mbH, Ottobrunn
- ⇒ Kayser-Threde GmbH, Munich
- ⇒ Remote Sensing Solutions GmbH, Munich
- ⇒ Vista Geowissenschaftliche Fernerkundung GmbH, Wessling

Institutions

- ⇒ German Remote Sensing Data Centre, Centre for Satellite Based Crisis Information (ZKI), Oberpfaffenhofen

on earth for deploying immediate humanitarian aid and protracted warning and management systems.

Being able to look through dense cloud formations, active radar sensors (SAR) represent an ideal technology for estimating the extent of a flood during prolonged rainfall. Radar sensors can also warn against catastrophic events such as landslides and volcanic eruptions by using the interferometric imaging mode. The European Space Agency is therefore planning to continue its line of radar satellites. Germany is complementing this fleet of radar satellites with the even more precise systems TerraSAR-X and TanDEM-X, for which EADS Space is responsible. Controlled from Bavaria, these satellites are also used by Bavarian companies and institutes, for example, in flood management systems. In GMES pilot projects, the potentials of these and other satellite systems will be coordinated to reduce the damage caused by natural disasters in Europe.

Today's optical satellite sensors can unravel details that allow the damage following a catastrophe to be shown in high spatial resolution. How strong is the windbreak in a forest? Which houses are destroyed? Which

roads can still be driven upon? Where are the camps for the homeless and fleeing population? This being important information for immediate humanitarian and logistical aid and for the reconstruction process.

To receive this essential satellite data during a natural disaster, international space agencies have called upon a special type of cooperation. The German point of contact for the international support of crisis management using satellite data is resident in Bavaria at the Zentrum für satellitenbasierte Krisen-Information (Centre for Satellite-based Crisis Information) (ZKI) (www.zki.caf.dlr.de). The centre is prominently involved in the GMES pilot project RESPOND (www.respond-int.org) as one of the Bavarian partners. The technologies developed and applied here are also useful to other countries, such as Indonesia, for example, with the deployment of a "Tsunami Early Warning System".

Civil security

In crises, terrorist attacks and catastrophes, new answers and solutions for civil security are required. This also involves the use of satellite technology. Bavarian companies are important points of contact for national and international authorities in this respect.



Companies

- ⇒ Definiens AG, Munich
- ⇒ EADS Space, Ottobrunn
- ⇒ ESG GmbH, Munich
- ⇒ GAF AG, Munich
- ⇒ IABG mbH, Munich

Institutions

- ⇒ Microwaves and Radar Institute, Oberpfaffenhofen
- ⇒ Institute for Remote Sensing Technology, Oberpfaffenhofen



Fire brigade deployment



The soccer arena in Munich, seen from above



Border control with integrated mission station (PTA)

The worldwide political situation and new threats to security demand new answers and solutions for civil security. In crises, terrorist attacks and catastrophes, the challenges clearly lie in the quick availability of relevant information and in the cooperation of all participating forces. Civil security issues require the networking and coordination of all participating forces. These include, in particular, authorities for order and safety such as the police, fire brigade, relief organisations, ambulance services and government departments, e.g., the ministries of the interior and defence. The core challenge here is to guarantee cooperation between the security forces – nationally and internationally.

In correlation with GMES, the following civil security issues are especially relevant:

- crisis management and disaster control
- monitoring of borders and crisis areas
- supervision of large-scale events

Before a critical event, the main aspects are the prevention or early detection of emergencies and catastrophes as well as the development of contingency plans should a crisis arise. Examples are early warning systems or the training of rescue crews on the basis of simulated scenarios. During a crisis, a rapid and comprehensive reaction is essential so that the consequences of catastrophes can be considerably alleviated or minimised. It is here that making relevant information available in real-time – such as satellite data – and internationally networked command, control and information and operation control systems – can contribute strongly to optimising the situation.

All these issues are addressed extensively by Bavarian companies within GMES. As the national centre for crisis cases, the Zentrum für satellitengestützte Kriseninformation, ZKI (Centre for Satellite based Crisis Information) operated by DLR, provides earth observation data for a more precise

analysis and evaluation of situations almost in real time. Within an EU project (GMOSS), DLR is coordinating a European network of specialists for the analysis of earth observation information for sensitive areas. In the framework of the EU project, ASTRO+, a consortium lead by Astrium was able to point out the applicability of space-supported systems and technologies for extraterritorial security deployment. ESG and IABG offer solutions for crisis management exercises and networked operation control for the police, border police, fire brigade and rescue services. Furthermore, IABG is responsible for the project management of integrating and networking the training nodes for rescue services and fire brigades all over Bavaria for the development and advanced training of future employees. Air-based platforms, such as ESG's integrated mission station for the police (PTA), provide a valuable service to the police during catastrophes and for security in large-scale events such as the Soccer World Cup. They can also be deployed in other areas of civil security such as police searches, visual observation and night-time border control. In the area of mobile solutions for civil security, Bavarian companies are also well equipped to provide solutions such as the GAF AG system, which was used at the international security conference to monitor persons at risk, or an ESG system that supports rescue services when identifying and treating injured persons.

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Secure infrastructure

In the world of traffic of information, passenger and goods, Europe, as an export-oriented economic area and as a region with a high population density and a complex infrastructure, is particularly subject to new threats. Bavarian companies are employing the most up-to-date information and satellite technologies for monitoring security-critical infrastructures.

Germany and the neighbour countries in Europe are particularly subject to new threats. Energy and transport networks, Internet and telecommunications are the lifeblood of our society. The flow of goods and supply chains, supply infrastructures and traffic management systems are vulnerable.

Security must, therefore, also have in focus the consequences of natural disasters or accidents and the limitation of damage caused. The partial breakdown of energy supplies through the build up of ice in the winter of 2005/2006 showed, for example, once again the dependency of society on perfectly operating supply systems. Preventative measures are about to detect risks and to encounter them as early as possible. Innovative security solutions should make transport systems, communication

networks, supply systems, security-critical buildings or the flow of goods more robust against catastrophes and make them, from the very outset, unattractive for potential attackers. To be able to react in crises in an optimum way is the aim of security research. Earth observation satellites represent here an important source of data. Should a catastrophe occur, the consequences must be minimized in such a way that an even greater crisis does not result from it.

Bavarian companies are also leading the way in the monitoring of security-critical infrastructures. For example, the GAF AG has established a service for supporting seismic and regional exploration activities for the oil and gas industries.

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Munich airport



Container transport

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- ☞ EADS Space, Ottobrunn
- ☞ ESG GmbH, Munich
- ☞ GAF AG, Munich
- ☞ IABG mbH, Ottobrunn
- ☞ Kayser-Threde GmbH, Munich

DLR and Definiens are working closely together with large gas-supply companies such as EON-Ruhrgas in satellite-based and aircraft-based pipeline-monitoring systems.

IABG is examining the dependencies of critical infrastructures and their interrelations so that measures of prevention and reaction can be worked on, as well as a security management systems that can be applied in other areas of security management.

ESG develops systems for the planning, control and monitoring of communication systems for the army and can also use this know-how for monitoring other telecommunication networks. Kayser-Threde and ESG offer telematics and transport solutions for monitoring security-critical logistics

processes and the status of the condition of security-relevant goods. These can, for example, be used for tracking dangerous goods transports. The challenges here are, along with the provision of data in real-time, the integration of the technology or the integration of navigation systems with other identification and communication technologies. Astrium develops innovative solutions for reliable and precise navigation environments, which can also be deployed under difficult receiving conditions in the case of a crisis, e.g., for landing strips, navigation of precision units, or for the coordination of relief and action forces and operation materials.



Space systems

Companies, test and control centres based in Bavaria traditionally have, besides appropriately specialised technical expertise, also wide ranging experience in satellite manufacture and qualification and in satellite control. In this context, they can rely on state-of-the-art, future-oriented infrastructure.

In the development chain for the GMES programme, satellites represent the data providers and thus stand at the very beginning. On the part of the European Space Agency ESA five different satellite systems, called "Sentinels", are being planned for relevant data acquisition. For the operation of these satellites the latest technologies in radar and optical remote sensing will be employed.

In Bavaria, there are not only specialised manufacturing facilities and clean rooms of all categories for integrating the satellites, but also large test chambers and shakers available for simulating launch loads and the environmental conditions prevailing in outer space. The IABG satellite test centre in Ottobrunn has built up, for example, an infrastructure for these tests that is unique throughout Europe. Several hundreds satellites and satellite subsystems have already successfully run through the pre-launch tests under utilisation of the vibration platforms and thermal test and

vacuum test chambers. IABG is well prepared for the forthcoming testing of Sentinel satellites in Ottobrunn.

Further Bavarian strengths are to be found in the extensive university and research establishment environment relevant for space technologies and the corresponding specialisation in various high-tech elements. This represents an indispensable prerequisite for the conception and understanding of modern satellites. Examples of emerging student satellite projects are BayernSat at the Technical University in Munich and CubeSAT at the University of Würzburg.

Bavaria is also well positioned for taking future key roles in establishing satellites for the GMES programme:

- ASTRIUM in Ottobrunn, for example, is leading the design and development of the 30 GALILEO satellites and the two SATCOMBw military communications satellites.

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*The German environment scout EnMAP –
A model of the Bavarian high-tech satellite*

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Companies

- ☞ EADS Space, Ottobrunn
- ☞ IABG mbH, Ottobrunn
- ☞ Kayser-Threde GmbH, Munich

Institutions

- ☞ German Space Operations Control Center; GSOC-DLR, Oberpfaffenhofen
- ☞ Technical University, Munich
- ☞ University of the German Armed Forces, Munich
- ☞ University of Würzburg

- With the decision to realise the optical hyper-spectral satellite EnMAP (Environmental Mapping and Analysis Program) as a national project, Germany is claiming a leading role in the European optical remote sensing arena.

The industrial leadership for EnMAP is at Kayser-Threde in Munich. This Bavarian enterprise is responsible for the design and the construction of EnMAP, scheduled for launch in 2010.

Owing to its experience in satellite control for more than 40 satellite systems – amongst them the navigation satellites for the GALILEO system – DLR's German Space Operations Control Center (GSOC) in Oberpfaffen-

hofen is best equipped to take care of future GMES satellites as well. The commands for data acquisition are prepared in Oberpfaffenhofen and then transmitted to the satellites via a station in Weilheim.

Thus Bavaria has an outstanding position to play key roles in all areas related to satellites. Bavarian companies provide a wealth of experience and are equipped with the most up-to-date infrastructure. In cooperation with Bavarian scientists representing brilliant research, these companies are ready and also in a position to meet the challenges of future European Union satellite activities and accordingly to take leading roles in the GMES programme.



The German Space Operations Control Center (GSOC) in Oberpfaffenhofen

Data centres

The data generated by earth observation satellites have to be received, processed, archived and distributed. The institutions of DLR in Bavaria are leading the way in the European network of data centres; Bavarian companies are involved in the commercial marketing of satellite information.



Companies

- ☞ Euromap, Munich/Neustrelitz
- ☞ European Space Imaging, Munich/Dubai

Institutions

- ☞ German Remote Sensing Data Centre, Oberpfaffenhofen
- ☞ World Data Center for Remote Sensing of the Atmosphere, DLR, Oberpfaffenhofen



The robot archive in Oberpfaffenhofen assures access to historical satellite data.



The German Remote Sensing Data Centre in Oberpfaffenhofen (DLR-DFD)

A corresponding infrastructure must be available on the ground so that satellites can work permanently, and so that the earth's data are recorded and transmitted to the earth, before they become images and geographical information. It is an infrastructure – available in Bavaria – that has been used for national and European missions for a long time now.

The DLR German Space Operations Control Center (GSOC) in Oberpfaffenhofen is designed for the command of satellites; it controls their functions and programs the recording of the images.

When the satellite has executed these commands, its digital data freight – images of gigapixel size – must be sent to the ground. Dish antennas, optimally positioned geographically on the globe, receive this yet to be processed data flow. The DLR Deutsche Fernerkundungsdatenzentrum (German Remote Sensing Data Center, DFD) in Oberpfaffenhofen operates such an international network of receiving systems. Antennas in Bavaria and Mecklenburg-Vorpommern (at DFD in Neustrelitz) are deployed for a multitude of missions – not only for the national satellites, but also on behalf of the ESA and in cooperation with companies. Companies such as GAF AG/Euromap and European Space Imaging, originating in Bavaria and among the European market leaders in the commercial marketing of satellite data. Besides the deployment of a transportable station at locations in Asia, Africa and soon in Mexico, the DFD has been operating a receiving station in the Antarctic for years, Bavaria's southernmost out post for contact with satellites!

It is the task of a processing and archiving centre (PAC), which is also operated at DFD, to convert these data into images and information, and to archive and distribute them. On behalf of ESA, the PAC at DFD manages the data load of the earth observation missions ERS and ENVISAT. Algorithms and software developed by DLR scientists and engineers convert, for example, holographic radar images into legible information. And this is not just for a few images. Millions of similar images must be processed and archived for the GMES services. Developed for the management of this vast amount of data in cooperation with industry, the DLR Data and Information Management System (DIMS) is now in use all over Europe.

The DFD in Oberpfaffenhofen operates a world data centre for remote sensing of the atmosphere (wdc.dlr.de), especially for the storage and distribution of data and measurements of the atmosphere using European and international sensors. The data centre is an important source of information for the GMES pilot project for establishing atmospheric services, but furthermore, it is also a recognised international partner.

The wealth of data collected over years – hundreds of terabytes – is held in the data centres in robotic archive systems. As a global wealth of data and as a national earth observation library, this information is accessible for all users via the electronic portal EOWEB on the Internet (www.eoweb.de). The data centres in Bavaria will also contribute with their infrastructure and their operational experience to the European system, GMES.

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1. GMES – Environment and security
2. Land
3. Atmosphere
4. Natural disasters
5. Civil security
6. Secure infrastructure
7. Space Systems
8. Data centres
9. Observational Networks



A world data centre assures the availability of satellite data.



Observational networks

Air-based and ground-based observational networks complement the monitoring from outer space. Bavaria has an excellent infrastructure for such stations and is therefore integrated in international networks. Bavarian institutions make geographical information and Internet portals available.

Along with space-based satellites, air-based monitoring systems are already delivering important geographical information for the observation of the earth. In some cases, space-based data are not geometrically exact enough or the air-based monitoring is to be given priority in terms of efficiency over space-based monitoring. Generally, the key for an optimum evaluation and situation analysis lies in the combination of acquired data from different monitoring sources and their integration with other data. Along with aeroplanes and helicopters, the deployment of UAV (Unmanned Aerial Vehicles) is being promoted as a new technology in GMES.

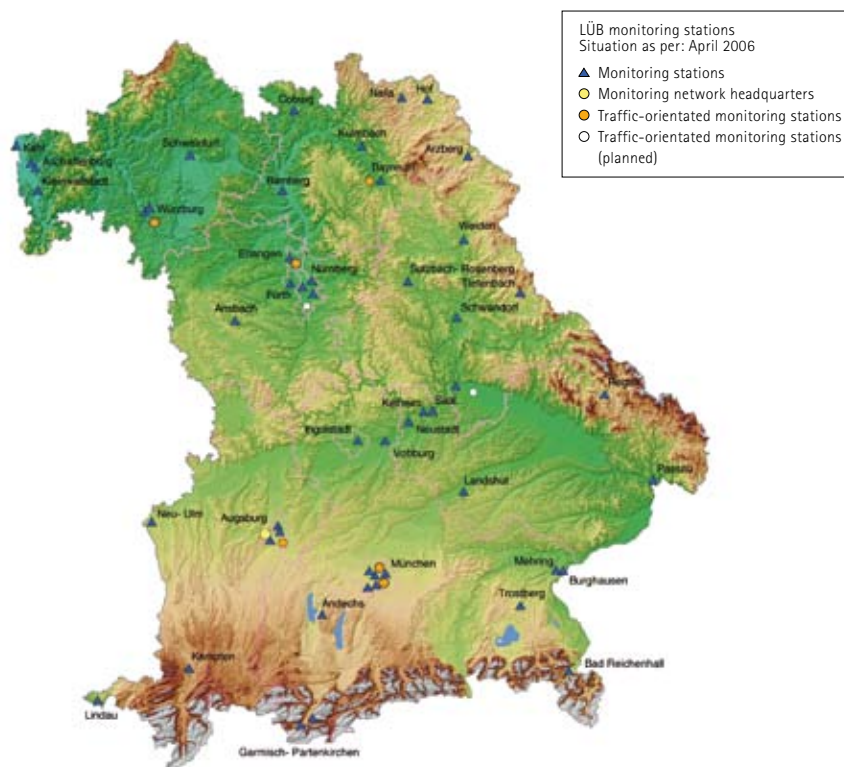
Bavarian aerospace companies are, in this respect, important authorities in technical competence and established contact partners for government departments, science and industry. The DLR operates a fleet of air-based observation platforms from the airfield in Oberpfaffenhofen. With integrated mission station (PTA), the ESG offers central support for

the police helicopter units in the Rhineland Palatinate and Bavaria for air-based observation. Bavarian companies and institutes have been active for more than three decades in the design, development and integration of platforms for aircraft-based remote sensing.

Bavaria also has a dense network of measuring stations, which permanently record valuable data on the atmosphere and the land surface. Besides the validation of satellite data, these stations also provide important additional information for the GMES services.

As examples, several activities have been selected and are listed below: With its Air Quality Monitoring System (LÜB) and Immission Observation Network for Radio Activity (IfR), Bavaria has a dense terrestrial network for recording critical environmental data online.

The Centre for High-altitude and Climate Research in Bavaria - Schneefernerhaus - offers in combination with the measuring stations for the



Lufthygienisches Landesüberwachungssystem Bayern (LÜB)
(Bavarian Air Quality Monitoring System)

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Companies

- ⇒ ESG GmbH, Munich
- ⇒ Intermap Technologies GmbH, Munich

Institutions

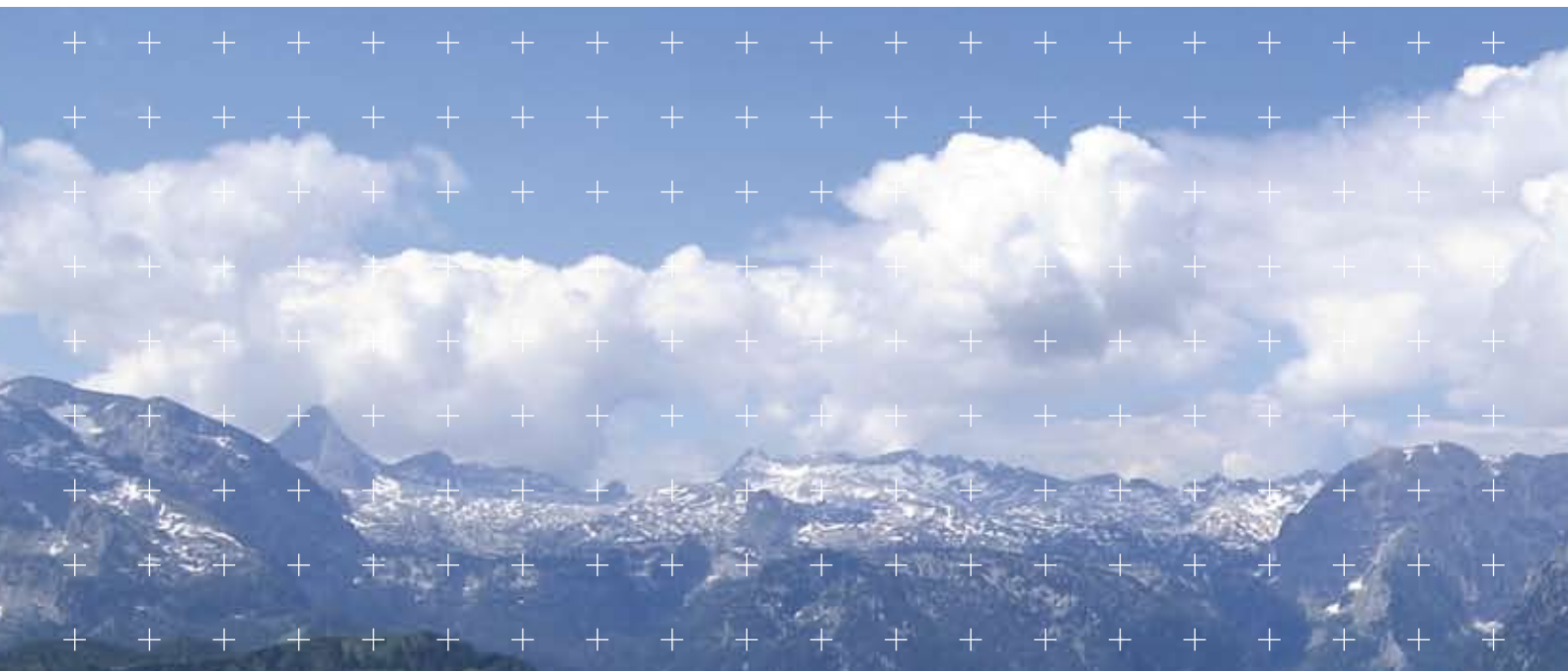
- ⇒ Institutes of DLR, Oberpfaffenhofen
- ⇒ Bavarian State Agency of the Environment, Augsburg
- ⇒ Bavarian Ministry of Finance, Bavarian Spatial Data Infrastructure, Munich
- ⇒ German Weather Service, Hohenpeissenberg observatory
- ⇒ GSF – Research Centre for Environment and Health, Neuherberg
- ⇒ Institute for Meteorology and Climate Research, Garmisch-Partenkirchen
- ⇒ Federal Environment Office, GAW station "Zugspitze/Hohenpeissenberg"
- ⇒ University institutes University and Technical University (LMU & TU), Munich
- ⇒ Centre for High-altitude and Climate Research in Bavaria, Schneefernerhaus, Zugspitze

research centre in Karlsruhe and the German Weather Service a particularly attractive observation platform for the long-term monitoring of atmosphere-relevant parameters. Furthermore, the Bavarian Earthquake Service operates all over the country a network of over 20 ultra-modern seismic stations for monitoring earthquake activity. A selection of individual stations is part of a worldwide seismological monitoring network. All data are evaluated in the control room in the geophysical observatory in Fürstfeldbruck and made available to the rest of the world. This also applies to the continuous magnetic field recordings in Bavaria, for which there is one of the longest time series in the world.

Access to and utilisation of basic and customized geodata for industry, associations, the public and government authorities in an efficient eGovernment is enabled by the Bavarian ministries and their government departments through the inter departmental GDI-BY (Geodateninfrastruktur

Bayern) (Geodata Infrastructure of Bavaria). After political agreements on a European geodata infrastructure (INSPIRE) and the joint establishment of a national geodata infrastructure in Germany (GDI-DE) coordinated by the IMAGI (Interministerial Committee for Geoinformation), the mandatory preconditions now exist.

These are consequently currently being realised in Bavaria with the Rauminformationssystem RISby (Space Information System), the Bayern-Viewer and the Integral Basis for Geodata (IGDB). Information is accessible via subject-specific web portals. Coupling the satellite positioning services SAPOS and GALILEO and preparing of interoperable services offer the option of using mobile access portals.



Monitoring for the environment and security – Bavaria's capabilities in GMES

Postscript

In the last few years, Bavaria has continued to develop its technological policies and – just like other regions as well – identified technology and industry-relevant clusters. In the framework of "Allianz Bayern Innovativ" (Innovative Alliance in Bavaria) 19 such clusters were described, among them 6 clusters representing high-technology. We consider clusters as another instrument in the Bavarian economic and technological policies. Thus, the following aims are linked to this:

- increasing the innovation dynamics
- strengthening productivity
- stronger commitment to the region

All clusters rely upon networks or cooperation setups and show links to research institutes and universities with specific, application-oriented working emphases.

The GMES initiative of the EU touches upon a series of clusters like:

- the space side of the aeronautics cluster
- satellite navigation
- environmental technology
- information and communication technologies
- forest and timber

The aim of GMES bavAIRia, initiated by bavAIRia e.V., the sponsor of the aeronautics and satellite navigation clusters, is to group together in Bavaria the GMES relevant capabilities, which extend from space technology to geographic information systems, so that promising partnerships can be entered into with other regions in Germany and Europe.



*bavAIRia e.V.
Dr. Martin Haunschild
Co-ordinator Aerospace
and Satellite Navigation
in Bavaria*

Partner of the Open Bavarian GMES Initiative (GMES bavAIRia)



**Bavarian Ministry of Economy Affairs,
Infrastructure, Transport and Technology**
Prinzregentenstrasse 28
80538 Munich
Phone: +49 (0)89 / 21 62 01
poststelle@stmwvt.bayern.de
www.stmwvt.bayern.de



**Bavarian State Ministry of the Environment,
Public Health and Consumer Protection**
Rosenkavalierplatz 2
Phone: +49 (0)89 / 92 14 00
81925 Munich
poststelle@stmugv.bayern.de
www.stmugv.bayern.de



**Bavarian Ministry of Finance;
Bavarian GeoData Infrastructure**
Odeonsplatz 4
80539 Munich
Phone: +49 (0)89 / 23 06 25 49
Robert.Roschlaub@stmf.bayern.de
www.gdi.bayern.de



bavAIRia e.V.
Building 319
Sonderflughafen Oberpfaffenhofen
D-82205 Gilching
Phone: +49 (0)8153 / 90 70 08
haunschild@bavAIRia.net
www.bavAIRia.net



German Aerospace Center, DLR
82234 Oberpfaffenhofen
Phone: +49 (0)81 / 53 28 13 75
gmes@dlr.de



Definiens AG
Trappentreustraße 1
80339 Munich
Phone: +49 (0)89 / 23 11 80
ubenz@definiens.com
www.definiens.com



EADS Space
81663 Munich
Phone: +49 (0)89 / 60 72 72 44
hendrik.thielemann@astrium.eads.net
www.space.eads.net



ESG Elektroniksystem- und Logistik-GmbH
Einsteinstrasse 174
81675 Munich
Phone: +49 (0)89 / 92 16 22 53
sonja.sulzmaier@esg.de
www.esg.de



ESRI Geoinformatik GmbH Deutschland
Ringstrasse 7
85402 Kranzberg
Phone: +49 (0)81 / 66 67 70
g.buziek@esri-germany.de
www.esri-germany.de



GAF AG
Arnulfstrasse 197
80634 Munich
Phone: +49 (0)89 / 12 15 28 0
info@gaf.de
www.gaf.de



IABG Industrieanlagen-Betriebsgesellschaft mbH
Einsteinstrasse 20
85521 Ottobrunn
Phone: +49 (0)89 / 60 88 27 84
mohr@iabg.de
www.iabg.de



IHK München
CCI Chamber of Commerce and Industry
for Munich and Upper Bavaria
Max-Joseph-Strasse 2
80333 Munich
Phone: +49 (0)89 / 51 16 78 5
fritzsche@muenchen.ihk.de



Kayser-Threde GmbH
Wolfratshauser Strasse 48
81379 Munich
Phone: +49 (0)89 / 72 49 50
timo.stuffer@kayser-threde.com
www.kayser-threde.com



**Umweltforschungsstation Schneefernerhaus mbH
c/o the Bavarian State Ministry of the Environment,
Public Health and Consumer Protection**
Rosenkavalierplatz 2
Phone: +49 (0)89 / 92 14 35 01
81925 Munich
ufs@stmugv.bayern.de
www.schneefernerhaus.de



**Julius-Maximilians University, Würzburg
Professorial Chair for Remote Sensing**
Am Hubland
97074 Würzburg
Phone: +49 (0)93 / 18 88 49 60
stefan.dech@mail.uni-wuerzburg.de



**Technical University, Munich
Professorial Chair for Remote Sensing Technology**
Arcisstrasse 21
80333 Munich
Phone: +49 (0)89 / 28 92 38 80
stefan.hinz@bv.tum.de

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bavAIRia e.V.
Dr. Martin Haunschild
Co-ordinator Aerospace and Satellite
Navigation in Bavaria

Building 319
Sonderflughafen Oberpfaffenhofen
D-82205 Gilching
Phone: +49 (0)8153 / 90 70 08
Fax: +49 (0)8153 / 90 70 09
Mobile: +49 (0)173 / 970 29 63
haunschild@bavAIRia.net
www.bavAIRia.net

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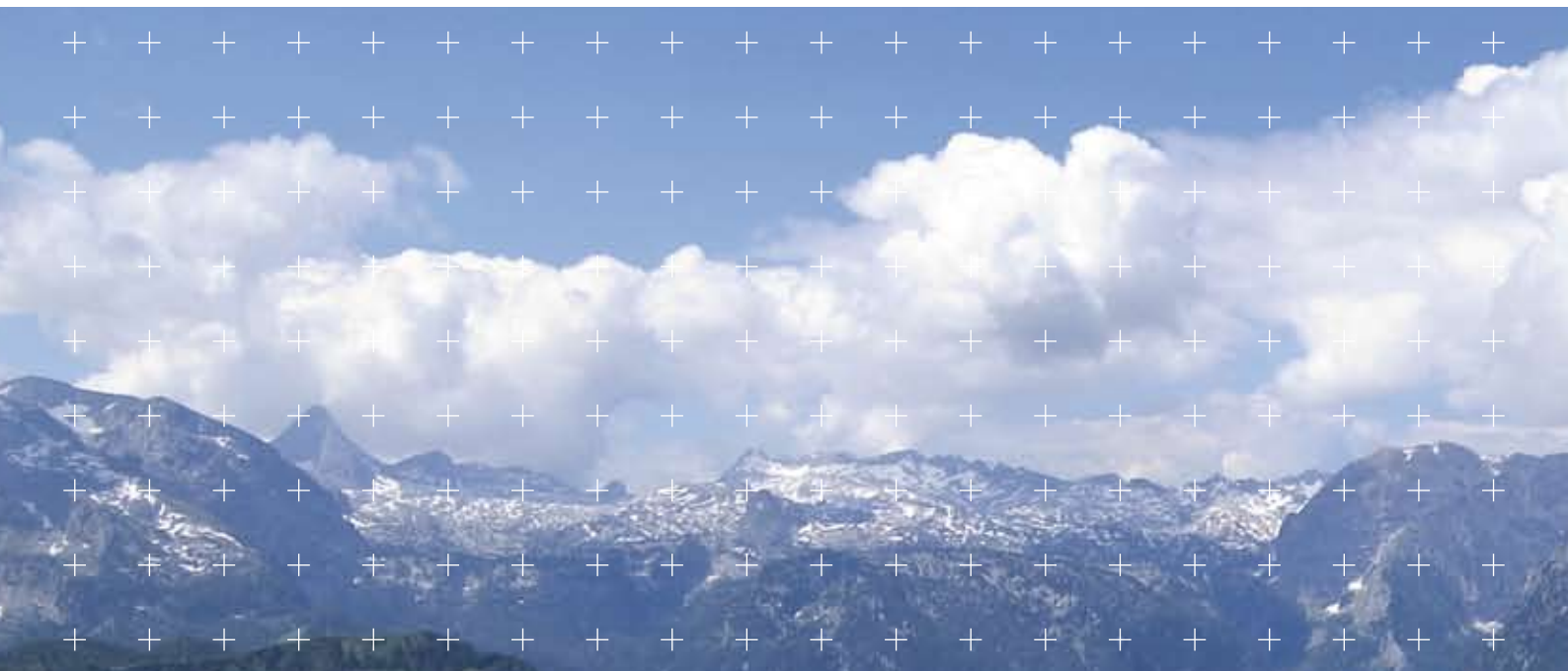
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Graphics and realisation

Jane Behrends, info@janebehrends.de

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bavAIRia e.V.
Dr. Martin Haunschild
Co-ordinator Aerospace and
Satellite Navigation in Bavaria

Building 319
Sonderflughafen Oberpfaffenhofen
82205 Gilching
Phone: +49 (0)8153 / 90 70 08
Fax: +49 (0)8153 / 90 70 09
Mobile: +49 (0)173 / 970 29 63
haunschild@bavAIRia.net
www.bavAIRia.net



Bavarian Ministry of
Economy Affairs, Infrastructure,
Transport and Technology

Prinzregentenstraße 28
80538 Munich
Phone: +49 (0)89 / 21 62 01
Fax: +49 (0)89 / 21 62 26 70
poststelle@stmwivt.bayern.de
www.stmwivt.bayern.de