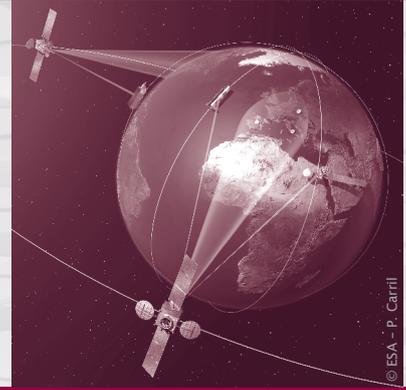


Remote sensing: Application potentials in Africa



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SUMMARY

- › Remote-sensing satellites are a core area of German space technology and a focus of the federal government's high-tech strategy which enjoys substantial public funding.
- › Developing countries offer considerable application potential for remote-sensing data (e. g. weather services, environmental monitoring, agriculture and forestry, urban development, disaster management).
- › User-oriented information services need to be developed in order to achieve these potentials. There are significant deficiencies in this regard in Africa, compared with other continents.
- › The state, as an important sponsor, supporting authority and regulator of technology development, can offer substantial support for applications in developing countries.

WHAT IS INVOLVED

Satellite-assisted remote sensing of the Earth enables the continual and increasingly detailed observation of objects on Earth. The potential applications range from resource management in agriculture and forestry to obtaining environmental information, mapping and planning of settlements and infrastructure, and on to disaster management. A major application potential is also assumed for developing countries since the benefits of remote sensing (largely autonomous, systematic data capture in areas with difficult access) can particularly come into play there. Increasing environmental and social challenges (desertification, erosion, urban development) confirm this assumption. Nonetheless, since the initial euphoria of the 1980s and 1990s, there has been a significant decline in interest in remote-sensing applications in the German development cooperation world. What are the reasons, and what options are available for improving the present situation?

OUTER SPACE POLICY AND REGULATION OF PROCESSES

The **UN Outer Space Treaty of 1967 unreservedly endorses activities related to remote sensing of the Earth.** Technology-leading countries have been capturing a wide range of ever more differentiated data on extremely varied »objects« on Earth without the approval of the states or regions surveyed and without notifying them. Satellite owners have sole copyright in the data. To date, regions observed are not granted any rights – and this is criticized by developing countries in particular.

To protect national security, leading industrial countries claim sovereignty rights at a national level **in the case of ultra-high-resolution and current data** relating to their territory by limiting the collection and dissemination of such data (satellite data security legislation) and internationally enforcing these restrictions in part by the threat of trade sanctions.

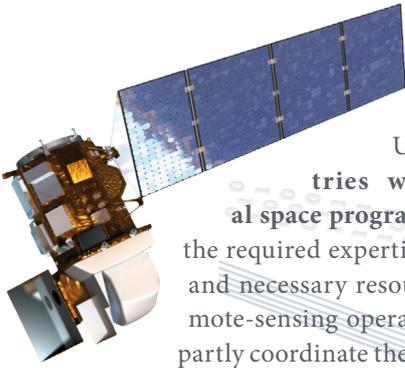
Because of the dual-use nature of the technology (civil and military use possible) Western industrial countries also restrict the export of almost all technical components including possible training programmes for building and operating satellites via multilateral **export control regimes**. Security reasons, which are reinforced by national economic policy interests of technology-leading countries, significantly restrict the transfer of both remote-sensing technology and of specific ultra-high-resolution satellite data and all but exclude it in »fragile states«.

CLIENT

Committee on Education, Research and
Technology Assessment
+49 30 227-32861
bildungundforschung@bundestag.de

TOPIC INITIATIVE

Committee on Economic Cooperation
and Development



SATELLITE
INFRASTRUCTURE

Up till now only **countries with ambitious national space programmes** were able to deliver the required expertise, technical requirements and necessary resources to run their own remote-sensing operation. **European countries** partly coordinate their projects via intergovernmental organizations (Eumetsat, ESA, but also increasingly via the EU). Some also conduct national remote-sensing activities autonomously. France is currently regarded as the technology leader in Europe. However, Germany also has an ambitious national space strategy which is currently targeting a scientific/technological leadership position in application fields with a high market potential. Satellite systems optimized for specific analytical issues in the northern hemisphere may quite possibly represent a sound basis for collecting data in comparable analyses in the south, but this is not automatically guaranteed in all cases.

Some **African countries** (Algeria, Nigeria, Egypt) have gained initial experience in building and/or operating remote-sensing satellites in cooperation with European countries. Only South Africa has started building and operating its own satellites. Intergovernmental organizations for pooling resources as in Europe do not yet exist in Africa. South Africa's current goal is to develop, build and operate a transnational African remote-sensing system consisting of several small satellites by 2018. Algeria, Kenya and Nigeria wish to be involved.

Since engineers have also started to focus on small, simply specified satellites, **some of the barriers to technology transfer to African countries** have been lowered. Yet even these small satellites are high-tech products which call for varied specialist expertise and a substantial input of resources, not only for building and operating the satellites,

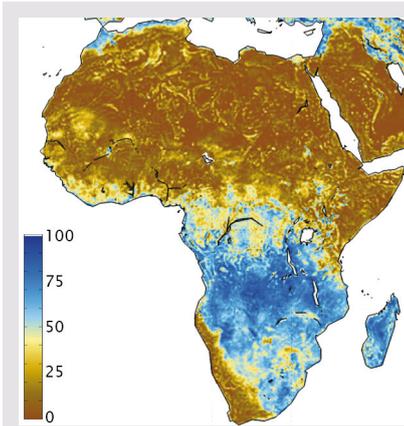
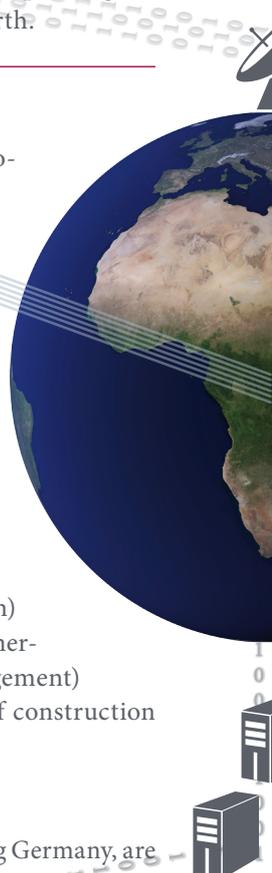
but also for using the data. Consequently, there will continue to be a **need for technology transfer programmes** in future. However, the Western industrial countries' applicable export control regimes significantly restrict the transfer of satellite technology. Instead, some technology-leading countries are tending to facilitate access to, and the application development of, satellite data which is non-critical in security terms, in order in part to justify the considerable, mainly public financial resources which have been made available for decades for installing and expanding the satellite infrastructure for observing the Earth.

DATA ACCESS

Satellite operators are offering a steadily growing volume of data. Technically, they hold the **copyright** for the data, though they grant certain usage rights via **licence agreements**. Users can obtain the data via a satellite-based distribution system with the appropriate terminal devices or via high-capacity internet connections. At present, the following **access forms**, which merge into each other, are available:

- > Completely unrestricted, free-of-charge data access (sometimes charges are levied depending on the cost of provision)
- > Splitting of data access into a non-commercial part (e.g. research, disaster management) and a commercial part (e.g. planning of construction projects)
- > Purely commercial sales

Many technology-leading countries, including Germany, are currently endeavouring to **convert national remote-sensing activities more and more into commercial structures**. As a result, they are increasingly giving away the decision-making power relating to data access. That is **com-**



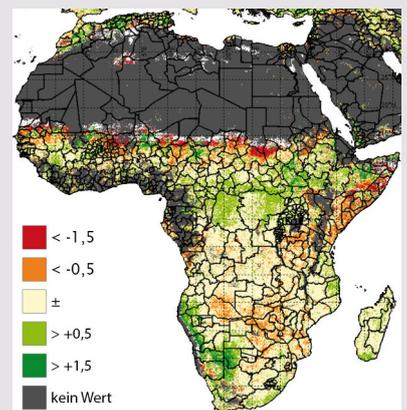
Soil moisture index (SMI)

Determined from radar data for estimates of biological processes, chemical and mechanical soil properties and consequences of climate change.

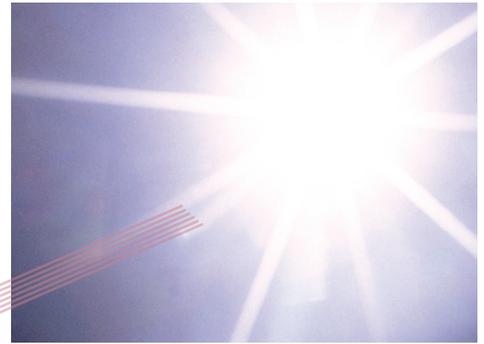
Vegetation productivity index (VPI)

Determined from optical data in order, among other things, to estimate vegetation changes and the agricultural productivity potential of an area over time.

Source: <http://gmfsgeonetwork.eftas.eu>



plicating national initiatives for simplifying data access for developing countries and even **open-data initiatives**. As an important member of intergovernmental organizations such as **Eumetsat, ESA** and the **EU**, however, Germany still has means of influencing policy here. These organizations have **similar data policies**, though they are not identical: Eumetsat currently offers the greatest freedoms, especially for activities in Africa. The ESA draws a sharper distinction between commercial and non-commercial use. The European Commission advocates free access to data, though to date, apart from declarations of intent, hardly any proposals for relevant processes have been forthcoming. Within these organizations »all« that is needed to enable the **data and information systems** established for the members to be **opened up to African users too** is for **appropriate policy directions to be set**.



- › specific user groups will first have to be developed for the information services: in industrial countries geo-information services are mainly developed in or for the public sector (e.g. environmental authorities, cartographic institutions); these potential users are structured quite differently in developing countries.

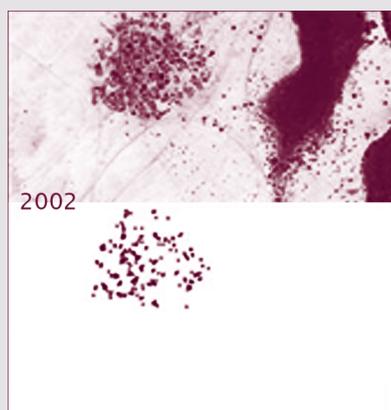
FROM SATELLITE DATA TO GEO-INFORMATION

In its raw form, satellite data can scarcely be used at a general level. Specific knowledge is needed in order to process and interpret it and **extract** usable **information**. To that end, satellite data is regularly linked with data from other sources and further processed to yield **geo-information systems**. Processing methods developed for specific user groups in industrial countries **cannot usually be meaningfully used in developing countries without adaptation**, because, for example

- › the objects under observation have, at least in part, specific inherent features (e.g. different plant populations, deserts)
- › the quantity and quality of necessary ground-level data in developing countries show significant differences from industrial countries

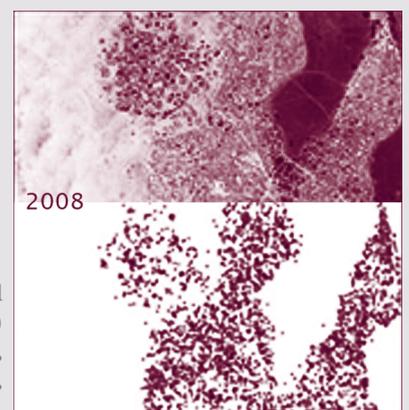
Industrial countries can significantly improve the options for using remote sensing by **simplifying data access** and **applying specialist expertise** for data processing. To achieve these options, however, **substantial involvement in African countries is needed**, and this must also be applied to the development of information products. It is especially important to also ensure the local development of specialist expertise and players who are capable of acting and can use geo-information profitably.

A number of **international initiatives** both for monitoring various environmental agreements and for disaster management (e.g. International Charter on Space and Major Disasters, which provides for satellite images to be made available free of charge in the event of disasters for assessing the situation and the aid logistics) offer points of contact and promote the use of remote sensing. **European programmes** are also specifically seeking to promote applications for remote sensing in Africa (longer-term cooperation between Eumetsat, ESA, the EU and the African Union).



Refugee camps in Darfur over time

Automatic recognition of habitation areas (bottom images) from high-resolution satellite data (top images) for estimating the logistical situation.



Source: Lang et al. (2010): Earth observation (EO)-based ex post assessment of internally displaced person (IDP) camp evolution and population dynamics in Zam Zam, Darfur. In: International Journal of Remote Sensing 31(21), S. 5709–5731

OPTIONS FOR ACTION

The state, as an important sponsor, supporting authority and regulator of technology development, can offer substantial support for applications in developing countries.

Collaborative agreements for planning and building satellites are already being entered into, though in Germany to date almost exclusively via established partnerships with other industrial countries. The US, France and the UK are already gaining initial experience in collaborative partnerships with individual emerging countries.

Transfer programmes for building and operating satellites can represent an alternative to joint missions. An evaluation of supplier options and client expectations could help in tailoring programmes more specifically to experts from developing countries. Links with projects for developing and extending data applications could underpin these collaborative schemes.

The decision to make **data from publicly funded satellites** freely available promotes its self-determined use in developing countries. The German government could also send out clearer signals in respect of data access. Pro and contra arguments relating to open data processes should be analysed more closely in order to create a specific knowledge base for a political opinion-forming process.

A **comprehensive inventory of German activities** relating to remote-sensing applications in Africa could be expanded to form a corresponding geo-information system and contribute to more transparent development cooperation. This is particularly important with remote-sensing projects because a lasting technology transfer only succeeds in stages over an extended period of time because of the complexity of the subject matter, though research projects and schemes related to development cooperation usually only last just a few years.

German expertise in climate or geographical research, hydrology or land and forest monitoring **could be expanded**

TAB REPORT NO. 154

FERNERKUNDUNG: ANWENDUNGSPOTENZIALE IN AFRIKA

KATRIN GERLINGER



WEBPAGE OF THE PROJECT

www.tab-beim-bundestag.de/en/research/u9200.html

PROJECT MANAGER AND CONTACT

Dr. Katrin Gerlinger
+49 30 28491-108
gerlinger@tab-beim-bundestag.de

to become lighthouse partnerships with individual countries and/or institutions. Germany could reposition itself by developing a multidisciplinary strategy for remote-sensing applications which also explicitly focuses on Africa and brings together the options relating to space strategy, science and economic collaboration.

Africa programmes initiated by Eumetsat, ESA and EU have substantially extended and, in part, also pooled the national activities of individual European countries. An **accompanying independent evaluation** which integrates European and African perspectives could help in specifically expanding strengths and reducing weaknesses in respect of programme development in order to ensure that the collaborative partners in African countries can gradually take on more complex tasks.

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