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of Education
and Research



ASEAN-EU

Year of Science, Technology & Innovation 2012



DLR

DAAD

“EYE OF THE SKY”

**A German contribution to the ASEAN – EU Year of Science,
Technology & Innovation 2012**



RESEARCH



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Aquatural-Systems in Thailand, © DigitalGlobe provided by European Space Imaging

Preface



The Asian-Pacific region is on its way to becoming an economic and scientific key player in the world. Germany and Europe believe this development will provide new opportunities to intensify cooperation with the lead nations in research and education in this region.

Scientific and technological cooperation between the European Union (EU) and the ASEAN states will be presented to the general public in the course of the ASEAN-EU Year of Science, Technology and Innovation (YoSTI2012). Joint activities will broaden the basis of cooperation while drawing interest in science and research, and illustrating its benefits to society. By selecting topical areas

that are of particular interest to Southeast Asia and Europe and of global relevance, the first bi-regional Year of Science highlights the impact and existence of cooperation between ASEAN and the EU.

As German contribution to the bi-regional Year of Science, the picture exhibition 'Eye of the Sky', features impressive satellite images made by the German Aerospace Center. The large-sized images of both continents help visualize the

challenges we face as a result of the changes occurring in natural environments. Science is taking on these challenges, through support from the Federal Ministry of Education and Research and from the EU's Seventh Research Framework Programme, by developing sustainable land use systems, efficient water technologies, strategies for coping with natural disasters, renewable energy systems and urban planning schemes.

My special thanks go to the German Academic Exchange Service, the German embassies and the local partners for organizing and hosting the exhibition. I hope all its visitors gain fascinating new insights into nature in the process of change. May it shed light on the important work done by science and research.

A handwritten signature in blue ink, reading "Annette Schavan". The signature is fluid and cursive.

Prof. Dr. Annette Schavan,
Federal Minister of Education and Research (BMBF)

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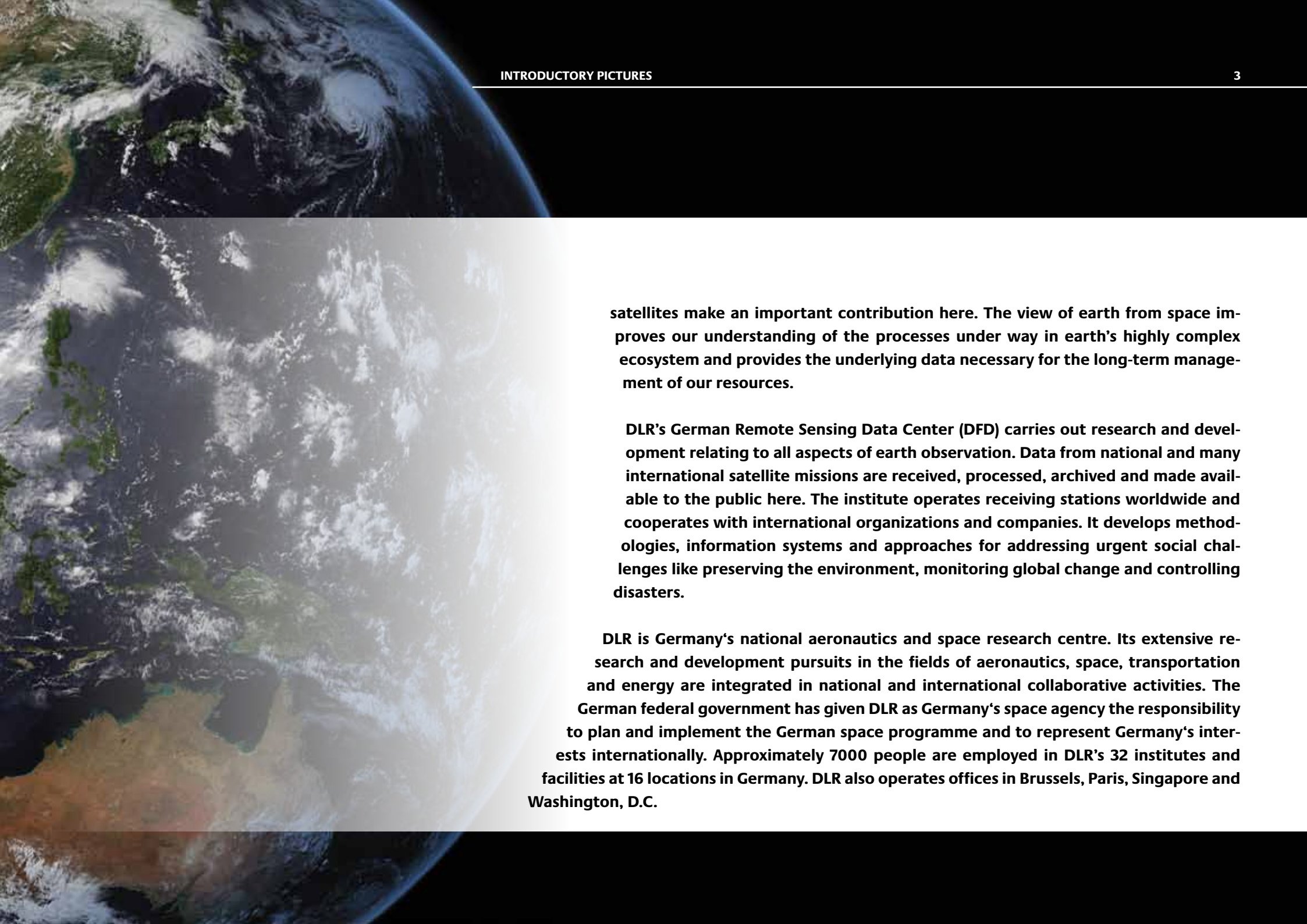
The Human Footprint

It was only forty years ago that for the first time in their history people could look at their home planet from a distance. The significance of those first photographs of Planet Earth for humanity's self-image can hardly be overstated. This first view from an outside vantage point showed our planet in all its beauty, but also its limitations and vulnerability, in a unique and comprehensible way which transcended cultural, linguistic and national borders.

Today, earth observation satellites are providing that outside view. Digital measurement data have meanwhile replaced analogue photographs. Satellite instruments exploit regions of the electromagnetic spectrum invisible to the human eye. They identify trace gases in the atmosphere, the vitality of plants and the growth of cities, as well as elevation profiles, ocean currents, glacier movement and many other features. The data they continuously supply provide a detailed picture of the health of our planet over large areas. And again and again they particularly show how human activity has radically and profoundly modified the earth.

Recorded from elevations ranging from several hundred to several thousand kilometres, satellite images induce shocking awareness of the artificial landscapes people have created and of natural landscapes which have become all too scarce. The aesthetics of these images are, however, often in glaring contradiction to the substance of their message. Many images reveal the consequences of our constantly increasing global population's hunger for resources and the need for corrective action. As objective, global observers,





satellites make an important contribution here. The view of earth from space improves our understanding of the processes under way in earth's highly complex ecosystem and provides the underlying data necessary for the long-term management of our resources.

DLR's German Remote Sensing Data Center (DFD) carries out research and development relating to all aspects of earth observation. Data from national and many international satellite missions are received, processed, archived and made available to the public here. The institute operates receiving stations worldwide and cooperates with international organizations and companies. It develops methodologies, information systems and approaches for addressing urgent social challenges like preserving the environment, monitoring global change and controlling disasters.

DLR is Germany's national aeronautics and space research centre. Its extensive research and development pursuits in the fields of aeronautics, space, transportation and energy are integrated in national and international collaborative activities. The German federal government has given DLR as Germany's space agency the responsibility to plan and implement the German space programme and to represent Germany's interests internationally. Approximately 7000 people are employed in DLR's 32 institutes and facilities at 16 locations in Germany. DLR also operates offices in Brussels, Paris, Singapore and Washington, D.C.





THE WORLD AT NIGHT 2010

A sleepless planet. Highly sensitive cameras could measure nearly every light on Earth. Populated areas appear literally as light oceans but the brightness of a spot does not always correspond properly to the population density. In other words, India and China, comprising more than two billion inhabitants, are comparatively dark.

This data could be used to get a first impression of the energy consumption of countries and regions. Especially in Europe and the USA the image reveals a thoughtless use of electricity. Even less populated areas appear relatively bright. This satellite technique was originally designed for an entirely different purpose: The US planned to observe rocket launches at night-time.

Satellite: DMSPOLS, 2,7 km

Image mode: gray / pseudo-color

Acquisition Date: 2010

Spectral channels: 0,40 – 1,10 μm ; 10,0 – 13,4 μm

Copyright: Satellite-data: © National Oceanic and Atmospheric Administration - National Geophysical Data Center

Image processing: German Aerospace Center (DLR)



THE EARTH FROM SPACE

Artificial perspective views rendered by computer are mimicking the view from a geostationary satellite. The images combine several different remote sensing datasets such as MODIS true colour images and weather information.

Geostationary satellites orbit the Earth in the Clarke Belt, which is located at 36,000 km above the equator. This is the only latitude that allows for stable, geostationary orbits. At this altitude the satellites circle the Earth at the same speed as the Earth's rotation so that they are always monitoring the same region. The cloud layer in this image is the combined information of several satellites. It has been recorded by the Chinese Meteorological Administration's (CMA) satellite Feng Yun 2, the Japan Meteorological Agency's (JMA) satellite MT-SAT, two American satellites GOES-West, located over the eastern part of the Pacific Ocean and GOES-East, centered at 75° W as well as Europe's satellite Meteosat.

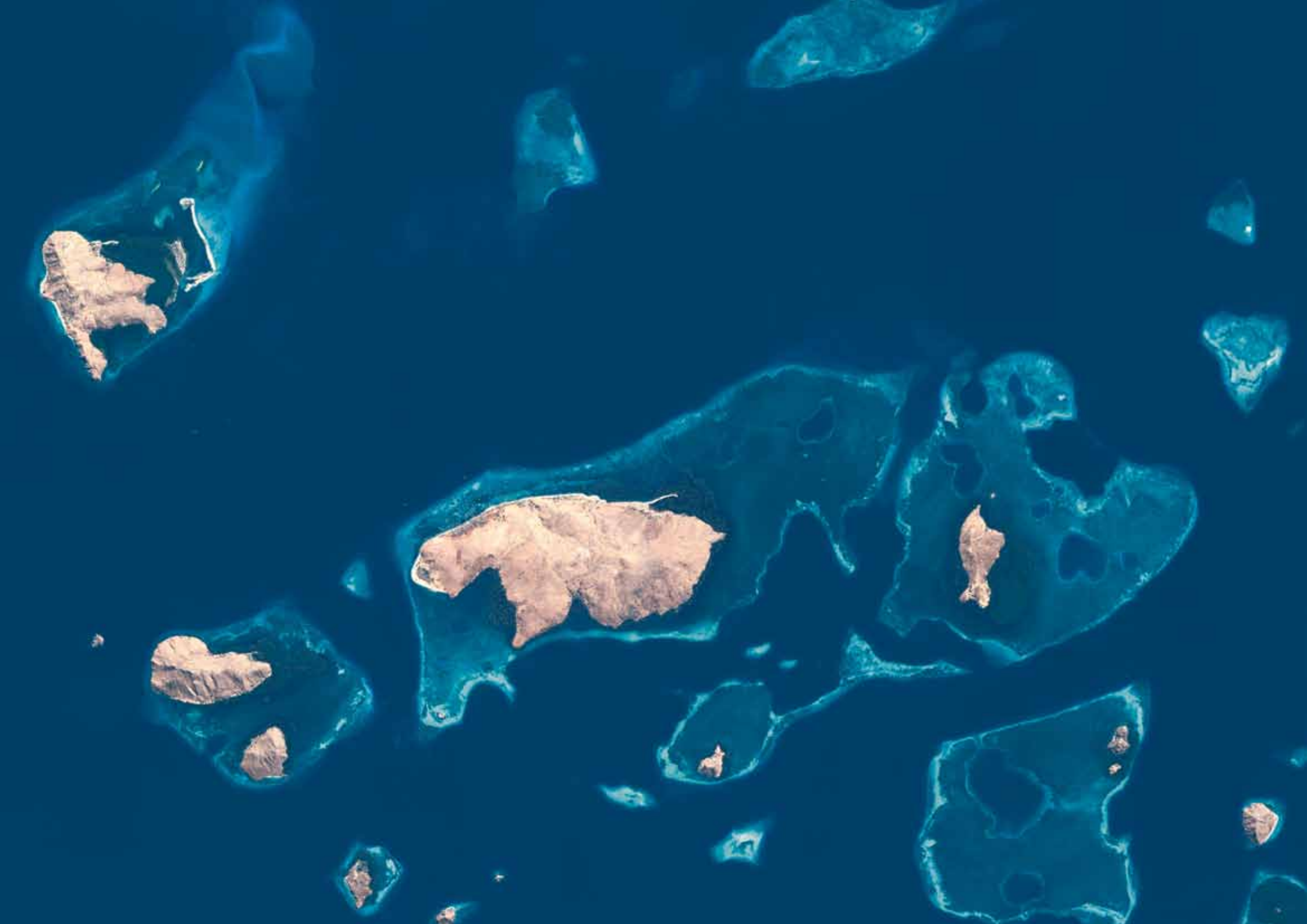
Satellite: MODIS, Meteosat, GOES east/west, Feng Yun 2, MT-SAT

Image mode: true color, perspective rendering

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © EUMETSAT, NOAA, Chinese Meteorological Administration, Japan Meteorological Agency

Image processing: German Aerospace Center (DLR)



ISLANDS OF KOMODO NATIONAL PARK, INDONESIA

Part of the lesser Sunda Islands and the Komodo National Park as seen from space, approx. 450 km above the Earth on July 4, 2004. The coral reefs surrounding the islands are in bright blue colours in an otherwise seemingly dark blue sea. The park was established in 1980 to protect the world's largest lizard, the Komodo dragon, and declared an UNESCO World Natural Heritage site in 1986. Today it protects not only the famous lizards, but also conserves the rich local marine and terrestrial biodiversity. The climate of the volcanic islands is relatively dry. The annual rainfall ranges from 800-1000 mm, figures comparable to a very wet central European weather event, but dry in terms of Indonesia.

Marine resources of insular Southeast Asia are vital for the livelihood of local people. Thus better knowledge and protection of these fishing grounds is a topical issue. For example, the EU-funded project ECOKNOWS aims to improve the

use of biological knowledge in fisheries science and management. The project uses fisheries models with state-of-the-art methodology to achieve more realistic assessments of resources. To this end, large existing biological and environmental databases, available literature and survey data sets are used. ECOKNOWS develops a computational learning approach that builds on the extensive information provided at FishBase (www.fishbase.org). The methodology will be of fundamental importance, especially for the implementation of the Ecosystem Approach to Fisheries Management. It has been a difficult challenge even for target species with long data series, let alone for new and/or poorly studied species. The project will improve ways to find generic and understandable biological reference points, such as the required number of spawning times per fish, which also supports the management needs in developing countries such as Indonesia.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: 04 July 2004

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



COASTLINE WITH REMNANTS OF MANGROVES, MALAYSIA

At the coast of the Kerian district in Perak, Malaysia, a high resolution Quickbird image shows remnants of a mangrove forest near to the fishing village of Tanjung Piandang. The area is dominated by agricultural land and even the small remaining mangrove belt has been altered by human activity. Aquacultural systems such as shrimp farms and tourism infrastructure are threatening mangrove forests. Over 50% of the worldwide mangrove ecosystems are already destroyed despite its extraordinary importance for the marine ecosystem, e.g. as breeding area for fish, the protection of coastlines and its resulting long-term economic value. While this image shows degraded mangroves, only some 25 kilometres towards the south the Matang Mangrove forest is located, the largest single block of this ecosystem in Peninsular Malaysia.

To date, comparatively little is known about the functioning and services of coastline ecosystems in the tropics. The BMBF-funded Indonesian-German research cooperation “Science for the Protection of Indonesian Coastal Ecosystems” (SPICE Program) addresses the scientific, social and economic issues related to the management of the Indonesian coastal ecosystems and their resources. Similar to Peninsular Malaysia, Indonesia is a centre of marine biodiversity with highly

productive ecosystems such as coral reefs, mangroves and sea grass meadows. All these ecosystems are stabilising the coastlines, are repositories of carbon and genetic information, and play a vital role in the lives of coastal population as a source of food, energy and income. Today the coastal ecosystems are under enormous pressure caused by rapid social and economic changes. Overexploitation and environmental degradation threaten the natural resource potential of coastline ecosystems.

A sub-group of SPICE is working on mangrove ecology to improve our understanding of the interaction between ecosystem and socioeconomic dynamics in the Segara Anakan region in central Java. The natural resources and hence socioeconomic goods and services of the mangrove-fringed lagoon are affected by high riverine sediment inputs, overexploitation of natural resources and effluents from agriculture, industry and households.

A better understanding of ecosystem services and raising environmental awareness among stakeholders are preconditions for developing sound and efficient measures for a sustainable use of these natural resources.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: 22 May 2007

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



SHRIMP PRODUCTION IN THAILAND

With declining sea catches, aquaculture already provides more than half of the seafood consumed. Aquaculture, the managed production of fish, crustaceans, mollusc and alga, has been the fastest growing bio-industry since decades. In Asia, which covers more than 85% of the global production, aquaculture is a major commodity sector, sustaining a livelihood for millions of rural families. The image shows a typical lay-out of an intensive shrimp farm along a river near Amphoe Klaeng in the northernmost part of the Gulf of Thailand, 100 km west of the Cambodian border.

The ASEM Aquaculture Platform, established in 2003, facilitates the Asian-European dialogue on a common research strategy serving sustainable, safe and healthy aquaculture production. The bi-regional network brings together

experts from research, industry, policy makers, and consumers to discuss mutual interests and elaborate recommendations for a common research strategy to address challenges in aquaculture development.

For the EU, the Platform contributes to a better overview on sources and quality of imported seafood. Asian members benefit from getting access to European know-how. For both sides, the project offers research-specific solutions for common problems in aquaculture, ranging from bio-technical and socio-economic to ecological issues.

The Platform is supported by the AqASEM project under FP7 (EC DG Research) and the Research Foundation – Flanders, Belgium.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: 08 January 2006

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



DANUBE DELTA: A NATURAL HERITAGE SITE

The Danube is the second largest river in Europe, passing ten European countries before flowing into the Black Sea. The Danube Delta, located in Romania, comprises three main and numerous lateral branches, reed areas, islands and lakes, but also riparian forests and arid dune biotopes. With an extent of 5000 km², this ecosystem constitutes Europe's largest wetland and the world's largest contiguous reed area, being the habitat for more than 4000 animal and 1000 plant species, respectively. In 1991, the UNESCO proclaimed the Delta as a World Natural Heritage site.

The true-colour image was recorded in August and October 2011 by the Thematic Mapper onboard Landsat 5.

Satellite: Landsat 5 TM, 30m

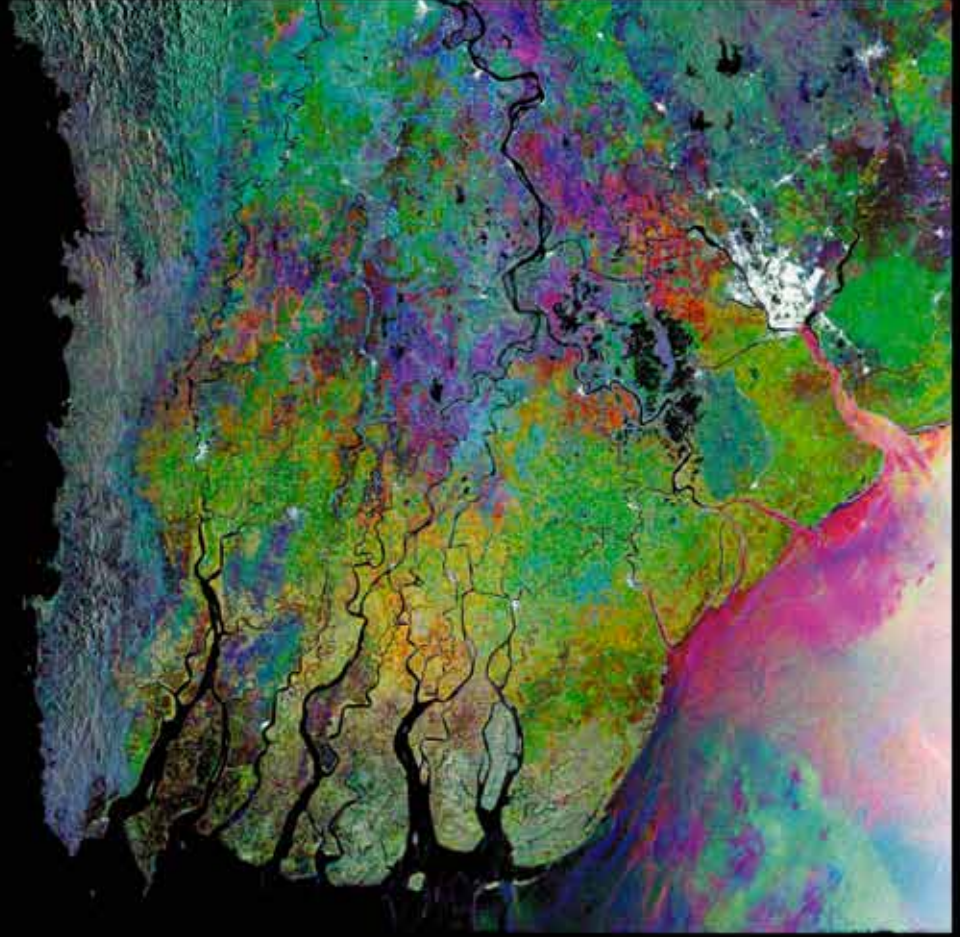
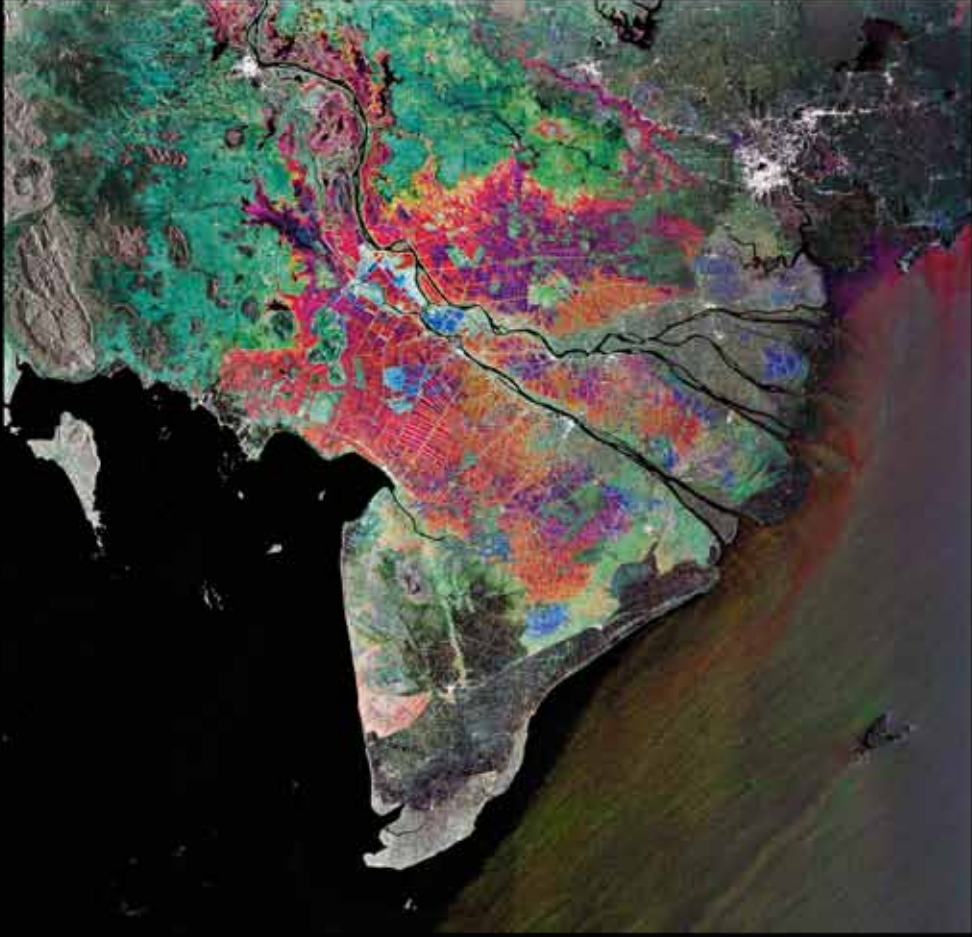
Acquisition Date: August / October 2011

Image mode: true color

Spectral channels: 0,76-0,90 μm , 0,63-0,69 μm , 0,52-0,60 μm

Copyright: Satellite-data: © Global Landcover Facility

Image processing: German Aerospace Center (DLR)



MAJOR RIVER DELTA SYSTEMS IN SOUTHEAST ASIA: MEKONG AND IRRAWADDY

The Mekong Delta on the left as seen by the Advanced Synthetic Aperture Radar (ASAR) aboard the satellite Envisat. The Mekong is the 12th longest river in the world running from the Tibetan plateau and passing six countries, i.e. China, Myanmar (Burma), Laos, Thailand and Cambodia, until it reaches its delta in Vietnam. The wetlands in the Mekong Delta are like sponges, storing vast amounts of water. This area is very fertile and particularly suitable for rice cultivation. Vietnam is the third largest rice exporter in the world. Urban centres show up as white spots in the radar image.

On the right side the Envisat ASAR image shows the Irrawaddy Delta in Myanmar. The large white area on the right is Yangon, the country's largest city and former capital. It is located at the convergence of the Yangon and Bago River, whose waters are flowing into the Andaman Sea. With a length of 2170 km, the Irrawaddy is the country's longest river. The river is crossing nearly the whole country before reaching the Andaman Sea through the nine-armed Irrawaddy Delta.

Each image was combined out of three satellite surveys taken at different times. Colourful spots indicate changes of the surface that occurred between

image acquisitions. Black and white tones mark areas with none or minor changes in vegetation and soil colour throughout the year.

Limited drinking water availability, increasing water pollution, and the loss of species and habitats, such as the decline of mangrove ecosystems, all have a negative effect on people's lives in both deltas. Population pressure and the incipient impacts of climate change pose increasing challenges to local people of these fast developing regions. In the Mekong Delta, the German-Vietnamese WISDOM project is addressing these issues by multidisciplinary research. The main project goal is to design and implement a comprehensive GIS-based information tool which supports regional government agencies in the Mekong Delta in their planning processes to develop the region and to adapt to climate change. The German side is funded by the Federal Ministry of Education and Research (BMBF), the Vietnamese partners by the respective counterpart, i.e. Ministry of Science and Technology (MoST).

Satellite: ENVISAT ASAR, 30m

Image mode: false color time-series image

Acquisition Date (left): 9 January 2007, 13 February 2007 and 20 November 2007

Acquisition Date (right): 2 January 2009, 17 April 2009 and 26 June 2009

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © European Space Agency

Image processing: German Aerospace Center (DLR)



RAJAPRABHA RESERVOIR AND KHAO SOK NATIONAL PARK IN THAILAND

Covered by an evergreen rainforest, the Khao Sok National Park is situated on the left between Phuket, Krabi, Khao Lak and Koh Samui, the most popular touristic destinations in southern Thailand. The huge Rajaprabha Reservoir or Chiao-Lan Lake is hardly noticeable within the dark green of the rainforest. The lake is a diving area and well-known for its limestone caverns. Approximately 70 km to the south of the reservoir lies the Phang Nga Bay. The bay is a famous tourist site as well, with the mangroves of the Phang Nga River delta and many small islands, including the “James Bond” island. Due to its outstanding ecological value, the area was declared a protected Ramsar site in 2002. On the right side of the image the mountains of the Phuket Range clearly stand out from the lighter background - among them the highest mountain of southern Thailand, the Khao Luang. The coastline facing the Indian Ocean on the left was hit by the Tsunami of 2004 with a great loss of life and damage to the infrastructure.

To improve disaster management in the region, the German-Indonesian GITEWS project focused on the development, installation and commissioning of a Tsunami Early Warning System for the Indian Ocean. An end-to-end approach hardware and software – from tsunami detection to decision making are the core elements of the system. Also strategies, standards, procedures and operational

processes for community-oriented tsunami preparedness were developed and implemented. Furthermore, procedures to disseminate early warning messages to communities and to react have been developed and tested in pilot areas. As a result, the operational warning system with sensors and monitoring systems regional-wide has been handed over to Indonesia in March 2011.

After the successful implementation, Germany continues to support Indonesia during the first few years of system operation with activities focused on training and consulting (PROTECTS). The project aims to support the sensor system maintenance, further advance tsunami simulation and modelling, and fine-tuning of the system infrastructure and processes at the National Tsunami Warning Centre at Badan Meteorologi, Klimatologi dan Geofisika (BMKG) in Jakarta. The strengthening of a community-orientated tsunami risk management and the further development of warning products and practice in accordance with the need of end-users are also included.

GITEWS and PROTECTS are funded by the Federal Ministry of Education and Research (BMBF), Germany.

Satellite: Landsat 5 TM, 30m

Image mode: true color

Acquisition Date: January / February 2002

Spectral channels: 0,76-0,90 μm , 0,63-0,69 μm , 0,52-0,60 μm

Copyright: Satellite-data: © United States Geological Survey

Image processing: German Aerospace Center (DLR)



KARST LANDSCAPE IN INDONESIA

Karst landscapes have been shaped by the dissolution of layers of soluble bedrock, usually Carbonate rocks such as limestone. The cone karst is typically for tropical karst areas. The image was taken by the satellite Quickbird in January 2007 at a resolution of 60cm/pixel, showing the karst region of Gunung Sewu (Thousand Hills) situated at the southern coast of the Indonesian island of Java. This karst region belongs to the greater district of Gunung Kidul – Yogyakarta Special Province – and is located ca. 70 km south-east of Yogyakarta City. This karst landscape covers an area of ca. 1400 km² with some 10.000 hills, a typical example of cone karst.

Extreme climatic and hydrogeological conditions are making water supply in developing countries often deficient. This particularly holds for karst regions where the underground is rapidly infiltrated by a large portion of the precipitation and stored in aquifers as well as in underground river networks. Extraction of water from these underground rivers is difficult and hence expensive so that people living in these areas are facing serious water scarcity. A water supply infrastructure implies major financial and technical input. Moreover, the quality of underground water resources is partially questionable due to the vulnerability of karst aquifers

to contamination owing to high infiltration rates. Therefore, innovative and appropriate technologies are required for the exploration, conveyance and distribution of underground water sources.

An interdisciplinary BMBF-funded research cooperation of the Karlsruhe Institute of Technology together with various partners (governmental and research institutions, industry partners and NGOs) from Germany and Indonesia are working in the Gunung Kidul area on the development and implementation of concepts and technologies for an adapted water resources management. An innovative conveyance system has been developed and since mid-2011 it is continuously operating under the responsibility of the Indonesian water authority. By early 2012, some 400 million litres of water have been conveyed through this system. The goal is to provide 80.000 people with continuous water supply. A success story which may serve as a template for other karst regions in Southeast Asia.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: January 2007

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



HANOI AND HA LONG BAY – DRAGONS OF VIETNAM

According to a local legend, the name Ha Long means the descending dragon while the old name of Hanoi, Thang Long means rising dragon. The bay was formed when the mother dragon descended into the sea and her tail carved deep canyons into the land which were flooded by the sea.

In this Landsat image Hanoi is shown right in the middle of the shores of the Red River. Hanoi is the oldest still serving capital of Southeast Asia. The region is dominated by the Red River and its large delta. From the left, the Black River with the hydropower plant and reservoir at Hoa Binh is easily detectable. These vast river systems have formed fertile agricultural land. Just to the north of the Red River delta emerges the Ha Long Bay, a famous touristic area consisting of 2.077 monolithic limestone islands. This area was declared an UNESCO World Heritage site in 1994.

The Ha Long Bay belongs to the Quang Ninh province which provides 95% of the total hard coal production of Vietnam. Large coal mining areas are even found in the close vicinity of this national touristic highlight which is provoking land use conflicts between industry, settlements and tourism. In the project, “Mining and Environment in Vietnam” (Research Association Mining and Environment RAME), jointly funded by the Federal Ministry of Education and Research (BMBF) in Germany and the Vietnam National Coal Mining Industries

Holding Corporation Ltd. (VINACOMIN), researchers and engineers develop methods to reduce environmental impacts due to hard coal mining in Vietnam by particularly focussing on:

- Improvement of the environmental conditions in Quang Ninh province by developing suitable technology and planning measures
- Implementation of pilot plants for developing environmental technologies in the fields of waste rock dumps, mine waters and dust
- Development of environmental planning methods for the prevention of conflicts in regions with a high land use intensity
- Integration into a central environmental management including environmental monitoring and environmental information systems
- Training of staff, building up environmental awareness in the mining companies

Satellite: Landsat 5 TM, 30m

Acquisition Date: September / November 2000 / 2001

Image mode: true color

Spectral channels: 0,76-0,90 μm , 0,63-0,69 μm , 0,52-0,60 μm

Copyright: Satellite-data: © Global Landcover Facility

Image processing: German Aerospace Center (DLR)



MOUNTAIN FORESTS IN THE PHILIPPINE CORDILLERAS

The Cordillera of Luzon in the Philippines is still characterised by a high cover of forests at higher elevations. The Quickbird image of December 16, 2009 shows several large landslides along the Bontoc-Banaue road. Road construction is a major factor for landslides, but improved road conditions have contributed to halt further degradation of slopes. The mountain forests in this area harbour a huge biodiversity with many endemic species, and even more important, provide continuous water supply for the famous rice terraces on lower slopes. These rice terraces are partly UNESCO World Heritage sites.

The LEGATO-project, funded by the Federal Ministry of Education and Research (BMBF) in Germany, investigates these landscape level interactions between forests and irrigated rice fields with a particular focus on ecosystem services like nutrient and water provision, biocontrol against potential pest species, and cultural functions including the role of tourism.

Studies, which involve more than 70 farmers and other stakeholders, are conducted across Southeast Asia, mainly in the Philippines and Vietnam, including associated partners from other countries such as Malaysia and Thailand. A key objective of LEGATO is to develop, test and implement “ecological engineering”, i.e. modifications of land use and landscapes to enhance ecosystem services in irrigated rice production systems in Southeast Asia.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: 16 December 2009

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



PRIMARY FOREST IN INDONESIA

Rainforest covers most of the image area located in the Sukamara Regency, Central Kalimantan, an Indonesian province on Borneo Island. Large parts of Bornean rainforests, particularly lowland areas, have been set aside to produce agricultural commodities such as palm oil, rubber, pepper and rice. Even in this seemingly undisturbed forest, the satellite image reveals footprints of human activity such as settlements at river banks and some logging operations. Indonesia has the second largest area of tropical rainforest in the world. But this natural treasure trove of biodiversity is endangered by land conversion and unsustainable and often illegal logging. The Indonesian government works on initiatives to support legal and sustainable timber production. The development of assessment and monitoring tools are crucial to this end.

The REDD Fast Logging Assessment & Monitoring Environment (REDD-FLAME) project, funded through the EU-FP7 programme will design, prototype and demonstrate a system capable of monitoring tropical and sub-tropical forests using high-resolution radar (and optical) imagery acquired by Earth Observation satellites. By focussing on early detection of logging activities, the system will provide the means to quickly identify the first signs of deforestation and thus act as a tool to control resource use and sustainable development within these fragile

environments. The system will form a high-resolution add-on for existing (semi-) operational low- to mid-resolution systems, providing hot-spot monitoring for areas at highest risk of deforestation. As such, it could be integrated into national forest monitoring centres and provide inputs for large scale carbon emission assessments in the context of the UN-REDD (Reducing Emissions from Deforestation and Forest Degradation) Programme.

The system is being developed in collaboration with scientists in Indonesia, Brazil and Mozambique. By implementing a dedicated version of REDD-FLAME in Central Kalimantan, results appropriate to its specific monitoring requirements will be provided to give timely information on logging activities to a wide range of stakeholders, whilst building capacity for the management of forest resources and carbon balances.

Satellite: Quickbird, 60cm

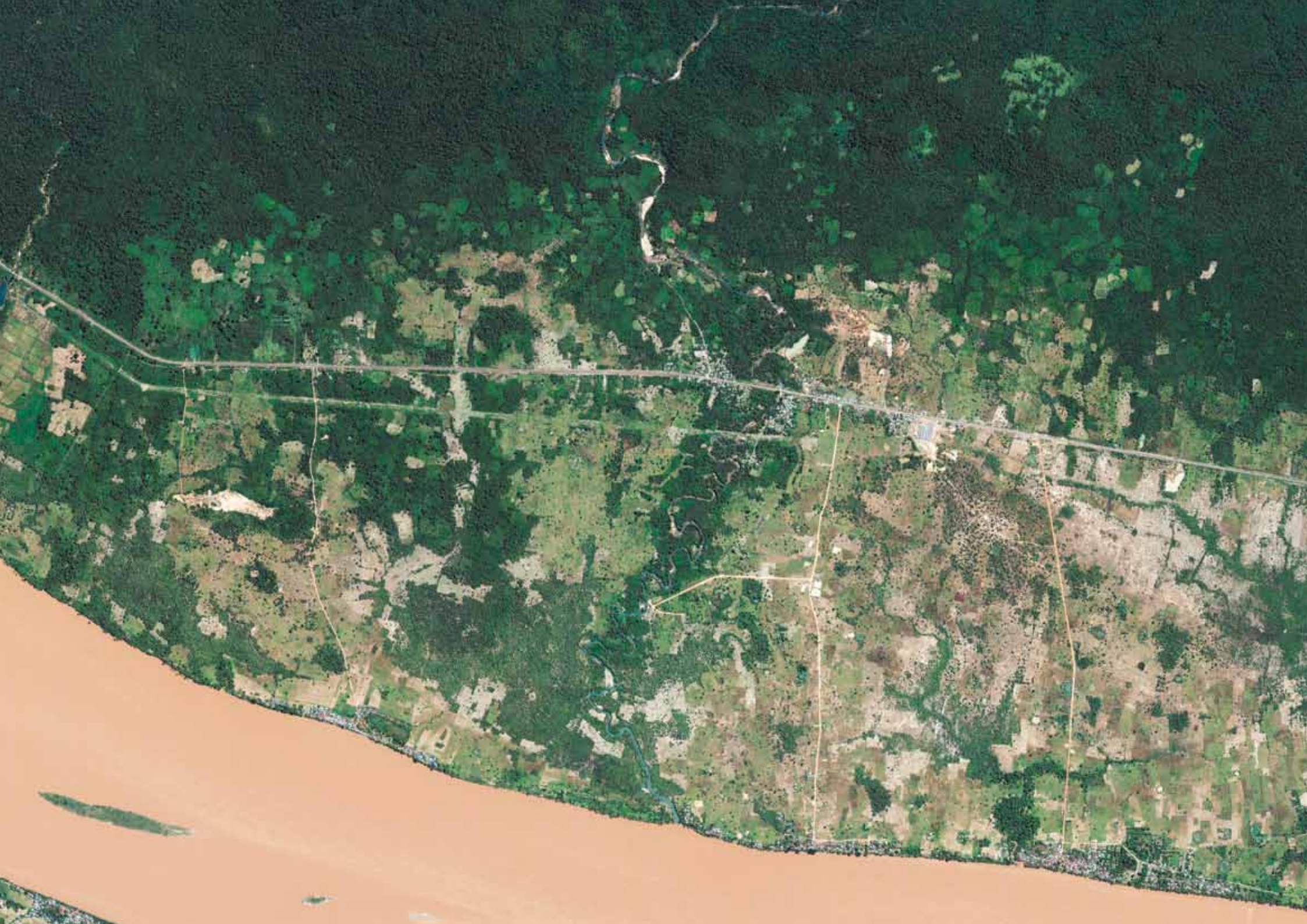
Image mode: true color

Acquisition Date: 07 December 2002

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



DEGRADED FOREST LAND IN LAOS

The province Champasak in south-western Laos shares borders with Thailand and Cambodia. The mighty Mekong River flows through this province and is clearly seen at the bottom of this image. Famous ruins of Wat Phou of the Khmer Empire are found in the forest a few kilometres away from the spot taken. This image documents the conversion of former rainforest into farmland. Using transport routes such as rivers or roads and associated settlements, land clearings are ever pushed further into the forest. To the north of the Route 13, shown in the centre of this image, the area is still dominated by pristine rainforest.

The Climate Conference in Copenhagen (2009) made a commitment on developing a mechanism for reducing greenhouse gas emissions (GHG) from deforestation and forest degradation and enhancing carbon stocks (REDD+). The research basis is limited for such a mechanism particularly with regard to the need for understanding and monitoring the impact of REDD+ activities on climate effectiveness, cost efficiency, equity and co-benefits. The EU-funded I-REDD+ project will approach these challenges from an interdisciplinary perspective by focussing on:

- how to reduce emissions of GHG and maintain or enhance existing stocks of carbon in vegetation and soil of various land cover types;
- impact livelihoods and welfare of local farming communities;
- impact biodiversity conservation, and
- how to provide a realistic framework for monitoring, reporting and verification of REDD+, including the importance of governance and accountability at multiple levels.

One of the Southeast Asian research sites is in the Lao PDR. Rapid land use transitions from forest and shifting cultivation to other, more intensive land use systems and widespread forest degradation are occurring in all study areas, making the potential for REDD+ particularly pronounced. The partners in I-REDD+ are leading research institutions in Europe and Southeast Asia, international research organisations, an NGO and private company. Emphasis is put on local dissemination and capacity development to ensure that project results influence REDD+ policy at all levels.

Satellite: Quickbird, 60cm

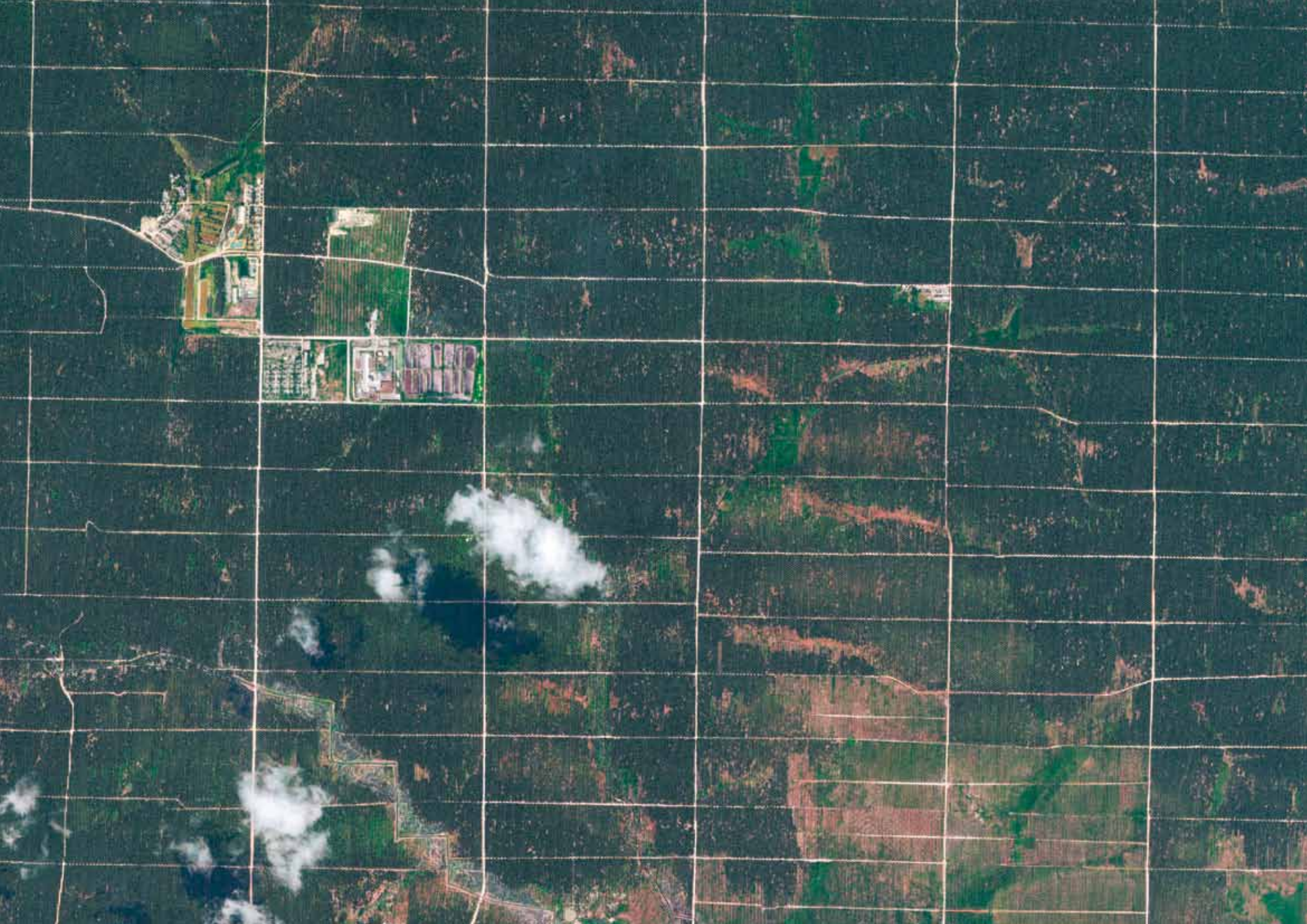
Image mode: true color

Acquisition Date: 21 October 2006

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

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Image processing: German Aerospace Center (DLR)



PALM OIL PLANTATION IN INDONESIA

The world's hunger for palm oil for nutrition, cosmetics and industrial applications is still increasing. Large areas of tropical rain forest are burned down and converted into palm oil plantations, particularly in Indonesia and Malaysia. A lucrative business but which implies environmental costs such as high CO₂ emissions by land clearing, river pollution by the application of pesticides and loss of biodiversity. The satellite image shows a plantation in South-Kalimantan, an Indonesian province on Borneo Island, in December 2005. The very high resolution earth observation data depicts the regular pattern of the plantation scheme.

The EU-funded project REDD-ALERT addresses deforestation in tropical areas: greenhouse gas (GHG) emissions, socio-economic drivers and impacts, and policy options for emission reduction. The project aims to contribute to the development and evaluation of mechanisms and the institutions needed at multiple levels for changing stakeholder behaviour to slow tropical deforestation rates and hence to reduce GHG emissions. This will be achieved through enhancing our understanding of the social, cultural, economic and ecological drivers of forest transition in selected case study areas, among others in Indonesia, partnered by the Indonesian Soil Research Institute (ISRI). This understanding will facilitate

the identification and assessment of viable policy options addressing the drivers of deforestation and their consistency with policy approaches on avoided deforestation, such as Reduced Emissions from Deforestation and Degradation (REDD), currently being discussed in the United Nations Framework on Climate Change (UNFCCC) and other relevant international fora. At the same time, ways of improving the spatial quantification of land use change and the associated changes in GHG fluxes will be developed, thereby improving the accounting of GHG emissions resulting from land use change in tropical forest margins and peatlands. This will allow the analysis of scenarios of the local impacts of potential international climate change policies on GHG emission reductions, land use, and livelihoods in selected case study areas. The results will be used to develop new negotiation support tools for use with stakeholders at international, national and local scales to explore a basket of options for incorporating REDD into post-2012 climate agreements.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: 07 December 2005

Spectral channels: 0,63 – 0,69 μm, 0,52 – 0,60 μm, 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



LAND CLEARANCE FOR ACACIA PLANTATIONS IN MALAYSIA

The image depicts a large-scale land clearance for short-rotation monocultures with *Acacia mangium* about 15 km south-west of Bintulu, Sarawak, Malaysia. Acacia, native to Papua-New Guinea and Australia, is one of the most important fast-growing tree species for pulp and paper production in Southeast Asia. The project site is in a region set aside for tree plantation projects, currently being implemented by Forestry Department of Sarawak, with the intention to capitalise on the lucrative pulp and paper industry. The pulp produced from the project in a nearby mill at Tatau is expected to cater for the international as well as domestic markets.

Major knowledge gaps for the development of socio-economic sustainability criteria and effective certification schemes are addressed by the Global-Bio-Pact project in a comprehensive approach involving partners from Europe, Latin America, Africa, and Asia. The Global-Bio-Pact is supported by the European Commission's 7th Framework Programme. The main aim of the Global-Bio-Pact project is the development and harmonisation of global sustainability certification systems for biomass production, conversion systems and trade to prevent

negative socio-economic impacts. Thereby, emphasis is placed on a detailed assessment of the socio-economic impacts of feedstock production and a variety of biomass conversion chains in the framework of globally conducted case studies. In Southeast Asia, the Indonesian palm oil and bioethanol sector has been investigated (case study reports are at www.globalbiopact.eu).

The results of these case studies are currently used for the identification of socio-economic sustainability indicators which could potentially be integrated into biofuel certification schemes. Furthermore, recommendations are currently elaborated on how to address socio-economic impacts in sustainability schemes as it has been requested by the European Commission in the Renewable Energy Directive (RED) for biofuels used in transport applications.

Satellite: Quickbird, 60cm

Image mode: true color

Acquisition Date: 25 May 2004

Spectral channels: 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © DigitalGlobe provided by European Space Imaging

Image processing: German Aerospace Center (DLR)



LEGACY OF DIFFERENT LAND USE HISTORY

Differences in agricultural practices between West-Germany and the former German Democratic Republic (GDR) clearly stand out in this Landsat image taken in September 1999. Even ten years after reunification the course of the former inner-German border is clearly marked by a different land-use pattern. In contrast to the small fields in western Germany, a relict of traditional division of land by inheritance, the fields in the east are much larger. Here, starting in the early 1950s, private farmholdings were expropriated by the then ruling communist party and re-organised into either state-owned farms or collective farms forming cooperatives with up to 4,000 to 5,000 hectares.

The image ranges from the city of Braunschweig in the north-west to Magdeburg at the Elbe River in the east and the Harz mountains at the bottom of the image.

Satellite: Landsat 7 ETM+, 15m

Acquisition Date: 4 September 1999

Image mode: true color

Spectral channels: 0,63-0,69 μm , 0,53-0,61 μm , 0,45-0,52 μm

Copyright: Satellite-data: © Global Landcover Facility

Image processing: German Aerospace Center (DLR)



AN OCEAN OF PLASTIC

One third of Spain is endangered by desertification. Bare soils in many parts of the country are exposed to erosion that will contribute to further soil degradation. Only irrigation systems in an otherwise semi-arid climate make intensive agriculture possible, as here in Almería, southern Spain. The plastic roofs of countless greenhouses become visible in bright white at the southern coast of the Mediterranean Sea approx. 20 km in the south of Almería. This area is called “El Mar de Plástico”, meaning “The plastic ocean”. It is the World’s largest greenhouse for vegetable and fruit production. By running this business, the poor Andalusian province of Almería has been converted into Europe’s most productive area for vegetable and fruit cultivation. However, the increasing depletion and salinisation of groundwater resources has forced farmers to invest in expensive, energy-intensive desalination plants. The image shows only a small fraction of the vast area under plastic around the small village of San Agustín.

Satellite: Terra (small image) – MODIS, 250 m; Ikonos, 1m

Acquisition Date: 28 May 2001 (small image); 21 September 2003

Image Mode: true color

Spectral channels: 0,62 – 0,67 μm , 0,55 – 0,57 μm , 0,46 – 0,48 μm (small image) 0,63 – 0,69 μm , 0,52 – 0,60 μm , 0,45 – 0,52 μm

Copyright: Satellite-data: © NASA (small image), European Space Imaging

Image processing: German Aerospace Center (DLR)



CITY AND PORT OF SINGAPORE

At a first glance, this picture seems to be an ordinary view on Singapore's downtown and harbour district. The three-dimensional impression in this extraordinary image is caused by typical effects of radar, called foreshortening and layover. Unlike optical satellites active radar, satellite systems send signals to the ground, listening to their echo. Returning signals are allocated to the fore- or background of the image according to their travel-time back to the satellite. But this assumption sometimes fails. In the case of steep mountains or high-rise buildings, the signal from the top of the object can reach the sensor earlier than that of its base and the object seems to be displaced or slightly distorted in the image causing a 3D-like effect. This image was acquired by the German Satellite TerraSAR-X. Due to its high resolution the satellite is even suited for the monitoring of cities. Although multiple reflections between the buildings make it difficult to interpret the images visually, the information about the travel-time of the signals allows to generate 3D-models, measuring movements within the range of millimetres or the accurate measuring of the speed of vehicles. Metallic or right-angled structures reflect well. Thus, the metallic containers in the docks and the high-rise buildings show up clearly in white.

Singapore is not only a major business and trade hub, but also plays an important role as a centre of education and research in the region. Since 2002 one of Germany's elite universities, the Technical University Munich (TUM) is present and active in Singapore through its subsidiary the German Institute of Science and Technology - TUM Asia. TUM Asia is involved in education and research, offering various undergraduate and postgraduate programmes mostly in cooperation with local institutions like the Singapore Institute of Technology (SIT), the National University of Singapore (NUS) and the Nanyang Technological University (NTU). Starting in mid-2010, TUM Asia is also actively involved in research, establishing a research centre on Electromobility in Megacities in cooperation with the National Research Foundation (NRF). This research centre is run by TUM Asia's subsidiary TUM CREATE. TUM Asia cooperates with various government agencies and industry partners. The DAAD supports TUM Asia by providing scholarships for outstanding students.

Satellite: TerraSAR-X high-resolution spotlight mode, 10m (resampled)

Image mode: grey-scale

Acquisition Date: 23 May 2010

Spectral channels: X-band

Copyright: Satellite-data: © German Aerospace Center

Image processing: German Aerospace Center (DLR)



ROTTERDAM TO BRUSSELS, CENTRAL EUROPE

Belgium and parts of the Netherlands, France and Germany (to the north, south and east) in spring 2001. This nearly cloud-free image mosaic shows an area of ca. 32.000 km². On the bottom of the image Brussels - seat of the European Commission and the administrative heart of Europe - can be seen. The centre of the image is dominated by the shape of the city and port of Rotterdam. Europe's busiest port is located at the Rhine River estuary. Data from earth observation satellites reveal the high population density in this area. Besides the agricultural landscape and the dense network of urban areas, huge dams in the north mark the "human footprint". The dams lying well below sea level are protecting large parts of the Netherlands.

Satellite: Landsat 5 TM, 30m

Acquisition Date: May 2001

Image mode: true color

Spectral channels: 0,76-0,90 μm , 0,63-0,69 μm , 0,52-0,60 μm

Copyright: Satellite-data: © Global Landcover Facility

Image processing: German Aerospace Center (DLR)

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