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Editorial

Guest-Editorial: 25 Years of Development to Improve Earth Observation and Processing of Geoinformation

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1 Scientific and Technical Frame Conditions

A quarter of a century ago, at the moment of the foundation of the EFTAS company, a real gap between the operational applications of airborne photogrammetry and spaceborne remote sensing existed due to several differences in technology and ground resolution. As in Central Europe the administrations of urbanism and environment used to work with maps at scales of 1:5,000 or larger, there was very little interest in ground sampling distances between 10 m and 30 m. Under to those general conditions at the end of the 80ies, the formation of a remote sensing company focussed on satellite maps and medium scale mapping of developing countries.

Nevertheless, the wider application of spaceborne Earth observation techniques helped to broaden the knowledge of our planet, sometimes characterized as the "third discovery of the Earth" (Komp et al. 2010). But in contrast to the first discovery of the Earth, based on point wise observations, now satellites allowed to map surfaces and their spatial relations. This offered a new quality of Earth observation by completing the overview mapping at the first stage and by starting refinements through better sensor systems later.

Different from single photogrammetric flight missions the permanently revolving satellites provide a huge number of repeated coverages with satellite images. This development marked the innovation step from status mapping to monitoring by Earth observation. This special quality of satellite remote sensing provides spatial knowledge beyond mapping, which is the evidence of changes in vegetation, urban sprawl etc. (Gerlinger 2012). This is finally the driving factor for technological and scientific development of geoinformatics and Earth observation, the need to monitor the manifold changes of our planet Earth.

2 Application Clusters and their Methodological Progresses

The development of the different fields of services of EFTAS can be described as clusters with changing dimensions over time and partially overlapping activities. One important complex of activities may be labelled as services for developing countries with overlaps to agriculture, forestry, land reform, natural, and mineral resources. Another important complex of activities is the monitoring of agriculture, partly related to the control of subsidies, geoinformatics for the management of land parcel information systems and partly related to changing environmental conditions.

The third cluster is grouped around the transition of computer assisted photo interpretation (CAPI) towards automated processing of change detection in digital 3D modelling of landscape structures and urban models. Overlapping to this, another cluster of environmental monitoring is formed by aspects of landscape changes, primarily the Natura 2000 requirements including GIS developments for tourism. Many of the methodological approaches of the clusters above reach into the last one, which focuses on monitoring of mining areas and their post mining impacts on the environment.

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2.1 *Services for developing Countries*

Right from the beginning of the young remote sensing company, EFTAS had a strong focus on developing countries following the challenges of the tropical forest action programme, the needs for vegetation mapping in Africa and mapping of urban sprawl for the extension of water supply networks like in Nigeria or in South-Yemen. With the detection, mapping and validation of the agricultural potentials of three provinces of Syria, EFTAS completed a sound contribution to the rural development in the early 90ies.

Besides such services, the experts of EFTAS contributed to the development policy of the German government to provide training for self-guided sustainability: Training of local personnel and project progress reviews were performed in North-Yemen, Syria, Zimbabwe, India, Benin, Sudan, Ethiopia, Mozambique and Kenya. On the other hand, many partners from India, Benin, Sudan, Mauretania and Mali were trained in Germany. Those broad experiences lead to an expert opinion to the report of the German Government on the potentials of Earth observation for developing countries (Komp et al. 2010, Gerlinger 2012).

After more than six years of commitment to the Ministry of Agriculture of the Sudan, a summary of technological transfer is given by Haub et al. under the title *Monitoring Services for Food Security – Successful Transfer of Technology to the Sudanese Government*. In this paper the authors demonstrate the aspects of the combination of various ground resolutions of satellites in conjunction with agronomic sampling for the government consultations.

2.2 *Monitoring of Agriculture*

In 1987 the European Commission started the so called regional inventories in preparation for the MARS-Project (monitoring agriculture by remote sensing) which was meant to transfer remote sensing applications from the American agricultural management to European small and medium scale agricultural holdings. After the development of methods by the Joint Research Centre in Ispra, Italy, and the creation of the legal framework by the regulation of 1992 the first operational control of agricultural applications for subsidies started in 1994. EFTAS became very soon an important and competent partner for the implementation of the EU-requirements to the national administrative systems, recognising the company's competence by its agricultural engineers and remote sensing specialists.

Though in the beginning the "Integrated Administrative Control System" (IACS) focussed on the control of crops of different subsidy rates including the control of set aside parcels, the Common Agricultural Policy of the European Union (CAP) changed several times in the last two decades. The present CAP-Reform will introduce revised requirements for the farmers and for the administrative implementation in the period after 2013. The article of Büker & Lettau titled *The Reform of the Common Agriculture Policy – Potentials and Limits of Remote Sensing Controls* demonstrates that EFTAS is well prepared to fulfil the new challenges.

Since 2002 EFTAS is active as a main contractor to create, update and maintain the agricultural GIS comprising the central application software for the German Federal State of Hessen. This also includes a yearly preparation of personalized application documents for each farmer and the compilation of on-the-spot-check documents for the administration. After this initial cooperation with the Hessian Ministry of Agriculture, the European requirements have been refined. Now there is a three years cycle mandatory to maintain and update a Land Parcel Information System (LPIS) which is the common instrument for farmers and the administration. Meanwhile, EFTAS has served several German administrations to fulfil their obligations for a regular update of their LPIS.

Furthermore, EFTAS is also increasingly involved in agricultural monitoring tasks under different climatic conditions. Besides the mentioned projects for food security in Sudan, Ethiopia and Mozambique, an R&D project to monitor the rubber cultivation in the Mekong delta (SURUMER) and a joint German-Russian project to monitor the effects of global warming on the agriculture in the Western Siberian Corn Belt (SASCHA) are worth mentioning.

2.3 *Automation and 3D-Modelling in Photogrammetry*

Starting from 1990, EFTAS has been actively involved in land cover mapping from satellites for different telecommunication providers in Europe and China. While in the beginning satellite imagery was seen as a sufficient 2D-base for calculating the antenna locations, the development of mobile communication very soon resulted in the photogrammetric measurement of 3D city models.

As often, soon after the mapping task met the demanded quality level an automation of the production process was required. This also applied to the initial mapping and the following update of land cover data under the Corine Land Cover programme of the EU. EFTAS has been involved in this programme since the 90ies including the preliminary R&D projects. One important of them was called DeCOVER (DeCOVER 2013), of which EFTAS managed the coordination of up to nine partners from industry and universities.

The sealing of the soil surface is acknowledged as an important issue on ground water renewal, soil-air-exchange and local flooding risk. Several attempts were published to map the sealed surface by remote sensing. While for environmental studies satellite images provide a first overview, local tax authorities required reliable measurements related to the cadastral boundaries to impose local taxes on sealed surfaces. These requirements were mostly fulfilled by photogrammetric measurement from aerial stereo images with typical ground sampling distances of 4 cm to 8 cm. The article of Rössmann et al. *Application of Change Detection Methods for the Update of GIS Data on Sealed Surfaces and Buildings* describes an automated approach for a change detection based on up-to-date aerial ortho images combined with a normalized elevation model.

2.4 *Environmental Monitoring*

During the life of EFTAS, environmental monitoring has been a topic of constant importance, of course adapting itself to the changing requirements of the European and the national environmental policies. The mapping of biotope habitats and natural protection zones have been processed successfully by using high resolution satellite images, colour infrared aerial images or later even VHR (very high resolution) satellite images. The federal states of Bavaria and Schleswig-Holstein played a precursor role when implementing Earth observation into their administrative practises. The Dutch agency *Rijkswaterstaat*, a department of the *Ministry of Infrastructure and the Environment* demanded several times the 3D-inventory of the whole flood plains of all major rivers in the Netherlands, which over the time provides a valuable multi temporal GIS data base for flooding preparedness, environmental development and wetland studies of which the title page may illustrate the potentials.

Related to the European Council Directive 92/43/EEC on the *Conservation of natural habitats and of wild fauna and flora* the obligation exists to report in a six years period on the actual favourable conservation status. This has been done under the general management of EFTAS from 2007 to 2012 for the entire federal state of Schleswig-Holstein. As the traditional repartition of ground inspections and Earth observation will hardly be financed in the future, there are several attempts to assure the obligations of the directive by a larger proportion of remote sensing methods. The development project of new approaches has been accepted as an FP7 project of *Multi-Scale Service for Monitoring Natura 2000 Habitats of European Community Interest* (MS.MONINA). The approach and first results are reported in the article of Buck et al. *Image Analysis Methods to Monitor Natura 2000 Habitats at Regional Scales – the MS.MONINA State Service Example in Schleswig-Holstein, Germany.* The European Commission has already started in 1992 the survey of area frame samplings throughout the twelve European member states for statistical purposes and for monitoring the dynamics of the land use and the environment. Until 2001 EFTAS provided repeated surveys for Germany, Austria and Denmark. The broader follow-up project called LUCAS was inaugurated under the direction of EUROSTAT. While in 2001 and 2003 the survey activities of EFTAS covered

Germany only, the following repetitions were extended regarding the number of member states and the items to be surveyed. The contribution of Haub et al. *Surveying European Landscape Dynamics* reports on the most recent survey of 2012 in which EFTAS carried out services or was the general contractor for 14 member states.

The present trends in geographic information are characterized by a development towards diversified information sources and a "transition" of professional themes to the broad public by means of mobile navigation, location based services, and ubiquitous technologies like smart phones. The European co-funded project *Eco tourism for Natura 2000 – Communicating environmental topics using Geoinformation technologies* offers a fascinating outlook onto future fields of our profession.

2.5 *Monitoring of Mining Impacts*

From the beginning of Earth observation the inventory of natural resources, especially mineral resources, has been an important field of application. EFTAS has contributed in the 90ies to detect circular geological structures in the pre-cambric formation of the "Birrimien" forming a belt from the Senegal River to the Niger River which indicate eroded intrusive bodies, potential primary deposits of e.g. gold, zirconium, and copper. After works in Niger, Senegal, Burkina Faso, and Mali, EFTAS also performed mapping of recent mining districts for industrial purposes in African and South American sites. Actual mining activities in central Europe concentrate on salt deposits and lignite coal while the traditional shaft coal mining in Germany will reach its political end by 2018. Therefore, the persistent impacts of abandoned mines will gain importance. García Millán et al. are investigating remote sensing potentials in the project *GMES4Mining – Description of a Flooding Process in Mining Areas using spectral Indices on multi-temporal Landsat Imagery* which is co-financed by the European Union and North-Rhine Westphalia.

3 The Position of EFTAS in the European EO-Community

The 27th September 1988, now 25 years ago, marks the official date of the formation of EFTAS and its legal registration. Starting with three people, the company has grown and reached 60 employees as an annual average today. Remote sensing, geographic information and photogrammetry have undergone many technical development steps and even a paradigm change. An intermediate appreciation can be found in Komp (2008). While in the 80ies in Central Europe photogrammetry still struggled to prove that its accuracy and completeness could cope with terrestrial surveying, the coarse ground resolution of satellite images did not seem to be competitive for practical applications. Unfortunately, some advertisements exaggerated the potential of satellite imagery. For instance, it was claimed that a ground sampling distance of a few metres is sufficient for the planning of high speed railway lines. This confusion gave room to institutions and companies which could clearly communicate the border line between applicable services and unproven results of on-going research.

EFTAS was soon recognized in the EO (earth observation) community at the national and the European level for its highly qualified experts in their respective professions like geographers, photogrammetrists, agronomists, environmental engineers, geologists, surveyors and remote sensing engineers. At the doorstep to the next 25 years EFTAS is still an owner managed small and medium company (SME) which not only offers reliable services in the operational sphere but also contributes with the experience and intellectual skills of its team to R&D challenges in GIS and Earth observation.

4 Innovation and Improvement as a persisting Challenge

As the time span of 25 years is rather important in an individual professional period the life time of a company has to aim at intergenerational persistence to meet every challeng-

es occurring from the market, the politics, the technological and scientific progress.

Germany as a country without natural resources of economic or political relevance has its only chance to rely on its intellectual resources, on its potential of scientific and technical innovation and on the not yet fully developed field of geographic information as a resource of the information society. Based on this general appraisal we need to scale down the action guidelines for the survival and the prospects of an SME. Currently our profession of GIS and EO experiences a bundle of changes and new developments. Between the existing sensor platforms from ground, air and space there are dozens of small unmanned aerial vehicles (UAV), operating or being under development. They will not open EO for "everyone" but will foster rethinking of the current practises and theories of photogrammetric calibration, triangulation and geo-referencing. New industrial offers like the data bases of ESRI, cloud computing and ubiquitous availability of hand held information devices will change business models, customer relations and work flows.

EFTAS is well prepared to go ahead towards the new challenges through our team which is constantly trained to use its force for innovation as the main resource for the forthcoming decades.

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Die Rückschau auf 25 Jahre EFTAS wird durch drei herausragende Beiträge der diesjährigen DGPF-Jahrestagung in Freiburg ergänzt.

Karsten Jacobsen (Hannover) gibt uns einen Statusbericht zu den hochauflösenden zivilen Satellitensystemen und zu deren Verwendbarkeit zur Erzeugung digitaler Höhenmodelle.

Michael Cramer et al. (Stuttgart) erläutern sehr präzise ihre Pilotstudie, der ersten bundesweit, zum Einsatz kamerabestückter unbemannter Fluggeräte in der Landesvermessung, konkret bei der Flurneuordnung in Baden-Württemberg.

Wolfgang Brandenburger et al. (München und Euskirchen) schließlich zeigen uns einen weiteren Entwicklungsschritt zur automatischen Erzeugung realitätsnaher digitaler Stadtmodelle. Sie zeigen, wie in Bildern Fensterverdachungen erkannt und vermessen werden können.

The review of 25 years of EFTAS is amended by three outstanding contributions to the annual German conference of DGPF in Freiburg. Karsten Jacobsen (Hannover) reports on the status of the very high resolution civil satellite systems and their use for digital elevation models. Michael Cramer et al. (Stuttgart) present a pilot-project which demonstrates the first successful application of UAVs within the German land survey administration, i.e. in land consolidation. Wolfgang Brandenburger et al. (München and Euskirchen) show a next step towards an automatic generation of lively city models – an automatic detection and survey of cornices.

Wolfgang Kresse