APPLICATION-TAILORED MAPPING AND MONITORING WITH HIGH RESOLUTION SPACEBORNE IMAGERY, USING AN INTERDISCIPLINARY CONNECTED COMPUTER NETWORK

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ABSTRACT:

The beginning of 1996 marks the start of the Austrian remote sensing project MISSION, involving most of the country's remote sensing experts and several possible user institutions. This project is going to use high resolution optical data from the MOMS-02 sensor on the German-Russian "Priroda"-mission in 1996/97. This sensor is the first of a new generation of high resolution optical sensors, which are expected to serve applications which until now were restricted to aerial imagery. Therefore, close cooperation between scientists and user experts will develop new relevant methods and products in an interdisciplinary environment. Supplementing the improved data-quality, the recent boost in network-technology adds a second new aspect to give the project a new dimension. Therefore, the networking-aspect is an important issue and will be used for advanced communication, data-browsing and retrieval as well as for establishing distributed databases and computing. By the project described, the Austrian remote sensing community is expected to enter a new era of user-support and data-integration.

1. REMOTE SENSING APPLICATIONS IN AUSTRIA

Remote sensing with spaceborne sensors started in Austria some 20 years ago at several research-institutions. Up to now they have acquired a high scientific standard on various kinds of land-applications. Still, in many cases introducing operational environmental mapping and monitoring failed, because possible users complained about the lack of detail with remote sensing sensors compared to aerial photography. Although in many cases the sub-meter resolution of aerial images is not necessary, the so far optimum 10m-pixelsize appeared to insufficient.

Thus, a fatal deadlock has prevented possible applications: On the one hand, despite their acknowledged operational merits, spaceborne data suffer from poor spatial resolution, while on the other limited acquisition capacity and high costs does prevent using aerial images (Kalliany,1995).

High resolution Russian spaceborne images appearing on the market by end of the eighties (Sirkiä and Laiho,1985) and - in specific for Austria - during the AUSTROMIR-mission in 1991 (Kalliany,1992; Kalliany et al.,1992) were a considerable step forward in terms of spatial resolution. However, usually just single takes from an arbitrary date are available and therefore at present state these products hardly are apt for operational monitoring.

With the expected advent of high resolution spaceborne digital sensors, this deadlock is going to be solved. While reportedly there also are several commercial plans in the USA for the very next years (Treadwell,1995; Fritz,1996), in 1996 the German/Russian MOMS-02/Priroda project will launch the first civil digital optical sensor with a resolution better than 10m (Zimmermann,1995; Bodechtel et al.,1994).

2. MOMS-2/PRIRODA BASED PROJECT "MISSION"

2.1 Basic concept

For assessing as early as possible the new technical and operational possibilities offered by high resolution optical sensors, an Austrian group of remote sensing experts has set up the interdisciplinary project MISSION (**M**ulti-**I**mage **S**ynergistic **S**atellite **I**nformation for the **O**bservation of **N**ature). It is based primary on MOMS-02/Priroda imagery from the MIR space station, offering a pixelsize of up to 6m, supplemented by 4 multispectral channels and inflight stereo capabilities (Seige,1995).

The Austrian MISSION-project is consisting of 8 tasks. Each is lead by a research body or similar organization, who will work in close cooperation with a partner-institution. Contrary to some previous remote sensing studies, where - according to their own views and results - researchers were tempted to define themselves what the user needs, for MISSION the close cooperation is the definitive goal. The researchers are bound to tailor their investigations and products to the actual requirements of an application.

The applications partners in MISSION typically are federal or provincial administrative bodies, responsible for certain tasks in mapping, regional planning or environmental monitoring and management. By this specific programme, they get an opportunity to find out if the latest sensors and methodologies fulfill (at least parts of) their requirements. MISSION also ia a forum to find solutions to specific problems in an interdisciplinary manner. Therefore, it is to be expected that the application partners will adopt major parts of the methods and products developed by MISSION, to incorporate them into their regular proceedings.

2.2 MISSION Tasks

2.2.1 Datapool: Implementation of a network-based provision of information and dissemination of data amongst all MISSION participant, under responsibility of Institute of Computer Graphics at Graz University of Technology. Most important partner is the topographic division of the Austrian Federal Mapping Agency, providing major parts of their digital database. More on concept and goals: See 3.

2.2.2 Biotop Mapping: Locating and classification of species of botanic communities, in specific in mountainous regions. Performed by Institute of Digital Image Processing at Joanneum Research in Graz, supported by Institute of Spatial Information Processing at the Austrian Academy of sciences and a botanist at Graz University. Partners are the environmental department of the provincial government of Styria and the Federal Environmental Agency (Vienna).

2.2.3 Landuse Mapping: Assessment and monitoring of actual landuse in urban and rural areas. The division for Environmental Planning at the Austrian Research Centre Seibersdorf (in cooperation with TU Vienna) will provide the required data to the regional planning section of the provincial government in Upper Austria.

2.2.4 Forestry: The capabilities of high resolution spaceborne for acquisition of forest-relevant primary data will be compared to methods based on aerial photography. This task is lead by the Institute of Geodesy, Remote Sensing and Geoinformation at the University of Agriculture in Vienna, in cooperation with a consultant office. The Forest Research Agency of the Federal Ministry of Agriculture will use the data for their forest inventories.

2.2.5 Hydrology: Prediction of water-runoff from monitoring snow and glaciers in a high mountain area. Specialists from the Institute of Meteorology at Innsbruck University will use optical and SAR-data of a testsite in the Zillertal (Tyrol). In addition to the local water power plants (providing terrestrial measurements), the research section of the National Energy Suppliers is partner in this task.

2.2.6 Topographic Mapping: Acquisition of topographic data from MOMS-02-data. The Institute of Photogrammetry and Remote Sensing at Vienna University of Technology (in cooperation with the Seibersdorf Research Centre) will provide spaceborne data to the Federal Mapping Agency, which is looking for means of data acquisition alternative to and supplementig traditional photogrammetric methods.

2.2.7 Environmental Monitoring: Thematic mapping of alpine pastures and forest-structures in a High Mountain National Park. This work is performed by Geospace Ltd. (Salzburg), cooperating with the "Nationalpark Hohe Tauern" management, responsible for the surroundings of Grossglockner, the highest peak of the Austrian Alps.

2.2.8 Geology and Micro-Tectonics: Mapping details of micro-tectonical features close to the surface for supporting geophysical and hydrological investigations. This task is performed on an equal basis by the Federal Geological Agency and Arsenal Research Centre, located in Vienna.

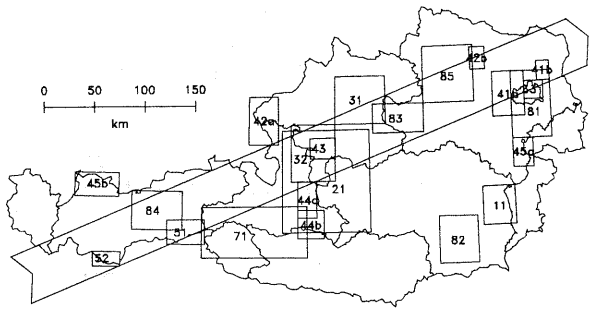

Fig 1: Planned targets and possible coverage with high resolution (6m) MOMS-02-data at one pass of MIR

2.3 Temporal Aspects

As by now (March 1996), the launches as well of the Priroda-module which will house the MOMS-sensor, as of the sensor itself on board of a Progress supply ship are scheduled for the very weeks to come. First imagery from the sensor are expected for the summer months, with the regular operation starting in early autumn. The full amount of data is expected not before 1997, where the major results will be obtained. Since MISSION is scheduled for two years, it will end by early 1998. Still, as the space segment might continue operation, some of the tasks may be prolonged, based on alternative funding.

2.4 Cooperative Aspects

From the breakdown in 2.2, the interdisciplinary composition of the MISSION-group is apparent. It is expected that this structure will lead to additional cross-links, as well as to sharing and exchange of value-added products. Since most topics are within the field of environmental monitoring, there is an apparent need for multitemporal, multispectral and multisensoral data. Another key issue is the exploitation and regular updating of databases which already are existing at the users.

As mentioned before, 1996 will provide some test-images, but not yet the full amount of data which is necessary in specific for multitemporal studies. Therefore, the 1st year is dedicated to preparations by establishing links amongst all partners within and across the tasks involved:

Hard- and software-level:
- Defining formats and media for data-exchange;
- exchange of methods and software;
- establishing network-based data-links.

Data level:
- Exchanging and explaining structure and contents of the datasets used by the partners as by now;
- generating simulated satellite-data and products;
- investigating primary data acquired already in 1996;
- ordering and assessing remote sensing data to supplement or possibly replace MOMS-imagery.

Human level:
- Understanding each other's "language";
- communicating expecatations, goals and problems;
- discussing possibilities and limitations of simulated and future data or derived value added products.

3. THE NETWORKING ISSUE

Participants of MISSION will work with similar datasets, at least in respect to MOMS-02/Priroda imagery. They also may use in common derived products like geocoded data, digital elevation models or existing geo-databases. Results from one group may as well be relevant for another one. There is a strong demand for information, data distribution and exchange. These issues have a strong networking component, which is to be covered by the Datapool task.

Datapool neither is a very specifically tailored information-facility as ISIS by DLR (Strunz and Lotz-Iwen, 1994) nor just a general framework for project management issues. Model and motivation for our plans are the current efforts of the European Commission launching the Centre for Earth Observation CEO (Churchill,1995). Our goal is to establish within MISSION a strong Austrian branch of the CEO, where most important institutions are contained.

3.1 CEO as a Model

By 1995, the CEO ended its "Pathfinder Phase". Based on applications studies, now the design is to be implemented. Contrary to its name, CEO is to be a loose organized decentralized network, which is expected to stimulate the market for remote sensing data by supporting the provision of new products and services. There are no intentions of establishing new hierarchies, but the system shall be as open and flexible as possible. Informations, data and services may live and develop on their own, independent of central organizations and facilities. However, CEO will edit recommendations for data-quality, terms of advertizing services etc., which are expected to be acknowledged by data-providers, customers and researchers as well.

According to this model and the specific requirements of MISSION, the framework to be set up has several goals:

3.2 Planned Services

3.2.1 Organisatorial issues:

- Project-coordination for MISSION;
- contacting German organizations DARA and DLR, for acquisition-planning and data-dissemination;
- organization of project meetings twice a year;
- compilation of project reports and documentation;
- public relations issues (employing various media).

3.2.2 Implementations:

- Establishing Hyper-G-based communication and data-dissemination within the project;
- providing simulated optical data (see Fig.2);
- exploiting high performance transfer capabilities using ATM (Walcher and Rehatschek,1995);
- organization of decentralized preprocessing (e.g. geocoding) within the MISSION-participants;
- developing JAVA-based query- and retrieval-tools;
- links among the partners to implement a distributed database within the MISSION-group;
- establishing the core of a CEO-oriented Austrian group of remote sensing scientists, providers and applications-oriented users.

3.2.3 Network-based services:

- Original image-data (e.g. from MOMS-02/Priroda or other satellites);
- preprocessed data (e.g. geocoded or radiometrically corrected);
- existing topographic databases provided by participants (e.g. DEM data);
- optional controlled disstribution of remote sensing images and other data (for copyright reasons);
- products and results made available by individual partners (e.g. landuse data);
- provide project- and product-information to the scientific community and the public on the net.

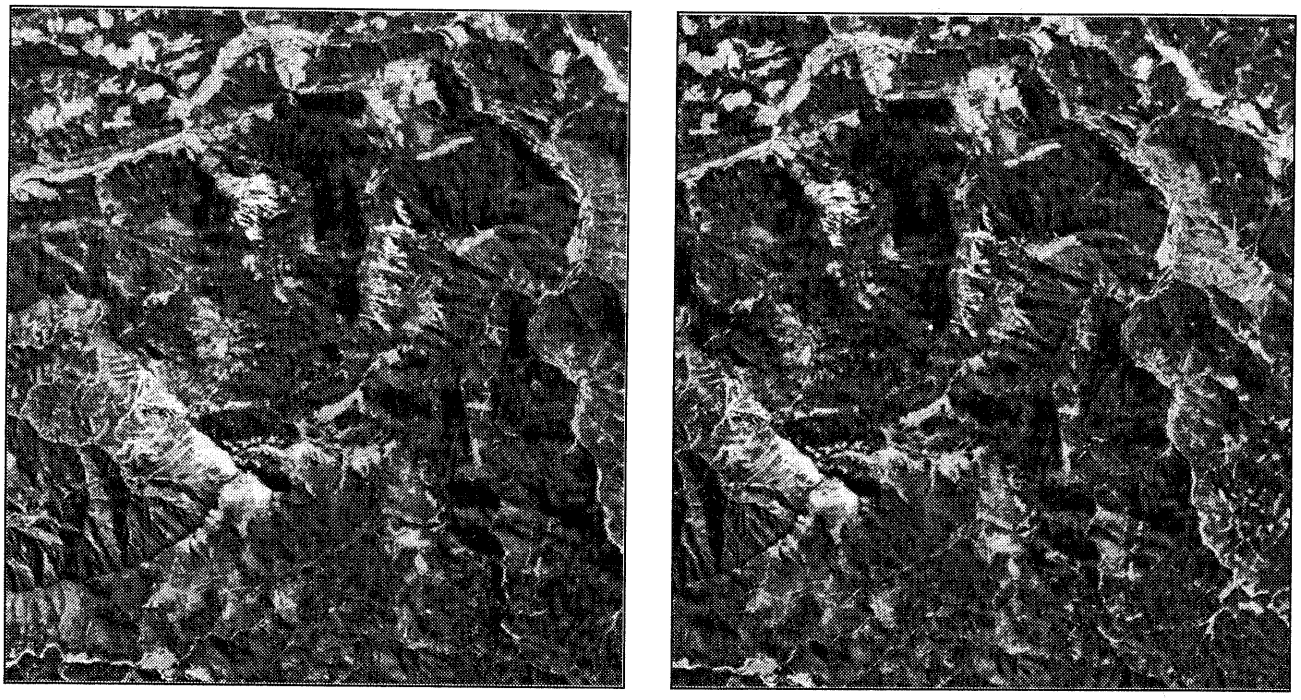

Fig.2: Simulation of Stereo-MOMS data by digitized KFA-1000 imagery (Oetscher region, Lower Austria).

4. OUTLOOK

Within the MISSION-project, Austrian remote sensing will get an important boost towards new applications, thus approaching new user groups. This expectation is based on the three major aspects to be exploited by MISSION:

- Employment of new high resolution optical sensors;
- Interdisciplinary and applications-oriented approach;
- New possibilities offered by computer-networks and a related new generation of software-tools.

In the near future, within Europe access to transnational networks like CEO will be a prerequisite for working with remote sensing data. This is especially important for the participation in international and interdisciplinary projects, be it on scientific or commercial basis (Leberl and Kalliany, 1995). In cooperation with the project partners, the Datapool task will combine operational needs of MISSION for information, data-management and distribution with the establishment of CEO-compatible structures.

Since most Austrian research institutes on remote sensing as well as a number of important users are involved in MISSION, the Austrian community will make a big step forward towards international collaboration based on up-to-date high performance communication systems.

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