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# **Gamma Remote Sensing AG**

## **ANNUAL REPORT 2001**

### **RESEARCH AND DEVELOPMENT**

#### **EC Project ERA-ORA (Jun. 1998 – May 2001)**

ERA-ORA was a forum of remote sensing specialists to support each others research activities with data and models supported by the EC Environment and Climate Programme, Framework 4, as a Concerted Action.

#### **KTI – CIRSTEN (Oct. 1999 – Dec. 2001)**

The KTI project Combined Remote Sensing Natural Monitoring, CIRSTEN, was a cooperation between the Institute of Geodesy and Photogrammetry of the ETH Zürich and GAMMA to combine the potential of optical and SAR EO data for mapping applications, in particular the mapping of natural hazards, with GAMMA's main focus on SAR based applications.

#### **ESA – GSTP (Sep. 2000 – 2002)**

The ESA GSTP Study on Multi-Sensor and Interferometric Retrieval Techniques study is done in cooperation with Joanneum Research, Graz, and the University of Innsbruck. In the frame of this two years project GAMMA investigates the potential of remote sensing, and in particular SAR, to map natural hazard events, including forest storm damage, flooding, and avalanches.

#### **ESA – TESEO Carbon (Aug. 2001 – 2002)**

In the frame of ESA's programme TESEO (Treaty enforcement services using Earth Observation) a project for the development of carbon monitoring services related to the implementation of the Kyoto Treaty, was successfully proposed by a team lead by VTT-Automation, Finland, with the European Forest Institute (EFI), Stora Enso, Finland, and GAMMA as partners. A project duration of 16 months is planned. GAMMA's responsibilities are to review the potential of existing and near future SAR techniques and sensors and to propose, implement, and demonstrate Kyoto related services.

#### **ESA – DUP – Subsidence (Sep. 2000 – May 2001)**

In the frame of the Data User Programme (DUP) project Differential Interferometric Applications in Urban Areas GAMMA developed and demonstrated SAR interferometric deformation mapping services. The focus of this phase was on the oil and mining sectors with specific potential users being involved to evaluate the proposed services and products. At the same time the application became more robust and operational.

### **ESA – DUP – Call in 2001**

Four proposals with GAMMA participation were accepted in 2001 in the frame of ESA's Data User Programme (DUP). The projects started in November 2001:

- VENEZIA: land subsidence monitoring service in the lagoon of Venice for regional and administrative authorities. This small service project is lead by GAMMA with CNR-ISDGM, Venice, Italy as project partner and will last for two years.
- ALPS: Alpine landslide periodical survey. This service definition project is lead by GAMMA and will last for six months.
- GLASNOWMAP: Glacier motion and snow water run-off monitoring service. This small service project is lead by Carlo Gavazzi Space, Milano, Italy with CNR-IREA, Milano, Italy, and GAMMA as project partners and will last for two years. GAMMA's role will be to determine the wet snow extent and the glacier equilibrium line based on SAR data.
- ALPSLOPE: Monitoring of unstable slopes in the Italian Alps based on Remote Sensing. This small service project is lead by Teledata Geoconsult GmbH, Bozen, Italy, with GAMMA as project partner and will last for 18 months. GAMMA's role will be the slope creeping identification and mapping with differential SAR interferometry.

### **ESA – EOMD – Subsidence (Nov. 2000 – Oct. 2001)**

The objective of ESA's Earth Observation Market Development (EOMD) element is to enable ESA and industry to respond jointly to market demands and new opportunities. GAMMA's short term activity Geophysical Surface Deformation Mapping Service concentrated on the integration of new commercial EO products and services and on strengthening GAMMA's market position. The German coal-mining company DSK and the Italian Oil&Gas Company ENI-Agip acted as interested end-users. DSK also contributed financially to this activity. Furthermore, DSK purchased a first fully commercial service from GAMMA in mid 2001, confirming GAMMA's readiness to provide related commercial services and products.

### **ESA – EOMD – UNOSAT (Nov. 2001 – 2004)**

The UNOSAT project to address thematic mapping for humanitarian aid and international development was accepted by ESA as a long term market development activity under the Earth Observation Market Development (EOMD) element. The UNOSAT project is lead by the United Nations Office for Projects Services (UNOPS), Geneva, Switzerland. Project partners are Spot Image, Toulouse, France, Digitech, Bagneux, France, UNITAR, Geneva, Switzerland, and GAMMA. GAMMA acts as SAR specialist of the team.

### **Infoterra/TerraSAR Service Definition Study (2001)**

As sub-contractor of Infoterra – ASTRIUM, GAMMA contributed to the Infoterra/TerraSAR service definition study for ESA ESRIN by covering the urban subsidence application.

## **PRODUCTS AND SERVICES**

### **Coherence Product**

The Coherence Product is a standard data product based on ERS Tandem coherence and backscattering coefficients developed by Spot Image (<http://www.spotimge.fr>) and GAMMA as a valuable source of SAR based information for non-SAR-specialists. The Coherence Product is produced by GAMMA and is offered in different image geometries. Data and documentation are in DIMAP format using XML and GEOTIFF files.

In mid 2000 ERS-1 ceased operation after nine years. This development prevents new acquisitions for production of the Coherence Product. However the Coherence Product continues to have a huge potential thanks to the large archive of ERS Tandem acquisitions.

### **Disaster mapping**

In 2001 GAMMA mapped a flood event in the upper Mekong river delta.

### **Interferometric DEMs**

Interferometric DEMs were generated using ERS and JERS interferometry.

### **Interferometric Deformation Maps**

Land surface deformation maps were generated using ERS and JERS differential interferometry, with first commercial sales being realized in the private (mining-sector, oil&gas) as well as public (institutes and authorities responsible for the monitoring of subsidence) sectors.

### **Consulting**

GAMMA's consulting activity included SAR and interferometric processing related aspects, application development support, and radar system engineering.

## **GAMMA SOFTWARE**

In 2001 GAMMA continued to provide licenses for its user-friendly and high quality software to support the entire processing from SAR raw data to products such as digital elevation models, deformation, and landuse maps. The software consists of the Modular SAR Processor (MSP), Interferometric SAR Processor (ISP), Differential Interferometry and Geocoding (DIFF&GEO), and Land Application Tools (LAT).

### **Developments**

Recent software developments include: radiometric calibration and direct geocoding of ground-range images (PRI), additional rasterfile generation programs (ras8\_float, ras24\_float) for multi-dataset display with high flexibility, ERS and JERS processing with secondary range migration, support different layover/shadow modes in terrain corrected geocoding, better interpolation and efficiency increase for forward geocoding and lookup table inversion.

A new phase unwrapping algorithm based on Delaunay Triangulation to support unwrapping of disconnected areas of high coherence and a Minimum Cost Flow algorithm for global optimization of the phase unwrapping solution was implemented in 2001. The new algorithm was already successfully applied internally at GAMMA and will be integrated into the ISP in 2002.

### **Sales activity**

Sales activities were continued with new licenses sold in Europe, USA, and Japan. User contacts indicate that our competent support is an important feature of our software. This is also confirmed by an increasing number of running maintenance contracts. On several occasions the software was presented to potential customers.

### **VARIA**

Tazio Strozzi of GAMMA returned from the University of Wales, Swansea, where he worked part time for a project of the University and part time for GAMMA. His research at Swansea focused on glacier velocity monitoring with interferometry and lead to very exciting results.

GAMMA has ongoing projects selected through Announcements of Opportunity to conduct ERS, ENVISAT, JERS, ALOS, and SRTM research and development projects.

### **PUBLICATIONS**

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