Dr. Urs Wegmüller
(+41-31-951 70 05

Gamma Remote Sensing AG

ANNUAL REPORT 2002

RESEARCH AND DEVELOPMENT

SIBERIA-II : Multi-sensor concepts for greenhouse gas accounting of northern Eurasia

In January 2002 the Project SIBERIA-II: Multi-sensor concepts for greenhouse gas accounting of northern Eurasia, started. SIBERIA-II is a project in the frame of the EC Environment and Climate Programme, Framework 5, CEO. GAMMA's part is supported by the Swiss Federal Office for Science and Education. The overall objective of SIBERIA-II is to demonstrate the viability of full carbon accounting (including greenhouse gases (GHGs): CO2, CO, CH4, N2O, NOx) on a regional basis using the environmental tools and systems available to us today and in the near future. The region under study is Northern Eurasia, covering an area of 200 million ha and representing a significant part of the Earth's boreal biome which plays a critical role in global climate. The tools and systems to be employed include a selected yet spectrally and temporally diverse set of multi-sensor Earth Observation instruments, detailed existing databases of field information and some of the worlds most advanced climate models to account for fluxes between land and atmosphere.

ESA – GSTP (Sep. 2000 – Oct. 2002)

The ESA GSTP Study on Multi-Sensor and Interferometric Retrieval Techniques study done in cooperation with Joanneum Research, Graz, and the University of Innsbruck was finalized in 2002. In the frame of this two years project GAMMA investigated the potential of remote sensing, and in particular SAR, to map natural hazard events, including forest storm damage, flooding, and avalanches.

ESA - CALL FOR INNOVATIVE TECHNOLOGY PROPOSALS - GEO (2002)

The development of a stand-alone SAR geocoding and image registration software is supported in the frame of an ESA contract. In the frame of the development elements which were already available in GAMMA software were used to develop a stand-alone SAR geocoding and image registration software module which is called GEO and which is fully compatible with other GAMMA software. The development also included adaptation to ENVISAT ASAR data and in depth testing and validation of the software. The project will be finalized in late 2002.

ESA – TESEO Carbon (Aug. 2001 – 2002)

This ESA TESEO (Treaty enforcement services using Earth Observation) project addresses the development of carbon monitoring services related to the implementation of the Kyoto Treaty. The project team is lead by VTT-Automation, Finland, with the European Forest Institute (EFI), Stora Enso, and GAMMA as partners. GAMMA's responsibilities are to review the potential of SAR and to propose, implement, and demonstrate Kyoto related services.

ESA – DUP – VENEZIA (Nov. 2001 –2003)

The project VENEZIA: land subsidence monitoring service in the lagoon of Venice for regional and administrative authorities is a small service project in the frame of ESA's Data User Programme (DUP). VENEZIA is lead by GAMMA with CNR-ISDGM, Venice, Italy as project partner and will last for two years. The responsibility of GAMMA includes the setting up of land surface deformation services based on conventional differential interferometry as well as on interferometric point target analysis (IPTA).

ESA – DUP – ALPS (Nov. 2001 – 2002)

The project ALPS: Alpine landslide periodical survey is a service definition in the frame of ESA's Data User Programme (DUP). ALPS was lead by GAMMA and was completed in 2002. In late 2002 ESA will issue a call for a larger project to implement related services. GAMMA intends to be part of a proposal to this call.

ESA – DUP – GLASNOWMAP (Nov. 2001 –2003)

The project GLASNOWMAP: Glacier and snow monitoring service is a small service project in the frame of ESA's Data User Programme (DUP). GLASNOWMAP 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 is to support the definition and implementation of services for the monitoring of snowcover extent, water run-off, and glacier extent with SAR data.

ESA – DUP – ALPSLOPE (Nov. 2001 –2003)

The project ALPSLOPE: Monitoring of unstable slopes in the Italian Alps based on Remote Sensing is a small service project in the frame of ESA's Data User Programme (DUP). ALPSLOPE is lead by Teledata Geoconsult GmbH, Bozen, Italy, with GAMMA as project partner. Failure of the ERS-2 gyroscopes and related unavailability of adequate SAR data for interferometry for 2002 due to non-overlapping azimuth spectra is causing a significant problem to the project. The strategy is now to demonstrate the service to the users based on historic ERS data and then to use ENVISAT ASAR data to continue the service into the future.

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

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

ESA – DUP – SKYPROV (Nov. 2002 –2003)

The project SKYPROV: Services for the Kyoto protocol verification is a service implementation project in the frame of ESA's Data User Programme (DUP). This project under the lead of INTECS, Italy, intends to build several nation-wide services of specific benefit to actors involved in the reporting for the Kyoto Protocol or in trading resulting from the Protocol. GAMMA is involved in the project as SAR specialist concerning the services of interest.

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 preventing new Tandem acquisitions. However the Coherence Product continues to have a huge potential thanks to the large archive of ERS Tandem acquisitions.

Disaster mapping

In 2002 hazard maps related to flooding, storm damage avalanches were generated.

Interferometric DEMs

Interferometric DEMs were generated using ERS and JERS interferometry. Furthermore development of DEM generation with radargrammetry was started in expectation of the increasing availability of adequate data from ENVISAT ASAR.

Interferometric Deformation Maps

Land surface deformation maps were generated using ERS and JERS differential interferometry, with 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. In 2002 training courses for SAR and interferometry took place in Europe and Japan.

GAMMA SOFTWARE

In 2002 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), complemented by the new stand-alone module for Geocoding and image registration (GEO).

Developments

Recent software developments include 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 and initial

adaptations for ENVISAT ASAR. In addition, a new package for interferometric point target analysis (IPTA) will soon be finalized.

Sales activity

Sales activities were continued with new licenses sold in Europe, North America, and Asia. 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

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

PUBLICATIONS

Del Frate F., P. Ferrazzoli, L. Guerriero, T. Strozzi, U. Wegmüller, G. Cookmartin, and S. Quegan, Wheat cycle monitoring using radar data and a neural network trained by a model, Proc. IGARSS 2002, Toronto, Canada, pp. 481-483, 24-28 June 2002.

Eriksson L.E.B, A. Wiesmann, C. Schmullius, and T. Riedel, "Multi-Temporal JERS Coherence for Observation of Siberian Forest", Procs. IGARSS 2002, Toronto, Canada, pp. 902-904, 24-28 June 2002.

Eriksson L., M. Santoro, A. Wiesmann and C. Schmullius, "Multi-seasonal study of the SIBERIA classification procedure." Procss ForestSAT Symp. Edinburgh, 5-9 August 2002.

Murray T., T. Strozzi, A. Luckman, H. Pritchard, and H.Jiskoot, Ice dynamics during a surge of Sortebrae, East Greenland, Annals of Glaciology 34, pp. 323-329, 2002.

Santoro M., J. Askne, L. Eriksson, C. Schmullius, A. Wiesmann, J.E.S. Fransson, "Seasonal dynamics and stem volume retrieval in boreal forests using JERS-1 backscatter",Procs SPIE Conf., Athens, Sept. 2002.

Schmullius C., S. Hese, H. Balzter, W. Cramer, F. Gerard, R. Kidd, T. LeToan, W. Lucht, A. Luckman, I. McCallum, S. Nilsson, A. Petrocchi, S. Plu,,er, S. Quegan, A. Shivdenko, L. Skinner, S. Venevsky, S. Voigt, W. Wagner, U. Wegmüller, and A. Wiesmann, Sensor systems and data products in SIBERIA II – a multi sensor approach for full greenhouse gas accounting in Siberia, Proc. ForestSAT'02 Conf. Edinburgh, Scotland, 5.-9. Aug. 2002.

Strozzi T., U. Wegmüller, L. Tosi, G. Bitelli, and V. Spreckels, Land subsidence monitoring with differential SAR interferometry, Photogrammetric Engineering and Remote Sensing, Vol. 67, No. 11, pp. 1261-1270, Nov. 2001.

Strozzi T., U. Wegmuller, L. Tosi, L. Carbognin, P. Teatini, and R. Rosselli, Thematic and land subsidence maps of the Lagoon of Venice from ERS SAR interferometry, Proc. CORILA Annual Workshop, Venezia, 4-5 April 2002.

Strozzi T., G.H. Gudmundsson, and U. Wegmüller, Estimation of the surface displacement of Swiss alpine glaciers using satellite radar interferometry, 3rd Workshop on Remote Sensing of Land Ice and Snow, Bern, Switzerland, 11-13 March 2002.

Strozzi T., U. Wegmüller, C. Werner, and A. Wiesmann, Alpine landslide periodical survey, Proc. IGARSS 2002, Toronto, Canada, pp. 3629-3631, 24-28 June 2002.

Tosi, L. L. Carbognin, P. Teatini, T. Strozzi, and U. Wegmüller, Evidence of the present relative land stability of Venice, Italy, from land, sea, and space observations, AGU Geophysical Research Letters, 18. Jun. 2002, (10.1029/2001GL013211).

Volden E., O. Arino, M. Cataldo, T. Häme, I. Hippi, Y. Rauste, L. Sirro, J. Van Brusselen, A. Schuck, and U. Wegmüller, Towards operational forestry tools for Kyoto Protocol reporting, Proc. ForestSAT'02 Conf. Edinburgh, Scotland, 5.-9. Aug. 2002.

Wegmüller U., A. Wiesmann, T. Strozzi, and C. Werner, ENVISAT ASAR in disaster management and humanitarian relief, Proc. IGARSS 2002, Toronto, Canada, pp. 2282-2284, 24-28 June 2002.

Wegmüller U., A. Wiesmann, T. Strozzi, and C. Werner, Forest mapping with multi-temporal SAR, Proc. ForestSAT'02 Conf. Edinburgh, Scotland, 5.-9. Aug. 2002.Wegmüller U., C. Werner, T. Strozzi, and A. Wiesmann, "Automated and precise image registration procedures", in Analysis of Multi-temporal remote sensing images, Bruzzone and Smits (ed.), Series in Remote Sensing, Vol. 2, World Scientific (ISBN 981-02-4955-1), pp. 37-49, 2002.

Werner C., U. Wegmüller, and T. Strozzi, Processing strategies for phase unwrapping for INSAR applications, Procs. EUSAR Conf., Cologne, Germany, 4.-6. June, 2002.

Werner C., T. Strozzi, U. Wegmüller, and A. Wiesmann, SAR geocoding and multi-sensor image registration, Procs. IGARSS 2002, Toronto, Canada, pp. 902-904, 24-28 June 2002.

Wiesmann A., Urs Wegmüller, M. Honikel, T. Strozzi, C. Werner, "Flood Mapping with Satellite Synthetic Aperture Radar", Procs. Int. Conf. On Flood Estimation, March 6-8, Bern, Switzerland, 2002.