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# Gamma Remote Sensing AG

## ANNUAL REPORT 2013

### RESEARCH AND DEVELOPMENT

#### **FP7 – DORIS: GMES downstream service for ground deformations (2010-2013)**

In this FP7 Space-Call Project coordinated by CNR-IRPI, Perugia, Italy, GAMMA addresses the combined use of space-borne and ground-based radar interferometry in the context of ground deformation risk scenarios. GAMMA processed Space-borne SAR and GPRI data over several sites in Switzerland and made GPRI measurements in Hungary.

#### **FP7 – PanGEO: Enabling Access to Geological Information in Support of GMES (2011-2014)**

In this FP7 Space-Call Project coordinated by CGG-NPA, UK, geological surveys and persistent scatterer specialists cooperate to provide free access to geohazard information for many of the largest European cities. GAMMA completed the PSI processing over Varna, Bulgaria; Copenhagen, Denmark; Miskolc, Hungary; Cluj-Napoca and Bucharest, Rumania; and Maribor, Slovenia. A relevant effort in 2013 is spent towards achieving sustainability for the PanGEO Service.

#### **FP7 - Cryoland: GMES Service Snow and Land Ice (2011-2014)**

In this FP7 Space-Call Project coordinated by ENVEO, Austria, the GMES Service Snow and Land Ice is developed to provide geospatial products on snow cover, glaciers, and lake/river ice derived from Earth observation satellite data. GAMMA addresses the improvement and validation of products on glaciers, lake and river ice and the development of tools for the use of Sentinel-1 for the derivation of snow products.

#### **FP7 – GIONET: Network for Earth Observation Research Training (2011-2015)**

In this FP7 Marie-Curie Action coordinated by the University of Leicester, UK, GAMMA trains two PhD students. In 2011 the students were selected and started then in October their work, Jessica Papke on “Monitoring landslide displacements with terrestrial and spaceborne Radar Interferometry” and Penelope Kourkouli on “DINSAR/PSI hybrid methodologies”.

#### **FP7 – GEOCARBON: Operational Global Carbon Observing System (2011-2014)**

In this project coordinated by the Centro Euro-Mediterraneo per i Cambiamenti Climatici, Italy, GAMMA contributes with the integration of existing forest biomass data products to a global biomass map.

#### **ESA - GMES - TERRAFIRMA (2005-2009, 2010-2012,2013-2014)**

The focus of the ESA GMES project TERRAFIRMA is on using SAR interferometric techniques to map surface motion of a large number of European Cities and landslides. GAMMA was involved with PSI processing over Swiss landslides and a Polish abandoned mining site. In 2013-2014 Terrafirma continues with activities mainly by DLR on the WAP product.

**ESA - Ku-Band Scatterometer Development and ESA- NOSREX-I/II/III (2007 - 2013)**

In 2013 the SNOWSCAT X- to Ku-band scatterometer was first used by the Finnish Meteorological Institute in the frame of the NOSREX projects. As novelty vertical measurements were conducted to study the snow structure. Later on the SNOWSCAT was used by the Delft University for measurements over agricultural fields in the Netherlands. GAMMA provided instrument maintenance and characterization.

**ESA - CCI - Glaciers (2010-2013)**

The main objectives of the Glaciers-CCI Project (coordinated by University of Zürich, Switzerland) in the frame of the Climate Change Initiative (CCI) are to provide EO based services for glacier monitoring, as developed and demonstrated under the DUE GlobGlacier Project. GAMMA's responsibilities are in the glacier flow monitoring and in the service engineering. In 2013 a proposal for CCI – Glaciers – Phase 2 was submitted.

**ESA - DUE – GlobSnow 2 (2012-2014)**

The objective of the GlobSnow-2 project coordinated by the Finnish Meteorological Institute, is further enhancement of the retrieval methodologies for Snow Extent and Snow Water Equivalent products and to re-process long term datasets utilizing the improved retrieval algorithms. GAMMA's main responsibility is the data processing system design and implementation.

**ESA - CCI - Landcover (2010-2012,2013)**

In this Project coordinated by UCL, Louvain, Belgium, GAMMA provides waterbodies information derived from multi-temporal SAR data and contributes multi-temporal SAR signatures to be used for urban mapping. In 2013 further work on the waterbody product and its validation was performed at GAMMA.

**ESA - Assimilation of high-temporal resolution SAR data into land process models (2011-2013)**

In preparation of Sentinel-1 GAMMA develops processing techniques and applications for multi-temporal SAR data with a high temporal resolution. A novel multi-temporal filtering approach and several multi-temporal retrieval concepts could be implemented. In 2013 the work focused on the selected multi-temporal applications and the final reporting.

**ESA –STSE - SMOS+ Innovation Permafrost (2012-2013)**

In this project coordinated by Finnish Meteorological Institute (FMI) the application of SMOS data for the characterization of the freeze/thaw cycle and the retrieval of permafrost information is addressed. GAMMA's contribution in 2013 focused on Radiative Transfer Modeling.

**ESA - IAP - Monitoring Alpine Transportation Infrastructure using Space Techniques (2012-2013)**

In cooperation with the Institute of Navigation of the Graz University of Technology, Austria (INAS), GAMMA develops integrated services for alpine railway and road operators. Slope stability / deformation information is provided using space-borne and terrestrial INSAR methods and GPS/GNSS.

**ESA - ARTES-20 - Improved Alpine Avalanches Forecast Service (2013-2014)**

In this project coordinated by WSL-SLF potential EO based solutions to close gaps in avalanche forecast services are investigated. GAMMA's focus is on the assessment of potential roles of space-borne and terrestrial radar data.

**ESA – WEOS: Waste Earth Observation Services (2013-2015)**

Under the lead of ERA Maptec the WEOS team looks at the area of waste management with the aim to extend the uptake of the Earth Observation (EO) based geo-information services to a wider set of end-users. GAMMA is involved as SAR and INSAR specialist mainly to assess the possibilities in the mapping and monitoring of ship dismantling and land fill sites.

**ESA – GEOSAT (2013-2014)**

In this study for the utilization of future telecom satellites for earth observation, SES and its team study the feasibility of geostationary SAR concepts. GAMMA is involved to contribute with GPRI measurements to the investigation of temporal decorrelation over different land classes.

**ESA – Updating the Radiative Transfer Model in L-MEB-INV (SMOS 2S) (2013-2014)**

In this work GAMMA tries to improve the radiative transfer model used in the forward model L-MEB, and to investigate the resulting impact on SMOS based soil moisture retrievals derived with the related inversion model L-MEB-INV.

**ESA - Dragon 3 Cooperation Programme (2012-2016)**

Dragon 3 focuses on exploitation of ESA, Chinese, and third party mission EO data for geo-science and applications development in land, ocean and atmospheric applications in 50 joint Sino-European projects. GAMMA is involved in the Forest Dragon 3 and Himalayan Glacier Dynamics projects.

**JAXA Kyoto & Carbon (K&C) Initiative, 3<sup>rd</sup> phase (2011-2014)**

The objective of the ALOS K&C Initiative is to define, develop and validate thematic products derived primarily from ALOS PALSAR data that can be used to meet the information requirements relating to Conventions, Carbon Cycle Science and Conservation of the environment. GAMMA supported related activities on forest change detection and biomass mapping

**CH Spacetechn Project “Spaceborne SAR Tomography” (2012-2014)**

Under the Swiss Space-Technology Programme Project “GAMMA Software Module for Spaceborne SAR Tomography”, lead by the ETH Zurich, Institute of Environmental Engineering, Earth Observation and Remote Sensing, Spaceborne SAR Tomography methodologies are developed, tested, and integrated into a related GAMMA Software Module.

**CH Spacetechn Project “Next Generation SAR Processing Tools” (2012-2014)**

In cooperation with the GRID & Cloud Computing Group the Ecole d'ingénieurs et d'architectes, Fribourg, (EIA-FR) and the Signal Processing Laboratory of the Ecole Polytechnique Fédérale de Lausanne (EPFL), GAMMA addresses the acceleration of the GAMMA Software through parallel processing methods and preparations for Sentinel-1 data processing.

## **PRODUCTS AND SERVICES**

### **Deformation Maps, DEMs , Landcover/Landuse and Change/Hazard Products**

A variety of products were generated in 2013 for customers in, Switzerland, Europe, Asia, and North America using data of the ERS, ENVISAT, Radarsat, ALOS, TerraSAR-X, and Cosmo-Skymed satellites. SAR, InSAR and Persistent Scatterer Interferometry (PSI) were used to generate forest biomass maps, deformation maps, deformation histories, terrain heights, and glacier velocity maps. In 2013 we also continued providing services using the GAMMA Portable Radar Interferometer (GPRI).

### **Consulting**

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

### **Training courses**

In 2013 we organized again training courses for SAR, SAR interferometry, and Interferometric Point Target Analysis (IPTA). Further courses will follow in spring 2014 (for information see our homepage (<http://www.gamma-rs.ch>)).

## **GAMMA SOFTWARE**

In 2013 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), Land Application Tools (LAT), and Interferometric Point Target Analysis (IPTA), complemented by the stand-alone module for Geocoding and image registration (GEO). In 2013 a significant effort was spent on parallelizing many programs. Furthermore, several programs were modified to further improve the support of GPRI data processing.

License sales activities were continued with new licenses sold in Europe, Asia, Australia, Africa, North and South America. User contacts indicate that the advanced algorithms supported and our competent support are important features 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.

## **GAMMA INSTRUMENT DEVELOPMENT**

In 2013 the X- to Ku-band scatterometer SNOWSCAT was used first in Finland and then in the Netherlands. The ELBARA radiometers were again intensively used in the field. The use of these instruments was further supported by GAMMA in the frame of ESA contracts. In late 2013 GAMMA started manufacturing a new ELBARA series. There was again a significant interest in the GAMMA Portable Radar Interferometer (GPRI). Existing customers promote the instrument with their high quality results. In 2013 an improved motor for the scanning was developed. Furthermore, upon request of ETH, a modified GPRI with polarimetric – interferometric capability was built.

**VARIA**

GAMMA employees are members of national (SIP, SED, SGPF) and international (IEEE, RSPSoc, AGU, EARSEL) organizations, acted as peer reviewers (various journals, books), were members of scientific committees, and engaged in University teaching and PhD supervision (FSU Jena, University of Berne, ETH Zürich, SLU Umeå). In 2013 Rafael Caduff completed his PhD at the Institute of Geology of the University of Berne, Switzerland, and started working full-time at GAMMA. GAMMA is engaged in the company TERRARSENSE Switzerland AG, directed by Dr. Andrew Kos, offering services in applied geology and covering a wide range of ground-motion measurements (including GPRI).

**PUBLICATIONS**
**Articles in journals and books:**

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- Articles in conference proceedings:**
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