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# Gamma Remote Sensing AG

## ANNUAL REPORT 2014

### RESEARCH AND DEVELOPMENT

#### **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. In early 2014 the EC funded project terminated. The project team attempts to continue the activities and to get further processing funded through local or national authorities.

#### **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.

#### **FP7 – APHORISM: Advanced Procedures for Volcanic and Seismic Monitoring (2014-2017)**

In this project coordinated by INGV two new methods to combine different types of Earth Observation satellite data and ground data, one for volcano ash monitoring and one for earthquake damage mapping are developed. GAMMA is mainly involved with the earthquake damage mapping product and provides elements related to the use of SAR data, including the mapping of ground deformation and change detection for damage mapping.

#### **FP7 – SEN3APP (2014-2017)**

In this project coordinated by FMI processing lines and operational services combining Sentinel and in-situ data for the terrestrial cryosphere and boreal forest zone are being developed. GAMMA is mainly involved with the use of SAR data from Sentinel-1.

#### **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 - 2015)**

In 2014 the SNOWSCAT X- to Ku-band scatterometer was updated for tomographic measurements. The instrument can be moved now over a two meter rail. In the winter 2014/15 measurements over a snow test site in Davos are taken and analysed. A first test campaign in Nov. 2014 confirmed the tomographic capability of the updated system. The objective is to resolve layer structures in the snow pack.

**ESA - CCI – Glaciers 2 (2014-2016)**

The main objectives of the Glaciers-CCI Project 2 (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 and CCI Glacier. GAMMA's responsibilities are in the glacier flow monitoring and in the service engineering.

**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 2 (2014-2016)**

In this Project coordinated by UCL, Louvain, Belgium, GAMMA provides waterbodies information derived from multi-temporal SAR data.

**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. SLF and GAMMA will continue some related joint activities in the winter 2014/15 (outside of the IAP program).

**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.

**ESA – GLOFS: Glacier Lake Outburst Flood – Danger Monitoring (2014-2014)**

In this project we want to provide the organizations involved as users a service that addresses their need for information on glacial lakes, glacial lake extent and glacial lake extent change, with respect to GLOF, together with detection, monitoring and modelling of slope instabilities and glaciers adjacent to the glacier lakes of concern. We setup and demonstrate a service that allows to map, monitor and forecast glacial lakes based on various sources of EO data (including optical and SAR high and very-high resolution data) together with in-situ data and models. GAMMA coordinates the project and is supported by the University of Zürich, the University of Oslo, and ASIAQ, Greenland.

**ESA – GlobBiomass (2014-2017)**

In this project lead by the University of Jena the main goal is to develop and demonstrate an integrated and validated methodology using EO and in-situ data to improve regional and global biomass estimates. Where possible, very recent and near-future satellite data such as from the Sentinel-fleet will be implemented. GAMMA's role is to lead the System Development and Prototyping and the Global Biomass Estimation.

**ESA – SAOCOM-CS bi-static science for land applications (2014-2015)**

In this study lead by DIET, La Sapienza Univ., the overarching objective activity is to consolidate the understanding of the L-band bi-static SAR signal (radiometry and phase) over land surfaces in the SAOCOM CS configuration. In particular, the study shall strengthen the scientific case for bi-static SAR acquisitions over land surfaces, consolidate potential applications and illustrate potential products.

**ESA –SMOS Expert Support Laboratory for Level 2 - Soil Moisture (2014-2019)**

The tasks of the SMOS ESL for soil moisture include the development, implementation and assessment of SMOS soil moisture retrieval algorithms. GAMMA's contributes new algorithm ideas arising from 2-flux radiative transfer modelling.

**JAXA Kyoto & Carbon (K&C) Initiative, 3<sup>rd</sup> phase (2011-2014), 4<sup>th</sup> phase (2014- 2017)**

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 Spaceteq 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, Spaceborne SAR Tomography methodologies are developed, tested, and integrated into a related GAMMA Software Module.

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

In cooperation with the GRID & Cloud Computing Group, EIA-FR, and the Signal Processing Laboratory of the 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 2014 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 2014 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 2014 we organized again training courses for SAR, SAR interferometry, and Interferometric Point Target Analysis (IPTA). Further courses will follow in spring 2015 (for information see our homepage (<http://www.gamma-rs.ch>)).

## **GAMMA SOFTWARE**

In 2014 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 2014 a significant effort was spent on supporting new satellite sensors, including Kompsat-5 (Korean Sensor), Sentinel-1 (European Sensor from ESA), and PALSAR-2 (Japanese Sensor). In particular the adaptations for Sentinel-1 were challenging because the new TOPS mode is used as the main acquisition mode. By now Sentinel-1 TOPS mode InSAR (starting from SLC data) is fully supported.

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 2014 the X- to Ku-band scatterometer SNOWSCAT was updated for tomographic measurements. After some test measurements conducted in Nov. 2014 it will be used in Davos, Switzerland, for snow measurements. In 2014 GAMMA worked on a new ELBARA series; a first instrument is now being tested and will be delivered soon. There was again a significant interest in the GAMMA Portable Radar Interferometer (GPRI). Existing customers promote the instrument with their high quality results. In 2014 several instruments were sold. Furthermore, upon request of ETH, a second polarimetric GPRI is being built to support bi-static measurements.

## 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). 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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- Santoro, M., Wegmüller, U., "Multi-temporal Synthetic Aperture Radar metrics applied to map open water bodies," *IEEE JSTARS*, vol. 7, 8, pp. 3225-3238, 2014.
- Tanase, M. A., Santoro, M., Aponte, C., de la Riva, J., "Polarimetric properties of burned forest areas at C- and L-band," *IEEE JSTARS*, vol. 7, 1, pp. 267-276, 2014.
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- Battaglia D., T. Strozzi and A. Bezzi, Landslide Hazard: Risk Zonation and Impact Wave Analysis for the Bumbuma Dam—Sierra Leone, in G. Lollino et al. (eds.), Engineering Geology for Society and Territory – Volume 2, DOI: 10.1007/978-3-319-09057-3\_199, Springer International Publishing Switzerland 2014.
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