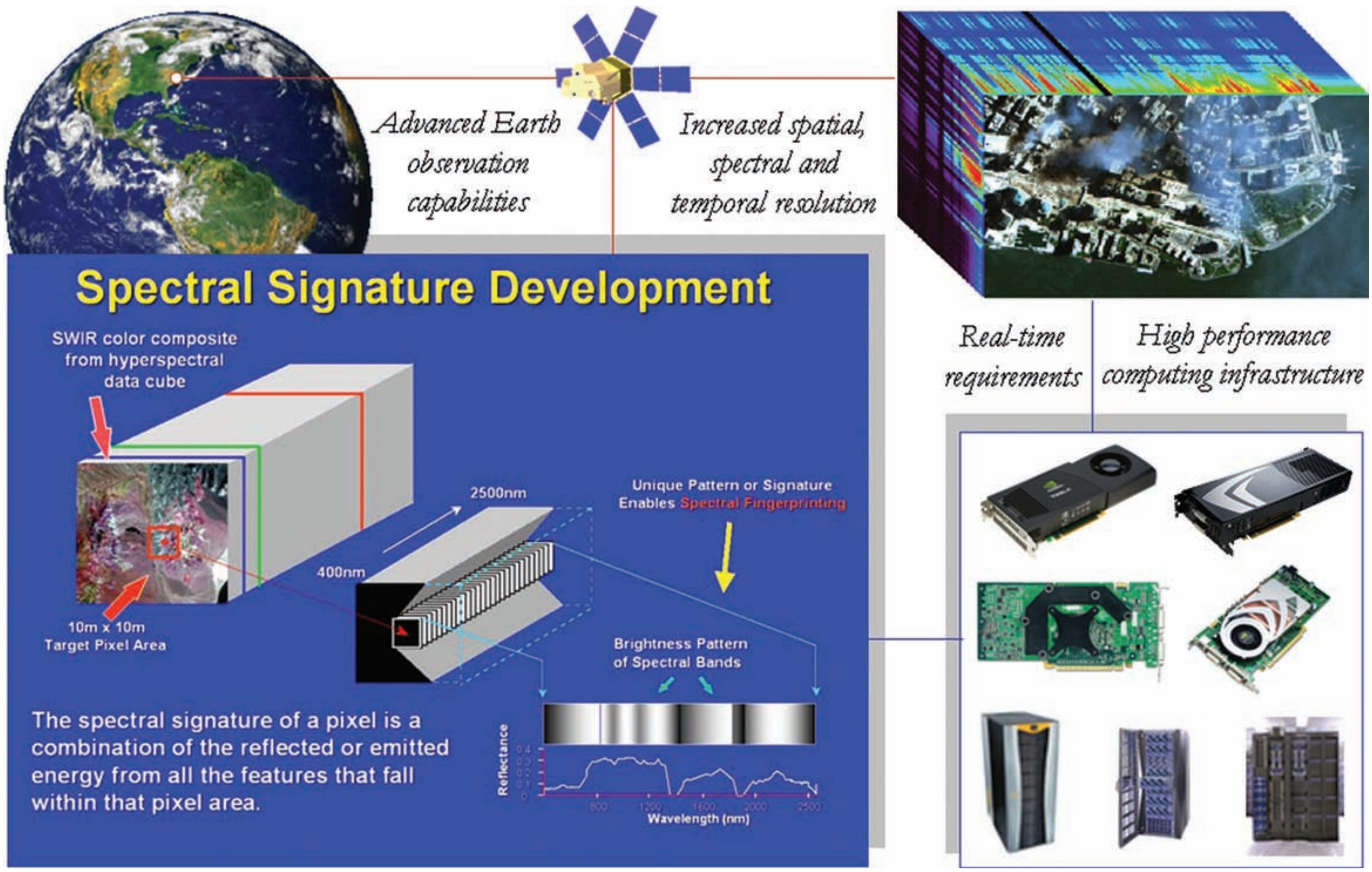
IEEE GEOSCIENCE and REMOTE SENSING Newsletter

http://www.grss-ieee.org/menu.taf?menu=Publications&detail=newsletter **Editor:** Lorenzo Bruzzone



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Newsletter Input and Deadlines

The following is the schedule for the GRS-S Newsletter. If you would like to contribute an article, please submit your input according to this schedule. Input is preferred in Microsoft Word, WordPerfect or ASCII for IBM format (please send disk and hard copy) as IEEE now uses electronic publishing. Other word processing formats, including those for Macintosh, are also acceptable, however, please be sure to identify the format on the disk and include the hard copy.

GRS-S Newsletter Schedule

Month	June	Sept	Dec	March
Input	April 15	July 15	Oct 15	Jan 15

IEEE GRS-S AdCom, Officers and Committee Chairs – 2010 GRS-29 (Division IX)

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Editor's Comments

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This issue of the IEEE Geoscience and Remote Sensing Newsletter follows the outstanding IGARSS edition held in Honolulu, Hawaii, at the and of July 2010. IGARSS was really exciting and represented a great opportunity for meeting people in the framework of a very attractive technical program and natural environment. Reports on this event are included in this issue and will be also presented in the December one.

Before providing an overview of the content of this issue, I would like to remind you that there is the possibility to download the electronic version of the Newsletter as soon as it is published at http://www.grss-ieee.org/category/newsletter/. I encourage all readers to exploit this new feature and to access the most "fresh" news of the GRS-S through the web site.

Starting from this issue, we have a new column: *New Remote Sensing Missions*. It is devoted to present to the readers the major satellite missions recently launched that include relevant remote sensing payloads. The main goal is to inform our community on the new instruments that becomes available and that are important for GRS-S members activities.

The main *Feature* article of this issue is devoted to a very important topic associated with the remote sensing technology, which is related to computing architectures and systems necessary for an effective data processing and analysis. In the last years we had a dramatic increase in both the amount of remote sensing data acquired by new generation satellites and the quality of these data. We have now available very high geometrical resolution images (both acquired by passive and active SAR sensors) and hyperspectral images, which result in a huge amount of data to process and analyze. In addition, the increased revisiting time of satellites (e.g. the operation of the Cosmo-Skymed constellation) increases the number of images potentially available for the analysis of a given geographical area. This points out the importance of defining effective data processing architectures that allow one to efficiently transform remote sensing data in products for the end-users. The article gives an overview on the current scenario on processing

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What a successful IGARSS 2010 in Honolulu! We commemorated the 30th anniversary of IGARSS, our International Geoscience and Remote Sensing Symposium that is currently considered the premier conference in the field of remote sensing. We had about 2000 participants, many young people, a great deal of networking among the participants, excellent plenary and technical oral sessions, very dynamic interactive poster sessions, several highlights like the Technical Committees and Chapters Luncheon, Young Professionals' Luncheon, Awards Banquet, and a most pleasant social program in a unique venue. I received considerable feedback from participants that it was the best IGARSS we have ever had. A web-based survey was available during the conference, and an e-mail notification about the survey has also been sent to all IGARSS participants as well as to all GRS-S members. Please take a few minutes to participate in this survey at http://www.grss-ieee.org/conferences/igarss-survey/, since your inputs and suggestions are essential for us to continually improve future IGARSS conferences.

One highlight of the IGARSS plenary session was the keynote address by two prominent officials from the U.S. White House Office of Science and Technology Policy (OSTP): Aneesh Chopra, Chief Technology Officer, and Shere Abbott, Associate Director for Environment. Their presentation focused on the IGARSS 2010 "Community Remote Sensing" theme, a concept that has been embraced by OSTP as a key future capability to provide the information needed to address national and

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Cover Information: Combination of hyperspectral imaging and high performance computing techniques.

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architectures and provides indication of the expected developments in this crucial field for remote sensing.

In the column on *New Remote Sensing Missions*, we have a contribution related to the launch of the OCEANSAT-2 satellite of Indian Space Research Organization (ISRO). OCEANSAT-2 is a satellite with sun-synchronous polar orbit, which mounts on-board three main payloads: i) K_u band pencil beam scatterometer to provide ocean surface wind vectors, ii) modified Ocean Color Monitor (OCM) instrument to provide ocean color variables, and iii) Radio Occultation Sounder of Atmosphere (ROSA) instrument to provide atmospheric humidity and temperature profiles.

A large part of the *Report* section is devoted to the IGARSS 2010 and, in detail, to the article on the Major Awards presented at the plenary session. As above-mentioned, IGARSS in Honolulu was really outstanding, and some data briefly reported in this contribution confirm this statement. The article recognizes the GRS-S members who where elevated to the Fellow degree in 2010 as well as the scientists who received major awards. The *Report* section also presents the five students who received the European GRS-S PhD Excellence Awards for PhD defended in 2008. Congratulations to all of them! A final article in this section is related to the XIII International Conference on Ground Penetrating Radar (GPR2010), held in Lecce, Italy from 21 to 25 June 2010.

The *Chapter Corner* introduces the new GRS-S Student Branch Chapter of the South Brazil Section that was recently established. This is a very important achievement for our Society because South America is an area of major interest for GRS-S, and the new Brazilian chapter represents a great opportunity for increasing the connection between GRS-S and the Latin America.

The *University Profile* section presents activities carried out in the Department of Electrical and Computer Engineering at the University of Puerto Rico at Mayaguez on weather radar for the low atmosphere.

Finally, I would like to draw your attention on the calls for nominations reported in this issue. It is very important that GRS-S members contribute to identify outstanding candidates for the different awards that are assigned by GRS-S and by our sister societies.

Sincerely
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Applications for senior membership can be obtained from IEEE website: http://www.ieee.org/web/membership/senior-members/index.html

You can also visit the GRS-S website: http://www.grss-ieee.org

IEEE GRS-S Awards: Call for Nominations

(http://www.grss-ieee.org/about/awards/)

Nominations for the IEEE GRS-Society awards are due December 15. For the first time not only for the Major Awards, but also for the Publication Awards nominations from the members are possible. Below the awards are listed with links to a detailed description and to the nomination forms.

GRS-S Distinguished Achievement Award (DAA)

***Eligibility*:** IEEE membership is not required but is recommended.

The Distinguished Achievement Award was established to recognize an individual who has made significant technical contributions, usually over a sustained period, within the scope of the Geoscience and Remote Sensing Society. In selecting the individual, the factors considered are quality, significance and impact of the contributions; quantity of the contributions; duration of significant activity; papers published in archival journals; papers presented at conferences and symposia; patents granted; advancement of the profession. The award is considered annually and presented only if a suitable candidate is identified. The awardee receives a plaque and a certificate.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-distinguished-achievement-award/

GRS-S Education Award (EA)

***Eligibility*:** Member or Affiliate Member of the IEEE GRS-S

The purpose of this award is to reward significant educational contributions in the field of remote sensing. The award shall be considered annually, but will only be awarded when an outstanding recipient is identified.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-education-award/

GRS-S Outstanding Service Award (OSA)

***Eligibility*:** Must be an IEEE GRS-S member.

The Outstanding Service Award was established to recognize an individual who has given outstanding service for the benefit and advancement of the Geoscience and Remote Sensing Society. The award shall be considered annually but not be presented if a suitable candidate is not identified. The following factors are suggested for consideration: leadership, innovation, activity, service, duration, breadth of participation and cooperation. The awardee receives a certificate.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/oss/

GRS-S GOLD Early Career Award (GA)

The GRS-S GOLD Early Career Award is to promote, recognize and support young scientists and engineers within the Geoscience and Remote Sensing Society that have demonstrated outstanding ability and promise for significant contributions in the future.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-gold-early-career-award/

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GRS-S Transactions Prize Paper Award

Description: The GRS-S established the GRS-S TRANSACTIONS Prize Paper Award (TPPA) to recognize the authors who have published in the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING (TGARS) during the calendar year an exceptional paper in terms of content and impact on the GRS-Society. If a suitable paper cannot be identified from among those published during the calendar year, papers published in prior years and subsequently recognized as being meritorious may be considered.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-transactions-prize-paper-award/

GRS-S Letters Prize Paper Award

Description: The GRS-S established the Letters Prize Paper Award (LPPA) to recognize the authors who have published in the IEEE Geoscience and Remote Sensing Letters during the calendar year an exceptional paper in terms of content and impact on the GRS-Society. If a suitable paper cannot be identified from among those published during the calendar year, papers published in prior years and subsequently recognized as being meritorious may be considered.

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Description: The GRS-S established the J-STARS Prize Paper Award to recognize the author(s) who published in the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing during the calendar year an exceptional paper in terms of content and impact on the GRS-Society.

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FEATURE

COMPUTATIONAL ISSUES IN REMOTE SENSING DATA ANALYSIS

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Overview

Recent advances in sensor and computer technology are revolutionizing the way remotely sensed data is collected, managed and analyzed [1]. The incorporation of latest-generation sensors to airborne and satellite platforms is currently producing a nearly continual stream of high-dimensional data, and this explosion in the amount of collected information has rapidly created new processing challenges. To address the computational requirements introduced by many time-critical applications, several research efforts have been recently directed towards the incorporation of high-performance computing (HPC) models and techniques into remote sensing missions [2]. HPC offers an integrated computing environment for solving large-scale computational demanding problems such as those involved in many remote sensing studies. In particular, many current and future applications of remote sensing in Earth Observation (EO), space science, and soon in exploration science require the incorporation of HPC practices to address applications with high societal impact such as monitoring of natural disasters including earthquakes and floods, or tracking of man-induced hazards such as wild-land and forest fires, oil spills and other types of chemical contamination [3]. Many of these applications require timely responses for swift decisions which depend upon (near) real-time performance of algorithm analysis. This is also the case for military-oriented reconnaissance and surveillance applications, in which moving targets are of interest, e.g., vehicles in a battlefield, drug trafficking in law enforcement or chemical and biological agent detection in bio-terrorism [4].

In future years, EO instruments will substantially increase their measuring resolutions, thus producing a nearly continual stream of high-dimensional data sets. Technological advances are not only expected in optical instruments, but also in radar and other types of remote sensing systems. Specifically, synthetic aperture radar (SAR) is a very important instrument for EO. SAR image processing is particularly time consuming [5], and can greatly benefit from HPC techniques and practices to speed up processing of this type of data, either after the data has been collected and transmitted to a ground station on Earth, or during the data collection procedure onboard the sensor, in real-time fashion. The explosion in the amount, size and dimensionality of optical and SAR data collected on a daily basis presents new challenges for high performance computing in EO and remote sensing applications.

Utilization of High Performance Computing Systems in Remote Sensing Applications

The utilization of HPC systems in remote sensing applications has become more and more widespread in recent years [2]. The idea developed by the computer science community of using COTS (commercial off-the-shelf) computer equipment, clustered together to work as a computational "team" is a very attractive solution. This strategy is often referred to as Beowulf-class cluster computing, and has already offered access to greatly increased computational power, but at a low cost (commensurate with falling commercial PC costs) in a number of remote sensing applications. In theory, the combination of commercial forces driving down cost and positive hardware trends (e.g., CPU peak power doubling ever 18–24 months, storage capacity doubling every 12–18 months and networking bandwidth doubling every 9–12 months) offers supercomputing performance that can now be applied a much wider range of remote sensing problems.

Although most parallel techniques and systems for remote sensing information processing employed by institutions such as NASA or the European Space Agency (ESA) during the last decade have chiefly been homogeneous in nature (i.e., they are made up of identical processing units, thus simplifying the design of parallel solutions adapted to those systems), a recent trend in the design of HPC systems for data-intensive problems is to utilize highly heterogeneous computing resources [6]. This heterogeneity is seldom planned, arising mainly as a result of technology evolution over time and computer market sales and trends. In this regard, networks of heterogeneous COTS resources can realize a very high level of aggregate performance in remote sensing applications, and the pervasive availability of these resources has resulted in the current notion of grid computing, which endeavors to make such distributed computing platforms easy to utilize in different application domains, much like the World Wide Web

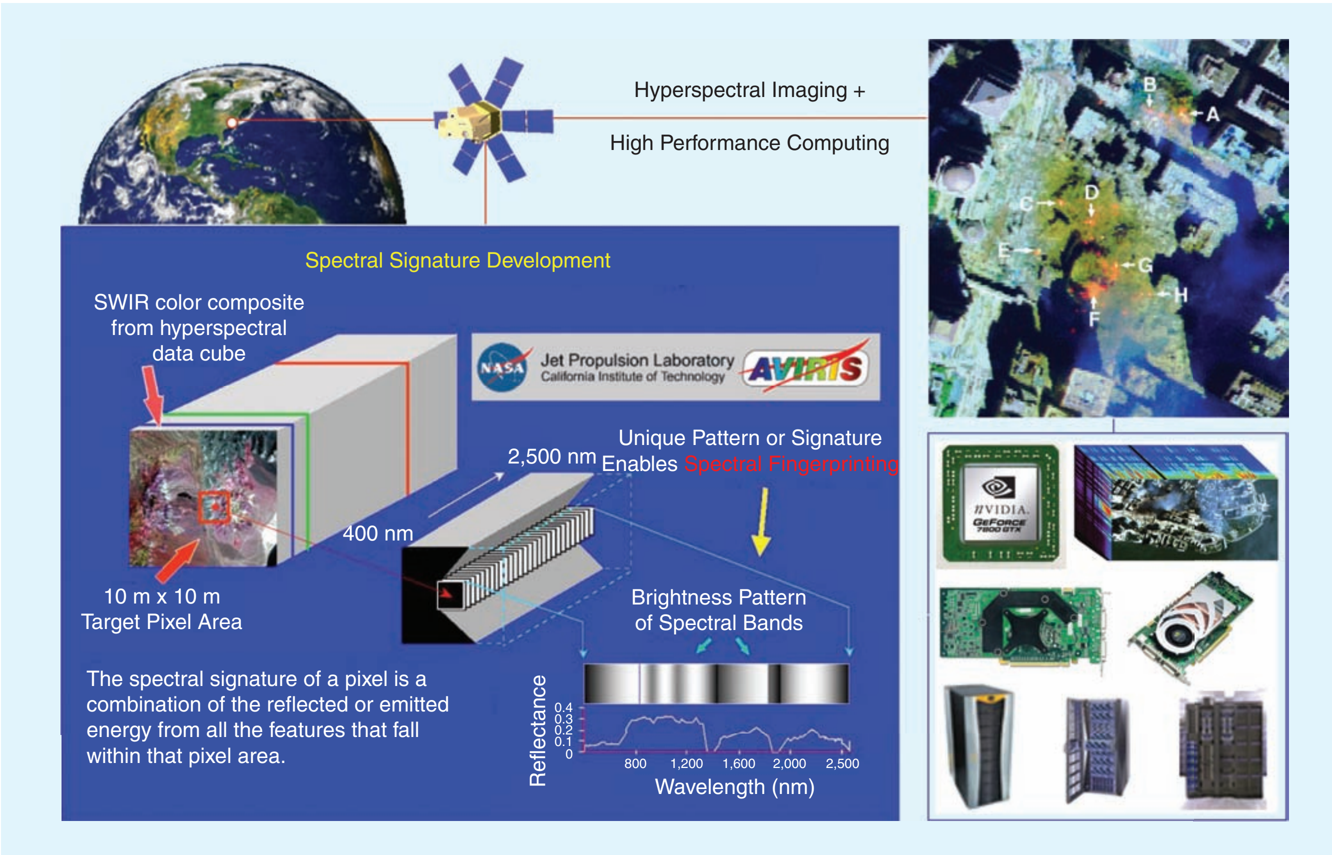

Figure 1. Combination of hyperspectral imaging and high performance computing techniques.

has made it easy to distribute web content. It is expected that grid-based HPC systems will provide significant contributions to high-dimensional data analysis in remote sensing.

Finally, although remote sensing data processing algorithms generally map quite nicely to parallel systems made up of commodity CPUs, these systems are generally expensive and difficult to adapt to onboard remote sensing data processing scenarios, in which low-weight and low-power integrated components are essential to reduce mission payload and obtain analysis results in real-time, i.e., at the same time as the data is collected by the sensor. In this regard, an exciting new development in the field of commodity computing is the emergence of programmable hardware devices such as field programmable gate arrays (FPGAs) [7] and commodity graphic processing units (GPUs) [8, 9], which can bridge the gap towards onboard and real-time analysis of remote sensing data. FPGAs are now fully reconfigurable, which allows one to adaptively select a data processing algorithm (out of a pool of available ones) to be applied onboard the sensor from a control station on Earth. On the other hand, the emergence of GPUs (driven by the ever-growing demands of the video-game industry) has allowed these systems to evolve from expensive application-specific units into highly parallel and programmable commodity components. Current GPUs can deliver a peak performance in the order of 1000 Gflops, several times the performance of the fastest quad-core processor. The ever-growing computational demands of remote sensing applications can fully benefit from compact hardware components and take advantage of the small size and relatively low cost of these units as compared to clusters or networks of computers.

Specific Case Study in Hyperspectral Image Processing

A relevant example of a remote sensing application in which the use of HPC technologies such as parallel and distributed computing are highly desirable is hyperspectral imaging, in which an imaging spectrometer collects hundreds or even thousands of measurements (at multiple wavelength channels) for the same area on the surface of the Earth [10]. The scenes provided by such sensors are often called "data cubes" to denote the extremely high dimensionality of the data. For instance, the NASA Jet Propulsion Laboratory's Airborne Visible Infra-Red Imaging Spectrometer (AVIRIS) is now able to record the visible and near-infrared spectrum (wavelength region from 0.4 to 2.5 micrometers) of the reflected light of an area 2 to 12 kilometers wide and several kilometers long using 224

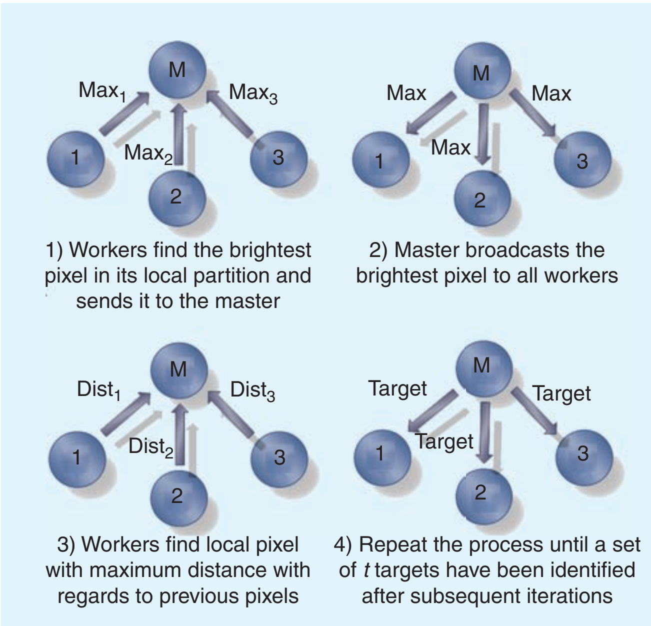

Figure 2. Parallel implementation of an automatic target detection method for hyperspectral imaging.

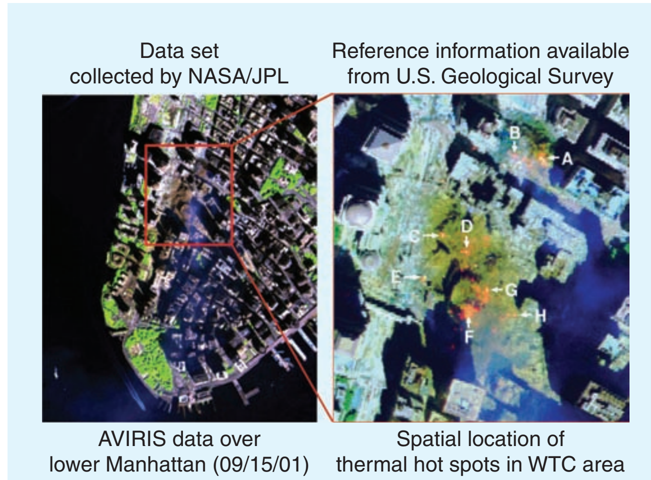

Figure 3. False color composition of an AVIRIS hyperspectral image collected over the World Trade Center in New York (left) and spatial location of thermal hot spots in the World Trade Center area (right).

spectral bands [11]. The resulting cube is a stack of images in which each pixel (vector) has an associated spectral signature or "fingerprint" that uniquely characterizes the underlying objects, and the resulting data volume typically comprises several GBs per flight, thus requiring the combination of hyperspectral imaging and HPC techniques to fully exploit the available data [12]. Although hyperspectral imaging is a good example of the computational requirements introduced by remote sensing applications, we would like to emphasize that there are many other remote sensing areas in which high-dimensional data sets are also produced. However, the extremely high computational requirements already introduced by hyperspectral imaging applications (and the fact that these systems will continue increasing their spatial and spectral resolutions in the near future) make them an excellent case study to illustrate the need for HPC systems in remote sensing and will be used in this article for demonstration purposes.

Over the last years, the hyperspectral computing laboratory (HYPERCOMP)[1] at the University of Extremadura has conducted extensive research oriented towards bringing the benefits of HPC to the hyperspectral imaging community. The developed parallel algorithms address different well-known hyperspectral image analysis problems, such as classification, spectral unmixing or target detection. To illustrate the potential advantages of HPC, we briefly refer to results provided by a parallel implementation of an automatic target detection algorithm (based on the concept of orthogonal projections [13] and illustrated by a flowchart, following the master-worker paradigm, in Fig. 2).

The parallel algorithm has been applied to a real hyperspectral image collected by the AVIRIS system over the World Trade Center (WTC) area in New York City on September 16, 2001. The data comprises 614 samples, 512 lines, and 224 spectral bands, for a total size of 140 MB. Fig. 3 shows a false-color composite of a portion of the scene, in which the spectral channels at 1682, 1107, and 655 nanometers (nm) are displayed as red, green, and blue respectively. Here, vegetation appears green, burned areas appear dark gray, and smoke appears bright blue due to high spectral reflectance in the 655 nm channel. For illustrative purposes, Fig. 3 also displays a thermal map centered at the region where the two main towers collapsed. The map shows the target locations of the thermal hot spots, considered in this work as ground-truth targets to validate the proposed parallel algorithm. The algorithm has been implemented in four different platforms:

- A Beowulf cluster called Thunderhead at NASA's Goddard Space Flight Center in Maryland, a 512-processor homogeneous Beowulf cluster composed of 256 dual 2.4 GHz Intel Xeon nodes, each with 1 GB of memory and 80 GB of main memory, interconnected with 2 Ghz optical fibre Myrinet [see Fig. 4(a)]. Our parallel implementation of the automatic target detection algorithm for the Thunderhead Beowulf cluster was developed using the C++ programming language with calls to the message passing interface (MPI)[2].
- A Xilinx Virtex-II XC2V6000-6 FPGA of Celoxica's ADMXRC2 board, with 33,792 slices, 144 Select RAM Blocks and 144 multipliers [see Fig. 4(c)]. This

[1] http://www.unex.es/grupos/hypercomp

[2] http://www.mcs.anl.gov/research/projects/mpi

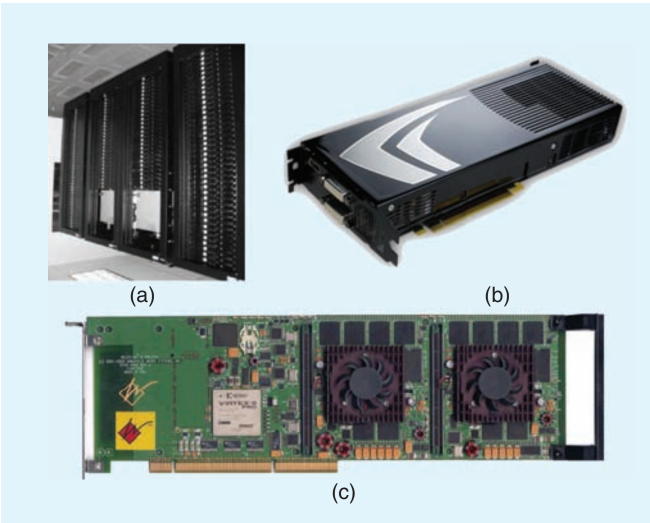

Figure 4. Parallel computing architectures used in our experiments: (a) Beowulf cluster called Thunderhead at NASA's Goddard Space Flight Center in Maryland, (b) NVidia Tesla C1060 GPU, and (c) Xilinx Virtex-II FPGA.

architecture is very similar to as a baseline architecture because it is similar to other FPGAs that have been certified by several international agencies for space operation. Our parallel implementation of the automatic target detection algorithm for the Xilinx Virtex-II FPGA was synthesized using Handel-C[3], a hardware design and prototyping language that allows using a pseudo-C programming style.

- An Nvidia Tesla C1060 GPU, which features 240 processor cores operating at 1,296 Ghz, with single precision floating point performance of 933 Gflops, double precision floating point performance of 78 Gflops, total dedicated memory of 4 GB, 800 MHz memory (with 512-bit GDDR3 interface) and memory bandwidth of 102 GB/sec [see Fig. 4(b)]. Both the Xilinx FPGA and the NVidia GPU are connected to an Intel core i7 920 CPU at 2.67 Ghz with 8 cores, which uses a motherboard Asus P6T7 WS supercomputer. Our parallel implementation of the automatic target detection algorithm for the NVidia Tesla C1060 GPU have been developed using the compute unified device architecture (CUDA)[4], a collection of C extensions and a runtime library that allows general-purpose programming of NVidia GPUs.
- Our MPI-parallel implementation of the automatic target detection algorithm was able to detect the spatial locations of all the thermal hot spots in the AVIRIS scene collected over the WTC in less than 10 seconds, using all available processing nodes in the Thunderhead Beowulf cluster. The speedup of our implementation (defined as the number of times that the parallel code is faster than the serial code optimized for execution in a single CPU) was above 200x. Despite the fact that Beowulf clusters can effectively assist end-users in the task of extracting information from hyperspectral data sets already transmitted to Earth, these systems are expensive and difficult to adapt to onboard data processing scenarios, in which low-weight and low-power integrated components are essential to reduce mission payload.

In turn, our Handel-C implementation of the automatic target detection algorithm on the Xilinx Virtex-II FPGA was able to detect all the thermal hot spots in about 20 seconds. Here, the maximum speedup measured was about 25x, and it was estimated that approximately 36% of available resources in the FPGA were consumed by our implementation. Although our implementation is not fully optimized and better results can be achieved in terms of speedup and execution times by increasing resource utilization on the FPGA, it is quite important to leave room in the FPGA for additional algorithms so that dynamic reconfiguration and algorithm selection can be performed on the fly. Finally, our CUDA implementation of the automatic target detection algorithm on the NVidia Tesla GPU was able to detect all the thermal hot spots in less than 5 seconds, achieving a speedup of approximately 70x. This result complies with real-time performance since the cross-track line scan time in AVIRIS, a push-broom instrument, is 8.3 msec (to collect 512 full pixel vectors). This introduces the need to process the considered scene (614 × 512 pixels) in less than 5.096 seconds to fully achieve real-time performance. Despite the promising results achieved by our GPU implementation, the full incorporation of GPUs into satellite-based EO missions is still subject to further developments, particularly given the higher power consumption of GPUs when compared to FPGAs and the fact that radiation-hardened GPUs for space operation are not yet as widely available as their FPGA counterparts.

Summary and Discussion

In this article, we have emphasized the increasing importance of computational aspects in different types of remote sensing applications. To illustrate the potential advantages of incorporating high performance computing techniques and practices to real remote sensing missions, we have explored different strategies to increase the performance of a case study application focused on hyperspectral imaging, and using different parallel computing architectures. Techniques discussed include a Beowulf cluster-based implementation, an FPGA-based implementation intended for onboard data exploitation, and a GPU-based implementation. Our study reveals that Beowulf clusters are indeed an appealing solution in order to process remote sensing image data sets which have

[3]http://www.mentor.com/products/fpga/handel-c
[4]http://www.nvidia.com/object/cuda_home.html

been already transmitted to Earth. PC workstations are everywhere, and it is not difficult to put together a network and/or a cluster, given the raw materials. For instance, the processing power offered by such systems has been traditionally employed in data mining applications from very large data archives, possibly distributed among different geographic locations. However, these solutions are costly and difficult to adapt to onboard data processing scenarios. First and foremost, a cluster of computers occupies much more space than an FPGA or a GPU. This aspect significantly limits the exploitation of cluster-based systems in onboard processing scenarios, in which the weight of processing hardware must be limited in order to satisfy mission payload requirements. If the cluster system is distributed across different locations, the space requirements increase. On the other hand, the maintenance of a large cluster represents a major investment in terms of time and finance. Although a cluster is a relatively inexpensive parallel architecture, the cost of a cluster can increase significantly with the number of nodes.

In turn, compact hardware devices such as FPGAs or GPUs offer significant advantages in time-critical applications that demand a response in real-time, mainly due to the low weight and size of these devices and to their capacity to provide high performance computing at lower costs. FPGAs offer the appealing possibility of being able to adaptively select the data processing algorithm to be applied (out of a pool of available algorithms) from a control station on Earth. This feature is possible thanks to the inherent re-configurability of FPGA devices, which are generally more expensive than GPU devices. A crucial goal in future EO missions will be to overcome the bottleneck introduced by the bandwidth of the downlink connection from the observatory platform. In this regard, the adaptivity of FPGA systems for onboard operation, as well as the low cost and portability of GPU systems, open many innovative perspectives. In the future, significant developments are expected in the active research area devoted to radiation-hardening of FPGA and, particularly, GPU devices.

Acnowledgement

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NEW REMOTE SENSING MISSIONS

SUCCESSFUL LAUNCH OF OCEANSAT-2 MISSION OF ISRO

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Coupled atmospheric and oceanic processes play an important role in controlling the weather and climate of the planet Earth. In order to understand these coupled ocean-atmospheric interactions it is important to acquire periodic and synoptic observations of various oceanic and atmospheric geophysical parameters on a global scale. OCEANSAT-2 spacecraft of Indian Space Research Organisation (ISRO) is the second satellite in ocean series, which was successfully launched on September 23, 2009 from Shriharikota by Polar Satellite Launch Vehicle (PSLV)-C14 rocket. The OCEANSAT-2 satellite carried three main instruments namely i) K_u band pencil beam scatterometer to provide ocean surface wind vectors, ii) modified Ocean Colour Monitor (OCM) to provide ocean colour variables and iii) Radio Occultation Sounder of Atmosphere (ROSA) instrument developed by the Italian Space Agency (ASI) to provide atmospheric humidity and temperature profiles. The spacecraft operates from a polar sun-synchronous orbit at an altitude of 720 km with a local pass time of 1200 hrs at the equator. The OCEANSAT-2 mission has two-days temporal resolution and has capability to provide complete global coverage of ocean surface winds in two days.

The Ku-band pencil beam scatterometer is an active microwave radar operating at 13.5 GHz frequency. A parabolic antenna of 1 m diameter operating with two beams (inner and outer beam) provides radar backscattering by scanning the ground surface in a conical manner. The inner beam operates with HH polarization with a swath of 1400 km and the outer beam operates in VV polarization with a swath of 1840 km. Algorithms for the wind vector retrieval from OCEANSAT-2 scatterometer have been developed to provide a wind speed range between 3–20 m/s with an accuracy of 2 m/s, the wind direction range will be provided with an accuracy of 20°. The initial data products generated from OCEANSAT-2 scatterometer have shown excellent data quality and currently geophysical model function (GMF) specific to OCEANSAT-2 scatterometer is being finalized. It is expected that the operational wind vector product will be available from July-2010 onwards. Figure 1 shows an example of interim wind vectors derived by OCEANSAT-2 scatterometer data for "Ward" cyclone on December 11, 2009, which was active in Bay of Bengal.

Scatterometer at a Glance

Operating frequency	13.5 GHz
Wind vector cell size	50 km × 50 km
Antenna	Parabola of 1.0 m dia
Swath	1400 km
Wind speed range	4 to 24 m/s
Wind speed accuracy	2 m/s
Wind direction accuracy	20 degree

The OCEANSAT-2 OCM is mainly designed to provide continuity to the OCEANSAT-1 OCM instrument and to obtain quantitative information of ocean-colour variables e.g. chlorophyll-*a* concentration, vertical diffuse attenuation of the light, (K_d) and total suspended matter (TSM) concentration in coastal waters. OCEANSAT-2 OCM is almost identical to OCEANSAT-1 OCM, however central wavelength of two spectral bands i.e. band 6 and 7 have been shifted. The spectral band 6, which was located at 670 nm in OCEANSAT-1 OCM, has now been shifted to 620 nm for improved quantification of suspended sediments.

OCM at a Glance

Spectral bands	8 VNIR bands
Spectral bands (nm)	412, 443, 490, 510, 555, 620, 740, 865
Resolution at nadir	360 m × 236 m
Swath	1400 km
Along track steering	± 200
SNR	> 300

The spectral band at 620 nm is also useful for substrate mapping of optically shallow coral reefs and other benthic ecosystems. The spectral band 7, which was located at 765 nm in OCEANSAT-1 OCM has been shifted to 740 nm to avoid oxygen (O_2A) absorption in OCEANSAT-2 OCM, this change is expected to improve the accuracy of the normalized water-leaving radiance in shorter wavelengths obtained after doing the atmospheric correction. The data products from OCM-2 are available at 360 meter spatial resolution for regional studies, which are also called local area coverage (LAC) products. The global area coverage (GAC) products are available at 1 km spatial resolution for global studies. These data products from OCM-2 are being used for studying oceanic primary production, fisheries resources, global carbon cycle, spatial and temporal patterns of algal blooms, dynamics of

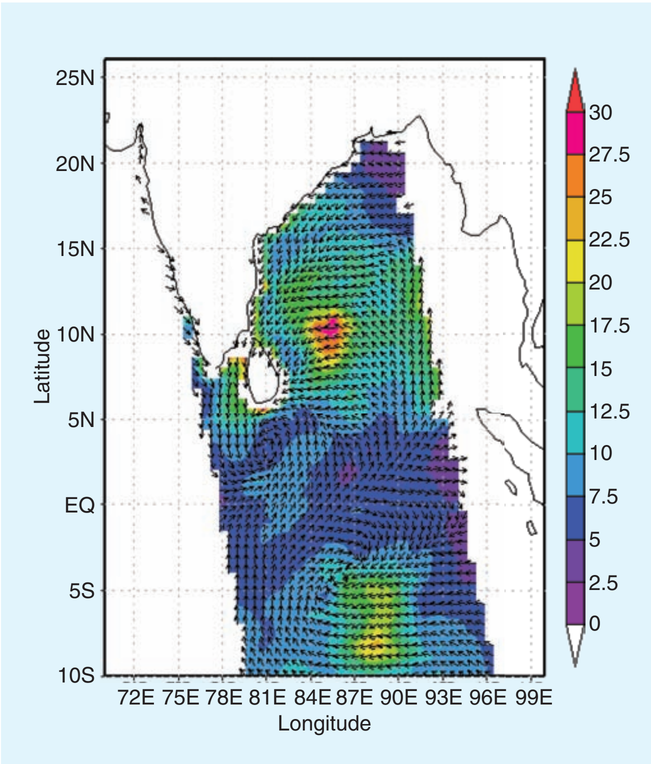


Figure 1. Pre operational interim wind vectors derived from OCEANSAT-2 scatterometer.

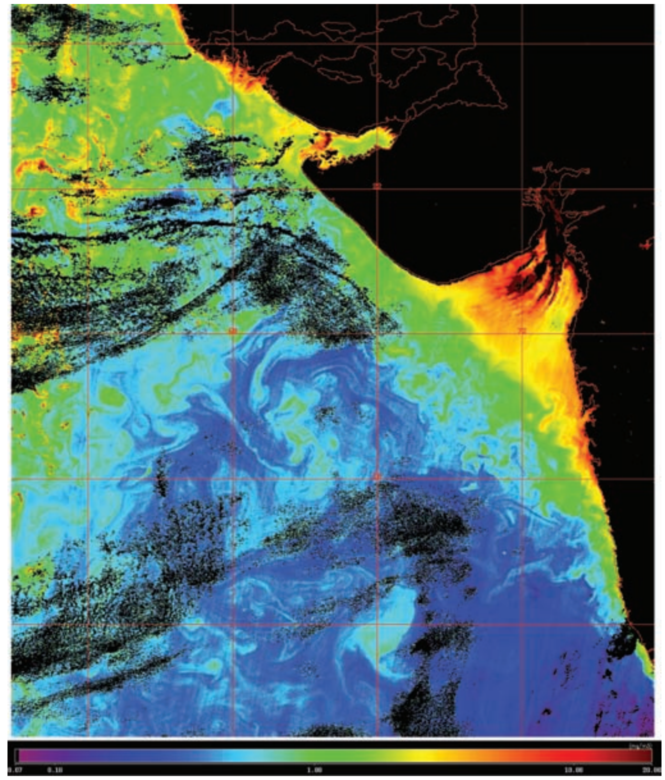


Figure 2. Chlorophyll-a distribution as captured by OCEANSAT-2 OCM over the parts of the Arabian Sea around western Indian Coast.

coastal currents, physics of mixing and relationship between ocean physics and large scale patterns of productivity, land-ocean interaction in the coastal zone and sediment dynamics on regional as well as global scales. Figure 2 shows an example of LAC chlorophyll-*a* concentration image as captured by OCEANSAT-1 OCM on February 22, 2010 over the parts of the Arabian Sea. This figure shows high chlorophyll concentration off Gujarat coast of India. This high chlorophyll concentration generally occurs in this region during the winter season. The GAC level-1B radiance data of OCM and derived geophysical products are now routinely available from National Remote Sensing Centre (NRSC) of ISRO located at Hyderabad, India.

ROSA payload onboard OCEANSAT-2 is a dual channel GPS receiver with two antennae and a receiver package. The Radio-Occultation antenna looking along the satellite velocity vector receives signals from the rising GPS satellites near the Earth's horizon. These signals get refracted by the atmosphere and from the bending angle, the temperature and humidity profiles are derived.

ROSA at a glance

Hardware	Radio Occultation Antenna, Precise Orbit determination antenna & receiver
Frequencies of operation	L1: 1560–1560 MHz L2: 1212–1242 MHz
Horizontal resolution	Less than 300 km for temperature & humidity
Vertical resolution	0.3 km (lower troposphere) 1–3 km (upper troposphere)
Accuracy	Less than 1.0 K for temperature and 0.2 g/kg for humidity

Efforts are currently on to generate operational data products on humidity and temperature profiles using ROSA data.

REPORTS

GRSS MAJOR AWARDS AND FELLOW RECOGNITIONS AT THE PLENARY SESSION

Werner Wiesbeck, IEEE GRSS Major Awards Committee Chair

IGARSS 30th Anniversary July 25–30, 2010 in Honolulu/Hawaii

IGARSS celebrated its 30th anniversary in Hawaii at the Hilton Hawaiian Village Conference Center from July 25th to 30th 2010. It is not necessary to exaggerate; this event was unique in many respects. Never had been so many papers submitted, never had so many papers been presented, never participated so many colleagues and never we were treated so well at the Reception on Sunday evening and at the Strolling Luau on Tuesday evening at an IGARSS. Many of us asked if we could have the 40th anniversary 2020 again here. The exhibition, the poster presentation and the breaks were excellent organized. I shall try to capture several events of the first three days.

The Welcome Reception Luau was held on Sunday, 25th evening, at the Hilton Hawaiian Village Great Lawn. At the entrance to the park young Hawaiian girls decorated each of us with a black stone chain. Unlike at other events the delicious food was more than enough for all of us. Everybody could meet with everybody; we were not bothered by long speeches, science was far away.

At the IGARSS 2010 Plenary Session on Monday morning, July 26th, in the Hilton Convention Centre in Honolulu, five IEEE 2010 Fellows were recognized, four 2010 Fellows were not able to be present, and three Major GRSS Awards were presented.

IGARSS 2010 was opened with the Plenary Session with distinguished guests. In their welcome addresses the IEEE Past President John Vig presented the IEEE vision and our GRSS President Alberto Moreira highlighted our GRS-Society Achievements. The conference co-chairs Karin St. Germain and Paul Smits highlighted the conference organization and the Technical Committee co-chairs Paolo Gamba and David Kunkee presented the impressive numbers of one of the most successful IGARSS conferences ever: 2857 abstracts submitted, 1.889 papers accepted, 875 oral presentations and

Around 1500 participants were hosted at the Great Lawn, surrounded by the sea and the Hilton Hotels. Many of us wore the Hawaiian blue shirts.

Guests at the Welcome Reception received from Hawaiian Girls black stone chains.

The beautiful sunset slowly ended the Reception.

IGARSS 2010 Co-Chairs Karin St. Germain and Paul Smits introducing to the conference.

IGARSS 2010 Technical Program Co-Chairs David Kunkee and Paolo Gamba presenting detailed conference information.

IEEE Past President John Vig presented view into the future of IEEE and its secret of success.

1014 poster presentations scheduled, more than 1.881 registered participants from 54 countries.

The IEEE GRSS President Alberto Moreira presented detailed data on the GRS-Society. The GRS-Society is doing very well within IEEE. It is the Society with the highest membership grow rate (41%) within the last 10 years.

IEEE Past President John Vig introduced the IEEE. He analyzed the past years, informed about the present status of IEEE, and gave a very positive vision for the next years.

IEEE GRSS President Alberto Moreira gives an insight into our GRS-Society.

The opening venue was chosen for the recognition 2010 IEEE GRSS Fellows as well as for presentation the IEEE GRSS Major Awards on stage by IEEE Past President John Vig and GRSS President Alberto Moreira.

IEEE Fellow Awards

The grade of IEEE Fellow recognizes unusual distinction in the profession and shall be conferred only by invitation of the IEEE Board of Directors upon a person of outstanding and extraordinary qualifications and experience in IEEE designated fields. The IEEE Bylaws limit the number of members who can be advanced to Fellow grade in any one year to one per mil, that is 1 in 1.000, of the Institute membership, exclusive of students and affiliates. To qualify, the candidate must be a Senior Member and be nominated by an individual familiar with the candidate's achievements. Endorsements are required from at least five IEEE Fellows and an IEEE Society best qualified to judge. The IEEE Fellow Committee, comprising 50 IEEE Fellows, carefully evaluates all nominations and presents a list of recommended candidates to the IEEE Board of Directors for the final election.

The following GRSS members were elevated to the Fellow status effective January 1st 2010:

- ***Prof. Lorenzo Bruzzone*** from the ***University of Trento, Trento, Italy***
- ***Prof. Norman Ross Chapman*** from the ***University of Victoria, Victoria, BC, Canada***
- ***Prof. Chein-I Chang*** from the ***University of Maryland, Baltimore County (UMBC), USA***
- ***Dr. David Daniels*** from the ***ERA Technology, Leatherhead, Surrey, UK***
- ***Dr. Diane L. Evans*** from the ***Jet Propulsion Laboratory, Pasadena, CA, USA***
- ***Dr. Soren N. Madsen*** from the ***Jet Propulsion Laboratory, Pasadena, CA, USA***
- ***Prof. Motoyuki Sato*** from the ***CNEAS, Tohoku University Sendai, Miyagi-ken, Japan***
- ***Dr. Valery U. Zavorotny*** from the ***NOAA/Earth System Research Laboratory, Boulder, CO, USA***

Prof. Lorenzo Bruzzone received his Fellow Award with the citation:

"For contributions to pattern recognition and image processing for remote sensing."

Lorenzo Bruzzone (S'95–M'98–SM'03–F'10) received the laurea (M.S.) degree in electronic engineering and the Ph.D. degree in telecommunications from the University of Genoa, Italy, in 1993 and 1998, respectively.

Lorenzo Bruzzone (center) receives his recognition from IEEE Past President John Vig (left) and GRSS President Alberto Moreira.

A really happy Dian Evans (center) receives her Fellow recognition.

He is currently a Professor of telecommunications at the University of Trento, Italy, where he is the Head of the Remote Sensing Laboratory. He teaches remote sensing, radar, pattern recognition, and electrical communications. His current research interests are in the areas of remote sensing, radar and SAR, signal processing, and pattern recognition. He is the author (or co-author) of 93 scientific publications in referred international journals (63 in IEEE journals), more than 140 papers in conference proceedings, and 13 book chapters. In 2008 he has been appointed as a member of the joint NASA/ESA Science Definition Team for *Outer Planet Flagship Missions*. Since 2009 he is a member of the AdCom of the IEEE Geoscience and Remote Sensing Society.

Dr. Bruzzone ranked first place in the Student Prize Paper Competition of the 1998 IEEE IGARSS. He was a recipient of the Recognition of IEEE Transactions on Geoscience and Remote Sensing (TGRS) Best Reviewers in 1999 and was a Guest Co-Editor of several Special Issues of the IEEE TGRS. In the past years joint papers presented by his students at international symposia and master theses that he supervised have received international and national awards. He was the General Chair and Co-chair of the First and Second IEEE International Workshop on the Analysis of Multi-temporal Remote-Sensing Images (MultiTemp). Since 2003, he has been the Chair of the SPIE Conference on Image and Signal Processing for Remote Sensing. From 2004 to 2006 he served as an Associated Editor of the IEEE Geoscience and Remote Sensing Letters, and currently is an Associate Editor for the IEEE TGRS. Since April 2010 he has been the Editor of the IEEE Geoscience and Remote Sensing Newsletter.

The next on to be recognized was ***Dr. Diane L. Evans*** with the citation:

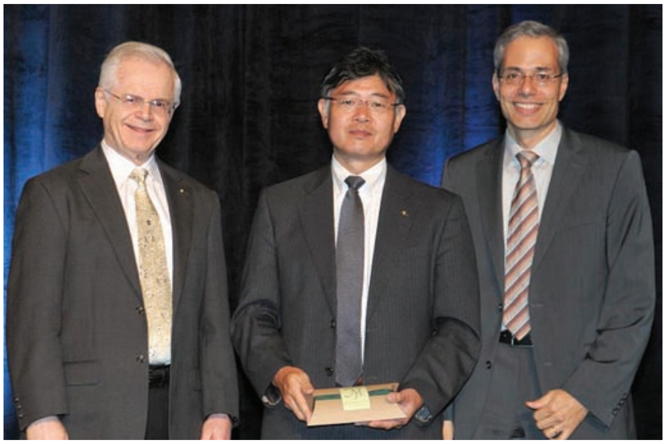
"For leadership in understanding of the Earth system through observations from space."

Diane L. Evans is the Director for Earth Science and Technology at the Jet Propulsion Laboratory. She joined JPL after receiving her Ph.D. in Geological Sciences from the University of Washington, Seattle. She has published extensively in the fields of geologic and radar remote sensing. Her field areas have included Northwest China, Australia, Hawaii, Wyoming, and the Mojave Desert of California. As Director for Earth Science and Technology, Dr. Evans is responsible for the development, implementation, and operations of JPL's Earth missions and flight experiments. These span the research areas of oceanography, atmospheric composition, and geophysics, and incorporate a broad spectrum of advanced technologies. She is also responsible for JPL's non-NASA research and technology activities, which focus on mutually beneficial collaborations with the four national space sectors.

The next on to be recognized was Prof. Motoyuki Sato with the citation:

"For contributions to radar remote sensing technologies in environmental and humanitarian applications."

Motoyuki Sato (S'79-M'80-SM'02-F'10) received the B.E., M.E. degrees, and Dr. Eng. degree in information engineering from the Tohoku University, Sendai, Japan, in 1980, 1982 and 1985, respectively. Since 1997 he is a professor at Tohoku University and a distinguished professor of Tohoku University since 2007, and he is the Director of Center for Northeast Asian Studies, Tohoku University since 2009. From 1988 to 1989, he was a visiting researcher at the Federal German Institute for Geoscience and Natural Resources (BGR) in Hannover, Germany. His current interests include transient electromagnetics and antennas, radar polarimetry, ground penetrating radar (GPR), borehole radar, electromagnetic induction sensing, interferometric and polarimetric SAR. He has conducted the development of GPR sensors for humanitarian demining, and his sensor ALIS, which is a hand-held dual sensor, has detected more than 40 mines in mine fields in Cambodia since May 2009. He is a visiting Professor at Jilin University, China, Delft University of Technology, The Netherlands, and Mongolian University of Science



Motoyuki Sato (center) receives his recognition from IEEE Past President John Vig and Alberto Moreira.

Valery Zavorotny (center), who recognizes his 2010 Fellow.

and Technology. Dr. Sato is a member of the GRSS AdCom (2006–) where he is responsible for specialty symposia and Asian issues. He is an associate editor of IEEE GRSS Newsletter, and a guest editor of the special issue of GPR2006 in Transactions on Geoscience and Remote Sensing and GPR2010 in J-STARS. He was the chair of the IEEE GRSS Japan Chapter (2006–2007). He is a general chair of IGARSS2011 to be held in Sendai, Japan.

The next Fellow to be honored is ***Dr. Valery U. Zavorotny*** with the citation:

"For contributions to ocean remote sensing and wave propagation in random media."

Valery U. Zavorotny (M'01–SM'03) received the M.Sc. degree in radio physics and electronics from Gorky State University, Gorky, Russia, in 1971, and the Ph.D. degree in physics and mathematics from the Institute of Atmospheric Physics, USSR Academy of Sciences, Moscow, in 1979. From 1971 to 1990, he was a Research Scientist with the Institute of Atmospheric Physics of the USSR Academy of Sciences, Moscow, where he introduces an innovative approach based on a method of path integrals applied for calculation of wave intensity statistics in the problem of strong scintillations of electromagnetic waves propagating through random media. This approach was used for modeling laser beam propagation through the turbulent atmosphere, optical remote sensing techniques to measure turbulence, astronomical imaging techniques. In 1990, he joined the Astro Space Center at Lebedev Physical Institute, Moscow, Russia were he has been studying effects of random interstellar medium on long-distance radio-interferometry.

In 1991–2000, he was a CIRES Research Associate in the Environmental Technology Laboratory of the National Oceanic and Atmospheric Administration (NOAA), Boulder, Colorado, U.S.A. Currently he is a physicist at the NOAA Earth System Research Laboratory, Physical Sciences Division, Boulder, Colorado. Dr. Zavorotny's current research interests include modeling of electromagnetic wave scattering from ocean waves, development of the GPS bistatic radar technique for ocean altimetry and scatterometry, for soil moisture and snow remote sensing applications.

Dr. Zavorotny is a member of URSI Commission F and the American Geophysical Union.

The next on to be recognized is ***Prof. Ian Cumming***. He received the Fellow Award 2009, when unable to be recognized. His citation is:

"For achievements in synthetic aperture radar signal processing."

Ian G. Cumming (S'63–M'66–SM'05–LSM'06) received the B.Sc. degree in engineering physics from the University of Toronto, Toronto, ON, Canada, in 1961, and the Ph.D. degree in computing and automation from Imperial College, University of London, London, U.K., in 1968. In 1977, he was with MacDonald, Dettwiler and Associates Ltd., Richmond, BC, Canada, where he developed SAR signal processing algorithms, including Doppler estimation and auto focus routines. He has been involved in the algorithm design of digital SAR processors for SEASAT, SIR-B, ERS-1/2, J-ERS-1, and RADARSAT, as well as several airborne radar systems. He was a Visiting Scientist with the German Aerospace Center (DLR), Oberpfaffenhofen, for one year in 1999. Since 1993, he has been with the Department of Electrical and Computer Engineering, University of British Columbia, Vancouver, BC, Canada, where he is the MacDonald Dettwiler/NSERC Industrial Research Chair in radar remote sensing. The Radar Remote Sensing Laboratory has published papers in the fields of SAR processing, SAR data encoding, satellite SAR two-pass interferometry, airborne along-track interferometry, polarimetric radar image classification, and SAR Doppler estimation.

The following 2010 IEEE Fellows were not able to attend the IGARSS Plenary Session to be recognized:

Ian Cumming (center) with John Vig and Alberto Moreira.

Prof. Norman Ross Chapman, citation:

"For contributions to geo-acoustic characterization of ocean bottom environments."

Prof. Chein-I Chang, citation:

"For contributions to hyperspectral image processing."

Dr. David Daniels, citation:

"For contributions to Ground-Penetrating Radar."

Dr. Soren Norvang Madsen, citation:

"For leadership in the design and development of air-borne and space-borne remote sensing instruments."

IEEE GRSS Major Awards

The call for nominations for the *GRSS Distinguished Achievement Award, GRSS Outstanding Service Award* and the *GRSS Education Award* are published in the GRSS Newsletter. The nomination forms are available on the GRSS home page (http://www.grss-ieee.org/about/awards/). Any member, with the exception of GRSS AdCom members, can make nominations to recognize deserving individuals. Typically the lists of candidates comprise three to five names. An independent *Major Awards Committee* makes the selection, which is approved by the GRSS AdCom.

IEEE GRSS Distinguished Achievement Award

The **Distinguished Achievement Award** was established to recognize an individual who has made significant technical contributions, within the scope of GRSS, usually over a sustained period. In selecting the individual, the factors considered are quality, significance and impact of the contributions; quantity of the contributions; duration of significant activity; papers published in archival journals; papers presented at conferences and symposia; patents granted; and advancement of the profession. IEEE membership is preferable but not required. The award is considered annually and presented only if a suitable candidate is identified. The awardee receives a plaque and a certificate.

The **2010 IEEE GRSS Distinguished Achievement Award** is presented to ***Prof. Dr. Jakob J. van Zyl*** from *Jet Propulsion Laboratory, Pasadena, CA, USA* with the citation:

"For contributions to the field of radar polarimetry, radar interferometry, and airborne and space borne synthetic aperture radars."

All present 2009/2010 IEEE GRSS Fellows (from left) with Awards Chair Werner Wiesbeck and IEEE Past President John Vig: Ian Cumming, Valery Zavorotny, Motoyuki Sato, Diane Evans, Lorenzo Bruzzone; GRSS President Alberto Moreira at the right.

The 2010 IEEE GRSS Distinguished Achievements Award recipient Jakob van Zyl (center) receives from the GRSS President Alberto Moreira a plaque and a certificate.

Jakob J. van Zyl (S'85-M'86-SM'95-F'99) was born in Outjo, Namibia in 1957. He received the Hons. B. Eng. degree *cum laude* in electronics engineering from the University of Stellenbosch, Stellenbosch, South Africa, in 1979, and also received the Siemens prize for best achievement in the graduating class from the electrical engineering department. He received the M.S. and Ph.D. degrees in electrical engineering from the California Institute of Technology, Pasadena, in 1983 and 1986, respectively. In 1984 he was the recipient of an Schlumberger Foundation fellowship. Dr. van Zyl received the 1997 Fred Nathanson Memorial Radar Award to the Young Engineer of the Year from the IEEE Aerospace and Electronics Systems Society. He joined the Jet Propulsion Laboratory in Pasadena, California in 1986, where he worked as a research scientist, the supervisor of the Airborne SAR Group, the Manager of the Radar Science and Engineering Section, and several other management positions. At present he is the Director for Astronomy and Physics at JPL. Dr. van Zyl teaches "Introduction to the Physics and Techniques of Remote Sensing" at the California Institute of Technology and is an Extraordinary Professor in the Electrical Engineering Department at the University of Stellenbosch in South Africa. He is the co-author of two books, has contributed to thirteen books and published numerous papers in peer reviewed journals and conference proceedings. His research interests include SAR polarimetry and interferometry, radar system engineering, and radar soil moisture development. He has participated as a researcher in several space missions, including SIR-C/X-SAR, SRTM and is on the Science Definition Team of the Soil Moisture Active Passive (SMAP) mission.

IEEE GRSS Outstanding Service Award

The **Outstanding Service Award** was established to recognize an individual who has given outstanding service for the benefit and advancement of the Geoscience and Remote Sensing Society. The award shall be considered annually but will not be presented unless a suitable candidate is identified. The following factors are suggested for consideration: leadership innovation, activity, service, duration, breadth of participation and cooperation. GRSS membership is required. The awardee receives a certificate.

The **2010 Outstanding Service Award** is presented to ***Dr. Tom Lukowski*** from the *Defence R&D Canada, Ottawa, Canada* with the citation:

"In recognition of his outstanding service for the benefit and advancement of the IEEE Geoscience and Remote Sensing Society."

Tom I. Lukowski (M'99) received the B. Eng. (Honours) in Engineering Physics from McMaster University, Hamilton, ON, Canada in 1976 and the M.S. from the Institute of Optics at the University of Rochester, Rochester, NY in 1979.

From 1983 until August 2005, he was at the Canada Centre for Remote Sensing (CCRS), now of Natural Resources Canada, Ottawa, ON. He was introduced to Synthetic Aperture Radar in the RADARSAT Project Technical Office while involved in systems design studies for the SAR to be carried on RADARSAT-1. He then worked on various aspects of SAR systems and their exploitation, both airborne (in particular, the C- and X-SARs on the Canadian Government Convair-580) and space-borne. He was a member of the team working on the image quality and calibration of RADARSAT-1. Other experience at CCRS was in ground station operations. Since 2005, he has been at Defence Research and Development Canada, Ottawa, ON where his interests continue to be in the characterization, analysis, and exploitation of SAR systems.

Mr. Lukowski was a Technical Program Co-Chair for the joint IGARSS 2002 / 24th Canadian Symposium on Remote Sensing (Toronto) and IGARSS 2004 (Anchorage). Since 2004, he has been an Associate Editor of the IEEE Geoscience

Tom Lukowski (center) is the recipient of the 2008 IEEE GRSS Outstanding Service Award.

and Remote Sensing Letters. He has been a member of the IGARSS Technical Program Committee (1998 to present). He was the Ontario Representative on the Executive of the Canadian Remote Sensing Society (2000–2005), and is an Associate Fellow (2001) and member of the Council of the Canadian Aeronautics and Space Institute (CASI) (2001 to present). He has participated on the organizing, scientific, and/or technical program committees for the Canadian Symposium on Remote Sensing, the CASI Conference on Astronautics, the CEOS Working Group on Calibration SAR Workshop and the Advanced SAR Workshop. He is a member of the Professional Engineers of Ontario.

IEEE GRSS Education Award

The **Education Award** was established to recognize an individual who has made significant educational contributions to the field of GRSS. In selecting the individual, the factors considered are significance of the educational contribution in terms of innovation and the extent of its overall impact. The contribution can be at any level, including K-12, undergraduate and graduate teaching, professional development, and public outreach. It can also be in any form (e.g. textbooks, curriculum development, educational program initiatives). IEEE GRSS membership or affiliation is required. The awardee receives a certificate.

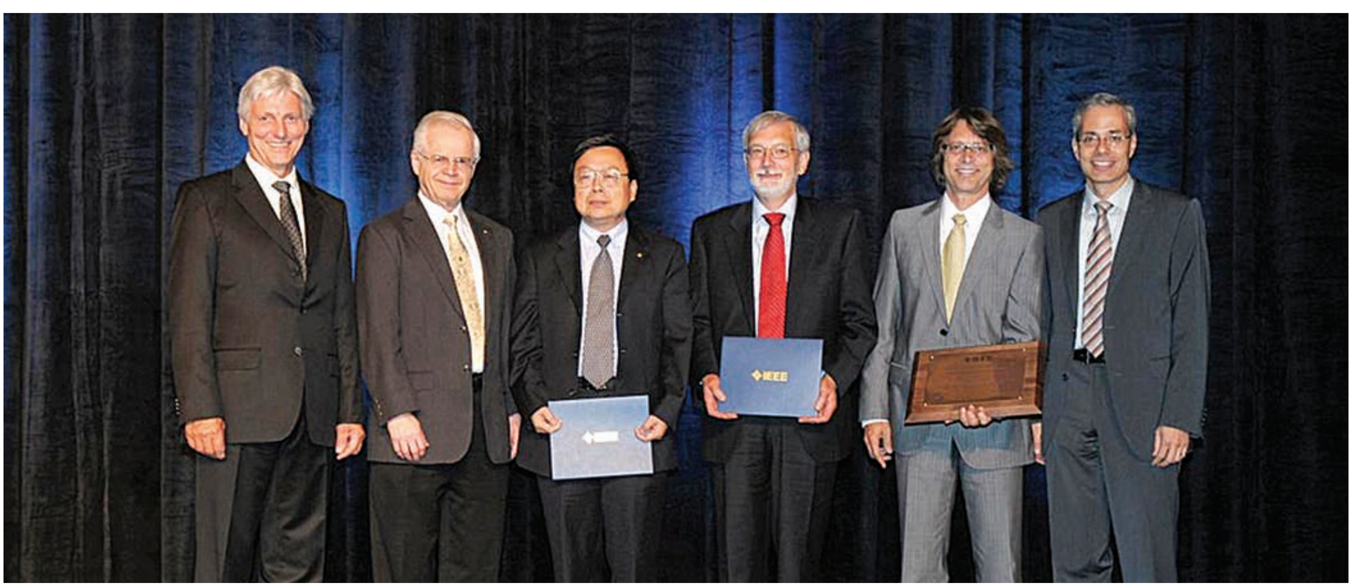
The **2010 Education Award** is presented to ***Prof. Ya-Qiu Jin*** from the Key Laboratory MOE, Fudan University, Shanghai 200433, China with the citation:

"In recognition of his significant educational contributions to Geoscience and Remote Sensing."

Ya-Qiu Jin graduated from Peking University, Beijing, China in 1970, and received the M.S., E.E., and Ph.D. degrees from the Massachusetts Institute of Technology, Cambridge, USA in 1982, 1983 and 1985, respectively. All the degrees are from electrical engineering.

He was the Research Scientist with the Atmospheric and Environmental Research, Inc., Cambridge MA, USA (1985); the Research Associate with the City University of New York (1986–1987); and the Visiting Professor with the University of York, U.K. (1993–1994), the City University of Hong Kong (2001) and Tohoku University, Japan (2005). He held the Senior Research Associateship at NOAA/NESDIS awarded by the USA National Research Council (1996). He is currently a Chair Professor of Fudan University, Shanghai, China, and

Ya-Qiu Jin (center) receives the third major IEEE GRSS Award, the Education Award from our President Alberto Moreira.



The group of all three major IEEE GRSS Award recipients poses with the Awards Chair Werner Wiesbeck (left), IEEE Past President John Vig and our GRSS President Alberto Moreira (right); Ya-Qiu Jin, Tom Lukowski and Jakob van Zyl.

the Director of the Key Laboratory of Wave Scattering and Remote Sensing Information (MoE, Ministry of Education). He has been appointed as the Principal Scientist for the China State Key Basic Research Project (2001–2006) by the Ministry of National Science and Technology of China to lead the remote sensing program in China.

He has published more than 590 papers in refereed journals and conference proceedings and ten books, three of which are in English [*Electromagnetic Scattering Modeling for Quantitative Remote Sensing* (World Scientific, 1994), *Information of Electromagnetic Scattering and Radiative Transfer in Natural Media* (Science Press, 2000), *Theory and Approach for Information Retrieval from Electromagnetic Scattering and Remote Sensing* (Springer, 2005)]. He is the Editor of SPIE Volume 3503 *Microwave Remote Sensing of the Atmosphere and Environment*, and the book *Wave Propagation, Scattering and Emission in Complex Media* (World Scientific and Science Press, 2004). His main research interests include polarimetric scattering and radiative transfer in complex natural media, microwave remote sensing, as well as theoretical modeling, information retrieval and applications in atmosphere, ocean, Earth and planetary surfaces, and computational electromagnetics.

Dr. Jin is an IEEE Fellow, the member of IEEE GRSS AdCom, Chair of IEEE Fellow Evaluation Committee in GRSS, the Associate Editor of IEEE Transactions on Geoscience and Remote Sensing, and IEEE GRSS Distinguished Speaker (2010-). He is Co-Chair of TPC of IGARSS2011, ISAPE (2000, 2010) and Chair of JURSE (2009) and several international conferences. He is the Founder and Chairman of IEEE GRSS Beijing Chapter (1998–2003).

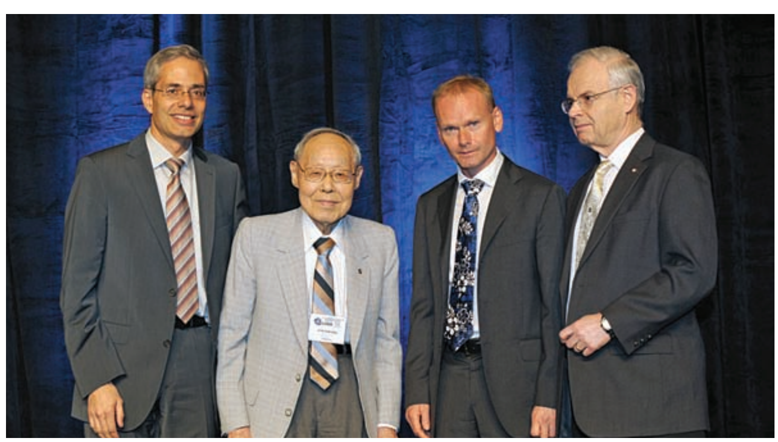
He received the China National Science Prize (1993), the first-grade MoE Science Prizes (1992, 1996 and 2009), and the first-grade Guang-Hua Science Prize (1993), Prize of Fudan President among many other prizes.

After the break a life videoconference with a Keynote – *Science and Technology in Support of Democracy: Citizen Participation* followed. The introduction was given by Session Moderator – *Dr. Shelby Tilford*. The keynote statements from the White House were given by *Aneesh Chopra, Chief Technology Officer and Assistant to the President* and *Shere Abbott, Associate Director for Environment from US Office of Science and Technology Policy (OSTP)*. They stressed the intention of the US Government in the future investment in Remote Sensing for the benefit of mankind, environment, resources, and living.

The keynote was followed by the Plenary Discussion, with presentations by leading scientists of international remote sensing institutions: *NASA – Dr. Michael Freilich, Director, Earth Science Division, Science Mission Directorate; JAXA – Dr. Masanobu Shimada, Space Applications Mission Directorate and ESA – Dr. Yves-Louis Desnos, Head of R&D Section & Senior Advisor Science, Applications and Future Technologies Department*. The plenary speakers outlined the state of Remote Sensing in their countries and gave plans and visions for the future. Shelby Tilford led the discussion again.

On Tuesday evening a Luau at the Sheraton Hotel, one km away from the conference center was held, especially for the IGARSS 30th anniversary. More than 2000 participated, including spouses and children. A fantastic event. Two bands entertained with Hawaiian music and on one of the tribunes Hawaiian dancers entertained so well that dozens of us could not stop taking movies. For some it became a long evening.

This photo shows Plenary speakers: Shelby Tilford (standing), Michael Freilich, Masanobu Shimada and Yves-Louis Desnos (from left).


Kiyo Tomiyasu, Alberto Moreira (left), Paul Smits (second right), John Vig (right).

Kiyo Tomiyasu was recently elected a member of the IEEE Heritage Circle of the IEEE foundation. This was recognized at the Plenary Session by President Alberto Moreira, and on Wednesday afternoon a session *Honoring the Achievements of Kiyo Tomiyasu* was dedicated to him. Kiyo has since more than 40 years set strategies for Radar Remote Sensing by visionary techniques, and he pursued the creation and development of our GRS-Society since its first days in 1980. He was a member of the GRSS AdCom and chaired the Awards Committee. His advice and his information sources are still of valuable support for our Society. The photo on the right was taken at the end of the Plenary Session.

This short illustration of the first days of IGARSS 2010 and the well organized oral sessions, the poster sessions and the exhibition show why some of the participants are already now dreaming of IGARSS 2020.

The presentation of the publication awards will be published in the December edition of the GRSS Newsletter.

Thanks to all contributors, especially Paul Smits for some of these photos.

Werner Wiesbeck

Impressions from the Tuesday IGARSS 30th anniversary celebration.

Kiyo Tomiyasu received standing ovations at the Plenary, never seen this before in such a session.

REPORT ON THE 2009 EUROPEAN GRS-S PHD EXCELLENCE AWARDS

Jocelyn Chanussot, GIPSA-Lab, Grenoble Institute of Technology, France

Introduction

In 2009, the IEEE Geoscience and Remote Sensing Society (GRS-S) decided to support an initiative emanating from European chapters and established the European GRS-S PhD Excellence Awards. The prizes were five awards of equal value consisting in an IEEE certificate of recognition and an honorarium of 500 USD for each awardee. The rationale behind this unranked list of winners lies in the diversity of our community. While it is easy to identify outstanding contributions, ranking these contributions, which can be of so many different natures, from applications to theoretical algorithmic development or physical modelling, in passive or active imagery, does not make much sense.

The call for applications was issued for all the young new doctors in remote sensing who defended their PhD in 2008. The applications went through the local chapters and the chapter chairs were asked to submit a short list of up to two applications to the award committee. The award committee consisted of Alberto Moreira, President of GRS-S, Jocelyn Chanussot, Chair of GRS-S membership development and Lorenzo Bruzzone, Chair of the GRS-S chapter activities. The final selection was made based on the recommendations of the Chapter Chairs and on the individual merits of the applications. It is our pleasure to present in this article the five awardees with a summary of their work. They are listed below in alphabetical order. We wish all of them a brilliant continuation of their career in remote sensing, with no doubt that their work will have a significant societal impact in the future. Congratulations to all of them!

Michael Esselborn
for his work on: LIDAR-measurement of the atmospheric aerosols' extinction based on the field study SAMUM-1

Giampaolo Ferraioli
for his work on: Multichannel SAR interferometry based on statistical signal processing

Luis Gomez Chova
for his work on: Cloud screening algorithm for MERIS and CHRIS multispectral sensors

Ting Peng
for her work on: New higher-order active contour models, shape priors, and multiscale analysis. Their application to road network extraction from very high resolution satellite images

Roberto Sabia
for his work on: Sea surface salinity retrieval error budget within the ESA Soil Moisture and Ocean Salinity mission

Please note that a similar procedure will be conducted to select the five best Geoscience and Remote Sensing PhDs defended in 2009. Stay tuned!

PhD summary of the five awardees

A. Michael Esselborn: LIDAR-measurement of the atmospheric aerosols' extinction based on the field study SAMUM-1

Atmospheric aerosol particles affect the Earth's climate system by scattering solar and terrestrial radiation and changing the properties of clouds, respectively. In contrast to green house gases the climatic effects of aerosols are much more complex and more difficult to assess. Currently, the magnitude of the aerosol's impact on climate is the largest uncertainty in our knowledge on climate change. Reducing these uncertainties particularly requires highly resolved observations of the aerosol extinction.

Using lidar (light detection and ranging) atmospheric aerosol profiling can be done with a vertical resolution as low as a few meters. However, standard backscatter lidar systems cannot measure aerosol extinction quantitatively. They detect only one signal which depends at least on two unknowns. In contrast, the method of high spectral resolution lidar (HSRL) takes advantage of the different spectral broadening of light scattered by aerosols and molecules, respectively. Using an ultra— narrow band spectral filter a HSRL provides a molecular backscatter signal from which the aerosol extinction can be directly derived.

Within the scope of this study an airborne HSRL has been successfully developed and deployed aboard the DLR research aircraft 'Falcon' during the Saharan Mineral Dust Experiment (SAMUM, 2006) in Morocco.

The HSRL was developed as an extension of an existing water vapor differential absorption lidar. For the purpose of high resolution spectroscopy an iodine vapor filter system was integrated into the sensor module of the lidar receiver. For successful HSRL operation the pulsed, high—power transmitter laser had to be frequency stabilized to keep relative wavelength deviations below the order of 10^{-8}. This has been achieved using a robust method based on acousto—optical modulation, which has been specifically developed for this purpose.

Using the new instrument optical properties such as extinction – and backscatter coefficients as well as lidar—and depolarization ratios of pure Saharan dust have been measured for the first time close to its source regions. The HSRL measurements were compared to independent and established ground—based instruments in order to validate the HSRL accuracy. The comparisons showed good agreement within the instrumental limits of uncertainty. Thus, the new HSRL can be deployed to validate remote sensing satellite instruments applied for aerosol detection. Within the scope of this work the aerosol—optical thickness retrieved by the MISR satellite instrument was validated with coordinated HSRL measurements during three measurement flights.

The HSRL development also contributes to the 'EarthCARE' satellite mission of the European Space Agency (ESA). One of the key instruments of this mission will be a HSRL for aerosol and cloud profiling on a global scale. During SAMUM a joint ESA—DLR project was successfully delivered to provide high—quality HSRL data products and observations of desert dust. A study, which is being performed in cooperation with ESA currently, aims at defining instrument performances and retrieval capabilities for future satellite missions.

Michael Esselborn received his PhD from the Ludwig Maximilians University Munich, Germany

B. Giampaolo Ferraioli: Multichannel SAR interferometry based on statistical signal processing

The aim of the thesis is to deeply study, discuss and analyze the Interferometric Synthetic Aperture Radar (SAR) processing based on Statistical Signal Processing when different multichannel data are available.

The first chapters of the thesis present recalls of Statistical Estimation theory, with a particular attention to Markov Random Field theory, and recalls of Interferometric SAR systems and of the height reconstruction problem.

Different innovative research contributions in the field of interest are presented. Initially, a Maximum Likelihood (ML) based technique to retrieve the phase offsets that affect multichannel interferometric data is presented. The interferograms are, in fact, known except for a not known slowly varying phase that arises from the presence of several factors, such as a non perfect synchronization in the acquisition system, SAR processing errors, atmospheric effects and parallel-baselines uncertainty. The phase offset is different for each interferogram. Without phase offset estimation, it is not possible to restore the correct relation between the available interferograms, which is needed by a multichannel phase unwrapping algorithm in order to retrieve the height of the considered scene.

The second interesting contribution provided in this thesis is related to building edge detection in urban areas. The idea is to use multichannel interferometric data in order to retrieve building edges in urban areas. The approach is based on the estimation of local hyperparameters, used to model the unknown height of the pixels image. The hyperparameters can be considered as an indicator of the spatial correlation between neighboring pixels. Once the hyperparameter estimation has been performed, building edges are easily detected. The method overcomes the traditional problems typical of SAR edge detectors.

A new technique to improve the height reconstruction in urban areas, affected by the layover phenomena, is also presented. The method is based on the use of multichannel InSAR data in combination with auxiliary data, which can be provided by the shadowing areas in SAR intensity images or by an optical image of the same scene. The auxiliary data are used to refine the hyperparameters map, on which the Maximum a Posteriori (MAP) multichannel height reconstruction is based. This allows to improve the height reconstruction, in particular on the phase discontinuities that the layover implies.

The last innovative aspect presented in the thesis is a new fast and robust multichannel phase unwrapping method. The proposed method is based on Total Variation energy model and Graph Cut optimization based algorithms. Towards other classic phase unwrapping techniques, thanks to the multichannel approach, the method is able to restore the solution in many critical cases (high discontinuities, low coherence). Moreover, the method overcomes some limits that can arise using other multichannel phase unwrapping techniques; in particular, the proposed method is at the same time robust and not time demanding, being able to guarantee the global optimum solution for the considered problem in a very short time.

Finally, in the last part of the thesis a quick overview on future developments of the work are presented: SAR Tomography and Ground Based Interferometric systems.

Giampaolo Ferraioli received his PhD from the Università degli Studi di Napoli Parthenope, Italy.

C. Luis Gomez Chova: Cloud screening algorithm for MERIS and CHRIS multispectral sensors

Earth Observation systems monitor our Planet by measuring, at different wavelengths, the electromagnetic radiation that is reflected by the surface, crosses the atmosphere, and reaches the sensor at the satellite platform. In this process, clouds are one of the most important components of the Earth's atmosphere affecting the quality of the measured electromagnetic signal and, consequently, the properties retrieved from these signals. The PhD Thesis "Cloud screening algorithm for MERIS and CHRIS multi-spectral sensors" faces the challenging problem of cloud screening in multispectral and hyperspectral images acquired by space-borne sensors working in the visible and near-infrared range of the electromagnetic spectrum. The main objective is to provide new operational cloud screening tools for the derivation of cloud location maps from these sensors' data. Moreover, the method must provide cloud abundance maps—instead of a binary classification—to better describe clouds (abundance, type, height, subpixel coverage), thus allowing the retrieval of surface biophysical parameters from satellite data acquired over land and ocean. In this context, this Thesis is intended to support the growing interest of the scientific community in two multispectral sensors on board two satellites of the European Space Agency (ESA). The first one is the MEdium Resolution Imaging Spectrometer (MERIS), placed on board the biggest environmental satellite ever launched, ENVISAT. The second one is the Compact High Resolution Imaging Spectrometer (CHRIS) hyperspectral instrument, mounted on board the technology demonstration mission PROBA (Project for On-Board Autonomy). The proposed cloud screening algorithm takes advantage of the high spectral and radiometric resolution of MERIS, and of the high number of spectral bands of CHRIS, as well as the specific location of some bands (e.g., oxygen and water vapor absorption bands) to increase the cloud detection accuracy. To attain this objective, advanced pattern recognition and machine learning techniques to detect clouds are specifically developed in the frame of this Thesis. First, a feature extraction based on meaningful physical facts is carried out in order to provide informative inputs to the algorithms. Then, the cloud screening algorithm is conceived trying to make use of the wealth of unlabeled samples in Earth Observation images, and thus unsupervised and semi-supervised learning methods are explored, giving special attention to advanced kernel methods. Results show that applying unsupervised clustering methods over the whole image allows us to take advantage of the wealth of information and the high degree of spatial and spectral correlation of the image pixels, while the proposed semisupervised learning methods, such as the Laplacian SVM and mean kernels, offer the opportunity of efficiently exploiting the available labeled samples.

Luis Gomez-Chova received his Ph.D. from the Universitat de Valencia, Spain.

D. Ting Peng: New higher-order active contour models, shape priors, and multiscale analysis. Their application to road network extraction from very high resolution satellite images

The need to segment, from an image, entities that have the form of a 'network', i.e. branches joining together at

junctions, arises in a variety of domains. Examples include the segmentation of road and river networks in remote sensing imagery, and of vascular networks in medical imagery. Detecting roads from remotely sensed imagery is critical for many applications, for example cartographic data updating, intelligent navigation, environmental monitoring, disaster management, and so on. Recently, the commercial availability of very high resolution (VHR) optical satellite images (QuickBird, Ikonos, and in the near future Pleiades, with sub-metric resolutions, provides new opportunities for the extraction of information from remotely sensed imagery. At this resolution, qualitatively new categories of information are available, and the accuracy of previously extracted categories of information can be quantitatively improved. As a result, road extraction from VHR images has become an increasingly important research topic in remote sensing.

Higher resolution brings with it new challenges however. The appearance of details invisible in lower resolution images can easily disrupt the recognition process. The difficulties lie in the following factors. First, much `noise' exists in the road region due to cars, road markings, shadows, etc., while the background is very diverse, containing many features that are locally similar to roads. Second, rather than being simple lines as in images at low resolutions, i.e. more than 5m/pixel, roads appear as elongated, more or less homogeneous surfaces with different widths and curvatures. It is a hard task to retrieve road surfaces. The above factors result in the relative failure of existing road extraction approaches.

In this PhD, we have successfully solved the problem of quasi-automatic road network extraction and map updating in dense urban areas from VHR optical satellite images. Our models are based on the recently developed higher-order active contour (HOAC) phase field framework: a phase field HOAC prior energy describes our prior knowledge of the geometry of a road network region; and a data energy describes the image we expect to see given a road network. By minimizing the total energy with respect to the road region, an estimate of the road network is obtained.

My research was carried out in the three following aspects. First, to overcome the great complexity of the information existing in VHR images, we focused on a multiresolution analysis of the model. On the one hand, we introduced a multiresolution statistical data model. The use of several resolutions allows the combination of coarse resolution data, in which the detail that can disrupt recognition has been eliminated, with fine resolution data to increase precision. On the other hand, we proposed a two-step robust multiresolution framework. In such a framework, we segmented at first a low resolution image, and obtained an approximate pre-segmentation of the object of interest. This preliminary result was then incorporated into the segmentation at full resolution. It can force the final segmentation to lie close to the pre-segmentation, and thus diminish the local minima of the total energy at full resolution.

Second, in the context of updating an outdated digital map, we proposed a specific prior term to incorporate the information available from a Geographical Information System (GIS) map. This map dates from before the image was acquired, and thus represents a different road network: the accuracy needs to be improved, and the network topology needs to be corrected. In this model, we included three different types of prior geometric knowledge characterized by their level of generality. From the most *generic* to the most specific, they are: generic boundary smoothness constraints; intermediate prior knowledge for modeling a family of shapes; and specific shape prior knowledge of the road network at an earlier date derived from GIS data. We showed all three types of prior knowledge to be essential for overcoming the complexity of 'geometric noise' in VHR images.

Third, we introduced two new models for network modeling: one with an additional nonlinear nonlocal HOAC term, and one with an additional linear nonlocal HOAC term, because the previous models suffer from a severe limitation: network branch width was constrained to be similar to maximum network branch radius of curvature, thereby providing a poor model of networks with straight narrow branches or highly curved, wide branches. Both nonlocal HOAC terms allow separate control of branch width and branch curvature, and furnish better prolongation for the same width. But the linear term has several advantages: it is more efficient from a computational standpoint, and it is able to model multiple widths simultaneously. To cope with the difficulty of parameter selection of these models, we analyzed the stability conditions for a long bar with a given width described by these energies, and hence showed how to choose rigorously the parameters of the energy functions.

We tested and evaluated the proposed models on QuickBird panchromatic images of Beijing, and compared them to several other techniques in the literature. The experimental results and comparisons demonstrated the superiority of our models. To summarize, in this thesis, we made two main contributions with respect to the literature. In problem-specific terms, we made progress towards an automatic road extraction system for VHR optical satellite images. In methodological terms, we developed several models that contain a great deal of prior knowledge about the appearance and shape of road networks, taking advantage of the multiscale nature of the phenomena in the images, the existence of outdated road maps, and the strong geometrical constraints that characterize roads.

Ting Peng received her PhD from the University of Nice Sophia-Antipolis, France and also from the Graduate University of the Chinese Academy of Sciences, China.

E. Roberto Sabia: Sea surface salinity retrieval error budget within the ESA Soil Moisture and Ocean Salinity mission

Global measurements of sea salinity will provide direct insights on the relationships and feedback between oceans and climate. Nevertheless, despite the recent deployment of the Argo-buoys system, over most of the global oceans extensive in-situ time series are still lacking.

The European Space Agency's Soil Moisture and Ocean Salinity (SMOS) satellite mission aims at filling this gap by providing synoptically and routinely this information. SMOS carries the first-ever, space-borne, 2-D interferometric radiometer and, since its launch in November 2009, measures the sea surface salinity (SSS) over the oceans by measuring the emitted microwave radiation at 1.4 GHz (L-band).

The retrieval of salinity is an inverse problem that involves the minimization of a cost function. In order to ensure a reliable estimation of this variable, all the other parameters affecting the measured brightness temperature (T_B) will have to be taken into account, filtered or quantified. The overall retrieved product will thus be salinity maps in a single satellite overpass over the Earth. The proposed accuracy requirement for the mission is specified as 0.1 psu (practical salinity unit) after averaging in a 10-day and 2×2 spatio-temporal boxes.

Within the framework of the pre-launch simulation studies, several analyses have been performed towards the determination of a reliable ocean salinity error budget.

The salinity retrieval main features and issues that are considered critical to the inversion procedure are:

- Scene-dependent bias in the SMOS measurements,
- Radiometric errors (associated with radiometric resolution or imperfect instrument and calibration),
- L-band forward geophysical model function (GMF) definition,
- Auxiliary data, namely sea surface temperature (SST) and wind speed (U10), collocation and uncertainties,
- Constraints in the cost function, especially in the salinity term, and
- Adequate spatio-temporal averaging.

Having in mind that different tuning and setting of the minimization algorithm lead to different salinity retrieval performances, the error budget has been progressively determined by evaluating the extent of the impact of different variables and parameterizations in terms of salinity error.

The impact of several multi-sources auxiliary data of SST and U10 on the final SSS error has been addressed. This provided a feeling of the quantitative error that should be expected in real measurements, whilst, in another study, the potential use of reflectometry-derived signals (GNSS-R) to correct for sea state uncertainty in the SMOS context has been investigated.

The core of the analysis concerned the overall retrieved SSS Error Budget. The error sources have been consistently binned and the corresponding effects in terms of the spatio-temporally averaged SSS error have been addressed in various algorithm configurations. A novel aspect that has been investigated dealt with the sensitivity analysis of the uncertainty of the auxiliary salinity field, to possibly identify whether SSS constraints are a bottle-neck for the retrieval. A proper balancing of the various terms of the cost function is proposed to address this issue in the near future. Regularization factors will likely to be introduced to ensure that the various terms are self-consistent.

Furthermore, a salinity horizontal variability study, carried out by using input data at increasingly variable spatial resolution, has been performed, with the aim of assessing the capability of retrieved SSS to reproduce mesoscale oceanographic features.

Roberto Sabia received his Ph.D. from the Universitat Politècnica de Catalunya (UPC), Barcelona, Spain.

REPORT ON THE XIII INTERNATIONAL CONFERENCE ON GROUND PENETRATING RADAR

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The XIII International Conference on Ground Penetrating Radar (GPR2010) was held in Lecce, Italy from 21 to 25 June 2010 (www.ibam.cnr.it/gpr2010, on line at least up to June 2012).

GPR2010 was held in the historical and fascinating frame of the castle "Carlo V", kindly made available by the Municipality of Lecce (see fig. 1), and set up on purpose for this conference (it usually hosts artistic exhibitions rather than scientific conferences).

The Conference had about 250 attendants, among which many young researchers and about 40 pupils of the School of Specialization in Archaeology of the University of Salento, 15 exhibitions and several sponsorships, further than several patronages, among which those particularly prestigious from UNESCO, Red Cross and WWF, to witness the interest of the GPR technique for cultural heritage, humanitarian and environmental applications.

The Conference attracted about 200 papers and 181 papers were accepted for the presentation whereas about ten papers were rejected. The review process was very accurate thanks to the work of about 90 reviewers, coordinated by three Technical Co-Chairs. The Proceedings are now available at IEEE Xplore (ISBN = 978-1-4244-4605-6) and three special issues are under preparation.

Within the conference, three tutorials and a workshop have been organized. The three tutorials have been focused on: the use of GPR in Archaeological Applications; the trade-offs between GPR and other geophysical techniques in the monitoring of structures; the measurement/characterization of the electromagnetic properties of the soils. The participants to any of the tutorials received a CD with the material comprehensive of the three tutorials (the CD is still available on request).

The workshop has been focused on positioning systems for 3D GPR prospecting. GPR2010 has also hosted a meeting of the European GPR Association (EuroGPR).

Four invited talks have been held during the conference, focused on: the history and the future of the GPR; the planetary exploration with a focus on Mars observation; glaciology issues; inversion methodologies for GPR data processing.

A Young Researcher award was organized and attracted about 60 papers with a young researcher (<35 year old) as first author. A thorough selection procedure was performed in two steps: first all the eligible papers have been reviewed by an international committee and the outcome was the selection of seven "finalist" papers. Then, the first (young) authors of these papers have

Figure 1. An image of the Room "Maria D'Enghien", in the castle 2Carlo V", during the Conference.

Figure 2. An image from the archaeological site of Cavallino.

presented their contributions in a specific plenary oral session. The result has been in our opinion very good, in fact the session was attended with great interest. After the session, the Award Committee had a meeting and we have had two *ex-aequo* winners: Dr Anja Klotzsche and Dr Kazunori Takahashi.

Important events of the conference were two experimental demonstrations.

The first one has been performed by several GPR manufacturers at the archaeological site of Cavallino (7 km from Lecce, see fig. 2). Cavallino is a Messapic town of the VI–IV Century B.C. and the site was kindly put at disposal by the Director of the excavation, Prof. Francesco D'Andria. The results of the surveys in Cavallino were presented by the companies in a plenary oral session.

A second demonstration on-the-field was held at a controlled site at University of Salento, built up on purpose for this event (see fig. 3), under a funding of the same University. The delegates and the exhibiting companies had the possibility to see and show GPR systems at the site, where several structures simulating the archaeological prospecting and cultural heritage monitoring had been set up. The test site has became now an outdoor laboratory of the Faculty of Science of the Materials of the University of Salento.

A significant social program was organized with several events. The social dinner has been held in a restaurant with big park outside, set up in a dismissed quarry of stone. A guided visit of the town of Lecce (that has important Roman and Baroque monuments) has been organized too. Another social event, both for delegates and accompanying members, was an outdoor concert in the yard of the "Rettorato" of the University of Salento, which is an historical buildings and has also very good acoustics.

A four-days program was organized for the accompanying members, consisting of visits at historical sites and museums of Lecce and of the near cities.

Last, but not least, the redundant food has been given in charity for the "soup kitchen" organized by the church of Santa Rosa in Lecce, the leftovers have been recycled for the production of compost and all the paper materials supplied by the conference was built of FSC paper, in order to avoid destruction of forests. Surely GPR2010 is not the first conference that does things like these, but we like to outline them in order to advertise the hope that the attention also to these aspects become soon a praxis shared by all the conferences in the world.

A simulated ancient road

A polystyrene sphere, simulating a cavity, with a tuff wall simulating a foundation

metallic bin

foundation walls in "Leccese" stone

Figure 3. Some images from the controlled test site at the moment of its excavation.

We have tried to conjugate scientific rigor and introduction of some novelties. In particular, many well known experts of GPR systems and applications were involved in the organization so to ensure the scientific quality to the events. In addition, we have also given space to some promising young (but well trained) researchers, involving them in the review process and as session chair. In particular, we have tried to make possible the participation of many young researchers, thanks to the sponsorships and to a patient and constant work that has allowed us to contain the cost.

During and after the conference, we have received positive feedbacks from the attendants.

Finally, during GPR2010, a Chinese bid for the next issue of the conference was presented and then accepted by the International Advisory Committee. So, the XIV International Conference on Ground Penetrating Radar is scheduled in Shangai, China, in 2012.

(President's Message continued from page 3)

global issues. Our Society has developed and promoted Community Remote Sensing over the last year to illustrate how the Internet, social networks, and other technologies will change the field of remote sensing by augmenting our traditional centralized satellite and aircraft data sources with citizen-supplied information and analysis. GRS-S has promoted this new field by identifying and spotlighting projects from around the world that are contributing to the advancement of Community Remote Sensing. After the keynote addresses by the OSTP representatives, we had a most interesting space agencies' panel discussion moderated by Dr. Shelby Tilford. Three representatives of space agencies spoke about the past and future of global observing: Dr. Michael Freilich (Director, Earth Science Division, NASA), Dr. Yves-Louis Desnos (Earth Observation Directorate, ESA) and Dr. Masanobu Shimada (Space Applications Mission Directorate, JAXA). This panel discussion was followed by a special session in the afternoon with a large attendance and lively discussions with the participants.

The IGARSS week was indeed a good time to look at the past and the future. From the past we can learn to understand the present better and learn how to make it better. What about the future? If we try to predict the future, we will spend a lot of time and in general our success will be very limited. Instead of trying to predict the future, we can shape the future! And this is exactly what makes the future very exciting for our remote sensing community. We are shaping the future. And this is something very special because the future of remote sensing looks fascinating. Indeed we have entered a Golden Age for many areas of remote sensing. Just as satellite communication did in the 1970s or global navigation-based systems did in the 1990s, we have now entered a Golden Age for remote sensing. I would like to give you a few examples to emphasize the changes that have occurred since our last IGARSS in Honolulu in 2000.

1) Consider that only 10 years ago international programs and initiatives such as GMES, GEOSS and the new set of U.S. Earth observing missions following the Decadal Survey Recommendations were not yet established, yet they are now playing a major role in the future development of remote sensing. We could not have imagined today's developments in remote sensing without these programs in place. In addition, we have several national or bilateral missions that serve as third-party contributions to these international programs.
2) Consider the examples of spaceborne synthetic aperture radar (SAR) satellites: 10 years ago, there were only two SAR satellites flying in space; today we have more than 15 satellites! I think that you agree with me that spaceborne SAR systems are one of the most prominent examples of a Golden Age in remote sensing.
3) Look now in the last half year: We have had the launch of three remote sensing satellites: SMOS, Cryosat and TanDEM-X. All of these have a high degree of technological innovation: SMOS, a mission for soil moisture and ocean salinity estimation with the first synthetic aperture radiometer in space, allowing an increase in spatial resolution by a factor of five or so; Cryosat, a mission to measure the topography of the polar caps with the first interferometric Doppler altimeter in space, and last but not least is TanDEM-X, the first single-pass SAR interferometer in space, producing since this July the first 3D images of the Earth with height accuracy of better than one meter. So there is a revolution in satellite remote sensing technology, and many first results of these missions were presented during the IGARSS week.
4) Get a glimpse of the future: The European Space Agency plans to launch 20 Earth remote sensing satellites in the next 10 years. The NASA Earth Science Division foresees the launch of about 16 Earth remote sensing satellites in the next 10 years. This will ensure data continuity to support the development of services using remote sensing data and also for understanding and/or monitoring Earth's dynamic processes and environmental changes. The next generation of satellites will provide better temporal and spatial resolution as well as information diversity, allowing reliable bio- and geophysical parameter retrieval. We have several examples of information retrieval that is only possible today with the next generation of sensors. Last but not least, satellite data access is becoming more affordable, with very open data policies.

The remote sensing community plays a key role for future development because the science community has been the ignition and motor for the development of new applications and satellite missions. Innovation in remote sensing is motivated by science. One of the most important aspects of our remote sensing community is the nature of our work; we are performing research on issues related to environmental monitoring, sustainable development, climate change, understanding Earth's dynamic processes, etc. Considering this unique nature of our research field, the key role of our remote sensing community for its development and the Golden Age that we have entered, Earth remote sensing is undoubtedly one of the most fascinating and most important research fields of all disciplines.

I would like now to make a link between these exciting developments in remote sensing and our Geoscience and Remote Sensing Society (GRS-S). Our society plays a key role in the future of remote sensing satellites. Our members are involved in almost all key developments that are taking place today. The aforementioned examples of the satellites launched in the last 6 months (SMOS, Cryosat and TanDEM-X) have the strong involvement of GRS-S members in the conceptual

(continued on page 39)

UNIVERSITY PROFILE

UPRM WEATHER RADARS AT THE CENTRAL AMERICAN AND CARIBBEAN GAMES AT MAYAGÜEZ 2010

José G. Colom, Sandra Cruz-Pol, Gianni Pablos, María F. Córdoba, Wilson Castellanos, Melisa Acosta, José A. Ortiz, Benjamín de Jesús, University of Puerto Rico at Mayagüez; Jorge Trabal, University of Massachusetts at Amherst

It is well documented in the literature that there is an under-sampling limitation of the lower atmosphere from long-range weather radars when observing at distant regions from the instrument's location [*NRC*, 1995, *NRC*, 2002, *Westrick*, 1999]. This problem is evident in the west part of Puerto Rico where the earth curvature and other NOAA radar operational specifications do not allow observations in the lower troposphere below 10,000 feet, and this is exactly where dangerous weather occurs. See Figure 1.

This radar gap in the lower atmosphere cannot be properly sampled by the NexRAD radar which is located in Cayey, approximately 70 miles east from Mayagüez (western part of PR). For this reason, many events, such as the water spout depicted in the photo below (Figure 2), which occurred in September 2005 in the Mayagüez bay, are completely invisible to the NexRAD radar which is used by the NWS Office in San Juan, PR. One option to overcome this problem is to create a network of X-band short range radars. Such a network has been developed and tested in Oklahoma [*McLaughlin* et al., 2006] with four fully polarimetric and Doppler radars. Using the same concept, the University of Puerto Rico at Mayagüez developed a similar network, but with low-cost radars. These low-cost radars are non Doppler, single polarization marine radar which were modified to measure rain reflectivity.

Low-power X-band radars from the Puerto Rico Testbed (PRTB) supplied coverage during the Central American and Caribbean (CAC) Olympic Games of Mayagüez 2010 by providing meteorological data of the western part of the island of Puerto Rico to the NWS in San Juan. The PRTB is part of the Center for Collaborative Adaptive Sensing of the Atmosphere (CASA), an NSF Engineering Research Center (ERC) housed at the Department of Electrical and Computer Engineering at UPRM. The students, under faculty supervision at UPRM, have developed four portable X-band off-the-grid (OTG) radars, using commercially available marine units (Furuno®). These marine radars were modified to achieve rain reflectivity measurements at ranges up to 15 Km and strategically located in the Mayagüez region. They are called OTG because are designed to operate even in the event of power loss, unplugged from the electrical grid, and transmit their data through wireless internet.

From the beginning of this project, one of the main motivations for this research was to have an OTG radar for weather applications in the tropics. The tropical regions are areas usually with higher precipitation than other places in the world due to the humidity found as well as the geographical location in which cloud formation is more feasible. It is the first time ever that a modified marine radar for weather applications operating with renewable energy is deployed and operated. The radars can continuously operate for eight hours with solar energy. Typical rain events at the west coast last an average of three hours so that the eight hours of continuous operation

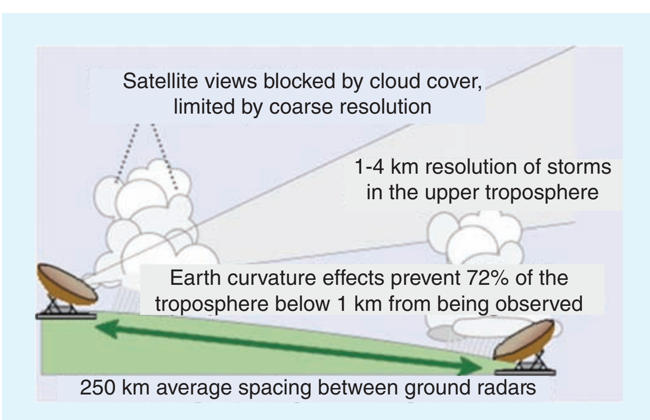

Figure 1. Lower atmosphere gap from current technology radar used by NOAA.

Figure 2. Water spout in Mayagüez bay, September 2005.

Figure 3. Students installing solar panels for operation of the OTG radar.

Figure 4. OTG radar (on seatrain) during cross calibration at CSU CHILL facilities.

should be enough for most cases. Figure 3 shows students installing the solar panels on top of a building located in Las Mesas hill. The CAC games at Mayagüez provided the opportunity to test for the first time a network of OTG radars in a tropical and mountainous region. In addition to the OTG radars, the CASA PRTB also counts with another X-band radar donated by EWR. All of these radars were modified and installed by undergrad and graduate students from the CASA PRTB which includes collaboration with the Universities of Massachusetts, Colorado State, and Oklahoma.

The first OTG radar (OTG-1) was modified by replacing the 41” fan-beam antenna by a small parabolic reflector dish with a beam width of 3.8 degrees, the data collection interface and an embedded computer were integrated to the radar to complete the system [*Pablos-Vega* et al., 2010]. In addition, a wireless communication link was also established to move the data from remote places to a server located in the main campus. Solar panels and batteries were added to keep the system operating in case there was a power failure (the OTG has the capacity to operate with solar energy, but electricity from the power grid was used if available). The OTG-1 was calibrated at the CSU-CHILL facilities (See Figure 4) and then used to properly calibrate the OTG-2, OTG-3 and OTG-4 radars at Puerto Rico.

The basic specifications of the radar are summarized in the table below:

The western Puerto Rico map shows the location of the 3 OTG radars used during the Games, and a fourth OTG remained in the lab in case that any of the others need to be replaced during the duration of the games (15 days). See Figure 5 for the radar locations. The coverage of each of the radars is limited to around 15 Km and they were placed in a triangular form to achieve overlapping in the middle region. Most of the sports facilities and entertainment activities for the games were located inside the triangle. The OTG-2 was located in the Campus on a 20 ft tower on top of the R&D Center building. The OTG-3 was located in Mount Las Mesas in the facilities of CROEM Prep-school, property of the Department of Education of Puerto Rico, while the third radar was located on a 60 ft tower at Cornelia Hill, property of UPRM. Pictures of the installation of the OTG at the Cornelia Hill site are shown in Figures 6 and 7.

Table 1. OTG Radar Specifications

Operational Range	15.36 km
Max Range	88.89 km
Minimum Range	42 m
Rated Voltage	12–24 V
Rated Current	5.6–2.7 A
Frequency	9410 ± 30 MHz
Wave length	0.03188 m
Peak power	4 kW
Intermediate frequency	60 MHz
Pulse length	0.8 μs
PRF	511 Hz
Bandwidth	3 MHz
Minimum Detectable Signal	–105 dBm
Noise Figure	4.6 dB
RPM	26
Polarization	Vertical

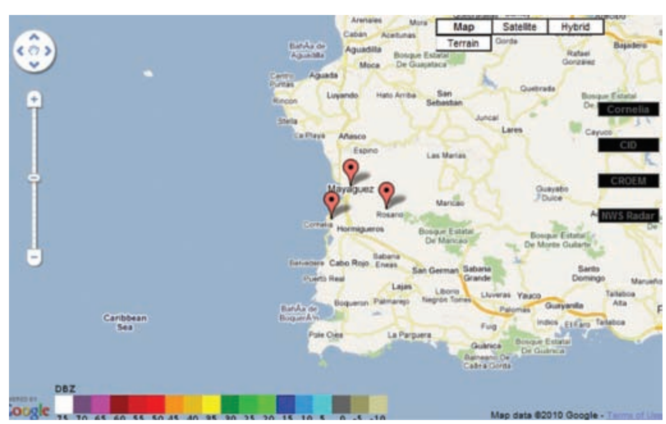

Figure 5. Location of the three OTG radars as seen in the PRTB web-site on the west coast of the island of Puerto Rico.

Figure 6. OTG radar at Cornelia Hill.

Figure 7. Students during installation of the OTG at Cornelia Hill.

Recent work was done by [*Ríos-Olmo*, 2009], who developed a tool to ensure the site chosen for the radar had the least blockage possible due to nearby mountains. Ríos-Olmo work was specifically designed for the Puerto Rico's west coast, but the tool can be applied to other locations as well. The tool provides a scale of colors in which the beam height goes from red to blue (low altitude to a higher altitude, namely 0 to 1 km). The beam is always between these colors unless it is on the border of the maximum range of the radar. If a black color appears on the map, it means blockage occurs and the antenna elevation should be changed. In the tool, different elevation angles and altitudes of the radar are considered in order to find the best location, final elevation and height for the radar. Figure 8 shows a final plot generated by this tool. The plot shows three circles corresponding to the area covered by each of the radars, optimized elevation

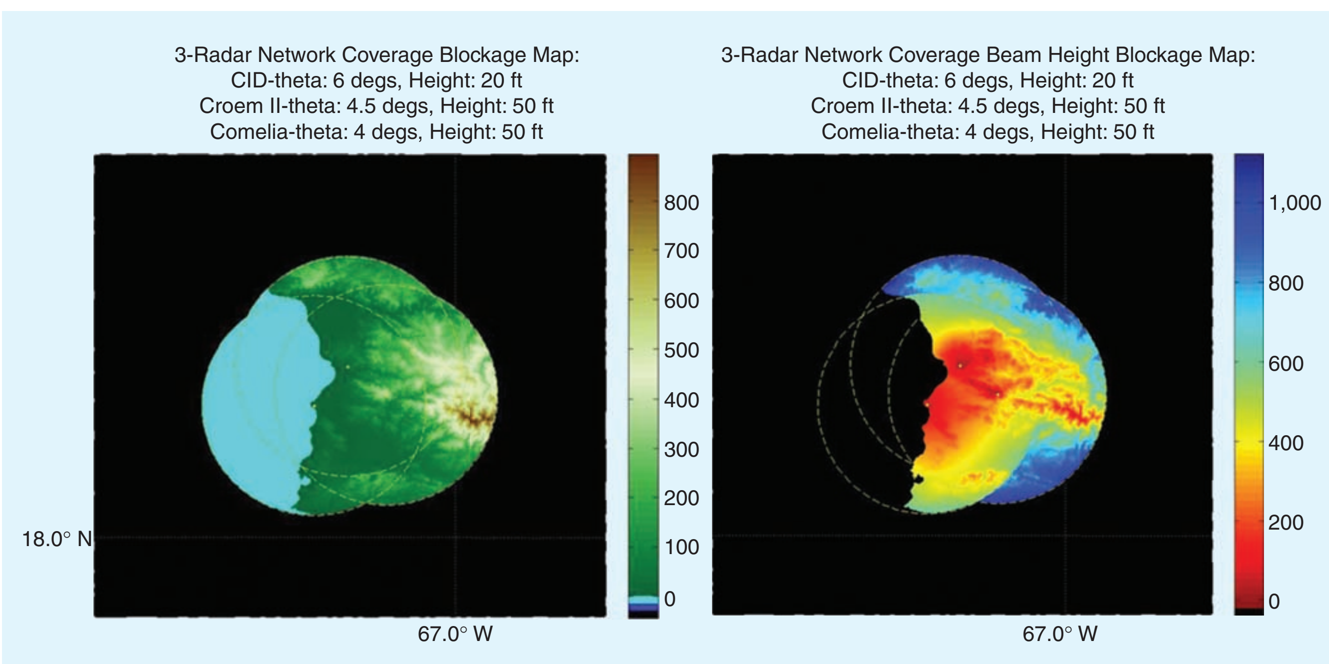

Figure 8. Plot used to study coverage and blockage from topography.

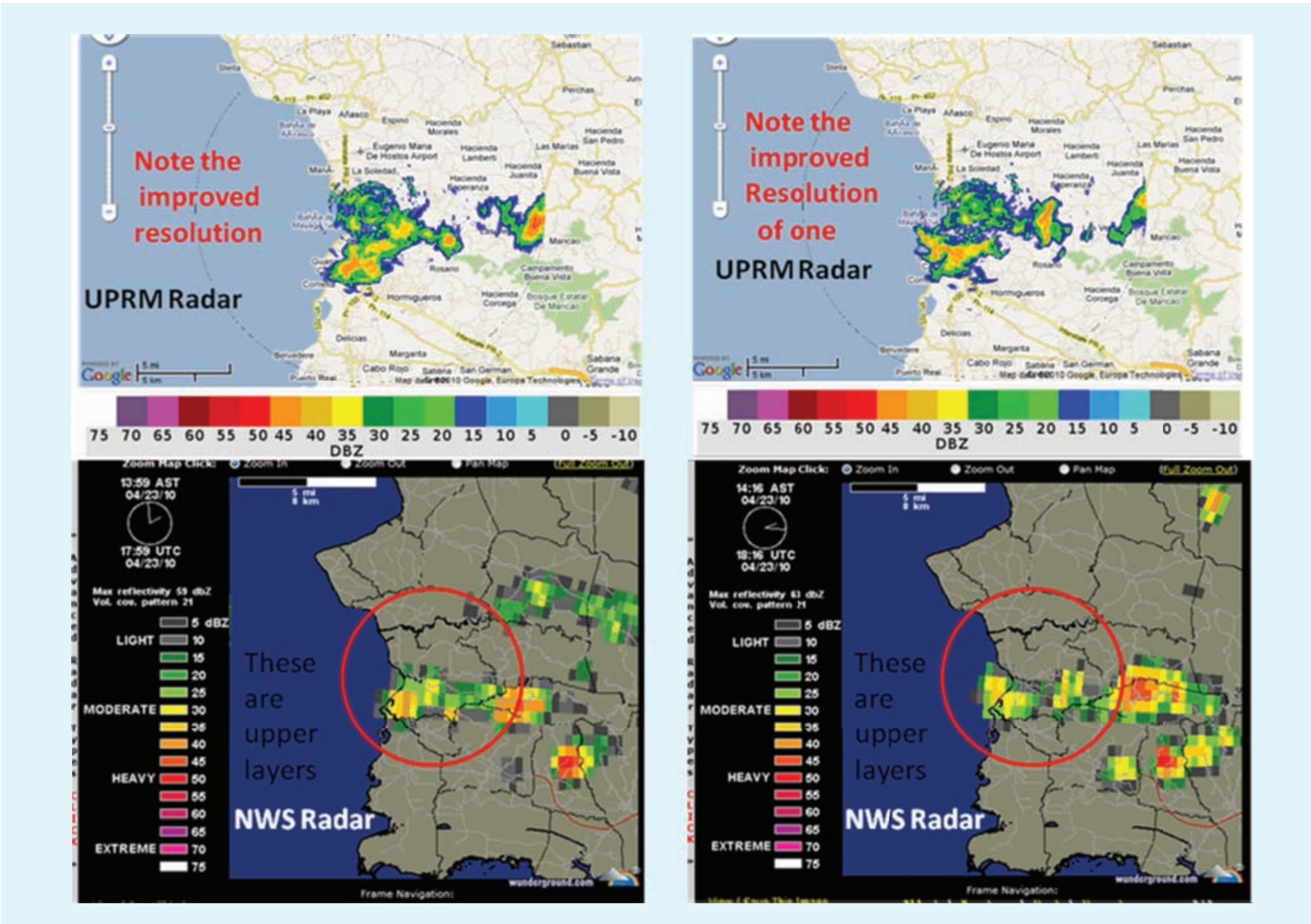

Figure 9. Comparison of OTG-2 images versus the NWS radar.

angle and altitude are given for each site after considering several options for radar locations.

The students and faculty, together with the physical plant staff from UPRM participated in the installation of the towers, the radars, and all the other activities associated with it (electrical installations, wireless link, safety features, permits request, etc.). The students had to adjust the azimuth position of the radars and also adjust the incidence angles after installation to minimize clutter, and at the same time observe the atmosphere as lower as possible. The radars were installed and ready for operation only a few days before the games. In Figure 9, an example of data collected from the OTG-2 is compared with the NWS radar during a typical evening rain storm at Mayagüez. The space (and time) resolution shows a

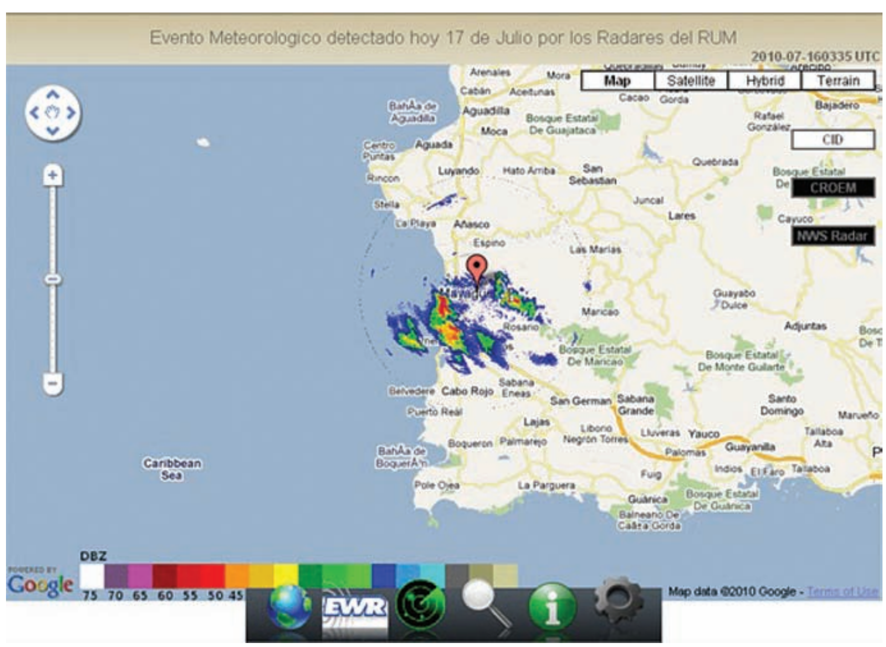

Figure 10. Squall line as seen by the OTG radar.

First family enjoys tennis sights on Main coast US & WORLD PAGE 8

PUERTO RICO

Daily Sun

YEAR 2, NO. 633

SUNDAY, JULY 18, 2010

$1.50

Boxer Juanma says "I do"

SPORTS PAGE 48

Games overturned

Wind gusts injure 25, postpone opening

LOCAL PAGE 3

Twenty-five workers were injured when Mother Nature turned on them as they set up equipment before Games Saturday.

OBJECTIVE REPORTING IS OUR LEGACY

Figure 11. Daily Sun Newspaper front page covering weather event at the Mayagüez games (July 18, 2010).

DECLARAN EXPERTOS

NO FUE UNA TROMBA MARINA

Figure 12. Paper picture of Dr. Sandra Cruz-Pol and Melisa Acosta during press conference (July 17, 2010).

significant improvement when compared to the NWS radar. Scientists from NWS Office in San Juan visited the PRTB facilities and a web-page was created to provide them with radar data updates every 3 minutes.

During the first day of the Games, an unannounced major weather event occurred and the opening acts had to be postponed for next day. The weather system destroyed part of the stage of the games and NWS and several TV weather figures used the images from the OTG radars to try to determine what took place that afternoon. The images were very helpful in concluding that a squall line (storm wind front) crossed the Puerto Rico west coast that day, and not a waterspout or tornado like it was originally reported. See images of the squall line as detected by the OTG radars in Figure 10. In addition, a video of the event can be observed at http://stb.ece.uprm.edu/NoonEvent.jsp. After that day, students and faculty were invited to radio and TV interviews and awareness of the PRTB was achieved around the whole island. See pictures during press conference and newspaper in Figures 11 and 12. Figure 13 shows the 20 ft tower on top of the CID building at the University of Puerto Rico.

Figure 13. Part of the radar team on the OTG2 tower on top of the CID tower at UPRM.

During the games, three (3) of the radars operated almost constantly and data was collected and archived every day. Studies to minimize clutter and to achieve better products are under way, considering all radars as a network and not independently. It is also expected that time resolution can be significantly improved by reducing the acquisition time from 3 minutes to 1 minute. A weather station grid in the Mayagüez area (1 Km^2) will also be used to validate the radars for future QPE applications. During the next year, PRTB will add a network of three fully polarimetric and Doppler X-band radars that will provide radar coverage of the whole west coast, while the OTG radars will be used to monitor weather in remote places and complex terrain locations, such as valleys or municipality islands in the east coast [*Galvez* et al., 2009]. It is expected that these radars will provide the NWS Office with the necessary data to improve weather forecast in Puerto Rico's west coast and be emulated in other countries with complex topography and where low-cost radars are considered necessary.

Acknowledgements

This work was primarily supported by the Engineering Research Center Program for the National Science Foundation under NSF Award Number 0313747. The authors want to thank the CASA Director Prof. David McLaughlin and Prof. Michael Zink from UMass as well as Prof. V. Chandrasekhar from ColoradoState for their support with the project.

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(President's Message continued from page 33)

design, science team as well as algorithm development for data processing and retrieval. Many of these ideas and concepts have been presented for the first time at IGARSS, and prominent papers have been published in our Journals.

Although GRS-S members know that GRS-S is the home of IGARSS, many IGARSS participants are not aware of it. IGARSS is only one of the many events and activities that GRS-S is conducting. GRS-S strives to address remote sensing techniques, applications and policies, as well as new research directions. In this way, we are making an impact on the future of remote sensing. By being a member of GRS-S, you too can be a part of this important voice. Benefits of being a GRS-S member are innumerable, and include electronic access to our three premier journals, conference proceedings, participation in our five Technical Committees (IFT, FARS, DF, DAD and ISIS), IGARSS participation at a reduced rate, our quarterly GRS-S Newsletter, educational programs (also web based), industrial relations newsletter, use of our distinguished speakers program, submission of proposals to our book series, joining our GOLD (Graduates of the Last Decade) program, access to tutorial on-line lectures, participation in one of our 34 chapters, etc.

Last but not least, I would like to briefly recognize the outstanding work of innumerable volunteers that are contributing to GRS-S. Our society operations are led by a team of 18 elected members that are also volunteers. However, the success of our activities and of every IGARSS is the result of the hard work of a much larger group of volunteers. The organization of an IGARSS conference starts approximately four years before the conference. We have over 1000 reviewers supporting the paper selection process. We have more than 50 scientists and engineers who participated in the IGARSS Technical Program Committee meeting and worked to finalize the conference technical program. My congratulations and sincere thanks to all of our colleagues involved in the organization and implementation of IGARSS for their excellent work performed. A special thank-you goes to Paolo Gamba and David Kunkee who have done an outstanding job as co-chairs of the IGARSS technical program. With excellent planning by a highly dedicated organizing committee under the leadership of our general co-chairs, Karen St. Germain and Paul Smits, this symposium has become a very special one and has set a very high standard for future IGARSS conferences!

During the IGARSS Awards Banquet, Paul Smits and Karen St. Germain handed over the responsibilities to the next IGARSS general chair, Prof. Motoyuki Sato. IGARSS 2011 will take place in Sendai, Japan, from 1 to 5 August. I wish the IGARSS 2011 team great success in the organization already underway, and I am looking forward to meeting you in Sendai next year!

Sincerely

Alberto Moreira

President, IEEE GRS-S

alberto.moreira@dlr.de

STUDENT BRANCH CHAPTER OF THE SOUTH BRAZIL SECTION

Sam W Murphy, University of Campinas, Brazil

The successes of remote sensing applications in the geosciences have lead to the growth of the Geoscience and Remote Sensing Society over time. In the last 12 months alone 5 new Chapters have come into existence. All but one of these Chapters are situated in the Southern Hemisphere. This reflects the current expansion of the GRSS into regions which have never before been represented, therefore allowing the society to more effectively benefit its members on an international scale.

One such new frontier for the GRSS can be found in the state of São Paulo, which is situated in south eastern Brazil. A Student Branch Chapter has been present and active in the area since January 2010. It was the first GRSS Chapter of any kind below the equator. This group is made up of students from the University of Campinas (UNICAMP) and the National Space Research Institute (*Instituto Nacional de Pesquisas Espaciais*, INPE), therefore bringing together two of the most experienced Brazilian institutions in the field of remote sensing.

The motivation for forming the group originated from the desire to discuss and share knowledge in the understanding that this would allowing us to grow together as well as satisfy our interests in one and others lines of research. We became aware of the possibility to take part in the GRSS during a guest lecture provided by Dr. Bill Emery of the University of Colorado. We subsequently decided to 'go global'.

The activities of our Chapter so far have largely catered towards achieving our initial founding purpose, namely swapping ideas and experiences in order to facilitate and promote technical expertise. This has in part been achieved through the development of a special lecture series in which post-graduate students have given presentations on theories and applications within remote sensing. Topics have so far included: Self-Organizing Maps, Fourier Transform Analysis and Fuzzy Logic. We have also offered short-courses on specialized software, namely ENVI, ArcGIS and ER Mapper, during the highly successful 'Geology Week' at the University of Campinas. We found that offering these courses within the context of a larger event was an excellent way of establishing effective channels of communication with our target audience.

Along a similar ilk our most immediate task involves representing the society during the up and coming 'Unicamp Open Day' an annual event in which around 40,000 members of the general public come to see the facilities on offer at the University of Campinas. We hope to engage both young and old visitors in the belief that many remote sensing applications are inherently interesting to a great number of people. Further along the line, in 2011, we will be setting up shop at the Brazilian Remote Sensing Symposium (*Simpósio Brasileiro de Sensoriamento Remoto*) to help establish the GRSS within the country and beyond.

Enjoying a coffee break after a talk on Self-Organizing Maps.

The Chapter committee from left to right: Mariana Velcic Maziviero (Treasurer), Prof. Carlos Roberto de Souza Filho (Chapter Advisor), Sam Murphy (President) and Joyce Rodrigues da Cruz (Vice-President).

With regards to local action, the future for our Chapter involves attracting speakers from outside of our group. Such activities include an eagerly anticipated course on the use of MATLAB, with specially tailored practical examples in the Geosciences. We shall also be taking advantage of the Distinguished Lecture Series program and on top of that wish to extend a warm welcome to any and all interested parties that might be keen to give a lecture to enthusiastic students on some aspect of remote sensing, be they from academic, business or government backgrounds.

If you would like to get in touch with this Chapter then feel free to contact us at *grss@ige.unicamp.br* or visit our website *www.grss-unicamp.com*.

CALL FOR PAPERS

Papers are solicited for a special issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing on *Ground Penetrating Radar: Modeling tools, Imaging methods and Systems concepts*. Submissions on Ground Penetrating Radar (GPR) related topics that address advancement of GPR technology are welcome. Paper submission in the following areas is highly encouraged:

- Novel GPR Systems & Antennas
- Quantitative and Qualitative Imaging methods
- Buried UXO/Landmine Detection/Classification Using Radars
- Subsurface Tomography Using Borehole Radars
- Subsurface Hydraulic Events Characterization Using GPR
- Planetary Subsurface Radar Survey
- Through- and Intra-wall surveys and concealed objects detection

Submission Instructions
Authors should submit their manuscripts electronically to http://mc.manuscriptcentral.com/jstars. Prospective authors should follow the regular guidelines of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing as listed inside the back cover of the Journal and on the website. Please indicate in your submission that the paper is intended for the special issue by selecting "Ground Penetrating Radar: Modeling tools, Imaging methods and Systems concepts" from the pull down menu for manuscript type. Questions concerning the submission process should be addressed to jstars-editor@ieee.org.

Manuscript Submission Deadline: October 1, 2010

Inquiries concerning the special issue should be directed to the Guest Editors:

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Call for papers

IEEE Transactions on Geoscience and Remote Sensing

Special Issue on Spectral Unmixing of Remotely Sensed Data

Submission deadline: 30 September 2010

A Special Issue of the *IEEE Transactions on Geoscience and Remote Sensing* on the topic of *Spectral Unmixing of Remotely Sensed Data* has been recently approved by the *IEEE Geoscience and Remote Sensing Society* (GRSS). Spectral unmixing has been an alluring exploitation goal since the earliest days of remote sensing. Due to limited spatial resolution, the spectral signatures collected in natural environments are invariably a mixture of the signatures of the various materials found within the spatial extent of the ground instantaneous field view of the imaging instrument. In recent years, the availability of instruments with a number of spectral bands that exceeds the number of spectral mixture components has fostered active research efforts in this area.

This *Special Issue on Spectral Unmixing of Remotely Sensed Data* is intended to present the state-of-the-art and the most recent developments in spectral unmixing from a remote sensing perspective. The *Special Issue* is expected to bring together experts from different institutions to provide a sample of latest-generation techniques in this active research area. The focus will be on recent developments in techniques and applications of spectral unmixing for data sets collected by hyperspectral imagers, which have substantially increased their spectral resolution (imagers with hundreds of narrow spectral channels are currently available, and instruments with thousands of spectral bands are under development), thus producing a nearly-continual stream of high-dimensional image data which demands effective techniques for data interpretation with sub-pixel precision.

Although analysis of hyperspectral data will be an important component of the *Special Issue*, contributions on spectral unmixing for other types of remotely sensed data are also welcome. Particular attention will be given to the possibility of applying spectral unmixing concepts to scenes with moderate spectral resolution (multispectral), and to the use of spectral unmixing for data compression purposes. High-quality contributions are solicited with emphasis placed on (but not limited to) the following topic areas:

- Linear and nonlinear mixture models for analysis of remotely sensed data
- Incorporation of spectral similarity measures in spectral mixture modeling
- Data dimensionality issues for spectral mixture analysis
- Automatic and semi-automatic endmember extraction in remotely sensed data
- Supervised endmember extraction and pure class modeling
- Adaptive endmember selection and multiple endmember spectral mixture analysis
- Unconstrained versus constrained fractional abundance estimation in remotely sensed data
- Blind source separation and its relation with spectral unmixing of remotely sensed data
- Incorporation of sparsity and spatial information in spectral unmixing of remotely sensed data
- Quantitative assessment of spectral unmixing
- Statistical validation of spectral mixture analysis models
- Extension of spectral unmixing to multispectral scenes
- Applications of spectral mixture analysis of remotely sensed data
- Analysis of intimate mixtures in remotely sensed data: soil, vegetation and other application-specific studies
- Spectral unmixing in planetary exploration
- High performance computing implementations of spectral unmixing techniques

Inquiries about the *Special Issue* may be directed to the Guest Editors listed below. Papers can be submitted using the manuscript central web link: **http://mc.manuscriptcentral.com/tgrs** and selecting *Spectral Unmixing Special Issue* from the 'Manuscript type' pull-down menu.

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IEEE Transactions on Geoscience and Remote Sensing

CALL FOR PAPERS

UPCOMING SPECIAL ISSUE AFTER IGARSS'10
REMOTE SENSING: GLOBAL VISION FOR LOCAL ACTION

2010 IEEE International Geoscience and Remote Sensing Symposium

Hawaii 2010

IGARSS

30th Anniversary

IGARSS 2010 marks the 30th anniversary for GRSS and IGARSS and continues the excellent tradition of gathering world-class scientists, engineers and educators engaged in the fields of geoscience and remote sensing to meet and present their latest activities. This is the second time that the event was held in Honolulu and the first time any previous IGARSS venue has been revisited. IGARSS 2010 is an exciting celebration of the 30th anniversary and emphasizes the emerging field of community remote sensing as part of the conference theme: Global Vision for Local Action. The rapid emergence of 'citizen science' and social networks is a promising new means for augmenting the foundation of knowledge from government sponsored satellites and observing systems, and heralds a new era for scientific developments in our community.

Accordingly, IGARSS 2010 presenters are invited to submit manuscripts for possible publication in the IEEE Transactions on Geoscience and Remote Sensing IGARSS 2010 Special Issue to be published in December 2011. Authors should submit their manuscripts electronically to http://mc.manuscriptcentral.com/tgrs. Prospective authors should follow the regular guidelines of the IEEE Transactions on Geoscience and Remote Sensing, which are available at http://mc.manuscriptcentral.com/tgrs. Select "IGARSS 2010 Special Issue" from the pull down menu for manuscript type. Questions concerning the submission process should be sent to tgrs-editor@ieee.org. **Submissions should be complete descriptions of new and significant results**. In most cases, the conference paper as it appears in the Symposium Proceedings will not be suitable for submission to the Transactions. Papers will be reviewed using the standard IEEE process. **Deadline for submission: October 31, 2010.**

Inquiries concerning the Special Issue should be directed to the Guest Editors:

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Special issue of the IEEE Transactions on Geoscience and Remote Sensing on

Space Technology

Call for Papers

Guest Editors: Maria Petrou, George A Lampropoulos and William J Emery

This special issue recognizes the need for cross-disciplinary collaboration and offers a much needed outlet for publishing inter-disciplinary research. The emphasis of the call is on the inter-dependence of software, applications and sensor technology, as it is clear that one cannot totally disassociate hardware from software, or applications from hardware, because they depend on each other very strongly, particularly for Remote Sensing applications. Limitations on the downloading time of images, of storage and computing capacities on board satellites affect very significantly the software that has to be developed and the applications of remote sensing.

- The submitted papers should concentrate on Remote Sensing applications of Space Technology, with emphasis on the interaction and interdependence of hardware-software-application. Papers must include a significant original application or demonstration of remote sensing capabilities using the new Space Technology. In particular, papers must include more than just a description of original new technology. They must also apply that technology to a remote sensing application in a substantive way.
- **Publication Schedule**
  Call for Submissions: 1 September 2010
  Deadline for Submissions: 1 December 2010
  Special Issue Publication: January 2012
- All submitted papers will be subject to the standard TGRS reviewing process.
- Papers should be submitted through the TGRS web page
  http://mc.manuscriptcentral.com/tgrs
  Instructions for creating new user accounts, if necessary, are available on the login screen. Please indicate during your submission that the paper is intended for this Special Issue by selecting "Space Technology" from the pull down menu for manuscript type. Questions concerning the submission process should be addressed to tgrs-editor@ieee.org. Other questions concerning the Special Issue should be addressed to the Guest Editors:

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SPECIAL ISSUE ON "REMOTE SENSING FOR AFRICA" INTERNATIONAL JOURNAL OF APPLIED EARTH OBSERVATION AND GEOINFORMATION, VOL. 12, SUPPL. 1, FEBRUARY 2010

Guest Editors: Tsehaie Woldai and Harold Annegarn***
** ITC, Enschede, The Netherlands (Woldai@itc.nl)*
*** University of Johannesburg, South Africa (hannegarn@gmail.com)*

Discussions have been underway within the African Association of Remote Sensing of the Environment (AARSE) for several years about the possibility of a dedicated journal of African Remote Sensing. The logistical and financial barriers for launching new journals appeared to be formidable. At an AARSE Council meeting in Ghana in September 2007, it was decided that it was more important to create opportunities for African voices to be heard within the main stream of the scientific literature, and, for the mean while, to forego the prestige of an AARSE own journal. A policy was adopted to negotiate with appropriate established RS journals for special issues devoted to African themes, in which AARSE would act as editors or co-editors.

There were multiple motivations for this policy:

1) African scientists are under-represented in the international main stream scientific literature. Of the identifiable African names in the field of remote sensing, the majority list their primary institutional affiliation in North America or Europe. Aspiring African scientists would like to have their work read and acknowledged in the main stream literature, not footnoted in a regionally distributed journal with limited international readership.
2) By creating structured channels for publication, the AARSE Board felt would create an effective way to enhance the publication opportunities and rate among its constituency. The importance of face recognition, of African scientists being seen as a collective scientific force, can further reinforce the positive role models needed to encourage younger scientists in the field to participate in journal publication.
3) In the last eight years, a number of geospatial-specific issues have brought to the front burners the need for proactive capacity development in geospatial technologies in Africa. Now, technological advancement on the continent has been sufficiently steady so as to supply the needs for high and medium resolution imagery from a completely African technology base. Four countries in Africa (Algeria with Algeriasat1 in 2002; Nigeria with Nigeriasat1 in 2003; Egypt with Egyptsat1 in 2007 and South Africa with Sumbandilasat1 in 2009) have launched their own mini-satellites to orbit thus joining the league of 'sensing' countries and moved Africa out of the former class of being totally a 'sensed' continent. Nigeria will launch its 2nd Nigeriatsat2 and Egypt is soon to follow with Egyptsat-2. Besides, more and more satellite attention is focusing on Africa, with its special and specific questions, its own set of conditions, and its particular type of problems.
4) A continent-wide, real-time earth observation infrastructure is emerging. It is based on African priorities, brain attraction rather than brain-drain, and African industry development. Across Africa, there are more than twenty national space agencies (also referred to as national remote sensing agencies), as well as regional centres and universities with special expertise in geospatial technologies.
5) In addition, it is a primary aim of the International Journal of Applied Earth Observation and Geoinformation journal to focus on developing countries, and for this particular reason we like to focus on remote sensing for Africa, in the widest possible sense.

To launch this initiative, negotiations were concluded for AARSE to edit a special issue of the Journal of Applied Earth Observation and Geoinformation. A call for papers elicited an encouraging response of over 60 initial submissions. In line with the focus for the special issue, a restriction was imposed, namely that the lead author, at least, should be affiliated to an African institution, reporting on RS work about Africa, carried out in Africa. This does not detract form fine work done by the African Diasporas elsewhere, and in fact there were several excellent contributions that were excluded for this reason. The remaining papers were pruned to approximately forty acceptances that were submitted to international referees for formal review, of which twenty one were accepted after revision.

The special issue provides a substantive collection of international quality articles, showing innovation and application of science of remote sensing in Africa. This mile-stone achievement gives us courage to proceed with our policy of publishing special collections of articles on remote sensing in Africa in main stream journals.

The Editors and the Board of the African Association for Remote Sensing of the Environment wish to thanks the ITC which has provided sustaining support for AARSE over many years. Again, in the provision of logistical and administrative support for the production of this journal, they have demonstrated their generosity of spirit and commitment to international partnerships for the betterment of the global environment. The Editors would also like to thank the European Space Agency (ESA), the University of Cape Town, the University of Johannesburg, the IEEE Geosciences and Remote Sensing Society, (formalized through a Memorandum of Understanding signed in 2008) for contributing fund to sponsor the color printing in this issue. The numerous referees, from Africa and elsewhere, who reviewed papers for this issue, are thanked for their contributions. The guest editors value the enthusiastic support of Ms Teresa Brefeld, Editorial Office, ITC, in bringing this supplement into print.

Editors:
Dr. Tsehaie Woldai (ITC, Enschede, The Netherlands)
Prof. Harold Annegarn (University of Johannesburg, South Africa)

GNSS-R'10 is the new edition of the series of GNSS-R workshops organized since 1999 and hosted at different Institutions, to provide a forum for researchers working on different aspects and applications of the GNSS Reflectometry.

The Workshop is organizad by the IEEC and will be held at the Universitat Politècnica de Catalunya (UPC), Barcelona, Spain on October 21-22, 2010.

A preliminary, non-exhaustive, list of topics to be treated in the workshop is: Receivers and Simulators, New GNSS-R signals, Models, Applications: Sea Altimetry, Scatterometry, Soil Moisture and Vegetation, Sea Ice and Dry Show, Radiometry/GNSS-R synergies, GNSS-R data and users, Planned missions etc.

Deadlines:

- Two page abstract: June 30, 2010
- Notification of acceptance: July 19, 2010
- Early payment and submission of final abstract: September 10, 2010

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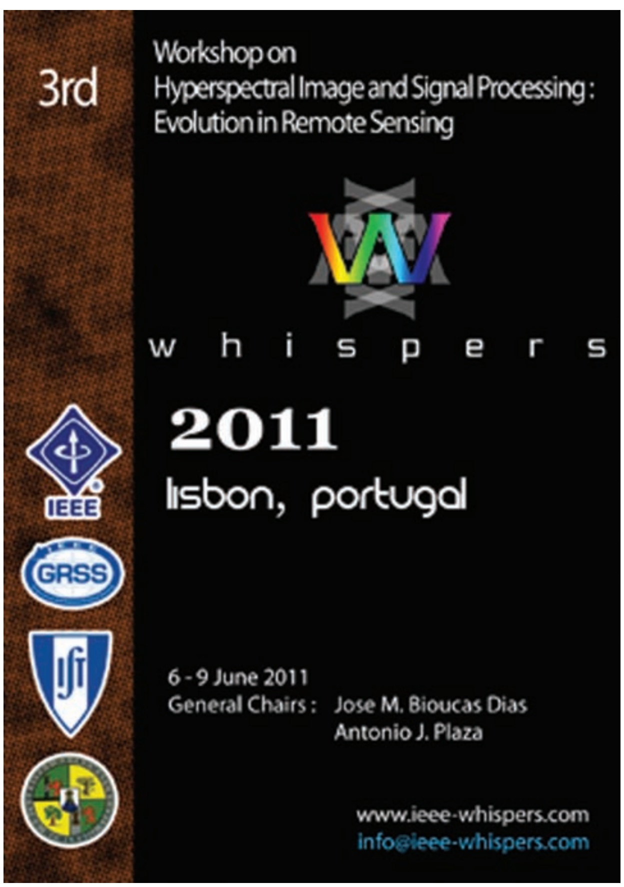

MultiTemp2011

6th International Workshop on the Analysis of Multi-Temporal Remote Sensing Images

Multi Temp 2011

July 12–14, 2011
Trento (Italy)

Chair:
Lorenzo Bruzzone, University of Trento

Extended Abstract Submission:
February 25, 2011

Registration Deadline:
June 15, 2011

Web Address: http://multitemp2011.org/

UNIVERSITY OF TRENTO - Italy

IEEE GRSS Geoscience and Remote Sensing Society

URSI Commission F
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&

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Web address: www.ursif2010.org
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GPR 2012:
Sustainable Development of Ground Penetrating Radar for Engineering and Environment

June 4–8, 2012
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Tongji University
National Natural Science Foundation of China

GPR 2012 Chair:
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Abstract submission:
Before November 15, 2011
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Early Bird Registration:
Before April 30, 2012

Registration fees:
CNY 4000

Web Address:
http://www.gpr2012.org

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UPCOMING CONFERENCES

See also http://www.techexpo.com/events or http://www.papersinvited.com

Name: SPIE Remote Sensing 2010
Dates: September 20–23, 2010
Location: Toulouse, France
URL: http://spie.org/remote-sensing-europe.xml?WT.mc_id=Cal-ERS

Name: URSI Commission F Microwave Signatures 2010
Dates: October 4–8, 2010
Location: Florence, Italy
Contact: Dr. Simonetta Paloscia
E-mail: s.paloscia@ifac.cnr.it
URL: http://www.ursif2010.org/

Name: Workshop on GNSS Reflectometry
Dates: October 21–22, 2010
Location: Barcelona, Spain
Contact: Dr. Adriano Camps
E-mail: camps@tsc.upc.edu
URL: http://congress.cimne.com/gnss-r10

Name: 8th International Conference of the African Association of Remote Sensing and the Environment (AARSE 2010)
Dates: October 25–29, 2010
Location: Addis Ababa, Ethiopia
URL: http://www.aarse2010.org

Name: International workshop on Multi-Platform/Multi-Sensor Remote Sensing and Mapping
Dates: January 10–12, 2011
Location: Xiamen, China
Contact: Prof. Ayman F. Habib
E-mail: habib@geomatics.ucalgary.ca
URL: http://www.mpmsrsm2011.org/

Name: Joint Urban Remote Sensing Event
Dates: April 11–13, 2011
Location: Technische Universitaet Muenchen (TUM), Muenchen, Germany
URL: http://www.pf.bv.tum.de/jurse2011/

Name: EOGC 2011 – Earth Observation for Global Changes
Dates: April 13–15, 2011
Location: Technische Universitaet Muenchen (TUM), Muenchen, Germany
URL: http://www.eogc2011.tum.de

Name: 3rd Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing
Dates: June, 2011
Location: Lisbon, Portugal
E-mail: info@ieee-whispers.com
URL: http://ieee-whispers.com/

Name: 25th International Cartographic Conference
Dates: July 3–8, 2011
Location: Paris, France
URL: http://www.icc2011.fr/

Name: 6th International Workshop on the Analysis of Multi-Temporal Remote Sensing Images
Dates: July 12–14, 2011
Location: Trento, Italy
Contact: Prof. Lorenzo Bruzzone
E-mail: multitemp2011@disi.unitn.it
URL: http://multitemp2011.org/