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Remote Sensing Spring School in Argentina

SAR for Environmental and Production Monitoring

In this column, we present a summary of the Third Remote Sensing Spring School at the Teófilo Tabanera Space Center, Córdoba, Argentina, 10–21 September 2018, to support the launch of the *Satélite Argentino de Observación con Microondas (SAOCOM) 1A* synthetic aperture radar (SAR) mission. Nearly all of the lecturers were IEEE Geoscience and Remote Sensing Society (GRSS) senior members. More than 90 specialists in a variety of areas and representing South and Central American countries and others around the world were present. Several international collaborations were proposed during discussions and meetings among participants and experts.

The school had a huge impact, and its multiplying effect will be positive for the region. It is essential to provide continuity to this valuable initiative and communicate the lessons learned. We include here the main conclusions agreed upon by the organizers and participants according to academic and stakeholder perspectives for the future. We also provide links to professors, theoretical and practice materials, participants' presentations, and interviews with lecturers and students.

The GRSS Argentine Chapter and the Gulich Institute at the Comisión Nacional de Actividades Espaciales (CONAE)–University of Córdoba organized the school, which was supported by the Centro Latinoamericano de Formación Interdisciplinaria (CELFI). The event was developed following the framework of the annual meetings held by the GRSS local Chapter and the Gulich Institute. The organizing committee obtained funding to support 40 Latin American participants and seven international experts. The call for presentations was published in March 2018, and we had more than 200 applications. On the basis of capacity, we opened the school with 97 participants: 34 from across Latin America and 63 from different regions of Argentina (Figure 1).

The 11-day program included the following topics:

- an introduction to the SAR technique
- the acquisition, geometry, focalization, and distortions of SAR images
- SAR image noise and preprocessing techniques
- statistics for SAR image analysis
- concepts of SAR interferometry
- mapping and monitoring of slow-moving landslides with multitemporal satellite radar imagery
- advanced concepts in polarimetric SAR image analysis
- geometric methods for the analysis of multitemporal and multipolarized SAR images
- change detection with SAR images
- polarimetric SAR image classification using reaction-diffusion systems
- SAR applications in oceanography
- SAOCOM 1A products and distribution.

On the school's last day, 20 participants and the international experts wrote a final-remarks document, approved by all of the attendees, which we summarize in this report.

In the framework of the Third Remote Sensing Spring School, specialists related to forest fires and land degradation, agricultural and forestry production, meteorology, wetlands, bioindicators, biomass, crop phenology, disaster risk, hydrographic basins, the cryosphere, hydrocarbon monitoring, interferometry, geomorphology, urban planning, and SAR product validation gathered. Scientists and stakeholders from Paraguay, Cuba, Brazil, Mexico, Venezuela, Ecuador, Argentina, Chile, Colombia, Guatemala, Uruguay, Peru, Bolivia, and Nigeria were present. During the event, experts from Brazil, Spain, India, the United States, Italy, Luxembourg, and Argentina discussed the physical fundamentals and statistics of SAR data, polarimetric decompositions, SAR image filtering, and SAR applications in agriculture, soil science, oceanography, glaciers, natural hazards, and interferometry.



FIGURE 1. Spring School participants gather at the Teófilo Tabanera Space Center on 20 September 2018.

Those theoretical concepts were complemented by practical classes in the processing, analysis, and classification of SAR images. Workshops were held to present practical problems and discuss solutions. Software tools, technologies, and data-repository applications development were discussed. The participants believed that the school provided important and valuable contributions to their training and practice, with a remarkable approach to the state of the art in SAR image processing. The workshops' format and schedule provided an opportunity for discussion of specific interests related to the core topics of the school. New problems that we can approach through SAR technology were articulated.

The participants agreed that they learned new concepts and updated their analysis and processing tools. Beyond the in-depth knowledge acquired during conferences and practices, the value of participating in discussions that occur in an enriching interdisciplinary environment was highlighted, with the goal of encouraging scientific and stakeholder collaborations in the region.

The applications submitted showed that SAR is an extremely useful imaging technique for monitoring multiple processes that occur on Earth. School participants learned that SAR data are obtained through microwave imaging and that the information can be analyzed to understand complex spatiotemporal phenomena on the Earth's surface. The school helped to make the professional practice of SAR more concrete and valuable when applied across the diverse territorial realities of the participants. Everyone agreed that the operative monitoring of some environmental risks, such as land deformation velocity, may be a limited or even an impossible task without this technique. The participants stressed that they acquired a new vision allowing them to improve their practices in

- ▶ education and teaching
- ▶ research
- ▶ development and innovation.

Emphasis was placed on the production and dissemination of knowledge through high-impact scientific journals. An important aspect of the school was the inclusion of pro-

professionals who specialize in different fields and have complementary skills. Groups were organized through social networks (Facebook and WhatsApp) to interact and remain in contact. Creating a group on LinkedIn to consolidate the interaction was also suggested. Proposals for institutional cooperation agreements were generated. Cooperation for the orientation and direction of projects was considered.

To consolidate these agreements and generate regional solutions from science, we suggest that supportive institutions, such as space agencies, environmental organizations, and universities and government agencies, should participate—in each country, if possible—in building an institutional and sustainable framework.

Our recommendations include the following:

- ▶ continue this type of event every two years in the framework of the CELFI program, which provides full financial support for travel expenses to foreign lecturers and Latin American participants
- ▶ create a network of participants and institutions to identify cooperation opportunities, for example, in the framework of the Ibero-American Programme on Science and Technology for Development, which offers financial support for scientific projects
- ▶ produce webinars and share them using multimedia platforms
- ▶ share information for the continuity of the research, training, and development of the applications generated in the schools
- ▶ keep this information updated
- ▶ increase lab hours and practical activities during upcoming events
- ▶ organize presentations by specialists as poster sessions
- ▶ encourage the use of SAOCOM data as well as those provided by participating countries in the practical classes.

We conclude by recognizing the effort of both the organizers and the funding agencies that made the school possible—the CELFI, Gulich Institute, and GRSS Argentine Chapter—and their fundamental role in promoting these activities in the region. The impact of this school was enormous,

and its multiplying effect will be positive. We believe that it is essential to give continuity to this valuable initiative.

Dissertations and participant presentations can be found at <https://sites.google.com/ig.edu.ar/3er-escuela-de-primavera/>. Interviews with specialists and experts are located at <https://www.youtube.com/watch?v=bRFG48JKWkA&feature=youtu.be&fbclid=IwAR1p-TmRGImmac73qBfGCVBqLmWm2GBy-KX6Rrk31awuPB7v2e4OKuk08fQ>. Interviews with participants are available at <https://www.youtube.com/watch?v=XyW1KAvv60Q&feature=youtu.be&fbclid=IwAR2Y7G9LmPRoY4WXa7VNR8NpObC1oDU7G2QMA-WZ3q7PhNawzsrqleCvlyk>.

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