Introduction to the Special Issue on the ESA’s Soil Moisture and Ocean Salinity Mission (SMOS)—Instrument Performance and First Results

The Soil Moisture and Ocean Salinity (SMOS) mission was launched on the 2nd of November 2009 and is one of ESA’s Earth Explorer Missions, being research missions dedicated to investigate specific aspects of our Earth System, thus addressing areas of immediate environmental concern. They are meant to explore new territory, both in technological terms and scientifically. SMOS is very true to this idea.

The SMOS mission provides—for the first time—global observations of soil moisture and ocean salinity from space, which are two key variables in the water cycle. Both are important for climate research as well as for a variety of oceanographic, meteorological, agronomical, and hydrological applications, such as water resources management. SMOS observations are also expected to provide valuable information on the characterization of sea ice and snow-covered surfaces and enhance our understanding of the exchange processes between the surface and the atmosphere.

Providing such data from space represented a real technical challenge. The instrument on SMOS, i.e., the Microwave Imaging Radiometer using Aperture Synthesis (MIRAS), operates in L-band at 1.4 GHz and measures brightness temperatures as a function of polarization and angle. It applies interferometry to provide a spatial resolution suitable for the global measurements required by the scientific users. SMOS is the first mission to apply such a technology in space.

Already in 2008, a special issue on the SMOS mission was published in this journal (IEEE Transactions on Geoscience and Remote Sensing, vol. 46, Mar 2008) and focused on the technological advances of the mission. Now, two years after launch, we would like to return to present first scientific results, more focusing on the calibration and validation of the SMOS data and the improvements to the retrieval algorithms to achieve the mission objectives, also giving an outlook to the applications ahead. The contributions in this special issue intend to summarize the extensive work by the involved SMOS teams for the first one to two years after launch. Some aspects might still be missing due to the publication deadlines for this special issue. The first six months after launch, which is the so-called commissioning phase, were dedicated to test the functionalities of the spacecraft, the instrument, and the ground segment, including the data processors. This phase was successfully completed in May 2010, and SMOS has since been in the routine operations phase and providing data products to the science community.

This special issue will be introduced by an overview paper by Mecklenburg et al., detailing the current technical status of the mission, providing an overall assessment as to achieving the mission’s scientific objectives, and pointing to the various contributions in this special issue. The paper by Kainulainen et al. details the radiometric performance of the MIRAS instrument. The subsequent papers by Kerr et al. and Yin et al. will provide some background and an update on the fundamentals for the soil moisture and ocean salinity retrievals that was described in the special issue in 2008. Given that the objectives and the technology of the SMOS mission are a first in many respects, new challenges are discovered as we continue to learn more about the SMOS data. One of them clearly was the detected radio-frequency interference (RFI), originating from man-made emitters on the ground, on aircraft, or spaceborne systems and disturbing the natural microwave emission in the protected L-band frequency region. You will see this reflected in the three contributions by Oliva et al., Castro et al., and Misra et al. We would also like to acknowledge the continuous collaboration with the NASA Aquarius and SMAP teams, which are two L-band missions dedicated to observing ocean salinity and soil moisture now and in the future. There are many common areas where we share our expertise, RFI clearly being one but also collaborating with regard to calibration and validation activities. You will see this reflected in some of the contributions in this special issue (e.g., Jackson et al.). The second half of this special issue will focus on the validation of the SMOS data products for soil moisture and ocean salinity.

Unfortunately, not all the contributions submitted could make it into this special issue but will most certainly be published at later stages. We still hope that the content of this special issue provides a good overview on the on-going scientific activities associated with the SMOS mission.

Finally, the guest editors would like to thank all the reviewers for dedicating their expertise and time in support of the review process.

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From 1980 to 1985, he was employed by CNES, Toulouse. In 1985, he joined LERTS, where he was Director from 1993 to 1994. He spent 19 months at JPL, Pasadena, from 1987 to 1988. Since 1995, he has been with CESBIO, where he has been Deputy Director and Director since 2007. His fields of interest are in the theory and techniques for microwave and thermal infrared remote sensing of the earth, with emphasis on hydrology, water resources management, and vegetation monitoring. He has been involved in many space missions. He was an EOS Principal Investigator (interdisciplinary investigations) and Principal Investigator and precursor of the use of the SCAT over land. In 1990, he started to work on the interferometric concept applied to passive microwave earth observation and was subsequently the science lead on the Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) project for ESA with Matra Marconi Space and Observatoire Midi-Pyrénées. He was also a Coinvestigator on IRIS, OSIRIS, and HYDROS for NASA. He was Science Advisor for MIMR and Coinvestigator on AMSR. In 1997, he first proposed the natural outcome of the previous MIRAS work with what was to become the SMOS mission, which was eventually selected by ESA in 1999 with him as the SMOS mission Lead Investigator and Chair of the Science Advisory Group. He is also in charge of the SMOS science activity coordination in France. He has organized all the SMOS science workshops.

Jordi Font received the B.Sc. and Ph.D. degrees in physics from the University of Barcelona, Spain, in 1973 and 1986, respectively.

He is a Research Professor with the Physical Oceanography Department, Institut de Ciències del Mar (Spanish Research Council, CSIC), Barcelona; a Participant in 42 oceanographic campaigns; an Author or Coauthor of 300 communications to scientific symposia and 260 published papers (75 in SCI journals); an Adviser of nine Ph.D. thesis; and a Principal Investigator in several Spanish and European research contracts. He is currently Colead Investigator for ocean salinity in the European Space Agency Soil Moisture and Ocean Salinity (SMOS) mission. His main research interests include ocean remote sensing, i.e., determination of sea surface salinity by microwave radiometry; physical oceanography of the Mediterranean Sea, i.e., water masses, circulation, and climate change; ocean circulation, i.e., operational measurements of ocean currents and technological improvements; and mesoscale dynamics, i.e., fronts, eddies, topographic interactions, and physical–biological processes coupling.

Dr. Font is a member of several international societies and committees. Until May 2010, he was Chairman of the Ocean Physics and Climate Committee of the International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM). He received the National Arts Award 2011 of the Catalan Government in the category of Thought and Scientific Culture.

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Dr. Martin-Neira is a Member of the Académie des Technologies of France. He was the recipient of the Confirmed Inventor Award from ESA in 2002 and the Salvà i Campillo Award and the Premio Jaime I in 2010 from Spain.
Susanne Mecklenburg received the Master’s degree in hydrology from the Technical University of Dresden, Dresden, Germany, and the Ph.D. degree in atmospheric science from Swiss Institute of Technology, Zurich, Switzerland.

In 2007, she joined ESA as SMOS mission Manager. Before joining ESA, she was with the British National Space Centre, U.K.