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Detail Submission Information

SMOS-CalVal Project

ID	3257
Password	92paled
Title	Multiscale validation of SMOS brightness temperature and products over West Africa.
Type	AO for SMOS CalVal
Class	CAL/VAL - Quality
Cost	Free of Charge
Primary Application Domain	Calibration/Validation
Secondary Application Domain	Hydrology
Location	Various

Principal Investigator

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Co-Investigators

Co-Investigators	Dr Yann Kerr, CESBIO, yann.kerr@cesbio.cnes.fr Dr Jean-Pierre Wigneron, INRA jpwigner@bordeaux.inra.fr Dr Jean-Christophe Calvet, CNRM, calvet@meteo.fr Dr Thierry Pellarin, LTHE, thierry.pellarin@hmg.inpg.fr Dr Jan Polcher, IPSL/LMD jan.polcher@lmd.jussieu.fr Dr Thierry Lebel, LTHE, Thierry.Lebel@hmg.inpg.fr

Team Composition, Experience, Innovation and Contribution

Team	Patricia de Rosnay, CESBIO, hydrologist, remote sensing expert Yann Kerr, CESBIO, lead investigator of SMOS project, remote sensing expert François Cabot, CESBIO, SMOS project, remote sensing expert Gilles Boulet, CESBIO, hydrologist, data assimilation expert Eric Mougin, CESBIO, remote sensing expert Mehrez Zribi, CETP, remote sening expert Philippe Waldteufel, IPSL/SA, SMOS project, remote sensing expert Jean-Pierre Wigneron, INRA, remote sensing expert Jean-Christophe Calvet, CNRM, remote sensing expert Aaron Boone, Météo-France/CNRM, land surface modelling expert Thierry Pellarin, LTHE, remote sensing expert Thierry Lebel, LTHE, hydrologist, co-investigator of AMMA international project Sylvie Galle, LTHE, hydrologist, soil moisture measurement expert Jan Polcher, IPSL/LMD, hydrologist, climatologist, lead investigator of AMMA european project

Experience	Christophe Peugeot, HSM, hydrologist Ramata Magagi, Sherbrook University, remote sensing expert The team has a considerable expertise in microwave radiometry as well as land surface processes and hydrological modeling. CESBIO, CNRM, INRA, SA are involved with the scientific team of the Soil Moisture and Ocean Salinity project. They have been contributing to the development of the SMOS land parameter retrieval algorithms, as well as to field experiments to validate the SMOS products. LTHE, IPSL/LMD are key investigators in AMMA European project and activities related to field experiments, land surface modeling and remote sensing applications. Team has been collaborating in the context of SMOS-AMMA projects to investigate to the use of passive microwave remote sensing of soil moisture to improve modeling of land surface processes and understanding of continental water cycle. Calvet, Noilhan, Bessemoulin Retrieving the root-zone soil moisture from surface soil moisture or temperature estimates: a feasibility study based on field measurements, J. Appl. Meteor., Vol. 37, No. 4. 1998. Polcher, Cox,, Dirmeyer, Dolman, Gupta, Henderson-Sellers,. Houser, Koster, Oki, Pitman, Viterbo, GLASS : Global Land-Atmosphere System Study GEWEX News, May 2000. Kerr, Waldteufel, Wigneron, Martinuzzi, Font, Berger, Soil moisture retrieval from Space: The soil moisture and ocean salinity (SMOS) mission, IEEE TGRS, vol 39(8), 2001. Wigneron, Calvet,. Pellarin, Van de Griend, Berger, Ferrazzoli, Retrieving near-surface soil moisture from microwave radiometric observations: current status and future plans, RSE Vol. 85, No. 4, 2003 De Rosnay, A GCM experiment on time sampling for remote sensing of near-surface soil moisture J. hydromet, vol4(2).2003 Pellarin, Calvet, Wigneron, Surface Soil Moisture Retrieval from L band radiometry: a Global Regression Study, IEEE TGRS, Vol. 41, No. 9, 2003. Lemaître, Poussière, Kerr, Dejus, Durbe, de Rosnay, Calvet: Design and Test of the ground based L-band radiometer for Estimating Water In Soils (LEWIS), IEEE TGRS Vol. 42(8), 2004.
Innovation	West Africa and more specifically Sahelian region is pointed out by Koster et al., 2004 (Sciences Vol305, pp 1038-1040) to be one of the region of the world with strongest feddbacks mechanims between soil moisture and precipitation. This hot spot “indicates where the routine monitoring of soil moisture, with both ground-based and space-based systems, will yield the greatest return in boreal summer seasonal forecasting.” One of the objectives of AMMA (African Monsoon Multidisciplinary Analysis) project is to address the role of soil moisture on monsoon dynamics and variability. AMMA is based on optimal modeling and multispectral remote sensing approaches together with a unique intensive field instrumentation to address scientific questions related to the role of land surface and human effects monsoon intensity, variability and predictability. Soil moisture remote sensing is a key component of AMMA project. It provides spatially integrated information on soil moisture at a scale relevant for atmospheric processes. METOP/ASCAT will provide soil moisture estimates for 2005-2007 from active measurements. AMSR microwave passive measurements has been providing soil moisture products since 2002. SMOS measurements for 2007-2010 period is particularly relevant to AMMA project to enhance the quality of soil moisture products over West Africa. In turn, West Africa is a hot spot region where SMOS is expected to have a major scientific feedback and crucial innovative applications for seasonal forecast, water resources management. AMMA project is a unique opportunity for SMOS project to validate soil moisture products and inversion algorithms at different spatial scales along a strong climatic gradient and for several annual cycles.
Contribution	For 2007-2010, meteorological ground and space based monitoring over West Africa will be ensured in the context of the Long Term Observing Period of AMMA. The topic of the present proposal is to ensure the continuity of soil moisture ground based measurements in AMMA sites, after the launch of SMOS, for 2007-2010. Together with the AMMA combined modeling and observing strategies, this complete data set will be used to: (1) compare and validate SMOS soil moisture products with both ground observation and land surface models output at different spatial scales by using aggregation procedure. (2) test microwave algorithms by comparing simulated and SMOS brightness temperature at the SMOS pixel size and antenna plot size along the meridional gradient. (3) Assimilate SMOS products in soil-vegetation-atmosphere-transfer schemes at both regional scale and SMOS pixel size. Down scaling approach and disaggregation of SMOS soil moisture product from multispectral assimilation will be addressed in link with the related proposed project “Disaggregation of SMOS data at the catchment scale and assimilation into distributed hydrological models” by J. Kalma. For these three objectives the related project, proposed to this AO, for ’L-band airborne experiment over land and ocean” will provide relevant information, for specific temporal scale and selected sites, at intermediate scale between SMOS measurements and ground measurements. The contribution of the present project to SMOS validation concerns a several year time period and a large region including several SMOS pixels. the following areas of the AO will be investigated: “comparison of soil moisture products with field measurements, considering scale issues”, “extension of soil moisture retrievals to surface types not covered yet in the proceeding (bare soil)”, “impact of auxiliary information used in the proceeding” related to scaling issues.

Executive Summary and Schedule

Executive Summary	Objective: The aim of this project is to use both ground measurements and land surface modeling approaches to compare and validate SMOS products over West Africa in the framework of AMMA project. Method: First we propose to keep the ground based continuous monitoring of soil moisture after the launch of SMOS for 2007-2010. Specific campaigns will complete this network of local scale soil moisture monitoring, by transect measurements of surface soil moisture to address the upscaling issue. The acquired soil moisture data set, combined with AMMA instrumental network, will provide distributed soil moisture information. On the other hand, an intercomparison experiment of the land surface models from local sites to meso and regional scale will be held in the context of AMMA. The models will be forced by a relevant forcing and parameter data base that is built in the context of AMMA project, from an optimal combination of space borne and ground based measurements. The present proposal is based on these two modeling and observing approaches. It is organized in three methodological components. (1) VALIDATION OF SMOS SOIL MOISTURE PRODUCTS. It consists in comparing SMOS soil moisture products to both simulated and observed soil moisture at different scales. (2) VALIDATION OF RETRIEVAL ALGORITHMS. This aims to test the direct algorithms by comparing simulated with observed brightness temperatures. To this end auxiliary data will be used to characterize the surface heterogeneities and their impact on the simulated brightness temperature. (3) ASSIMILATION OF SMOS PRODUCTS. A third component of the proposal concerns the assimilation of the SMOS products in soil-vegetation-atmosphere-transfer schemes to retrieve the root zone soil moisture. Deliverables: The team will provide scientific reports on (1) comparison between SMOS soil moisture products, ground based measurements and modeled soil moisture over West Africa, (2) algorithm validation and comparison between simulated and observed brightness temperature and (3) soil moisture root zone retrieval at different spatial scale. Funding sources: AMMA API (French program): 2005-2009, including soil moisture measuremnets for 2005-2007 (110keuros). AMMA european project 2005-2009 TOSCA 2007-2010: financial support asked to ensure the continuity of soil moisture measurements after the launch of SMOS for 2007-2010.
Schedule	2005 and 2006 are devoted to the preparation. In 2005 a ground based network of soil moisture monitoring will be installed over the three meso scale sites over West Africa in Benin, Mali, Niger. A total of 23 soil moisture profiles will be monitored continuously for 2005-2007. SMOS data will be collected by CESBIO, INRA, CNRM, LTHE just after launch in 2007. In 2008, Intensives validation campaigns will be held on the three meso-scale sites during the rainy season. A first report will be provided by the end of 2008 to describe the results of the comparison of SMOS soil moisture products with field measurements. Land surface modeling of soil moisture and comparison of modeled soil moisture and brightness temperature with SMOS products will be carried out in 2009 and 2010.

Detailed Description

Detailed Description	OBJECTIVES AND SCIENTIFIC ISSUES West Africa and more specifically Sahelian region is pointed out by Koster et al., 2004 (Sciences Vol305, pp 1038-1040) to be one of the region of the world with strongest feddbacks mechanims between soil moisture and precipitation. This hot spot “indicates where the routine monitoring of soil moisture, with both ground-based and space-based systems, will yield the greatest return in boreal summer seasonal forecasting.” One of the objectives of AMMA (African Monsoon Multidisciplinary Analysis) project to address scientific questions related to the role of land surface and human effects monsoon intensity, variability and predictability. AMMA is based on optimal modeling and multispectral remote sensing approaches together with a unique intensive field instrumentation. AMMA has been endorsed by the World Climate Research Programme (WCRP) as a major contribution to the goals of CLIVAR and GEWEX. GEWEX as recognized AMMA as one of its continental scale experiment. More information on AMMA project are given on: http://amma.mediasfrance.org/ while http://amma.mediasfrance.org/france/what_is_amma_html/what_is_amma.html provides information about AMMA region and observing strategy. Soil moisture remote sensing is a key component of AMMA project. It provides spatially integrated information on soil moisture at a scale relevant for atmospheric processes. METOP/ASCAT will provide soil moisture estimates for 2005-2007 from active measurements. AMSR microwave passive measurements has been providing soil moisture products since 2002. SMOS measurements for 2007-2010 period is extremely relevant to AMMA project to enhance the quality of soil moisture

products over West Africa. In turn, West Africa is a hot spot region where SMOS is expected to have a major scientific feedback and crucial innovative applications for seasonal forecast, water resources management. AMMA project is a unique opportunity for SMOS project to validate soil moisture products and inversion algorithms at different spatial scales along a strong climatic gradient and for several annual cycles.

The aim of this project is to use both ground measurements and land surface modeling approaches to compare and validate SMOS products over West Africa in the framework of AMMA project.

TECHNICAL AND SCIENTIFIC APPROACH AND METHODS

First we propose to keep the ground based continuous monitoring of soil moisture after the launch of SMOS for 2007-2010. Specific campaigns will complete this network of local scale soil moisture monitoring, by transect measurements of surface soil moisture to address the upscaling issue. The acquired soil moisture data set, combined with AMMA instrumental network, will provide distributed soil moisture information. On the other hand, an intercomparison experiment of the land surface models from local sites to meso and regional scale will be held in the context of AMMA. The models will be forced by a relevant forcing and parameter data base that is built in the context of AMMA project, from an optimal combination of space borne and ground based measurements.

The present proposal is based on these two modeling and observing approaches. The following areas will be investigated: “comparison of soil moisture products with field measurements, considering scale issues”, “extension of soil moisture retrievals to surface types not covered yet in the proceeding (bare soil)”, “impact of auxiliary information used in the proceeding” related to scaling issues.

The proposal is organized in three methodological components:
(1)VALIDATION OF SMOS SOIL MOISTURE PRODUCTS. It consists in comparing SMOS soil moisture products to both simulated and observed soil moisture at different scales.
(2) VALIDATION OF RETRIEVAL ALGORITHMS. This aims to test the direct algorithms by comparing simulated with observed brightness temperatures. This issue will be addressed at local scale from ground measurements of soil moisture coupled to microwave emission models. Theoretical development in microwave development carried out in the SMOSREX experiement will be considered to address specific effects of vegetation litter as well as penetration depth in dry conditions which are relevant for Sahelian regions. Auxiliary data of leaf area index and surface temperature, as well as possible airborne measurements, will be used to address the upscaling issue from ground measurements to SMOS plot scale. In addition, validation of the algorithms will be addressed trough the coupling between land surface models and microwave models. To this end auxiliary data will be used to characterize the surface heterogeneities and their impact on the simulated brightness temperature.
(3) ASSIMILATION OF SMOS PRODUCTS. A third component of the proposal concerns the assimilation of the SMOS soil moisture products in soil-vegetation-atmosphere-transfer schemes at both regional scale and SMOS pixel size, to retrieve the root zone soil moisture. In coordination with activities conducted over the Murray Darling Basin (related proposed project “Disaggregation of SMOS data at the catchment scale and assimilation into distributed hydrological models” by J. Kalma.), disaggregation of SMOS soil moisture products will be investigated from multispectral assimilation.

WORK PLAN OF THE INVESTIGATIONS, INCLUDING A DESCRIPTION OF THE KEY MILESTONES AND ASSOCIATED DELIVERABLES, THE PLANED USE OF DATA.

2005 and 2006 are devoted to the preparation. In 2005 a ground based network of soil moisture monitoring will be installed over the three meso scale sites over West Africa in Benin, Mali, Niger. A total of 23 soil moisture profiles will be monitored continuously for 2005-2007.

In 2007 data will be collected just after launch. In 2008, Intensives validation campaigns will be held on the three meso-scale sites during the rainy season. A first report will be provided by th end of 2008 to describe the results of the comparison of SMOS soil moisture products with field measurements. Land surface modeling of soil moisture and comparison of modeled soil moisture and brightness temperature with SMOS products will be carried out in 2009 and 2010.

We request to access to SMOS products and brightness temperature (level1C and level2) at a global scale. The extraction over selected areas will be made by the project team members.

Non ESA Comment

Non ESA Data

File Upload

Upload file comment
Upload Filename

Product of ENVISAT / ASAR Global Monitoring Mode

Product	Total	New	Archived
Global Monitoring Mode Image (ASA_GM1_1P)	2000	2000	0

Product of ENVISAT / MERIS

Product	Total	New	Archived
Level 2 Reduced Resolution Vegetation indices (MER_RRV_2P)	3000	2000	1000

Product of SMOS / MIRAS

Product
Level 1B
Level 1C
Level 2 (Soil Moisture)
Level 3

Data Requirements

ERS/ENVISAT: Details about archived data	Geographic location is the West Africa sub-regional scale defined in AMMA between 5°N-18°N and 2°W-5°E
ERS/ENVISAT: Details about new acquisitions	Geographic location is the West Africa sub-regional scale defined in AMMA between 5°N-18°N and 2°W-5°E
Specific polarisation schemes required for ASAR	no
Specific swaths required for ASAR	no
Alternative bands set required for MERIS	no
Simultaneous acquisition of different sensors required	no
NRT Data requirements	no

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