Special Issue on Global Land Product Validation

I. Overview of the Special Issue on Global Land Product Validation

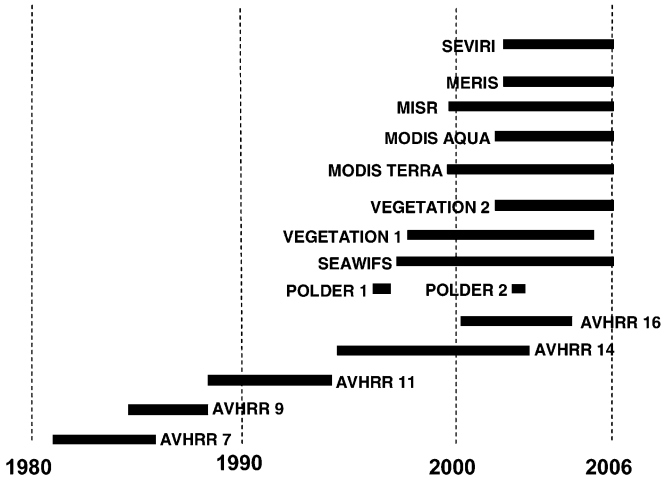
IN PARALLEL with the recent bloom of sensors providing frequent medium-resolution observations (Fig. 1), global land products have been increasingly developed and released within the community. The raw data acquired by these sensors are transformed into higher level products that can be more easily exploited by the user community. In many cases, multiple products are developed from each sensor and similar products derived from different sensors. With this, users need access to quantitative information on product uncertainties to help them assess the most suitable product, or combination of products for their specific needs. As remote sensing observations are generally merged with other sources of information or assimilated within process models, evaluation of product accuracy is required. Making quantified accuracy information available to the user can ultimately provide developers the necessary feedback for improving the products, and can possibly provide methods for their fusion to construct a consistent long-term series of surface status.

The Committee on Earth Observation Satellites (CEOS) established a working group on Calibration and Validation (WGCV) in 1984. Initially, this group focused on wavelength-specific calibration issues. However, as CEOS members started to develop higher order products, there grew the need to direct some CEOS WGCV activity toward the validation of these products. With this, in 2000, the Land Product Validation (LPV) subgroup was established under WGCV in recognition of the need for, and benefits of, international land product validation coordination (http://lpvs.gsfc.nasa.gov/). The LPV subgroup's mission is to foster quantitative validation of higher-level global land products derived from remote sensing data. This is being achieved through the following three specific objectives:

1) facilitating international cooperation and coordination of validation activities by sharing information on instruments, analyses, and field activities;
2) increasing the quality and economy of land product validation by developing standards and protocols for field sampling, error budgeting, data exchange, and product evaluation;
3) providing a forum for discussion of current issues and for exchange of technical information on efficient approaches to global validation.

During the August 2004 workshop on the validation of Leaf Area Index products [3], it was decided that a special issue on global land product validation was warranted, resulting in this IEEE special issue designed to contribute to the three specific objectives.

Overview and framework topics related to the first objective are presented within three papers (Harold *et al.*, Morisette *et al.*, Baret *et al.*). A series of 19 product validation papers address the second objective by describing the acceptable practices for quantifying the accuracy of the global products covered in these papers. Finally, to achieve the third objective, papers were solicited to present the user perspective on how accurate the products need to be, why it is important to quantify the uncertainty, and how closely the available products meet those needs. This resulted in four special issue communications related to the user response. Table I lists the papers in this special issue broken down by sensor and product.



	Albedo/BRDF	Land cover	Snow Cover	Fire/Burnt Area	Veg. Index	LAI	fAPAR	Productivity
AVHRR	✓	✓		✓	✓		✓	
SEAWIFS					✓		✓	
POLDER	✓					✓	✓	
SPOT VGT				✓	✓	✓	✓	
MODIS	✓	✓	✓	✓	✓	✓	✓	✓
MISR	✓							
MERIS		✓			✓	✓	✓	
SEVIRI	✓			✓				

Fig. 1. Medium-resolution Earth observing sensors covering the last 25 years and the standard, higher level land products available for current sensors. Note that for a single sensor, several products may exist.

II. Validation Stages

The papers in this special issue show various stages of validation for multiple global land products. It is difficult to answer strictly "yes" or "no" to the question of whether a product been validated or not. With this, and in recognition of the cost and effort involved in global product validation, CEOS, through the work and consensus of LPV, has defined the following validation hierarchy for global land products.

Stage 1 Validation: Product accuracy has been estimated using a small number of independent measurements obtained from selected locations, time periods, and ground-truth/field program efforts.

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TABLE I
LIST OF PAPERS IN THE SPECIAL ISSUE BROKEN DOWN BY PRODUCT AND SENSOR AS WELL AS THE "FRAMEWORK" AND "USER-RESPONSE" PAPERS. NOTE THAT ALL REFERNCES ARE TO THIS SPECIAL ISSUE AND DO NOT ALL APPEAR IN THE REFERNCE LIST

Sensor	Product: BRDF	Land Cover	Snow	Fire & Burnt Area	Vegetation Index	fAPAR	Leaf Area Index	Productivity
MISR	Abdou et al. Lyapustin et al.							
MODIS		Cohen et al. See et al.	Salomonson et al.	Csiszar et al. Boschetti et al.	Brown et al. Fensholt et al.	Steinberg et al. Yang et al. Yang et al. (2)	Pandya et al. Huang et al. Abuelgasim et al. Yang et al. (2) Cohen et al.	Turner et al. Heinsch et al.
SPOT VGT		Mayaux et al. See et al.			Brown et al.		Abuelgasim et al.	
POLDER							Abuelgasim et al.	
AVHRR					Brown et al.			
SeaWiFS					Brown et al.			
MERIS					Fensholt et al.			
Framework		Herold et al.			Baret et al.		Morisette et al. Baret et al.	Baret et al.
Response		Lambin et al.		Roy et al.	van Leeuwen et al.			Plummer Xiao

Stage 2 Validation: Product accuracy has been assessed over a widely distributed set of locations and time periods via several ground-truth and validation efforts.

Stage 3 Validation: Product accuracy has been assessed, and the uncertainties in the product well-established via independent measurements made in a systematic and statistically robust way that represents global conditions.

This special issue presents the current status of international validation activities. The 19 product validation papers provide results leading to stage one through three validation. The three framework papers (see Table I) demonstrate how emerging activities are gathering significant contributions from several institutions working toward stage two and stage three validation. At any stage, the feedback from the user community is essential, calling for open and easy access to all products and their accuracy estimates. The four user-response papers provide an example of such feedback. We believe this special issue reflects a snapshot of ongoing communication efforts within the community of global land product providers and users. The set of papers within this special issue help define where we are along the path of validation.

The outcome of the validation efforts presented in the special issue and continued work on global land products can lead to recommendations for the best use of current products and inform the design of future missions, both for the space and ground segments. This will ensure continuous improvement in our monitoring and understanding of the Earth.

JEFFREY T. MORISETTE
NASA Goddard Space Flight Center
Greenbelt, MD 20771 USA

FRÈDÉRIC BARET
INRA-CSE Agroparc
84914 Avignon, France

SHUNLIN LIANG
University of Maryland
Department of Geography
College Park, MD 20742 USA

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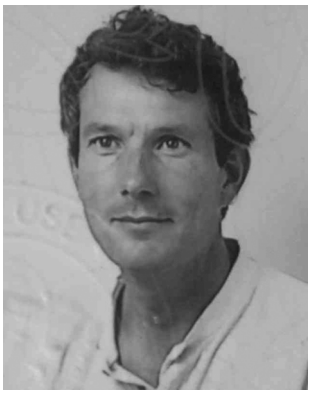
Jeffrey T. Morisette received the M.S. degree in statistics from Oakland University, Rochester, MI, and the Ph.D. degree from North Carolina State University, Raleigh, in 1992 and 1997, respectively. He also attended the International Space University's Summer Program, Vienna in 1996.

He helped establish the CEOS "Land Product Validation Subgroup," serving as Deputy-Chair from its inception in 1999 to 2002, and Chair from 2003 to 2006. He is currently a member of NASA's MODIS science team, serving as the Land Product Validation Coordinator.



Frédéric Baret received the Ph.D. degree in 1986 on the application of remote sensing to agriculture.

Since that time, he has been working at the National Institute of Agronomical Research, focusing on radiative transfer modeling in the solar domain, estimates of canopy and soil characteristics from radiometric observations, and assimilating these data into canopy functioning models. He was also coordinating large experiments such as Alpilles-ReSeDA, ADAM, and is currently in charge of the VALERI and CYCLOPES projects for the development and validation of medium-resolution satellite products.

Shunlin Liang received the Ph.D. degree in remote sensing and GIS from Boston University, Boston, MA, in 1993.

He was a Postdoctoral Research Associate in Boston University from 1992 to 1993, and Validation Scientist of the NOAA/NASA Pathfinder AVHRR Land Project from 1993 to 1994. He is currently an Associate Professor in the University of Maryland, College Park. His research interests focus on land surface data assimilation and quantitative optical remote sensing. He is a member of NASA ASTER, MISR, and MODIS science teams. He is the author of *Quantitative Remote Sensing of Land Surfaces* (Wiley, 2004).

Dr. Liang is Co-Chairman of the International Society for Photogrammetry and Remote Sensing Commission VII/WG1 on Fundamental Physics and Modeling. He is an Associate Editor for the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING.