

Characterizing and Validating Global Land Cover Workshop

IIASA 13-15 June 2011

Workshop Report

Introduction

Accurate spatial characterization of agricultural lands is critically important for agricultural monitoring to agricultural decision making at global, national and local levels. Satellite imagery combined with ground based data and spatial mapping tools are a powerful means for producing such timely and accurate agricultural land cover maps at global to local scales. Remotely sensed technologies are advantageous because they have low marginal cost; they provide higher levels of spatial resolution than alternate approaches; they are the only feasible data gathering mechanism in some locations; they provide precise, automated repetition of data collection efforts; and they can be combined with geolocalised in-situ data collection to generate value-added products.

However, there are still many problems with existing products in characterizing croplands and rangeland extent. Land cover / land use is often subject to rapid change, and in general, is poorly characterized using current general land cover maps particularly in Africa and regions with subsistence or low-intensity agriculture where ground data availability is poor and field sizes are small. For this reason the workshop on Characterizing and Validating Global Land Cover was held at the International Institute of Applied Systems Analysis (IIASA) in Laxenburg, Austria from 13 to 15 June 2011 to consider improvements to cropland and rangeland mapping with a particular focus on Africa.

The workshop was funded by CCAFS (<http://ccafs.cgiar.org/>) with additional travel funds provided by the Joint Research Center of the European Commission. The workshop was hosted by IIASA and CGIAR CSI (Consortium for Spatial Information), in close collaboration with the Group on Earth Observation (GEO), the Agricultural Monitoring Communities of Practice (COP), GOF-C-GOLD and the Joint Research Centre of the European Commission (JRC).

The workshop brought together more than 70 international experts on remote sensing, land cover (to consider issues of training, calibration and validation), land use, cropland and rangeland mapping, crop type mapping, area estimation and crowd-sourcing. Several international organizations were represented including FAO, IFPRI, ILRI and ICRISAT as well as universities and experts working in national agencies concerned with cropland and/or land cover/land use mapping.

Objectives of the Workshop

The main objectives of the workshop were: a) to integrate the best land cover information that is currently available on cropland extent in order to create a hybrid map at a 1 km resolution shortly after the workshop – the list of data collected is provided in Appendix A; b) to build an improved land cover validation dataset by encouraging participants to contribute geo-tagged photos, validation points and existing reference validation datasets; and c) to build a continuing international collaboration via Geo-Wiki in the collection of data related to land cover validation and through the GEO Agriculture Community of Practice

(CoP). The agenda of the workshop is provided in Appendix B and Appendix C contains a list of workshop participants.

The GOF-C-GOLD Land Cover Implementation Team with the CEOS Land Product Validation Working Group held a two day meeting on land cover product validation at IIASA directly after the workshop (from 16-17 June 2011). The workshop provided a good link to the subsequent discussions of the latter meeting.

Workshop Sessions

A number of presentations were given in three plenary sessions held during the workshop. These video presentations are available for viewing at the following site:

<http://www.iiasa.ac.at/Research/FOR/lc/presentations.html>

Four breakout group sessions were held covering ten different topics including cropland/crop type/crop distribution mapping; rangeland mapping; integration of remote sensing and other types of data; soft validation; crop area estimation; availability of validation data, and cropland datasets in Africa and outside. Presentations from the breakout groups and a summary of the breakout group discussions are provided at this site:

<http://www.iiasa.ac.at/Research/FOR/lc/breakout.html>

Workshop Summary

Themes	Main Points
Current State	Current global land cover maps do not depict cropland sufficiently for certain applications in ecosystem services and food security. Some of the products are poor in some areas (e.g. parts of Africa). However, it is recognized that there are general limitations to current approaches due to the identical seasonal profile of natural vegetation and cropland.
Methods for cropland and crop type mapping (global, regional, national)	There was no consensus on whether automated or interactive/visual methods of classification are better. There is a clear need to better define cropland. Cropland/crop type maps are advocated as auxiliary variables for area estimates. Products need to be fit for purpose (e.g. modeling vs. monitoring). The quality may be good for one application but not another, i.e. one size does not fit all. We need to be aware of the limitations of land cover in land use applications. There is a need for good regional networks and ground validation.
State of Datasets	A considerable amount of data was contributed by workshop participants in the cropland domain in Africa. Data were also received from other areas (China, Brazil, Eastern Europe, India, USA and Australia). The datasets contributed are listed in Appendix A. This process will continue beyond the workshop.
Technology and Data Volumes	We should exploit new developments in creating land cover using multiple years of data from one sensor and data from multiple sensors. Large volumes of data are now available, e.g. 30m resolution

	Landsat. Even higher resolution data are available (though with often prohibitive associated costs) but it will take some time (even years?) before these products are more readily accessible. There are technological and funding challenges associated with this. Since we need the data now, we should continue to make use of existing products, e.g. hybrid maps and collect what is already available in terms of national maps (which are considerable in number).
Legend Harmonization	LCCS classifiers should be used to assign attributes to the classes. We need to go from percentage cropland to drill down further to herbaceous, tree crops, irrigated/non-irrigated. We must document the data which contribute to the new hybrid map. We should consider innovative developments, e.g. distance and overlap to conceptualize legend differences and the use of attributes. We must stress the importance of metadata (and retain the information about map production for the hybrid map).
Rangeland Mapping	Further work is needed on defining rangelands. The current classification systems use land cover and proxies such as Length of Growing Period and population density so a more accurate land cover map is still useful. The situation is more complex than cropland because rangeland is land use rather than land cover. Unlike land cover and the LCCS, land use still needs standardization.
Crowd-sourcing (Soft validation)	This new and challenging field has a big potential. It can be used as complementary information for soft validation of land cover products. It can potentially be used for training depending upon the method used. To use it for validation, further studies are needed to evaluate how good this source of data is.
Data Sharing	Some satellite data policies remain restrictive. There is an absolute need to be able to share satellite images. One option is to approach commercial providers to share very high resolution data and to try to work with Google on this. The scientific community needs access to validation data. This is not straightforward but there is a need to harmonize validation datasets through a transparent process and share this data more freely. There needs to be a commitment to better integrate existing socio-economic data. Many national and regional agricultural land cover datasets exist though cannot be shared due to restrictive data policies. This community will continue to advocate for open data policies.

Recommendations from the Workshop

Curtis Woodcock	<ol style="list-style-type: none"> 1. There is a need for better community participation and incentives in land cover validation. 2. There should be a community initiative in the validation of the global 30m land cover product (being developed by China and the USA).
Olivier Leo	<ol style="list-style-type: none"> 1. We should exploit the new opportunities associated with the GEO Ag initiative G20.

	<ol style="list-style-type: none"> 2. There is a need for a reliable, stable crop mask and to specify the characteristics (renewed on a 5 year basis). 3. Further research and development are needed in understanding the dynamics of land use change. 4. More care is needed in area estimation. 5. The proliferation of products can confuse users and synthesis may increase error and will need traceability so the community could give guidance on the best available product for the food security community. 6. There is some benefit to duplication of effort but there is also a need to reduce confusion. 7. Probability products need better explanation for users. 8. We need to find ways to engage African partners in agricultural monitoring through building on capacity (with an emphasis on institutions). There are some clear benefits to bottom up crowd-sourcing approaches, which need further investigation.
Adam Gerrand	<ol style="list-style-type: none"> 1. The LCCS should be used. 2. We must find ways to reduce the duplication of efforts. 3. We must recognize the constraints of national sovereignty on FAO efforts. 4. Nationals should be involved early on in new product development. 5. There is a need for clarification of the definitions of cropland. 6. There is a need for clear definition of the purpose of the products at the outset.
Pierre Defourny	<ol style="list-style-type: none"> 1. There is a need for the community to read documentation and pay attention to metadata. 2. The LCCS3 legend documentation should be more flexible but also need guidelines and default definitions for users. 3. We should recognize the limitations of global land cover for local use and also that there is a data gap in terms of what certain communities need. 4. The recent ESA initiative to identify climate modeling user requirements for land cover identified the need for consistency vs. accuracy. 5. We should expand crowd-sourcing to the farming community. 6. We should pay more attention to LCC validation. 7. Reference datasets need to be consolidated.
Chris Justice	<ol style="list-style-type: none"> 1. Restrictive data policies remain a major obstacle to progress in land cover mapping. 2. Increased attention is needed to the characterization of croplands in global land cover maps. 3. A joint task between GOF/GOLD and the GEO Agricultural Monitoring Task should be initiated specifically on global cropland mapping, resulting in new periodic global products, taking advantage of the new moderate resolution coverage from LDCM, Sentinel 2 and other available international assets.

	4. Capacity building for operational agricultural monitoring in Africa is much needed.
Workshop participants	<ol style="list-style-type: none"> 1. We should recognize that the workshop has been largely product-driven rather than addressing the needs of the user. 2. Accuracy requirements from the user community need further attention. 3. As the modeling community is being expanded to include Integrated Assessment, this will require better categorization of cropland types. 4. We should move beyond land cover to land use. 5. There are regional opportunities to implement operational LULC mapping in support of agricultural decision making and policy (nesting global and regional) with the opportunities from high resolution data. 6. We should recognize similarities between GEO AG and GEO Forest and exploit the lessons learnt. 7. The JECAM initiative in GEO to obtain data from multiple satellites for experimental mapping, monitoring and modeling for the community should include validation of cropland products. 8. The importance of metadata standards should be recognized. 9. The broader community should be involved in the entire product process including validation.

Key Actions from the Workshop

1. IIASA should initiate and lead a new subtask under the GEO Agriculture task, and work with the GEO Agriculture 'Community of Practice', to complete the hybrid map of current cropland distribution. A follow on meeting is needed focused specifically on rangelands mapping and monitoring.
2. Tom Loveland and Peng Gong: To develop the validation plan for the emerging global 30 m land cover product and include the broader community.
3. The GEO Global Agricultural Monitoring G20 Initiative working with CEOS and private industry data providers, should help coordinate acquisition and availability of the satellite observations necessary for operational agricultural monitoring. GEO AG Co-chairs: To develop the cropland initiative in cooperation with the global land cover initiative of GOFI/GOLD through addition of a sub-task under the GEO AG work plan.

Workshop Outputs

In addition to the main recommendations and actions arising from the workshop, a global hybrid map of cropland extent will be created at a 1km resolution using all the relevant contributions of data from the workshop process. A journal paper will be written documenting the hybrid map. Any data that have been contributed as part of the workshop process (and for one month after) which are then used in the creation of the map, will be acknowledged through inclusion of the participant as a co-author. The hybrid map will be a living product that will be continuously updated when new and better land cover

information becomes available. The hybrid map will be available to the community for viewing and downloading via geo-wiki.org.

Appendix A: Data Shared or Downloaded as Part the Workshop Process

Workshop participants were asked to contribute cropland percentage maps at a 1km resolution at a global, regional or national level prior to the workshop in order to develop a global, hybrid cropland product. Spatial gaps in the provision of cropland will be identified and organizations will be approached after the workshop to contribute.

Workshop participants were requested to provide metadata with each data set. This metadata is available from Geo-Wiki both for searching and for adding/updating metadata to existing/new datasets.

Other data relevant to the training, calibration and validation of land cover maps were also requested. These include geo-tagged photos, geo-tagged points and geo-tagged areas on the ground from existing field surveys or related research. Below is a summary of these datasets.

Global Datasets of Cropland Percentage

Dataset	Source	Year(s)
GLOBCOVER	Downloaded from the ESA website and processed to produce 1km % cropland	2009
Global Cropland Extent	South Dakota State University, Matt Hansen	2000-2008
M3-Cropland	McGill University, Navin Ramankutty	2000
Cropland proportion layer at a 10km resolution reconciled with cropland statistics at the national level	Institute of Social Ecology, Karlheinz Erb	2000

Regional/National Datasets of Cropland Percentage

Dataset	Source	Year(s)
Hybrid cropland extent map of Africa	IIASA/IFPRI, Steffen Fritz	2000 to 2011
Hybrid cropland extent map of Africa	JRC, Christelle Vancutsem	Various temporal extents
Africover for East African countries Map of cropland extent for Senegal	FAO, Giulia Conchedda	2000 2005
Cropland extent from the CORINE land cover dataset	Downloaded from the European Environment Agency (100m resolution) and processed to a 1km % cropland map	2005
Cropland extent for South Africa	GeoTerralImage (Pty) Ltd, Fanie Ferreira	2010
Cropland extent for several states in India	ISRO, Rajak Ram	2010-2011
Map of cropland extent for Australia	Downloaded from ACLUMP website (30m resolution) and processed to a 1km % cropland map	2010
Cropland extent for the USA	USDA/NASS, Rick Mueller	2010 Updated annually

Dataset	Source	Year(s)
Cropland extent for China	Chinese Academy of Agricultural Sciences, Wu Wenbin	2000
Cropland extent for Southern Sudan	Southern Sudan Food Security Secretariat, Alex Tiangwa	2010
Cropland extent for Mali	CIRAD, Elodie Vintrou	2007
Cropland extent for Nigeria	University of Lagos, Olesegun Adeaga	2007
Cropland extent for Zimbabwe	Inbal Becker-Resheff	Unknown
Cropland extent for Burkina Faso	UNECA, Andre Nonguierma	1983
Cropland extent for Gambia	CIESIN, Jaiteh Maitlending	Unknown
Crop masks for sugar cane and summer crops in Brazil	INPE, Jansle Rocha	2010 Updated annually
Cropland extent for one oblast in Kazakhstan	Institute of Space Research, Alexey Terekhov	2005

Other Datasets

Dataset	Source	Year(s)
Field survey data in Argentina	INTA, Diego de Abellyara	2010, 2011
Field survey data in Russia	Space Research Institute, Igor Savin	Unknown
Classified Landsat image of three NELDA sites	University of Oregon, Olga Krankina	2000
Classified Landsat image of Fakara (Niger)	ILRI, Bruno Gerard	2004
Validation points in a number of different African countries	ILRI, An Notenbaert	2000 to 2010
Geo-tagged photos with global coverage	University of Oklahoma, Xiao Xiangming	Various years
Geo-tagged photos in Mali Validation points in Mali	CIRAD, Elodie Vintrou	May to Oct 2009
Geo-tagged photos in Kenya	University of Maryland Alyssa Whitcraft, and Tatiana Loboda	Unknown
Validation points in Sudan Videos of land cover in Sudan	Sudan University of Science and Technology, Mohammed El-Gamri	2004

Appendix B: Agenda of the Workshop

Monday 13 June

- 13.30-13.35 Welcome address (Nebojsa Nakicenovic, Deputy Director of IIASA)
- 13.35-14.00 Welcome, objectives of the workshop, overview of shared data (Steffen Fritz/Linda See, IIASA)
- 14.00-14.30 Overview of global landcover datasets (Matt Hansen, South Dakota State University)
- 14.30-15.00 Overview of agricultural mapping (Pierre Defourny, Université Catholique de Louvain)
- 15.00-15.20 Deriving global agricultural distribution from conventional sources (Stanley Wood, IFPRI)
- 15.20-15.40 Coffee break
- 15.40-16.00 M3 Global agricultural landcover datasets: Current version and latest updates (James Gerber, University of Minnesota)
- 16.00-16.30 Static and dynamic mapping of cropland areas in Africa (Christelle Vancutsem, JRC)
- 16.30-18.00 Introduction to Breakout Group Session 1 (10 minutes)
- Group 1a: Datasets in Africa/Gap Analysis/Qualitative Validation**
Chair: Renato Cumani / Fanie Ferreira
Presenters: Renato Cumani / Giulia Conchedda, Fanie Ferreira, Stanley Wood, Francois Kayitakire
- Group 2a: Methods for Cropland/Crop Type Mapping**
Chair: Christelle Vancutsem / Matt Hansen
Presenters: Christelle Vancutsem, Megan Salmon, Pierre Defourny, Rick Mueller, Bernardo Rudorff
- Group 3: Methods for Rangeland/Livestock Mapping/Systems Classification**
Chair: Mario Herrero / Diego de Abellera
Presenters: Mario Herrero, Jan de Leeuw, An Notenbaert / Giuliano Cecchi, Diego de Abellera
- Group 4: Methods for Distributing Crops/Crop Type Mapping**
Chair: Stanley Wood / Rick Mueller
Presenters: Liangzhi You

Tuesday 14 June

- 09.00-09.50 Report back from Breakout Group Session 1
- 09.50-10.10 Status of legend harmonisation (Ola Ahlqvist, Ohio State University)
- 10.10-10.45 Global intercomparison studies, synergy maps and proposed updating procedure of products (Steffen Fritz /Linda See, IIASA)

- 10.45-11.00 Coffee break
- 11.00-12.30 Introduction to Breakout Group Session 2 (10 mins)
- Group 1b: Datasets in Africa/Gap Analysis/Qualitative Validation Continued**
 Chair: Françoise Kayitakire / Fanie Ferreira
 Presenters: Fanie Ferreira, Miriam Haffani, Adeaga Olesun, Jaiteh Malanding
- Group 2b: Methods for Cropland/Crop Type Mapping Continued**
 Chair: Tom Loveland
 Presenters: Continuation from 2a
- Group 5: Legend Harmonization**
 Chair: Ola Ahlqvist / Martin Herold
 Presenters: Renato Cumani, Martin Herold, Liangzhi You, Gerard Bruno
- Group 6: Integration of RS with Statistical Data; Algorithms for Creating Hybrid Maps**
 Chair: Steffen Fritz / Karlheinz Erb
 Presenters: Steffen Fritz, Karl Heinz Erb, Thomas Kummerle, Ian Jarvis
- 12.30-14.00 Lunch hosted by IIASA at Gallo Rosso
- 14.00-15.00 Report back from Breakout Group Session 2
- 15.00-15.20 Approaches to accuracy assessment (Curtis Woodcock, Boston University)
- 15.20-15.40 Break
- 15.40-16.00 Findings from example product intercomparison studies (Olga Krankina, Oregon State University)
- 16.00-16.20 Status of validation data sets (Joanne Nightingale, Sigma Space Corporation and Martin Herold, Wageningen)
- 16.20-18.00 Introduction to Breakout Group Session 3 (10 minutes)
- Group 7: Regional/National Datasets for Areas Outside of Africa**
 Chair: Jansle Rocha / Peng Gong
 Presenters: Peng Gong, Alex Held, Jansle Rocha, Pierre Defourny, Diego de Abelleira, Olga Krankina
- Group 8: To be confirmed**
- Group 9: Other Global Activities; Integration of Socio-Economic and Other Data**
 Chair: Mario Herrero / Stanley Wood
 Presenters: Monika Zurek, Mario Herrero, François Kayitakire
- Group 10a: Approaches to Soft Validation**
 Chair: Giles Foody / Xiao Xiangming
 Presenters: Giles Foody, Xiao Xiangming, Steffen Fritz, Christoph Perger/Linda See, Lucy Bastin, Steve Stehman, Curtis Woodcock, Peng Gong

Wednesday 15 June

09.00-10.00 Report back from breakout group session 3

10.00-11.30 Introduction to Breakout Group Session 4 (10 minutes)

Group 10b: Approaches to Soft Validation Continued

Chair: Lucy Bastin / Giles Foody

Presenters: Continuation from 11a

Group 11: Data Availability for Validation

Chair: Martin Herold / Adam Gerrand

Presenters: Martin Herold, Adam Gerrand, Alex Held, Diego de Abelleira

Group 12: Crop Area Estimation

Chair: Rick Mueller / Olivier Leo

Presenters: Olivier Leo, Wu Bingfang

Group 13: Data Sharing of Existing and Future Datasets

Chair: Chris Justice / Pierre Defourny

Presenters: Pierre Defourny, Curtis Woodcock

11.30-12.30 Report back from Breakout Group Session 4

12.30-13.30 Lunch

13.30-13.40 Overview of CCAFS (Mario Herrero)

13.40-15.00 Revisiting issues that were raised in the breakout groups

15.30-16.00 Coffee break

16.00-17.00 Panel discussion on program opportunities

Chair: Steffen Fritz

Panel members: Renato Cumani, Pierre Defourny, Chris Justice, Olivier Leo, Curtis Woodcock

Panel members will be given 5 mins each to provide comments and then the floor will be opened to a broader discussion.

The questions to be addressed will include:

1. What has been useful in the workshop?
2. What more can we do and how can we make it better?
3. What is needed to ensure continuity of the program?
4. What are the next steps and actions?
5. What publications/outputs will be produced from the workshop?

17.00-17.30 Close: Way Forward

Appendix C: Workshop Participants

Olusegun Adeaga

Department of Geography, University of Lagos
Akoka, Yaba
Lagos, 101017
Nigeria
Tel.: +234-8029052849
Email: oadeaga@yahoo.com;
oadeaga@unilag.edu.ng

Karl Ola Ahlquist

Department of Geography, University of Ohio
1049B Derby Hall, 154 N Oval Mall
Columbus OH, 43210
USA
Tel.: +1-614-247-7997
Email: ahlqvist.1@osu.edu

Lucy Bastin

Joint Research Centre of the EC
TP440, Via Enrico Fermi
Ispra, 21027
Italy
Tel.: +39 0332 78 6896
Email: lucy.bastin@jrc.ec.europa.eu

Inbal Becker-Reshef

University of Maryland
4321 Hartwick Rd Suite 209
College Park MD, 20740
USA
Tel.: +13014057954
Email: ireshef@iluci.umd.edu

Hannes Böttcher

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361
Austria
Tel.: +43-2236-807538
Fax: +43-2236-807599
Email: bottcher@iiasa.ac.at

Giuliano Cecchi

FAO
Viale delle Terme di Caracalla,
Rome, 00153
Italy
Tel.: +393479379787
Email: giulianocecchi@libero.it

Giulia Conchedda

FAO
Viale delle Terme di Caracalla
Rome, 00153
Italy
Tel.: +39 06 57052082
Email: giulia.conchedda@fao.org

Renato Cumani

FAO
Viale delle Terme di Caracalla
Rome, 00153
Italy
Tel.: (+39) 06 57051
Email: Renato.Cumani@fao.org

Diego de Abelleira

National Institute of Agricultural Technology
(INTA)
Repetto y de los Reseros s/n
Hurlingham, Buenos Aires, 1686
Argentina
Tel.: 541146211684
Email: ddeabelleira@cnia.inta.gov.ar

Pierre Defourny

Earth and Life Institute, Université Catholique De
Louvain
Croix Du Sud, 2 Bte 16
Louvain-la-Neuve, 1348
Belgium
Tel.: +32 (0) 10 47 23 74
Email: Pierre.Defourny@uclouvain.be

Carlos Di Bella

INTA
Los Reseros y Las Cabañas s/n, Castelar
Buenos Aires, 1712, Argentina
Tel.: +541146210125
Email: cdibella@cnia.inta.gov.ar

Jan de Leeuw

International Livestock Research Institute
P.O.Box 30709
Nairobi, Kenya
Tel.: +254-20-422-3000
Email: j.leeuw@cgiar.org

Karlheinz Erb

Institute of Social Ecology
Schottenfeldgasse 29
Vienna, A-1070
Austria
Tel.: +43-1-5224000-405
Email: karlheinz.erb@aau.at

Jinlong Fan

National Satellite Meteorological Center,
China Meteorological Administration
No. 46 Zhongguancun South Avenue,
Haidian District, Beijing
China
Tel.: +86 10 6840 9406
Email: fanjl@cma.gov.cn

Stefanus Ferreira

GeoTerraImage (Pty) Ltd
477 Witherite Street, Wilgers
Pretoria, 20
South Africa
Tel.: +27-12-807 9480
Email: fanie.ferreira@geoterraimage.com

Günther Fischer

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361, Austria
Tel.: +43-2236-807-292
Email: fisher@iiasa.ac.at

Giles Foody

School of Geography, University of Nottingham
Nottingham, NG7 2RD
United Kingdom
Tel.: +44 (0)115 951 5430
Email: giles.foody@nottingham.ac.uk

Steffen Fritz

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361
Austria
Tel.: +43-2236-807-353
Fax: +43-2236-807-599
Email: fritz@iiasa.ac.at

Adam Gerrand

Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
Rome, 00153
Italy
Tel.: +39 340 6999 650
Email: a.gerrand@fao.org

Sven Gilliams

Vito
Boeretang 200
Mol, 2400, Belgium
Tel.: +32 14336827
Email: sven.gilliams@vito.be

Peng Gong

Tsinghua University
607 Weiqing Building
Beijing , 100084
China
Tel.: 86 1861-138-3711
Email: penggong@tsinghua.edu.cn

Bruno Gérard

International Livestock Research Institute
PO BOX 5689
Addis Ababa
Ethiopia
Tel.: +251 910 69 42 23
Email: b.gerard@cgiar.org

Myriam Haffani

Centre National de la Cartographie et de la
teledetection
BP 200
Tunis, 1080
Tunisia
Tel.: 00 216 20 52 12 12
Email: myriam.haffani@yahoo.fr

Matt Hansen

South Dakota State University
Box 506B Wecota Hall
Brookings SD, 57007
USA
Tel.: 001-605-688-6591
Email: Matthew.Hansen@sdstate.edu

Petr Havlik

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361, Austria
Tel.: +43-2236-807511
Fax: +43-2236-807599
Email: havlikpt@iiasa.ac.at

Alex Held

CSIRO
GPO Box 3023
Canberra, ACT, 2601
Australia
Tel.: 61262465718
Email: alex.held@csiro.au

Martin Herold

Center of Geo-Information, Wageningen University
Droevendaalsesteeg 3
Wageningen, 6708 PB
Netherlands
Tel.: +31 (0)317 481276
Email: Martin.Herold@wur.nl

Mario Herrero

International Livestock Research Institute (ILRI)
ILRI-Kenya, P.O.Box 30709
Nairobi, Kenya
Tel.: +254 20 422 3000
Fax: +254 20 422 3001
Email: M.HERRERO@cgiar.org
www: www.ilri.org

Noriko Hosonuma

MEXT of Japan / Wageningen University
Diedenweg 87
Wageningen, 6706 CK
Netherlands
Tel.: +31 622765619
Email: noriko.hosonuma@wur.nl

Ian Jarvis

Agriculture and Agri-Food Canada
960 Carling Ave
Ottawa ON, K1A0C6
Canada
Tel.: 613-759-1477
Email: Ian.Jarvis@agr.gc.ca

Chris Justice

Department of Geography, University of Maryland
1119 LeFrak Hall
College Park, MD, MD 20742
USA
Tel.: +1-301-405-1600
Fax: +1-301-314-6503
Email: cjustice@umd.edu

Martin Kappas

Institut of Geography
Goldschmidtstr. 5
Goettigen, 37077
Germany
Tel.: +49551398071
Email: mkappas@gwdg.de

Patrick Kasangaki

Rural Empowerment Network (REN)
P.O.Box 9602 Kampala
Kampala, Uganda
Tel.: +256-782-671846
Email: ren_empower@yahoo.com

Francois Kayitakire

Joint Research Centre - European Commission
Via Fermi 2749, TP 266
Ispra, 21027
Italy
Tel.: +390332786580
Email: Francois.Kayitakire@jrc.ec.europa.eu

LeeAnn King

University of Maryland
1104 Lefrak Hall
College Park MD
USA
Tel.: 01.443.695.3669
Email: mkinglee@umd.edu

Olga N. Krankina

College of Forestry
Oregon State University
202 Richardson Hall
Corvallis, OR 97331-5752
USA
Phone: (541) 737-1780
FAX: (541) 737-1393
Email: krankinao-at-fsl.orst.edu

Tobias Kummerle

Potsdam Institute for Climate Impact Research P.O.
Box 60 12 03
Potsdam, D-14412
Germany
Tel.: +49 331 288 2574
Email: kuemmerle@pik-potsdam.de

Rick Leiterer

Friedrich-Schiller-University Jena
Grietgasse 6
Jena, 7745
Germany
Tel.: +49 (0) 3641 948970
Email: reik.leiterer@uni-jena.de

Olivier Leo

Joint Research Centre - European Commission
Via Fermi 2749, TP 266
Ispra, 21027
Italy
Tel.: +39 0332 78 94 74
Email: olivier.leo@jrc.ec.europa.eu

Tom Loveland

USGS EROS
47914 252nd Street
Sioux Falls SD, 57198, USA
Tel.: 01 605 594 6066
Email: loveland@usgs.gov

Jaiteh Malanding

CIESIN at Columbia University, Lamont Doherty
Earth Observatory
61 Route 9W
Palisades, 10964, USA
Tel.: 8453658984
Email: mjaiteh@ciesin.columbia.edu

Ian McCallum

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361, Austria
Tel.: +43-2236-807328
Email: mccallum@iiasa.ac.at

Hawa Mohammed

Ministry of Agriculture
Khomdurman Althora Street
Khartoum, Sudan
Tel.: 249922315884
Email: Hawaahassan77@yahoo.com

Rick Mueller

USDA/NASS
3251 Old Lee Hwy, Rm 305
Fairfax VA, 22030
USA
Tel.: +11 703 877 8000 x111
Email: rick_mueller@nass.usda.gov

Joanne Nightingale

NASA Goddard Space Flight Center
Code 614.5
Greenbelt MD, 20771
USA
Tel.: 1 301 614 6647
Email: Joanne.M.Nightingale@nasa.gov

Andre Nonguierma

UNECA
ECA - Menlik II Avenue, P.O. Box 3001
Addis Ababa, 3001
Ethiopia
Tel.: +251115444718
Email: ANonguierma@uneca.org

An Notenbaert

International Livestock Research Institute
PO Box 30709
Nairobi, 100
Kenya
Tel.: +254204223000
Email: a.notenbaert@cgiar.org

Michael Obersteiner

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361
Austria
Tel.: +43-2236-807460
Fax: +43-2236-807599
Email: oberstei@iiasa.ac.at

Pontus Olofsson

Dept of Geography and Environment, Boston
University
675 Commonwealth Avenue
Boston MA, 2446
USA
Tel.: +1-617-353-9374
Email: olofsson@bu.edu

Alexander Prishchepov

Leibniz Institute for Agricultural Development in
Central and Eastern Europe (IAMO) Halle (Saale)
Theodor-Lieser Str. 2
Halle, 6120
Germany
Email: Prishchepov@iamo.de

Li Qiangzi

Institute of Remote Sensing Applications (IRSA),
Chinese Academy of Sciences (CAS)
Olympic Village Science Park, West Beichen Road,
Chaoyang District
Beijing, 100101
China
Tel.: 86-10-64855094
Email: lqz@irsa.ac.cn

Rajak Ram

SAC (ISRO)
CMD / ABHG / EPSA
Ahmedabad, Gujarat, 380015
India
Tel.: +919428499221
Email: rajakdr@yahoo.com

Jansle Rocha

Laboratório de Geoprocessamento, Unicamp/Fac.
Eng. Agrícola
Av. Candido Rondon, 501
Campinas-SP, 13083-875
Brazil
Tel.: 55-19-35211060
Email: jansle.rocha@feagri.unicamp.br

Bernardo Rudorff

National Institute for Space Research
Av. dos Astronautas, 1758
Sao Jose dos Campos, Sao Paulo, 12227-010
Brazil
Tel.: 55-12-3208-6490
Email: bernardo@dsr.inpe.br

Megan Salmon

Dept of Geography, Boston University
675 Commonwealth Ave
Boston MA, 2215
USA
Tel.: 1 617 353 5746
Email: jmsalmon@bu.edu

Igor Savin

Space Research Institute of Russian Academy of
Sciences
Profsoyuznaya str., 84/32
Moscow, 117997
Russia
Tel.: +7-495-3335313
Email: savigory@gmail.com

Dmitry Schepaschenko

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361 Austria
Tel.: +43-2236-807460
Fax: +43-2236-807599
Email: schepd@iiasa.ac.at
Fax: 7 095 5869134
Email: schepd@gmail.com

Linda See

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361 Austria
Tel.: +43-2236-807460
Email: see@iiasa.ac.at

Joe Sexton

Global Land Cover Facility,
University of Maryland
2181 LeFrak Hall
College Park MD, 20742 USA
Tel.: 301-405-8165
Email: js Sexton@umd.edu

Yosio Shimabakuro

National Institute for Space Research
Av. dos Astronautas, 1758
Sao Jose dos Campos, Sao Paulo, 12227-010
Brazil
Tel.: 55-12-3208-6483
Email: yosio@dsr.inpe.br

Steve Stehman

State University of New York
1 Forestry Drive, 320 Bray Hall
Syracuse, NY, 13210 USA
Tel.: 1 315 470 6692
Email: svstehma@syr.edu

Alexey Terekov

Institute of Space Research
Shevchenko st. 15,
Almaty, 50010
Kazakhstan
Tel.: +7 7272416771
Email: aterekhov1@yandex.ru

Pierre Christophe Sibiry Traore

ICRISAT
CRRR de Sotuba
Bamako, Mali
Tel: +223 79026428
Email: p.s.traore@cgiar.org

Hugo Valin

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361
Austria
Tel.: +43-2236-807405
Fax: +43-2236-807599
Email: valin@iiasa.ac.at

Christelle Vancutsem

Joint Research Center (Ispra)
Via E. Fermi, 2749
Ispra, 21027
Italy
Tel.: 39 0332 78 9846
Email: christelle.vancutsem@jrc.ec.europa.eu

Elodie Vintrou

CIRAD, Maison de la Télédétection
500 rue JF Breton
Montpellier, 34090
France
Tel.: 33677900988
Email: elodie.vintrou@teledetection.fr

Thorsten Wendt

ISICAD
Ellerstraße 26
Bonn, 53119
Germany
Tel.: +491634578181
Email: twendt@uni-bonn.de

Alyssa Whitcraft

Dept of Geography, University of Maryland
2181 Lefrak Hall, College Park MD, 20742
USA
Tel.: +1-805-680-1945
Email: alyssakw@gmail.com

Stanley Wood

IFPRI
2033 K Street NW
Washington DC, 20006
USA
Tel.: +1(202)862-8122
Email: s.wood@cgiar.org

Curtis Woodcock

Professor, Department of Geography and
Environment, Boston University
675 Commonwealth Avenue
Boston, MA, MA 02215
USA
Tel.: +1-617-353-5746
Fax: +1-617-353-8399
Email: curtis@bu.edu

Bingfang Wu

Institute of Remote Sensing Applications (IRSA),
Chinese Academy of Sciences (CAS)
Olympic Village Science Park, West Beichen Road,
Chaoyang District
Beijing , 100101
China
Tel.: 86-10-64855689
Email: wubf@irsa.ac.cn

Xiangming Xiao

Stephenson Research and Technology Center,
University of Oklahoma
101 David L. Boren Blvd
Norman, OK, 73019
USA
Tel.: 405-3258941
Email: xiangming.xiao@ou.edu

Liangzhi You

International Food Policy Research Institute
2033 K Street, NW
Washington DC, 20006
USA
Tel.: +1-202-862-8168
Email: l.you@cgiar.org

Pei Zhiyuan

Chinese Academy of Agricultural Engineering
No 41 Maizidian Street
Chaoyang District, Beijing, 100125
China
Email: peizhiyuan@agri.gov.cn

Marijn van der Velde

IIASA, ESM Program
Schlossplatz 1
Laxenburg, A-2361
Austria
Tel.: +43-2236-807451
Fax: +43-2236-807599
Email: velde@iiasa.ac.at