

Dr. Steffen FRITZ

International Institute for Applied Systems Analysis (IIASA) / Strategic Initiatives Program & Advancing Systems Analysis Program / 2361 Laxenburg (Austria) / +43-676-838-07353 / fritz@iiasa.ac.at

Date of birth: June 11th, 1969
Place of birth: Metzingen, Germany
Nationality: Germany
Family status: Married, 1 child



PROFILE

Dr. Steffen Fritz studied physics and geography at the University of Tübingen and received a Master of Science degree from the University of Durham in 1996 in Geographical Information for Development. Subsequently, he was then awarded a studentship from the School of Geography at the University of Leeds where he finished his PhD in 2001. Dr. Fritz was already at that time interested in the interface between humans and their environment where he researched the topic of how the wild land perception of people could be mapped.

Dr. Fritz undertook a Postdoctoral Fellowship at the Joint Research Centre (in Italy) from 2002. During this time, he learned image classification techniques for land cover, where his primary task was to mosaic, harmonize, and produce the Global Land Cover 2000 database. Based on his work on land cover, Dr. Fritz investigated the uncertainties in global land cover, which has resulted in many subsequent publications.

However, in the joint effort search for a solution to this big global data problem, Dr. Fritz had initial thoughts to develop an open transparent land cover visualisation and validation tool. The opportunity to do so came along in 2009 at IIASA, where Dr. Fritz has become the initiator and driving force behind Geo-Wiki.org and Geo-Wiki mobile, a global land cover validation tool based on Web 2.0 and crowdsourcing. The initial paper published on Geo-Wiki.org was awarded the 2nd best paper in the Journal Remote Sensing (<https://www.mdpi.com/2072-4292/5/2/862/pdf>).

Dr. Fritz was the Principal Investigator of the ERC funded "CrowdLand" and the H2020 funded "LandSense" and "WeObserve" projects, as well as many others. Dr. Fritz currently is going to lead the ERC Grant "Picture Pile Platform".

The research interests of Dr. Fritz are transformative societal and policy solutions, machine learning and artificial intelligence, earth observation, citizen science, crowdsourcing, volunteered geographical information, food security, land-use science, global and regional vegetation monitoring, crop yield and crop acreage estimations of agricultural crops, serious gaming, gamification, and in-situ data collection of land-use and land cover via mobile technologies, as well as citizen science for SDG monitoring and implementation.

As of January 2021, Dr. Fritz leads as Program Director the Strategic Initiatives Program (SI), which aims to improve the prospects of a sustainable future for humanity and to deliver transformative policy solutions.

In addition, Dr. Fritz is Researcher at the Novel Data Ecosystems Research Group which is part of IIASA's Advancing Systems Analysis Program (ASA).

EDUCATION AND ACADEMIC QUALIFICATION

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| 1997 - 2001 | Ph.D. Geographical Information Systems, Wildland Research, Biogeography, Biodiversity, University of Leeds, UK
Thesis: <i>Mapping and Modelling of wild land areas in Europe and the British Isles: A multiscale approach.</i> |
| 1995 – 1996 | M.Sc. Masters in Geographical Information for Development
Theory of Geographical Information Systems, Remote Sensing, Integration of GIS and Remote Sensing, University of Durham, UK |

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Dissertation: *Wilderness mapping of Venezuela (distinction)*

- 1994-1995 **Graduate studies** in physics and geography at the University of Tübingen, Germany
Physics: Practical work in Experimental Physics II, Geography: Map Interpretation, Civilisation Ecology, University of Tübingen, Germany
- 1993-1994 Exchange student, Geography Department, University of Newcastle, UK
- 1990-1993 Graduate studies in physics and geography, University of Tübingen, Germany
- 1980-1989 High school graduation (Abitur), Gymnasium Metzingen, Germany

PROFESSIONAL

- Since 01/2021 **Program Director** Strategic Initiatives Program (SI) and **Researcher** at the Novel Data Ecosystems Research Group (NODES) within the Advancing Systems Analysis Program (ASA)
International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
- 04/2020 – 12/2020 **Deputy Program Director** of the Ecosystem Services and Management (ESM) Program, IIASA, Laxenburg, Austria
Centre Head of the Earth Observation and Citizen Science (EOCS) Research Group, IIASA, Laxenburg, Austria
- 07/2019 - 04/2020 **Acting Program Director** of the ESM Program, IIASA, Laxenburg, Austria
- 2007 - 07/2019 **Deputy Program Director** of the ESM Program
Centre Head of the EOCS Research Group
Research Scholar, ESM Program, IIASA, Laxenburg, Austria
- 2007-2010 **Research Scholar**, Forestry Program, IIASA, Laxenburg, Austria
- 2005 - 2007 **Researcher** at the Agricultural Unit, Joint Research Centre (JRC), Ispra, Italy
- 2004 **Research Scholar**, Forestry Program, IIASA, Laxenburg, Austria
- 2002 - 2004 **Postdoctoral Research Scientist** at the Global Vegetation Monitoring Unit (GVM), JRC, Ispra, Italy
- 2001 - 2002 **Consultant** for INFOTERRA at the JRC, Ispra, Italy
- 1999 **Consultant** for Scottish Natural Heritage at the University of Leeds, UK
- 1998-1999 **Part-time Lecturer** at Trinity College Horsforth, Leeds, UK
- 1997 **Researcher** at the World Conservation Monitoring Centre, Cambridge, UK

SCIENTIFIC NETWORKS

- Since 2020 **Member** and part of the expert group of the European Space Agency on AI - AIREO Network (AI-ready Earth Observation training datasets)
- 2018-2020 **ISO/TC 211 N5425**
- Since 2019 **Member** of the GEO Community of Practice on Earth Observation and Citizen Science
- 2013 -2017 **Vice Chair** of the COST action "Mapping the Citizen Sensor" (Lead: Prof. Giles Foody, Nottingham)
- Since 2012 **Participant** in the GEOGLAM initiative supported by the Group on Earth Observation
- 2009-2012 **Member** and task contributor to the Group on Earth Observation Initiative, member of the GEO science and technology committee and geo data sharing working group

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FUNDING

Dr. Fritz was responsible for the budget and tasks in the following projects either as Co-ordinator, work package leader or task leader:

- Since 2013 *GeoCarbon- Operational Global Carbon Observing System (FP7 Project 283080):* The project is coordinating the contribution of European and international research institutes to the development of an Operational Global Integrated Carbon Observation and Analysis System. **Task Leader**, Budget 189,882 €
- 2011 – 2013 *GEOSAF-Using GEO for Early Warning and Food Security in East Africa.* Within the project researchers will create short-term soil moisture forecasts using several crop growth and soil moisture models as well as the dissemination of this data using smartphones. **Work package leader**, Budget 82,460 €
- 2011 – 2013 *FarmSupport- Weather Forecasts and Soil Data for African Farms:* Funded by the Austrian Science Fund; ASAP) The project is developing an application to provide farmers in Ethiopia and Kenya with weather forecasts and soil moisture information to help them make better agricultural decisions. At the same time management data from farmers are collected. **Project Co-ordinator**; Budget 150,000 €
- 2011 – 2012 *LandSpotting-Collecting in-situ Data for Earth Observation Product Validation via Social Games* (Funded by the Austrian Science Fund; ASAP, Nr. 828332): The project contributed to the improvement of the quality of land cover information by vastly increasing the amount of validation data available for calibration and validation of satellite-derived land cover. **Co-ordinator**; Budget 361, 664 €
- 2010 – 2013 *ISAC-Information Service on Agricultural change (FP7 Project 262937):* High-frequency, high-resolution imaging from new satellites and ag. Statistics is providing detailed agricultural information that will allow scientists to better monitor the impacts of drought and climate change on crops and model future agricultural productivity under different climate change scenarios. **Work package leader**. Budget: 400.000 €
- 2010 – 2013 *BalkanGEONet- Towards Inclusion of Balkan Countries into Global Earth Observation Initiative (FP7 Project 265176):* The project is designed to strengthen existing Earth Observation research and participation among the Balkan countries and encourage those countries not yet involved to join the GEO initiative. **Task Leader**; Budget: 74,001€
- 2010 – 2012 *EGIDA- Improving Earth Observation Methodology (FP7 Project 265124):* The project fosters a standard methodology to support GEOSS, the Global Earth Observations System of Systems, through development of evaluation processes, assessment indexes, and databases. The candidate is **Work Package Leader**; Budget: 117,800 €
- 2009 – 2012 *EuroGEOSS-A European Approach to GEOSS (FP7 Project 226487):* The project contributes to the international efforts to create the Global Earth Observation System of Systems (GEOSS) by making existing systems that gather data on forestry, drought, and biodiversity interoperable and easier to use; to incorporate data from citizen science and Geo-wiki. **Work package leader**; Budget: 584,350€

POSTDOCTORAL SUPERVISION

Dr. Fritz has supervised or co-supervised more than 25 PhD students which were selected to take part in IIASA's young summer student program (YSSP).

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NON-REMUNERATED APPOINTMENTS AND ACTIVITIES

Lead Author, Millennium Ecosystems Assessment

Editorial Board, Open Geography Journal

Guest Editor, Special Issue, MDPI (from 01/2020-05-2021)

Guest Editor, Special Issue, MDPI “Citizen Science and the Role in Sustainable Development” (ISSN 2071-1050)

Guest Editor, Editor of a special issue on Collaborative Mapping for the ISPRS International Journal of Geo-Information

Editorial Board, Nature Scientific Data

Reviewer for: PNAS, Remote Sensing of Environment, Canadian Journal of Remote Sensing, Remote Sensing, International Journal of Earth Observation and Geo-information, Journal of Land-use Science, Open Geography Journal, IEEE Remote Sensing, Environmental research letters

AWARDS

2013 “Best paper award” of the journal Remote Sensing of the year 2009 with the title “GeoWiki.org: Using Crowd Sourcing to improve global Landcover”

2016 „Citizen Science Awards” – use of app “FotoQuest”

2020 “Innovative Applications in Analytics Award” from Analytics Society of INFORMS, Kinaxis and Adelphi University. The Award is to recognize the creative and unique application of a combination of analytical techniques. The prize promotes the awareness and value of the creative combination of analytics techniques in unusual applications to provide insights and/or business value.

PUBLICATIONS

PEER-REVIEWED JOURNAL ARTICLES

2020 Laso Bayas, J.C., Gardeazabal, A., Karner, M., Folberth., C., Vargas, L., Skalský, R., Balkovič, J., Subash, A., Saad, M., Delerce, S., Cuaresma J.C., Hlouskova, J., Molina-Maturano, J., See L., **Fritz, S.**, Obersteiner, m., Govaerts, B., *AgroTutor: A mobile phone application supporting agricultural sustainable intensification*, MDPI: sustainability-923577

2020 Ferri, M., Wehn, U., See, L. Monego, M., & **Fritz, S.**. *The value of citizen science for flood risk reduction: cost–benefit analysis of a citizen observatory in the Brenta-Bacchiglione catchment*. Hydrology and Earth System Sciences 24 (12) 5781-5798. 10.5194/hess-24-5781-2020

2020 Laso Bayas, J.C., See, L., Bartl, H., Sturn, T., Karner, M., Fraisl, D., Moorthy, I., Busch, M., Van Der Velde, M., **Fritz, S.**, *Crowdsourcing LUCAS: Citizens Generating Reference Land Cover and Land Use Data with a Mobile App.*, MDPI: land-958050

2020 Crespo Cuaresma, J., Danylo, O., **Fritz, S.**, Hofer, M., Kharas, H. & Laso Bayas, J.C. *What do we know about poverty in North Korea?* Palgrave Communications 6 (1): e40.

2019 **Fritz, S.**, See, L., Carlson, T., Haklay, M., Oliver, J.L., Fraisl, D., Mondardini, R., Brocklehurst, M., Shanley, L., Schade, S. et al. *Citizen science and the United Nations Sustainable Development Goals*. Nature Sustainability 2: 922-930.

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- 2019 Marshall, M., Crommelinck, S., Kohli, D., Perger, C., Yang, M.Y., Ghosh, A., **Fritz, S.**, Bie, K. & Nelson, A. *Crowd-Driven and Automated Mapping of Field Boundaries in Highly Fragmented Agricultural Landscapes of Ethiopia with Very High Spatial Resolution Imagery*. *Remote Sensing* 11 (18): e2082.
- 2019 Cooper, M.W., Brown, M.E., Hochrainer-Stigler, S., Pflug, G., McCallum, I., **Fritz, S.**, Silva, J. & Zvoleff, A. *Mapping the effects of drought on child stunting*. *Proceedings of the National Academy of Sciences*: e201905228.
- 2019 Waldner, F., Schucknecht, A., Lesiv, M., Gallego, J., See, L., Pérez-Hoyos, A., d'Andrimont, R., de Maet, T., Laso Bayas, J.C., **Fritz, S.** et al. *Conflation of expert and crowd reference data to validate global binary thematic maps*. *Remote Sensing of Environment* 221: 235-246.
- 2019 **Fritz, S.**, See, L., Bayas, J.C.B., Waldner, F., Jacques, D., Becker-Reshef, I., Whitcraft, A., Baruth, B., Bonifacio, R., Crutchfield, J. et al. *A comparison of global agricultural monitoring systems and current gaps*. *Agricultural Systems* 168: 258-272.
- 2018 Tsendbazar, N-E., Herold, M., de Bruin, S., Lesiv, M., **Fritz, S.**, Van De Kerchove, R., Buchhorn, M., Dürauer, M., Szantoi, Z. & Pekel, J.-F. *Developing and applying a multi-purpose land cover validation dataset for Africa*. *Remote Sensing of Environment* 219: 298-309.
- 2018 Lesiv, M., See, L., Laso Bayas, J.C., Sturn, T., Schepaschenko, D., Karner, M., Moorthy, I., McCallum, I. & **Fritz, S.** *Characterizing the Spatial and Temporal Availability of Very High Resolution Satellite Imagery in Google Earth and Microsoft Bing Maps as a Source of Reference Data*. *Land* 7 (4): p. 118.
- 2018 Olteanu-Raimond, A.-M., Jolivet, L., Van Damme, M.-D., Royer, T., Fraval, L., See, L., Sturn, T., Karner, M., Moorthy, I. & **Fritz, S.** *An Experimental Framework for Integrating Citizen and Community Science into Land Cover, Land Use, and Land Change Detection Processes in a National Mapping Agency*. *Land* 7 (3): p. 103.
- 2018 Waha, K., van Wijk, M.T., **Fritz, S.**, See, L., Thornton, P.K., Wichern, J. & Herrero, M. *Agricultural diversification as an important strategy for achieving food security in Africa*. *Global Change Biology* 24 (8): 3390-3400.
- 2018 Wannemacher, K., Birli, B., Sturn, T., Stiles, R., Moorthy, I., See, L. & **Fritz, S.** *Using Citizen Science to Help Monitor Urban Landscape Changes and Drive Improvements*. *Journal for Geographic Information Science-GI_Forum* 1: 336-343.
- 2018 Romijn, E., De Sy, V., Herold, M., Böttcher, H., Roman-Cuesta, R.M., **Fritz, S.**, Schepaschenko, D., Avitabile, V., Gaveau, D., Verchot, L. et al. *Independent data for transparent monitoring of greenhouse gas emissions from the land use sector – What do stakeholders think and need?* *Environmental Science & Policy* 85: 101-112.
- 2018 Ji, L., You, L., See, L., **Fritz, S.**, Li, C., Zhang, S. & Li, G. *Spatial and temporal changes of vegetable production in China*. *Journal of Land Use Science* 12 (5): 494-507.
- 2018 Lesiv, M., See, L., Laso Bayas, J.C., Sturn, T., Schepaschenko, D., Karner, M., Moorthy, I., McCallum, I. & **Fritz, S.** *Characterizing the Spatial and Temporal Availability of Very High Resolution Satellite Imagery for Monitoring Applications*. *Earth System Science Data Discussions*: 1-24. (In Press)
- 2018 Lesiv, M., Shvidenko, A., Schepaschenko, D., See, L. & **Fritz, S.** *A spatial assessment of the forest carbon budget for Ukraine*. *Mitigation and Adaptation Strategies for Global Change* 24 (6): 985-1006.
- 2018 Salk, C., **Fritz, S.**, See, L., Dresel, C. & McCallum, I. *An Exploration of Some Pitfalls of Thematic Map Assessment Using the New Map Tools Resource*. *Remote Sensing* 10 (3): p. 376.
- 2018 Foody, G., See, L., **Fritz, S.**, Moorthy, I., Perger, C., Schill, D. & Boyd, D. *Increasing the Accuracy of Crowdsourced Information on Land Cover via a Voting Procedure Weighted by Information Inferred from the Contributed Data*. *ISPRS International Journal of Geo-Information* 7 (3): p. 80.

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- 2018 Liu, W. , Dugar, S., McCallum, I., Thapa, G., See, L., Khadka, P., Budhathoki, N., Brown, S., Mechler, R., **Fritz, S.** et al. *Integrated Participatory and Collaborative Risk Mapping for Enhancing Disaster Resilience*. ISPRS International Journal of Geo-Information 7 (2): p. 68.
- 2017 Austin, K.G., Mosnier, A., Pirker, J., McCallum, I., **Fritz, S.** & Kasibhatla, P.S. *Shifting patterns of oil palm driven deforestation in Indonesia and implications for zero-deforestation commitments*. Land Use Policy 69: 41-48.
- 2017 Schepaschenko, D., **Fritz, S.**, See, L., Laso Bayas, J.C., Lesiv, M., Kraxner, F. & Obersteiner, M. *Comment on "The extent of forest in dryland biomes"*. Science 358 (6362): eaao0166.
- 2017 Zhao, Y., Feng, D., Yu, L., See, L., **Fritz, S.**, Perger, C. & Gong, P. *Assessing and Improving the Reliability of Volunteered Land Cover Reference Data*. Remote Sensing 9 (10): e1034.
- 2017 Laso Bayas, J.C., Lesiv, M., Waldner, F., Schucknecht, A., Duerauer, M., See, L., **Fritz, S.**, Fraisl, D., Moorthy, I., McCallum, I. et al. *A global reference database of crowdsourced cropland data collected using the Geo-Wiki platform*. Scientific Data 4: e170136.
- 2017 Laso Bayas, J.C., See, L., Perger, C., Justice, C., Nakalembe, C., Dempewolf, J. & **Fritz, S.** *Validation of Automatically Generated Global and Regional Cropland Data Sets: The Case of Tanzania*. Remote Sensing 9 (8): e815.
- 2017 Mathieu, P.-P., Borgeaud, M., Desnos, Y.-L., Rast, M., Brockmann, C., See, L., Kapur, R., Mahecha, M., Benz, U. & **Fritz, S.** *The ESA's Earth Observation Open Science Program [Space Agencies]*. IEEE Geoscience and Remote Sensing Magazine 5 (2): 86-96.
- 2017 **Fritz, S.**, See, L., Perger, C., McCallum, I., Schill, C., Schepaschenko, D. , Duerauer, M., Karner, M., Dresel, C., Laso-Bayas, J.-C. et al. *A global dataset of crowdsourced land cover and land use reference data*. Scientific Data 4: p. 170075.
- 2017 **Fritz, S.**, Fonte, C.C. & See, L. *The Role of Citizen Science in Earth Observation*. Remote Sensing 9 (4): p. 357.
- 2017 Herrero, M., Thornton, P.K., Power, B., Bogard, J.R., Remans, R., **Fritz, S.**, Gerber, J.S., Nelson, G., See, L., Waha, K. et al. *Farming and the geography of nutrient production for human use: a transdisciplinary analysis*. The Lancet Planetary Health 1 (1): e33-e42.
- 2017 Ermolieva, T., Ermoliev, Y., Havlik, P., Mosnier, A., Leclere, D, **Fritz, S.**, Valin, H. , Obersteiner, M. , Kyrzyuk, S.V. & Borodina, O.M. *Dynamic Merge of the Global and Local Models for Sustainable Land Use Planning with Regard for Global Projections from GLOBIOM and Local Technical–Economic Feasibility and Resource Constraints*. Cybernetics and Systems Analysis 53 (2): 176-185.
- 2017 Crespo Cuaresma, J., Danylo, O., **Fritz, S.**, McCallum, I., Obersteiner, M. , See, L. & Walsh, B. *Economic Development and Forest Cover: Evidence from Satellite Data*. Scientific Reports 7: art.no.40678.
- 2017 Schepaschenko, D. , Shvidenko, A., Perger, C., Dresel, C., **Fritz, S.**, Lakida, P.I., Mukhortova, L.V., Usoltsev, V.A., Bobkova, K.S., Osipov, A.F. et al. *Forest Biomass Observation: Current State and Prospective*. Siberian Journal of Forest Science (4): 3-11.
- 2017 Ermoliev, Y., Ermolieva, T., Havlik, P., Mosnier, A., Leclere, D., **Fritz, S.**, Obersteiner, M. , Kyrzyuk, S. & Borodina, O. *Robust downscaling approaches to disaggregation of data and projections under uncertainties: Case of land use and land use change systems*. Cybernetics and Systems analysis 53 (1): 31-41.
- 2017 Danylo, O., See, L., Gomez Sanabria, A. , Schnabel, G. & **Fritz, S.** *Using the LCZ framework for change detection and urban growth monitoring*. Geophysical Research Abstracts 19: p. 18043.
- 2016 Herold, M., See, L., Tsensbazar, N.-E. & **Fritz, S.** *Towards an Integrated Global Land Cover Monitoring and Mapping System*. Remote Sensing 8 (12): p. 1036.
- 2016 Salk, C., Sturn, T., See, L. & **Fritz, S.** *Local knowledge and professional background have a minimal impact on volunteer citizen science performance in a land-cover classification task*. Remote Sensing 8 (10): e774.

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- 2016 **Fritz, S.**, Schepaschenko, D. & See, L. *Carbon tracking: Limit uncertainties in land emissions*. Nature 534 (7609): 0621.
- 2016 See, L., Mooney, P., Foody, G., Bastin, L., Comber, A., Estima, J., **Fritz, S.**, Kerle, N., Jiang, B., Laakso, M. et al. *Crowdsourcing, Citizen Science or Volunteered Geographic Information? The Current State of Crowdsourced Geographic Information*. ISPRS International Journal of Geo-Information 5 (5): p. 55.
- 2016 Waldner, F., **Fritz, S.**, Di Gregorio, A., Plotnikov, D., Bartalev, S., Kussul, N., Gong, P., Thenkabail, P., Hazeu, G., Klein, I. et al. *A Unified Cropland Layer at 250 m for Global Agriculture Monitoring*. Data 1 (1): e3.
- 2016 Salk, C., Sturn, T., See, L. & **Fritz, S.** *Limitations of Majority Agreement in Crowdsourced Image Interpretation*. Transactions in GIS: 1-17.
- 2016 Salk, C.F., Sturn, T., See, L. & **Fritz, S.** *Assessing quality of volunteer crowdsourcing contributions: lessons from the Cropland Capture game*. International Journal of Digital Earth 9 (4): 310-426.
- 2016 Lesiv, M., Moltchanova, E., Shchepashchenko, D. , See, L., Shvidenko, A., Comber, A. & **Fritz, S.** *Comparison of Data Fusion Methods Using Crowdsourced Data in Creating a Hybrid Forest Cover Map*. Remote Sensing 8 (3): e261.
- 2016 Danylo, O., See, L., Bechtel, B., Schepaschenko, D. & **Fritz, S.** *Contributing to WUDAPT: A Local Climate Zone Classification of Two Cities in Ukraine*. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (J-STARS) 9 (5): 1841-1853.
- 2016 Laso Bayas, J.C., See, L., **Fritz, S.**, Sturn, T., Perger, C., Dürauer, M., Karner, M., Moorthy, I., Schepaschenko, D. , Domian, D. et al. *Crowdsourcing In-Situ Data on Land Cover and Land Use Using Gamification and Mobile Technology*. Remote Sensing 8 (11): e905.
- 2016 Comber, A., Fonte, C., Foody, G., **Fritz, S.**, Harris, P., Olteanu-Raimond, A.-M. & See, L. *Geographically weighted evidence combination approaches for combining discordant and inconsistent volunteered geographical information*. Geoinformatica 20 (3): 503-527.
- 2016 Antoniou, V., Fonte, C., See, L., Estima, J., Arsanjani, J., Lupia, F., Minghini, M., Foody, G. & **Fritz, S.** *Investigating the Feasibility of Geo-Tagged Photographs as Sources of Land Cover Input Data*. ISPRS International Journal of Geo-Information 5 (5): e64.
- 2016 See, L., **Fritz, S.**, Dias, E., Hendriks, E., Mijling, B., Snik, F., Stammes, P., Vescovi, F.D., Zeug, G., Mathieu, P.-P. et al. *Supporting Earth-Observation Calibration and Validation: A new generation of tools for crowdsourcing and citizen science*. IEEE Geoscience and Remote Sensing Magazine 4 (3): 38-50.
- 2015 Foody, G.M., See, L., **Fritz, S.**, van der Velde, M., Perger, C., Schill, C., Boyd, D.S. & Comber, A. *Accurate attribute mapping from volunteered geographic information: issues of volunteer quantity and quality*. The Cartographic Journal 52 (4): 336-344.
- 2015 See, L., **Fritz, S.**, Perger, C., Schill, C., McCallum, I., Schepaschenko, D. , Dürauer, M., Sturn, T., Karne, M., Kraxner, F. et al. *Harnessing the power of volunteers, the internet and Google Earth to collect and validate global spatial information using Geo-Wiki*. Technological Forecasting and Social Change 98: 324-335.
- 2015 Schepaschenko, D. , See, L., Lesiv, M., McCallum, I., **Fritz, S.**, Salk, C., Perger, C., Shvidenko, A., Albrecht, F., Kraxner, F. et al. *Development of a global hybrid forest mask through the synergy of remote sensing, crowdsourcing and FAO statistics*. Remote Sensing of Environment 162: 208-220.
- 2015 Waldner, F., **Fritz, S.**, Di Gregorio, A. & Defourny, P. *Mapping priorities to focus cropland mapping activities: Fitness assessment of existing global, regional and national cropland maps*. Remote Sensing 7 (6): 7959-7986.
- 2015 See, L., Schepaschenko, D. , Lesiv, M., McCallum, I., **Fritz, S.**, Perger, C., Vakolyuk, M., Schepaschenko, M., van der Velde, M., Kraxner, F. et al. *Building a hybrid land cover map with*

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- crowdsourcing and geographically weighted regression*. ISPRS Journal of Photogrammetry and Remote Sensing 103: 48-56.
- 2015 **Fritz, S.**, See, L., McCallum, I., Bun, A., Moltchanova, E., Dürauer, M., Perger, C., Havlik, P., Mosnier, A., Schepaschenko, D. et al. *Mapping global cropland field size*. Global Change Biology 21 (5): 1980-1992.
- 2015 Trapp, N., Schneider, U.A., McCallum, I., **Fritz, S.**, Schill, C., Borzacchiello, M.T., Heumesser, C. & Craglia, M. *A meta-analysis on the return on investment of geospatial data and systems: A multi-country perspective*. Transactions in GIS 19 (2): 169-187.
- 2015 See, L., **Fritz, S.**, You, L., Ramankutty, N., Herrero, M., Justice, C., Becker-Reshef, I., Thornton, P., Erb, K., Gong, P. et al. *Improved global cropland data as an essential ingredient for food security*. Global Food Security 4: 37-45.
- 2015 Exner, A., Bartels, L.E., Windhaber, **M.**, **Fritz, S.**, See, L., Politti, E. & Hochleithner, S. *Constructing landscapes of value: Capitalist investment for the acquisition of marginal or unused land. The case of Tanzania*. Land Use Policy 42: 652-663.
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- 2019 Rovenskaya, E., Aghababaei Samani, K., Baklanov, A. , Ermolieva, T., Folberth, C. , **Fritz, S.**, Hadi, H., Javalera Rincón, V. , Krasovskii, A. , Laurien, F. et al. *Artificial Intelligence and Machine Learning for Systems Analysis of the 21st Century*. IIASA Working Paper. Laxenburg, Austria.
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CONFERENCES AND WORKSHOPS

- 2020 **Fritz, S.**, moderating a panel session on “Synergies between Citizen Science Data and the UN Sustainable Development Goal (SDG) Indicators”, at International FAIR Convergence Symposium, 27 November – 4 December 2020, online
- 2020 **Fritz, S.**, “Lecture on the contribution of spatially explicit information and inclusive science to address the global challenges”, at the 18th (1st) Online 2-Week Refresher Course in Geography and Environmental Studies, Jamia Millia Islamia (JMI) India (online)
- 2020 Fraisl, D., Moorthy I., **Fritz, S.**, “IIASA’s contribution of Citizen Science Data to Monitoring the SDGs”, in Citizen Science SDG Conference, 14-15 October 2020, online
- 2020 **Fritz, S.**, GEO Workshop, 18-19 February 2020, Laxenburg, Austria

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