Title of Grant / Cooperative Agreement:	Integrating Landsat 7, 8 and Sentinel 2 data in improving crop type identification and area estimation
Type of Report:	Summary of Research
Name of Principal Investigator:	Matthew C. Hansen
Period Covered by Report:	07/01/2015-12/31/2018
Name and Address of recipient's institution:	University of Maryland, College Park, 20742
NASA Grant / Cooperative Agreement Number:	NNX15AK65G

Reference 2 CFR § 1800.908 or 14 CFR § 1260.28 Patent Rights *as applicable (abbreviated below)*
The recipient may use whatever format is convenient to disclose subject invention required in subparagraph (c)(1). NASA prefers that the recipient use either the electronic or paper version of NASA Form 1679, Disclosure of Invention and New Technology (Including Software), to disclose subject inventions. Both the electronic and paper version of the NASA Form 1679 may be accessed at the electronic New Technology Reporting Web site https://invention.nasa.gov.
A final new technology summary report listing all subject inventions (or a statement certifying there were none) for the entire award period; which report shall be submitted within 90 days after the end date for the period of performance within the designated system noted within the award document."

Have any Subject Inventions / New Technology Items resulted from work performed under this Grant / Cooperative Agreement?	No ◉	Yes ○
If yes a complete listing should be provided here: Details can be provided in the body of the Summary of Research report.		

Reference 2 CFR § 1800.907 or 14 CFR § 1260.27 Equipment and Other Property *as applicable* (abbreviated below)
A Final Inventory Report of Federally Owned Property, including equipment where title was taken by the Government, will be submitted by the Recipient no later than 60 days after the expiration date of the grant. Negative responses for Final Inventory Reports are required.

Is there any Federally Owned Property, either Government Furnished or Grantee Acquired, in the custody of the Recipient?	No ◉	Yes ○
If yes please attach a complete listing including information as set forth at § 1260.134(f)(1).		

Attach the Summary of Research text behind this cover sheet.

Reference 2 CFR § 1800.902 or 14 CFR § 1260.22 Technical publications and reports *as applicable* (abbreviated below)
Reports shall be in the English language, informal in nature, and ordinarily not exceed three pages (not counting bibliographies, abstracts, and lists of other media).

A Summary of Research (or Educational Activity Report in the case of Education Grants) is due within 90 days after the expiration date of the grant, regardless of whether or not support is continued under another grant. This report shall be a comprehensive summary of significant accomplishments during the duration of the grant.

DEPARTMENT OF
GEOGRAPHICAL SCIENCES
AT THE UNIVERSITY OF MARYLAND, COLLEGE PARK

Grant #: NNX15AK65G
Matt Hansen, PI, University of Maryland
Peter Potapov, Co-PI, University of Maryland
Dr. Garik Gutman, Land Cover and Land Use Change Program Manager

Integrating Landsat 7, 8 and Sentinel 2 data in improving crop type identification and area estimation

Final Report
30 April 2018

The project proposed the following principal deliverables: Comparative assessments of different multi-temporal inputs in mapping crop type cover with study areas for a range of commodity crop types, field sizes, cropping patterns and levels of intensification and be performed for 1) soybean, corn and wheat in the United States, 2) soybean and corn in Argentina, 3) wheat in Punjab, Pakistan, 4) corn in Morogoro District, Tanzania, 5) soybean in Heilongjiang province, China, and 6) possible European site to be determined.

Our research has concluded with the papers listed below as direct results and outcomes in the peer-reviewed literature. We have a number of papers in progress on the topics of USA, Pakistan and South America crop type area estimation and mapping, for which the LCLUC program will be fully acknowledged upon publication.

Summary of research to date:
Results of our project to date have been published in the following peer-reviewed journal articles:

Zalles, V., Hansen, M.C., Potapov, P.V., Stehman, S.V., Tyukavina, A., Pickens, A., Song, X.P., Adusei, B., Okpa, C., Aguilar, R. and John, N. (2019) Near doubling of Brazil's intensive row crop area since 2000. *Proceedings of the National Academy of Sciences*, 116 (2) 428-435.

Khan, A., Hansen, M.C., Potapov, P.V., Adusei, B., Pickens, A., Krylov, A., Stehman, S. (2018) Evaluating Landsat and RapidEye Data for Winter Wheat Mapping and Area Estimation in Punjab, Pakistan. *Remote Sensing*, 10(4), 489.

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Khan, A., Hansen, M.C., Potapov, P.V., Stehman, S.V., Chatta, A.A. (2016) Landsat-based wheat mapping in the heterogeneous cropping system of Punjab, Pakistan. *International Journal of Remote Sensing*, Vol. 37, Issue 6, pp. 1391-1410.

Song, X.P., Potapov, P.V., Krylov, A., King, L., Di Bella, C.M., Hudson, A., Khan, A., Adusei, B., Stehman, S.V., Hansen, M.C. (2017) National-scale soybean mapping and area estimation in the United States using medium resolution satellite imagery and field survey. *Remote Sensing of Environment*, 190, 383-395.

King, L., Adusei, B., Stehman, S.V., Potapov, P.V., Song, X.P., Krylov, A., Di Bella, C., Loveland, T.R., Johnson, D.M., Hansen, M.C. (2017) A multi-resolution approach to national-scale cultivated area estimation of soybean. *Remote Sensing of Environment*, vol. 195, pp. 13-29.

Should you want any further information on our efforts in support of this project, please do not hesitate to contact me.

Regards,

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