A.2 LAND-COVER/LAND-USE CHANGE

NOTICE: The emphasis of this ROSES-2020 Land-Cover/Land-Use Change call is Multi-Source Land Imaging of High Impact Land-Cover and Land-Use Change. This year this program element will not use a two-step proposal process.

1. The LCLUC Program

The NASA Land-Cover/Land-Use Change (LCLUC) program is aimed at using satellite observations to improve our understanding of LCLUC as an important component of Earth System Science. The LCLUC program includes studies that detect and quantify changes in land cover and land use; examine their impact on the environment, climate, and society; or model future scenarios of LCLUC and its various impacts and feedbacks. The LCLUC program is developing interdisciplinary research combining aspects of physical, social, and economic sciences, with a high level of societal relevance, using remote sensing data methods, and tools. The LCLUC program is aimed at developing the capability for periodic satellite-based inventories of land cover to characterize and monitor changes in land cover and land use. Additional information on the NASA LCLUC program can be found at http://lcluc.hq.nasa.gov or contact Dr. Garik Gutman, the NASA Land-Cover/Land-Use Change Program Manager, see Section 3 below.

2. Scope: Multi-Source Land Imaging of High Impact LCLUC ("Hot Spots")

This call is requesting proposals on the use of Multi-Source Land Imaging to identify high impact LCLUC "hotspot" areas around the globe where human-induced LCLUC is occurring at a landscape scale (of the order of 10,000 km^2). The types of LCLUC considered should include at least two of the following sectors: agriculture, forestry, urban, coastal zone.

The increased availability of moderate resolution (≤30m) optical and microwave data, Very High Resolution (VHR) commercial data (≤5m) and high-performance computing is enabling multi-source monitoring of the land surface at regional to global scales. The combined use of data from multiple sensors/satellites provides a means for enhanced monitoring of LCLUC. This solicitation calls for the use of multi-source data to identify and quantify areas of high impact LCLUC. The emphasis for this solicitation is threefold: i) development of methods for multi-data fusion for detecting and quantifying LCLUC over large areas of change, ii) focus on LCLUC that has a significant impact, for example in terms of ecosystem services or societal relevance and quantifying that impact, iii) demonstration that the methods developed are scalable to similar changes taking place in different parts of the globe.

Moderate resolution data are well-suited to spatially explicit land-change monitoring over large areas. The NASA LCLUC Program is interested in the development of multi-sensor, multi-resolution fusion methods based on increased spectral, temporal and spatial coverage to advance the virtual constellation paradigm for land imaging systems with continental to global scale coverage. To get the most out of current remote sensing capabilities to study land surface, estuarine, and coastal processes as related to land-use change, NASA solicits for efficient use of satellite sensor data from US and non-US moderate resolution sources (Landsat-class observations), combining optical data with

radar and thermal IR observations, newly available sensors on board of the International Space Station (GEDI, ECOSTRESS, DESIS), and commercial VHR data.

A proposal to the current solicitation must use data or data products from at least two of the mid-resolution systems in combination with at least one source of VHR (≤5m) data. Automated VHR resolution change detection is an area for research and development. Proposers are encouraged to utilize the available time-series record of VHR data that may extend for several years (e.g. 10 years for RapidEye) and to quantify the benefit of using the dataset comprising Planet Lab and Digital Globe data that are available free of charge at NASA Goddard Space Flight Center (https://earthdata.nasa.gov/esds/small-satellite-data-buy-program) as well as from non-U.S. sources that are freely available. For example, the French-Israeli Venμs mission 5 and 10m data are available for registered applicants on the following site: https://theia.cnes.fr/atdistrib/rocket/#/search?collection=VENUS. The map with the locations of sites with Venμs data is on https://umap.openstreetmap.fr/fr/map/theias-vens-sites_235143#2/27.0/23.6). Proposals highlighting novel methods of multi-resolution data fusion and approaches are encouraged. Proposals need to include a description of the algorithm approach and describe preliminary validation (accuracy assessment) of the product.

Land-use change is receiving increased attention from the scientific and policy communities, as recently evidenced by the IPCC Special Report on Climate Change and Land (https://www.ipcc.ch/report/srccl/), the IPBES Global Assessment Report on Biodiversity and Ecosystem Services (https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services) and the central role of land in the UN Sustainable Development Goals (SDG's) (https://sustainabledevelopment.un.org/sdgs). LCLUC, ubiquitous around the globe, is having a significant impact on the environment, the provision of ecosystem services and human livelihoods at the national, regional or global scale, often with economic and policy implications. Such policy implications can be in terms of current policies that have prompted, or exacerbated land-use change.

Note that the LCLUC process proposed for a study should have national to regional importance, with significant impact and policy relevance. The proposal should analyze and quantify the impact of the identified changes. Quantifying LCLUC and the impacts of change are key aspects of land system science and a hallmark of this program.

This solicitation does not require the incorporation of a socio-economic research component normally requested by the LCLUC program, although the analysis to quantify the impacts of LCLUC may include the use of socio-economic methods. That is, the socio-economic part is not mandatory in this solicitation but may be included. Selections of this solicitation will enhance the Multi-Source Land Imaging (MuSLI) Science component of LCLUC with the development of potential new products and will also enhance the incorporation of VHR observations in the MuSLI methodology. Proposers are encouraged to visit the LCLUC Web site to explore the previously completed or currently funded projects in the research of interest. Where similarities in the previous and proposed work exist, proposers should elaborate on what is novel about the newly proposed work as compared to what has been accomplished in the program to date. Funded investigators will be expected to attend at least one NASA MuSLI annual meeting held in conjunction with NASA LCLUC Program Science Team Meetings. P.I.'s

of successful proposals will be expected to provide and update project (and collaborators') information for the LCLUC webpage associated with the funded research. Commercial data requirements should be identified with associated costs. If data are available at NASA (https://earthdata.nasa.gov/esds/small-satellite-data-buy-program) or will be obtained by NASA through a special purchase, then data will be provided without the associated funding and the proposal cost will be adjusted.

2.1 International collaboration

For those examining LCLUC outside the U.S., proposals should identify an explicit collaboration with non-U.S. partners, e.g., those working on the non-U.S. sensor data or land-use experts for the regions being studied. Proposers are encouraged to explore the existing regional collaborations in the GOFC-GOLD (Global Observations of Forest Cover and Land Dynamics) Regional Information Networks (http://gofcgold.org). The non-U.S. partners should provide letters signed by the authorities of the collaborating institution, which would indicate agreement to participate in the project as proposed, with the necessary institutional support to participate in the collaborative research and attend team meetings. All else being equal, preference will be given to proposals that include partnerships with international investigators. The rationale for the latter is that U.S. PIs would benefit from the partners' experience in using non-NASA data or work on the ground in the region of interest.

NASA's policy welcomes the opportunity to conduct research with non-U.S. organizations on a cooperative, no-exchange-of-funds basis. Although Co-Principal Investigators (Co-Is) or collaborators employed by non-U.S. organizations may be identified as part of a proposal submitted by a U.S. organization, NASA funding may not normally be used to support research efforts by non-U.S. organizations at any level. The *NASA Guidebook for Proposers* states "NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted…". NASA funding may not be used for travel expenses by any participant who is not employed either full-time or part-time by a U.S. organization. See also Section III (c) of the *ROSES Summary of Solicitation* for restrictions involving China.

2.2 Expected deliverables

It is expected that proposals funded through this solicitation will result in peer-reviewed publications quantifying high impact LCLUC around the World. The findings of each funded research project and 'hot spots' will be incorporated in an interactive web page on global LCLUC Hot Spots and it is expected that PI's will contribute material for the LCLUC web-site, as requested. In addition to quantifying LCLUC and its impact, it is expected that the proposals will develop, test, and publish methods for multi-source data fusion and the use of VHR data to studying LCLUC. It is expected that PI's will make available any data products generated under this research following the data management plan outlined in the proposal.

2.3 Programmatic Information

2.3.1 *Period of Performance for Selected Proposals*

Research awards will be for three-year period of performance (or less) with annual funding contingent upon satisfactory progress reporting and available funding.

2.3.2 *Funding Available for Support of Selected Proposals*

About $2.5M per year is expected to be available for new awards with annual budgets of $200-250K per project. NASA will make selections for this announcement in September-October of 2020. Anticipated starting date for selected projects is January 1, 2021.

A budget for travel to at least one MuSLI Science Team session per year, which will be a part of the LCLUC Science Team meeting, is required in the proposal. In addition, sufficient international travel should be included in the proposal budget for productive collaboration between U.S. PI's and the non-U.S. partners. See Section 2.1 on what is and what is not allowed in the budget concerning non-U.S. participation.

2.3.3 *Evaluation of Proposals*

All proposals will be submitted to the NASA peer review process in accordance with the guidelines provided in Section VI of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers*. This peer review will be followed by a programmatic review in which NASA will assess program balance across the competitive range of proposals and evaluate any logistical, implementation, cost, and/or management concerns. The funding recommendations will then be forwarded to a Selecting Official for confirmation. NASA then will announce the official selection of proposals for award.

3. Summary of Key Information

Expected annual program budget for new awards	~ $2.5M
Number of new awards pending adequate proposals of merit	10-12
Maximum duration of awards	3 years
Due date for NOI	See Tables 2 and 3 of this ROSES NRA.
Due date for Proposals	See Tables 2 and 3 of this ROSES NRA.
Planning date for start of investigation	January 1, 2021
Page limit for the central Science-Technical-Management section of proposal	15 pp; see also Table 1 of the *ROSES Summary of Solicitation* and the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA

General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
General requirements for content of proposals	See Section IV and Table 1 of the *ROSES Summary of Solicitation* and Section 3 of the *NASA Guidebook for Proposers*.
Detailed instructions for the submission of proposals	See https://nspires.nasaprs.com/tutorials/ Sections 3.22-4.4 of the *NASA Guidebook for Proposers* and Section IV(b) of the *ROSES Summary of Solicitation*.
Submission medium	Electronic proposal submission is required; no hard copy is permitted.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH20ZDA001N-LCLUC
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