

## A.2 LAND-COVER/LAND-USE CHANGE

**NOTICE: This program element uses a two-step proposal process (see Section 4.3), with required Step-1 proposals.**

### 1. The LCLUC Program

The Land-Cover/Land-Use Change (LCLUC) program is developing interdisciplinary approaches combining aspects of physical, social, and economic sciences, with a high level of societal relevance, using remote sensing tools, methods, and data. One of its stated goals is to develop the capability for periodic satellite-based inventories of land cover and monitoring and characterizing land-cover and land-use change. The program focuses on analysis at global to regional scales, taking advantage of the synoptic capability afforded by satellite remote sensing and with the understanding that land-use change occurs locally. Additional information on the NASA LCLUC program can be found at <http://lcluc.hq.nasa.gov> or contact Dr. Garik Gutman, the Land-Cover/Land-Use Change Program Manager, see Section 5, below.

### 2. Scope of the current solicitation

The current solicitation consists of two elements: LCLUC in Southeast Asia and LCLUC in the Caucasus.

#### 2.1 LCLUC in Southeast Asia

From previous LCLUC studies, we have learned that economic development and population growth in Southeast Asia are leading to significant land-cover and land-use changes associated primarily with agriculture, forestry, and urban land uses. Underlying these changes are a number of trends with respect to urban growth, rural out-migration, increased demand for natural resources, expanding transportation infrastructure, land speculation, and changes in the commodity market, etc. Countries in this region are developing rapidly so that, Indonesia, Malaysia, Thailand, Philippines, and Viet Nam are expected to be ranked with the higher income countries in Asia, such as Japan, Korea, and Singapore, within the next few decades. Efforts are underway at the national and international level to assess accurately the deforestation rates for the region, however, forest fragmentation is continuing at an alarming rate, resulting in habitat and biodiversity loss, often with negative impacts on the environment. Deforestation in the region can be attributed to agricultural expansion, timber harvest, and the increase in commercial plantations. The causative and enabling factors of land use change are complex, vary geographically, and operate at multiple scales, such as the increase in demand for palm oil and rubber, government policies and economic development initiatives, weak governance, land ownership, lack of zoning, and inappropriate land management. More than sixty percent of the land in Southeast Asia is used for agriculture. However, rapid urban expansion is replacing productive agricultural lands, rural areas are depopulating, and agricultural intensification is increasing throughout the region, with the use of chemical fertilizers, pesticides, intensive irrigation and mechanization. Thus, land-use change is a major cause for concern throughout the region. Inappropriate land-use practices can result in negative impacts on the environment such as increased erosion, degraded air quality, ground water pollution, depletion of ground water resources, and eutrophication of rivers and lakes. Further, a recent rise in the global price of

commodity crops like rubber and oil palm has resulted in them replacing forest and woodlands and in some cases traditional food production, leading to increased food costs. In this context, documenting land-use transitions using satellite observations and understanding the causative factors and various impacts in the region gain significance. In addition, extreme climate events (e.g., drought, flooding) and their related environmental and humanitarian disasters have recently disrupted economic development and impacted livelihoods in several Southeast Asian countries. The degree of adaptive capacity of any region to such disasters depends on effective land use planning and resource management. In this region where rapid land-use change has such visibility, there is an opportunity for land-use science to inform land use policy.

The scope of the Southeast Asia component of the solicitation is on identifying where land-use change is presently occurring, quantifying recent rates of change, understanding the impacts of these changes on physical or social systems, understanding the process of change, addressing the trajectory of change, and assessing whether recent trends are likely to change in the near future. To understand the drivers of land-use change, the socioeconomic processes need to be considered and as such, social science needs to be an integral part of each proposal. Successful proposals should address and integrate socioeconomic dimensions of land-use/cover changes and feedbacks among them, to help answer the above questions. Studies can be from the landscape to regional scale, integrating multiple data sources as needed and providing an understanding of LCLUC dynamics at multiple spatial and temporal resolutions. For example, a variety of multispectral, hyper-spectral, optical, thermal, and radar data may be integrated in the analysis, as needed. Local case studies that document LCLUC trajectories and their causative factors are welcome, however, the analysis and outputs should be scaled to larger regions. Proposals should highlight the theoretical and analytical frameworks appropriate for investigating the patterns of physical and socioeconomic interactions influencing land-use and land-cover changes in the region. Further, proposals including data acquisition, preprocessing, image interpretation, and accuracy assessment for land-use and land-cover characterization, mapping and change analysis, should apply state-of-the-art methods and techniques. The Southeast Asia geographic region of interest for this solicitation extends from Burma (Myanmar) in the west to Papua in the east and from Indonesia in the south to Hong Kong in the north. The successful proposals from this round will contribute to South/Southeast Asia Regional Initiative (SARI; <http://www.sari.umd.edu/>)

## 2.2 LCLUC in the Caucasus

The Caucasus is the region in Northern Eurasia that has not received sufficient attention in the LCLUC program. However, the breakup of the Soviet Union resulted in institutional changes in the former Soviet republics that, in turn, altered land use and land management. Over 50% of the land in the Caucasus is used for agriculture and 17% is forested land. Changes in land use in the Caucasus during the last couple of decades include changes from rainfed-agriculture to tree crops, irrigated agriculture, grasslands, and open shrublands. Overgrazing and tree overharvesting for fuel wood and timber cause degradation of natural resources in the Caucasus due to mismanagement of pastures and forest land. As the system becomes more degraded, the pressures increase on pastures and forests resulting in soil erosion. The LCLUC program welcomes proposals to study changes in forest, agriculture, urban, and coastal zones, as well as impacts of LCLUC on carbon and water cycles during the last two decades in the Caucasus region. Research should highlight land-use trends that have developed since the breakup of the Soviet Union and examining the implications of the changes in terms of their impacts, for

example, on the vulnerability of the associated land use or social systems and their adaptability to a changing climate. The region of interest encompasses the geographic area from the Black Sea coast (Turkey and Georgia) to the Caspian Sea coast (Azerbaijan and Iran).

Note: For regional proposals on both South/Southeast Asia and the Caucasus, the LCLUC program strongly encourages collaborations with regional scientists with experience and insights on the topic of the proposal. It is intended that such collaborations will strengthen the research with local knowledge. Collaborations may be developed following the guidelines and with the appropriate letters of support at Step 2.

### 3. Principles of the LCLUC program to be reflected in proposals

#### 3.1 Social and economic sciences in the NASA LCLUC program

The NASA LCLUC program is aimed at using satellite observations to improve our understanding of land-cover and land-use change as an important component of global and climate change. The LCLUC program includes studies that quantify land-cover and land-use changes; examine their impact on the environment, climate, and society; or model future scenarios of land-cover and land-use change and its various impacts and feedbacks. Humans play an important role in modifying land cover and are instrumental in land-use change. To understand the process of land-use change it is, therefore, important to address its human dimensions.

Social and economic science research plays an important role in the NASA LCLUC program and includes analyses of the impacts of changes in human behavior at various levels on land use, studies of the resultant impacts of land-use change on society, or how the social and economic aspects of land-use systems adapt to climate change.

The LCLUC program evaluates a proposal's responsiveness to the above aspects in terms of a meaningful integration of social and economic science theories, perspectives, methods, and data (quantitative and/or qualitative) with innovative analyses of land system dynamics in the proposed research. In this context, simple treatments of human dimensions, such as mere correlations of socioeconomic variables in lieu of rich empirical analyses linked to theorized social dynamics, or summary descriptions of potential societal or policy benefits of the proposed study without demonstrable linkages to the same, are not considered adequately responsive to the socioeconomic aspect of the program. Successful proposals will fully integrate social and economic sciences into the research questions, data used, and analytical approaches in order to couple remote sensing observations of land-cover with research on the human dimensions of land-use change.

#### 3.2 Remote Sensing Component

The NASA LCLUC program will only support proposals with a strong remote sensing component. The use of observations and data products from U.S. and/or non-U.S. Earth-observing satellites, especially those of NASA, is a requirement for each proposal. The use of

commercial satellites with fine spatial resolution is also encouraged (see, e.g., <http://cad4nasa.gsfc.nasa.gov/>)

To get the most out of current remotely sensing capabilities, we encourage data fusion from various sources with different spatial and/or temporal resolution and different parts of the solar and microwave spectra. Proposals that undertake fusion of data from various sources of Landsat- type data (e.g., [Landsat](#), [IRS](#), [CBERS](#), [SPOT](#), [Sentinel-2](#)), with coarser or higher resolution data, as well as radar observations, are welcome. This approach may provide better temporal-spatial coverage and contribute to a Land Surface Imaging constellation paradigm for future systems (<http://ceos.org/>). Special attention should be given to the dissemination of data and products associated with the proposed research. If appropriate, we also encourage use of NASA's new collaboration facility for the NASA Earth science community: NASA Earth Exchange (NEX; <https://c3.nasa.gov/nex/>) web portal. This portal includes a state-of-the-art supercomputing Earth system modeling system for the use of remote sensing data from NASA and other agencies. Much of the global Landsat data have been transferred to that facility. The NEX web portal represents a scientific social networking platform to deliver a complete work environment in which users can explore and analyze large Earth science data sets, run modeling codes, collaborate on new or existing projects, and share results.

### 3.3 International Collaboration

NASA's policy welcomes the opportunity to conduct research with non-U.S. organizations on a cooperative, no exchange-of-funds basis. Although Co-I.'s 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. Paragraph (c)(8)(iv) of Appendix B of 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." Note that travel by a non-U.S. participant in the research investigation, whether for the purpose of conducting the research, for collaboration, or for attending a conference, is considered to be a research expense. NASA funding may not be used for research efforts by foreign organizations at any level, including payment of travel expenses by any participant who is not employed either full-time or part-time by a U.S. organization (see Section 1.6 of the *NASA Guidebook for Proposers*; see also Appendix B, part (c)(8)(iv) of that document and Section III (c) of the *Summary of Solicitation* of this document for restrictions involving China).

## 4. Programmatic Information

### 4.1 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. P.I.'s are expected to provide input to the program website and participate in the program webinar and outreach activities.

#### 4.2 Funding Available for Support of Selected Proposals

Approximately \$2M per year is expected to be available for new awards from proposals submitted to this program element. NASA anticipates supporting eight to ten investigations, each with annual budgets in the \$200-250K range. NASA will make selections for this announcement in the fall of 2017. Anticipated starting date for selected projects is early 2018.

A budget for travel to at least one LCLUC Science Team Meeting per year is required in the proposal. In addition, international travel should be included in the proposal budget if the region of investigation is outside of the U.S. Involvement of local scientists from the selected region is strongly encouraged and letters of endorsement from foreign partners, with financial commitments, although not needed at Step-1, will be required at Step-2. Note that direct support of research by foreign investigators is not allowed, including services and supplies that constitute research (see the *NASA Guidebook for Proposers*, Sections 1.6 and 2.3.11(b)(vi)). See more details above in 3.3 on what is and what is not allowed in the budget concerning non- U.S. participation.

#### 4.3 The Two-Step Proposal Procedure

To streamline the proposal process and relieve the work load on the community of interested applicants and those that help NASA in reviewing proposals, the LCLUC program is using a two-step procedure (see also Section IV(b)(vii) of the *ROSES Summary of Solicitation*). Step-1 Proposals replace the Notice of Intent (NOI). Step-1 Proposals must be submitted electronically by the NOI/Step-1 Due Date (see Tables 2 and 3 in the *ROSES Summary of Solicitation*). Unlike an NOI, a Step-1 proposal is required and must be submitted electronically by the Authorized Organizational Representative (AOR). Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) page for this program.

NSPIRES will be open for the submission of Step-1 Proposals starting ~30 days in advance of the Step-1 Due Date. NASA will then review each Step-1 Proposal to determine whether or not the anticipated research project is considered of sufficient merit, responsiveness, and relevance to warrant submission of a full Step-2 Proposal. A separate Step-1 Proposal must be submitted for each intended (and thus corresponding) Step-2 Proposal.

Submission of a Step-1 Proposal is required in order to submit a Step-2 Proposal. Step-2 Proposals must contain the same scientific goals and Principal Investigator (PI) proposed in Step-1, but the rest of the proposal team of the Step-2 Proposal may be different from that of the Step-1 proposal. However, the submission of a Step-1 Proposal is not a commitment to submit a Step-2 Proposal.

The NSPIRES system will guide proposers through submission of all required proposal information. Please note that the Proposal Summary, Business Data, Program Specific Data, and Proposal Team are required Cover Page Elements for a Step-1 Proposal. A budget should not be included with the Step-1 Proposal, but will be needed with a budget explanation at Step 2.

To facilitate the work by reviewers on Step-1 Proposals, the following abbreviated template is suggested for use. Step-1 Proposals should be provided as a PDF proposal document-upload not to exceed five pages, including any references or citations. The five-page, Step-1 Proposal should:

- a) Emphasize responsiveness, clearly indicating how the proposed project addresses the call, and which remote sensing assets are to be used. Identify social science aspects in the proposed study.
- b) Describe the proposed research, showing knowledge of previous research carried out by the international scientific community in the subject area. Identify new research aspects being proposed.
- c) Outline the expected outcomes of the research. Identify proposed deliverables. Provide a tentative schedule.

Following the submission and evaluation of a Step-1 proposal, the proposer will be notified through NSPIRES whether the Step-2 proposal is "encouraged" or "discouraged," at which point the proposer will be able to submit a Step-2 proposal.

Step-2 Proposals should provide more detail on the previous studies related to the research topic and the proposed research methodology, the anticipated results and deliverables, and schedule. Step-2 proposals should include a budget and the associated explanation. For consistency and to ease the burden of reviewing, it is preferable that Step-2 Proposals follow approximately the same structure as outlined for the Step-1 Proposals expanded to 15 pages.

Step-2 Proposals must be submitted electronically by the Proposal Due Date in full compliance with the requirements specified in this NRA's *Summary of Solicitation* and the *NASA Guidebook for Proposers*.

#### 4.4 Evaluation of Proposals

All proposals will be submitted to the NASA peer review process in accordance with the guidelines provided in this NRA and the *NASA Guidebook for Proposers*. This program is unique in that the evaluation of Relevance will include an assessment of the extent to which the proposal successfully includes social and economic sciences, as described in Section 3.1. The inclusion of remote sensing is not an evaluation criterion, but is a compliance requirement: proposals that don't address remote sensing, as described in Section 3.2 may be rejected without review. Finally, International Collaboration is encouraged, but not required, i.e., all else being equal when deciding between proposals of otherwise equal merit NASA will give preference to those with International Collaboration.

The 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 the Selecting Official for confirmation. NASA then will announce the official selection of proposals for award via NSPIRES.

## 5. Summary of Key Information

Expected annual program budget for new awards	~ \$2M
Number of new awards pending adequate proposals of merit	8-10
Maximum duration of awards	3 years
Due date for Step-1 proposals	See Tables 2 and 3 in the <i>ROSES Summary of Solicitation</i> .
Due date for Step-2 proposals	See also Tables 2 and 3 in the <i>ROSES Summary of Solicitation</i> .
Planning date for start of investigation	Early Calendar 2018
Page limit for the central Science/Technical/Management section of proposal	15 pp; see also Chapter 2 of the <i>NASA Guidebook for Proposers</i> .
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 <i>ROSES Summary of Solicitation</i> .
Detailed instructions for the preparation and submission of proposals	See the <i>NASA Guidebook for Proposers</i> at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a> .
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the <i>ROSES Summary of Solicitation</i> and Chapter 3 of the <i>NASA Guidebook for Proposers</i> .
Web site for submission of proposals via NSPIRES	<a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)
Web site for submission of proposals via Grants.gov	<a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH16ZDA001N-LCLUC
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