A.6 BIODIVERSITY

NOTICE: Clarified on March 4, 2016. To address questions regarding the last paragraph in Section 2.1 ("A proposed field campaign scoping study must...") vs. the second paragraph in Section 2.1.1 ("Proposals should identify the scientific questions...") we have added the following text to section 2.1.1: "Please note that a funded scoping study will develop the final key questions and the study design to implement them. The proposal should identify initial questions/topics to be pursued by the scoping study. These questions/topics should be developed, fleshed out, and refined by the scoping study." New text is in bold. The due date has not changed. Proposals are due March 18, 2016.

Amended on December 17, 2015. This Amendment announces the release of final text for Biodiversity. Notices of Intent (NOIs) to propose are requested by January 15, 2016, and proposals are due by March 18, 2016.

1. Scope of Program

Biodiversity is the measure of the variety of life on Earth at all levels of organization, from ecosystems to species to genes. Biodiversity results from variations in the compositional, structural, and functional aspects of life at these different levels. Biodiversity enables and represents life’s responses to changing environments on our dynamic planet, while also serving as a driver of environmental change. It encapsulates life’s evolutionary history. Earth’s biodiversity provides humanity and all life with a tremendous resource of opportunities to survive and thrive on an evolving planet.

Recent efforts to track the status of biodiversity globally have consistently reported significant declines throughout its levels of organization. A growing scientific consensus posits that biodiversity is declining at rates comparable to those seen in major extinction events documented in the geologic record. Concerns over the loss of the many benefits, goods, and services we derive from biodiversity demand efforts to understand biodiversity levels and distributions, and how and why they are changing over time. In addition, there is a need to understand biodiversity because it drives changes in the wider Earth System. Thus, NASA seeks tools to understand the condition of biodiversity and how it is changing.

This NASA program focuses on determining and monitoring the distribution and abundance of biodiversity across its levels of organization: ecosystems, species, and genes, as well as how and why these distributions and abundances are changing through time. Another focus of the NASA program is to increase knowledge of how biodiversity drives changes in the wider Earth System of which it is a part. NASA studies biodiversity and its change by combining observations from satellites, airborne platforms, and in situ sensors to explore biodiversity patterns in terrestrial, freshwater, and marine systems. Our macroscopic observations illuminate patterns of biodiversity through direct identification of ecosystems and certain species distributions and abundances. Understanding the processes behind these patterns often requires the use of models to integrate observations across spatial and temporal scales.
2. Description of Solicited Research

This solicitation seeks proposals for (Section 2.1) targeted scoping studies for potential biodiversity-related field campaigns and (Section 2.2) workshops on specific biodiversity topics. These scoping studies and workshops will provide guidance for the future of the Biodiversity program. A proposal should only address one of the four topics described in Sections 2.1 and 2.2. However, an investigator may submit more than one proposal.

2.1 Scoping Studies for Potential Field Campaigns

NASA has traditionally mounted field campaigns to address scientific problems lending themselves to a combination of satellite, airborne, and in situ sensing. This solicitation offers resources to facilitate planning for and the design of a notional, future, biodiversity-related field campaign. Proposals should build upon NASA’s capacity to organize and operate coordinated field campaigns.

This solicitation requests scoping studies for field campaigns addressing either "Synergistic Use of Imaging Spectroscopy and Lidar Remote Sensing for Biodiversity," or "The Living Atmosphere: Exploration Aerobiology." Each topic is described in detail below.

A proposed field campaign scoping study must (1) identify the key scientific questions to be addressed should the campaign be carried out and (2) develop an initial study design and implementation concept.

2.1.1. Synergistic Use of Imaging Spectroscopy and Lidar Remote Sensing for Biodiversity

The NASA Earth Science Division is funding enhancements of three imaging spectrometers and a scanning laser altimeter to enable flight on its high altitude ER-2 aircraft. The spectrometers are the Portable Remote Imaging Spectrometer (PRISM) operating in the near-ultraviolet to the near-infrared region of the electromagnetic spectrum (350 to 1050 nm), the Next Generation Airborne Visible/Infrared Imaging Spectrometer (AVIRIS-NG) operating in the visible to shortwave infrared region (380 to 2510 nm), and the Hyperspectral Thermal Emission Spectrometer (HyTES) operating in the thermal infrared region (7.5 to 12 µm). The laser altimeter is the Land, Vegetation, and Ice Sensor (LVIS). The combination of these imaging spectrometers with the LVIS lidar constitutes a uniquely powerful sensor suite for biodiversity observation. Together, these sensors provide imagery directly relevant to the composition, function, and structure of ecosystems. PRISM is particularly designed to support imaging of marine and coastal environments.

Proposals should identify the scientific questions to be addressed by, and develop an initial study design and implementation concept for, a field campaign that would include the following elements:
- in situ surface sensors that complement the airborne measurements (the airborne measurements must be the central focus and core observations of the campaign);
- the ER-2 aircraft outfitted with at least two of the following three imaging spectrometers PRISM, AVIRIS-NG, and HyTES, along with the LVIS scanning laser altimeter; and
relevant satellite datasets from NASA and other sources (e.g., radars, other thermal infrared sensors, other lidars, etc.).

Observations from other airborne sensors, not listed above, will also be considered in proposals for this scoping study—but would be in addition to the required ER-2 aircraft sensor observations described above. The use of other sensors must be clearly justified, specifically coincident with, and scientifically complementary to the ER-2 airborne sensor data that is the focus of this solicitation.

Please note that a funded scoping study will develop the final key questions and the study design to implement them. The proposal should identify initial questions/topics to be pursued by the scoping study. These questions/topics should be developed, fleshed out, and refined by the scoping study. [Added March 3, 2016]

These proposed field campaigns must include a combination of sites that together allow data acquisitions from terrestrial, freshwater, and marine ecosystems.

Proposed field campaigns under this topic should be designed to provide airborne and other data that will help inform NASA about the measurements’ potential for biodiversity investigations if obtained globally from future satellite missions.

In identifying key scientific questions, proposals under this topic should address one or both of the following themes.

- The distribution and/or abundance of components of biodiversity (focusing on one or more of ecosystems, species, and genes) and the drivers and mechanisms of change in the distribution and/or abundance of these components of biodiversity (ecosystems, species and genes)
- The impacts of changing biodiversity on the wider Earth System, e.g., the feedbacks from biodiversity to climate and/or other aspects of the Earth system

Information about the three spectrometers, laser altimeter, and ER-2 aircraft is available at the following URLs.

- PRISM: http://prism.jpl.nasa.gov
- AVIRIS-NG: http://avirisng.jpl.nasa.gov
- ER-2 Aircraft: http://www.nasa.gov/centers/armstrong/aircraft/ER-2/index.html

2.1.2. The Living Atmosphere: Exploration Aerobiology

The atmosphere, like the ocean, is a fluid medium that is increasingly known to harbor a rich diversity of living microscopic, as well as macroscopic organisms. NASA seeks proposals for integrated airborne, satellite, and in situ field campaigns to improve understanding of the distribution and abundance of life in the atmosphere and its movement within this fluid medium. Here, life includes organisms (macroscopic and microscopic) and their propagules. We are
interested in demonstrating directly how NASA instruments (e.g., those observing atmospheric aerosols) and models can be used to document and investigate the richness of atmospheric life and its interactions with other atmospheric, terrestrial, and marine life—including humans. Overall, this topic represents foundational discovery science.

The primary area of focus for a field campaign under this topic should include one of the following themes:

- Enhancing our understanding of the biogeography of the atmosphere, including its potential organization into dynamic functional ecosystems and biomes
- Movement and the resulting dispersal of organisms and propagules within the atmosphere and between the atmosphere, ocean, and land
- The impact of life in the atmosphere upon physical processes in the Earth system (e.g., the possibility of enhanced formation of cloud nuclei by living atmospheric particles and propagules)

Proposals should identify the scientific questions to be addressed by, and develop an initial study design and implementation concept for, a field campaign that would include the following elements:

- any NASA aircraft platform and associated sensors, for both in situ sensing within and remote sensing of the atmosphere;
- relevant satellite imagery; and
- ground- and in water-based surface sensors that allow understanding of the interactions between life in the atmosphere and life on the terrestrial and marine surfaces of Earth through the medium of the planetary/atmospheric boundary layer.

2.2 Workshops

NASA often supports workshops to assemble experts to explore means of advancing a particular scientific discipline through space-based observations and related models.

This solicitation requests proposals for a workshop(s) addressing either "Lessons from Climate Modeling for Improved Large-scale Biodiversity Modeling" or "Mapping and Understanding with Satellites the Interface of Life and Earth Science." Proposals should both (1) identify a key scientific question(s) for a topic and (2) develop an outline for a workshop or series of workshops to address the question(s) and inform the topic. Each topic is described in detail below.

2.2.1. Lessons from Climate Modeling for Improved Large-scale Biodiversity Modeling

General concerns over global trends in biodiversity, the need to provide inputs for Working Group II and other elements of the Intergovernmental Panel on Climate Change (IPCC), and the advent of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) as the global body for the assessment of conditions and trends in biodiversity have all driven efforts to design and build large-scale to global models of biodiversity in both terrestrial and marine realms. Much biodiversity science and its associated modeling focuses on only one taxon or a
small number of taxa at fine spatial scales of square meters to a few hectares. This makes the creation of biodiversity models that are both general and large-scale quite challenging.

NASA seeks proposals for a workshop or a series of workshops that would bring together individuals from two groups:

- climate modelers working at regional to global scales and
- the growing community of modelers exploring concepts and implementing designs for large-scale biodiversity models to support global assessments and efforts by national governments to comply with international conventions demanding the development of national strategies and action plans for biodiversity.

Proposals should bring together approximately equal numbers of modelers from these two communities to transfer lessons learned from advances in general circulation models, Earth system models, regional climate models, and data assimilation for weather and hydrological forecasting into large-scale biodiversity modeling. A common theme for all workshop proposals must be the use of satellite remote sensing to address challenges of working at large spatial scales. Such a workshop or series of workshops should not only move forward the state of biodiversity modeling, but also provide Earth system and climate modelers with new insights that enhance the role of living systems (e.g., through trophic webs) in their models.

### 2.2.2. Mapping and Understanding with Satellites the Interface of Life and Earth Science

Efforts to designate areas critical for biodiversity conservation are frequently frustrated by a lack of knowledge of biodiversity on the ground—and even more so in the water. Recently, there has been a call to develop a strategy for conserving elements of Nature’s geophysical stage (here defined as the geological, hydrological, and oceanic and atmospheric fluid dynamics components of the Earth system) as a means of conserving the players on Nature’s stage (i.e., its living elements or biodiversity). Currently lacking is a detailed understanding of the degree to which conserving examples of broadly defined geophysical features might actually conserve important biodiversity. At issue is whether we can meet a fundamental goal of conservation biology—saving all of the pieces of Nature, i.e., its critical biodiversity—by saving key geophysical environments, i.e., the stage upon which Nature’s play (the evolution of life) operates. Efficiently protecting a smaller and perhaps more easily managed number of geophysical environments (on the order of hundreds to thousands) in order to conserve a much larger number of, for example, species (on the order of millions) requires more knowledge of the relationship between geophysical diversity and biodiversity.

NASA seeks proposals for a workshop or a series of workshops that would explore the relationship of geophysical diversity or geodiversity to important components of biodiversity. A key element of such a workshop(s) is the integrated use of satellite and airborne remote sensing with in situ observations to map relationships between geophysical diversity (as represented by one or more of the following: geology, hydrology, and/or ocean and atmosphere fluid dynamics) and biodiversity (as represented by one or more of the following: ecosystems, species, and genes). This mapping is not an end in itself, but must serve to enlighten both the biological and geophysical sciences as to the processes driving the patterns arising in observations and models.
The end goal is the advancement of improved approaches for the conservation of biodiversity through the mechanism of conserving underlying geophysical diversity.

3. General Information

The most important aspect of proposals for all topics of this solicitation, including those for both scoping studies for potential field campaigns and for workshops, will be identification of the scientific question(s) and issues to be addressed by the field campaigns and workshops. All proposals must describe:
- the current state of the science,
- the potential for a significant scientific advance,
- the concepts for implementation of next steps, and
- the central and critical role for use of, or impact on planning for, NASA remote sensing systems (please remember this is a NASA solicitation).

Scoping study and workshop proposals should include the essential scientific components of the study and why coordinated teamwork is required in their implementation. They must develop an overall study design identifying the required observational (e.g., spaceborne, airborne, and/or supporting in situ) and analytical (e.g., models, data, and/or information systems) infrastructure. They must also address the technical, budgetary, and logistical feasibility of the proposed activities. Scoping study and workshop proposals must engage the broader research community in order to seek feedback on the ideas proposed and to allow objective determination of the breadth and depth of community interest and priority.

Selected and funded scoping studies and/or workshops must produce a written report providing a scientific justification and the initial design for a field campaign or the next steps arising from a workshop.

Proposers are advised that the award of a scoping study for a field campaign or a workshop does not obligate NASA to conduct the field campaign or implement any recommendations arising from the workshop. NASA will likely solicit proposals for an actual field campaign or to implement actions resulting from a workshop when NASA is ready programmatically and otherwise to proceed. That said, selected proposals will likely play significant roles in shaping NASA’s future thinking for its Biodiversity program.

4. Summary of Key Information

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<tr>
<th>Expected total program budget for all new awards in both areas solicited</th>
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<tr>
<td>Number of new awards pending adequate proposals of merit</td>
<td>Scoping Studies for Potential Field Campaigns: 1-2 Workshops: 1-3</td>
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<td>Maximum duration of awards</td>
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<td>Due date for Notice of Intent to propose (NOI)</td>
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<td>Due date for Proposals</td>
<td>March 18, 2016 [Corrected December 18, 2015]</td>
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<td>Planning date for start of investigation</td>
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<td>Relevance to NASA</td>
<td>This program is relevant to the Earth science strategic goals and subgoals in NASA’s <em>Strategic Plan</em>; see Table 1 and the references therein. Proposals that are relevant to this program are, by definition, relevant to NASA.</td>
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<td>General information and overview of this solicitation</td>
<td>See the <em>ROSES Summary of Solicitation</em>.</td>
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<td>Submission medium</td>
<td>Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the <em>ROSES Summary of Solicitation</em> and Chapter 3 of the <em>NASA NRA/CAN Proposers Guidebook</em>.</td>
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<td>Funding opportunity number for downloading an application package from Grants.gov</td>
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