A.4 TERRESTRIAL ECOLOGY

NOTICE: Corrected June 16, 2015: The point of contact for this program has been changed. See Section 6. Summary of Key Information.

NOTICE: A note to proposers to this program has been posted on the NSPIRES web page for this program element under "Other Documents", along with the previously posted FAQ. Anyone considering submitting a proposal in response to A.4 is strongly encouraged to read both of these documents.

NOTICE: Amended December 9, 2014. This amendment releases the final text for A.4, Terrestrial Ecology, which replaces in its entirety the placeholder text that was included in ROSES-2014. Notices of intent to propose are requested by January 20, 2015, and proposals are due March 20, 2015.

1. Scope of Program

NASA Terrestrial Ecology research addresses changes in Earth's carbon cycle and ecosystems using space-based observations in order to improve understanding of the structure and function of global terrestrial ecosystems, their interactions with the atmosphere and hydrosphere, and their role in the cycling of the major biogeochemical elements and water.

The focus of this solicitation is the initial research to begin the Arctic-Boreal Vulnerability Experiment (ABoVE) field campaign -- a large-scale study of ecosystem responses to environmental change in western North America's Arctic and boreal region and the implications for social-ecological systems. The Overarching Science Question for ABoVE is:

> How vulnerable or resilient are ecosystems and society to environmental change in the Arctic and boreal region of western North America?

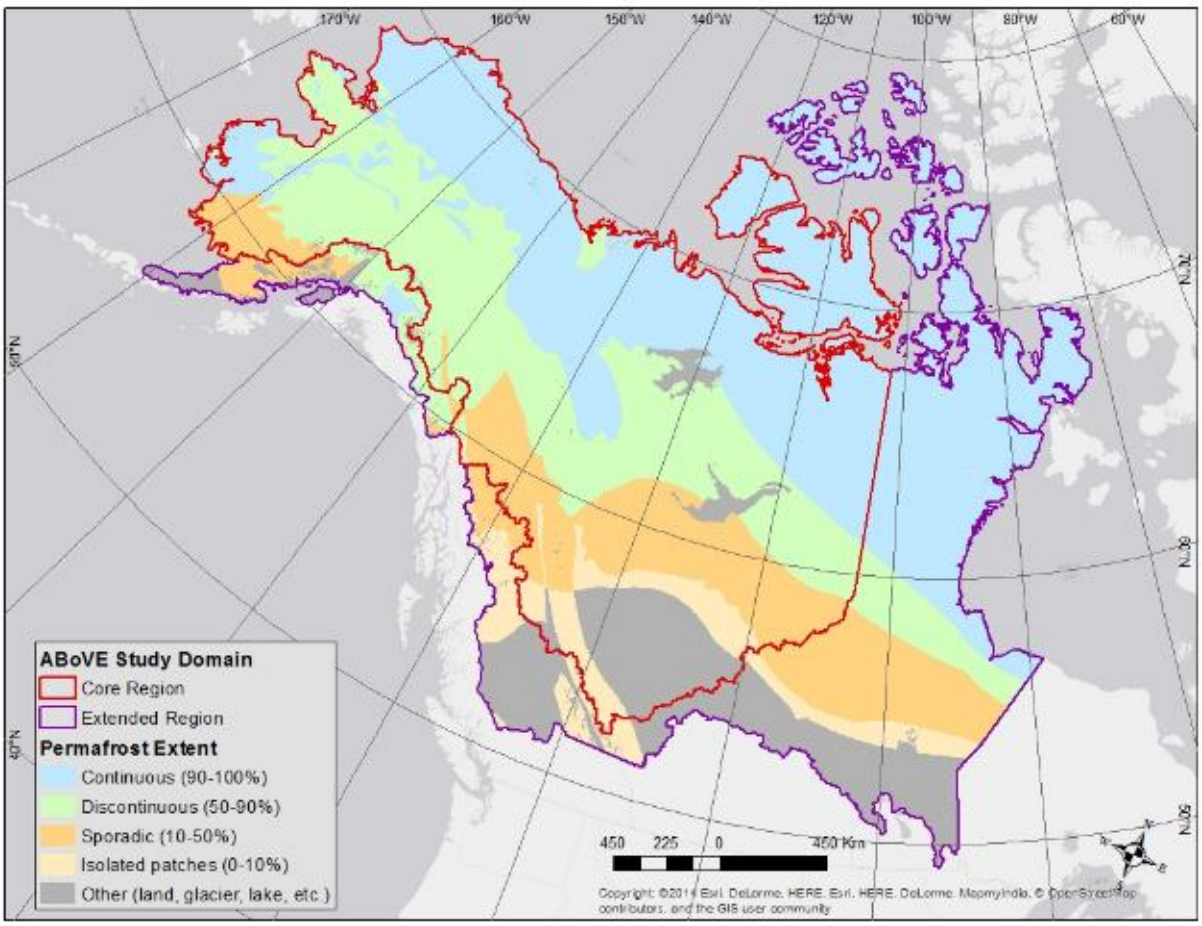
Research for ABoVE will link field-based, process-level studies with geospatial data products derived from airborne and satellite sensors, building a foundation for improving the analysis and modeling capabilities needed to understand and predict ecosystem responses and societal implications. It is envisioned that a successful ABoVE will (1) contribute to greater scientific understanding of the vulnerability and resilience to environmental change of Arctic and boreal ecosystems in western North America, and (2) provide the scientific basis for informed decision-making to guide societal responses at local-to-international levels.

The scientific rationales and societal importance for ABoVE, as well as specific science questions to be addressed and the study's top-level requirements are documented in the *ABoVE Concise Experiment Plan* (ACEP; http://above.nasa.gov/acep.html). Many aspects of NASA's organizational structure, management support, interagency/international partnerships, geographical focus, and collaboration/investigation policies have been established; relevant

detailed information for proposers is provided in Section 2 of this solicitation and on this landing page at the ABoVE Web Site: http://above.nasa.gov/2014_NRA.html.

The region of study for ABoVE, hereafter referred to as the ABoVE Study Domain, is shown in Figure 1. ABoVE activities will take place over a ten-year time frame (see Figure 2 in Section 3 below), with the first investigations starting in late Fiscal Year (FY) 2015. Coordinated ABoVE activities will be conducted in three phases: a first three to four year period (Phase I) emphasizing ecosystem dynamics objectives, followed by a second three to four year period emphasizing ecosystem services objectives (Phase II), and a concluding two to three year period (Phase III) of synthesis research focused on data analysis and integration of research findings.

Figure 1. The ABoVE Study Domain is depicted on this map of northwestern North America. The area outlined in red is the Core Region and the areas outlined in purple are the Extended Region. Together, they comprise the ABoVE Study Domain. The background mapping of permafrost extent shows the variability of just one of the many environmental factors of interest for ABoVE.



This solicitation primarily invites proposals for research investigations to begin the field program and to develop the *ABoVE Implementation Plan*, further refining the ABoVE study design. The *ABoVE Implementation Plan* will detail the specific activities to be carried out (what, when, where, how, for how long, etc.) based upon the investigator studies that are selected for participation by NASA and its partner organizations in ABoVE. It will be used by ABoVE managers to organize and manage their support to ABoVE researchers and by ABoVE

researchers as a resource for communication and coordination. Research proposed must address one or more of the following science questions (see Section 3.1.1 below for specific details):

- What processes are contributing to changes in disturbance regimes and what are the impacts of these changes?
- How are flora and fauna responding to changes in biotic and abiotic conditions, and what are the impacts on ecosystem structure and function?
- How are the magnitudes, fates, and land-atmosphere exchanges of carbon pools responding to environmental change, and what are the biogeochemical mechanisms driving these changes?
- What processes are controlling changes in the distribution and properties of permafrost and what are the impacts of these changes?
- What are the causes and consequences of changes in the hydrologic system, specifically the amount, temporal distribution, and discharge of surface and subsurface water?
- How are environmental changes affecting critical ecosystem services - natural and cultural resources, human health, infrastructure, and climate regulation – and how are human societies responding?

As discussed in more detail in Section 3.1.2 below, it is expected that the ABoVE-relevant activities associated with the suite of selected proposals from this solicitation will include:

- Development and analysis of remote sensing data products;
- Collection and analysis of field-based (surface, *in situ*) data;
- Collection and analysis of socioeconomic data;
- Modeling investigations; and
- Synthesis investigations.

All investigators on selected investigations will become members of – and must demonstrate in their proposals how they will contribute in a sustained way to – the ABoVE Science Team (ST). The Principal Investigator will be responsible for his/her investigation's participation in ST activities. The ST will be responsible for setting and advancing the ABoVE scientific content, direction, and priorities throughout all phases of ABoVE. As discussed in detail in Section 3.2 below, this solicitation also invites proposals for an ABoVE Science Lead (ASL) to provide scientific leadership and direction for ABoVE and foster efficient communications within the ST and with a wide variety of external audiences. The ASL will lead the writing and updating of the *ABoVE Implementation Plan* and will be responsible for calling and organizing ABoVE ST meetings, and interfacing with NASA and related organizations to review progress, resolve problems, and guide implementation. Proposers requesting consideration for the ASL position must present in their proposal a separate ABoVE Science Lead Plan with the information outlined in Section 4.3.7 below.

The scope and complexity of the ABoVE campaign require that this solicitation provide more background information than is usual in typical ROSES calls; similarly, proposers must provide specific, detailed information on their planned contributions and commitments to the broad range of ABoVE activities. The text of the solicitation below includes background on ABoVE Organization and Management (S2), including the Carbon Cycle and Ecosystems Office and

Field Operations Support (Section 2.1); the ABoVE Science Cloud (section 2.2), Data and Publication Policies (Section 2.3); Data Archive (Section 2.4); and ABoVE Partner Organizations, Programs, and Projects (Section 2.5). Section 3 presents the detailed scientific substance of the solicitation, including the ABoVE science questions and objectives to be addressed in proposals, types of investigations requested, and investigation responsibilities to the activities of the ST (see also Section 3.1.3 for ST member responsibilities). Section 4 describes unique required proposal elements, including the Project Management Plan (Section 4.3.1), Resource Needs and Utilization Plan (Section 4.3.2), Data Management Plan (Section 4.3.3), Training and Communications Plan (Section 4.3.4), Stakeholder Engagement and Interactions Plan (Section 4.3.5), Statement of Team Member Commitment (Section 4.3.6), and the optional ABoVE Science Lead Plan (Section 4.3.7). Section 5 outlines programmatic information, including eligibility, available funds/budget profiles/periods of performance, and proposal evaluation criteria.

Proposers are advised to check the ABoVE Web site (http://above.nasa.gov/) periodically for helpful information and updates on CCEO capabilities and ABoVE partner organizations. The following landing page was created to make available information that will be useful to proposers: http://above.nasa.gov/2014_NRA.html. A checklist will be posted on this landing page at least a month before proposals are due to be used as a guide for proposers in preparing their proposals.

2. Background on ABoVE Organization and Management

Many aspects of NASA's organizational structure and management support for ABoVE have already been planned and/or established. This section provides essential information for proposers regarding aspects of ABoVE organization and management that are unique to ABoVE and important for proposers to understand and integrate into their approach to ABoVE research.

2.1 Carbon Cycle and Ecosystems Office and Field Operations Support

NASA has established an ABoVE implementation and management group within the Carbon Cycle and Ecosystems Office (CCEO) at the NASA Goddard Space Flight Center (GSFC). Field activities and operations to be conducted within the ABoVE Study Domain will be organized, coordinated, and supported through the efforts of the CCEO. Important aspects include coordination and support for field operations and logistics, safety and risk management, and interactions with local and regional stakeholders. The CCEO will provide cyberinfrastructure for data analysis and management (e.g., the ABoVE Science Cloud, see Section 2.2). The CCEO will assist ST members with permit applications to appropriate authorities. Depending on the needs of the selected ABoVE ST, the CCEO may also arrange for the collection of core variable data and installation of infrastructure at ABoVE field sites. The CCEO will be responsible for managing the airborne science campaigns.

Investigators should plan to work closely with the CCEO and rely upon guidance from its staff for field activities, communications with local and regional stakeholders and authorities, and utilization of ABoVE cyberinfrastructure. Proposers desiring specific information about the CCEO are encouraged to contact its lead:

Dr. Peter Griffith
Chief Support Scientist, Hydrospheric and Biospheric Sciences Support Contract
Code 618
NASA Goddard Space Flight Center
Greenbelt, MD 20771
peter.griffith@nasa.gov
301-614-6610

2.2 The ABoVE Science Cloud (ASC)

The NASA Center for Climate Simulation (NCCS) at GSFC has partnered with the CCEO to create the ABoVE Science Cloud (ASC). The ASC combines high performance computing with emerging technologies to create an environment specifically designed for large-scale modeling, analysis of remote sensing data, copious disk storage with integrated data management, and integration of core variable data from *in situ* networks. The ASC will:

- Provide a shared set of computational and data resources to the ABoVE ST,
- Enable access to large, common data sets (both observation and model) that are relevant to ABoVE research,
- Provide a system by which results may be quickly and readily shared with the ABoVE research community,
- Enable researchers to propose larger problems and more scientific analyses than they would typically be able to leverage on their desktop computers, and
- Provide tailored computational, analysis, and data management environments to meet the needs of the individual science investigations.

Investigators will be able to request assistance from the CCEO in: use of the ASC, provisioning of key data products needed in their research, creation of appropriate metadata, generation of Digital Object Identifiers (DOIs) for publication-ready data products and preparation of finalized data products for archiving. More information about the ASC, its capabilities, and potential use for ABoVE research is available on the ABoVE website (see http://above.nasa.gov/science_cloud.html) and will be updated periodically.

2.3 Data and Publication Policies

The ABoVE ST will be expected to develop and comply with data and publication policies that respect and recognize the needs of partnering organizations and graduate researchers while being consistent with NASA data policies as described below. The CCEO and ASL, in consultation with NASA HQ program managers and ABoVE partner organizations, will develop and coordinate the implementation of ABoVE data and publication policies.

All data collected and science data products (including important model products) produced under NASA sponsorship will be managed in accordance with the NASA Earth Science Data and Information Policy specified at http://science.nasa.gov/earth-science/earth-science-data/data-

information-policy/. Public release of all data shall conform to the NASA Earth Science Data and Information Policy, and there can be no period of exclusive access to the data or data products by either an individual scientist or a science team. A short period of time for calibration, correction, and quality assessment prior to public release is permissible. Some exceptions regarding full public access may need to be established for data obtained from sources that bind users to more restrictive data policies or that are inherently sensitive in nature (e.g., commercial satellite data or confidential human-subjects data).

Researchers will be expected to share their data using ABoVE's cyberinfrastructure (see Sections 2.2 and 2.4) and/or partnering data system capabilities as guided by the CCEO. For ABoVE investigations supported by NASA, a tailored, alternate Data Rights section will be applied to the resultant award document, under which scientific data and scientific software will be exchanged without restriction as to its disclosure, use, or duplication.

2.4 Data Archive

The NASA-designated long-term archive for ecological and biogeochemical data from field campaigns is the Distributed Active Archive Center (DAAC) at the Oak Ridge National Laboratory (ORNL; http://daac.ornl.gov/). Thus, much of the data collected through ABoVE will ultimately be archived and distributed by the ORNL DAAC. NASA anticipates the possibility that some types of ABoVE data might be more appropriately archived at another NASA DAAC or other equivalent long-term archive, including those of ABoVE partner organizations. NASA managers and the CCEO will assist each investigator in identifying the appropriate archive for their data and products.

The following apply to data and products to be archived:

- The science data product formats from awarded projects shall conform to Earth Science Division (ESD) approved data system standards for data and metadata published at https://earthdata.nasa.gov/data/standards-and-references.
- Prior to the end of the project, awarded projects will be required to deliver all data products, along with the scientific algorithm software, coefficients, and ancillary data used to generate these products, to the DAAC in keeping with the need to ensure long-term stewardship of the data. [The requirement to archive supporting algorithm software, coefficients, and ancillary data is applied primarily to satellite and airborne data products, but while it may be a best practice to be encouraged, it is not usually applied to other types of data to be archived, such as the wide diversity of field data, process data, and social science data that will be produced during ABoVE.]
- All terms and conditions of the transfer of data products and associated information to the archive will need to be documented in the awarded *Data Management Plan*.

2.5 ABoVE Partner Organizations, Programs, and Projects

NASA's approach to implementing ABoVE relies on building strong, mutually-beneficial collaborations with other groups working within the ABoVE Study Domain. ABoVE has ambitious science questions, its region of study has a vast geographic extent, and there are many

ongoing research, management, and policy-related projects with similar interests in vulnerability and resilience in Arctic and boreal ecosystems and/or the consequences of environmental changes on ecological and social systems in Arctic and boreal regions. These considerations not only necessitate partnering, but also make it highly desirable.

Discussions have been held and are ongoing with a number of organizations which have expressed interest in collaborations with NASA during ABoVE, including those already carrying out significant research and monitoring activities, as well as those responsible for land management within the ABoVE Study Domain. NASA anticipates that collaborative activities during ABoVE may vary in nature and level of commitment depending on the objectives and capabilities of each partner, but could involve, for example, exchanging data, developing information products needed for decision support, sharing access to research infrastructure, providing logistical support, supporting additional research investigations, or participating in joint or parallel solicitations for research investigations.

The ABoVE experiment design outlined in the ACEP has been strongly influenced by the interests and activities of potential partners. The boundaries set for the core and extended ABoVE Study Domain (see Figure 1) and associated spatial hierarchy fundamental to the ABoVE experiment design (see Section 4.1.1 of the ACEP) were defined based on the science requirements established by the ABoVE Science Definition Team and then refined to take into account the interests and field sites of potential ABoVE partner organizations. For example, the hubs of the research areas, where most ABoVE field investigations are expected to occur, are areas where ongoing research and inventory work is occurring and existing research infrastructure and/or logistical support is or could be made available to ABoVE researchers (the hubs are denoted by flags in Figure 4.1 of the ACEP; see also the *More About Research Areas for ABoVE* document at: http://above.nasa.gov/2014_NRA/research_areas.html).

The following descriptions of potential partnerships are neither exhaustive nor exclusive, but do reflect at this point in time those organizations or programs comfortable in being identified as partners or potential partners and for which specific areas of mutual interest for cooperation have been identified. NASA expects its partnerships in ABoVE to grow and evolve over the course of the study.

The Department of Energy's (DOE) Next Generation Ecosystem Experiment (NGEE) Arctic (see http://ngee-arctic.ornl.gov/) is conducting a coordinated set of investigations that target improved process understanding and model representation of important ecosystem-climate feedbacks for high-latitude regions. The focus of NGEE-Arctic research is on *interactions that drive ecosystem-climate feedbacks through greenhouse gas fluxes and changes in surface energy balance* that will result in the fundamental knowledge needed to *reduce uncertainty and improve representation of processes in Earth System Models*. NASA and DOE are planning to work together to integrate and coordinate NGEE-Arctic and ABoVE research activities in areas where their respective goals and objectives converge. In particular, NASA will be able to contribute airborne and satellite remote sensing observations, regional data products, and spatial scaling expertise and DOE will be able to contribute indepth tundra process information and advanced models and modeling expertise.

The Canadian High Arctic Research Station (CHARS) (see https://www.aadnc-aandc.gc.ca/eng/1314731268547/1314731373200) will provide a world-class hub for science and technology in Canada's North that will complement and anchor the network of smaller regional facilities across the North. While its main laboratory will be located in Cambridge Bay, Nunavut, CHARS will support monitoring and research activities in the Arctic and Taiga Ecozones in northwestern Canada that align with its Science and Technology priorities and within its operating area. NASA and CHARS are planning to work together to coordinate monitoring activities and research on terrestrial ecology and hydrology within the ABoVE Study Domain in northwestern Canada, including the installation of ground instrumentation and development of geospatial data products.

In addition to NGEE Arctic and CHARS, NASA and the following U.S. and Canadian organizations have identified activities and/or research topics of mutual interest for collaborations during ABoVE.

- Landscape Conservation Cooperatives (LCCs) enhance the ability of organizations and communities to understand, manage, and adapt to landscape change. LCCs provide information and tools to land managers and policy makers to benefit resource conservation. In Alaska, LCCs are interested in measuring and projecting the impacts of landscape-scale environmental change on fish and wildlife habitat, key species, and social-ecological systems, including use of remote sensing techniques. NASA has discussed potential ABoVE collaboration with the Steering Committees and staffs of the Arctic, Western Alaska, and Northwest Boreal LCCs and has confirmed these topic areas are of mutual interest.
- The Department of Interior's (DOI) National Park Service, Fish and Wildlife Service, and Bureau of Land Management are all developing inventory and monitoring programs to assess the impacts of environmental change in Alaska, and coordinating these observations with those of ABoVE is of mutual interest.
- The DOI's U.S. Geological Survey (USGS) is conducting a wide range of research activities in the Arctic and boreal ecosystems of the northern high latitudes. The ongoing research interests and activities include field-based, remote sensing, and modeling projects represented by a number of USGS science centers and mission areas. Specific areas of mutual interest include studies of ecological, physical, hydrological, and biogeochemical processes of the interconnected terrestrial and aquatic complexes and understanding of the drivers and consequences of environmental change in relation to challenges of management of the lands and ecosystem services in the regions.
- The intergovernmental North Slope Science Initiative is developing databases needed by a range of stakeholders to assess the impacts of environment change on resource development in northern Alaska, and exchanges of data from these databases with data collected by ABoVE is of mutual interest.
- The U.S. Department of Agriculture (USDA) Forest Service is conducting research 1) on insect pests and diseases; 2) on forest land cover, use, and health through the establishment of new Forest Inventory and Analysis (FIA) plots and measurements in Alaska; and 3) to assess the impacts of environmental change and management decisions on ecosystem services, and NASA has confirmed that these topic areas are of mutual interest.
- Within Natural Resources Canada, scientists with the Canadian Forest Service (CFS) and the Canada Centre for Remote Sensing (CCRS) are conducting research to monitor and assess

the consequences of environmental change based on field observations, remote sensing data, and modeling, and NASA has confirmed that cooperation in all of these areas is of mutual interest.

- The Changing Cold Regions Network (funded by the Natural Sciences and Engineering Research Council of Canada) is combining data from long-term monitoring stations in western Canada with new field observations to assess the impacts of environmental change on ecohydrological systems, and NASA has confirmed that coordinating these research activities with ABoVE research in this area is of mutual interest.
- The Governments of Yukon and the Northwest Territories have identified priority research areas that align with ABoVE's goals and objectives, offer key datasets that will be needed to study the societal consequences of environmental change, and have expressed willingness to provide key logistical support and insights into the needs of stakeholders within their territory during ABoVE. NASA is keenly interested in working with these governments in all of these areas with respect to ABoVE research conducted within their territory.

In addition, discussions have been initiated with several state agencies in Alaska, and NASA anticipates identifying specific opportunities for collaborations of mutual interest in the future.

Additional information provided to NASA from these and other organizations regarding potential collaborations, including links to Web sites and information about scientific activities, and/or the sharing of data, infrastructure and/or logistical support, is available at http://above.nasa.gov/2014_NRA.html (or go directly to http://above.nasa.gov/2014_NRA/collaborators.html for research and monitoring activities and http://above.nasa.gov/2014_NRA/research_logistics_support.html for research and logistics support organizations).

3. Types of Proposals Solicited

The study design for ABoVE calls for an overall nine to ten year program of research composed of an initial one to three year ramp up of funding and research activities, a five to six year period of peak funding and intensive studies, and a concluding one to three year ramp down of synthesis research focused on continued data analysis and integration of research findings. Due to budget availability limitations, funding for science investigations must be increased initially from approximately $3M per year in 2015 to approximately $7-8M per year in 2017. Thus, this solicitation is for an initial set of research activities to begin the field program and to develop the *ABoVE Implementation Plan*, further refining the study design. Specifically, this solicitation requests proposals for:

1) ABoVE ST members to conduct an initial set of research investigations focused on addressing the Overarching Science Question for ABoVE and ABoVE Tier 2 Science Questions (see Table 3.1 of the ACEP, reproduced below), and
2) The ABoVE Science Lead to guide the overall scientific implementation of ABoVE and serve as Science Team Leader.

All proposals submitted in response to this solicitation must explain the significant advance in scientific understanding anticipated and how their study addresses vulnerability and resilience in social-ecological systems of the Arctic-boreal regions of western North America.

Table 3.1 Tier 2 Science Questions and Objectives for ABoVE.

Tier 2 Science Questions					
Section 3.1: How are environmental changes affecting critical ecosystem services - natural and cultural resources, human health, infrastructure, and climate regulation - and how are human societies responding?	Section 3.2: What processes are contributing to changes in disturbance regimes and what are the impacts of these changes?	Section 3.3: What processes are controlling changes in the distribution and properties of permafrost and what are the impacts of these changes?	Section 3.4: What are the causes and consequences of changes in the hydrologic system, specifically the amount, temporal distribution, and discharge of surface and subsurface water?	Section 3.5: How are flora and fauna responding to changes in biotic and abiotic conditions, and what are the impacts on ecosystem structure and function?	Section 3.6: How are the magnitudes, fates, and land-atmosphere exchanges of carbon pools responding to environmental change, and what are the biogeochemical mechanisms driving these changes?

Tier 2 Science Objectives: Ecosystem Dynamics			
1. Determine how interactions among vegetation, soil characteristics, hydrology, and disturbances influence surface energy exchange and mediate permafrost vulnerability and resilience to climate change.	2. Determine how and where interactions among microbes, plants, and animals exert control over ecosystem responses to climate change and disturbances.	3. Understand how vegetation attributes and hydrologic conditions interact, and respond and feedback to disturbance.	4. Quantify how changes in the spatial and temporal distribution of snow impacts ecosystem structure and function.
5. Determine the causes of greening and browning trends and their impacts on ecosystem form and function.	6. Elucidate how climate change and disturbances interact with above- and belowground communities and processes to alter carbon biogeochemistry, including release to surface waters and the atmosphere.	7. Determine how the spatial and temporal dynamics in both faunal abundance and characteristics of fish and wildlife habitat co-vary across gradients of climate and disturbance.	

Tier 2 Science Objectives: Ecosystem Services					
1. Assess how future climate warming is likely to affect infrastructure and transportation networks.	2. Determine how changes to disturbance regimes, flora and fauna, permafrost conditions, and/or hydrology influence human health outcomes in the ABR.	3. Evaluate how changes to ecosystems will influence subsistence opportunities.	4. Analyze how changes to natural and cultural resources will impact local communities as well as influence land management policies and practices.	5. Determine the sources of variations in climate feedbacks from Arctic and boreal ecosystems and assess the potential for future changes to climate regulating services at regional to global scales.	6. Determine the degree to which changing environment and altered human activities result in synergistic or antagonistic changes in ecosystem services.

This table is identical to the one in the ACEP with the exception that none of the text is displayed in bold type.

While not all proposals submitted in response to this solicitation are required to make significant use of remotely sensed data, all proposals must explain any utilization of satellite or airborne observations and the relevance of their investigation in the context of a remote sensing-oriented regional field campaign.

3.1 Arctic-Boreal Vulnerability Experiment (ABoVE) Research Investigations Focused on ABoVE Science Questions

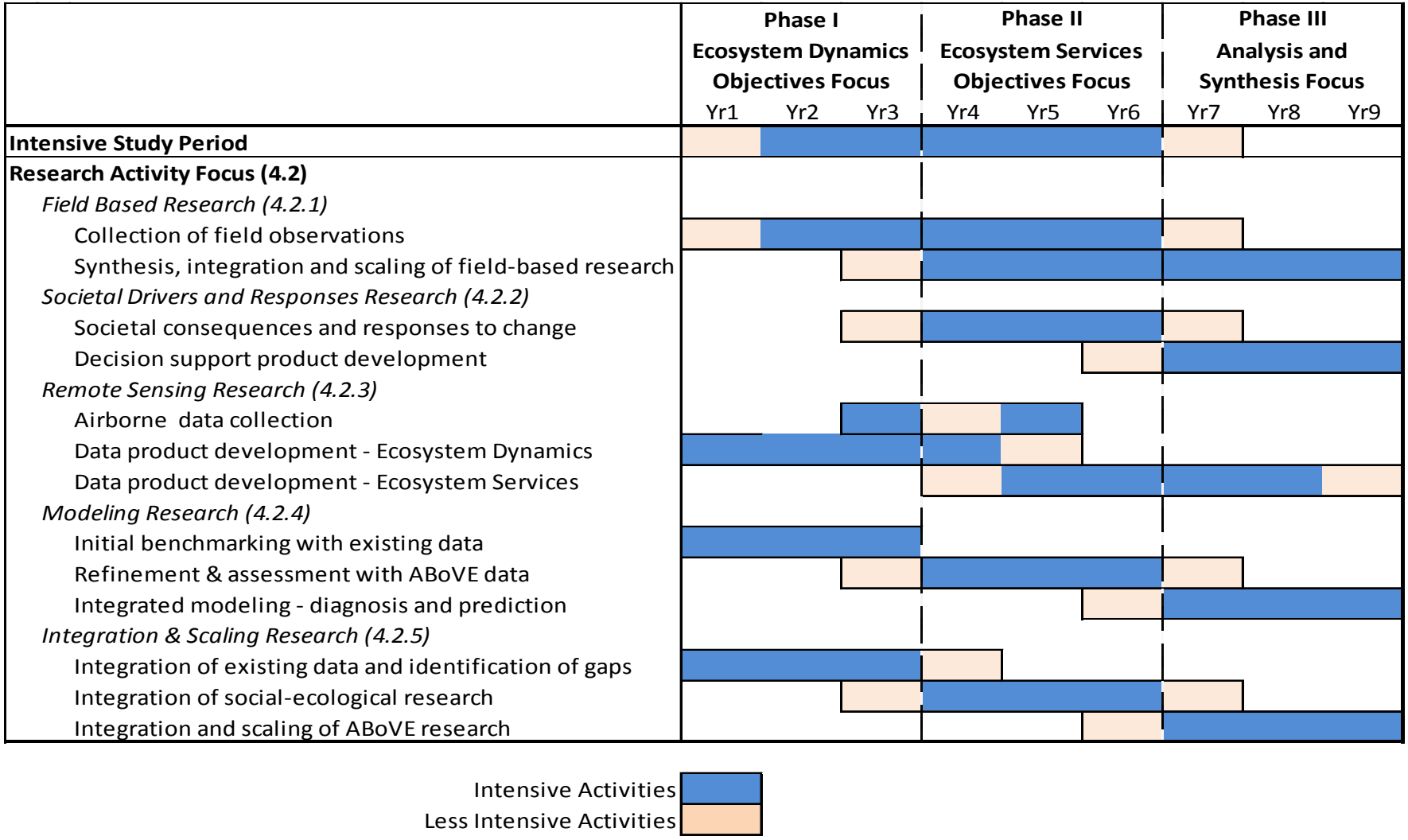
To more fully understand the response of Arctic and boreal ecosystems and society to their changing environment and provide the information required to develop options for societal responses to the effects of environmental change, Arctic-boreal social-ecological systems must be studied holistically, taking into account the complex interactions within them and their tightly coupled nature. While the ABoVE Study Domain is vast and existing *in situ* observations are generally sparsely distributed, there has been and continues to be a great deal of research and inventory work being conducted in this region. ABoVE's study design emphasizes building upon and partnering with the organizations and individuals responsible for such activities and emphasizing a whole system, regional approach enabled by space-based and airborne remote sensing in the new investigations to be conducted.

Many ABoVE research investigations will integrate and synthesize geospatial data collected by airborne and spaceborne sensors with information obtained from surface-based observations and process research. ABoVE will address questions that are associated with processes that are critical to understanding the effects of environmental change, focusing on ecosystem services and society, land surface processes, and interfaces with the hydrological system, adjacent coastal ocean, and overlying atmosphere. ABoVE research activities will involve surface-based, *in situ* observations, process-oriented analyses, modeling focused on social-ecological systems, and scientific syntheses. The surface-based, *in situ* research will emphasize observations and process studies to fill critical data gaps and target key information needed to address ABoVE's Tier 2 Science Questions and Objectives (see Table 3.1 of the ACEP, reproduced above). Most ABoVE investigations will be expected to address more than one of these questions or objectives.

ABoVE's scientific scope includes research on the human dimensions of environmental change. To succeed, ABoVE must engage with disciplines in the social sciences to jointly develop understanding of global environmental change in Arctic-boreal social-ecological systems. Therefore, NASA seeks a set of initial investigations to identify and develop the scientific foundation for specific areas of inquiry where remote sensing can contribute to social-ecological studies focused on the ABoVE Tier 2 Ecosystem Services Science Objectives.

The timeline for ABoVE (see Figure 2) calls for an emphasis in the first 3-4 years (Phase I) on the Ecosystem Dynamics Science Objectives, to be followed in the second 3-4 years by an emphasis on the Ecosystem Services Science Objectives (Phase II). Recognizing that some research on the Ecosystem Dynamics Science Objectives may need to continue beyond Phase I and that basic research to identify and develop the Ecosystem Services Science Objectives may need to be initiated in the first 3-4 years in order to produce desired scientific understanding and decision support information in Phases II and III, NASA plans to support both types of activities

Figure 2. Timeline for ABoVE Research Activities. The timeline depicted below differs from that in the ACEP; in particular, the Airborne Data Collection line was modified to reflect updated plans regarding the timing of major airborne campaigns.



in both phases. In Phase I, the approximate proportion of ecosystem dynamics-oriented studies to ecosystem services-oriented studies will be 2:1. In Phase II, this approximate proportion will be reversed.

3.1.1 Research Topics

For this initial ABoVE solicitation, highest priority will be accorded to initiating interdisciplinary studies that address the following Tier 2 Science Questions:

- What processes are contributing to changes in disturbance regimes and what are the impacts of these changes?
- How are flora and fauna responding to changes in biotic and abiotic conditions, and what are the impacts on ecosystem structure and function?
- How are the magnitudes, fates, and land-atmosphere exchanges of carbon pools responding to environmental change, and what are the biogeochemical mechanisms driving these changes?

However, the complex interactions that influence ecosystem response in this region cannot be understood without taking into account what is happening in the cryospheric and hydrologic components of the system, and therefore these influences also must be addressed in studies of ecosystem response. Thus, studies addressing the following Tier 2 Science Questions from the perspective of ecosystem response to environmental changes are also requested:

- What processes are controlling changes in the distribution and properties of permafrost and what are the impacts of these changes?
- What are the causes and consequences of changes in the hydrologic system, specifically the amount, temporal distribution, and discharge of surface and subsurface water?

Studies wholly focused on cryospheric or hydrologic states or processes, and lacking an ecosystem response perspective, will not be entertained at this time. NASA hopes that such studies can be sought in the future either through its own efforts or those of its ABoVE partners.

Finally, it is imperative that initial ABoVE research set the stage for addressing ABoVE's overarching goal of better understanding vulnerability and resilience in Arctic-boreal social-ecological systems, including and especially how people may respond to changes within these systems. Thus, all investigations should address how their research will contribute to a body of knowledge that will enable ABoVE synthesis and integration phase (Phase III) researchers to address the following Tier 2 Science Question, and approximately one third of the investigations for Phase I should directly address this question, focusing on one or more of the ecosystem services objectives noted in Table 3.1 of the ACEP:

- How are environmental changes affecting critical ecosystem services - natural and cultural resources, human health, infrastructure, and climate regulation – and how are human societies responding?

3.1.2 Types of Research Activities

NASA requests the following types of research activities to address the ABoVE Tier 2 Science Questions and to be focused on the ABoVE Study Domain.

3.1.2.1 Development and Analysis of Remote Sensing Data Products

Addressing the Tier 2 Science Questions and Objectives will require use of existing and new data products derived from satellite remote sensing systems. Research to produce and analyze these data products should emphasize the unique capabilities provided by remote sensing for studying important surface and atmospheric characteristics. Ensuring that the remote sensing data are compiled and co-registered will be a key priority; thus, one of the most important research opportunities in ABoVE is to develop a set of readily accessible, validated data products derived from multiple sensors that can be integrated to form the basis for investigations of social-ecological system responses over the entire ABoVE Study Domain. Since the ABoVE Study Domain includes two different nations, the compatibility of existing national data products (e.g., land cover) may require investigation and efforts to either harmonize or create new, mutually acceptable seamless data products for the ABoVE study domain. At landscape to regional scales, remote sensing data products will be critical to the spatial and temporal scaling of observations made from field studies. In addition, these data products will be used for initializing, driving, calibrating, and validating models. This solicitation emphasizes the production and utilization of data products from satellite sensors, but analysis of existing airborne remote sensing data is also of interest. Priority will be accorded to investigations that address the high importance remote sensing data products identified in Table 4.2 of the ACEP.

Proposals to collect new data from aircraft are not being sought in this first solicitation for ABoVE research. Detailed plans for ABoVE airborne science will be developed in the next year and NASA intends to solicit for airborne science investigations in ROSES-2016. Proposers are advised to take into account the fact that complementary airborne campaigns are planned to occur in 2017 and 2019 (see Figure 2) and be prepared to contribute to further scientific planning for these campaigns if they are selected for ABoVE ST membership.

3.1.2.2 Collection and Analysis of Field-based (Surface, *In Situ*) Data

Previous field studies have demonstrated that dynamics of Arctic and boreal ecosystems are driven by highly-coupled processes that together determine the region's resilience and vulnerability to climate and other environmental changes. Addressing the Tier 2 Science Objectives will require process studies, data collections, and interdisciplinary approaches to field-based research to support an integrated understanding of ecosystem (social-ecological) change. To this end, field studies during ABoVE should contribute towards an improved, mechanistic understanding of the most critical processes and their interactions needed to address the Tier 2 Science Objectives, and towards determining the ecological and societal responses to these changes. Field-based research should focus on mechanisms underlying relationships that can be generalized across the applicable areas of the ABoVE Study Domain.

In selecting locations for surface-based field investigations, researchers are encouraged to use sites with previous and/or ongoing research, including sites associated with research stations, when these sites meet their study's needs and when their activities are compatible with the other

work being conducted at these sites (see http://above.nasa.gov/2014_NRA/research_logistics_support.html for some candidate sites). When proposing to work at other sites, proposers should provide a compelling rationale that supports their choice of site(s). Proposals should detail the specific measurements to be made as part of the investigation, and note if any ABoVE core variables (see Table B1 of the ACEP) are to be collected as part of the investigation or expected from other providers.

3.1.2.3 Collection and Analysis of Socioeconomic Data

One of the primary motivations for ABoVE is to understand how human activities are driving, interacting with, and responding to changes in ecosystems. The specific Tier 2 Ecosystem Services Science Objectives were selected because they represent important areas for research where society is vulnerable to the impacts of environmental change over a range of spatial scales. Some studies will likely rely on data collected by ABoVE researchers working on the Ecosystem Dynamics Science Objectives, but include data from other sources as well, such as: a) important social-economic and environmental data bases (including those based on local and traditional knowledge) compiled by government and nongovernment organizations; b) data products generated through integration of remotely sensed data products with other geospatial data; c) data products developed through the integration and synthesis of field-based research conducted during ABoVE and elsewhere; and d) model outputs. When appropriate, researchers should work with communities to understand how to enhance their research through use of local and traditional knowledge. This research should explore opportunities for collaboration with ongoing research focused on the responses of society to environmental change that is being sponsored by other agencies.

3.1.2.4 Modeling Investigations

Modeling provides an integrating framework for translating data from the field and remote sensing studies into diagnostic and predictive information products for scientific analysis and decision support. Diagnostic modeling is required to assess the rates, extent and severity of changes and their impacts on the key indicators of ecosystem dynamics across the study domain. Models run in prognostic mode will provide information on possible outcomes for ecosystem services under different scenarios that will be used as a basis for decision support. Modeling will be an essential activity in all phases of ABoVE.

For this initial ABoVE solicitation, modeling research should focus on evaluating and improving model performance for Arctic-boreal social-ecological systems and exercise or intercomparison of models to identify critical data gaps while there is still time to influence the ABoVE field program. Modeling research must make significant use of remote sensing data. ABoVE modeling activities should be planned to complement and leverage ongoing modeling research being conducted by partner organizations to avoid duplication of effort and foster synergistic interactions (e.g., by enabling greater utilization of remotely sensed data and products). Important modeling activities to complement and/or build upon include DOE's NGEE Arctic project and the Integrated Ecosystem Model developed by the Alaska Climate Science Center.

Modeling activities focused on identifying critical data gaps or model weaknesses are encouraged to consider a performance period of one to two year duration so that their findings

can be made available in time to influence the ABoVE field program or model development and improvement priorities.

3.1.2.5 Synthesis Investigations

Integration, synthesis, and spatial scaling research is needed for connecting and translating results from field, remote sensing, and modeling research into a broader knowledge-base. While synthesis research will be the primary focus of Phase III for ABoVE, synthesis, integration, and scaling research will be conducted throughout the field campaign. Initial activities should focus on providing an integrated assessment of the results of previous studies that will serve as a foundation for future ABoVE research. Such work can also yield data and information to improve models and to identify the most important gaps in the data and system-level understanding needed to address the ABoVE science questions.

Because of the importance of integration, synthesis, and scaling research, there needs to be a coordinated and well-designed planning effort within the ST to ensure that data are interoperable and research results can be integrated across studies and spatial scales. This planning should include key stakeholder groups so that careful consideration is given to developing data products at the scale and with information content that maximizes their value for decision support. Proposers should take these considerations into account in their proposals.

Synthesis activities are encouraged to consider a performance period of less than three years if their analyses can be completed and made available sooner and thus be more likely to influence future directions for ABoVE.

3.1.3 Science Team Membership

All investigators selected for participation in ABoVE will become members of the ABoVE Science Team (ST), with the Principal Investigator, or his/her designee, serving as the official representative to the ST for their investigation. The following describe a minimum set of requirements for each ABoVE investigation. These responsibilities are a guide for investigators proposing in response to this solicitation, and may be updated as the detailed *ABoVE Implementation Plan* is developed and refined. These responsibilities are in addition to those associated with conducting the research proposed.

- Participate fully in ABoVE ST meetings, workshops, and other team activities (each investigation should be appropriately represented in these activities and the Principal Investigator will be responsible for determining which investigation members participate in which activities);
- Assist the ASL in the development of the *ABoVE Implementation Plan* and contribute needed information, as requested;
- Complete all safety training as advised by the CCEO and adhere to all safety and reporting procedures established for ABoVE;
- Coordinate with the CCEO as advised regarding all field activities and required logistical and infrastructural support;

- Coordinate with other ABoVE ST members regarding related and/or complementary research activities;
- As appropriate, assist in the development and or/selection of ABoVE data standards, formats, and protocols and comply with them in the research to be conducted;
- Engage in training and knowledge transfer activities relevant to ABoVE;
- Communicate regularly and substantively with stakeholders regarding ABoVE activities, particularly with local and regional communities and organizations;
- Adhere to ABoVE data policies and practices and applicable data policies of ABoVE partner organizations; and
- Document and prepare for archive all data and products produced for ABoVE.

3.2 ABoVE Science Lead

NASA requests proposals for the ABoVE Science Lead (ASL). Investigators offering an ABoVE research investigation and desiring to be considered for the ASL position must indicate their candidacy by answering the relevant cover sheet question and including a separate ASL section within their proposal (see detailed requirements in Section 4.3.7).

The ASL will be responsible for providing scientific leadership and direction for ABoVE, providing scientific inputs regarding ABoVE priorities and activities to NASA management, and communicating about ABoVE to a wide variety of scientific, governmental, and public audiences. The ASL, in close coordination with the ABoVE Science Team, the CCEO, ABoVE program management at NASA HQ, and ABoVE partner organizations will be responsible for writing and keeping up to date the *ABoVE Implementation Plan* detailing the research activities to be conducted and specifying roles and responsibilities for investigators involved in those specific activities during the execution of ABoVE. He/she will be responsible for calling and organizing ABoVE ST meetings and related activities in coordination with NASA HQ managers and CCEO staff. He/she should expect to meet with NASA HQ and CCEO management on a quarterly basis to review progress, resolve problems, and discuss next steps for implementation.

Proposers for ASL should indicate their ability and willingness to serve in this role for the full nine to ten year duration of ABoVE, but recognize that their performance in this role will be reviewed periodically and could be subject to change – either through mutual agreement or as a result of inadequate performance. The initial period of performance for the ASL will be four years, after which a new proposal for full peer review will be required for renewal. NASA estimates the time commitment necessary for service as ASL to be approximately half time, but recognizes that it could range from 1/3-2/3 time depending on the particular circumstances of the candidate.

The Budget Justification: Narrative and Details section of the proposal must include a detailed budget for only the ASL activities and a narrative and justification for the ASL work that are separate from those for their ABoVE ST member research activities. NASA desires to track the budget request for the ASL separately from that for ST member research. Therefore, the total budget associated with the ASL work should be listed under “Other” in the budget information provided in the proposal cover page.

NASA reserves the option to select an ASL through an alternative process (e.g., from among the ST members) should proposals of adequate merit and suitability not be received for the ASL role.

4. Required Elements for Proposals

For this solicitation, the Scientific/Technical/Management section of the proposal will be replaced with a separate Scientific/Technical section and six (or seven, if the ASL position is sought) separate management-related sections (see Section 4.3 below). In addition, all proposals must respond to the requirements detailed in Sections 4.1 and 4.2 below.

4.1 Requirement to Address Errors and Uncertainties

All proposals submitted in response to this solicitation must include 1) a discussion in the Scientific/Technical section describing how errors and uncertainties will be addressed and 2) a description in the Data Management Plan (see Section 4.3.3 below) of how they will be reported with the data and products to be shared and archived. The research supported will be expected to characterize uncertainties and quantify errors associated with data, analytical approaches, model results, and scientific interpretations.

4.2 Requirement to Attend ABoVE ST Meetings and Workshops

NASA expects at least one representative from each selected investigation to attend each ABoVE ST meeting (normally one per year) to promote coordination of research activities and timely exchange of findings. Co-investigators and collaborators will be welcome to participate in all meetings – as will be student researchers. Support for all such travel must be included in the proposal budget and it will be up to the Principal Investigator to determine who attends.

Proposers should budget for two three-day ABoVE ST meetings in their first year, and one three-day meeting per year thereafter, and for additional travel to one workshop per year. Proposers should assume a mix of ABoVE ST meeting locations to include some in Alaska and Canada and some in the conterminous U.S. For planning purposes only, proposers should assume there will be two ABoVE ST meetings in Alaska during the first year, one in western Canada in year two, one in the eastern or central U.S. in year three, and one in Alaska in year four. Workshop activity will start in year two and is intended to allow for more specialized ABoVE ST coordination activities and/or for subgroups of the ABoVE ST to meet; the purposes and locations will be determined by the ABoVE ST. For planning purposes only, proposers should assume one workshop in each of years two through four to be held within the ABoVE Study Domain.

4.3 Required Plans and Statements

All proposals for participation in ABoVE must include the plans detailed below in Sections 4.3.1-4.3.6, and these plans must be presented as separate sections of the proposal to follow the References and Citations section. Proposals lacking these required plans will not be considered for selection and will be returned without review. The plan for ASL, required only for proposals

requesting consideration for the ASL position, is described in Section 4.3.7. All of these plans are in addition to the Scientific/Technical Plan and are not included in its 18-page limit.

4.3.1 Project Management Plan (PMP)

Proposals must include a separate Project Management Plan (PMP) that presents a management structure describing how the proposed research activities will be organized, who will be doing what work, and what procedures will be followed to ensure that work is safely and responsibly conducted. The Project Management Plan section should be inserted after the References and Citations section in the proposal and does not have a page limit (in most cases, two to three pages are likely to be adequate for the Project Management Plan).

4.3.1.1 PMP: Roles and Responsibilities of all Investigators

The Project Management Plan must present a management structure describing roles and responsibilities for the Principal Investigator and all Co-Investigators and Collaborators and how the research activities will be coordinated and integrated. If students and postdoctoral scientists are involved, their roles should be described in this plan. Consistent with this section, the proposal budget section and proposal cover page must include budgetary information for all Co-investigators to receive funding.

4.3.1.2 PMP: Summary of Institutional Collaboration(s)

In order to facilitate proposal analysis by the NASA program office, proposers must briefly summarize the number and nature of all institutional collaborations integrated within their proposed research investigation. The relationship(s) with the collaborating institution(s) and terms and conditions of their participation should be clearly described. This section should include a summary of any resources provided by these collaborating institutions (i.e., cost-sharing; in-kind resources, such as access to research infrastructure or equipment, personnel time, data or data products; and/or matching funding). In support of this summary information, letters of commitment from each collaborating institution documenting their role in and specific contributions to the investigation should be included in an appendix to the proposal. The generic statement of commitment provided in Section 2.3.9 of the *NRA/CAN Proposers Guidebook* (see: http://www.hq.nasa.gov/office/procurement/nraguidebook/) does not provide an acceptable level of detail for this solicitation's needs and should not be utilized.

The summary of institutional collaboration(s) element of the Project Management Plan is required, but, while collaborations of all types are encouraged and will be viewed favorably, collaborations are not required. An acceptable summary of institutional collaboration(s) may simply state: "No institutional collaborations are proposed."

4.3.1.3 PMP: Safety and Risk Management

For efforts involving field operations, the investigator's Project Management Plan should address risk management under applicable institutional, state, and national requirements, with respect to insuring that team participants are aware of field hazards and either have or plan to acquire the

equipment and training to mitigate against those hazards. Proposers may assume the CCEO will assist with this process through a Web-based hazard analysis and work with each team to identify appropriate training. The CCEO will provide basic safety orientations, site specific safety plans for multiuse areas, and a variety of basic training for general hazards, wildlife safety, boat operation, and use of off-road vehicles. While NASA intends to assist with risk management, safety planning, and training, proposers are advised that it is the legal responsibility of the investigators and their home institutions to address the health and safety needs of their employees and students. Specialized training needs may not be provided by the CCEO, so it is important for proposers to identify such needs and include them in their budget plan. Examples of such specialized training needs include swiftwater traverse, aircraft operations, and cold water immersion training.

4.3.2 Resource Needs and Utilization Plan

The CCEO will provide logistical and field operations support to the ABoVE ST and will work to efficiently arrange for field infrastructure and seek economies of scale that will minimize costs and maximize utilization. Special support for individual investigations will be provided when it is most efficient and cost effective to do so. Selected scientists should expect a dialog with the CCEO, ASL, and NASA Headquarters managers, to ensure that their infrastructural and logistical needs are met adequately and in a cost-effective manner – either through the efforts of the CCEO or through their own funding award.

Proposals must include a separate Resource Needs and Utilization Plan that details the research infrastructure and logistical support needed for the investigation. Requirements for *in situ* observations, logistical support, NASA computer use, etc., must be detailed. Special support required that is likely to be unique to an individual investigation must be described. Proposers are urged to delineate such needs specifically in their budget or budget justification, item by item, if at all possible. Proposers should clearly state what support exists and they are leveraging, what they propose to do within their funded investigation, and what they expect the CCEO or other investigators to provide.

All use of the ABoVE Science Cloud (ASC) for analysis and collaborative sharing of data and results should be detailed in the Resource Needs and Utilization Plan section of ABoVE proposals. While use of the ASC for data analysis and modeling will not be required of ABoVE researchers, proposers are encouraged to request use of the ASC when existing computational resources are not available to them. NASA will not view favorably requests for purchase of new computational equipment or time on other systems without a compelling rationale for why the ASC would be unsuitable for meeting the needs of the research investigation.

Consistent with the Resource Needs and Utilization Plan, costs for all logistical and infrastructural support items must be included in the budget presented in the proposal. However, proposers are advised that some or all of these costs may be pulled out postselection and funded directly through the CCEO. If difficulties arise in estimating costs for requested logistical and infrastructural support, proposers should describe their needs in sufficient detail that CCEO staff can evaluate the requirement. Questions regarding planned CCEO support may be directed to Dr. Peter Griffith (see Section 2.1).

The Resource Needs and Utilization Plan section should be inserted after the Project Management Plan section of the proposal and does not have a page limit (in most cases, two to three pages are likely to be adequate for the Resource Needs and Utilization Plan).

4.3.3 Data Management Plan

Proposals must include a separate Data Management Plan that addresses the dissemination and sharing of research results and compliance with the NASA Earth Science data policy (http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/). The Data Management Plan should include, when relevant to the type of study being proposed, the existing data and data products or other materials to be utilized in the course of the project, the data and data products or other materials to be produced in the course of the project, the standards to be used for data and metadata formats, and plans for providing access to and archiving the data and other research products consistent with ABoVE data policies and management practices. Any use of proprietary or sensitive information requiring special protection or constraints on re-distribution should be identified, and plans/processes for sharing research findings or derived products and for others to secure access to the data should be described. The data sharing plan called for in Section 2.3.5 of the *NRA/CAN Proposers Guidebook* must be included in the Data Management Plan.

The Data Management Plan should describe how errors and uncertainties will be reported with the data and products to be shared and archived.

An outline describing in greater detail desired content for the Data Management Plan is available on the ABoVE Web site (http://above.nasa.gov/2014_NRA/data_management_plan.html) and additional information about data management is available at the ORNL DAAC Web site (http://daac.ornl.gov/PI/pi_info.shtml).

If use of the ABoVE Science Cloud (ASC) is planned for extensive sharing of data prior to long-term archival, then this plan should be noted in the Data Management Plan. All ABoVE researchers are strongly encouraged to use the ASC for data and product sharing. The system has been designed to facilitate early availability of data and to make the transition to a long-term archive less burdensome for the investigator.

NASA intends for the Data Management Plan to become a living document; successful proposers will be requested to update their Data Management Plan annually as to the status of and schedule for data set production, sharing, and archive.

Consistent with the Data Management Plan, costs for all data management activities, including quality assessment, documentation, data and product sharing, and preparation for long-term archive, must be included in the budget presented in the proposal.

The Data Management Plan section should be inserted after the Resource Needs and Utilization Plan section of the proposal and does not have a page limit (in most cases, 2-3 pages are likely to be adequate for the Data Management Plan).

4.3.4 Training and Communications Plan

Proposals must include a separate Training and Communications Plan that details training, knowledge transfer, and public communications activities to be undertaken as part of the ABoVE investigation.

Field campaigns provide abundant opportunities to train a next generation of researchers as well as to conduct professional development activities with a wide variety of groups including educators, applied scientists with partnering organizations, field workers and technicians, and local stakeholders. To the extent possible, training of technicians, undergraduate and graduate students and post-doctoral fellows should be directly incorporated into ABoVE investigator studies. In addition to being directly involved in research, students and post-docs should be encouraged to participate in the annual ABoVE ST meetings. Proposers should assume the CCEO may organize some additional opportunities for training and knowledge transfer, all focused on the research objectives for ABoVE, and investigators should indicate their ability and willingness to participate in such ABoVE-wide activities and make note of any particular expertise and skills they can offer for such activities.

Opportunities for capacity building and public outreach abound across the ABoVE Study Domain, including communications activities that are necessary to inform and fully engage important stakeholders at all stages. Researchers will be expected to take advantage of time in the field to work with community colleges, museums, community centers, tribal councils, and other local organizations in outreach activities. In addition to participating in meetings or public presentations, researchers should also expect to meet with members of the local print and broadcast media. Proposers should assume that the CCEO will be available to coordinate these activities and may assist in organizing many of them.

The Training and Communications Plan section should be inserted after the Data Management Plan section of the proposal and does not have a page limit (in most cases, one-half page is likely to be adequate for the Training and Communications Plan).

4.3.5 Stakeholder Engagement and Interactions Plan

As is essential in all field campaigns, ABoVE investigators will need to develop courteous, open, and constructive relationships with the people within their study area, as well as with other relevant stakeholder groups and organizations. These interactions will require early engagement, full and open communications, sustained attention, and appropriate acknowledgement – and must begin early in the planning for ABoVE field activity and prior to final site selection and the initiation of any field research. In some cases, these interactions may need to be coordinated with those of groups with existing activities in the same area.

Proposals must include a separate Stakeholder Engagement and Interactions Plan that describes how they plan to interact with and/or develop partnerships with stakeholders pertinent to their investigation. Such stakeholders may include the indigenous/aboriginal peoples on whose land the research will take place as well as others with land ownership/usage rights; local

communities; local, regional and national government organizations; and partner organizations with specific decision support needs.

Proposers should assume that the CCEO will be responsible for organizing and coordinating many of these stakeholder interactions so that contacts are efficient and respectful of the stakeholder's time and interests and that the purpose and intent of ABoVE research and its activities are clearly, accurately, and consistently communicated. However, all ABoVE investigators will be expected to engage in such communications with stakeholders, keep the CCEO informed regarding such interactions, and be responsive to stakeholder's desires for information and consideration of their interests and concerns.

It is anticipated that some interactions may lead to involvement of local people in ABoVE research and implementation activities and/or collaborations involving citizen science. When known at the time of proposal submission, these types of stakeholder interactions and the groups involved should be identified in the Stakeholder Engagement and Interactions Plan.

The Stakeholder Engagement and Interactions Plan section should be inserted after the Training and Communications Plan section of the proposal and does not have a page limit (in most cases, one-half to one page is likely to be adequate for the Stakeholder Engagement and Interactions Plan).

4.3.6 Statement of Team Member Commitment

Proposals must include a brief Statement of Team Member Commitment describing the proposing team's understanding of and qualifications for the role(s) they will play as members of the ABoVE ST. Many of the commitments to be made as ABoVE ST members are covered in the required plans called for in Sections 4.3.1-4.3.5 of this solicitation and need not be repeated in this statement. What is desired here is a statement of the team's commitment to becoming active, productive, and constructive members of the ABoVE ST and a description of any specific, special contributions to ST activities that individual team members plan to provide.

Documentation and/or descriptions of past performance on relevant science teams or similar group activities should be presented in this section.

The Statement of Team Member Commitment section should be inserted after the Stakeholder Engagement and Interactions Plan section of the proposal and does not have a page limit (in most cases, one-half to one page is likely to be adequate for the Statement of Team Member Commitment).

4.3.7 ABoVE Science Lead Plan (required only if this position is sought)

Proposals requesting consideration for the ABoVE Science Lead (ASL) position must present in their proposal a separate ABoVE Science Lead Plan that addresses the following aspects of ABoVE science leadership:

- The proposer's scientific knowledge of and research experience in Arctic-boreal ecosystems (social-ecological systems);
- The management experience and scientific leadership skills of the proposing ASL, including his/her ability to find solutions to problems and work constructively with people to resolve issues;
- A statement of the time and priority commitment the proposer will make to his/her role as the ASL, if selected;
- A clear articulation of the proposed ASL's vision for ABoVE and its contribution to science and society;
- The ability of the proposing ASL to represent ABoVE's overall goals and objectives to the broader scientific community and constructively interact with a wide variety of stakeholders and to understand their needs for scientific information and data products that could be provided through ABoVE research; and
- A management plan that describes the approach to ABoVE leadership, how interactions with the ST and ABoVE management (i.e., the CCEO, NASA HQ, and partner organizations) will be conducted, and how ABoVE ST business and meetings will be organized and conducted.

If the ASL position is sought, the ABoVE Science Lead Plan section should be inserted in the proposal after the Scientific/Technical section and before the References and Citations section and may not exceed five pages in length – these five pages are in addition to the 18-pages for the Scientific/Technical section. In addition, the proposer must answer the relevant proposal cover sheet question indicating they wish to be considered for the ASL position and include in the Budget Justification: Narrative and Details section of the proposal a detailed budget and narrative for only the ASL activities proposed (see Section 3.2).

5. Programmatic Information

5.1 Eligibility

This solicitation is open to all categories of institutions interested in conducting ABoVE research. Proposals from non-U.S. organizations should propose to participate on a no-exchange-of-funds basis (see Section 1.6 of the *NRA/CAN Proposers Guidebook*). Collaborations between researchers at U.S. and non-U.S. organizations are welcome, but the portion of the work to be conducted by the non-U.S. institution must be funded through other sources in order to comply with NASA's no-exchange of funds policy.

No-cost, low-cost, or cost-shared proposals from researchers supported by partner organizations are encouraged and will be given favorable consideration in NASA's selection process.

NASA anticipates establishing more informal relationships with individual research investigators or organizations interested in exchanging information about related research and monitoring activities with ABoVE and/or collaborating on certain aspects of ABoVE. Researchers wishing to informally affiliate with ABoVE need not apply to this solicitation, but can await the establishment of the process for requesting Affiliate ABoVE ST member status. However, if

such researchers wish to become involved as Affiliate ABoVE ST members from the beginning, they may submit a full proposal for no cost (to NASA) in response to this solicitation.

5.2 Available Funds, Budget Profiles, and Periods of Performance

The availability of funds is such that it will take three years to bring Terrestrial Ecology Program funding for ABoVE up to the approximately $7-8M per year planned for the data collection phases of the study. Funding available for this solicitation is approximately $3M in FY 2015 and $4M in FY 2016 and thereafter. NASA anticipates issuing another solicitation in ROSES-2016 for ABoVE research to be initiated with additional FY 2016 or FY 2017 funding, very likely with a focus on airborne science investigations and working with partners to fill gaps in the overall suite of research activities being conducted or to take advantage of new partnership opportunities.

NASA anticipates that up to a full year of preparation, to include arranging for infrastructure and logistical support and securing permissions and permits, will be required for the majority of field research investigations (i.e., those making surface-based *in situ* measurements and conducting process studies) selected for ABoVE. Therefore, NASA expects that most proposals offering new field studies may require reduced resources in their first year (e.g., travel to meetings, planning time, and some advance purchase of field equipment and supplies) and then full funding in the years of field research activity. Therefore, field research investigations that fit this description may request up to four years of funding, provided their first, preparatory year budget request is less than that for each of the following three years.

It is possible that some surface-based field research investigations may be able to begin data collection in their first year (e.g., if they offer to augment or extend an existing study that already has relevant infrastructure, logistical support, and permissions and permits in place). If so, then they should offer a three-year program of research and also address in their Scientific/Technical Plan the pros and cons of not being synchronized with the majority of ABoVE field investigations.

Proposers requesting consideration for the ASL position may request up to four years of funding for their research.

All other types of investigations may only request up to three years of funding. However, studies of shorter duration are welcome and specifically encouraged if earlier delivery of their findings or data products is feasible and would benefit ABoVE study design and/or future directions.

Proposers, especially those offering field investigations, are advised to consider the possibility of a six to seven year research activity that would be subject to full competition and external peer review after each three (or four) year period (this six to seven year estimate assumes that after field data collection ceases, one to two years may be necessary to complete data analysis). Annual progress reports, to be reviewed internally, also will be required. NASA intends to request continuation and new proposals after three (or four) years, with the expectation that some of the original investigations will be successfully renewed; some of the original investigations will evolve, shifting emphasis from the ABoVE Ecosystem Dynamics Science Objectives to the

ABoVE Ecosystem Services Science Objectives; and there will be some turnover in favor of entirely new investigations.

5.3 Proposal Evaluation Criteria

Proposals will be evaluated according to the criteria specified in Section C.2 of the *NRA/CAN Proposers Guidebook*. In addition to the factors given in the *NRA/CAN Proposers Guidebook*, the determination of a proposal's intrinsic merit shall take into account the following considerations:

- The quality and completeness of the following required plans: Project Management Plan, Resource Needs and Utilization Plan, Data Management Plan, Training and Communications Plan, and Stakeholder Engagement and Interactions Plan, and
- The proposer's ability to serve as a constructive, productive team member as demonstrated in the proposal, Statement of Team Member Commitment, and related and relevant projects.

In addition to the proposal's responsiveness to the goals, objectives and requirements described in this program element, the determination of a proposal's relevance shall take into account the following considerations:

- The degree to which the investigation will contribute to an understanding of regional-scale responses of social-ecological systems to environmental change, taking into account vulnerability and resilience and the complex interactions within the Arctic-boreal system and its tightly coupled nature, and
- The quality and desirability of any collaborations with potential partner organizations, including the reasonableness and desirability of any cost-sharing arrangements (while appropriate collaborations will be viewed favorably, a lack of collaborations will not be viewed unfavorably).

If the proposal requests the ASL position, then the following factors will be considered in evaluating its ABoVE Science Lead Plan:

- The proposer's scientific qualifications, leadership skills, management experience, and communications skills for the leadership position,
- The proposer's time commitment and management plan describing his/her approach to ABoVE leadership, and
- The proposer's understanding of ABoVE social-ecological science and ability to work creatively, flexibly, and constructively with scientists, NASA and partner organization managers, and a wide variety of stakeholders.

6. Summary of Key Information

Expected program budget for first year of new awards	~ $3M (~$4M per year thereafter)

Number of new awards pending adequate proposals of merit	~15-35
Maximum duration of awards	3 years (4 years if first year is preparatory or if proposing for ABoVE Science Lead, see Sections 3.2 and 5.2)
Due date for Notice of Intent to propose (NOI)	January 20, 2015. See also Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for Proposals	March 20, 2015. See also Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	August 1, 2015
Page limit for the central Scientific/Technical section of proposal	18 pp; see also Chapter 2 of the *NASA NRA/CAN Proposers Guidebook*
Relevance to NASA	This program is relevant to the Earth science strategic goals and subgoals in NASA's *Strategic Plan*; see Table 1 and the references therein. 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*.
Detailed instructions for the preparation and submission of proposals	See the *NASA NRA/CAN Proposers Guidebook* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA NRA/CAN Proposers Guidebook*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposal 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	NNH14ZDA001N-TE
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