A.35 SERVIR APPLIED SCIENCES TEAM

NOTICE: Amended February 4, 2019. As a result of the partial government shutdown and concomitant delay in the review of Step-1 proposals, the date by which NASA plans to announce Step-1 selections is now April 19, 2019, and the Step-2 proposal due date is now July 19, 2019. New text is bold and deleted text is struck through.

This program element uses a binding two-step proposal process, in which the Notice of Intent is replaced by a required five-page Step-1 proposal that must be submitted by an Authorized Organizational Representative. Only those organizations that are invited to do so may submit a Step-2 proposal. See Section 4 for details.

Two Preproposal telecons will occur. Telecon A will be on March 14, 2018. For more information, visit https://www.servirglobal.net/AST-TeleconA. Telecon B will be on September 13, 2018. For more information visit https://www.servirglobal.net/AST-TeleconB.

1. Introduction and Background

1.1 Overview

SERVIR, a joint initiative of NASA and the U.S. Agency for International Development (USAID), fosters applications of Earth observations to help developing countries assess environmental conditions to improve their planning and actions. This program element requests proposals for the SERVIR Applied Sciences Team (AST), which will improve the abilities of SERVIR regional hubs, national stakeholders, and users to apply Earth observations.

The primary purpose of this team is to provide geographic and thematic applied science expertise to regions supported by the SERVIR global network. Geographic regions include Eastern and Southern Africa, Hindu-Kush Himalaya, Lower Mekong, West Africa, and Amazonia. Thematic topic areas for this program element include Agriculture and Food Security, Water Resources and Hydroclimatic Disasters, Land Cover and Land Use Change and Ecosystems, Weather and Climate. Each AST member will co-develop application(s) with, and transfer them to, SERVIR regional hubs to strengthen capacity of hubs and their users to address users' decision-making needs. Team members will also communicate, coordinate, and share expertise with each other and SERVIR hubs across thematic and regional interests.

This program element will use a two-step selection process. A brief Step-1 proposal evaluation will identify proposers that NASA will invite to prepare an in-depth Step-2 proposal. The invited proposers are expected to collaborate with SERVIR regional hub representatives in developing their Step-2 proposals by defining the scope of their projects to ensure the proposals align with regional needs.

1.2 Applied Sciences Program Objectives

Within the Earth Science Division (ESD) of NASA's Science Mission Directorate (SMD), the Applied Sciences Program discovers and demonstrates innovative uses and practical benefits of NASA Earth science and data from Earth-observing satellites. The Program partners with organizations from the public and private sector to apply scientific findings and satellite data in their decision-making activities. The Program has three primary areas of operations: applications, capacity building, and mission planning.[1] All Program activities support goals to deliver near-term uses of Earth observations, build capabilities to apply Earth science data, and contribute to satellite mission planning. By working with partners and continuing to build new collaborations, the Applied Sciences Program is identifying ideas and priorities for new applications.

Within the Applied Sciences Program, the Capacity Building program sponsors projects that improve the capabilities of decision makers, community leaders, and resource managers in the United States and abroad to access and apply Earth observations data, products, and tools. A variety of methods and approaches are employed and experimented with to better build capabilities in individuals and institutions. These activities build capacity within the United States and the developing world to expand the Earth observations user base, and build the capacity of nontraditional audiences to be aware of and able to use Earth observations in decisions and actions. The SERVIR program element is within the Capacity Building program. More information is available through the Applied Sciences Program's website at http://appliedsciences.nasa.gov/.

1.3 SERVIR Objectives

SERVIR partners with regional, technical institutions around the globe, establishing SERVIR "hubs" within those institutions, to help them become stronger service providers to assist their member countries in improving the information used in development decision-making. Government policy makers and resource managers comprise the primary target audiences for SERVIR hubs. The goal of SERVIR is to improve environmental management and resilience by strengthening the capacity of governments to integrate Earth observation information and geospatial technologies into development decision-making. SERVIR has organized thematic priorities along four thematic service areas: Agriculture and Food Security, Water Resources and Hydroclimatic Disasters, Land Cover and Land Use Change and Ecosystems, Weather and Climate (see Section 2.4). Within each thematic service area, SERVIR provides services, which are comprised of any or all combinations of data, products, tools, applications, platforms, and training to meet the needs of users. SERVIR provides services to accomplish the following results in each region:

[1] The Program's applications themes align with the societal benefit areas of the international Group on Earth Observations: Biodiversity and Ecosystem Sustainability, Disaster Resilience, Energy and Mineral Resource Management, Food Security and Sustainable Agriculture, Infrastructure and Transportation Management, Public Health Surveillance, Sustainable Urban Development, and Water Resource Management. Applications refer to the use of remotely sensed observations and derivatives, modeling products, *in situ* data or any combination thereof, to generate outcomes of relevance and utility to the end user or decision maker.

1. Building the capacity of analysts and decision makers to use Earth observation information and geospatial information technologies;
2. Improving awareness of and access to available services; and
3. Providing user-tailored services to inform development decision-making.

An important related objective is to build the capacity of SERVIR hubs and their partners to provide high quality services, creating a stronger network at the regional level. NASA supports the SERVIR Science Coordination Office (SCO), which provides science coordination and opportunities for exchange among partners to create a global, interconnected network.

SERVIR hub host institutions have a unique set of characteristics, including political buy-in from member countries; technical capabilities in remote sensing, geographic information systems, and database management; and established relationships with users. SERVIR's network of hubs includes:

- Eastern and Southern Africa region. The regional hub is hosted by the Regional Center for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya;
- Hindu-Kush-Himalayan region. The regional hub is hosted by the International Center for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal;
- Lower Mekong River region. The regional hub is hosted by the Asian Disaster Preparedness Center (ADPC) in Bangkok, Thailand; and
- West Africa region. The regional hub is hosted by AGRHYMET in Niger, and is supported by a consortium of regional technical partners, including CSE, CERSGIS, and ACMAD.
- Amazonia region. The acquisition of the regional hub in TBD country(ies) is underway at the time of this program element release.

Each regional hub works with a number of focus countries. NASA and USAID have selected subsets of countries as foci for this program element:

- SERVIR Eastern and Southern Africa: Foci are Ethiopia, Kenya, Malawi, Rwanda, Tanzania, and Uganda;
- SERVIR Hindu Kush Himalaya: Foci are Afghanistan, Bangladesh, Burma, Nepal, and Pakistan;
- SERVIR Mekong: Foci are Burma, Cambodia, Laos, and Vietnam; and Thailand and other countries as a part of the broader regional perspective;
- SERVIR West Africa: Foci will be Burkina Faso, Ghana, Niger, and Senegal; and
- SERVIR Amazonia: Foci will be Brazil, Columbia, Peru, Suriname, and Guyana.

A list of all countries supported by the respective hubs can be found on www.SERVIRGlobal.net.

SERVIR Global works with regional hubs and their national users to co-develop services to meet their specific requirements. SERVIR also makes these available to the public and other potential users via an online portal. The SERVIR Global website, including region-specific pages linking to regional geoportals, can be found at www.SERVIRGlobal.net, and the product catalog can be found at https://www.servirglobal.net/ - productcatalog.

Additional reference information about SERVIR is provided in Section 6.

2. Scope of Program Element

This section describes the scope of the SERVIR Applied Sciences Team, Team members, priority topics, and project timeline. This section also provides specific suggestions and considerations.

2.1 SERVIR Applied Sciences Team

The Applied Sciences Program invites proposals for membership on the third SERVIR Applied Sciences Team and Team member projects through this program element. The primary purpose of this Team is to improve, enrich, and expand the use of Earth observations in the countries associated with the SERVIR regions based on the needs of the region. The Team will be a resource and base of expertise in research, applications, information utilization and management, and innovation that the SERVIR SCO and regions can draw on, consult, and engage.

It is expected that the Team will collectively possess a range of experience, skills, and expertise related to user engagement, decision support, Earth science, monitoring and evaluation, applied science, and international development. Selected participants will likely include social scientists and economists, Earth science researchers, technical experts, modelers, geospatial experts, visualization specialists, applications specialists, international development specialists, and others.

A SERVIR SCO representative will serve as the Team Lead and will be supported by the AST Portfolio Manager. In addition to the Lead, the AST will have one "thematic service area lead" for each of the four topic areas (see Section 2.4) with an aim to synergize and integrate the AST projects in that thematic service area across SERVIR regions. Proposers are asked to identify their interest in serving as a Thematic Service Area Lead.

Key objectives of the Team are to:

- Advance innovative and practical uses of Earth observations serving regional and/or national needs for decision-making through co-development of solutions with SERVIR regional hubs.
- Strengthen the capacity of regional hubs and national users to use Earth observations in decision-making.
- Provide an expert knowledge base for the SERVIR regions and the SERVIR SCO.
- Provide feedback to NASA regarding usability and usefulness of satellite data and derived products for fulfilling the needs of decision makers in developing[2].
- Identify potential new data products of value to users.

Key responsibilities of the Team are to:

- Share information with each other and the SERVIR network.

[2] Feedback may be provided to the NASA SERVIR Science Coordination Office, the NASA data centers, science teams, the Applied Sciences Program, and/or missions in development including their early adopters programs.

- Share lessons learned to assist other AST members and the SERVIR network.
- Communicate across regions along each thematic service area to assist in inter-hub collaborations.
- Communicate regionally across each thematic service area to assist in holistic multidisciplinary perspectives and decision-making.

While each selected PI may have co-investigators or collaborators on their own project, only the PI will serve a member of the overall AST. Thus, proposers should not propose an entire Applied Sciences Team. This program element is expected to select the Team comprised of approximately 20 members.

The success of the Team depends on active collaboration with the hubs and with other team members. NASA ASP judges the success of the SERVIR AST through monitoring of a set of performance metrics that include two major attributes – collaboration with the hub and users in the region of study, and collaboration across the team.

2.2 Team Members

Each Team member will work primarily with one hub region. In collaboration with regional hub institutions, members will conduct activities, such as workshops and assessments, to identify gaps in hub and user capabilities, present approaches their project is taking to address the gaps to get feedback, and define measures of success. Each Team member will co-develop elements of services with SERVIR regional hubs to support identified needs in a thematic service area with their respective region's hub personnel and national users. Members will assist the SERVIR SCO and the respective regional hub in product transfer to the user through training and capacity building activities. The Team members will also support training and capacity building for the other SERVIR regions, as needed.

The PIs selected ("invited") to submit Step-2 proposals are expected to include SERVIR regional hub scientists as collaborators/co-Is on their project. These scientists will join in the co-development of the service and should be considered a part of the respective project team. SERVIR regional hub participation and co-development will be funded separately.

2.3 Thematic Service Area Projects

Each Team member's thematic service area project will contribute to hub services and may include data, products, tools, platforms, and training. The AST projects are not expected to deliver an entire service for the hub, instead the AST projects are expected to co-develop elements of the service identified by the hub. SERVIR's past experience shows that a clear and comprehensive articulation of assumptions, as well as identification of inputs, outputs, intended outcomes, and ultimate impact, is necessary to evaluate project effectiveness. This information (termed theory of change[3]) is used by the SERVIR hubs for each service the hubs develop. AST projects should ensure their projects are integrated into existing/evolving theories of change created by the hubs.

[3] A theory of change is a description of the logical causal relationships between multiple levels of conditions or interim results needed to achieve a long-term objective. It outlines pathways or steps to get from an initial set of conditions to a desired end result. A theory of change is analogous to a project hypothesis.

2.4 Priority Topics

Applicants for the Team should propose projects aligned with one or more of the thematic service areas and regions based on the needs described below. The following priority thematic service areas and topics are based on a) regional consultation and needs assessments conducted in the SERVIR regions and b) Applied Sciences applications areas (see Section 1.2). Investigators are encouraged to propose projects to address needs in all or part of a SERVIR region. In collaboration with the regional hubs, the awardees are expected to contribute to hub services and demonstrate them in the planned user environment. The user environment includes, but is not limited to, geospatial information systems (GIS), web map services and Internet bandwidth limitations. Available Internet bandwidth is an important consideration given connectivity challenges in some SERVIR regions. The awarded projects, as part of the application development, are expected to transfer the routine execution of the developed applications to the regional hubs and their users. In addition, it is expected that the project team will transfer the application, including source code and other relevant information, to the SERVIR hubs and SCO for archival purposes.

Priorities are organized by thematic service area and by region. Each AST project is expected to contribute to regional hub thematic services. All projects are expected to address short-term to seasonal forecasts to enable SERVIR's goal to improve environmental management and resilience. A general overview of regional and thematic services across the SERVIR network is provided below. Several of the services have a strong collaborative role by the current and previous SERVIR AST. The thematic service areas for this program element are Agriculture and Food Security, Water Resources and Hydroclimatic Disasters, Land Cover and Land Use Change and Ecosystems, Weather and Climate.

2.4.1 *Agriculture and Food security*

SERVIR is focusing on several services within this thematic service area, and a listing of ongoing regional services is given below. These services indicate the direction of services that will likely be undertaken by the SERVIR hubs in years to come. Across the network, this thematic service area focuses on drought management, improved accuracies in agricultural yield and area estimation, rangeland management, and pastoralism. Proposals are strongly encouraged to focus on supporting the services being developed in the region.

SERVIR-Eastern and Southern Africa. SERVIR E&SA has several ongoing services, including regional cropland and rangeland drought monitoring. Proposals are encouraged to address agricultural yield assessment uncertainties for key agricultural value chains across timescales from seasonal to annual. Proposals are also encouraged to improve drought assessment, methods for in-season cropland mapping for key agricultural value chains such as maize, and biomass assessments for rangelands. Data sets supporting the region's upcoming crop insurance partnerships are also encouraged.

SERVIR-Himalaya. SERVIR-HKH has several ongoing services, including regional drought monitoring and early warning system, Agro-met advisory service, food security vulnerability information system, and wheat sown area assessment

service. Proposals are encouraged to build on existing services that address agricultural drought and crop productivity assessments, examining seasonal and longer-term climate scenarios and agricultural drought characterizations and forecasts. Creation and characterization of data sets supporting crop insurance markets would be valuable.

SERVIR-Mekong. SERVIR Mekong is focusing on regional drought forecasting, supporting national and provincial government entities for improved agricultural planning, and on crop type mapping. Proposals are encouraged to address agricultural area mapping, and improving crop yield estimation and forecasting accuracies. Proposal ideas adding value to the ongoing services are encouraged.

SERVIR-West Africa. SERVIR-West Africa's ongoing services include locust monitoring and rangeland degradation. Proposals that offer an innovative expansion of this service are welcome. Proposals that address Earth observations-based estimation of crop planted areas and agricultural productivity assessments are welcome, especially examining the impacts of seasonal forecasts on agricultural drought characterizations, and rangeland management.

SERVIR-Amazonia. SERVIR-Amazonia is expected to start in 2018. The hub is expected to focus on ways to improve the drought forecasting tools and their impacts on reducing food insecurity in the region. Proposers are encouraged to use of satellite-derived products in a holistic drought assessment.

2.4.2 *Water Resources and Hydroclimatic Disasters*

SERVIR is focusing on several services within this thematic service area, and a listing of ongoing regional services is given below. These services indicate the direction of services that will likely be undertaken by the SERVIR hubs in years to come. Across the network, this thematic service area focuses on streamflow and flood modeling and early warning systems, Proposals are strongly encouraged to focus on supporting the services being developed in the region.

SERVIR-Eastern and Southern Africa. SERVIR E&SA is focused on regional streamflow monitoring and forecasting, as well in satellite-based water quality monitoring services. Proposals are encouraged to support the ongoing services by improving the holistic assessments of agriculture and water, focusing on seasonal and annual forecasts; and drought characterizations and forecasts with an aim to create and support a robust framework for decision makers in integrated water resource management. Proposals are also requested to focus on co-developing an impact-based flood early warning system with users, that links hydrologic forecasts with vulnerability assessment and risk analysis.

SERVIR-Himalaya. SERVIR-HKH is focusing on river/floodplain information management system and flood early warning system. Proposals are encouraged to build on the work already done in hydrologic modeling and short-term to seasonal forecasting of floods by adding quantifiable uncertainty estimation, flash flood estimation and forecasting, landslide probability estimation, holistic assessments of agriculture and water, and focusing on seasonal forecasts. Proposals are encouraged that link the latest relevant science from the High Mountain Asia Team (HiMAT) to SERVIR-HKH services.

SERVIR-Mekong. SERVIR-Mekong is focusing on services that are improving flood modeling and forecasting. Proposals are encouraged to support ongoing services by improving the forecasting accuracies, as well as on salt-water intrusion, sediment transport and holistic assessments of agriculture and water, focusing on seasonal forecasts. Proposals are welcome to address landslide risk assessment and monitoring of land subsidence.

SERVIR-West Africa. SERVIR West Africa is focusing on ephemeral water body mapping in Senegal and on groundwater status assessments. Proposals are encouraged to support the ongoing services, either in geographical scope or accuracy and spatial extent improvements. Proposals that address groundwater replenishment are encouraged. Flood modeling and forecasting, especially using short-term and seasonal forecasts will add value to ongoing work at the hub.

SERVIR-Amazonia. SERVIR-Amazonia is expected to start in 2018. The hub is expected to focus on ways to improve regional flood forecasting, especially in accurate timing and magnitude of floods. Proposals are encouraged to focus on improved hydrologic modeling products that can effectively use available ground observations for improved characterization of floods.

2.4.3 *Land Cover and Land Use Change and Ecosystems*

SERVIR is focusing on several services within this thematic service area, and a listing of ongoing regional services is given below. These services indicate the direction of services that will likely be undertaken by the SERVIR hubs in years to come. Across the network, this thematic service area focuses on regional landcover monitoring, forest vulnerability management system streamflow and flood modeling and early warning systems. Proposals are strongly encouraged to focus on supporting the services being developed in the region.

SERVIR-Eastern and Southern Africa. SERVIR E&SA services target land cover change mapping as well as invasive species mapping. Proposals are encouraged that can support the regional hub improve and connect land cover mapping efforts with sustainable landscapes and ecosystem services. Proposals are also encouraged in ecosystem valuation that will enable the hub and users to determine the impact of human activities on environmental systems by assigning an economic value.

SERVIR-Himalaya. SERVIR-HKH is focusing on regional land cover monitoring system, through development of primitive layers of biophysical quantities that can be deduced using Earth observations. Proposals are encouraged that can bring innovative primitives to the region with an aim of supporting the regional goals of sustainable landscapes and ecosystem services. Proposals are encouraged that link the latest relevant science from the South/Southeast Asia Research Initiative (SARI) to SERVIR-Himalaya services.

SERVIR-Mekong. SERVIR-Mekong is improving the regional landcover monitoring system with additional datasets, as well as supporting integrated land cover management toolbox for Cambodia's protected areas. Proposals are encouraged that can support enhancement of ongoing services at the regional hub to connect land cover maps with sustainable landscapes and ecosystem services. Proposals

that address crop type mapping are welcome. Proposals are encouraged that link the latest relevant science from the South/Southeast Asia Research Initiative (SARI) to SERVIR-Mekong services.

SERVIR-West Africa. SERVIR West Africa is working on deforestation precursor assessments. Proposals are encouraged to support this service, in addition to assessing potential areas of urban and agricultural expansions in next several years.

SERVIR-Amazonia. SERVIR-Amazonia is expected to start in 2018. The hub is expected to focus on the decision makers' need for an integrated development planning that prioritizes biodiversity conservation and ecosystem services. Proposals are encouraged to address the ecosystem services through a holistic perspective.

2.4.4 *Weather and Climate*

SERVIR is focusing on several services within this thematic service area, and a listing of ongoing regional services is given below. These services indicate the direction of services that will likely be undertaken by the SERVIR hubs in years to come. Across the network, this thematic service area focuses on monitoring extreme weather and integrated vulnerability assessments. Proposals are strongly encouraged to focus on supporting the services being developed in the region.

SERVIR-Eastern and Southern Africa. SERVIR E&SA services are expanding on their work in integrated disaster vulnerability and impact assessments. Proposals are encouraged to seek innovative ways to build on existing services to improve the vulnerability assessment methodologies. SERVIR E&SA is working closely with existing regional climate experts, such as the IGAD Climate Prediction and Applications Center (ICPAC) in Nairobi, Kenya. Proposals are encouraged that enhance work being done at ICPAC and SERVIR E&SA to quantify the uncertainties in sub-seasonal to seasonal forecasts.

SERVIR-Himalaya. SERVIR-HKH is focusing on monitoring extreme weather, and connecting the forecasts to hydrologic models. Proposals are encouraged to seek innovative ways to examine impacts of weather variability on sub-seasonal to seasonal, annual timescales to help users in the region with improved forecasting capability in hydrology, agriculture and beyond.

SERVIR-Mekong. In this thematic service area, proposals are encouraged to seek innovative ways to examine impacts of variability on sub-seasonal to seasonal to help users in the region, such as Mekong Regional Commission, with a comprehensive forecasting capability in water resources and agriculture.

SERVIR-West Africa. In this thematic service area, proposals are encouraged to seek innovative ways to link in sub-seasonal to seasonal forecasts for improved water and agricultural productivity. Proposals that link remotely sensed datasets and products to augment the capabilities of African Center of Meteorological Application for Development (ACMAD) for regional weather scale and longer forecasts are welcome.

SERVIR-Amazonia. SERVIR-Amazonia is expected to start in 2018. The hub is expected to focus on the decision makers' need to measure the impact of weather

and climate on the Amazonian ecosystem, especially in the context of length of dry season. Proposals that seek innovative ways to link seasonal forecasts to provide quantifiable estimate of uncertainties in dry season length and onset of rains are welcome.

2.5 Timeline of Projects

2.5.1 *Year 1 of Project*

During the first year of the project, the Team is expected to:

- Align the project activities (defined during the Step-2 proposal development process; see Section 4) with the identified needs of the user. During the first year, the regional hub institution will liaise with the users as part of the hub's consultation and needs assessment process and will make the connection between the project and the user activities.
- Contribute to the hub's service concept, as well as service design documents[4] and begin work along the project plan.
- Provide bi-monthly updates and develop an annual report and presentation at the end of Year 1 based on the interaction with the regional hub regarding the user needs.
- Actively participate in technical interchange teleconferences and meetings with the SERVIR SCO, USAID-Washington and regional mission, SERVIR Support Team, regional hub personnel, and other Team members.
- Provide an obligation and costing phase plan within two months after award and designate a point of contact in the PI's financial accounting department. In support of the NASA Headquarters Program Officer, the SCO will maintain a regular communication with that point of contact for costing and budget phasing adjustments throughout the award period.
- Adjust project ideas within the scope of the overall project to become cohesive with the other selected AST projects in the same region or theme to avoid duplication of efforts to ensure better coordinated Team.

Project continuation beyond Year 1 will be determined by the Applied Sciences Program based upon the following performance assessment factors. It is the intention of Applied Sciences Program to support all projects meeting these performance assessment factors.

- Quarterly progress updates.
- Demonstration of active participation in the service planning process.
- Alignment and inclusion of AST projects in a regional hub's work plan with demonstrated feasibility to impact users.

[4] SERVIR uses Service Planning approach comprised of consultation and needs assessments, development of service concept documents that provide the vision and approach for the service, and service design documents, which can include Product Definition Documents, Training Definition Documents, Data Management Definition Documents among others. Monitoring and Evaluation and Learning is conducted throughout the service planning and captures the Theory of Change for the service and establishes a clear mechanism for ensuring the service achieves a lasting impact. These are living documents and are meant to ensure awareness of all ongoing activities. When changes are necessary, they are communicated to all parties prior to implementation. More information on SERVIR's Service Planning Toolkit is at this link.

- Submission of an annual report that demonstrates the expected outputs from models, applications, and/or decision support tools that will support the user needs; ARL progression, commitment to AST team communications and activities; plans to build regional hub user capacity to sustainably transfer the project outputs for lasting impact; and rationale for project success and continuation beyond Year 1.
- Contribution to the SERVIR AST performance metrics.

2.5.2 *Years 2 and 3 of Project*

During the remaining two years of the project, the Team is expected to:

- Continue and complete the work outlined in the project plan to develop the application or tool in support of hub-identified service.
- Actively collaborate with the regional hub and their users consistent with the service design documents developed during the first year. Strengthen capacity of users to use the products.
- Support transfer of products and source code to the hubs and their users, consistent with the NASA Earth Science Data System's open source policy. Provide archival copies to the SERVIR SCO.
- Monitor the key indicators of success for the project. A list of AST performance metrics will be provided to the Team at the time of selection.
- Support the SERVIR SCO to articulate and communicate the results, benefits and successes of the applications produced by the Team.
- Actively participate in technical interchange teleconferences and meetings with the NASA Headquarters, SERVIR SCO, USAID-Washington and regional missions, SERVIR Science Coordination team, regional hub personnel, and other Team members.
- Continue to provide quarterly updates and annual reports.

Years 2 and 3 will be continued based upon satisfactory reporting and continued progress towards achieving project plan objectives.

2.6 Specific Suggestions and Considerations

The Applied Sciences Program strongly encourages projects to use an array of Earth observations and science research results, including multiple spacecraft observations, geophysical parameters, Earth system models, and predictive capabilities. At least one NASA Earth observation product or model output must be used. The Program encourages project teams to consider and leverage products from NASA missions, as well as simulated products from upcoming, planned missions (e.g., GRACE-FO, SWOT, NISAR), and NASA-sponsored activities (e.g., NASA Food Security and Agriculture Consortium, SPoRT, Western Water Applications Office (WWAO), NASA Earth Exchange - NEX). In addition, the Program encourages projects that integrate multiple sources of Earth observations and information. Examples include commercial[5] and international satellite Earth observations, airborne observations, *in situ* (i.e., ground-based) sensor measurements, surface observation networks (e.g., SCAN, SNOTEL,

[5] Proposals that plan to use commercial data should include the costs in their proposal. SERVIR can facilitate access to limited high-resolution electro-optical multispectral imagery.

NEON), socioeconomic data (SEDAC, U.S. Census/equivalent), and operational and scientific models. Proposers may propose new *in situ* and airborne data collection as a small part of the overall proposal.

The Program strongly encourages the use of visualizations and visualization techniques to illustrate alternative scenarios and support decision-making activities. The Program strongly encourages multi-organizational, multidisciplinary, and multi-sectoral project teams. The PI or the designated project team members are strongly encouraged to have colleagues familiar with resource management, business, or policy-making activities and users' needs. The Program encourages early interaction with personnel knowledgeable about NASA Earth science, models, and sensors (e.g., science teams and instrument scientists) to understand capabilities and limitations.

Applicants should be aware of existing SERVIR products and capabilities to avoid duplication; information about these and others are available on the SERVIR website in the Product Catalogue. These products can be leveraged. Applicants should also be aware of non-SERVIR projects in the region to avoid duplication. More information on existing SERVIR efforts can be found in the SERVIR Product Catalog (https://www.servirglobal.net/ - productcatalog).

3. Programmatic Information

3.1 Period of Performance

Awards will be for a three-year period of performance with annual funding contingent upon criteria above (Sections 2.5.1 and 2.5.2 above) and available funding.

3.2 Budget

The expected annual program budget for awards is approximately $4.4 million, and proposers are strongly encouraged to keep the total average cost per investigation to approximately $220,000 per year per award, depending on the complexity of the proposed effort. When developing annual budget requirements, please account for time needed to get the project team up and running in year one and adjust the year to year phasing accordingly. This budget total includes NASA civil servant salaries and indirect costs, despite the fact that these costs may not be included in the budget section of a submitted proposal. (For more information on this, see Section IV(b)iii of the *ROSES Summary of Solicitation* and the SARA website at http://science.nasa.gov/researchers/sara/how-to-guide/nspires-CSlabor/). Thus, any NASA civil servant Co-Investigators on proposals submitted by other organizations must share their total costs, including salaries and indirect costs, with the submitting organization so that the proposing organization knows when they are exceeding $220,000 per year.

The budget for each project should include at least one domestic and one international trip per year for programmatic meetings (annual program review and SERVIR Annual Global Exchange). In addition to the programmatic travel, each project is expected to include at least six international trips (at least two per project year, on average) during the project's three-year life for engagement with regional hub personnel and regional/national users.

Cost sharing is not part of the evaluation criteria. However, cost sharing may become a factor at the time of selection when deciding between proposals of otherwise equal overall merit.

4. The Two-Step Proposal Process

The Program is using a binding two-step proposal submission process, introduced in Section IV(b)vii of the ROSES-2018 *Summary of Solicitation*, and described below. A Step-1 proposal is required, limited to five pages, and can only be submitted by an Authorized Organizational Representative (AOR). The five-page Step-1 proposal must present the proposed concept based on thematic service areas identified in Section 2.4. The Step-1 proposers shall not contact hub scientists for the purposes of their Step-1 proposal development.

After review of submitted Step-1 proposals and decisions by the selecting official, a subset of the proposers will be invited to submit Step-2 proposals. Only those who are invited to submit a Step-2 proposal will be able to do so. During development of Step-2 proposals, the investigators are expected to collaborate with SERVIR regional hubs to ensure alignment of proposed Step-2 work with the regional hub needs, priorities, and work plans.

4.1 Step-1 Proposals

A five-page Step-1 proposal is required and must be submitted electronically by the AOR by the Step-1 due date given in Tables 2 and 3 of this NRA. No budget is required for Step-1 proposals. Submission of a Step-1 proposal is required in order to submit a Step-2 Proposal. Proposers should refer to the "Instructions for Submitting a Step-1 Proposal" under "Other Documents" on the NSPIRES page for this program element. Please note that the Proposal Summary, Business Data, Program Specific Data, and Proposal Team are required Cover Page Elements for a Step-1 proposal. Submission of the Step-1 proposal does not obligate the proposer to submit a Step-2 proposal.

4.1.1 *Step-1 Proposal Content*

Step-1 proposals must be uploaded as a PDF file not to exceed five pages, including any references or citations. The five-page, Step-1 proposal should:

a. Emphasize responsiveness, clearly indicating how the proposal addresses the program element.
b. Specify the SERVIR hub region, sub-region, and country(s) for the proposed activity, and how the proposed work aligns with the regional and thematic service area needs outlined in this program element.
c. Include a brief description of the proposed applied research, illustrating experience of the team in connecting their work with users in the subject area.
d. Include a brief description of previous research carried out by the international scientific community in the subject area.
e. Briefly identify existing decision methods being used and new approaches/aspects being proposed.
f. List the remote sensing assets, models, or tools the proposed work can potentially use.

g. Identify potential societal impacts of the proposed effort.
h. Outline potential expected outputs and outcomes of the work.
i. Identify proposed deliverables.
j. Provide a tentative schedule.
k. Identify Co-Is and other personnel deemed critical to the success of the proposed activities (see 4.2 below, the identified critical personnel cannot be changed between Steps 1 and 2).

4.1.2 *Step-1 Evaluation Criteria*

Step-1 proposals will be evaluated for relevance and intrinsic merit. Relevance of the proposed efforts will be assessed based on alignment with the regional needs, USAID and hub regional priorities, and utility and potential alignment of proposed effort with the SERVIR regional hub work plan. Intrinsic merit will be evaluated on the novelty of the proposal ideas, past experience of the PI and the proposing group, and the perceived impact of the proposed work, e.g., the ability to meet the needs of the region as expressed by SERVIR regional hubs. Cost reasonability will not be an evaluation criterion for Step-1 proposals.

A peer-review panel will evaluate the Step-1 proposals. NASA expects to have separate Step-1 peer review panels for each region. Proposals will be assigned to a panel based on a) the proposer's identification of the appropriate region, and b) NASA's assessment of proposal content. While NASA expects to select proposals in each of the regions, NASA reserves the right to select proposals in none, some, or all of these depending on the nature and distribution of proposals received and the outcome of the peer review process. All proposers will be notified of the outcome of the evaluation process.

4.2 Step-2 Proposals

The investigators invited to submit the Step-2 proposals will be required to interact and work with SERVIR regional hubs for their Step-2 proposal development. The Step-2 proposals are intended to closely complement the work plans at the SERVIR regional hubs (regional hub work plans are funded separately through USAID mechanisms). The synergy between Step-2 proposal and hub work plan is expected to result in seamless, innovative science efforts needed by the regional hubs and their users in SERVIR regions.

Because NASA will be deciding which projects are invited to continue to Step-2 based on peer review of the Step-1 proposal, NASA must limit the changes that occur between Step-1 and Step-2. Step-2 proposals must contain the same application goals (thematic service area) proposed in Step-1. The PI may not be changed, nor may Co-Investigators or other critical professional personnel who were proposed to support the Step-1 proposal be removed. Proposers who want to add funded investigators to the Step-2 proposals must inform the points of contact identified in the summary table of key information and cc sara@nasa.gov at least two weeks in advance of the Step-2 due date. Collaborators, students, and other personnel who are not critical to the success of the project may be changed between Step-1 and Step-2.

The content of Step-2 proposals should adhere to the *ROSES-2018 Summary of Solicitation* (*SoS*) see Table 1, and Section 3.7 of *Guidebook for Proposers*. Where they

disagree the *ROSES SoS* takes precedence. Step-2 proposals must include a paragraph that details their commitment to being part of the Team. The commitment can include a) what it means to be a team and b) why the proposing PI thinks they are a good team contributor. In addition to being on the Team, if the PI is interested in serving as the thematic service area lead for SERVIR AST, the leadership commitment and experience should be included in this section.

4.2.1 Step-2 Proposal Format and Regional Hub Alignment

Proposers should refer to the PDF entitled "Instructions for Submitting a Step-2 Proposal" that will appear under "Other Documents" on the NSPIRES page for the program of interest. All proposals submitted to ROSES must strictly conform to the formatting rules in Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*. Those that violate the rules may be rejected without review.

Following the 15-page Scientific/Technical/Management section of the proposal, the respondents must include an additional two-page section titled "SERVIR Regional Hub Alignment" which will be used to clearly identify how the proposed work will complement the regional hub work plans. The societal impact of the proposed work and planned approaches to qualify or quantify the work's impacts on decision-making should be clearly illustrated.

4.2.2 Step-2 Proposal Review and Evaluation Criteria

Step-2 proposals will be evaluated based on the criteria given in Section VI of the *ROSES Summary of Solicitation.* The evaluation will be based on the proposal's relevance, intrinsic merit, and cost. The evaluation of relevance will be based on the proposal's alignment with needs in the region and with the regional hub work plan. The evaluation of intrinsic merit will include the quality of proposed tool or application and methods proposed, demonstrated ability to work with users, the time table for the application development, and the credentials of the proposing team.

NASA may use multiple Step-2 peer review panels for each region, and proposals will be assigned to a panel based on a) the proposer's identification of the appropriate region and b) NASA's assessment of proposal content, including thematic emphasis. While NASA expects to select proposals in each of the regions, NASA reserves the right to select proposals in none, some, or all of these depending on the nature and distribution of proposals received and the outcome of the peer review process.

5. Award Reporting Requirements

Each awarded project will be responsible for quarterly maintenance of project information, status updates, highlights, and milestone achievements. NASA will coordinate with each PI at award to provide the necessary information for the online system.

The following reports will be required of awardees. In cases where teams of organizations or subcontractors exist, consolidated project reports, including financial records must be submitted and are the responsibility of the lead organization. The proposed budget should provide for these reporting requirements.

5.1 Quarterly Reports

A one-page project "quad-chart" (format provided at award) with Purpose and Objectives, Approach, a Figure, and Key Milestones and Application Readiness Levels (ARLs, see Section 6.2 below) is required to be updated quarterly, and provided with additional charts to summarize progress. Progress is also verbally reported at quarterly SERVIR AST teleconferences.

5.2 Annual Reports

The Year 1 Report summarizes the first year of project development, regional hub engagement, user engagement, and progress to date. Part 1 of this report should articulate the thematic and regional challenge and decision-making activity, application of Earth observations, product definition, and starting and ending ARLs (with justifications). The report should explain any variations in the anticipated results, a discussion of major problems (technical or other), and lessons learned and recommendations.

For consideration to continue through the remaining two years of the project, Part 2 of the report should provide a plan for remaining activities. Part 2 should articulate the approach to implement the application, the baseline users' approach to the decision to be affected, updated assessments of the potential impact of the application, any changes to the composition of the team, preliminary transition approach, key milestones and final expected ARL, and key challenges to address.

Year 2 and 3 reports summarize progress, results, transition, and illustrations of regional hub and user engagements.

5.3 Financial Updates

Quarterly financial updates will be provided from the PI institution to the SERVIR SCO financial analyst and will reflect the latest costing information. In addition to tracking performance, this information may be used by the Headquarters Program Officer and SERVIR SCO to adjust the budget phasing plan, in agreement with the PI and her/his financial point of contact.

6. Reference Information

6.1 SERVIR Global Network

6.1.1 *NASA's Role*

NASA funds the Applied Sciences Team of U.S.-based researchers to provide opportunities for collaborative research with regional hubs, partners, and local experts to solve regional and local development challenges. The SERVIR Science Coordination Office (SCO), based at the NASA Marshall Space Flight Center in Huntsville, Alabama, provides technical support to SERVIR regional hubs/consortia related to data access, science, technology, and geospatial information technology management and policy, in line with NASA's assets and capabilities in these areas.

6.1.2 *USAID's Role*

USAID funds and manages agreements with regional hubs/consortia to implement SERVIR activities through its regional field offices. USAID facilitates connections to USAID-funded programs and partners that may be interested in connecting with SERVIR regional hub/consortia institutions and partners to benefit from their data, tools, trainings, or other services. USAID manages the SERVIR Support Team to assist regional hubs (see below).

6.1.3 *The SERVIR Support Team's Role*

A SERVIR Support Team, led by a contractor, provides technical support for SERVIR regional hubs/consortia related to service planning, communications and outreach, sustainability planning, knowledge management, and program planning and management. This helps to ensure consistent quality and recognition of SERVIR's efforts, as well as sustainability of SERVIR within regional organizations.

6.1.4 *What is a SERVIR Regional Hub or Consortium?*

USAID and NASA have identified seven capabilities of a successful SERVIR regional hub or consortium:

- Political – mandate to convene and advise member states;
- Technical – ability to work with remote sensing information, models, and GIS, and provide training on these tools and models;
- Engagement/Outreach – ability to reach out to and communicate effectively with users;
- Organizational/Financial – ability to manage and finance operations;
- Infrastructure – availability of hardware, software, and reliable internet;
- Network – ability to connect with partners doing related work;
- Thematic expertise – subject matter knowledge in the priority service areas.

SERVIR has operated through two different models in other regions to access these capabilities: as a single regional institution or "regional hub" (e.g., Hindu-Kush Himalaya), and as a consortium of institutions (e.g., Mekong and West Africa). In the Mekong region, Spatial Informatics Group (SIG), Deltares, and the Stockholm Environment Institute (SEI) join ADPC in a consortium. In West Africa, CSE, CERSGIS, and ACMAD join AGRHYMET to form the regional consortium.

6.1.5 *What are SERVIR Computational Capabilities?*

SERVIR has an internal pilot computational capability that includes a computer cluster, called SOCRATES, of 500+ virtual CPUs, 4TB memory, and 200+ TB of disk space. The hubs have access to the cluster, and can spawn machine images of standard operating systems (Linux, Windows, etc.) where pilot application development is expected to take place. The cluster is expected to grow in size as more users and tools are developed over time. Additionally, hubs have their own hardware infrastructures, often a mix of Linux and Windows servers. SERVIR also heavily leverages commercial solutions such as Amazon AWS, Microsoft Azure, and Google Cloud, in addition to use of Google Earth Engine.

6.2 Application Readiness Levels (ARLs)

The Applied Sciences Program developed a nine-step Application Readiness Level (ARL) index to track the development of applications and integration of Earth observations into partner organizations' decision-making activities. The ARL index is an adaptation of the Technology Readiness Level (TRL) scale used in NASA to assess technical maturity in sensors and hardware development. The ARL index provides a scale for the expected advancement along a continuum, starting with a concept and progressing through levels of development and transition to operational use. (Compared with the technology-based TRL, the operational decision-making activity of the practitioner organization is the applications analog to space.)

The ARL reflects three main tiers in application development. In general, ARLs 1-3 encompass application discovery and feasibility; ARLs 4-6 address application development, test, and validation; and, ARLs 7-9 focus on application demonstration in partners' system and transition.

The nine ARLs defined as follows:

1. Basic Research – Basic principles and phenomenology observed and reported. Scientific research produces results that could begin to be translated into applied research and development.
2. Application Concept – Application invention and formulation begins. Once basic principles are observed and products produced and validated, practical applications can be invented. Initial understanding and characterization of the decision-making activity.
3. Proof of Application Concept - Feasibility studies to assess the potential viability of the application. More complete characterization of the decision-making process, including baseline performance and mechanisms. Analytical and experimental studies to set the Earth science products into the decision support context.
4. Initial Integration and Verification (in laboratory environment) - Basic components of Earth science products and decision-making activity (decision support system, tool, etc.) are integrated together to establish that they will work together.
5. Validation in Relevant Environment – Basic components are integrated with reasonably realistic supporting elements to application can be tested in a simulated decision-making environment.
6. Demonstration in Relevant Environment – Major increase in the application's demonstrated readiness. Prototype system demonstration in a relevant environment or simulated operational decision-making environment.
7. Application Prototype in Partners' Decision-making – Prototype near or at planned operational system. A major advance from ARL 6, requiring prototype system demonstration of an actual system prototype in an operational environment, such as partners' decision-making activity.
8. Application Completed and Qualified – Actual system completed and "qualified" through test and demonstration for partners' decision-making activity. Application has been proven to work in its final form and under expected conditions.
9. Approved, Operational Deployment and Use in Decision Making – Actual operational, successful use of application by users in decision-making activities.

7. Summary of Key Information

Expected program budget for first year of new awards	~ $4.4M, see Section 3.2
Number of new awards pending adequate proposals of merit	20; notionally 4 for each SERVIR region
Award duration	3 years
Proposers' Telecon	Telecon A: March 14, 2018 - more information at https://www.servirglobal.net/AST-TeleconA; Telecon B: September 13, 2018 - more information at https://www.servirglobal.net/AST-TeleconB
Due date for mandatory Step-1 proposals	See Tables 2 and 3 of this ROSES NRA.
Notifications of Step-1 selections	~~February 1~~ **April 19**, 2019
Due date for invited Step-2 Proposals	See Tables 2 and 3 of this ROSES NRA.
Planning date for start of investigation	October 1, 2019
Page limit for the central Science-Technical-Management section of proposal	Step-1 proposals: 5 pp; Step-2 proposals: 15 pp; and an additional 2 pp for Regional Hub Alignment, see Section 4.
Relevance to NASA	This program is relevant to the Earth science strategic questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is permitted.
Web site for submission of proposals via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov/ (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH18ZDA001N-SERVIR

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