A.43 NASA SCIENCE DEFINITION TEAM FOR THE NASA ISRO SYNTHETIC APERTURE RADAR (NISAR) MISSION

NOTICE: Amended March 9, 2015. This amendment releases this new program element, A.43, NASA ISRO Synthetic Aperture Radar (NISAR) mission Science Definition Team. Notices of Intent are requested by May 1, 2015, and proposals are due by June 8, 2015.

1. Scope of the Program

The NASA ISRO Synthetic Aperture Radar (NISAR) mission has evolved from the radar part of the Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI) mission concept. DESDynI was one of four missions recommended for launch by NASA in the 2010-2013 timeframe by the U.S. National Research Council (NRC) *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (http://www.nap.edu/catalog.php?record_id=11820). The 2012 Administration budget required NASA to reformulate the DESDynI mission as an L-Band SAR only design to meet budget constraints.

Since then, NASA has worked to establish a partnership with the Indian Space Research Organisation (ISRO) as the major international partner of the NISAR mission. NASA will provide the L-band radar instrument with associated reflector and boom assembly, several flight system elements (high rate telecom, GPS receiver, high capacity solid state recorder, and payload data subsystem), and ground data system. ISRO will provide the spacecraft, the launch vehicle, a secondary S-band SAR instrument, and an S-band science data system.

The NASA contribution to the NISAR mission is a directed mission within the NASA Earth Systematic Missions (ESM) Program, with project execution and management responsibility delegated to the Jet Propulsion Laboratory (JPL). The NISAR Mission is currently in formulation and transitioned into Phase B on March 1, 2015. The current launch readiness date is late 2020 or early 2021. Further information on the NISAR mission can be found at http://nisar.jpl.nasa.gov/.

The NISAR mission will provide large scale data sets of Earth surface dynamics that are critical to three Earth Science disciplines: 1) Deformation (Solid Earth), 2) Ecosystems (Vegetation, Carbon Cycle) and 3) Cryosphere (Climate Change). To achieve the science objectives, the NISAR mission will be capable of performing repeat-pass interferometry and collecting polarimetric data. In addition, an applications objective of the NISAR mission relates to its potential role to inform the hazard/disaster management cycle (understanding, hazard/risk assessment, forecast/warning, situational awareness, response, recovery and mitigation).

The core of the payload is an L-band SAR to meet all of the NASA science/applications requirements. An S-band SAR will be contributed by ISRO to meet additional ISRO requirements. The payload includes a large diameter deployable reflector and a dual-frequency antenna feed to implement the SweepSAR concept that provides both wide swath and high resolution. It also includes a Global Positioning System (GPS) receiver for precision orbit

determination. Due to the large amount of expected science data, a high rate data downlink subsystem and a solid state recorder are included in the NISAR payload.

The NISAR mission will be the first NASA radar mission to systematically and globally study the dynamics of solid Earth, the ice masses, and ecosystems, all of which are sparsely sampled at present. The NISAR mission has three science foci (surface deformation, ecosystem dynamics, and cryosphere dynamics) and one application focus (hazard/disaster management). The associated objectives are:

Improve knowledge of surface deformation required for understanding solid Earth dynamics and associated natural hazard risks and resource management

- Observe secular and local surface deformation on active faults to constrain lithospheric and mantle rheology and model earthquakes and earthquake potential.
- Catalog and model aseismic deformation in regions of high hazard risk.
- Characterize magma migration through the lithosphere and observe volcanic deformation to model volcanic interiors and forecast eruptions.
- Map pyroclastic and lahar flows on erupting volcanoes to estimate damage and model potential future risk.
- Map fine-scale potential and extant landslides to assess and model hazard risk.
- Characterize water resources, including aquifer physical and mechanical properties affecting groundwater flow, storage, and management.
- Map and model subsurface reservoirs for efficient resource recovery (e.g., hydrocarbons, geothermal fluids, water) and disposal (e.g., wastewater, CO_2 sequestration).

Enhance knowledge of ecosystem structural dynamics to determine environmental change and ecological impacts

- Determine the changes in carbon storage and uptake resulting from disturbance and subsequent regrowth of woody vegetation.
- Determine the area and crop aboveground biomass of rapidly changing agricultural systems and land use patterns.
- Determine the extent of wetlands and characterize the dynamics of flooded areas.
- Characterize freeze/thaw state, surface deformation, and permafrost degradation.
- Explore the effects of ecosystem structure and its dynamics on biodiversity and habitat.

Advance knowledge of cryosphere dynamics to understand and describe changes of ice sheets, sea ice and glaciers over short and extended time scales

- Understand the response of the ice sheets and glaciers to climate change.
- Determine the displacements of ice sheets to better understand the contribution of ice sheets to sea-level change and coastal zone dynamics.
- Understand the interaction among sea ice, oceans, and climate.
- Characterize freeze/thaw state, surface deformation, and permafrost degradation.
- Characterize the short-term interactions between the changing polar atmosphere and changes in sea ice, snow extent, and surface melting.

Strengthen the use of satellite-dependent information for hazard/disaster management to inform decision-making:

- Detect, characterize, and model hazards and potential disasters, including those from floods, volcanoes, landslides, wildfires, earthquakes, tsunamis, and cyclones.
- Characterize secondary hazards associated with primary events.
- Demonstrate rapid damage assessment to support rescue and recovery activities, system integrity (water and energy utilities), lifelines and public health, levee stability, transportation and urban infrastructure, food security, and environment quality.

These objectives guide development of Level-1 and 2 science requirements that flow down to the NISAR engineering requirements. A competitively selected Science Definition Team (SDT), working iteratively with the NISAR Program Scientist, Program Applications Lead, and the Project Scientist at JPL, develops NASA's baseline and threshold science requirements for the NISAR mission. The initial SDT was selected in 2012 for the DESDynI-Radar mission for a period of three years. This solicitation will recompete the SDT for the NISAR mission (NSDT). The NSDT supports the NISAR project to provide the science requirements flow down, science algorithms definition, guidance on development of algorithms and associated error models, data acquisition plan, data latency and data dissemination plans, definition of a calibration and validation plan, publication of results, and public engagement including liaison with the broader science and applications communities. The SDT also assists in the promotion of early adopter activities that may conduct prelaunch research and evaluation using data (simulated or from field campaigns) to accelerate use of data after launch. The NISAR Science Team is expected to be selected prior to launch to support Phase D and E activities; these include support to the NISAR project on calibration and validation of science data products, refinement of science algorithms and formats, publication of results, and public and user engagement.

Given the global, systematic, and frequent repeat coverage expected for the NISAR mission that will be required in order to accomplish the science objectives, these same data would be available to serve a broad variety of other basic and applied science objectives. The NISAR project, in conjunction with NASA's Applied Sciences Program, holds periodic applications workshops in order for the NISAR project to be better informed of such potential applications, gain feedback on products and algorithms from early adopters, provide education, and ensure the larger community is better prepared for the future availability of the NISAR data and product streams and the prospective generation of value-added products, information, and decision-support services. The first NISAR Applications Workshop was held October 28-29, 2014, in Reston, VA (https://nisar.jpl.nasa.gov/missionthemes/applications/) and ISRO held a Science Workshop November 17-18, 2014, in Ahmedabad, India.

NISAR will be the first free-flying dual-frequency SAR/InSAR mission. While the L-band SAR alone can meet all NASA mission requirements, the provision of S-band opens the opportunity to (1) supplant L-band coverage with S-band and (2) explore the use of dual-frequency data. The S-band SAR will have more limited acquisition time due to increased power and thermal requirements. Overall, the data acquisition plan is constrained by the downlink capabilities. The Science Definition Team will need to evaluate the science and applications opportunities afforded by the S-band capability relative to the mission requirements and provide guidance on options for an associated observation plan to the NISAR Project Scientist and Program Scientist.

This solicitation seeks proposals for membership in a NASA NISAR Science Definition Team (NSDT) to support further prelaunch planning and preparation for the NISAR mission during Phases B and C of formulation and development. The NSDT will function for a three-year period, at which time NISAR is expected to transition into Phase D and NASA will solicit a NISAR Science Team. Subject to NASA programmatic goals and requirements for the NISAR mission, the NSDT will refine the scientific requirements for NASA elements of the NISAR mission in support of the NASA NISAR Project Scientist. ISRO is also expected to separately select an ISRO Science Definition Team and Science Team to support ISRO requirements for NISAR. The NASA and ISRO teams will coordinate and harmonize the joint NISAR science observation plan.

2. NASA Science Definition Team for the NISAR Mission

2.1 Structure of NASA's NISAR Science Definition Team (NSDT)

The NSDT will consist of approximately sixteen members with expertise in radar scientific data analysis, applications, and/or technology. The NSDT is planned to be led by four co-leads representing the three principal scientific disciplines (Solid Earth, Ecosystem Science, and Cryospheric Science) and Applications. The NSDT membership will include balanced representation from these three principal disciplines, along with the inclusion of other scientific disciplines that contribute to the utility of and/or benefit from the NISAR mission, such as Hydrology, Geodesy, and related Hazard/Disaster Science. While the main focus is on the objectives given in Section 1, NASA also seeks to address key applied research and applications questions and to encourage and demonstrate significant applications of NISAR to societal-benefit needs, including Governmental decision making, disaster risk reduction activities, and other matters of societal importance. Therefore, membership on the NSDT is open to members of the applied research and applications communities, including key partners from other Federal and state agencies. Proposers are encouraged to provide information on their NISAR relevant applied sciences expertise and how the NISAR mission can benefit that application area (e.g., subsurface reservoirs, forest and agricultural land use, natural disasters preparedness, response and recovery, hazard exposure and critical infrastructure, and ocean, coastal, and sea ice dynamics).

2.2 NSDT Responsibilities

The NASA NSDT will work closely with the NASA NISAR Project Scientist to provide expert scientific guidance to the NISAR project in the areas of measurement requirements, product definition, algorithm development, calibration, validation, and liaison with the early adopter and broader science and applications user communities. The NSDT will support the NISAR Project Scientist in providing regular and frequent reports on findings and progress to the NISAR Program Scientist, Program Applications Lead, and NISAR Program Executive. The NISAR Level-1/2 requirements and more information on the NISAR cal/val plans can be found at http://nisar.jpl.nasa.gov/nisarmission/.

During NISAR Phases C and D, the members of the NSDT will be responsible for:

- Developing the Science Requirements Document;
- Providing inputs on measurement capabilities for incorporation into the Level-1 Scientific Requirements Document;
- Evaluating, as requested by the Project Scientist, the proposed NISAR mission designs in achieving the goals of the Scientific Requirements Document;
- Drafting and/or advising the NISAR Project on drafting Algorithm Theoretical Basis Documents (ATBD);
- Supporting the development of calibration and validation plans;
- Promoting early adopter activities through participation in the Applications Workshops in coordination with the Program Science and Applications Leads;
- Supporting the NISAR Project Scientist in the development of required analyses and documentation during the development of the NISAR mission including, but not limited to, Level-1/2 requirements documentation and scientific inputs for the several reviews and key decision points leading to the launch of the NISAR mission; and
- Attending the NSDT meetings regularly.

2.3 NSDT Team Member Proposals

The body of the NSDT member proposals for the Principal Investigator's (PI) membership on the NSDT should be limited to fifteen pages, and include the following information:

- The scientific research and/or societal application that the proposer wishes to represent as a member of the NSDT, with supporting documentation of expertise and potential role of NISAR;
- Only the Principal Investigator (PI) will be named to the NSDT. The specific role and contributions of any other team members must be clearly articulated; and
- A budget and budget justification that provides adequate support for the PI's strong contribution to the NSDT. This budget section is not included within the fifteen-page limit of the proposal's body.

2.4 NSDT Proposal Content

The proposals should identify particular scientific expertise and objectives of the team member and should describe how these qualities will support the development of the NISAR mission. Proposals should address how the proposer will contribute to the development of NISAR's scientific and technical capabilities during the remainder of mission formulation (Phase B) and the early part of mission implementation (Phase C). The proposal should identify and describe one or more of these elements that the team member will contribute to the NISAR mission development.

In addition, the NSDT member proposal should address the following:

- The Principal Investigator's experience and facility in the acquisition and analysis of Synthetic Aperture Radar (SAR) and Interferometric Synthetic Aperture Radar (InSAR) data;
- The Principal Investigator's experience and facility with large regional to global scale data sets;

- The Principal Investigator's experience and facility in basic and/or applied research directly relevant to NISAR's goals and objectives; and
- How the proposed work contributes to the development of the NISAR mission and its societal contributions.

The NSDT will conduct its business through regular meetings with more frequent teleconference calls and E-mail. The proposed budget should include funds for the Principal Investigator to participate in three NSDT face-to-face meetings per year and one Applications workshop, lasting three days each. For planning purposes, proposers should budget for two meetings per year in Pasadena, CA, and two meetings per year in the Washington, DC, area. In addition, NSDT members should budget for one trip over the three-year period to attend a three-day meeting held jointly with ISRO, nominally in Ahmedabad, India.

For planning purposes, it is anticipated that NSDT membership budgets will average approximately $115K per year and Co-Leader budgets average approximately $155K per year.

Proposals for participation in the NSDT from other U.S. Government agencies are encouraged to show significant cost sharing and/or in-kind support.

2.5 NSDT Co-Lead Proposals

Proposers who wish to be considered for the four potential Co-Lead positions should indicate their candidacy by answering the relevant cover sheet question and including a Team Leader section within their proposal. NASA reserves the option to select no team Co-Leaders or to select team Co-Leaders from among the team membership proposals should proposals of adequate merit not be received for the four team Co-Lead positions.

The Team Leader section can use up to five additional pages and should include:
- A clear articulation of the proposed Co-Team Leader's vision for the NISAR mission and its contribution to science and society;
- A statement of which Co-Lead position is sought (Solid Earth, Ecosystem Science, Cryospheric Science, or Applications) and the qualifications that make the proposer a prime candidate for NSDT co-leadership;
- A management plan that describes the approach to science team leadership including interactions with other NSDT members within that science or application area, interactions among the four Co-Leaders, and coordination with the NASA Project Scientist;
- The scientific qualifications and leadership skills of the proposing Team Co-Leader;
- The ability of the proposing Team Co-Leader to represent his/her scientific community's interests in the NISAR mission; and
- The ability of the proposing Team Co-Leader to represent the NISAR mission's overall goals and objectives.

In addition, in the Budget and Budget Justification sections of the Team Member proposal, Team Co-Leader proposals should include a budget and justification for that role that is separate from the budget for their team member activities. In addition to the travel expected for all NSDT members, the Team Co-Leaders should also include budget for two additional trips to India,

nominally Ahmedabad for three days, one trip for each of the two years not included on a team member proposal. In other words, the Team Co-Leaders are expected to attend one meeting each year with ISRO in India.

3. Evaluation and Selection of the NASA NISAR Science Definition Team

Proposals will be evaluated by a panel of scientific peers from the three principal scientific disciplines mandated by this call, Solid Earth, Ecosystem Science, and Cryospheric Science along with experts in other disciplines and the applied sciences, as needed.

All proposals will be evaluated according to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*. In addition to the factors given there, the evaluation of intrinsic merit for a proposal shall consider the ability and experience of the Principal Investigator in serving as a constructive, productive team member in related and relevant projects.

4. Summary of Key Information

Expected program budget for first year of new awards	$2.0M, see also Section 2.4
Number of new awards pending adequate proposals of merit	~16
Maximum duration of awards	3 years
Due date for Notice of Intent to propose (NOI)	May 1, 2015
Due date for proposals	June 8, 2015
Planning date for start of investigation	September 25, 2015
Page limit for the central Science-Technical-Management section of proposal	15 pp for NSDT member proposals and 20 pp for NSDT co-lead proposals; see also Chapter 2 of the *NASA Guidebook for Proposers*
Relevance	This program is relevant to the Earth Science questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
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 required or permitted. See Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guidebook for Proposers*.
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	http://grants.gov/ (help desk available at

proposal via Grants.gov	support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH15ZDA001N-NSDT
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