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NAOJ Project Review Report
for
Solar Science Observatory

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NAOJ External Evaluation Committee

Change Record

Version	Date	Affected Paragraph(s)	Reason/Initiation/Remarks
V0.0	2026-5-15	All	Draft completed
V1.0	2026-5-31	All	Agreed draft from EEC
V1.1	2026-6-30	All	Final version from EEC following comments from the NAOJ Project Review Committee.

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Contents

General Introduction

The External Evaluation Committee (EEC) for the Solar Science Observatory (SOL), composed of the members listed above [NAOJ-EEC-SOL-001-A], held an online kickoff meeting on November 12, 2025 [NAOJ-EEC-SOL-003-B], led by the Chair of the NAOJ Project Review Committee. Following this meeting, the EEC Chair led an additional meeting with the EEC members only on December 11, 2025, to discuss the review plan. The EEC members then drafted the Review Plan [NAOJ-EEC-SOL-009-A]. The EEC received the documents listed under the List of SOL Review Documents in Appendix A, last updated on February 16, 2026. The EEC met at the Mitaka campus of the National Astronomical Observatory of Japan (NAOJ) on February 24 and 25, 2026. The meeting followed the agenda outlined in the Review Plan [NAOJ-EEC-SOL-009-A] and included in Appendix B.

The purpose of the evaluation was to identify and summarize the activities of the project since the previous project review conducted in FY2017, on Monday, November 27, 2017, and Friday, December 1, 2017, from the following perspectives, and to make recommendations for improving future activities:

- Does the project produce internationally competitive science through its Open-Use programs?
- Does the project improve the research capabilities of universities and other institutions?
- Does the project contribute to human resource development of young researchers?

This report describes the findings of the EEC review, based on the written submissions from the project team, detailed interviews conducted with the Director and members of the project team during the two-day review meeting, and interviews with graduate students. This report is structured according to the review categories and evaluation items listed in the Review Plan [NAOJ-EEC-SOL-009-A] and provides detailed replies to each charge. An Executive Summary is provided to summarize the main recommendations by the EEC.

Executive Summary

Overall assessment

SOL has achieved important and internationally visible results across ground-based observations, Hinode operations, small-scale flight missions, and the development of SOLAR-C, despite very limited human and financial resources. The long-term datasets from the Mitaka telescopes and NoRP (Nobeyama Radio Polarimeters) are valuable assets for studies of long-term solar-activity variations, extreme events, and space weather. Hinode continues to produce scientific results nearly 20 years after launch, and the small-scale missions, including CLASP (Chromospheric Lyman-Alpha SpectroPolarimeter), SUNRISE, and FOXSI (Focusing Optics X-ray Solar Imager), have produced internationally competitive scientific and technical achievements, demonstrating SOL's strong capabilities in instrumentation and international collaboration.

At the same time, many of SOL's current achievements depend heavily on a small number of experts and the dedicated efforts of staff members on the ground. To ensure sustainability in the next phase, SOL needs clearer and more trackable plans for technical succession, staffing, engineering support, protected research time, data stewardship, and future strategy.

Strengths

First, the Mitaka telescopes and NoRP have been operated for many years with a surprisingly small amount of staff and budget. The team has repeatedly recovered from instrument troubles and returned to observations, which deserves strong recognition. The continuity of long-term observations is a major strength of SOL. The infrared and chromospheric magnetic-field observations at Mitaka and the multi-frequency microwave observations by NoRP provide valuable foundations for solar physics and space-weather research in Japan and internationally.

Second, Hinode continues to produce important scientific results as a long-running space-based solar observatory. In particular, the long-term and precise polar magnetic-field observations by SOT/SP (the Solar Optical Telescope / Spectro-polarimeter) provide a unique and valuable dataset for studies of the solar magnetic cycle and Hinode EIS (the Extreme-ultraviolet Imaging Spectrometer) provides information on the sources of the solar wind. SOL's contribution to Hinode operations is also clear and significant, including its roles as Chief Planners and Chief Observers and its substantial contribution to stable operations and the joint-use program.

Third, the small-scale missions are a major strength of SOL. CLASP, SUNRISE, and FOXSI have each produced unique and competitive scientific results, while also contributing to the development of key component technologies such as polarization modulation units, opto-mechanical design, scan-mirror-related technologies, ground-test systems, and test procedures. These missions have also provided excellent training opportunities for young researchers to experience instrument development, testing, operations, data analysis, and international collaboration. They serve as effective bridges for technical and human-resource development toward SOLAR-C and future missions.

Fourth, there has been positive progress toward the next phase. The transition from NoRP to YoRP (Yokosuka Radio Polarimeter), work on calibration and archiving, SOL's clearly defined contribution to SOLAR-C, and the proposal to the NAOJ Science Road Map are all important developments for future planning. It is also positive that regular meetings and seminars are promoting information sharing and communication within SOL.

Concerns

First, the most important concern is human resources and technical succession. Key functions in Mitaka, NoRP, Hinode operations, and SOLAR-C development depend on a small number of experts. Retirements, a resignation and staffing shortages could directly affect observational continuity, data quality, and research activity. In particular, the framework for maintaining Mitaka/SFT (the Solar Flare Telescope) after the retirement of experienced staff and the successor plan for SFT have not yet been sufficiently clarified. For NoRP, although the transition to YoRP is progressing positively, the post-decommissioning framework for data stewardship, responsible persons, contact points, calibration, and maintenance of data-quality information remains insufficiently defined.

Second, protected research time for SOL researchers is not sufficiently secured. SOLAR-C is a high-priority and important project for SOL/NAOJ, and SOL's contribution is clearly recognized. However, SOL staff, especially senior researchers and professors, spend substantial time on time-consuming and highly pressured project tasks and testing activities. This reduces the time available for scientific research, paper writing, student supervision, and

future planning. This situation may affect both research vitality and the development of the next generation.

Third, research visibility and community engagement also need strengthening. For Hinode, the number of papers including SOL members as co-authors and the number of first-author papers by SOL members or Japan-based researchers appear limited. For NoRP, many papers in the atmospheric-science field appear to be produced mainly by overseas groups, and stronger links with the domestic atmospheric-science community would be beneficial. For Mitaka/SFT data, international recognition, provision of calibrated data, database development, and connection to space-weather applications are still not fully developed.

Fourth, for young-researcher development, graduate-student training and training through small-scale missions are functioning well. However, opportunities for postdoctoral researchers and project researchers are limited, which may weaken career pathways for young researchers who wish to remain in academia and reduce near-peer mentoring for graduate students. The current lack of doctoral research primarily based on Mitaka ground-based observations is also a concern from the viewpoint of future technical and scientific succession of ground-based observations.

Finally, communication and strategic discussion within and beyond SOL need further attention. Regular meetings and seminars in person are useful mechanisms for information sharing, but opportunities for deeper discussion of future scientific strategy, technical succession, the role of ground-based observations, and post-SOLAR-C planning still appear limited. Related to this, the leadership and governance structure within SOL could be further clarified. The role of SOL leadership should be clearly distinguished from ordinary project responsibilities, so that it can integrate members and projects across SOL, provide strategic oversight, and support top-class science from both scientific and management perspectives.

Summary of Recommendations

1. **Develop a continuous personnel plan for SOL, including succession appointments after recent retirements.**
   Continuous personnel planning is important both for preparation toward SOLAR-C and for the development of the next generation of researchers and technical personnel. Recent and upcoming retirements create significant risks for technical succession, operations, and project continuity. Therefore, successor appointments for recently retired or retiring key personnel are strongly desirable, especially in areas that support SOLAR-C preparation, ground-based observations, and long-term data stewardship.
2. **Strengthen engineering and technical support to protect research time for SOL researchers.**
   Time available for scientific research has decreased because of operational duties and the development of SOLAR-C. SOL researchers spend a substantial amount of time on testing activities and project tasks, which limits time for research, paper writing, student supervision, and future planning. The tasks involved are often engineering tasks that would benefit from senior engineers, project managers, or system engineers working alongside them. Increasing the number of technical staff who can take responsibility for testing and related technical tasks would help increase protected research time. One possible measure would be to establish or assign a system engineer for space missions,

for example at ATC, who can support SOL missions, including SOLAR-C and future mission development.

3. **Secure engineering support and clarify the future plan for Mitaka/SFT observations.**
   The Mitaka observations are a valuable long-term asset, but their continuity depends on technical expertise that is currently concentrated in a small number of experienced individuals. To ensure the continuation and future development of Mitaka ground-based observations, SOL and NAOJ should secure engineering staff who can support operation, maintenance, repair, and development of the facilities. Future-planning documents should also include more concrete descriptions of how Mitaka observations will be maintained, how SFT capabilities will be succeeded or complemented, and how Mitaka data will be connected to solar physics, space-weather research, international networks, and broader user communities.
4. **Define the post-FY2027 NoRP/YoRP data-stewardship framework.**
   SOL should clarify who will be responsible after the termination of NoRP operations, who will serve as the contact point, and how calibration, archive maintenance, data-quality information, and user support will be maintained. This framework should also support broader and more systematic use of NoRP/YoRP data, including stronger links with relevant domestic communities such as atmospheric science.
5. **Improve the usability and visibility of released datasets.**
   Continued data release, calibration, and database development are encouraged. Establishing a system for assigning Data DOIs to released datasets may be useful for increasing visibility, usability, and scientific impact. For Mitaka/SFT data in particular, continued efforts toward calibration, database development, international recognition, and practical connection to space-weather applications would help increase scientific impact.
6. **Use regular meetings and roadmap activities for deeper scientific-strategy discussions.**
   Existing meetings and seminars are useful mechanisms for information sharing. In the future, these activities should be further developed as opportunities to discuss future scientific plans, technical succession, the role of ground-based observations, post-SOLAR-C strategy, and implementation priorities. The strategy should engage members of the group as well as outside stakeholders in solar physics. These discussions should also help clarify the leadership and governance structure within SOL, including how scientific strategy and project-level activities are integrated across SOL.

Evaluation:

[A] Achievement of Establishment Objectives

(A-1) Response to the Mission

a. Are the ground-based observation facilities (solar telescopes at Mitaka and Nobeyama Radio Polarimeters) being operated stably?

The committee considers that the current ground-based observation facilities, namely the Mitaka telescope group and the Nobeyama Radio Polarimeters (NoRP), are being operated mostly stably at present. They appear to be operated stably except for exceptional situations,

and previously acquired data are being released in a timely fashion. The Mitaka telescopes are also operating well, and NoRP has produced valuable data for many years.

At the same time, the current stable operation and long-term sustainability should be considered separately. For both Mitaka and Nobeyama, succession and the transfer of technical know-how as experienced staff retire are key challenges. In particular, NoRP has aged to the point where continuing operation indefinitely is no longer realistic, and decommissioning sooner or later appears unavoidable.

It is remarkable that the Mitaka solar observations and NoRP have been sustained for many years with extremely limited human resources and funding. The continuity of long-term observations is a major strength of SOL. While occasional technical troubles are unavoidable for aging facilities, the team has repeatedly carried out maintenance and restored operations; these efforts deserve strong recognition.

It is also important that previously acquired data are being released appropriately in sequence. The continued availability of the valuable data produced by NoRP over many years represents an important contribution to the community.

A key concern for both Mitaka and Nobeyama is succession and the transfer of technical know-how as experienced staff retire. Expertise appears to be concentrated in a small number of individuals, creating a risk that the retirement of specialists could affect both the feasibility of continued operations and the quality of the observational data.

For the Mitaka telescopes, although they are currently operating well, plans for using them for space-weather purposes are restricted by staff resources. In particular, staffing is limited for autonomous operation, coordination with other telescopes to obtain “24/7” coverage, and provision of near-real-time data. Discussions have taken place with NICT and funding has been requested, but this has not yet been successful.

For NoRP, although it has produced valuable data for many years, the facility is now too old to continue operation indefinitely. Therefore, it will be important to proceed on the assumption of decommissioning and transition, while ensuring continued data availability, transfer of technical know-how, and establishment of an appropriate successor framework.

b. Are the ground-based observation facilities (solar telescopes at Mitaka and Nobeyama Radio Polarimeters) producing results through joint use and collaborative research?

The committee considers that the ground-based observation facilities are producing scientific results through joint use and collaborative research. Results are being produced through the use of historical sunspot observations, SFT long-term data, and comparisons with data from other observatories, contributing to the refinement of long-term solar activity research. The NoRP data are also widely utilized both domestically and internationally, not only as conventional flare context data but also for studies of long-term variations. The efforts involved in data-format conversion are highly commended.

Both Mitaka and NoRP have been producing stable scientific outputs despite extremely limited resources, and the projects are highly productive. NoRP has notably expanded its user base, including users outside solar physics and especially in the atmospheric science community. The frequent use of NoRP data in fields other than solar research is an important strength and demonstrates the broader value of the dataset.

The Mitaka observations also have strong scientific potential. In particular, the He I 1083 nm polarization observations at SFT provide chromospheric magnetic-field information and sit at the forefront of solar research. If the full-disk NIR vector magnetograms from the Mitaka telescopes are well calibrated and routinely available, joint use and collaborative research may be further accelerated. Mitaka data also have potential to contribute to space-weather forecasting.

However, several limitations remain. The unique SFT He I 1083 nm polarization data are not yet widely recognized globally, despite their high potential, and broader utilization should be planned. There also remains significant room for growth in collaborative research between general Mitaka data and space-based observations. The scientific connection between ground-based and space-based observations is still restricted and should be developed, in particular before the launch of SOLAR-C. The lack of discussion on collaboration with Hinode was noted as disappointing. PhD students could assist with this by developing observing plans between the facilities. Future plans could also build on upcoming space-weather projects, such as Vigil at L5.

For NoRP, while its user base has expanded, publications in the atmospheric science field appear to be mainly from overseas groups, and stronger interaction with the domestic atmospheric community is desirable. For Mitaka, space-weather applications require near-real-time data delivery, but current limited staffing constrains the ability to realize this potential. Plans for the new YoRP system, including possible SOL support for the archive, are also relevant to the continuation and broader use of these ground-based data resources.

c. Is the expected contribution to the operation of the Hinode satellite being made?

The committee considers that SOL has made the expected contribution to the operation of the Hinode satellite. In particular, SOL has contributed significantly to Hinode operations by serving as Chief Planners (CPs) and Chief Observers (COs). SOL members also hold key and responsible roles in the Hinode operations team, making substantial contributions to stable operations and to the joint-use program. The current contribution of SOL to Hinode operations is therefore clear and significant.

At the same time, there is a concern about the sustainability of this operational framework. Some staff members who have already reached retirement age still hold responsible roles. Although they continue these duties on a volunteer basis, this does not appear to be a sustainable long-term arrangement. It would be desirable to transfer both knowledge and responsibilities related to Hinode operations to younger members in a planned and step-by-step manner.

d. Are results being produced through joint use and collaborative research with the Hinode satellite?

Scientific results are still being produced through joint use and collaborative research with the Hinode satellite. Achievements have been demonstrated in long-term observations of polar magnetic fields using SOT/SP and in studies of surface thermal convection. It is also impressive that Hinode continues to produce good scientific results through the joint-use program and that the paper publication rate has been kept high, even though the mission is now about 20 years after launch. This demonstrates the continuing scientific value of Hinode observations and of the joint-use framework.

At the same time, the level of joint-use and collaborative research with Hinode appears to be lower than it could be, considering, for example, the large number of joint observing programs with Solar Orbiter. Hinode has the only coronal spectrometer capable of reasonable velocity measurements and hence its importance is crucial for many Solar Orbiter science topics. Staff time is limited because of project load, which constrains further development of such collaborations. The current role with DKIST also appears to be rather passive, and a more active role would be desirable; continued attention will be needed for joint observations with DKIST. It is also a concern that only a small number of Hinode papers include SOL members as co-authors, despite SOL's strong contribution to operations. In addition, there are only a few papers with SOL members or other Japan-based researchers as first authors. This appears to be a long-standing issue that has also been discussed in Hinode extension reviews, and it may be better addressed together with the wider domestic community rather than by SOL alone.

e. Are technical and scientific achievements being obtained through small-scale sounding rocket and balloon experiments (CLASP2/2.1, FOXSI-3/4, SUNRISE-3)?

The small-scale sounding rocket and balloon experiments, including CLASP2/2.1, FOXSI-3/4, and SUNRISE-3, have produced very strong technical and scientific achievements. All of these small-scale flight experiments have achieved outstanding and unprecedented results, and their scientific outcomes are internationally acknowledged. CLASP, FOXSI, and SUNRISE are producing highly impressive technical and scientific achievements, demonstrating SOL's strong capability in both instrumentation and science.

For CLASP2/2.1, repeated launches have supported both the training of people and the development of key technologies. The team successfully detected polarization signals and has produced solid scientific results. For SUNRISE-3, magnetic-field structures and dynamics from the photosphere to the chromosphere and transition region are being obtained, and publication of the papers now in preparation is highly expected. FOXSI has also been steadily stepping up both technically and scientifically through frequent flights.

The importance of these small-scale missions is not limited to their scientific outputs. For these missions, NAOJ carries out part of the design and fabrication, which strongly helps to build in-house component-level technologies. This is especially important because many satellite developments are typically carried out by industry. These missions also serve as valuable training opportunities, allowing young researchers and engineers to gain experience in instrument development, testing, operation, and data analysis.

At the same time, some key science goals are still in progress. For example, deriving chromospheric magnetic fields using the Hanle effect in CLASP2/2.1 has not yet been achieved, although it remains an important target for the next step. Therefore, timely publication of major results and clear next steps will be important. For SUNRISE-3 as well, the publication of the papers currently in preparation is strongly expected.

f. Is resource allocation for the development of the SOLAR-C satellite being carried out appropriately?

Limited human resources are being allocated flexibly between SOL-related projects and SOLAR-C development. It is a positive practice that individual researchers can express their preferred effort allocation. The project is also managed with a small number of people, and the effort to move SOLAR-C forward under these conditions should be recognized. Indeed one of the senior staff left this year leaving a knowledge gap for Solar-C. It will therefore be important for SOL/NAOJ management to ensure appropriate sharing of responsibilities and support for knowledge transfer so that project continuity is maintained.

At the same time, the shortage of human resources is apparent, and the current resource allocation cannot be regarded as fully appropriate. Because of this shortage, nearly all SOL staff are involved with the development of SOLAR-C, leaving little room for doing science, supervising students, and working on future science and instruments. SOL staff appear to be working over capacity on SOLAR-C.

SOLAR-C also needs more engineering capacity. Resources for some basics, such as the clean room, are not sufficiently available. Some new hires are being advertised, but it should be ensured that they can be used for SOLAR-C. It is desirable to address the labor shortage by collaborating with ATC and SIC, specifically through close cooperation with engineers from those organizations.

In addition, formally defined effort allocations do not appear to reflect actual work in a meaningful way. As a result, it becomes difficult to evaluate efficiency and outcomes relative to the allocated effort. Therefore, in addition to flexibly allocating limited personnel, SOLAR-C development requires effort management that reflects actual workload, strengthened engineering support, and secured basic infrastructure.

g. Is there a clearly defined plan and responsible framework for scientific activities, data stewardship, and observational strategy after the termination of the Nobeyama Radio Polarimeters operation in FY2027?

It is very positive that a successor project, YoRP, is progressing toward the planned decommissioning and transition of NoRP. Collaborative work with the Yokosuka Radio Polarimeter appears to be progressing well, and YoRP is succeeding to the heritage of NoRP. It is also important that the historical data will be placed in the archive. In addition to instrument development, it is excellent that NAOJ is involved through collaborative research in data calibration and data archiving. Continued support for these activities and a smooth transition are strongly encouraged.

At the same time, the responsible framework for scientific activities, data stewardship, and observational strategy after the termination of NoRP operations should be further clarified. In particular, data stewardship appears to depend heavily on a small number of individuals. There is a risk that, if a key staff member retires, the community may lose a clear contact point for questions about the data. Therefore, it may be necessary for SOL as a whole to discuss and clarify the post-decommissioning framework for data stewardship and the designated contact person(s). It would be good to define and document a post-decommissioning data stewardship plan, including clear responsibilities and contact person(s), in order to avoid single-point-of-failure risks for data support. Where relevant, the long-term preservation of legacy solar radio datasets, including NoRH-related data, should also be clarified.

While there is increasing demand for 1 GHz observations, it is disappointing that the successor YoRP does not include 1 GHz capabilities. It would be good to continue structured discussions with the community on future observing needs, including 1 GHz, and on how they should be addressed in successor or complementary capabilities.

(A-2) Status of Achievement of Scientific Objectives

a. Is the research contributing to clarifying short-term and long-term variations in solar activity and their impact on the inner heliosphere?

Long-term and precise observations of polar magnetic fields by Hinode SOT/SP provide a unique and highly valuable dataset. These observations offer fundamental information for studies of solar magnetic-cycle variations and the sources of the solar wind, and represent a major contribution to understanding long-term variations in solar activity.

Full-disk chromospheric magnetic-field observations at Mitaka also provide a unique dataset with strong potential for studies of the inner heliosphere and space weather. However, data preparation, calibration, and practical use for forecasting applications are still limited, and further effort is desirable to make this dataset more readily usable and to connect it more explicitly to inner-heliospheric and space-weather studies.

During the current solar maximum, many flares are occurring, and further scientific results are expected from observational data related to these short-term variations. Overall, SOL has established valuable observational foundations for this scientific objective, while further studies explicitly linking these datasets to the inner heliosphere would strengthen the impact.

b. Is the research contributing to capturing the magnetic field structure from the solar surface to the upper layers and its temporal variations?

The project is systematically conducting research to capture magnetic-field structures in different layers from the photosphere to the chromosphere through spectropolarimetry using ground-based, balloon, and rocket experiments. This multi-platform approach is well aligned with the scientific objective of measuring magnetic structures from the solar surface to the upper layers and tracing their temporal evolution.

CLASP2/2.1 has made a highly valuable contribution through high-precision UV spectropolarimetry. By using spectral lines sensitive to the Zeeman and Hanle effects, it has

provided important results, including magnetic-field mapping from the photosphere to the very top of the chromosphere. This is a significant achievement and should be highly appreciated.

SUNRISE-3/SCIP is also making an important contribution through near-infrared spectropolarimetry. It is obtaining high-spatial- and high-temporal-resolution observations of three-dimensional magnetic-field structures in the photosphere and chromosphere. Polarization signals associated with spicules and dynamic chromospheric phenomena have also been detected. The timely publication of the papers currently in preparation is strongly encouraged.

(A-3) Response to Key Issues Listed in Scientific Goals and Missions (June 2021 – March 2024)

a. Has consideration been given to scientific objectives, operational plans, and collaborative frameworks for ground-based solar observations beyond FY2024, in consultation with domestic and international research institutions, and have these been clearly defined within the review period?

The response to the key issues concerning ground-based solar observations beyond FY2024 cannot be considered fully sufficient. While the handover of NoRP to the National Defense Academy is progressing well, the maintenance plan for SFT after the retirement of key faculty members remains vague and appears to depend on future personnel decisions. Furthermore, no specific policy for the successor to SFT was presented. Succession of technical expertise is therefore an important issue for ground-based solar observations beyond FY2024. It would be important to have an overlap period between experienced staff and their successors, although it is understandable that this may be difficult under limited resources.

At the same time, there are positive developments. Preparations for further data release are steadily progressing. To maximize the value and impact of these efforts, it may become important to establish a system for assigning Data DOIs to released datasets in the future.

Communication within SOL has been promoted through group meetings and seminars. However, opportunities to discuss scientific strategy appear to be limited. It would be beneficial to have more opportunities within SOL to discuss future scientific plans for ground-based solar observations. The proposal to the NAOJ Science Road Map, which includes coordinated observational plans using Hinode and ground-based facilities to study solar activity, is highly appreciated. It would be desirable for this roadmap to be discussed more deeply within SOL.

[B] Benchmarking Against Similar Projects

(B-1) Compared with other similar projects in Japan and abroad, can the SOL's results and plans be considered sufficiently competitive?

The projects led by or centrally involving SOL are highly unique within Japan and constitute a very valuable foundation for solar physics and space-weather research in the country. Internationally, SOL's results can also be considered sufficiently competitive, particularly in the areas of small-scale flight missions, long-term Hinode observations, multi-frequency long-

term microwave observations by NoRP, and chromospheric magnetic-field observations at Mitaka.

For Mitaka, long-term ground-based solar observations are carried out in several countries, and it may require careful assessment whether all Mitaka observations are internationally unique and competitive. However, chromospheric magnetic-field observations at Mitaka are unique and valuable. Their competitiveness and scientific value would be significantly enhanced through further calibration, database development, and promotion of international use.

For NoRP, full-disk microwave observations of the Sun, such as F10.7, are also carried out abroad. However, NoRP is highly distinctive as a long-term multi-frequency dataset that can provide spectral information. It is particularly valuable not only for studies of long-term solar activity, but also for studies of the effects of solar activity on the Earth's atmosphere, ionosphere, and thermosphere, where unique scientific results have already been produced.

For Hinode, nearly 20 years of continuous observations have continued to produce internationally competitive results, including long-term polar magnetic-field observations. These long-term and precise datasets are of international importance for understanding the solar magnetic cycle and the sources of the solar wind.

The small-scale missions, including CLASP, SUNRISE, and FOXSI, have each produced unique and competitive results. These missions demonstrate SOL's strength not only in scientific output, but also in instrumentation, human-resource development, international collaboration, and technical succession toward future missions.

Regarding future plans, SOL's clearly defined contribution to SOLAR-C, the connection of technology and human resources from small-scale missions to larger missions, and the start of discussions on the post-SOLAR-C phase represent competitive directions. At the same time, the competitiveness of SOL's future plans would be further strengthened by more concrete planning for the future maintenance of Mitaka observations, their connection to international networks and space-weather applications, and the data-stewardship framework after the transition from NoRP to YoRP.

[C] Response to Issues Identified in the Previous Evaluation

(C-1) Was the coordination between space-based (Hinode/sounding rocket/balloon) observations and ground-based observations appropriately implemented?

The committee recognizes that coordination between flight and ground-based observations has not yet been fully developed and that there remains room for further effort. At the same time, the committee also acknowledges the practical difficulty of linking Mitaka's wide-field, long-term observations with space missions beyond their use as context data. The successful coordinated observation of FOXSI using a flare-prediction model provides a useful example that could be extended to future coordination between space-based missions and ground-based observations.

(C-2) Has management, including sharing awareness between junior and senior researchers and among small-scale projects, been strengthened?

The management of the technical and scientific transition from small-scale projects to SOLAR-C appears to be proceeding very well. It is remarkable from a management point of view that SOL is advancing many diverse projects in parallel despite limited human resources. In particular, each small-scale project appears to be conducted with a clear awareness of its connection to SOLAR-C, and shared awareness at the SOL-wide level seems to have been fostered.

It is also positive that regular meetings and seminars provide opportunities for communication across projects and career stages, and that progress and issues are being shared. These efforts are useful mechanisms for strengthening shared awareness within SOL. It would be desirable for such communication opportunities to develop beyond information sharing and further contribute to deeper discussions on future planning and technical succession.

At the same time, it should be noted that the current high productivity appears to rely not only on management, but also heavily on the dedicated efforts of staff members on the ground. There appears to be some shared awareness between senior and younger researchers, but more opportunities for communication between them would likely be effective for developing a deeper shared understanding. The heavy workload of SOL staff in their respective projects should also be taken into account.

From the viewpoint of technical succession, the limited absolute number of young researchers appears to make management more difficult. It is not easy to evaluate in detail the degree of shared awareness among the small-scale projects themselves, but the fact that each project is being conducted with an awareness of the pathway toward SOLAR-C indicates strategic consistency at the SOL-wide level.

Concrete solutions for this labor shortage should be sought through active cooperation from ATC and NAOJ executive management, rather than by the SOL project alone.

[D] Future Plans

(D-1) Have future directions and prospects been discussed with the community and appropriately formulated (including contributions to SOLAR-C, post-SOLAR-C, and budget outlook)?

The committee recognizes that future directions and prospects for SOL have been formulated to a certain extent, particularly with respect to SOLAR-C. Contributions to SOLAR-C are proceeding without major issues, and the priority of SOLAR-C for SOL/NAOJ and the expected contributions from SOL are clearly defined. In the JSPC future-planning roadmap, the positions of the individual SOL projects and SOLAR-C are also clearly described. Based on the project's track record, the ambition to launch subsequent small-scale missions, such as balloon and rocket experiments, after SOLAR-C is considered feasible, and discussions on the post-SOLAR-C phase have already started.

At the same time, there are concerns about the strength of communication within SOL and with the Japanese solar community. One view is that the roadmap was developed without sufficient communication. Although future directions have been discussed with the community on a regular basis through future-planning symposia and Solar Research Liaison Committee symposia, further efforts to strengthen internal and community-wide discussion would be beneficial.

It would also be desirable for future-planning documents to include more concrete descriptions of how the Mitaka observations will be maintained in the future. This is important because the future of ground-based observations, including their operational framework and scientific role, should be more clearly connected to the overall SOL roadmap, including SOLAR-C, post-SOLAR-C activities, and longer-term budget outlook.

(D-2) Has the development of young researchers been appropriately carried out?

The development of graduate students is functioning, and SOL has been continuously training multiple graduate students. The students generally seem to be highly motivated, have good support networks at their universities, and have opportunities to get involved with new instruments and operations. The project is appropriately supervising multiple graduate students, which is commendable. Small-scale projects have also made a large and effective contribution to human-resource development, and researchers who gained experience through such projects are now leading the next projects in responsible positions.

At the same time, the development of young researchers is constrained by limited supervisor time and the small number of postdoctoral positions. Although students meet their supervisors regularly, they would prefer more face-to-face meetings, and some students feel short of help from supervisors and senior scientists who are very busy. In addition, the closure of the cafeteria has changed the social aspects of lunchtime, which may have reduced informal opportunities for communication and support among students, postdoctoral researchers, and staff. Postdoctoral researchers can serve as accessible mentors and near-future role models for graduate students, but there are not many postdoctoral positions. Opportunities for early-career development have also decreased due to the reduction in project-researcher positions, although such positions still exist in the broader framework.

Looking toward the future, including SOLAR-C, it would be desirable to advance more systematically the development of personnel capable of technical development. It is also somewhat disappointing that there are currently no doctoral students conducting PhD research based primarily on the Mitaka ground-based observations. Involving young researchers in Mitaka observations, even partially through technical training or instrument-related work, may lead to more constructive use of the facilities and contribute to training the next generation for ground-based solar observations.

(D-3) Are the available human resources adequate to achieve the stated scientific goals? Is sufficient protected research time secured for SOL researchers?

The available human resources cannot be considered sufficient to achieve SOL's stated scientific goals, and protected research time for SOL researchers is not adequately secured. Senior scientists, including professors, are involved in many projects, and time available for

scientific research has decreased because of operational duties and the development of SOLAR-C. Securing research time is particularly difficult when staff are involved in a large project such as SOLAR-C.

A major concern is that researchers spend substantial time on the projects. As a result, there is limited time left for scientific research, paper writing, supervision of students, and work on future science and instruments. The shortage of supporting engineers and technical staff contributes to this situation. Increasing the number of technical staff who can take responsibility for testing and other technical tasks would help to increase protected research time for SOL researchers.

The small number of young researchers, such as postdoctoral fellows, is also a concern. With too few young researchers, it is difficult for SOL to appear active and lively as a research group, and the continuity of research activities may be constrained.

To improve the situation, some form of effort management is considered necessary, in addition to personnel support from NAOJ management. An agreement within the group to secure “research time” as a goal may also help. The visiting researchers hosted through the Research Exchange Committee provide good opportunities to stimulate research activities, and maintaining this activity may help sustain the research activity of SOL members.

(D-4) Is the technical and human resource development achieved through small-scale missions being effectively connected to the development of SOLAR-C and other potential future SOL missions?

The technical and human-resource development achieved through small-scale missions can be considered to be effectively connected to the development of SOLAR-C and other potential future SOL missions. Small-scale projects provide an excellent training ground for more complex projects such as SOLAR-C, and they serve as bridges to large-scale projects across various aspects, including technical development, scientific study, and mission management.

In particular, small-scale missions such as CLASP, SUNRISE, and FOXSI have been very successful and have contributed to the development of important instrumental elements and key component technologies, including polarization modulation units, CMS sensors, opto-mechanical design, scan-mirror-related technologies, ground-test systems, and test procedures. These technologies are being effectively applied to SOLAR-C, and testing activities conducted in collaboration with ATC also contribute to the training of technical personnel.

In terms of human resources, small-scale projects have also made a large and effective contribution. Researchers who gained experience through small-scale projects such as CLASP are now leading subsequent projects in responsible positions. Considering that the major tasks in the small-scale missions are almost complete, the transition of human resources from these missions to SOLAR-C is also understandable.

The experience of international collaboration gained through small-scale missions is also important. The know-how for transporting instruments overseas, conducting tests at foreign institutions, and maintaining international human networks appears to be a valuable asset for

SOLAR-C and other potential future SOL missions. Overall, small-scale missions play a very important role in SOL's technical succession, human-resource development, and formation of future missions.

List of Appendices:

Appendix A
List of SOL Evaluation Materials

Applicable **D**ocuments				
ID	Doc #	Doc Title	File Name	# of Pages
AD01	NAOJ-EEC-SOL-001-A	List of the External Evaluation Committee (EEC) Members	[AD01]EEC_Members_List_FY2025_SOL_Review.pdf	1
AD02	NAOJ-PROJECT-042-B	Scientific Goals and Missions – Solar Science Observatory (2025 March 04)	[AD02] NAOJ-PROJECT-042-B_SSO_2025-03-04.pdf	4
AD03	NAOJ-PROJECT-042-A	Scientific Goals and Missions – Solar Science Observatory (2021 June 14) *previous SG&M	[AD03] NAOJ-PROJECT-042-A SSO Scientific Goals and Missions 2021-06-14.pdf	4
AD04	NAOJ-EEC-SOL-003-B	External Evaluation of Solar Science Observatory (SOL), NAOJ - kick-off meeting -	[AD04] SOL Reivew kick-off meeting_20251112.pdf	26
AD05	NAOJ-EEC-SOL-004-A	FY2025 NAOJ Project Review: SOL Review Charges	[AD05] ReviewCharges_SOL_20251112.pdf	3
AD06	NAOJ-EEC-SOL-009-A	2025 JFY NAOJ Project Review Plan for Solar Science Observatory	[AD06] ReviewPlan_NAOJ-EEC-SOL-009-A_20251226.pdf	12

Reference **D**ocuments				
ID	Doc #	Doc Title	File Name	# of Pages
RD01	NAOJ-RESO-0007-A	国立天文台平成29年度プロジェクト評価報告書　太陽観測科学プロジェクト SOLARーC準備室（平成 30 年2月）	[RD01] FY2017 NAOJ Project Review Report - SOLAR - NAOJ-RESO-0007-A(20180726).pdf	7
RD02	NAOJ-EEC-SOL-002-A	FY2017 NAOJ Project Review Report - Solar Science Observatory and SOLAR-C Project Office (English Version) February 2018	[RD02] FY2017 NAOJ Project Review Report - SOLAR - NAOJ-RESO-0007-A(20180726)-E.pdf	8
RD03	NAOJ-EEC-SOL-005-A	Annual Report of NAOJ 2017-2024 (Solar Science Observatory (SSO))	[RD03] Annual_Report_of_SOL_2017-2024e.pdf	22
RD04	NAOJ-EEC-SOL-006-A	国立天文台年次報告 2017−2024 年度（太陽観測科学プロジェクト）	[RD04] Annual_Report_of_SOL_2017-2024j.pdf	22
RD05	NAOJ-EEC-SOL-007-A	Observations of solar activities by the ground- and space-based telescopes Yukio KATSUKAWA (NAOJ Future Planning Symposium 2023)	[RD05] NAOJFutureSympo2023-Katsukawa.pdf	26
RD06	NAOJ-EEC-SOL-008-A	Continuous observations of solar activity: HINODE, Mitaka ground-	[RD06] NAOJFutureSympo2024-Katsukawa.pdf	24

		based telescopes, and build-up for future observations Yukio KATSUKAWA (NAOJ Future Planning Symposium 2024)		

Deliverable **D**ocuments (From SOL)

ID	Doc #	Doc Title	File Name	# of Pages
DD01	NAOJ-EEC-SOL-010-A	SOL Members List as of Jan 28, 2026	[DD01] SOLmembers_20260128.pdf	1
DD02	NAOJ-EEC-SOL-011-B	2025JFY Document for the Project Review of Solar Science Observatory, NAOJ	[DD02] SOL_ReviewDocument_20260216.pdf	77
DD03	NAOJ-EEC-SOL-012-A	NAOJ Solar Facility Tour Rev. 20260210	[DD03] solar_tour_20260210.pdf	1

Presentation Slides (From SOL)

ID	Doc #	Doc Title	File Name	# of Pages
PS01	NAOJ-EEC-SOL-013-B	Project Review Solar Science Observatory, NAOJ	[PS01] SOL_ReviewPresentation_20260225.pdf	85

Appendix B:
SOL Review Meeting Timetable

Day 1 Date: Tuesday, February 24, 2026 9:00–18:00 Place: Large Conference Room, Mitaka Campus at NAOJ	
◆Advance Meeting (Closed)	
09:00 – 09:30	EEC meeting
◆Opening & Introductions (Open)	
09:35 – 09:55	Opening remarks by NAOJ, Mutual introductions between the EEC and the SOL members, Introduction of the meeting agenda by the EEC Chair
◆Presentation from SOL (1) (Open)	
09:55 – 12:05	Presentation from the project for Evaluation Item **[A]** + Q&A
12:05 – 13:05	(Lunch meeting with NAOJ Director)
13:05 – 14:25	Presentation from the project for Evaluation Item **[B]** + Q&A
◆Interview with SOL members (Closed)	
14:40 – 16:20	– Researcher Interviews – Senior Specialist interview
16:20 – 16:30	(Break)
16:30 – 17:40	Group Interview with SOL Graduate Students
◆Discussion (Closed)	
17:40 – 18:00	EEC meeting

Day 2 Date: Wednesday, February 25, 2026 9:00–17:00 Place: Lecture Room, Mitaka Campus at NAOJ	
◆Presentation from SOL (2) (Open)	
09:02 – 10:36	Presentation from the project for Evaluation Item **[C]** + Q&A
10:36 – 10:50	(Break)
10:50 – 12:20	Presentation from the project for Evaluation Item **[D]** + Q&A
12:20 – 13:00	(Lunch break)
◆NAOJ Solar Facility Tour	
13:00 – 13:05	Walk to the Advanced Technology Center (ATC)
13:05 – 14:30	Advanced Technology Center – Machine shop & metal 3D printer (Exhibition of components developed for the rocket & balloon experiments) – Optical shop

	– Cleanroom for SOLAR-C development (Check-out room)
◆Interviews with SOL Director and NAOJ Executives (Closed)	
14:30 – 15:19	Interview with SOL Director
15:19-15:20	(Break)
15:20 – 15:55	Interviews with NAOJ Executives Responsible for SOL and for Budget
◆Discussion (Closed)	
15:55 – 16:30	EEC meeting
◆Closing (Executive Summary) (Open)	
16:38 – 16:53	Executive Summary : Briefing for all project members and NAOJ
16:53 – 17:00	Group Photo

・Review Style: "open" – all project members are welcome; "closed" – invitation-only (by EEC).

Evaluation Items

[**A**] Achievement of Establishment Objectives
[**B**] Benchmarking Against Similar Projects
[**C**] Response to Issues Identified in the Previous Evaluation
[**D**] Future Plans

Appendix C:

Solar Science Observatory Members

As of February 2026

Name	Position (affiliation)	Job description
KATSUKAWA, Yukio	Professor, Chief	SOL management, HINODE SOT(PI), Sunrise-3 SOLAR-C
HARA, Hirohisa	Professor (SOLAR-C)	HINODE EIS (PI), Sunrise-3, SOLAR-C chief
HANAOKA, Yoichiro	Associate Professor	Mitaka Telescopes
ISHIKAWA, Ryohko	Associate Professor	HINODE SOT, CLASP2/2.1, SOLAR-C
SEKII, Takashi	Associate Professor (Grad Education)	HINODE SOT, Education office
SHIMOJO, Masumi	Associate Professor (ALMA)	HINODE XRT, NoRP
NARUKAGE, Noriyuki	Assistant Professor	HINODE XRT, FOXSI-3/4/5, SOLAR-C
KAWABATA, Yusuke	Assistant Professor (SOLAR-C)	HINODE SOT, Sunrise-3, SOLAR-C
KUBO, Masahito	Assistant Professor (SOLAR-C)	HINODE SOT, Sunrise-3, SOLAR-C
OKAMOTO, Takenori	Assistant Professor (SOLAR-C)	HINODE SOT (SSC), CLASP2/2.1, SOLAR-C
SHINODA, Kazuya	Engineer	Mitaka, SOLAR-C
TEI, Akiko	JSPS Fellow	
SHINOHARA, Noriyuki	Part-time Re-employment Staff	NoRP
NISHIDA, Kazuki	Senior Specialist	Mitaka, computer & network
YONETANI, Natsuki	Senior Specialist	Mitaka, PO
MITSUTAKE, Masaaki	Senior Specialist (SOLAR-C)	SOLAR-C
OSHIMA, Tomohito	Research Supporter (UK budget)	HINODE EIS
TAKAMIZU, Aki	Research Supporter (SOLAR-C)	academic assistant
HARA, Yukiko	Administrative Supporter	SOL administration
SUZUKI, Yoko	Administrative Supporter (SOLAR-C)	SOLAR-C administration