Argentine Republic / Republic of Chile

FY2021 Ex-post Evaluation Report of Technical Cooperation Project

"The Project for Development of the Atmospheric Environmental Risk Management System in South America (SATREPS)"

External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

0. Summary

"The Project for Development of the Atmospheric Environmental Risk Management System in South America (SATREPS)" (hereinafter referred to as "the Project") was implemented in Argentina and Chile with the purpose of developing an "Atmospheric Environmental Risk Management System" which monitor and analyze the ozone layer and ultraviolet (UV) rays as well as conditions of aerosol such as volcanic ash, and provide the results in near-real-time to the meteorological agencies and other related agencies in both countries. The Project is consistent with the development plans and needs of both countries and the Japan's ODA policy, both at the time of planning and at the time of completion. Although an issue can be pointed out regarding the selection of the implementing agencies, it is not so serious as to reduce the relevance of the Project, therefore, the relevance and consistency of the Project are high. The observation network of the two countries was strengthened, and research on aerosols and ozone/UV rays, as well as analysis of atmospheric environmental risks and development of an information sharing system were promoted under the Project. However, the development of the Atmospheric Environmental Risk Management System could not be completed, and the project purpose was partially achieved. Although the overall goal was not achieved, data from the observation network enhanced by the Project are being used for atmospheric environmental risk management and related research. Therefore, a certain level of impacts has been achieved through the implementation of the Project, and the effectiveness and impact of the Project are moderately low. Although the project cost was almost as planned and the project period was as planned, outputs of the Project were achieved only partially, and therefore, the efficiency of the Project is moderately low. There are some technical and financial difficulties in sustaining the results of the Project, and the prospects for improvement and resolution are unclear. Therefore, the sustainability of the project effects is moderately low. In light of the above, the Project is evaluated to be partially satisfactory.

1. Project Description

Project Location Map

LIDAR Observation Facility of National Meteorological Service of Argentine

1.1 Background

The Andean region has many active volcanoes, and the volcanic ash scattered by eruptions not only causes damage to crops in the surrounding areas, but also seriously affects aircraft operations even in areas far from the volcanoes. For the operational safety of aircrafts, it is necessary to monitor the ever-changing volcanic ash distribution and predict its movement. In addition, the Patagonia region of Argentina and southern Chile is close to Antarctica and often falls directly under the ozone hole. UV rays cause skin cancer and cataracts, but normally the ozone layer absorbs UV rays and thus daily life is protected. However, below the ozone hole, UV rays reaching the ground directly increases, posing a serious risk to the residents of the area. Therefore, along with monitoring of the ozone hole, a prompt and appropriate response based on accurate and timely measurement of UV rays is required. On the other hand, in the Southern Hemisphere, including the Andes and Patagonia, ground-based observation networks for the atmospheric environment were not much developed compared to the Northern Hemisphere, where there are many developed countries, and there was no sufficient observation system.

Based on the above, Argentina and Chile requested technical cooperation to establish a system to monitor, properly assess, and promptly warn local communities of two major atmospheric environmental risks: aerosols and ozone/UV rays. In response to this request, the Project was implemented from April 2013 to March 2018 as the Science and Technology Research Partnership for Sustainable Development (SATREPS).

1.2 Project Outline

Overall Goal		Relevant ministries and agencies use "the Atmospheric Environmental Risk Management System" to minimize the risks and damages into the society due to UV rays, aerosols, and others.
Project Purpose		The Atmospheric Environmental Risk Management System is developed.[1]
Outputs	Output 1	Near-real-time aerosol monitoring network is developed.
	Output 2	The main properties of the aerosols focusing on source areas, types of aerosols, transportation, and seasonal variation are clarified.
	Output 3	The existing ozone and UV observation system (MM-wave radiometer, ozone LIDAR and associated instruments) are improved.[2]
	Output 4	Based on the monitoring, ozone hole variation and the dilution-mixing process of the ozone depleted air from ozone hole to the mid-latitude region of South America are analyzed.
	Output 5	An integrated analysis system of atmospheric environmental risks is developed.
	Output 6	A system to share the data analyzed at the Project with relevant ministries and agencies is developed.
Total cost (Japanese Side)		341 million yen
Period of Cooperation		April 2013 - March 2018
Target Area		Argentina, Chile (throughout)
Implementing Agency		Argentina: Institute of Scientific and Technical Research for Defense (CITEDF) Laser Application Research Department (DEILAP: then CEILAP), National Meteorological Service (SMN) Chile: Magellan University, Meteorological Direction of Chile (DMC) (Note: Both meteorological agencies were added to the implementing agencies since the March 2016 mid-term review study)
Other Relevant Agencies/ Organizations		None
Organizations in Japan		Nagoya University, National Institute for Environmental Studies (NIES)
Related Projects		Technical Cooperation "Strengthening Ozone Layer Observation" (Argentina, 2004-2007), Technical Cooperation "Project to Strengthen the Capacity to Measure the Ozone Layer and UV Radiation in Southern Patagonia and the Projection towards the Community"(Argentina, Chile, 2007-2011), "Empirical Study of Assimilation by the Southern Hemisphere Air Quality Observation Network" (Dispatch of an expert, 2009-2011), "Seminar on Ozone Layer Protection Measures II" (Thematic Training, Group Training, 2007)

[1] "The Atmospheric Environmental Risk Management System" is a system that provides data on ozone, UV, and aerosol obtained at each monitoring station in near real-time from the counterpart agencies to the relevant agencies" (Ex-ante evaluation summary).

[2] LIDAR is an acronym for Light Detection and Ranging, which stands for "light detection and ranging" or "laser image detection and ranging". It is a remote sensing technology that uses light to analyze the distance to a distant object and the properties of that object by measuring the light scattered by pulsed laser radiation.

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

The project purpose "the Atmospheric Environmental Risk Management System is developed" is assessed as generally progressing well. The two IT platforms that comprise the system, Geo UV for UV rays and Geo Aerosol for aerosols, are expected to be completed by the end of the Project, although the development of the latter is somewhat delayed. In addition, there is currently some concern about the stable and constant operation of the observation system that is a prerequisite for system operation.

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation (including other impacts)

The likelihood of achieving the overall goal is high. A schedule has been established to have Geo UV and Geo Aerosol operational by the end of the Project, and the overall goal may be achieved within the project period.

1.3.3 Recommendations from the Terminal Evaluation

(1) Recommendations until the completion of the Project

- Improve the operational environment of LIDAR to ensure reliable and continuous acquisition of data on aerosols. The Laser Application Research Department (hereinafter referred to as "DEILAP") and the National Meteorological Service (hereinafter referred to as "SMN") of Argentina will agree on the transfer of LIDAR and the operational structure for them.
- Solve power supply problems related to the aerosol LIDAR in Punta Arenas, Chile.
- Complete the installation of the main server at SMN and the development of Geo Aerosol and Geo UV.
- Write research papers on research results and try to get them accepted in international journals.
- The meteorological agencies of both countries will sign an agreement to share observation data and maintain close cooperation.
- The Japanese side will provide inputs to ensure that the Project Purpose are achieved.

(2) Recommendations for post-project period

- Sustained budget and enhanced strategic research
- Actively utilize the results of the Project in other related projects
- Use of research results for policy making
- Sustainable operation and maintenance of observation networks (Argentina)
- Continued development of cooperation between the Meteorological Direction of Chile (hereinafter referred to as "DMC") and the Magellan University (Chile)

・ Continued cooperation between Argentina, Chile, and Japan

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: January 2022 - February 2023

Duration of the Field Study: June - July 2022

3. Results of the Evaluation (Overall Rating: C[3])

3.1 Relevance/Coherence (Rating:③[4])

3.1.1 Relevance (③)

3.1.1.1 Consistency with Development Plan of Argentina/Chile

Argentina and Chile ratified the Vienna Convention for the Protection of Ozone Layer (1985) and the Montreal Protocol (1987). The Protocol stipulates cooperation in research, systematic observation, and exchange of information on legal, scientific, and technical matters related to the substances that deplete the ozone layer, and both countries have been implementing ozone layer protection measures in accordance with these protocols. Furthermore, in August 2003, both countries signed the "Calafate Declaration" and agreed to cooperate in addressing climate change and ozone-related issues, particularly in the southern regions of both countries, and to obtain technical cooperation from the international community. The Project is positioned as an embodiment of these agreements. After the start of the Project, the two countries signed the "Maipu Treaty" in 2014, confirming that the two countries will cooperate with each other in the event of an emergency disaster. In addition, both Argentina and Chile place a high priority on UV protection for the general population and society as a whole, and both countries have established their own UV protocols and have committed themselves to thorough implementation of such measures. Therefore, the Project is consistent with the development plans of both Argentina and Chile, both at the time of planning and at the time of completion.

3.1.1.2 Consistency with Development Needs of Argentina/Chile

As described in "1.1 Background," at the time of the planning, appropriate measures were necessary in the target area to cope with such atmospheric environmental risks as volcanic ash and increased UV rays due to ozone depletion, which required the development of ground

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3 A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

4 ④: Very High ③: High, ②: Moderately Low, ①: Low

observation networks, appropriate risk assessment, and a system that would enable prompt warning to local communities. Although DEILAP in Argentina and Magellan University in Chile, the implementing agencies at the beginning of the Project, had accumulated extensive research experience in atmospheric environment, they had limited experience in aerosol observation and analysis using LIDAR. In addition, the meteorological agencies of Argentina and Chile, which became full-fledged implementing agencies after the mid-term review of the Project, were facing challenges in improving the accuracy of observation data and observation techniques. Therefore, the promotion of research on the atmospheric environment and capacity building of related technologies in the Project are the efforts consistent with the needs of the organizations concerned in both countries. Therefore, the Project is consistent with the development needs of Argentina and Chile both at the time of planning and at the time of completion.

3.1.1.3 Appropriateness of the Project Plan and Approach

The Project did not fully achieve the purpose within the cooperation period. Furthermore, after the completion of the Project, activities to achieve the project purpose were not continued, and the overall goal was not achieved. The following situations regarding the selection of implementing agencies can be pointed out as one of the reasons for the above. However, this is not an issue that reduces the relevance of the Project.

The Project did not fully achieve its purpose because the development of the “Atmospheric Environmental Risk Management System” for aerosols was delayed due to unstable observations by LIDAR (aerosol observation device) which was designed by DEILAP of Argentina incorporating Japanese technology. LIDAR was designed as if researchers were to be stationed in the field, and its operation required a high degree of expertise and skill. In reality, although local SMN staff trained by DEILAP operated LIDAR at observation stations nationwide where LIDAR was installed, it was difficult to adjust LIDAR and to properly respond to frequent instrument malfunctions caused by severe weather conditions and power outages. In addition, the responsibility for malfunctions was not clearly defined between the two institutions,[5] and budgetary constraints at DEILAP meant that it took time for researchers to visit and deal with the malfunctions, resulting in delays in responding to the malfunctions and unstable observations by LIDAR.

The goal of the Project was to develop the “Atmospheric Environmental Risk Management System” that could be used by relevant institutions in both countries to meet the needs of citizens for life protection and disaster prevention, a goal that had not only a research aspect but also a practical nature. However, at the beginning of the Project, only the research institutes of each country (DEILAP of Argentina and Magellan University of Chile) were the implementing

[5] The observation equipment was owned by DEILAP, but the operation was outsourced to SMN, which caused confusion in the field as to who was responsible in the event of trouble.

agencies, and the meteorological agencies of both countries (SMN of Argentina and DMC of Chile), which were supposed to play an important role in observation as their routine operation, were finally added as implementing agencies in the latter half of the Project after the mid-term review. If SMN had been added to the implementing agency from the beginning, and if DEILAP had designed and built LIDAR with a full understanding of the conditions at the SMN observation sites and the capabilities of its staff, it is thought that observations could have been stabilized to some extent by creating a LIDAR with higher practicality.

3.1.2 Coherence (②)

3.1.2.1 Consistency with Japan's ODA Policy

In the Official Development Assistance Charter (ODA Charter), Japan has designated "addressing global environmental issues such as climate change and global warming, which are threats to humanity," and "protection of the people of recipient countries from threats" as important cooperation areas, and has actively promoted research, systematic observation, and exchange of information on science and technology (Articles 3 and 4, below) by ratifying the Vienna Convention and the Montreal Protocol in 1988. In the "Direction of JICA's Cooperation in the Field of Climate Change" (June 2012), JICA defines "adaptation measures" as support for risk management in recipient countries where the adverse effects of climate change are the concern. The Project is in line with the Global Issues Program under the "Environmental Conservation" development agenda for Argentina and the Climate Change Response Support Program under the "Environmental Measures with a Focus on Disaster Prevention" priority area of the Country Assistance Policy for Chile.

Based on the above, the Project is consistent with Japan's ODA policy at the time of planning.

3.1.2.2 Internal Coherence

In Patagonia and Antarctica in South America, two technical cooperation projects,[6] dispatch of experts, and thematic training had been conducted within the framework of JICA's "Climate Change Response Support Program" to address environmental and climate change issues. The projects included the introduction of ozone layer observation technology by LIDAR to DEILAP, expansion of the ozone layer observation network in the Patagonia region by DEILAP and Magellan University, and establishment of a warning system for residents in the same region by using UV signals.

Based on the experience of these two preceding technical cooperation projects, the Project was implemented with DEILAP and Magellan University as the initial implementing agencies. The

[6] Technical Cooperation "Strengthening Ozone Layer Observation" (Argentina, 2004-2007, Implementing Agency: DEILAP), Technical Cooperation "Project to Strengthen the Capacity to Measure the Ozone Layer and UV Radiation in Southern Patagonia and the Projection towards the Community" (Argentina, Chile, 2007-2011, Implementing Agencies: DEILAP, Magellan University))

observation network was expanded nationwide, and aerosol observations by LIDAR were newly started, and the “Atmospheric Environmental Risk Management System” in which observation data from across the country would be provided in near-real-time to all relevant organizations was aimed to build. In other words, the Project is a nationwide development of the ozone layer observation network, enhancement of UV observation capacity, and communication of information to local residents, which was started in the Patagonia region through the preceding technical cooperation mentioned above, with the addition of aerosol observation and risk management system. Such results of the proceeding technical cooperation as the observation equipment installed and the experience and human connections in each country, and the experience of joint observation and joint research in the Patagonia region spanning both countries provided the basis for smooth implementation of the Project, and the Project was positioned to complement and complete the objectives of the earlier technical cooperation.

Based on the above, it can be said that the Project has been implemented in a way that further enhances the results of past projects. No specific collaboration with other JICA projects in the implementation was identified. The Project also triggered the start of the third country training program “Ground-Based Remote Sensing for Latin America” at SMN from 2022.

3.1.2.3 External Coherence

No specific plans or results have been identified for collaboration with external donor projects that preceded or were implemented in parallel with the Project.

Based on the above, the Project is consistent with the development plans and needs of the both target countries. Some issues can be pointed out in the project plan and approach, but these issues do not reduce the relevance of the Project. In addition, the Project is consistent with the development cooperation policies of the Government of Japan and JICA, and was implemented on the basis of the results attained by JICA’s previous projects. Therefore, the relevance and coherence of the Project are high.

3.2 Effectiveness and Impact[7] (Rating:②)

3.2.1 Effectiveness

3.2.1.1 Achievement of Outputs

(1) Development of aerosol observation network and analysis of aerosol characteristics (Outputs 1 and 2)

Volcanic ash from large volcanic eruptions that occur every few years in the Andes Mountains affects aircraft flight schedules. In order to understand the ever-changing distribution of volcanic ash along air routes and around airports and to make short-term forecasts, it is necessary to develop a ground observation network that can monitor the situation in near-real-time and analyze aerosol characteristics such as the source, type, transport routes, and seasonal changes of aerosols. In the Project, nine LIDAR were deployed over a wide area centered on airports in Chile and Argentina to establish an observation network for volcanic ash and other aerosols, and a system was constructed to organize and transmit necessary information to related organizations to accumulate observation data and analyze aerosol characteristics.

All nine planned LIDAR were installed by April 2017. They were designed and manufactured by DEILAP, but Japanese technology was incorporated to obtain the performance required for the Atmospheric Environmental Risk Management System.[8] Although some of LIDAR types were changed due to exchange rate fluctuation and other factors during the project period, the planned performance was ensured. Thus, the establishment of LIDAR observation network (Output 1) was largely achieved.

In October 2016, SMN became fully involved in the observations, and a full-fledged regular observation system was established, starting with LIDAR that had been installed earlier. Based on the observation data, the source areas and transport pathways of three aerosol sources (volcanic ash, Patagonian dust, and forest fire aerosol) were identified. However, because the observations were not stable and data could not be obtained throughout the year, seasonal changes could not be determined. Therefore, the characterization of aerosols (Output 2) was partially achieved.

The reasons for the unstable observations by LIDAR include the frequent troubles with observation equipment due to the severe weather conditions and power outages at the observation sites. In addition, as described in "3.1.1.3 Appropriateness of the Project Plan and Approach," coordination and troubleshooting capabilities of the staff in charge of SMN were

[7] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

[8] The identification of spherical and non-spherical particles based on polarization resolution measurements is useful for identifying volcanic ash, which is a non-spherical particle. The multi-wavelength high spectral resolution LIDAR is also observable in daylight, and patents have been filed in Japan and Argentina. In Japan, the patent was granted in 2017 with the NIES, the National Scientific and Technical Research Council of Argentina, and the Argentine Ministry of Defense as patent holders. In Argentina, the application was filed in 2021.

limited, and coordination between DEILAP and SMN as well as budget of DEILAP and SMN for failure response were limited.[9]

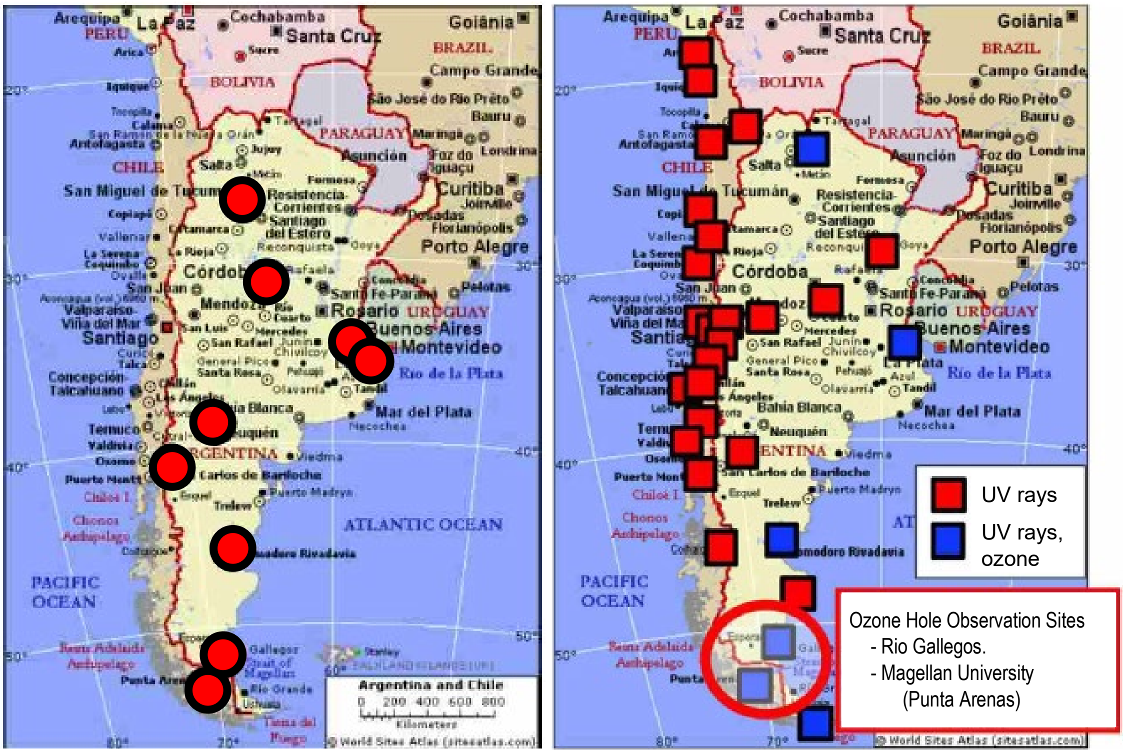


Figure 1 Aerosol (left) and UV/ozone (right) observation points

Source: JST terminal evaluation report

(2) Development of ozone and UV rays monitoring networks and research on the ozone hole (Outputs 3 and 4)

The southern tip of the South American continent, where the ozone hole arrives, includes the cities of Rio Gallegos and Ushuaia in Argentina and Punta Arenas in Chile with a combined population of about 300,000 people in these three cities. In order to provide real-time UV information and forecasts to the people in these areas, it was important to obtain detailed measurement data on the amount of ozone and UV rays at the time of entry under the ozone hole, and establish seasonal trend and inter-annual variations through observation.

In the Project, the existing ozone and UV observation equipment (superconducting spectrometer for millimeter-wave) at the Southern Patagonian Atmospheric Observatory in Rio Gallegos, Argentina, was upgraded to higher precision, and new observation equipment

[9] In the Project, in principle, domestic travel expenses for staff of the implementing agencies were to be borne by the counterpart country so that the counterpart country could maintain its own activities after the Project was completed. However, frequent field trips were required to resolve a number of problems, and securing travel expenses became a major problem for the counterpart countries.

(Brewer spectrometer, narrow-band multi-wavelength UV radiometer, cloud camera, etc.) was introduced. The excimer laser was updated to continue operation of the ozone LIDAR, an important instrument that can observe the vertical distribution of ozone introduced in the preceding technical cooperation, but it was not operational because DEILAP was unable to procure the dye gas necessary for its operation. The Magellan University, Chile, assisted the ozone sonde to make periodic ozone sonde emission observations, and the data were used to confirm the accuracy of the ozone LIDAR and millimeter-wave spectrometer. The ozone and UV observation systems showed the targeted accuracy and availability. Thus, Output 3 was partially achieved.

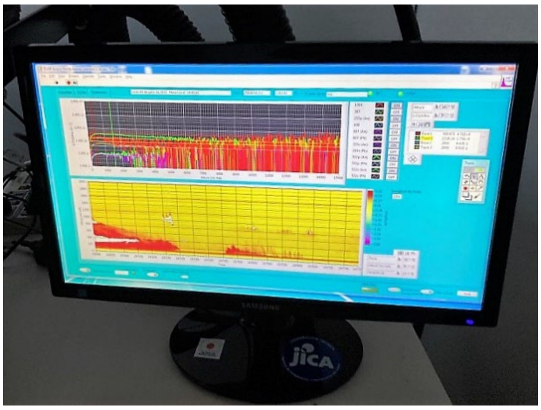
By combining the results of the chemical transport model calculations with the results of observations at Rio Gallegos and monitoring by the ozone sonde at Punta Arenas, which are inputs to the Project,[10] the shape of the ozone hole and the mechanism of ozone hole shape change have been elucidated.[11] Thus, Output 4 was largely achieved.

As DMC joined the implementing agency in the middle of the Project, its existing UV observation network was added to the Project's observation network, and DMC's know-how on UV observation was transferred to SMN and utilized in the development of SMN's observation network.


SMN's LIDAR instruments (left), instruments for UV etc. (right)

[10] The chemical transport model is one of the mass transport models that expresses changes and movement of substances in the atmosphere using mathematical equations. It predicts ozone concentrations above and near the ground by considering the movement of ozone and substances involved in its change by wind, its fall to the ground, and its change through chemical and light-induced reactions.

[11] For example, the relationship between the meteorological settings and the location of the center of the ozone hole gradually became to understand, and were able to interpret meteorologically the cause of the 2009 ozone hole's approach to South America and staying still over a period of about three weeks.

LIDAR Observation Facility at Magellan University: exterior (left), observation data display (right)


Aerosol Observation Facility of Magellan University

(3) Atmospheric environmental risk analysis and development of information sharing system (Outputs 5 and 6)

The Project aimed to improve the accuracy of the model by incorporating satellite data into the existing mass transport model for ozone and aerosols and comparing it with ground-based observation data, with a view to providing short-term forecast information as well as a quick understanding of the current situation using near-real-time data acquired from ground-based observation networks. This was accomplished for ozone, but the short-term prediction of aerosol distribution could not be completed by the end of the Project because sufficient observational data for the analysis was not available due to low availability of LIDAR. Therefore, Output 5 was partially achieved.

The Project aimed to develop an IT platform for information sharing of the Atmospheric Environmental Risk Management systems. A server was installed at SMN, but due to information security constraints, access to the network server by external organizations was not realized. SMN and DMC proceeded with preparations for information sharing, and upon mutual agreement, a mirror server was also set up in DMC and connection tests were conducted. However, it turned out that it was not possible to clear the information security issue, and it was not connected to SMN's server in the end. For UV rays, Geo UV was almost completed, and a UV forecast map and a near-real-time observation data map were created to be displayed in the system. On the other hand, Geo Aerosol for aerosols, although the platform itself was prepared, still required improvements in the algorithm for appropriate analysis of observation data. The types of data to be displayed to users and the method of displaying maps and other information were also not completed by the time the Project was completed.[12] Therefore, Output 6 was partially achieved.

3.2.1.2 Achievement of Project Purpose

Table 1: Achievement of Project Purpose

Project Purpose: "An Atmospheric Environmental Risk Management System" is developed.	Indicator 1: The atmospheric (ozone, UV, aerosol mainly) monitoring network and existing alert/protocol system are integrated into "the Atmospheric Environmental Risk Management System".	Results: partially achieved. Of the Geo UV and Geo Aerosol components of the "Atmospheric Environmental Risk Management System," only Geo UV was completed.
	Indicator 2: The performance of "the Atmospheric Environmental Risk Management System".	Results: partially achieved; Geo UV performed adequately, but Geo Aerosol was not completed.

The "Atmospheric Environmental Risk Management System" is a system for observing, analyzing, and sharing information on UV rays (ozone hole) and aerosols. The data obtained from the enhanced observation network will be used for research on aerosol and ozone hole, an integrated analysis system will be used to generate information necessary for risk management, and Geo UV and Geo Aerosol will be used to share information to support decision making by risk managers.

For UV rays, Geo UV has been developed to obtain near-real-time data within 15 minutes from a network of UV monitors in major cities in Argentina and Chile, and to alert relevant agencies when UV levels exceed preset levels. The system provides time series of UV index for the past hour, 12 hours, 24 hours, and one week for each monitoring station, as well as regional forecast maps of UV index over a three-day period (one for clear skies and one for cloud cover). However, Geo UV was not connected to the relevant agencies by the Project completion.

[12] The scope of the Project was to provide air traffic controllers with information that they can use to make decisions. According to DEILAP and SMN, a system like Geo Aerosol, which aims to provide a clear visual representation of volcanic ash distribution and forecasts in near-real time, is unprecedented in the world, and its development was more complicated than expected and could not be completed within the timeframe due to a lack of human resources.

For aerosols, LIDAR observation network can produce time-series plots of the vertical distribution of aerosols at each observation point. The plan was to display the risk of health hazards of aerosols near the surface (below 1 km altitude) on a map in four levels, along with the type of aerosol (air pollution, soil, etc.). It was also planned to estimate the weight concentration of volcanic ash up to an altitude of 12 km and display the risk level in four levels on a map, as well as the altitude change of volcanic ash over the past three days. However, the Project was completed without realizing these features.

Based on the above, the Project achieved its project purpose at a limited level.

3.2.2 Impacts

3.2.2.1 Continuation of Activities after Completion of the Project

After the completion of the Project, research activities were continued in both Argentina and Chile, with observation networks and linkages with JICA and Japanese cooperating organizations being maintained. However, the analysis of atmospheric environmental risks and the development of an information sharing system were not continued. The specific situation is described below.

(1) Development of observation network and analysis of aerosol characteristics

<u>Argentinean Implementing Agencies</u>

In Argentina, seven of the eight LIDAR were transferred to the SMN, except for one located at the DEILAP site, to create a permanent observation system in line with the recommendations of the Terminal Evaluation. The SMN has been working to ensure continuous operation through maintenance, with the help of the Japanese experts visiting and working remotely, repairing malfunctioning air conditioning and cooling systems, replacing lamps, and performing other routine maintenance work necessary to operate in severe weather conditions.

As of June 2022, two of the eight units are in constant observation; three are on standby for observations as needed and can begin observations in about 30 minutes if activated by a well-trained operator. In fact, in August 2022, they have observed smoke from a large fire and provided information to the aviation department and the public. The remaining three units are awaiting repair.[13]

LIDAR will perform as expected if adjusted correctly, but if the optical alignments are not adjusted properly, the quality of the signal will deteriorate. Since adjustment requires skill, SMN, in cooperation with DEILAP, has developed software to assist in the adjustment of the instruments, which is now being used on a trial basis. In the future, with the cooperation of the National Institute for Environmental Studies (Japanese cooperating organization; hereinafter referred to as “NIES”), SMN and DEILAP plan to improve the hardware so that it does not require complicated adjustment work. In addition, SMN is developing new software for the

[13] One LIDAR from CEILAP and two LIDAR from SMN.

algorithm to analyze LIDAR data, based on the results of the Project, in collaboration with the Brazilian National Institute for Space Research.

Regarding analysis of aerosol characteristics, six new scientific papers, which were prepared by authors including the counterparts, were published on volcanic ash movement, LIDAR observations, and aerosol analysis in books, international and domestic journals in Argentina.

Chilean Implementing Agencies

LIDAR operated by Magellan University in Chile failed in 2020 and 2021 due to power outages, but university researchers repaired and operated it, and it is now in constant observation. Research on the origin and characteristics of aerosols has been promoted at the University, recording aerosols from the fires in Australia in 2019, aerosols from the fires in central Chile, and 11 new scientific papers and presentations with the counterparts among the authors. The Project also triggered the University to collaborate with a German research institute (Leibniz Institute for Tropospheric Research).

(2) Development of ozone and UV monitoring network and research on ozone hole

Argentinean Implementing Agencies

The SMN installed a new UV observatory in October 2018 at the site where the Argentine Plains Hydrographic Institute is located. At the time of the ex-post evaluation, some of SMN's ozone and UV instruments are under repair or maintenance, but their operational status is generally good.

The ozone LIDAR at Rio Gallegos operated by DEILAP experienced a new cooling system failure without procurement of the dye gas that needed to be replaced. Subsequently, the ozone LIDAR was left inoperable due to the resignation of the locally based DEILAP researcher in charge of the Project and the fact that field visits from Buenos Aires were constrained by the pandemic of COVID-19. Due to the obsolescence of technology for this LIDAR, DEILAP plans not to reactivate the LIDAR in 2021, but to utilize one of its two lasers as an experimental facility for another division of DEILAP, and the other as part of a new aerosol LIDAR. Among the other ozone instruments at DEILAP, the Brewer spectrometer is in operation. The millimeter-wave radiometer, which was upgraded to higher accuracy under the Project, failed in 2018, but repairs are underway with the cooperation of the Japanese experts both visiting and remotely.

Research on ozone by SMN and DEILAP has been continuing even after the Project's completion, with several scientific papers published in international and national journals. In addition, joint research is underway in Argentina for the utilization of solar energy, using

SMN's observation data and observation network.[14]

Chilean Implementing Agencies

The ozone sonde has been suspended since the completion of the Project because the equipment and materials for the ozone sonde provided to Magellan University have been used up. Magellan University has published two scientific papers/presentations on ozone since the completion of the Project.

DMC operates a UV observation network and operates a UV index website. However, there is no direct involvement of the Project in this.

(3) Development of an atmospheric environmental risk analysis and information sharing system

According to SMN, development of the unfinished integrated analysis system (Output 5) and Geo Aerosol (Output 6) was halted after the Project was completed. This is because it was difficult to maintain the complex observation network dispersed over a vast area and to deploy human resources continuously due to the outflow of human resources associated with rapid inflation in Argentina[15], lack of financial resources in the government sector, and the spread of new coronavirus infections.

Observation data are stored on a server located at SMN, but due to information security restrictions, only SMN and DEILAP have direct access to this server. Other organizations are provided with data on an individual request basis.

(4) Cooperation with JICA and Japanese cooperating organizations

JICA third country training was conducted in Argentina in March 2022, with SMN and DEILAP serving as instructors and 37 participants from 7 countries.

SMN and DEILAP maintain the cooperation with the NIES initiated by the Project and have a permanent collaboration on the operation and maintenance of LIDAR since 2018 and every year except 2021, an expert from the Institute has visited Argentina to sequentially repair and adjust LIDAR in different locations.

Magellan University maintains cooperative relationships with Nagoya University and the NIES. The expert from Nagoya University had installed a millimeter-wave spectrometer at the

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[14] SMN has been evaluating solar power generation efficiency with the Nuclear Energy Agency, and optimizing solar power generation forecasts with the National Science and Technology Agency's Computer Simulation Center. An evaluation of Buenos Aires' solar power generation potential with the Buenos Aires Municipal Government's Environmental Protection Agency are currently underway. In addition, SMN, together with the National Institute of Defense Science and Technology, the University of Luján, and the Nuclear Energy Agency, will implement the project "Development of Infrastructure, Calibration, and Instrument Production Capabilities for Nation-wide Measurement of Solar Energy" in order to increase the observational capacity of solar radiation.

[15] Argentina has experienced rapid inflation of 30-50% per annum since 2018. Salary increases in the government sector did not keep pace with this, resulting in an exodus of highly specialized personnel, researchers, and technicians to the private sector in SMN and DEILAP. In particular, IT technicians are in great demand in the private sector, and the exodus of personnel involved in the Project was a major blow to the continuation of activities.

Magellan University Observatory in Rio Gallegos, and joint research funded by Nagoya University's budget and the Ministry of Education's Grant-in-Aid for Scientific Research is underway using the observation equipment of the Project.[16]

3.2.2.2 Achievement of Overall Goal

The Atmospheric Environmental Risk Management System ceased operation in 2019 because Geo Aerosol was not yet complete, the completed Geo UV was not connected to the relevant agencies, and the IT technician who was managing the system at SMN left and could no longer update it. Thus, the overall goal "relevant ministries and agencies use the Atmospheric Environmental Risk Management System to minimize the risks and damages into the society due to UV rays, aerosols, and others" has not been achieved.

On the other hand, instead of Geo Aerosol and Geo UV, which were incomplete, SMN publishes some observation data on its website under the name of Savernet.[17] The only data that is routinely updated here are observations of UV rays. Apart from this, SMN and DMC publish on their respective websites the observed data of UV rays (UV index) and the forecast for the day. According to SMN and DMC, the Savernet site is hardly known to the general public, and UV data is exclusively referred to at the websites of the respective weather stations.

3.2.2.3 Other Impacts regarding Overall Goal

(1) Impact on Atmospheric Environmental Risk Management

In order to manage risks due to UV rays and aerosols, both Argentina and Chile are making use of the observation network and observation data of the Project, and are working on the following.

Argentina

SMN has been working on predicting volcanic ash movement and ash fall through a numerical model since 2017.[18] Observations from the Project were used to validate this model, and the numerical model was also included in the content of the Project's training in Japan. The model predicts volcanic ash movement and fallout based on LIDAR observations, reports from pilots and airports, and information from volcano related agencies, etc. SMN operates one of nine Volcanic Ash Advisory Centers worldwide and provides information to airlines and airports in collaboration with the Argentine Civil Aviation Authority.[19] LIDAR observation

[16] Magellan University is also collaborating with other institutions, including the National Institute of Polar Research (Japan), Hiroshima University, University of Toyama, and La Union University (France).

[17] http://data.savernet-satreps.org/

[18] FALL3D: Created by Barcelona Supercomputing Center, Spain

[19] The International Civil Aviation Organization, in cooperation with the World Meteorological Organization, has established an international airway volcanic ash monitoring system that provides volcanic eruption monitoring and

data developed under the Project will be used when necessary, such as during volcanic eruptions.

Together with the city of Vincente Lopez near Buenos Aires, SMN is implementing an UV protection program “Responsible Use of Sunlight,” which includes the preparation of educational materials, educational awareness activities, installation of UV signals, an initiative started by the preceding technical cooperation and used in the Project, and real-time publication of UV indices.

The Argentine Association of Hygienists worked with the SMN on UV protection for workers, evaluating the health risks from UV, proposing a segmented UV index, and organizing a menu of UV protection measures. The new UV index is based on SMN’s previous observations. The new UV index is available on the SMN website.

Chile

Magellan University forecasts UV indices for Magellan Province using the Norwegian Global Ozone Model and its own model based on historical data from satellite and ground-based observations. The information is published by the provincial authorities and warnings are issued as necessary. The collaboration between the Magellan University and the Provincial Office of the Ministry of Health, which was initiated by the preceding technical cooperation, was strengthened by the provision of UV signals through the Project. After the completion of the Project, the collaboration activities were suspended due to the change of administration and the spread of the new coronavirus infection, but at the time of the ex-post evaluation, coordination will be initiated to resume the collaboration.

(2) Impact on research on atmospheric environmental risk management

As mentioned above, studies on ozone and UV levels and aerosols based on the results of the Project are continuing in both Argentina and Chile. In addition, some of the observation data obtained by SMN, DEILAP, and Magellan University through the observation network of the Project are provided to the following international observation networks, and are used for ozone and aerosol monitoring and research worldwide.

- LATINET: South American LIDAR Network
- Pandonia Global Network: A global monitoring network using the instrument which was included in the Project for air quality, including ozone and aerosols, which is operated by NASA and the European Space Agency (ESA)
- AERONET: NASA’s network for aerosol observation data

actual and forecast volcanic ash cloud information from airway volcanic ash information centers to their respective areas of responsibility, and designated nine Volcanic Ash Advisory Centers worldwide.

3.2.2.4 Other Positive and Negative Impacts

(1) Impact on the natural environment

No direct environmental impacts have been identified.

(2) Resettlement and Land Acquisition

There was no resettlement nor land acquisition by the Project.

(3) Gender Equality, Marginalized People, Social Systems and Norms/Human Well-being and Human Rights, etc.

No impacts of note regarding the above have been identified.

In the Project, aerosol and ozone/UV observation networks were strengthened in both Argentina and Chile, and research based on the data obtained, analysis of atmospheric environmental risks, and development of an information sharing system were promoted. However, the development of an atmospheric environmental risk management system based on these data could not be completed, and the project purpose was partially achieved. Although the system was partially incomplete and ceased operation in 2019, and the overall goal were not achieved, the observation data from the observation network enhanced by the Project are being used for atmospheric environmental risk management purpose and related research. Based on the above, since the Project has to some extent achieved the project purpose and overall goal, effectiveness and impact of the Project are moderately low.

3.3 Efficiency (Rating:②)

3.3.1 Inputs

3.3.1.1 Elements of Inputs

Table 2 shows the planned and actual inputs to the Project from the Japanese, Argentinean, and Chilean sides. In addition to the experts dispatched by the Japanese side, nine other researchers joined the joint research at partner institutions in Japan.

DEILAP contributed to the construction of the observation network by investing a large amount of money in the first half of the Project, including the construction of five LIDAR nationwide at its own expense. However, as described in “3.2.1.1 Achievement of Outputs (1) Development of aerosol observation network and analysis of aerosol characteristics (Outputs 1 and 2),” observations by LIDAR were not stable. On the other hand, the ozone LIDAR directly operated by DEILAP could not be fully operational until the Project was completed because DEILAP was unable to procure the dye gas necessary for its operation due to budget constraints. Against this backdrop, there were delays in the Project’s activities, and the outputs and project purpose remained unachieved.

Since the mid-term review, the need to establish a regular observation system was recognized, and the meteorological agencies of Argentina and Chile were added as implementing agencies to serve as the core users of the Atmospheric Environmental Risk Management System. Human input from the meteorological agencies of both countries contributed greatly to the progress of the Project. In particular, the participation of SMN, whose main task is to conduct regular observations in Argentina, was important for the implementation of stable observations and the preparation of a system to continue observations after the completion of the Project. On the other hand, the participation of the Chilean DMC was beneficial for the establishment of the UV observation network in Argentina, but it was reported that the investment of personnel and budget for the Project, which were not originally planned, put pressure on the DMC's regular work.

Table 2: Planned and actual inputs

Elements of Input	Planned Inputs	Actual Inputs
(1) Dispatch of Experts	Expert Coordinator	1 long-term expert (resident: coordinator) 5 short-term experts (16.0 person-months)
(2) Acceptance of trainees	Training in Japan	Training in Japan: 7 courses for a total of 11 participants (7 from Argentina, 4 from Chile)
(3) Equipment	Research equipment	Observation equipment (183 million yen) Brewer spectroradiometer Excimer laser Transient recorder, etc.
(4) Operational expenses	-	42 million yen
Total project cost on the Japanese side	340 million yen	341 million yen
(5) Counterpart personnel	Counterpart personnel	Project director and project manager (One from each country) Counterpart personnel Argentina: 35 persons, Chile: 9 persons
(6) Facilities and equipment	Materials and equipment for research	Argentina: 580 thousand USD Project office, LIDAR UV observation equipment, etc. Chile: 8 thousand USD Computer, observation vehicle modification, etc.
(7) Others		Operating expenses (travel, conference, etc.) Argentina: 220 thousand USD Chile: 40 thousand USD

Source: Material provided by JICA (at the time of planning: Ex-ante Evaluation Sheet, Detailed Design Study Report, actual results: Terminal Evaluation Report)

According to the experts, communication among the implementing agencies in the two countries was not particularly problematic, in part because of the same language. However, in the first half of the Project, the experts tended to stay in the field for a limited period of time and took longer to recognize and address problems.

3.3.1.2 Project Cost

Project cost of the Japanese side was almost in line with the plan, with actual project cost of 341 million yen (100% of the plan) compared to the planned 340 million yen.

3.3.1.3 Project Period

The project period was five years, from April 2013 to March 2018, as planned.

Although the project cost was almost as planned and the project period was as planned, the efficiency of the Project is judged to be moderately low because the outputs were only partially achieved as described in "3. 2. 1. 1 Achievement of Outputs."[20]

3.4 Sustainability (Rating: ②)

3.4.1 Policy and System

The policies of both countries regarding atmospheric environmental risks at the time of project completion were maintained at the time of ex-post evaluation, and the need for monitoring atmospheric environmental risks due to UV rays (ozone hole), volcanic ash, etc. remains unchanged.[21] In Argentina, SMN is responsible for UV observation and forecasting and warning, and for monitoring volcanic eruptions and providing actual and forecast information on volcanic ash clouds to its responsible areas as a Volcanic Ash Advisory Centers. In Chile, DMC is the official organization responsible for the observation and dissemination of information on UV rays, in accordance with the law for the protection of the ozone layer. In addition, Chilean environmental law establishes standards for air pollution, including aerosols and ozone, and pollution control.

Based on the above, there are no issues with the sustainability of the policy and system aspect of the Project.

3.4.2 Institutional/Organizational Aspect

Argentinean Implementing Agencies

The organizational structure of SMN has not changed since the Project was completed.

[20] Output 1 and Output 4 were judged to be "generally achieved", while Output 2, Output 3, Output 5, and Output 6 were all judged to be "partially achieved". (3. 2. 1. 1 Achievement of Outputs)

[21] In Argentina, efforts to utilize renewable energy, including solar energy, have been intensified in recent years, and the observation network of the Project will be useful for this purpose as well.

CEILAP at the beginning of the Project was renamed DEILAP, but the actual organizational structure remains the same. The transfer of ownership of LIDAR observatories in Argentina (excluding the ozone LIDAR) from CEILAP to SMN was realized after an agreement was signed in September 2018, after project completion. Close collaboration between CEILAP and SMN has been maintained since the completion of the Project, as two of CEILAP's key counterparts have moved to SMN.

Chilean Implementing Agencies

There has been no change in the organizational structure of DMC and Magellan University since the completion of the Project, and a cooperative relationship has been maintained between DMC and Magellan University, mainly in the areas of observations and development of numerical models.

International Cooperation

The collaboration between the Argentinean and Chilean implementing agencies was not maintained after the Project was completed. This may be due to constraints caused by the pandemic of the new coronavirus infection, as well as to the outflow of human resources on the Argentine side.[22] In addition, since Chile is hardly affected by Argentina with regard to volcanic ash, DMC was not proactive in maintaining collaboration, believing that "there is no particular need for permanent collaboration with SMN" and that "it is sufficient to share information only when necessary." SMN stated that "although the scientific research need for collaboration between the two countries is obvious, it is not easy for related organizations to actually coordinate and conduct joint observations." Since the Atmospheric Environmental Risk Management System linking the two countries was virtually never completed and both countries maintain their own observation networks, the failure to maintain collaboration between the two countries does not undermine the sustainability of the actual outcome and impact of the Project.

Experts from Japanese cooperating institutions (Nagoya University and NIES) maintain cooperative relationships with SMN and DEILAP in Argentina and mainly with Magellan University in Chile.

Based on the above, there are no issues with the sustainability of the Project in institutional/ organization aspect.

[22] See "3.2.2.1 Continuation of Activities after Completion of the Project (3) Development of an atmospheric environmental risk analysis and information sharing system" and footnote 15 for more information on the outflow of human resources.

3.4.3 Technical Aspect

Argentinean Implementing Agencies

Seven of the 18 DEILAP counterparts left their jobs (two of them moved to SMN); five of the 12 SMN counterparts left their jobs (one of them passed away). Among others, the resignation of the DEILAP researcher in charge of the ozone LIDAR at Rio Gallegos and the IT specialist in charge of operating and updating the Atmospheric Environmental Risk Management System at SMN have directly affected the sustainability of the Project. It is not easy to obtain replacements for personnel who have left their positions after gaining a high level of expertise and competence through the Project.

DEILAP has the organizational and technical capacity to develop equipment and conduct observations, analysis, and research, and SMN has many years of practical experience in UV observations and a sufficient number of observers throughout the country. However, since the operation and maintenance of LIDAR requires expertise and skill, some of the observatories have not been able to conduct stable observations. On the other hand, the remaining counterparts in SMN and DEILAP are actively continuing their research activities, and communication with Japanese cooperating institutions is being maintained, so there are no particular technical challenges.

Chilean Implementing Agencies

There are no technical concerns because there have been none of the researchers left Magellan University, stable observations continue using LIDAR and other equipment after the completion of the Project, and international joint research is being conducted with Japan and other countries.

One of the four DMC counterparts has moved to the training institute for aviation human resources, while the remaining three continue to work at DMC. It should be noted that the role expected of DMC after the completion of the Project, such as providing UV observation data to the Atmospheric Environmental Risk Management System, is no longer required since Geo UV has ceased operations.

As mentioned above, in Argentina, as the resignation of some counterparts and SMN staff has seriously affected the sustainability of the Project, and the prospect of obtaining replacement personnel is uncertain. Therefore, the technical aspect of the Project has some issues.

3.4.4 Financial Aspect

Argentinean Implementing Agencies

According to SMN, due to the rapid rise in prices in Argentina, SMN’s real budget level (budget level after taking price fluctuations into account) has decreased by about 40% since 2017. Foreign exchange fluctuations are also severe, making it difficult to purchase replacement parts and renewal of observation equipment requiring foreign currency as planned. SMN has secured minimum financial resources from the government budget and other sources, and has secured financial resources for the maintenance, renewal, and new installation of observation equipment through research projects funded by other organizations. However, this is not a stable source of financial resources.

Although financial information of DEILAP was not obtained, the situation is believed similar since it is the same government department as SMN. In fact, the fact that DEILAP did not procure the dye gas needed for the ozone LIDAR even after the Project was completed suggests that DEILAP does not have much room in its budget.

Chilean Implementing Agencies

DMC has a budget to continue its weather observation and forecasting services, but the budget for new equipment is scarce.

Magellan University has a budget to continue the necessary observations, but it is not always sufficient to repair or renew observation equipment or to install new equipment because it is necessary to obtain research projects. The ozone sonde implemented under the Project has not been able to continue because the equipment and materials have been exhausted.

As described above, the implementing agencies in both countries are in a poor financial position, and there is some concern about the financial resources to continue the observations currently being made, especially in Argentina, where the economic situation is difficult. Thus, the financial aspect of the Project has some issues.

3.4.5 Environmental and Social Aspect

There are no issues that need to be noted in terms of environmental and social aspects with regard to the sustainability of the Project.

3.4.6 Preventive Measures to Risks

There are no issues that need to be noted in terms of addressing risks for the sustainability of the Project.

3.4.7 Status of Operation and Maintenance

Most of the materials and equipment for the Project were provided to the Argentinean side; of the 13 pieces of materials and equipment costing more than 1 million yen, 6 items are in need of repair as of June 2022.

Argentinean Implementing Agencies

The operation status of observation equipment on the Argentine side is described in "3.2.2.1 Continuation of Activities after Completion of the Project." SMN is working to ensure proper operation by sequentially upgrading its observation network, including LIDAR. For the operation and maintenance of LIDAR, SMN has obtained the cooperation of experts from the NIES, and has reduced operating costs by limiting the number of LIDAR that are in operation at any given time. Some observation equipment needs to be sent to the U.S. and Europe for adjustment and repair, which involves significant costs, but SMN, together with the National Institute for Defense Science and Technology and others, has launched a project to enable the production and repair of observation equipment in Argentina.[23]

Chilean Implementing Agencies

The mirror server provided to the Chilean side could not be connected to SMN, so it is being operated at DMC for a different purpose than originally intended. LIDAR at Magellan University continues constant observations while making necessary repairs.

As described above, some minor issues have been observed in terms of the technical and financial aspects, and the prospects for improvement and resolution are unclear. Therefore, sustainability of the Project effects is moderately low.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented in Argentina and Chile with the purpose of developing an "Atmospheric Environmental Risk Management System" which monitor and analyze the ozone layer and UV rays as well as conditions of aerosol such as volcanic ash, and provide the results in near-real-time to the meteorological agencies and other related agencies in both countries. The Project is consistent with the development plans and needs of both countries and the Japan's ODA policy, both at the time of planning and at the time of completion. Although an issue can be pointed out regarding the selection of the implementing agencies, it is not so serious as to reduce the relevance of the Project, therefore, the relevance and consistency of the Project are high. The observation network of the two countries was strengthened, and research on aerosols and ozone/UV rays, as well as analysis of atmospheric environmental risks and development of an information sharing system were promoted under the Project. However, the development of the Atmospheric Environmental Risk Management System could not be completed, and the project purpose was partially achieved. Although the overall goal was not achieved, data from the

[23] See footnote 14.

observation network enhanced by the Project are being used for atmospheric environmental risk management and related research. Therefore, a certain level of impacts has been achieved through the implementation of the Project, and the effectiveness and impact of the Project are moderately low. Although the project cost was almost as planned and the project period was as planned, outputs of the Project were achieved only partially, and therefore, the efficiency of the Project is moderately low. There are some technical and financial difficulties in sustaining the results of the Project, and the prospects for improvement and resolution are unclear. Therefore, the sustainability of the project effects is moderately low. In light of the above, the Project is evaluated to be partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agencies

- SMN needs to properly operate LIDAR and other observation equipment installed under the Project and utilize them for the management of atmospheric environmental risks due to aerosols. It is important to work continuously on issues identified after the completion of the Project, including the urgent repair of inoperable LIDAR, the practical application of software to support the adjustment necessary for observations, hardware improvements to reduce the burden of adjustment, and improvements in analysis algorithms, while also utilizing the cooperation of external organizations.
- DEILAP, SMN, Magellan University, and DMC should continue to actively promote joint research utilizing the information obtained from the observation network developed in the Project, based on the experience gained from the collaboration. While maintaining international collaboration with Nagoya University and NIES, scientific knowledge that can be applied to risk management of aerosols, ozone, and UV rays should be obtained in both countries, and research should be conducted with practical applications in mind by the meteorological agency of both countries.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Selection of implementing agencies with social implementation in mind

In the Project, it was planned to analyze aerosol characteristics and develop an atmospheric environmental risk management system based on the assumption that aerosols would be constantly observed by LIDAR. As the Argentinean implementing agency, DEILAP, which has experience in ozone layer observation using LIDAR in an earlier technical cooperation project, participated in the Project and was in charge of the design and fabrication of LIDAR. While, SMN, which had a nationwide observation network, was the actual operator of LIDAR in various parts of the country. However, the design of LIDAR did not adequately take the harshness of the operational environment in the field into account, such as the severe climate and frequent power outages, as well as the level of expertise and competence of the SMN staff, and this affected the achievement of the outputs, as stable observations were not possible.

In the Project, DEILAP was selected as the implementing agency on the Argentine side based on its track record of observations with research as the main objective. The objective of the Project was to develop a practical atmospheric environmental risk management system, but at the beginning of the Project, the implementing agencies were only research institutes in each country (DEILAP and Magellan University). The meteorological agencies of both countries (SMN and DMC), which were supposed to play an important role in the observation and utilization of the system as an actual business, had been participating in the Joint Coordinating Committee since the beginning of the Project, and were finally added as implementing agencies in the latter half of the Project after a mid-term review. If SMN had joined the implementing agency in Argentina from the beginning, it is possible that DEILAP would have had a good understanding of the situation at SMN observation sites and the capabilities of its staff before designing and building LIDAR, and that it would have been able to ensure stable observations by manufacturing more practical LIDAR. On the other hand, DMC reported that joining the Project in the middle of its course and investing human resources and budget that were not originally planned into it put pressure on the DMC's regular operations.

Therefore, it is important that a technical cooperation project for the purpose of social implementation not be pursued solely by research organizations, but that the organization responsible for social implementation be included in the implementing agencies from the beginning. If the need for such an organization is recognized, it is desirable to add it to the implementing organizations even in the middle of the cooperation period. In addition, it is important that the planning of a project, including the consideration of the implementation structure, not only rely on the ideas of researchers who do not necessarily have much experience in practical aspects, but also fully utilize JICA's experience in practical technical cooperation.

Follow-up cooperation for SATREPS

The terminal evaluation of the Project concluded that the project purpose would be largely achievable, with the expectation that the remaining works, including the completion of Geo Aerosol, would be completed during the cooperation period. In reality, however, Geo Aerosol could not be completed, and the project purpose was only partially achieved. While SATREPS basically does not allow for an extension of the cooperation period, the experts were aware of the possibility that the outputs could not be achieved sufficiently within the cooperation period. In addition, the counterparts could not accurately predict whether the work could be completed within the time frame because they had never experienced it before. However, they could not tell the terminal evaluation team, which was assuming that there would be no extensions, that the work could not be completed within the cooperation period. In addition, no additional inputs were made that would have accelerated the work in the remaining period.

In light of the above, if there is no prospect of achieving outputs satisfactory during the cooperation period of SATREPS, which is basically without extension, consideration should be given to either providing additional inputs to achieve the outputs within the cooperation period, or to providing necessary follow-up cooperation by JICA alone after the Project is completed. Furthermore, in the mid-term review and terminal evaluation, it is important to examine as concretely as possible whether the planned outputs can be realized within the cooperation period, and to consider plans for the remaining period after thoroughly examining their feasibility and risks.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective perspective (N/A)

5.1.2 Subjective Perspectives (N/A)

5.2 Additionality

None