

Country Name	<b>Prediction of Climate Variations and Its Application in the Southern African Region</b>
Republic of South Africa	

**I. Project Outline**

Background	<p>Abnormal weather has been partly attributed to the phenomena of different sea surface temperatures between two areas – the Indian Ocean Dipole Mode (IOD) and El Niño/La Niña in the Pacific Ocean. For instance, when record rainfall adversely affected South Africa, there was speculation of an impact on the subtropical IOD. South Africa has been establishing a unique research center in Africa through observation research based on geological characteristics bordering between the Indian Ocean and the Pacific Ocean, and simulation research by regional models, though simulation research for interpreting results of climate observation had not been sufficiently conducted. On the other hand, country reports for Sub-Saharan Africa produced by the United Nations Framework Convention on Climate Change (UNFCCC) revealed weak capacity of scientific observation and forecast. Given this, it was clear that research has been essential to clarify mechanisms of climate change phenomena, to establish forecast models for simultaneous simulation of climate change and weather phenomena, and to apply simulation results to an early warning system.</p>				
Project Objectives	<p>Through clarification of the mechanism of the Sub-tropical Dipole Mode and long-term climate change mechanism, development of the Scale Interaction Experiment-Frontier (SINTEX-F1) as an ocean-atmosphere coupled general circulation, development and improvement of a prototype of an early prediction system as well as networking of scientists involved in climate variation research, the project aimed at enhancing the capacity of seasonal climate prediction in South Africa, thereby contributing to the application of seasonal climate prediction for management of environmental problems in the Southern African Region.</p> <ol style="list-style-type: none"> <li>Expected Overall Goal: N/A</li> <li>Project Purpose: Capacity of seasonal climate prediction in South Africa is enhanced so that it can be applied to management of environmental problems in the Southern African Region.</li> </ol>				
Project Activities	<ol style="list-style-type: none"> <li>Project Site: Cape Town and Pretoria</li> <li>Main Activities: i) clarification of mechanism of the Sub-tropical Dipole Mode and long-term climate change mechanism, ii) development and deployment of SINTEX-F1, iii) development and improvement of a prototype of an early prediction system, and iv) networking of scientists involved in climate variation research</li> <li>Inputs (to carry out above activities): <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Japanese Side</p> <ol style="list-style-type: none"> <li>Experts: 68 persons</li> <li>Equipment: Automatic weather stations (AWSs), computer cluster and peripheral equipment, disk Array and peripheral equipment</li> <li>Operational Cost</li> </ol> </td> <td style="width: 50%; vertical-align: top;"> <p>South African Side</p> <ol style="list-style-type: none"> <li>Staff: 55 persons</li> <li>Land and Facilities: Project Office at the Centre for High Performance Computing (CHPC) in Cape Town, and the Council for Scientific and Industrial Research (CSIR) in Pretoria</li> <li>Operational Cost: Personnel, domestic travel, and allowances</li> </ol> </td> </tr> </table> </li> </ol>			<p>Japanese Side</p> <ol style="list-style-type: none"> <li>Experts: 68 persons</li> <li>Equipment: Automatic weather stations (AWSs), computer cluster and peripheral equipment, disk Array and peripheral equipment</li> <li>Operational Cost</li> </ol>	<p>South African Side</p> <ol style="list-style-type: none"> <li>Staff: 55 persons</li> <li>Land and Facilities: Project Office at the Centre for High Performance Computing (CHPC) in Cape Town, and the Council for Scientific and Industrial Research (CSIR) in Pretoria</li> <li>Operational Cost: Personnel, domestic travel, and allowances</li> </ol>
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Project Period	April 2010 – March 2013	Project Cost	Ex-ante: 300 million yen    Actual: 222 million yen		
Implementing Agencies	Department of Science and Technology (DST) (DST was changed to the Department of Science and Innovation in 2019), Alliance for Collaboration on Climate and Earth Systems Science (ACCESS), University of Pretoria (UP), University of Cape Town (UCT), Council for Scientific and Industrial Research (CSIR), South African Weather Service (SAWS), and Agricultural Research Council (ARC)				
Cooperation Agency in Japan	Japan Agency for Marine-Earth Science and Technology (JAMSTEC), and University of Tokyo				

**II. Result of the Evaluation**

< Special Perspectives Considered in the Ex-Post Evaluation >

[Expected Overall Goal and Utilization of Research Outcomes]

For this SATREPS project, no expected Overall Goal was set forth at the time of project design. However, since the Project Purpose is “Capacity of seasonal climate prediction in South Africa is enhanced so that it can be applied to management of environmental problems in the Southern African Region”. Therefore, it can be interpreted that expected utilization of the research outcomes, which could be an expected Overall Goal, is “Seasonal climate prediction in South Africa is applied to management of environmental problems in the Southern Africa Region”. In addition, in the Terminal Evaluation Report, the use of outputs from the improved climate prediction systems was attempted to produce tailored indices in agriculture, such as the number of rainy days, drought indices by analyzing rainfall and temperature changes. Therefore, the status of application of seasonal climate prediction by SINTEX-F was verified as “Envisaged Overall Goal” as part of the expected positive impact by this SATREPS project at the time of ex-post evaluation.

**1 Relevance**

<Consistency with the Development Policy of South Africa at the Time of Ex-Ante Evaluation and Project Completion>

The Project was consistent with South Africa’s policies to prioritize science and technology to global change such as the “10-Year Innovation Plan” (2008-2018) covering grand challenge areas including global change science, with a focus on climate change, and presenting a vision for South Africa in 2018 to be a world leader in climate science and the response to climate change.

<Consistency with the Development Needs of South Africa at the Time of Ex-Ante Evaluation and Project Completion>

The Project was consistent with South Africa’s development needs for enhancement of the capacity of seasonal climate prediction in

<sup>1</sup> SATREPS: Science and Technology Research Partnership for Sustainable Development

order to clarify mechanisms of climate variability, to establish forecast models to simultaneously simulate climate change and weather phenomena, and to apply simulation results to an early warning system.

<Consistency with Japan’s ODA Policy at the Time of Ex-Ante Evaluation>

The Project was consistent with Japan’s ODA Policy for South Africa prioritizing human resource development for growth strategy, including the scientific and technology/climate change programme, and as policy support for the “Accelerated and Shared Growth Initiative of South Africa (ASGISA)” and the “Joint Initiative on Priority Skills Acquisition (JIPSA)”, agreed to at the policy dialogue between South Africa and Japan in November 2008, and the 9<sup>th</sup> Japan-South Africa Partnership in January 2009<sup>2</sup>.

<Evaluation Result>

In light of the above, the relevance of the project is high.

## 2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the time of Project Completion>

The Project Purpose was achieved at the time of project completion. Climate prediction results from SINTEX-F included in the pre-existing system and disseminated through the website, South African Risk and Vulnerability Atlas (SARVA) (Indicator 1).

<Continuation Status of Project Effects at the time of Ex-post Evaluation>

The project effects have continued since project completion. SINTEX-F outputs have formed part of an ensemble of forecasts for seasonal climate forecasting. Calibration of bias in data produced by seasonal climate forecasting, which is part of this SATREPS project’s research outputs, has been a standard part of data processing by seasonal climate prediction. ARC has provided the data to the SATREPS project’s participants, and it has been used for various projects, including another SATREPS project titled “Development of Infectious Diseases Early Warning System for Southern Africa incorporating Climate Predictions (iDEWS Project)” (2014-2019). The iDEWS Project has benefited from this SATREPS project, and the system was developed for Limpopo.

The seasonal climate prediction data is not available on all websites, but the new system was replaced and it’s now available on request and is being placed on the Climate System Analysis Group (CSAG)’s website via the File Transfer Protocol (FTP). Out of the 25 AWSs initially installed by the project, 21 are still operational and receiving positive feedback from data recipients. AWSs are being managed by ARC, who is experiencing some difficulties with budget and staff shortages. The AWS network has been maintained and valuable data has been collected from the network though four stations are not in use due to vandalism and theft, and they have not been replaced<sup>3</sup>.

<Status of Achievement for Expected Overall Goal at the time of Ex-post Evaluation>

The Expected Overall Goal was achieved at the time of the Ex-Post Evaluation. Climate services are being developed for all scales of weather to climate change time scales. SINTEX-F is continuously being included in ensemble products and remains an important model. There are several ongoing activities where work is applied, including the iDEWS Project for establishing the system for malaria as mentioned above. A few papers were jointly written by South Africa and Japan, named “Seasonal forecasts of the SINTEX-F coupled model applied to maize yield and streamflow estimates over north-eastern South Africa”, and “Dynamical seasonal prediction of Southern African summer precipitation”.

<Other Impacts at the time of Ex-Post Evaluation>

There are some positive impacts of the Project confirmed at the time of the Ex-Post Evaluation. As mentioned above, the weather station network with AWSs has been expanded by 21 additional AWSs installed after project completion. ARC researchers are constantly making use of weather data. The project improved the capacity of several scientists by offering training in SCP technology and research opportunities for higher degrees.

The SATREPS project improved various projects in ARC, and private consultants are making use of the weather data. Not only related government entities, but also broader scientific literacy has been improved. The weather station network created for students and farmers an awareness of climate and its influences in daily life. In particular, farmers have used the weather data for their daily planning and farming activities and started to support the maintenance of AWSs.

The project improved networking amongst South African researchers as well as enhancing relations with Japanese counterparts. The project was helpful in establishing a stronger and wider network between South African and Japanese researchers. The project was a useful opportunity for the creation of a SCP fraternity in South Africa, and for connecting colleagues who otherwise would not be working together.

<Evaluation Result>

Therefore, both the effectiveness and impact of the project is high.

Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) Capacity of seasonal climate prediction in South Africa is enhanced so that it can be applied to management of environmental problems in the Southern African Region.	Dynamical climate prediction results are included in the existing environmental data dissemination system for societal as well as scientific use.	Achievement Status: Achieved (Continued) (Project Completion) ● Climate prediction results from SINTEX-F are included in the pre-existing system and disseminated through the website (SARVA). (Ex-Post Evaluation) ● SINTEX-F is part of an ensemble product for seasonal climate forecasting. Bias correction is also a standard part of data processing. ● Regarding new research projects based on the SATREPS project’s research outputs, all iDEWS Project participants utilized the outcomes of this initiative for the successful development of a system for malaria. ● The seasonal climate prediction data is not available on a website, but the new system was replaced and is now available on request, and it is

<sup>2</sup> Ministry of Foreign Affairs, “ODA Country Databook 2009”

<sup>3</sup> One AWS in Limpopo was stolen and replaced, but the replaced one was vandalized and moved to another site. One AWS in Mpumalanga and the ones in Western Cape were destroyed by a veldt fire. One AWS in the Western Cape was vandalized.

		being placed on CSAG's website via FTP. Out of the 25 AWSs initially installed, 21 are still operational and receiving positive feedback from data recipients. Four AWSs located in remote areas have been destroyed or stolen. The weather station network has been expanded and valuable data have been collected from the network.
(Expected Overall Goal) Application of seasonal climate prediction in South Africa to management of environmental problems in the Southern African Region.	Seasonal climate prediction by SINTEX-F is applied to management of environmental problems in the Southern Africa Region	(Ex-Post Evaluation) Achieved <ul style="list-style-type: none"> <li>● There are several ongoing activities where work is being applied, including the iDEWS Project for establishing the early warning system for malaria.</li> <li>● Climate services are being developed for all weather scales to climate change time scales.</li> <li>● A few papers jointly written by South Africa and Japan, named "Seasonal forecasts of the SINTEX-F coupled model applied to maize yield and streamflow estimates over north-eastern Southern Africa", and "Dynamical seasonal prediction of Southern African summer precipitation". This covered Agriculture as one of three themes identified by the project.</li> </ul>

Source : Terminal Evaluation Report, Questionnaires and interviews with ACCESS, UP and ARC

### 3 Efficiency

The project period and the project cost were within the plan (with the ratios against the plan being 100% and 74%, respectively). The project outputs were produced as planned.

Therefore, the efficiency of the project is high.

### 4 Sustainability

#### <Policy Aspects>

"The Draft National Climate Change Adaptation Strategy for South Africa", announced in May 2019 by the Minister of Environmental Affairs, will enable the country to plan and better respond to intensified impacts of climate change. The Department of Environmental Affairs (DEA) has developed substantially, including the application of SCP to various sectors. The Limpopo Department of Health (LDOH) has adopted the system for malaria. The National Department of Health (NDOH) has monitored and has been considering a national adoption of the system for malaria adopted by LDOH under the iDEWS Project.

#### <Institutional Aspects>

The Strategic Cooperation Framework (SCF) for application of the seasonal prediction data, including the iDEWS Project, has been continuing under the network amongst UP, CSIR, SAWS, ACCESS and others. In addition, as mentioned above, in Limpopo Province, the system for malaria established by using the seasonal prediction data has been adopted by LDOH. The latter will set up the iDEWS Bureau for sustained application of the research outcomes.

As for maintenance of equipment installed by the project, all equipment was formally transferred to the appropriate entities for integration into their maintenance plans. The ownership (and regular maintenance responsibility) was transferred to counterparts; the SINTEX-F to the CSIR, and AWSs to ARC. Most AWSs have been regularly maintained as part of the overall weather station network maintenance plan, and data is being collected and processed daily by ARC. On the other hand, ARC has been requiring additional staff for general maintenance and expansion of the weather station network, however, the personnel for ARC has not been replaced in the last 6 years .

For utilization of research outcomes, the high turn-over of government staff remains a challenge.

#### <Technical Aspects>

SAWS and ARC have retained well-trained staff for operating AWSs and collecting weather data for the seasonal prediction data. Since SINTEX-F has not been used, and with the next generation SINTEX-F2 replacing it, researchers/scientists have not been using the SINTEX-F manuals.

For AWSs operation and maintenance (O&M), ARC staff has sufficient technical knowledge and skills. The AWSs' O&M has been incorporated in the routine work of ARC.

#### <Financial Aspects>

ARC has been maintaining AWSs based on the maintenance plan, although no additional budget has been allocated to AWSs installed by the SATREPS project. ARC is also experiencing budget shortages for extending the weather station network and the personnel and budgetary constraints has been an ever worsening situation.

ACCESS, who greatly contributed to the success of the iDEWS Project, has been advocating for the iDEWS Bureau, as agreed among the South African side, including SAWS, National Institute for Communicable Diseases (NICD), ACCESS/CSIR, South African Medical Research Council (SAMRC), the Limpopo Provincial Department of Health and DSI, and the Japanese side, including Nagasaki University, JAMESTEC and JICA. The Bureau was scheduled to be launched at a side event during the South African Science Forum in December, 2019. DSI will allocate the project budget from the iDEWS Project. For the seasonal prediction, DSI has not allocated budget to ACCESS after the completion of this SATREPS project. However, after starting the iDEWS project, DST has allocated the project budget for the iDEWS Project to ACCESS.

#### <Evaluation Result>

In light of the above, some challenges were observed with institutional and financial aspects. Therefore, the sustainability of the effects through the Project is fair.

### 5 Summary of the Evaluation

The project has achieved the Project Purpose and Overall Goal through utilizing the seasonal climate prediction in South Africa developed by this project to manage environmental challenges in the South Africa Region. As for sustainability, although the implementing agency has been experiencing personnel and budget shortages for the expanding weather station network, the strategic cooperation framework has been maintained for the application of the seasonal climate prediction data and the equipment installed by the project has been properly maintained. Considering all of the above points, this project is evaluated to be highly satisfactory.

### III. Recommendations & Lessons Learnt

#### Recommendations for Implementing Agency:

- DSI should encourage the submission of proposals for advancing project outcomes, especially with Agriculture and Water, and utilizing research outcomes.

#### Lessons Learnt for JICA:

- Through the implementation of the SATREPS project, the strategic cooperation network among the government authorities, universities and research institutes was promoted and the network has been sustained even after the project's completion. The project researchers, particularly both countries' leaders, endeavored to establish a trusting relationship among the stakeholders by having continuous communication between the South African and Japanese sides. Examples of this include organizing lectures by young Japanese researchers to South African students, motivating the project's members by closely supervising the manuscripts of their collaborative research's outcomes, and holding international symposiums, seminars and workshops by both countries' senior researchers. Obtaining approval for the 2<sup>nd</sup> phase SATREPS project (iDEWS), which applies this project's outputs/outcomes toward the infectious diseases field, was also considered as helping to sustain the cooperation network.



One of the 6 automatic weather stations acquired for the SATREPS project on Seasonal Climate Projection.



Colleagues from SATREPS project on Seasonal Climate Projection science meeting in Pretoria