Summary of Terminal Evaluation Study Results

<table>
<tr><td colspan="3">I. Outline of the Project</td></tr>
<tr><td colspan="2">Country : Republic of South Africa</td><td>Project title : Prediction of Climate Variations and its Application in the Southern African Region</td></tr>
<tr><td colspan="2">Sector : Environmental Management - Gloval Climate Change</td><td>Cooperation scheme : Science and Technology Research Partnership for Sustainable Development (SATREPS)</td></tr>
<tr><td colspan="2">Division in charge :
Environmental Management Division 2, Environmental Management Group, Global Environment Department</td><td>Total cost: 235 million yen</td></tr>
<tr><td rowspan="3">Period of Cooperation</td><td rowspan="3">(R/D) February 26, 2010

April 2010 to March 2013</td><td>Partner country's implementing organization :
Department of Science and Technology (DST)
Applied Centre for Climate and Earth System Studies (ACCESS)</td></tr>
<tr><td>Supporting organization in Japan:
Japan Science and Technology Agency (JST)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
The University of Tokyo</td></tr>
<tr><td>Related cooperation: NA</td></tr>
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1 Background of the Project

The Project, focusing on the Southern African region, promotes climate variation prediction with research aimed at development of a new Ocean-atmosphere coupled general circulation models through the collaborative research with the climate research institutions in South Africa. This model predicts climate variation and clarifies its impacts specifically on the Southern African regions with improved accuracy. The weather/ climate variation prediction system, using data from satellite and ocean observatory, is expected to downscale to the regional or local level, such as Limpopo and Western Cape regions in South Africa as well as verification of the prediction. With the verified downscaled prediction, climate prediction for the next several months to several years will also be attempted. It is also expected to enhance systems for climate prediction research in South Africa, through conducting collaborative academic research and strengthening the networks.

2 Project Overview

(1) Overall goal

Overall goal was not set.

(2) 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.

(3) Outputs

1. Predictability of the Subtropical Dipole Mode and its influence on the Southern African Region is evaluated.
2. Seasonal climate prediction for the Southern African Region becomes available by use of an ocean-atmosphere coupled general circulation model.
3. Ocean-atmosphere coupled general circulation models are improved.
4. A prototype of early prediction system for mitigating impacts of abnormal weather is developed and implemented.
5. Network for scientists involved in climate variations research is strengthened in the Southern African Region.

（4） Inputs（to the point of the terminal evaluation study）

Japanese side：

Dispatch of long-term-experts	2 persons
Dispatch of short-term-experts	66 persons
Provision of equipment	47,904,000 yen
Local Cost	21,339,000 yen
Invitation of trainees	27 persons

South African side：

Assignment of 55 counterparts (for management and researchers: some are overlapped)
Provision of facilities
Local cost ZAR4.31 million

II. Evaluation Team

Members of evaluation team	1. Mr. Ichiro Adachi (Leader) Director, Environmental Management Division 2, Environmental Management Group, Global Environment Dept., JICA 2. Prof. Yoshifumi Yasuoka Professor Emeritus, the University of Tokyo Program Officer, Research Partnership for Sustainable Development Division, JST 3. Mr. Akio Takahashi Senior Staff, Research Partnership for Sustainable Development Division, JST 4. Mr. Hideaki Matsuoka Deputy Director, Environmental Management Division 2, Environmental Management Group, Global Environment Dept., JICA 5. Ms. Rie Kawahara R-Quest Corporation	
Evaluation period	October 7 – 20, 2012	

III. Results of Evaluation

1 Project Performance

(1) Achievement of the Project Purpose

It is highly expected that the Project Purpose will be achieved by the end of the Project. A planned indicator was attained as climate prediction results from SINTEX-F are already included in the pre-existing prediction system of South Africa, and disseminated and updated regularly through the website (“SARVA”).

Seasonal prediction of precipitation in austral summer (December-February) by the SINTEX-F model achieved anomaly correlation coefficient of 0.7 with lead-time of 3 months. This is higher than the anomaly correlation of 0.6, which is regarded as the criterion for successful prediction in the climate prediction community. Thus, by incorporating the SINTEX-F prediction results, the existing prediction system in South Africa is enhanced.

Also, supplied computers that were solely devoted to seasonal climate prediction and downscaling, and supplied AWSs, that will be used for verification of downscaled seasonal prediction, are contributing to enhanced capacity of seasonal climate prediction in South Africa. The above climate prediction information has been already disseminated through the web sites in both South Africa and Japan, and will be applied to management of environmental problems in the

Southern African Region. The South African researchers have made a first attempt of application by incorporating the SINTEX-F results to crop and stream flow models, and more societal applications are expected in future.

Numbers of scientific research papers published and submitted to the international journals are 44 in total, and this is far more than expectations in numbers as summarized below. .

- Accepted:
  Published: In Japan: 1, International: 32
  In Press: In Japan: 0, International: 2
- Submitted:
  In Japan: 0, International: 9

(2) Achievement of the Results

Output 1

All the 7 planned activities were successfully completed, and the results of all activities were reported in 24 published research papers. In addition, 6 papers were already submitted to the international journals. As a comparison with the indicator planned, far more numbers of publications were made successfully.

24 research papers were accepted and published by peer reviewed international journals as compared with more than 3 research paper in the plan.

Major achievements through the activities are as follows:

1) The mechanism of Subtropical Dipole Modes was clarified. Major findings were reported in research papers.
2) Predictability of Subtropical Dipole Modes was assessed using the SINTEX-F model, and it was shown for the first time that the model can successfully predict the Subtropical Dipole Modes at lead time of up to 1-2 seasons. These results were reported in a submitted paper.
3) Variability in the Agulhas and Benguela systems was examined. Major findings were reported in research papers.

Output 2

All the 5 planned activities were completed. Seasonal climate prediction is verified by the pre-existing international datasets. Weather data collected during the Project period at the weather stations installed in Limpopo (20) and Western Cape (5) regions will be used for verification of downscaling seasonal prediction by University of Pretoria and University of Cape Town with the Japanese researchers by the end of the Project period.

Seasonal prediction is conducted by SINTEX-F, and the prediction results were posted on the web-sites of JAMSTEC and CSIR (Web-sites: SA: Risk and Vulnerability Atlas, CSIR), as it was planned.

Five research papers were accepted by peer reviewed international journals, and 1 research paper was submitted to an international journal as compared with acceptance of at least one scientific research paper in the plan.

Major achievements of the activities are as follows.

1) Using the Earth Simulator, ensemble prediction experiments of the SINTEX-F model were conducted every month for seasonal prediction up to one year lead. These prediction results were posted on the project web site as a part of Group 4 activity.
2) Downscaling simulations for the Southern African Region were conducted using the WRF model. Results from these simulations were reported in a research paper.
3) Seasonal prediction results from SINTEX-F model were downscaled using the WRF model. These prediction results are reported in a research paper.

Output 3

All the 7 activities were completed. As compared with the indicator that aimed acceptance of more than one scientific research paper, 3 research papers listed below were accepted and published.

Major achievements of the activities are as follows.

1) Common experiments were conducted using general circulation models in both Japan and South Africa. These results were reported in research papers.
2) Roles of land-surface forcing in relation to ocean forcing are examined by modifying vegetation specification, albedo, and soil moisture in general circulation models. These results were reported in a research paper
3) The UTCM was installed in computers supplied by JICA to CSIR and University of Pretoria.

Output 4

Output 4 was mostly achieved, and it is expected that all the activities planned will be completed by the end of the Project. A report, which describes how the existing early prediction systems, has not been made yet, but it is planned to be prepared by the end of the Project. Access to the augmented system was already established by posting seasonal prediction results on the website named "South African Risk and Vulnerability Atlas" in South Africa.

Major achievements of the activities are as follows.

1) Results from seasonal prediction conducted by Group 2 are posted on the Project web site.
2) Regional predictions for the Southern African Region are posted on the Project web site.
3) The existing early prediction systems will be augmented by incorporating seasonal prediction results from the SINTEX-F model by the end of this Project.

Output 5

All of the 3 activities were successfully completed. In comparison with the indicators, the followings are attained. Eight times of international events were organized in total for 3 years as compared with at least 1 time in the plan. Ten times of seminar series and workshops were organized in South Africa as compared with at least 1 time annual in the plan.

As listed below, 3 levels of interactions among researchers and organizations on climate forecasting were enhanced during the course of the Project. These interactions are expected to be further strengthened in future.

- Bilateral interactions between South Africa and Japan
- Intra-South African climate research/forecast institutions
- Linkage with the SADC countries

Regarding the intra-South African interactions, this was the first time for such a large number of the South African climate research institutions to be involved in as single Project. As a by-product and outcomes of the Project, "forum" composed of the partners relating climate forecasting/research in South Africa is under preparation, and it will be started quarterly around the end of 2012 or the beginning of 2013. SAWS will play a pivotal role to coordinate the forum with coordination of ACCESS.

2 Summary of the Evaluation Results

Results of five criteria evaluation are summarized in five ratings. The highest rate is "very high", and followed by "high", "fair", "low" and "very low".

(1) Relevance: Relevance for the Project is judged to be very high

Purpose of the Project is consistent with the South Africa's national policies on human resources development and strengthening science, which are both addressed in "Accelerated and Shared Growth Initiative for South Africa (AsgiSA) (2005)." It is also consistent with the DST's strategy of "INNOVATION TOWARDS A KNOWLEDGE-BASED ECONOMY: Ten-Year Plan for South Africa (2008 – 2018)," in which South Africa's prospects to improve competitiveness and economic growth through the production and dissemination of knowledge and Research and Development. The plan stipulates that South Africa is in the position to lead scientific research in response to "the climate change" in the African continent.

The Project satisfies the need of the planned direct-beneficiaries, such as researchers and students, through enhancing institutional capacity for the climate prediction research community and the climate prediction systems in South Africa. Selecting Limpopo and Western Cape regions, as the downscaling sites, was also appropriate in light of utilization of the downscaling data for both the scientific researches, and application to agricultural productions (Limpopo) in future, and climate data validation (Western Cape).

The Project is also in line with Japan's foreign policy on contributing to global measures against climate change, and Japan's cooperation policies in South Africa, which emphasize capacity enhancement of human resources and technologies in the science and environmental sectors. JICA also priotizes to support generation of innovation in scientific fields and thus its societal application will realize the benefits of society.

(2) Effectiveness: Effectiveness of the Project is judged to be high.

Seasonal prediction of precipitation in austral summer (December-February) by the SINTEX-F model achieved anomaly correlation coefficient (0.7) with lead-time of 3 months, and this is higher (+1) than the anomaly correlation (0.6), which is regarded as the criterion for successful prediction in the climate prediction community. Having the SINTEX-F prediction results, the existing prediction system in South Africa is thus enhanced.

Supplied computers and AWS also contribute to enhance capacity of seasonal climate prediction in South Africa. The climate prediction information is already started to be disseminated through the web sites, and will be applied to management of environmental problems in the Southern African Region. Total number of scientific research papers published and submitted is 44, as a part of deliverables/ products, during the Project were far more than expectation.

Also the Project generated the 3 different levels of interactions among researchers and organizations on climate research/forecasting in South Africa as follows.

- Bilateral interactions between South Africa and Japan
- Intra-South African climate research/forecast institutions
- Linkage with the SADC countries

(3) Efficiency: Project was implemented efficiently

According to interviews to both South African and Japanese side researchers, it was pointed out inputs from the both sides were appropriate, and used in efficient ways to carry out the activities and to produce the expected Outputs.

In particular, as stated, equipment supplied by JICA during the course of the Project was highly appreciated and satisfied needs of the South African researchers. In particular, provision of computers, which are solely devoted to use for seasonal climate prediction and downscaling, and AWS, which will be used for verification of downscaled seasonal prediction and incorporated into the national weather station system by ARC, contributed for enhancing capacity of climate prediction in South Africa. While procurement and installation of 25 sets of the AWS were delayed, and it made periods of collecting the weather data shortened a half year to one year, as compared with the initial plans. However, after the installation, the AWS is already integrated into the ARC's national weather station networks, which are composed of more than 600 weather stations. They are well operated and maintained by ARC as it was expected in the plan.

Deployment of Project Director (DST), Project Managers (ACCESS) and 5 working group members in both the South African and the Japanese sides were with high capability and

expertize, so that progress of the activities were made as planned in successful ways. In particular, endeavors by Project Manager from ACCESS for supervision and coordination of the South African side activities and inputs, and the coordinators from JICA and JAMSTEC to bridge the both country side members, are highly recognized as one of key contributing factors for success among the both sides of researchers. There was no significant negative factor affecting efficiency during the course of the Project.

(4) Impact: Impact of the Project is judged to be very high

Impact is prospected to be high since the Project attained creation and operation of improving climate seasonal forecasting models. Improved climate forecasting system is already running not only in South Africa but also for SADC countries as the results of the Project, and prediction is posted and updated regularly in the web sites.

If seasonal climate prediction information is suitably applied and accepted for sectors of agriculture, health/sanitation and water resources, it is expected that risks from extreme climate and natural environments are mitigated. Thereby economic and social impacts of the Project results would be evaluated high.

In the Project, the use of the Output from the improved climate forecasting systems was attempted to produce tailored indices in agriculture, such as number of rain days, drought indices by analyzing rainfall and temperature changes. Possibilities of societal application, by using the result of developed and improved forecasting systems, will be expanded further in future.

It is highly anticipated that polices and strategies on facilitating scientific advancement on seasonal climate forecasting/prediction in South Africa will not be changed, and continues after the Project.

(5) Sustainability: Sustainability is judged to be high

Institutional/policy aspects

As DST's plan of "INNOVATION TOWARDS A KNOWLEDGE-BASED ECONOMY: Ten-Year Plan for South Africa (2008 – 2018)" stipulates, improvement of scientific knowledge regarding climate forecasting/prediction and its social application for mitigating risks to society is committed by the South African government. The government also anticipates the scientific knowledge and researches on climate changes and forecasting/prediction systems to apply for the extend area in the Africa continents and to play the leading roles in the region, as stated in the national strategies. Thereby, it appears that continuity of research and operation of the improved climate forecasting systems by forecasting, research and service institutions such as CSIR, SAWS, ARC and Universities in South Africa, are ensured.

Ideas and possible means of applying the forecasting information to the societal benefits in future have been already under development at some institutions, such as ARC, MRC and universities.

Organizational aspects

There is adequate human resources development at the research institutions and higher education systems.

Sense of the ownership on the Project, and the achievement of the Project has been high since the start of the Project, and ensured by the South African side. There are also sufficient and very appropriate operation and management capabilities to keep the Outputs generated by the Project at the research institutions in South Africa. There are also ideas between the South

African side and the Japanese researcher side to prepare MOU or an agreement to keep the relations and a joint research in further.

Financial aspects

According to the finding in the evaluation study, South African research institutions and universities have good measures to secure budget /finance for continuing the Outputs of the Project, and to continue running supplied equipment by their own efforts.

Technical aspects

Each institution and university has high capacity to manage continuity of researches (mostly exchanges of individual researchers between two counties, or JAMSTEC's partnerships with these institutions), and operation and maintenance of equipment after the Project are also ensured by the South African side.

3 Factors that promoted realization of effects

(1) Factors concerning the planning contents

Due to the provision of computers for climate prediction and AWSs, data collection, analysis and handling could be processed smoothly.

(2) Factors concerning the implementation process

- Interactions between the South African and Japanese researchers through the joint researches
- Consolidation of relations/linkages among the South African climate forecasting research institutions
- High standard expertize, accumulated experiences and knowledge of Japanese side research institutions/researchers
- Supply of computers, which made possible data processing, model simulation and data storing, and AWSs, which are now integrated into the national weather station system, and run and managed well in South Africa.
- Efforts made by DST's Project Director, ACCESS's Project Managers and coordinators of JICA and JAMSTEC.

4 Factors that impeded realization of effects

(1) Factors concerning the planned contents

There is no particular issue to be noted.

(2) Factors concerning the implementation process

According to the interview results from South African researchers, there are gaps on funding systems between practices in South African research institutions and funds disbursed by SATREPS. In South Africa, most of the budget at the research institutions is generated from their earnings based on a contract with clients. On the other hand, there is no finance arrangement to cover costs on research activities in SATREPS. As a result, some South African working group members found a little difficulties and restriction to allocate their time and labor for the SATREPS activities, and needed to find financial resources by themselves to involve the SATREPS activities.

Reflecting this lessons and experience, it is necessary to build consensus and make agreements on possible budgetary arrangement, and options on financial resources for the research activities by the partner countries before starting Projects in the future similar projects.

5 Conclusion

The Project has completed most of the necessary tasks for achieving the planned Outputs. According to the series of related document reviews, interviews and discussions in both South African and Japanese sides, the Evaluation Team concludes that all the planned Outputs and Project Purpose will be successfully achieved by the end of the Project.

As stated, the existing prediction system in South Africa has been enhanced, and scientific research papers published during the course of the Project were 44, which are far more than expected numbers in the plan. The 3 different levels of interactions among the both countries' researchers and organizations on climate forecasting started and deepened, as activities of the Project were preceded.

It is expected that the results and Outputs, such as information of seasonal climate prediction, will be adopted in future decision making processes for the benefit of the society in the field of agriculture, medical/health and water resources among others.

6 Recommendations (Specific measures, suggestions and advices)

This Project gave a good opportunity to researchers, administrators and coordinators from different institutes in South Africa and Japan collaborated and built the basis for the seasonal climate prediction and its application. These efforts should be continued to achieve not only the Project purpose but further benefit to the scientific field as well as the society even after the Project period.

It is recommended that the possibility of dissemination of the information acquired from the seasonal climate prediction model be continuously discussed with prospective stakeholders in various field, such as agriculture, health (infectious diseases), disaster management, and water resource management, so that the usefulness of the model can be broadly acknowledged. Thus, SAWS will take the initiative to coordinate this with these stakeholders and this will happen in partnership with ACCESS.

7 Lessons Learned (References drawn from this Project to develop and formulate, implement and administer further projects)

Although there were some difficulties at the beginning of the Project with regards to a shared common understanding of the Project among the researchers and administrators from different institutes, the relationship has gradually improved with continuous effort of communication from both South African and Japanese sides, and as a result, a trustful relationship has been established between both sides. It was acknowledged that the frequent communication and building of firm relationship among stakeholders were keys to the success of the Project.

The lecture series carried out for university students was positively evaluated by the South African side. In this activity, Japanese researchers visited universities in South Africa and gave lectures to young students on climate variations etc. Although this activity was not directly linked to the Outputs of the Project, it has had a significant impact to strengthen the relationship between South African and Japanese sides. It is also noted the Project also provided good opportunities for the students and the relatively younger researchers to present their research results to workshop audiences and notable senior researchers. This would contribute in view of capacity building in the field of climate forecasting research, and benefit the scientific advancement in future for both the South African and Japanese sides.

8 Follow-ups

Possibility to apply the results of this Project in disaster management, agriculture, health sectors etc. will be continuously studied.