SOUTHERN AFRICAN REGIONAL SEASONAL CLIMATE OUTLOOK PROCESS

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MAHE,
SEYCHELLES
19-23 SEP 2016

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SADC-CSC
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Format of Presentation

SADC CLIMATE SERVICES CENTRE

• Historical background
• Operational Activities
• Seasonal climate forecasting tools
• SARCOF & CSC Products
• Concepts of Seasonal Climate Prediction
• Verification
• 2016/17 Seasonal rainfall outlook
SADC Climate Services Centre

Responsible for monitoring and predicting of climatic extremes such as floods and droughts in a timely manner with respect to their intensity, geographical extent, duration and impact upon various socio-economic sectors and giving early warning for the formulation of appropriate strategies to combat their adverse effects thus contributing to minimizing their negative impacts.
Drought, Flood & Impact

Climate prediction

Training
HISTORICAL BACKGROUND OF DMC/CSC


- Central objective to have regional approaches in mitigating adverse climate impacts to socioeconomic developments.

- Initial funding from UNDP

- Next funding from the Belgian Government, with a condition that SADC gradually takes over the funding of the then DMC Harare.

- Since April 2002, core activities are funded by SADC.

- However, programme activities are still being funded by cooperating partners: WMO, USAID, NOAA and others.
ROLE OF THE SADC CSC

1) OBJECTIVE

To contribute to mitigation of adverse impacts of extreme climate variations on socioeconomic development.

- This is achieved through the monitoring of near real-time climatic trends and generating medium-range (10-14 days) and long-range climate outlook products on monthly and seasonal (3-6 months) timescales.

- These products are disseminated in timely manner to the communities of the sub-region principally through the NMHSs, regional organizations, and also directly through email services to various users who include media agencies. Our products are readily available on our website: [http://www.sadc.int](http://www.sadc.int), e.mail address is: dmc@sadc.int
The provision of products and services enables the formulation of appropriate strategies to combat the adverse effects of climate extremes on socio-economic development.

Since establishment, the center has played an important and useful role in providing the sub-region with weather and climate advisories and more importantly, timely early warning on drought, floods and other extreme climate events.
2. OPERATIONAL ACTIVITIES

- Developing and archiving of global, regional and national quality controlled climate databanks
- Providing of climate monitoring, prediction and application services,
- Conducting training and capacity building activities in the generation and application of climate products,
- Organizing the Climate Outlook Forum for the SADC region,
- Enhancing the interactions with the user through regional users workshops and application pilot projects.
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- This is achieved through the monitoring of near real-time climatic trends and generating medium-range and long-range climate outlook products on monthly and seasonal (3-6 months) timescales.

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The provision of early warning for the formulation of appropriate strategies to combat the adverse effects of climate extremes affords greater opportunity to decision-makers for development of prudent plans for mitigating the negative impacts on socio-economic.
2. OPERATIONAL ACTIVITIES CARRIED OUT

- Developing and archiving of global, regional and national quality controlled climate databanks
- Providing of climate monitoring, prediction and application services,
- Develop synergies with international sister organizations
- Conducting training and capacity building activities in the generation and application of climate products
- Organizing the SARCOFs (Southern Africa Regional Climate Outlook Forums), and
- Enhancing the interactions with the users through regional users workshops.
3. CAPACITY BUILDING ACTIVITIES

- Training SADC (NMHSs) staff on developing climate monitoring and prediction techniques of NMHSs through Southern Africa Region Climate Outlook Forum (SARCOF) process.

- Developing synergies with sister organization in order to provide best practice in climate diagnosis & prediction.

- Strengthening links with users from sectors such as health, food security (early warning systems), water resources management, media, tourism industry, etc.
Concepts of Seasonal Climate Prediction
Scientific Basis of Seasonal Climate Forecasting

• The evolution of the atmosphere is partly driven by the evolution of external forcing conditions (SST and continental surfaces).

• The evolution of external forcings is often slow and predictable. It gives a slow memory to the atmosphere; the evolution of the latter becoming partly predictable.

• The successive instantaneous states of the atmosphere have a limited predictability while the mean states of the atmosphere have a greater predictability.

• The mean circulation in tropical regions is strongly influenced by the large scale organised convection.
Climate monitoring Indicators

The frequently used indicators for monitoring, analyzing and predicting extreme climate events include:

• Sea Surface Temperatures (SSTs)
• Sea surface Temperature Gradients (SSTGs)
• El-Niño Southern Oscillation (ENSO) Indices
• Indian Ocean Dipole (IOD)
• Tropical Cyclones (TC)
• Stratospheric winds (Quasi-Biennial Oscillation)
• Inter-Tropical Convergence Zone (ITCZ)
• Rainfall, surface winds, Air temperature and Humidity
Southern Oscillation Index Centres

Darwin

Tahiti
Historical Sea Surface Temperature Index

Time Period
• Prediction of future state of Atmosphere
  – Understanding the physics of the atmosphere
  – Using computer models (high power)
  – Important for application in socio-economic sectors

• Basic approaches
  – Analogue, Stats and Dynamical
Seasonal Climate Prediction in Southern Africa: Current and Future Trend

STATISTICS (Now)

TECHNIQUES DEVELOPMENT

DYNAMICAL (Now & Future)
Seasonal Climate Prediction in Southern Africa: Current and Future Trend

Regressing Models

PERFECTING & OPERATIONALIZING

TRAINING PERIOD

PCA Derived Homogeneous rainfall zones

Rainfall zone Indices

STATISTICS (Now)

ANALOGUES

Current condition & Similarity with historical pattern

Projection

Predictors Identification
Seasonal Climate Prediction in Southern Africa: Current and Future Trend

DYNAMICAL (Now & Future)

AGCMS

i) $dT/dt \sim$ several k/day
ii) Parameterization
iii) Downscaling

RCMS

Full physics
Seasonal Climate Prediction in Southern Africa: Current and Future Trend

**TECHNIQUES DEVELOPMENT**

- Actual mean SSTs
- Circulation Stats
- Radiative Transfer

**ANALOGUE**
- Current condition
- Similarity with Historical pattern

**R C M (dynamical)**

**Statistical Prediction techniques**

**Regional Seasonal Climate Prediction**

**GUIDANCE**

**Correlation Stats. Model Construction Regression**

**Downscaling**

**MAN-MACHINE MIX**

*Accuracy
*Reliabilty
*Skill

**TECHNIQUES DEVELOPMENT**

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**MAN-MACHINE MIX**

*Accuracy
*Reliabilty
*Skill
Limitations

- Inadequate observations
- Inexact definition of climate
- Incomplete understanding of system
- Cost of running models
- Other resources
- Affordability of developing countries
Ten-day Drought Watch
for Southern Africa
Drought Monitoring Centre (Harare)

Issue No 6 - 2000/2001
Period: 21 - 30 November 2000
Issued: 08 December 2000

Synoptic review

The main area determined to have been well watered down to the beginning of November was that located in the eastern region of Southern Africa. Thereafter and until the end of the month, the region generally received rain and this extended to the western part of the sub-region. The general absence of significant rainfall in the eastern region was associated with the movement of high pressure systems over the region.

Rainfall summary

The third decade of March was generally wet. Rainfall was above average (100-300 mm) over south eastern Malawi and Mozambique. It was below average (0-100 mm) over southern Africa throughout the period. The rainfall totals over southern Africa for the month are shown in Figure 1.

As can be seen from the data, there were generally wet conditions over southern Africa for the month. The rainfall distribution and percentage of normal across the sub-region during the third decade of the month are illustrated in Figures 2(a) and 2(b).

Figure 1. SST Anomaly

The Southern Oscillation Index (SOI) remained at -1.6 since the beginning of the month. The SOI has been negative since late November 2000, which is consistent with the generally wet conditions over southern Africa.

Figure 2: SST Anomaly

The SST anomaly for the month of March 2001 shows that the area with the highest anomaly was in the Indian Ocean, indicating a strong La Niña event.

SOUTHERN AFRICAN DEVELOPMENT (SADC) RAINFALL OUTLOOK FOR APRIL-MAY-JUNE 2001
Drought Monitoring Centre (Harare)

Issue No 5
April-May-June 2001

The likelihood of a wet region, Mozambique, the Democratic Republic of Congo and Zambia, for the month of May to June 2001 was rainfall during the second half of the month.

Sea surface temperatures

The warming in the southern part of the ocean (Figure 1) is a result of the Indian Ocean Basin warming (IOBW). The warming in the southwestern part of the ocean (Figure 2) is a result of the Indian Ocean Basin warming (IOBW).

Figure 3: SST Anomaly

Figure 3 shows the SST anomaly for the Indian Ocean Basin, indicating a strong La Niña event.

Figure 4: SST Anomaly

Figure 4 shows the SST anomaly for the Indian Ocean Basin, indicating a strong La Niña event.

Figure 5: SST Anomaly

Figure 5 shows the SST anomaly for the Indian Ocean Basin, indicating a strong La Niña event.

Ten-day Drought Watch
for Southern Africa
Drought Monitoring Centre (Harare)

Issue No. 18 - 2000/2001
Period: 21 - 31 March 2001
Issued: 10 April 2001

Synoptic review

The middle (500 hPa) level anticyclone centred over the central Mozambique and the southwestern part of Namibia and western Namibia were the dominant features during the third decade of March. Meanwhile, the effects of the southern limit of the Intertropical-Convergence Zone (ITCZ) were oscillating over northern Zambia. DMC, northern Mozambique, Tanzania and northern Angola. This resulted in intense convective activity over the northern area of the sub-region for most of the period under review. Meanwhile, the Intertropical-Convergence Zone (ITCZ) was located over the northwestern Indian Ocean remained active along the northern Madagascar.

Figure 1: Typical middle (500 hPa) level average circulation pattern during most of the period from 21 to 31 March 2001

Figure 1: Typical middle (500 hPa) level average circulation pattern during most of the period from 21 to 31 March 2001

Countries of the sub-region including, central Tanzania, western and southern part of Mozambique, Zimbabwe, Botswana, most of Angola, south Angola, most of South Africa, Swaziland, southern half of Lesotho, southwestern part of Zambia received 60 mm or less rainfall during the period under review. North-eastern Angola, Seychelles, eastern and northern Mozambique, northern Lesotho, northern and central Zambia, a bulk of Tanzania, Mauritius and a strip of central South Africa and northern Malawi received more than 800 mm rainfall during this period.
Global Prediction Centre Product
Contents

• 1. Uncalibrated (Ensemble frequency) forecasts
• 2. CPT CCA Forecasts of seasonal rainfall and skill assessments
  • For OND
  • For JFM
• 3 Multi-model skill
  • ROC and Reliability
  • For OND
  • For JFM
• 4 Multi-model forecasts
  • For OND
  • For JFM
During January through mid-March 2015, near-to-below average SSTs were observed in the eastern Pacific, and positive SST anomalies persisted across.

Recent Evolution of Equatorial Pacific SST Departures (°C)
The latest weekly SST departures are:

- Niño 4: 1.1°C
- Niño 3.4: 2.4°C
- Niño 3: 2.6°C
- Niño 1+2: 2.5°C
During the last four weeks, tropical SSTs were above average across the central and eastern Pacific, with the largest anomalies in the eastern Pacific.
During the last four weeks, tropical SSTs were above average across the central and eastern Pacific and most of the Indian Ocean. SSTs were below average near Indonesia.
Upper-Ocean Conditions in the Equatorial Pacific

The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

Recent values of the upper-ocean heat anomalies (positive) and thermocline slope index (negative) reflect El Niño.

The monthly thermocline slope index represents the difference in anomalous depth of the 20ºC isotherm between the western Pacific (160ºE-150ºW) and the eastern Pacific (90º-140ºW).
The most recent ONI value (July - September 2015) is 1.5°C.
**Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v4**

Recent Pacific warm (red) and cold (blue) periods based on a threshold of +/- 0.5 °C for the Oceanic Niño Index (ONI) [3 month running mean of ERSST.v4 SST anomalies in the Niño 3.4 region (5N-5S, 120-170W)]. For historical purposes, periods of below and above normal SSTs are colored in blue and red when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

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<th>MAM</th>
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Predictive power of SADC CSC Ocean Basins for DJF Forecasting using Nov SSTs
Region 1: Correlations versus existing ocean basins
Region 2: Correlations versus existing ocean basins
Region 3: Correlations versus existing ocean basins
Region 4: Correlations versus existing ocean basins
Region 5: Correlations versus existing ocean basins
Region 6: Correlations versus existing ocean basins
Region 7: Correlations versus existing ocean basins
Region 8: Correlations versus existing ocean basins
Region 9: Correlations versus existing ocean basins
4. SOUTHERN AFRICA REGIONAL CLIMATE OUTLOOK FORUM

The SADC DMC/CSC organized the fourteen Southern Africa Climate Outlook forums (SARCOF),

- It provided a consensus seasonal climate outlook form for the SADC region.

- Strengthened interaction between the users and the climate scientists to enhance the application of meteorology to the reduction of climate related risks to food security, water resources and health for sustainable socio-economic development in the SADC region.
The SARCOF Process

CAPACITY BUILDING WORKSHOP

CONSENSUS MEETING

Mid-Aug  Late-Aug

In Addition

User (e.g. Media, Health, Agric, Water and Disaster) Workshops
SADC CSC PRODUCTS

The SADC CSC uses several tools to realize its objective and they are listed below:
SARCOF Forecast 2015

Oct - Dec 2015 Rainfall Forecast

Forecast Interpretation Key:
- Above-normal to Normal
- Normal to Above-normal
- Normal to Below-normal
- Below-normal to Normal

Above/Normal/Below

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SARCOF Forecast 2015

Forecast Interpretation Key:

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</table>

**Figure 1 (b)**

Nov 2015 - Jan 2016 Rainfall Forecast

- > 600
- 501 - 600
- 401 - 500
- 301 - 400
- 201 - 300
- 101 - 200
- < 100
- N/A
SARCOF Forecast 2015

Dec 2015 - Feb 2016 Rainfall Forecast

Figure 1 (c)

Forecast Interpretation Key:

Enhanced chances of:
- Above-normal to Normal
- Normal to Above-normal
- Normal to Below-normal
- Below-normal to Normal

Above/Normal/Below

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Legend:
- > 600
- 501 - 600
- 401 - 500
- 301 - 400
- 201 - 300
- 101 - 200
- < 100
- N/A
SARCOF Forecast 2015

Jan – Mar 2016 Rainfall Forecast

Figure 1 (d)

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Above/Normal/Below

- > 600
- 501 - 600
- 401 - 500
- 301 - 400
- 201 - 300
- 101 - 200
- < 100
- N/A
Verification of SARCOF Forecasts

2015-2016
FORECAST VERIFICATION SCORES

0. INTRODUCTION
The method of verifying the probabilistic approach of the seasonal rainfall depends upon the type of information provided in the forecast.

There exists a number of quantities that can be computed as measure of verifying skills of any given forecast

Rank Tercile Method (Hit Rate and Hit Skill Score) is the one used for the verification of the last season.

I. METHODOLOGY

The observed data are transformed in the tercile scale, using the long term mean and the standard deviation based on the 1971-2000 period. The observed data is interpolated onto a 2º by 2º lat/long grid.

The Hit rate and the FAR provide an estimate of the probabilities for which a warning (W) was followed by the occurrence (E) or non-occurrence (E') of the event.
When the observed data coincided with Highest probability in the tercile category, then a hit occurred => (Hit)

When the observed data coincided with the second middle highest probability, a half score was recorded => (Half Hit)

When the observed value coincided with above 2 categories missed, a false alarm was noted => false alarm (2 errors)

II. RESULTS
SADC OND 2015 VERIFICATION RESULTS

OND 2015 FORECAST

OND 2015 OBS

OND long-term average
OND 2015 VERIFICATION

Hit 31%
Half Hit 54%
False Alarm 5%
SADC JFM 2016 VERIFICATION

JFM 2016 FORECAST

JFM 2016 OBSERVED

JFM LONGTERM MEAN

JFM 30 YEAR MEAN
1971 - 2000

Key (mm)
- < 100
- 100 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- > 600
- No Data
JFM 2016 VERIFICATION

- Hit: 28%
- Half Hit: 70%
- False Alarm: 2%
OND 2015 forecast verification had more hits than half hits.
The 2016 JFM verification had almost equal hits and half hits.
SADC-CSC
Seasonal Rainfall forecast
2016/2017 season
Consensus (OND)
Consensus (NDJ)
Consensus (DJF)

Legend

djf2016_17
- Blue: 40 35 25
- Cyan: 35 40 25
- Yellow: 25 40 35
- Brown: 25 35 40

A  N  B
Thank you for your attention!

Merci Beaucoup!

Obrigado!