WEATHERSMART

Scientific meteorological and climatological news from the South African Weather Service **News**

February 2016

Stepping towards improved Seasonal Forecasts with the use of Africa's first Coupled Model

Solutions for a WeatherSmart South Africa

Rain4Africa Project

WeatherSmart App for Androids

The use of Geostationary Satellite Tools for Nowcasting and Very Short Range Forecasting in Data Sparse Regions

South African Weather Service

ISO 9001 Certified Organisation

WEATHERSMART News

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MESSAGE BY THE BOARD CHAIRPERSON

The South African Weather Service (SAWS), an entity of the Department of Environmental Affairs (DEA), has been operating as a state-owned entity since 2001. It is mandated by Parliament, by means of the South African Weather Service Act (No 8 of 2001 as amended), to provide public good and commercial services to the broad spectrum of the South African public. The board has over the years noticed that SAWS does a lot of scientific work which is not communicated to the broader public. Although numerous scientific contributions appear in academic journals, not much is found in more general publications about the organisation's scientific research and collaborations.

As we are now, more than ever, experiencing the impact of climate change and global warming, it is important for our research to be collaborative and to ensure that research outputs are communicated widely. This is essential if we are to empower our communities to respond to climate change impacts and thus become weather-smart. This not only alerts various stakeholders on the research activities of the organisation, but it will also assist them in developing climate change mitigation and adaptation strategies. This platform also provides an opportunity to our scientists to showcase their work and provides opportunities for collaboration on similar work with other institutions. This is essential for the nation as well as to optimise the use of available national resources.

Through this initiative I hope that deeper interest in meteorology and climatology will be created and with time, attract young minds to this premier scientific institution.

Lastly, I would like to recognise the role of Prof Magi, my predecessor, for his support in making this initiative a reality.

I hope that you will enjoy this publication.

Ms Ntsoaki Mngomezulu
Board Chair

FOREWORD BY THE SAWS CEO

The launch of this first scientific external newsletter to South African Weather Service (SAWS) users, stakeholders and interested parties is indeed a milestone in the history of the organisation.

With weather and climate having become increasingly variable, SAWS has been promoting weather-readiness or "weather-smartness" amongst communities. This will, however, not be possible without the backing of sound meteorological and climatological research.

Knowledge generation is an essential tool in developing adaptation strategies at national, provincial and local government level and SAWS, in partnership with the DEA, is at the forefront of this movement. SAWS has enhanced its strategy to ensure that it provides relevant products and services that empower communities, the various sectors of the South African economy and government to develop resilience to climate change impacts.

The question on whether Climate Change is real, has been posed many a times and our research from measured data in South Africa concludes that there has been a definite warming trend measured in surface temperatures in South Africa over the past decades, in line with the world-wide trend. The latest outcomes of COP21 for the Climate Change Convention, thus bode well to governments managing greenhouse gas emissions as the world's governments are now fully convinced of the scientific evidence of climate change and the need to take urgent action. Individual citizens, community leaders, businesses, civil society organisations, governments and the United Nations system must all contribute.

Therefore, this publication comes at an opportune time as it will be an essential vehicle for SAWS to inform various stakeholders of its work.

I hope that opportunities for collaboration and innovation created through this newsletter will have long-lasting impacts on the lives of people nationally, regionally and globally.

Dr Linda Makuleni
Chief Executive Officer:
South African Weather Service

EDITORIAL

The first scientific external newsletter of the South African Weather Service is a testament to the excellent scientific and technical work done by the organisation. SAWS is an internationally reputed provider of weather and climate services and products, and its work is underpinned by a wealth of knowledge generated primarily through research and analysis of observations.

With this newsletter, we aim to shed light on some of the scientific work undertaken by the organisation as well as its possible application and impacts.

With the world having recently concluded COP21 and South Africa in 2015 having experienced the driest year since 1904, it is essential that we share knowledge generated with our various stakeholders to create solutions to climate change related challenges.

In enhancing its strategy, SAWS enriched its vision of empowering the nation to respond adequately to the impacts of climate change. This was called creating a weather-smart nation where **SMART** relates to **S**afe, **M**ore informed, **A**lert, **R**esilient and the provision of relevant information and services in a **T**imeous manner.

Our first issue covers a wide array of topics ranging from improving meteorological observations in Africa, to the development of applications and products that will assist in water management. Africa frequently lacks adequate observations equipment and technology, and by employing geostationary tools, remarkable value is added to observations over Africa. The article on the use of geostationary satellite tools for Nowcasting over the African continent, demonstrates the value of this technology for data sparse countries.

One of the central topics currently discussed, is the strong El Niño that has established in the Pacific Ocean. We shed a light on how long range forecasters have developed a model to capture the development and maturity of El Niño and La Niña episodes.

The current El Niño event has played a significant role with drought conditions being experienced. The article on the collaborative Rain4Africa Project addresses, in an innovative way, possible solutions through the development of applications to benefit small scale farmers and other weather sensitive industries.

In this issue, we also take a closer look at the various impacts of climate change on our Coasts and Estuaries as well as the impact on disaster management. An impact-based severe weather warning system for South Africa has also been developed and will contribute to increasing weather resilience amongst communities.

Lightning in South Africa poses a significant threat to lives and property and the article on the developing of a lightning threat index in South Africa shows how this will improve the forecasting of lightning.

I hope readers will find the content valuable and that this will contribute to enhancing the understanding of meteorology and its impacts on our lives, communities and nation.

Dr Ziyanda Majokweni
General Manager: Corporate Affairs

RESEARCH AND DEVELOPMENT

A LOOK AT THE MOST RECENT AND EXCITING NEWS

STEPPING TOWARDS IMPROVED SEASONAL FORECASTS WITH THE USE OF AFRICA'S FIRST COUPLED MODEL

– Dr Asmerom Beraki - Senior Scientist: Long Range Forecasting

Whilst significant progress has been made to unfold the mystery of the earth climate system, many aspects of these complex natural processes still remain beyond our understanding. Seasonal forecasting becomes possible when the interaction between the ocean and atmosphere is properly described in order to influence the mean state of weather conditions that we experience every day. In fact, the coupling of the ocean and atmosphere is the minimum level of complexity required for seasonal to inter-annual climate predictions to work since all climate components believed to be relevant need to be included in a forecast climate model. Driven by this state of knowledge, the South African Weather Service (SAWS) has become the first African institution to develop and use an Ocean-Atmosphere coupled General Circulation Model (OAGCM), referred to as "SAWS Coupled Model (SCM)", for operational seasonal forecasting production. The work is published in one of the American Meteorological Society (AMS) Journals.

Coupled climate models hold great potential for predicting seasonal climate variations across the globe, since they are able to describe, among others, the interaction between the ocean and the atmosphere realistically. This spontaneous two-way feedback mechanism renders them to be most convenient for seasonal to interannual climate productions. Notwithstanding, owing to the enormous computational needs of and complexity associated with these types of models, their engagement for seasonal forecasts in South Africa was initially not considered feasible, particularly in an operational environment. SAWS in collaboration with the Centre for High Performance Computing (CHPC) and other international partners, is able to transform its seasonal climate prediction capability to a promising level.

The model performance in the context of El Niño - Southern Oscillation (ENSO) is found to be successful in capturing the development and maturity of El Niño and La Niña episodes up to 8 months ahead. The fact that this coupled model has achieved comparable levels of skill for the ENSO prediction with state-of-the-art coupled models administered by other international centres is encouraging.

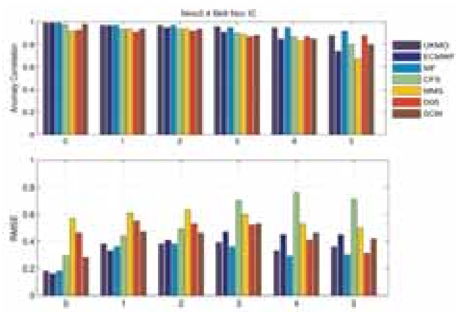


Figure 1: *Skill of the SCM in comparison to other leading institutions such as the UKMO, ECMWF, MF, CFS and others predicting ENSO as measured using anomaly correlation (upper panel) and Root Mean Square Error (RMSE; lower panel)*

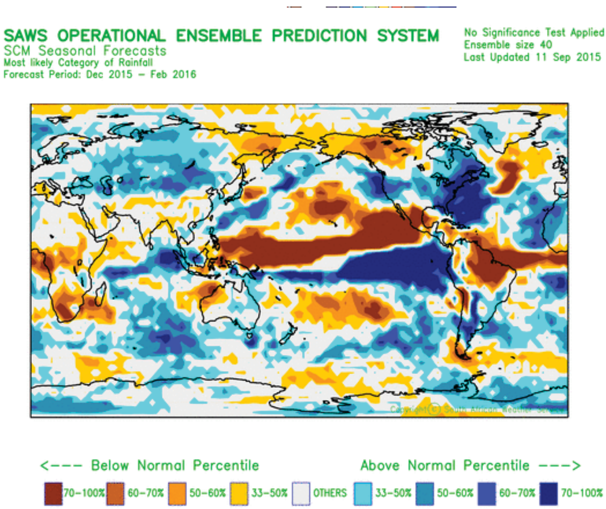
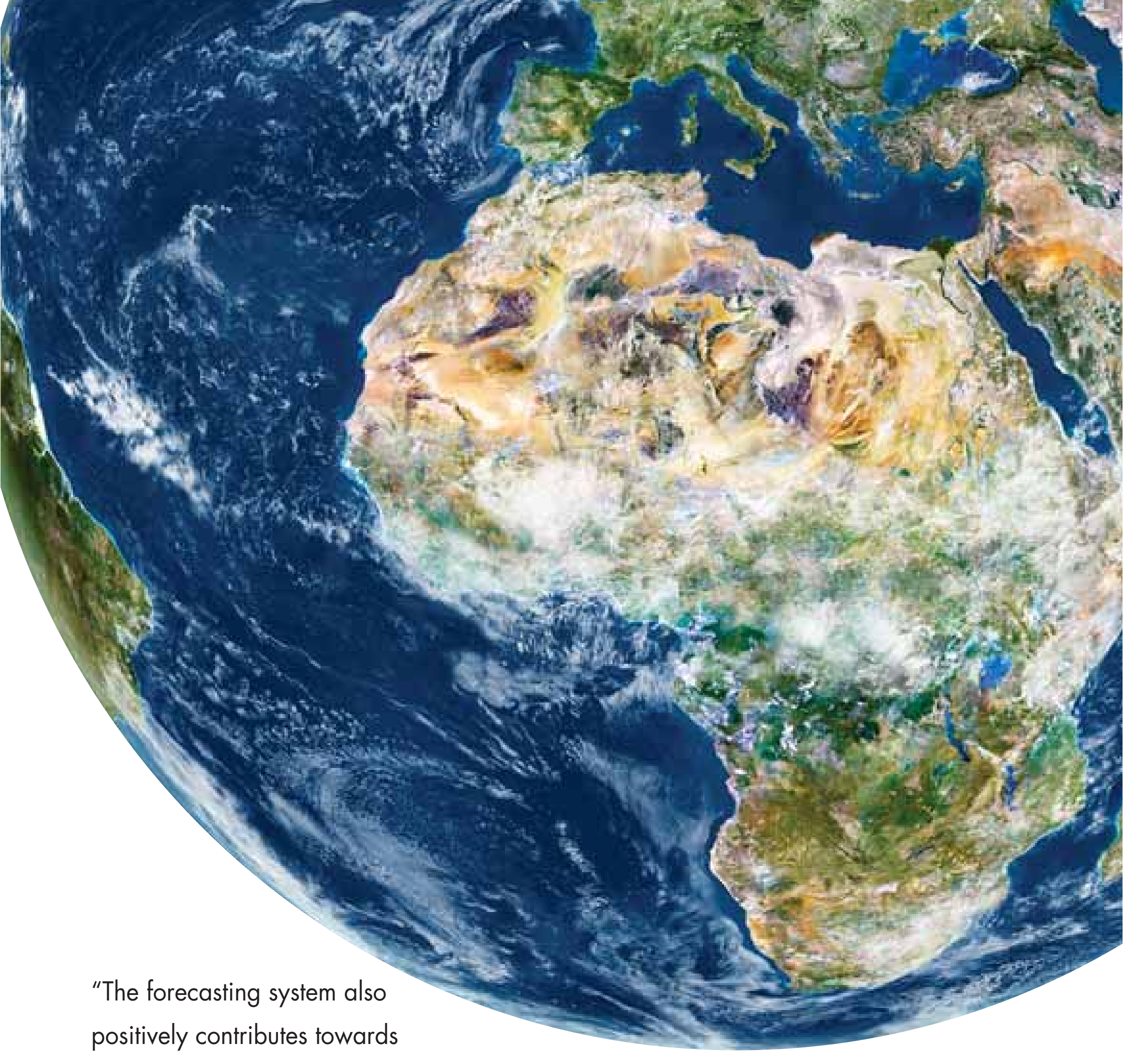


Figure 2: *According to the forecast released in September 2015, the SCM reveals that the likelihood of Southern Africa, north-eastern Australia and north-eastern Brazil heading for drier conditions toward the mid-summer season is high.*



"The forecasting system also positively contributes towards sustainable development on national, regional and global domains."

Further diagnosis revealed that the model was successful in capturing observed features of the Southern Annular Mode (SAM) and Indian Ocean Dipole (IOD) during their maturation phases. The role of these climate drivers and their importance to the southern African climate variability is reported in the scientific arena.

The implementation of the SCM for operational seasonal climate prediction has made a significant contribution to the forecast skill enhancement of the SAWS' ensemble prediction system and its operational multi-model forecasting system.

The forecasting system also positively contributes towards sustainable development on national, regional and global domains. This enhancement is a major development in local numerical modelling effort following the SAWS being granted the World Meteorological Organization's Global Producing Centre (GPC) status for Long-Range Forecasts (LRF) in 2009.

THE USE OF GEOSTATIONARY SATELLITE TOOLS FOR NOWCASTING AND VERY SHORT RANGE FORECASTING IN DATA SPARSE REGIONS

- Dr Estelle de Coning - Chief Scientist: Nowcasting and very short range forecasting

Nowcasting and very short-range forecasting is defined as the observation and anticipation of weather phenomena with a lead time of up to 12 hours. Small scale severe weather events, such as heavy rainfall in short periods of time, strong wind, hail and tornadoes, usually occur in this time range and these events can have devastating consequences, including damage to property and loss of life.

Operational forecasters aim to issue timeous warnings to prevent the negative impact of these events. In an ideal world, remote sensing by means of weather radar systems is the most important part of nowcasting. However, many developing countries (DC), and even more so least developed countries (LDC), do not have operational radar systems, due to the high costs involved with acquiring and maintaining these powerful data sources.

Nowcasting and very short-range forecasting systems for DC and/or LDC thus tend to focus on the use of remote sensing tools such as satellite and other observation data to address these needs. Geostationary satellites are most useful for nowcasting purposes due to the real-time availability of the data. The Meteosat Second Generation (MSG) geostationary satellite products for nowcasting go beyond the availability of 12 channels which can be visualized every 15 minutes. It also includes various satellite-based products to identify specific weather systems, provide information about atmospheric instability, identify severe weather features and estimate rainfall, to mention just a few.

The Nowcasting Satellite Application Facility (NWC SAF) in Europe has developed several products to aid nowcasting.

"this satellite based precipitation estimation technique is very useful to monitor the rainfall rates in real time"

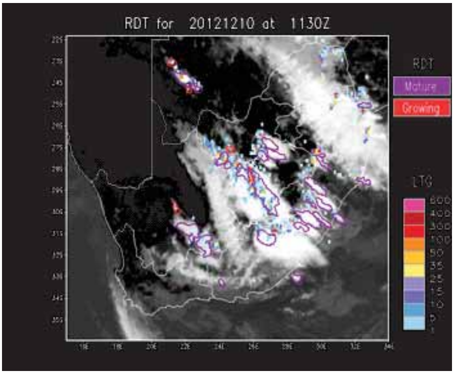


Figure 1: *RDT for 10 December 2012 at 1130 UTC. The RDT polygons are indicated in red for growing storms and purple for mature storms. Also shown is the lightning data in the 10 minutes surrounding the RDT time (1120-1140 UTC)*

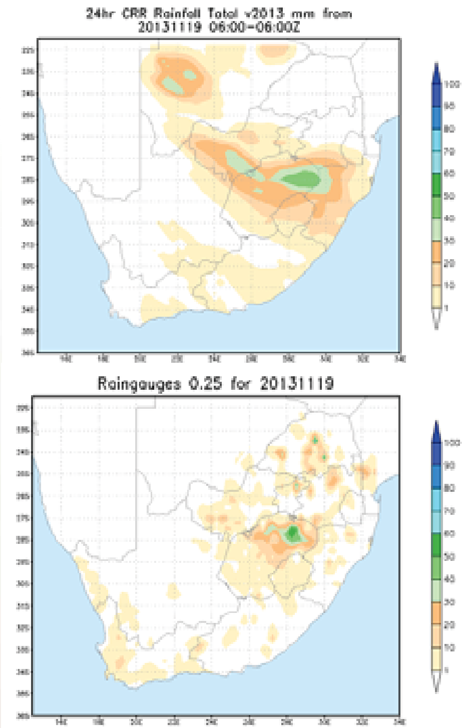


Figure 2: *Daily rainfall total as measured by the rain gauges (right) and daily rainfall total as estimated by CRR (left) for 19 November 2013*

These include satellite-based precipitation products and instability indices as well as identification and tracking of Rapidly Developing Thunderstorms (RDT). Although this software is used operationally in many Meteorological Services in Europe, South Africa is the only country in Africa which could install the software to run operationally using input data from the MSG satellite and the local version of the UK Met Office's Unified Model. The installation and verification of the RDT product was done as part of a project funded by the Water Research Commission (WRC) up to 2015. A new project is now funded by the WRC to improve on and validate the RDT as well as another product, called the Convective Rainfall Rate (CRR). This project started in 2015 and will end in 2017.

The aim of the RDT product is to identify and track rapidly developing thunderstorms. These would be the kind of thunderstorms for which a forecaster would issue a warning, due to possibility of severe weather. This product can be especially helpful for aviation forecasters guiding flights over the data sparse regions of Africa, where thunderstorms have led to more than one aviation disaster in recent years. In South Africa the data from radar systems (where available) and the lightning detection network is used to validate the RDT product. An example of the product is shown below. In Figure 1 the RDT polygons (red and purple) indicate the growing and mature thunderstorms. It is clear that the occurrence of the more intense lightning stokes are inside these polygons – thus validating that the RDT polygons are indeed identifying and tracking the more intense thunderstorms.

The CRR product is a Nowcasting tool that provides information on convective and the associated stratiform instantaneous rain rates. In the absence of enough rain gauge data, this satellite-based precipitation estimation technique is very useful to monitor the rainfall rates in real time. Figure 2 is an example of the daily rainfall total on the CRR compared to the rainfall total as measured by the rain gauges. Good correlation between the two measurements is obvious.

Both of these products are available to the forecasters in real time (every 15 minutes) through a website with all relevant forecasting information, called FCASTweb. For the SADC region the RDT product is available through the World Meteorological Organization (WMO) Severe Weather Forecasting Demonstration Projects (SWFDP) website (Regional Specialized Meteorological Centre) which aims to improve nowcasting and very short range forecasting of severe weather events in DC and LDC by providing access to forecasting information through a website instead of expensive software packages.

HISTORICAL CLIMATE TRENDS FROM MEASURED DATA IN SOUTH AFRICA

- Dr Andries Kruger – Chief Scientist: Climate Data Research and Analysis

As the custodian of national climate data base, the South African Weather Service (SAWS) has done a substantial quantity of research on the climate data. Particularly, as interest in trends in the climate has become important in the light of climate change, the emphasis of historical climate data research has shifted in emphasis from the mean climate and variability to changes in the recent climate. These research and analysis initiatives included the investigation of trends in the climate parameters temperature, rainfall, wind and cloudiness. Of these, temperature, due to the clear warming signal that can be detected, and rainfall, due to its relative socio-economic importance, can be considered to be the two most important parameters. The estimation of trends in the historical climate trends involves certain expertise, including the quality control of the data, homogenisation of data sets and the application of the most appropriate statistical methods.

The first comprehensive study by SAWS on historical temperature trends in South Africa was published internationally in 2004 and thereafter in 2012. In summary, the vast majority of stations showed positive trends in their annual mean maximum temperature series. The trend analyses of mean seasonal temperature indicated that temperature trends were not consistent throughout the year, with the average trend for autumn showing a maximum and spring a minimum. It was also shown that in general, days and nights with relatively high temperatures have increased, while days and nights with relatively low temperatures have decreased. El Niño and La Niña events did not seem to play a significant role in the increasing temperatures observed. SAWS also took part in a regional WMO ETCCDI (World Meteorological Organization Expert Team on Climate Change Detection and Indices) workshop in 2004, which produced historical trend results from countries in sub-Sahara and West Africa. These results,

in general, confirmed those of SAWS' previous studies, i.e. a general warming trend but exhibiting regional variability in the magnitude thereof. The South African results could also be included in global trend assessments, of which several publications were contributed to.

Some regional trends could also be identified, indicating that the western half as well as parts of the north-east and east of South Africa, showed relatively stronger warming than elsewhere in the country (see Figure 1). The additional analyses of longer time series than the common period indicated that it is highly likely that warming in South Africa accelerated since the mid-1960s.

While SAWS will endeavour to publish comprehensive temperature trend results on a regular basis, e.g. every five years, contribution on the annual state of the climate is published annually in the Bulletin of the American Meteorological Society Annual State of the Climate reports. This publication provides a platform to disseminate the state of the climate on a regular basis, through the provision of relevant information regarding trends and extreme events that occurred over the region. The annual mean temperature anomalies for 2014 from the preliminary data of 21 climate stations were on average about 0.5ºC above the reference period of 1961-90. A warming trend of 0.13 ºC per decade is indicated by the data of these particular climate stations, statistically significant at the 5% level. Figure 2 overleaf shows that the mean temperatures of the past 17 years were all above normal.

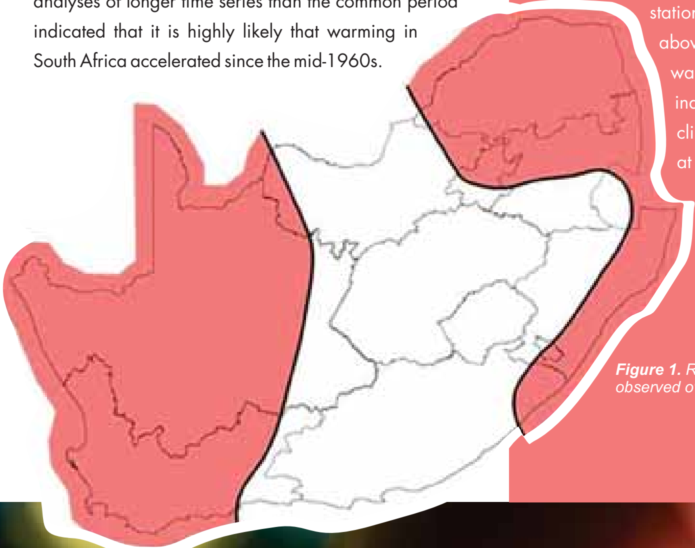


Figure 1. *Regions of strongest warming observed over the period 1962-2009*

"mean temperatures of the past 17 years were all above normal"

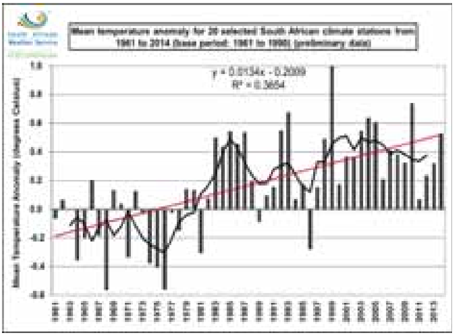


Figure 2. *Annual mean temperature anomalies (base period 1961-90) of 20 climate stations in South Africa, 1961-2014. The red line indicates the linear trend, with black the 5-year moving average.*

In 2014 a historical temperature homogenisation project was initiated at SAWS. This opened the possibility to estimate historical temperature trends over a longer period further back than 1961, which was determined as the starting year in previous studies. Some findings for the period 1931-2014 are:

- In general, the number of days per year with low minimum temperatures have declined, while days with high minimum temperatures have increased. These trends are more pronounced in the larger centres, e.g. Cape Town, Port Elizabeth and Gauteng.
- In general, the number of days per year with low maximum temperatures have declined, while days with high maximum temperatures have increased.
- In the larger centres there is a tendency for the annual absolute minimum temperatures and the annual absolute maximum daily minimum temperatures to increase.
- The annual absolute minimum daily maximum temperatures have increased at most places along the coast and some places in Gauteng, while the absolute maximum temperatures have increased for most places in the western half of the country.
- Significant decreases in cold spell duration are evident for most places in the eastern half of country as well as along the coast.
- Significant increases in warm spell duration are evident over the most of the western and northern interior.
- Increases in the mean diurnal temperature range are evident over the western interior, while decreases are evident over most places in the east and south.

RAINFALL

Some significant changes in extreme precipitation indices, averaged over specific areas in South Africa, could be identified. These include isolated areas with significant changes in annual precipitation, but with larger areas showing increases in the longest annual dry spell, indicating more extreme dry seasons, increases in longest annual wet spells indicating more extreme wet seasons, and increases in high daily precipitation amounts. The conclusion is that, while for the largest part of South Africa there has been no real evidence of changes in precipitation over the past century, there are, however, some identifiable areas where significant changes in certain characteristics of precipitation occurred. The most significant of these were increases in daily extreme rainfall and intermittent dry periods over parts of the southern Free State and the Eastern Cape provinces.

WIND

SAWS co-authored a paper on global trends in wind speed in the Journal of Hydrology, which won the 2013 CSIRO Land and Water Publication Award. One objective of this paper was to review and synthesize the literature to assess whether stilling (decrease in mean wind speed) is a globally widespread phenomenon. The stilling constitutes globally a -0.7m/s change over 50 years. This trend was also confirmed in some South African wind data, of which the results were included in the paper.

CLOUDINESS

Amounts of cloud cover have changed significantly over most areas of South Africa, also with differences in trends between seasons. In general, one can say that there was a decrease in total and low cloud cover over most of the interior, but an increase in the south and south-west. ENSO is significantly correlated with cloud cover over a large part of the late-summer rainfall region, but does not seem to play a significant role in the trends of cloudiness.

CONCLUSIONS AND WAY FORWARD

The studies done on historical temperature trends in South Africa indicate that there is a general warming trend in surface temperatures. These results reflect the mean global trend, which is attributed to anthropogenic climate change due to an increase in greenhouse gases in the atmosphere. However, while a general warming trend can be regarded as the signature signal of climate change, it is expected that climate change might also be manifested in changes in other climate parameters, such as an increase in extreme precipitation events.

The evidence of significant climate change gleaned from historical climate data could provide indications on where climate change could have more serious impacts. Also, the observed changes could be used to verify the reliability of climate model outputs, which is intended to indicate the mean state of the future climate under various emission scenarios.

WeatherSmart APP for Androids

With today's mobile technology at the forefront of assisting companies to reach their target markets through delivering products and services instantly, efficiently and in an effective manner, the South African Weather Service together with mobile technology provider Afrigis have teamed up to develop the Mobile App called WeatherSmart.

The WeatherSmart app is location based, meaning that a user who has downloaded the app to his android handset will automatically receive weather forecast-related information based on his or her current location. The app will provide any form of weather condition updates such as rain forecasting, temperatures, storm alert, and other severe weather alerts.
The WeatherSmart App is positioned as public good with free download, but it will have other special paid-up features enabling the user to customise his or her location to receive early warning alerts such as storm alerts or forecasts for lightning as part of a feature called "bufferzones".

With so many weather apps in the market, this app will stand out as a unique innovation when it comes to reliability and accuracy. This tool is a must have for any person who is travelling from one region to the other, farmers who need to protect their livestock from extreme weather conditions, sports persons or event organisers responsible for outdoor activities, or the individual who needs to prepare for any changing weather conditions.

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SAWS' ESTUARY EARLY WARNING
EMERGENCY PREPAREDNESS AND RESPONSE GUIDE

– Mr Johan Stander – Regional Manager: Western Cape

SAWS was the main author in finalising the Estuary Early Warning – Emergency Preparedness and Response Guide (EEW-EPRG). This guide was completed in consultation with the Ethekwini Municipality, Nelson Mandela Bay Municipality, CapeNature, Department Environmental Affairs: Oceans and Coasts, Eden District Municipality, Western Cape Disaster Management, West Coast District Municipality, Department of Water Affairs and Sanitation and various technical experts.

Background to the Estuary Early Warning Guide

An estuarine system is a receiving environment for fresh water flowing out of the catchment as well as saline water intruding from the ocean. The freshwater flow rates reaching the estuary are determined by key drivers such as weather events, rainfall intensity in the catchment, as well as geology, soil type and ground cover. Other factors contributing to freshwater flow rates, which can then be related to flood risk, are channel depth, instream channel constrictions, e.g. bridges, impoundments, debris, hard structured shorelines and land use and development in the catchment, e.g. hardened surfaces in cities. The response of an estuary to increased inflows and flooding will vary significantly according to various unique characteristics of the particular estuary. These include the extent of the floodplain (buffer area) and its associated ecological condition, mouth state and impact of the ocean, e.g. waves that enter the estuary.

Estuary mouth condition plays a critical role with regards to estuary functioning, so much so that estuarine systems are classified accordingly. Generally two types of estuarine systems are to be found in South Africa, namely permanently open (30%) and temporarily open/closed (70%). Estuary mouth condition regulates the access of fresh water to the sea, the interaction between fresh and salt water in the estuary as well as the level of the water in the estuary.

Temporarily open/closed estuaries generally have the higher risk of flooding events especially when there is development in the floodplain. The closure of an estuary mouth during periods of low freshwater inflow, results in a significant increase inwater level during the following wet period when freshwater flows increase and water levels rise. The associated sand berm at the mouth of the estuary will set the required estuarine water level prior to the needed breaching level.

Permanently open systems are less prone to flooding. In general, there is less fluctuation in estuarine water level with the main changes reflecting tidal changes. They are often fed by larger catchments but despite having permanently open mouths are subject to occasional large floods, e.g. 1:100 year flood events. Permanently open estuary mouths allow for ongoing intrusion of saline oceanic water, which will vary according to tidal influences as well as storm surge.

It should be noted at this stage that the ever-changing climatic conditions may bring about an increased likelihood of extreme events leading to flood events of such magnitude that impacts cannot be mitigated completely. In these cases, the response strategy will need to focus on preventing loss of life. This approach will be applicable to both open and closed systems.

Changing climate and land use planning

As a result of the increased intensity and frequency of adverse weather conditions, South Africa's coastal and/or estuarine communities are becoming increasingly vulnerable. The flood risk to inappropriately located developments in estuary floodplains is exacerbated by the disregard for the 1 in 100 year flood line restrictions (ref National Water Act No 36 of 1998).

The ICMA makes provision for coastal setback lines/management lines in order to prevent and address inappropriate coastal and estuarine developments. Recent estuary flooding (e.g. Eden District Municipality 2007/2008/2011/2012) has highlighted how vulnerable South Africa's coastal and estuary communities are to the impacts associated with estuarine flooding as well as the negative secondary impacts (e.g. ruptured sewerage pipes leading to pollution in the estuary). Therefore, there is clearly an urgent need for effective, proactive actions to minimise the negative impacts of estuarine flooding, whilst maintaining a functional ecosystem. This need will increase in the light of Climate Change and growing coastal developments and populations.

Proactive risk identification and subsequent risk reduction and mitigation

What is urgently needed is a concurrent pro-active approach to Disaster Risk Reduction (DRR) and mitigation, with a focus on those estuary systems that are most at risk with respect to loss of life and damage to infrastructure, property and socio-economic activities, due to flooding from land and sea, as well as associated secondary risks such as pollution. The integrity of the associated ecological infrastructure should not be sacrificed in the process. Specific sacrifices may be made under predetermined emergency conditions.

The proactive systems and processes should aim at risk reduction and includes an early warning aspect, risk mitigation measures on site and rehabilitation measures after the event. A management model developed encompassed all the systems, drivers and mitigation measures.

This Estuary Early Warning guide forms part of the South African Multi-Hazard Early Warning System. In line with the general principles of effective Early Warning Systems, the guide addresses five elements, namely:

Risk identification

- High risk estuaries identified
- Specific weather indicators identified
- Risk reduction system for each estuary

Monitoring and warning system

- Information flow prior to and during incidents, emergencies
- Requirements for monitoring and real time data acquisition
- Infrastructure and equipment requirements

Alert dissemination

- Information flow prior and during incidents, emergencies
- Infrastructure and equipment requirements

Response actions

- Institutional arrangements
- Roles and responsibilities of role players and stakeholders

Reporting and evaluation

- Institutional and information flow
- Infrastructure and equipment requirements

TOWARDS AN IMPACT-BASED SEVERE WEATHER WARNING SYSTEM FOR SOUTH AFRICA

- Dr Eugene Poolman - Chief Forecaster: Disaster Risk Reduction

INTRODUCTION

More than 90% of disasters in South Africa related to natural hazards are caused by severe weather hazards. Severe weather-related disasters lead to significant negative consequences to human livelihood, the economy or the environment, including lives lost, property damaged, or vital infrastructure disrupted. Damages exceeding R2.5 billion were caused by eight severe weather systems in the Western Cape between 2003 and 2008. This is globally a problem and occurs despite the vast improvement in the science of weather forecasting by weather services over the last few decades.

An accurate and timely weather forecast, though, does not guarantee safety of life or prevent major economic disruption. The main reason for this is the gap between the scientific weather forecasting by forecasters and the appreciation of the resulting socio-economic impacts by disaster managers and communities in danger.

There is clearly a need to bridge this gap between natural sciences and social sciences, to move from predicting the weather to predicting the risks associated with weather.

This would allow disaster management agencies to prioritize their deployment of prevention and response services, and provide local communities more information about the most appropriate reaction.

In an effort to operationalize this concept, the South African Weather Service (SAWS) is embarking on a joint multi-year project with the National Disaster Management Centre (NDMC) for the development and implementation of an Impact-based Severe Weather Warning System for South Africa. In support of this project, scientists at SAWS developed a prototype decision support system to provide an outlook of potential flash floods and the expected adverse impact associated with these potential flash floods.

FORECASTING THE IMPACT RISK OF FLASH FLOODS

Flash floods are but one of the severe weather-related hazards that SAWS issues warnings for. Other hazards include heavy rain, gales, severe thunderstorms, disruptive snow, veld fires and destructive coastal waves. Of these hazards, though, flash floods are by far the most frequent and cause the most disruption. Consequently, the prototype decision support system was prepared for flash flood hazards.

By linking the flash flood guidance products of the South African Flash Flood Guidance (SAFFG) modelling system with a series of rainfall forecasts of the Unified Model (UM) of the UK Met Office (running at SAWS), an extended outlook of the probability of flash floods was generated. This probabilistic flash flood outlook was then linked through a hazard impact model with a set of relevant vulnerability indicators (such as population distribution, distribution of aged people, number of schools, bridges, etc.) for small areas to provide a forecast of the potential flood impact risk. This forecast provided an indication of the adverse socio-economic impact the expected flash floods could have on local communities. It identified "hot spots" distinguishing between less severe and more severe events based on the local social and structural vulnerability.

An example of such a forecast for the flash flood event that occurred in Port Alfred in October 2012 is shown in Figure 1. By combining the indicators for flood vulnerability (top left panel) with the outlook of potential flash floods in the next 18 hours (top right panel) a forecast of potential impact risk levels can be made (lower right panel). The red circles indicate the town of Port Alfred on the maps. Three areas of higher risk for adverse impacts (dark blue areas in the bottom panel) can be clearly seen. The dark blue circles indicate an area of higher flood likelihood than Port Alfred, but with a lower risk of adverse impacts, due to its lower social and structural vulnerability to flash floods.

Figure 1: *Impact risk level forecast for the Port Alfred flash flood of 20 October 2012.*

AN IMPACT-BASED SEVERE WEATHER WARNING SYSTEM

The joint SAWS-NDMC project to develop, test and implement an Impact-based Severe Weather Warning System (Imp-B SWWS) for South Africa will exploit the concepts illustrated above in a practical way. The main aim is to change the focus of the early warning systems from weather prediction to people-centred risk prediction tailored to local conditions. Collaboration between weather forecasters and disaster managers is a crucial component of the project. Essentially there will be two main outcomes:

Outcome 1 will focus on developing the operational warning decision making process by forecasters supported by disaster managers. Figure 2 provides a graphical illustration of this process, based on the combination of (1) the likelihood and expected intensity of the hazard occurring and (2) the expected severity level of impact (economically, socially and environmentally). This combination will determine the final warning risk level as either a yellow, orange or at the worst a red warning.

Determining the likelihood and expected intensity of the hazard is done by the weather forecasters based on numerical weather prediction models, weather radars and satellite images. The expected severity level of the impact is determined from information provided by local disaster managers based on vulnerability assessments at local levels.

Outcome 2 will focus on the development of an objective decision support system, based on the concepts developed in the flash flood impact model described earlier. The decision support system will provide objective guidance to forecasters and disaster managers on the potential likelihood and impact level associated with the expected severe weather hazard.

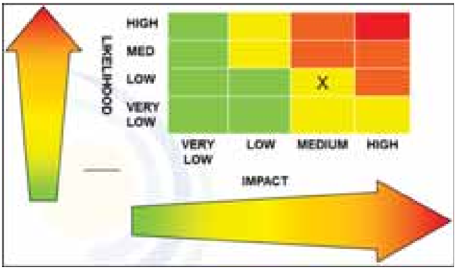


Figure 2: *Warning Risk Matrix showing the combination of hazard likelihood on the vertical axis, and expected level of adverse impact on the horizontal axis.*

CONCLUSION

The development of the Imp-B SWWS will support people-centred service delivery. It will relay a message of greater relevance to disaster managers and communities at risk, enabling them to take appropriate actions in order to mitigate the overall adverse effects of hydrometeorological hazards. In this way it will contribute to increasing resilience against the adverse impacts of severe weather related hazards.

USSD FOR ALL TYPES OF HANDSETS

USSD (Unstructured Supplementary Service Data) is widely used for services such as account balance, cell phone airtime recharge and other banking services. The South African Weather Service, in partnership with technology provider Afrigis, has developed a USSD weather forecasting service that delivers weather forecasting to the mobile handset regardless of the model. The service is location based, meaning that the service is able to pick up your current location and pushes the weather forecast instantly to your mobile handset. The service has three menus to choose from:

1. Area – a user can browse any area in South Africa which he or she wishes to get the weather forecasting from
2. Date – user may select a future date up to seven days ahead for any area for which a weather forecast is required
3. SMS - weather forecast is sent to the user handset by SMS

This service is easy to access, user simply dial *120*7297(SAWS)# and Dial button to view the weather forecast of the current location.

The associated cost is 20c per 20 second interval. The service is targeted at all users especially those with feature phones, commuters, farmers, a traveller, sport person for outdoor activity and mostly those who wishes to view occasional weather forecast.

simply dial

*120*7297(SAWS)#

South African Weather Service

ISO 9001 Certified Organisation

A LIGHTNING THREAT INDEX

FOR SOUTH AFRICA USING NUMERICAL WEATHER PREDICTION DATA

- Mr. Morne Gijben - Scientist: Nowcasting and Very Short Range Forecasting

Lightning is a product of most thunderstorms that can result in death or injury among humans and animals, damage to infrastructure, and can be hazardous to various sectors like the aviation and forestry industry. South Africa is a country that frequently experiences lightning, with flash densities exceeding 20 flashes/Km^2/year in some areas. South Africa has an estimated annual death rate of between 1.5 and 8.8 per million of the population, but this number is likely to be an underestimation. It is said that the number of lightning deaths in South Africa is about four times higher than the global average. South Africa also experiences great financial losses and damages due to lightning, which is evident in the insurance sector, where claim amounts of more than R500 million per annum are recorded. It is also said that 24% of the electrical faults reported by the electricity provider, Eskom, are due to lightning. These statistics highlight the need to forecast the areas where lightning can cause a threat to ensure the protection of people and property.

To forecast the exact location of where a lightning bolt will strike the earth is most probably impossible. However, areas where lightning or thunderstorms may occur can be forecast. Statistical techniques have been used extensively to predict thunderstorms and lightning and these prediction schemes forecast the threat of lightning by relying on connections between lightning occurrence and parameters of the pre-storm environment. Parameters are often derived from atmospheric soundings to predict lightning, but soundings are typically only performed once or twice daily and at a limited number of locations. As a result, inaccurate forecasts can occur due to later changes in the atmosphere or areas that have not been sounded.

Numerical Weather Prediction (NWP) models offer an alternative for lightning prediction since they are capable of providing forecasts from the information obtained by soundings with high spatial and temporal resolution and can improve forecasts.

Many institutions that predict lightning are moving away from empirical lightning prediction methods, to NWP model based techniques. The advantage of these methods is that lightning can be predicted on both the very short range (2 – 12 hours ahead) as well as short range (12 - 72 hours ahead) forecast scale, due to NWP models' capability to provide accurate parameters related to lightning formation for several hours ahead. Statistical prediction schemes that forecast the threat of lightning, by relying on connections between lightning occurrence and parameters of the pre-storm environment, have also been developed by making use of NWP data.

Many of the statistical lightning prediction techniques make use of thermodynamic parameters to forecast lightning and typically perform quite well to forecast the likelihood that lightning will occur. However, they have a much lower capability to forecast the number of lightning strokes. Due to this limitation, attempts to forecast the amount of lightning that will occur should not be considered with thermodynamic parameters from NWP models. However, useful guidance forecasts about the location of where lightning may occur can be successfully developed.

The Lightning Potential Index (LPI) forms the basis for this work and was developed by the National Weather Service Forecast Office in Grand Junction, Colorado. The LPI uses the NWP prognosis of most unstable Convective Available Potential Energy (muCAPE), Lifted Index (LI), Equivalent Potential Temperature lapse rate (ΘeΓ), Temperature (T), Precipitable Water (PW) and Relative Humidity (RH) to calculate the potential of lightning. This version of the LPI, is still in the developing phase but has shown the ability to be useful in improving lightning prediction. The same methodology of the LPI was tested over South Africa and showed potential for lightning prediction in the country. However, in spite of relatively good results, the Index had to be changed to accommodate the unique South African weather conditions.

A completely new index, named the Lightning Threat Index (LTI) was developed for South Africa by using NWP model parameters from the Unified Model (UM) which is operational at the South African Weather Service (SAWS) as well as lightning data from the Southern African Lightning Detection Network operated by SAWS. The most optimal parameters to predict lightning were selected and from this, new equations could be developed.

Figure 1(a) shows a typical forecast from the new LTI that provides the probability that lightning will occur between 07:00 and 22:00 GMT.

The associated lightning that occurred during the forecast period of the LTI is shown in Figure 1(b). By comparing the two images, it is clear that the LTI performs quite well where most of the lightning occurred in the areas where the LTI forecasted probabilities greater than 60%.

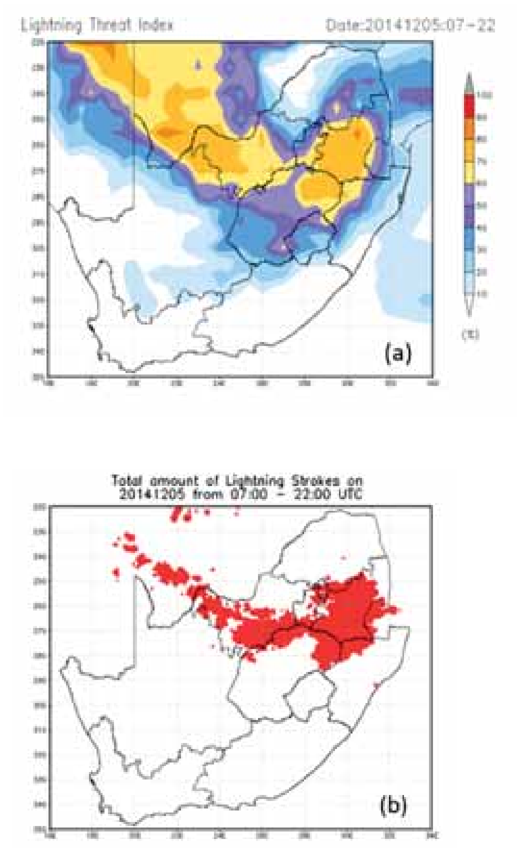
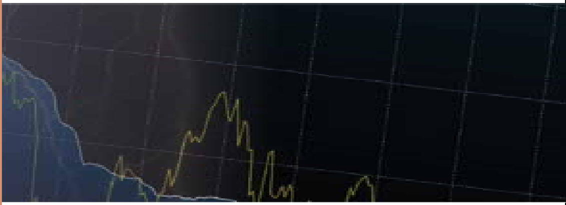


Figure 1: *(a) The LTI and (b) the total amount of lightning strokes for 5 December 2014 between 07:00 and 22:00 UTC.*



The LTI was evaluated against lightning data for an entire spring and summer season that was independent from the period used to develop the LTI. The evaluation statistics show that the LTI performs quite well, and that the LTI performs better during the summer months than during the spring months. This can be due to the atmospheric conditions being different during spring and summer. In early summer, the atmospheric circulation is generally extra-tropical, with a conditionally unstable atmosphere over certain parts of South Africa, while in late summer the circulation is tropical, with a convectively unstable atmosphere. Another possibility is that the UM model can resolve the atmospheric conditions better during summer compared to spring. Nevertheless, the LTI shows skill during both seasons. One must remember that the performance of the LTI on a particular day is dependent on the performance of the NWP model for that particular day, and as such, there may be a few days where the LTI does not perform as well as on other days.

The new LTI is a valuable additional tool that can be used by operational weather forecasters or by various sectors interested to know where lightning or thunderstorms may occur during the day. The LTI forecast is available early in the morning (at approximately 05:00 GMT) and gives a prediction of where lightning is likely to occur between 07:00 and 22:00 GMT. Additionally, a forecast for the next day between 07:00 and 22:00 GMT is also available and provides an overview of the areas at risk from lightning with a longer lead-time. The LTI has now also been extended to cover the data-sparse regions of SADC and may provide important information to forecast lightning and thunderstorms in these regions.

INTERNATIONAL COLLABORATIONS

A LOOK AT RECENT INTERNATIONAL PROJECTS AND COLLABORATIONS

RAIN FOR AFRICA (R4A) PROJECT

Dr Estelle de Coning - Chief Scientist: Nowcasting and Very Short Range Forecasting and
Mr Nico Kroese – Unit Manager: Prediction Research

INTRODUCTION

The South African Weather Service (SAWS) formed part of a partnership that was awarded an internationally funded project, called Rain for Africa (R4A) in August 2015. The project forms part of an initiative of the Netherlands Government called Geodata for Agriculture and Water (G4AW), whereby applications that will benefit the smallholder farmer on the African continent, will be developed. The main South African partner in this project is the Agricultural Research Council, while several partners from the Netherlands are also involved: HydroLogic (Netherlands), Koninklijk Nederlands Meteorologisch Instituut (KNMI), Mobile Water Management (Netherlands), eLEAF (Netherlands), Waterschap Groot Salland (Netherlands), WineJob (Netherlands) and Weather Impact. This 3 year project has a funding model, where 60% of the funds are provided by the Dutch government and 40% by the partner institutions. SAWS will play a critical role in this project as it is responsible to provide reliable information necessary to develop precipitation estimation products for agricultural applications.

THE CHALLENGE

When will the raining season start? How much rain is expected the coming week? How much rainfall has fallen since sowing? And how much of this rainfall has evaporated? All farmers in Africa, large or small, need reliable information on historic, current and forecast weather conditions to optimize crop growth and to generate income for their families. On the African continent, even the simplest information on weather is not available for farmers. The effects of this are disastrous. Every year, for millions of farmers, crop production is unnecessarily reduced because of the lack of timely delivery of reliable weather data.

For Africa, a lot of weather-related data is available: from automated or manual gauges, radars, satellites to national or global weather forecast models. However, this data is not easily accessible for organisations that play a key role in providing farmers the right information at the right time (commercial farmers, application developers, commercial weather organisations, national weather services and national department of agriculture).

Reasons are:

- Many providers available: It is often unclear which organisation provides what data and how reliable the data is.
- Many products: It is unclear which data is most suitable for the end-user who makes decisions based on this data.
- Difficult to understand data: Expert knowledge is needed to correctly interpret the data and to translate this data into information and knowledge.
- No archive available: Because of the size of the weather datasets, data is often not archived and therefore not available after a few days.
- Difficult format: Data is mainly available in difficult data formats.
- A lot of time is required: In order to produce the datasets required, a lot of manual work is needed from National Meteorological Services (NMS) to collect the required data from their archives.
- The best available data is unaffordable: For example, output from one of the best available weather forecast models, the ECMWF model, is very expensive and unaffordable for application developers or farmers.

There is a lot of basic data available and there is a clear end-user need for this weather information. For this reason, the Rain4Africa (R4A) consortium wants to bridge the gap that exists between the data suppliers and end users.

Via the R4A platform historical, actual and forecast weather data will be accessible for each farmer, NMS, application developer, service provider or governmental organisation in Africa for an affordable price.

THE SOLUTION

The R4A platform provides one central access point where data will be collected, stored, interpreted and disseminated. All available weather data from gauges, satellites, radars, weathers forecast models can be easily uploaded to the R4A platform by data providers.

R4A provides a toolbox which easily enables NMS's and other data owners to connect their raw radar and rain gauge data, if available. The data will be automatically verified and stored. Furthermore, the different data sources are automatically combined to improve the quality of the data. For example, the rainfall data from satellites will be automatically adjusted with rainfall information from surface based networks to achieve an improved area-covered rainfall product. Even the best available and often expensive data (e.g. ECMWF model data) will become viable for everybody, even for small scale farmers. By buying this data as part of the R4A platform and making this data available to millions of farmers and other potential users, the data costs per user is envisaged to be extremely low.

Once the user has requested data for a certain location and period, the best available rainfall data is made available via: API, web services, a web application, mobile application, or text message service. Automatic data feeds can also be provided. Depending on the type and amount of data or service that is requested, the user pays directly via the R4A platform and then receives all data he/she needs. The R4A platform has a clearly defined and proven business model which automatically divides the revenue between the data providers.

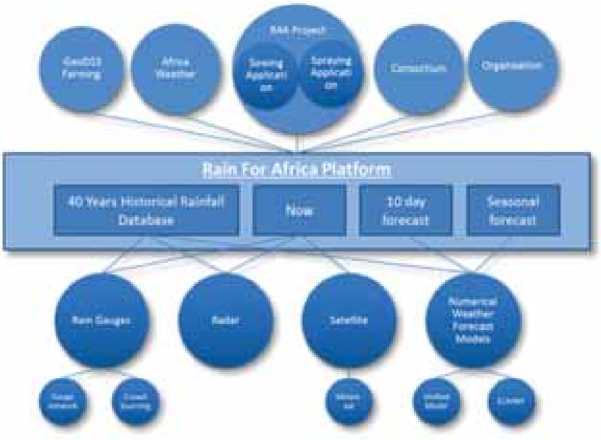


Figure 1: A schematic diagram of the Rain 4 Africa (R4A) technical and data flow structure.

For areas without the availability of surface observations, the (R4AW) platform plans to offer a very low-cost crowdsourcing solution for measuring rainfall which uses an almost freely available standardized plastic tube as rain gauge and an innovative mobile application to automatically measure rainfall.

Within the G4AW (Geodata for Africa and Water initiative) project, we will implement and demonstrate the R4A portal for South Africa. However, it is also the ambition to upscale to the Southern Africa Development Community (SADC) region and ultimately rest of Africa and other parts of the globe.

To make sure that the R4A project provides the right information for small-scale and commercial farmers in Southern Africa, two key decision support applications will be developed within this project which include information for farmers of the best seeding time and the best time to apply pesticides.

This R4A service will be made available for other G4AW project consortia so that the improved rainfall information can be used in their applications to indirectly reach hundreds of thousands of small scale farmers.

THE TARGET MARKET

The R4A platform focusses on the following key users:

- Farmers in Southern Africa: there are millions of small scale farmers and hundreds of thousands of commercial farmers. Weather information will be offered to them through a simple mobile or web - application or text message. The R4A project will target 125 000 small scale and commercial farmers in South Africa and the SADC region.

- Agricultural service providers/application developers/G4AW consortia: all these organisations need reliable weather data. Usually it will take them a big proportion of the available development time to find and collect the right rainfall data. The R4A portal will solve this problem and will save them a lot of time and costs which will eventually lead to cheaper agro-food services all over Africa.

- National Meteorological Services (NMS): R4A provides a toolbox which supports national weather services with the automatic collection, storage, interpretation and dissemination of their own data. Benefits for National Weather Services: increased revenue from selling rainfall solutions; increased client base and client satisfaction; improved back-end processes to process the raw data into reliable information; increased quality of rainfall information by smartly combining different data sources; improved insights into the quality of the rainfall products; reduced time and costs for back-end processes and storage with increased time allocations for more focused research; enhanced innovation.

THE CONSORTIUM

A consortium of partners has been established that can make the R4A platform happen. The consortium consists of application/service providers, knowledge providers, data providers and national weather services (KNMI, SAWS) who will play a key role in the success of R4A. Ninety percent of the required techniques for R4A are proven technology. During the G4AW project all these techniques which have been applied within different projects will be combined, configured and implemented for R4A. The roles and responsibilities of each partner are summarised in the table below.

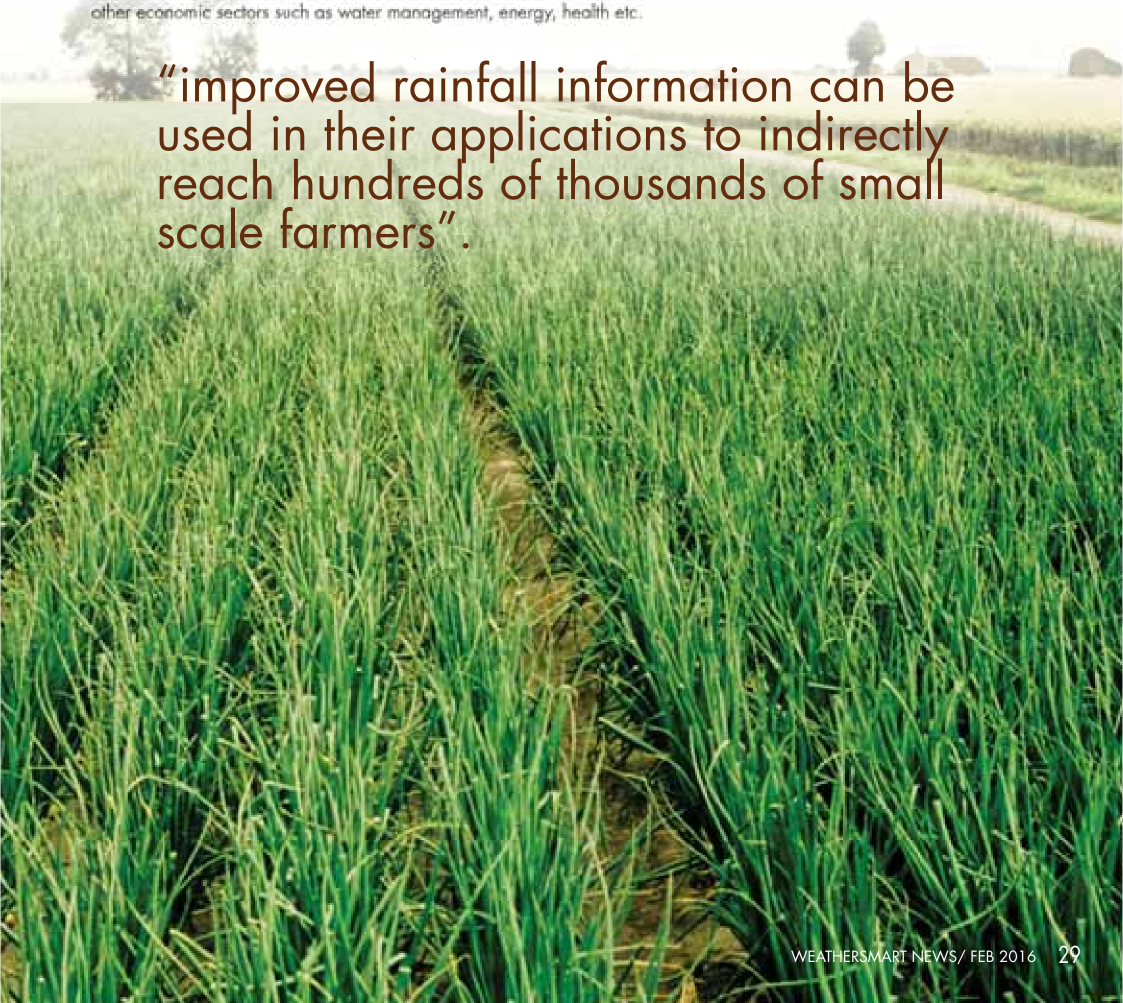
Organisation	Role and Responsibilities
SAWS	- Access to African Meteorological Services to expand the R4A platform. - Provider of surface observation, radar and satellite data covering the whole of Southern Africa - Training/capacity building of African weather services - User of the R4A platform
HydroLogic Systems	- Implementation of the R4A platform based on the HydroNET platform - Provide toolbox and training for national weather services - Implementation of automated calibration processes - Provide Software development kit and training for application developers
KNMI	- Knowledge providers - Data provider of ECMWF data and satellite based data sets for Southern Africa - Link to other G4AW projects
ARC	- Project management - Development of 2 decision support applications for farmers - Input of expert knowledge on requirements of the agro/food market and farmers - Market analysis
Mobile Water Management	- Implementation of low cost crowdsourcing solution for measuring rainfall information via mobile app

THE EXPECTED IMPACT OF THE PROJECT

- Improved knowledge on the impact of weather on food production.
- Improved community awareness about the importance of reliable weather information.
- Empowerment of farmers by providing improved, personalised weather services with special focus on female farmers.
- Improved food production by more than 10% due to the improved weather forecast and the sowing and spraying advices, food production will increase.
- Reduced spraying by 20% due to personalised spraying advice.
- Reduced risk of crop failure by more than 10% of crop failure, due to the personalised sowing and spray advice.

The ultimate objective of this project is to improve the efficiency with which small-scale farmers on the African continent practise their trade. The platforms being developed in this project can also serve as basic building blocks for services to other economic sectors such as water management, energy, health etc.

> "improved rainfall information can be used in their applications to indirectly reach hundreds of thousands of small scale farmers".



WMO AVIATION RESEARCH DEMONSTRATION PROJECT (WMO AVRDP)

Dr Estelle de Coning - Chief Scientist: Nowcasting and Very Short Range Forecasting

The WMO Commission for Atmospheric Science/World Weather Research Programme has organised several Research and Development Projects (RDP) with great success in the past years for advancing nowcasting and mesoscale modelling sciences. During the joint meeting of the Working Group for Nowcasting Research and the Working Group on Mesoscale Weather Forecasting Research (WGMWF) held in 2012 in Brazil, a proposal was made to set up an Aviation specific Research Demonstration Project (AvRDP) at several airports in different climatological locations. The purpose of the AvRDP is to demonstrate the capability of nowcasting and mesoscale modelling techniques in support of the development of the next generation aviation initiative, namely, the Aviation System Block Upgrade (ASBU) under the new Global Aviation Navigation Plan (GANP) which was endorsed by ICAO in 2013. The key concept in ASBU is the Trajectory Based Operation (TBO) approach, which would integrate seamlessly high-resolution, rapidly-updated observation, nowcasts and forecasts along the entire flight trajectory, from take-off, ascending, en-route, descending and to landing phases, into the air traffic management (ATM) system (Fig.1). The meteorological elements include convection and thunderstorms, ceiling and visibility, wind, windshear, upper-air and low-level turbulence, in-flight icing, winter weather, surface icing and airframe icing, tropical cyclone, wake vortex, volcanic ash, radiative cloud and space weather.

The WMO Congress approved this new research project at the end of 2014 and emphasized that WMO should play a lead role in the development of new services to Air Traffic Management (ATM) through an accelerated transfer of the nowcasting research and technology achievements into operational practice.

Congress also noted that AvRDP should also demonstrate a strong partnership approach through the engagement of several WMO Programmes (AEMP, WWRP, GDPFS), several technical commissions (CAeM, CAS, CBS), and WMO Members (Canada, China, France, Hong Kong, China and South Africa, committed to participate in the first research phase). OR Tambo international airport has been incorporated as one of the participating airports for this project.

The AvRDP will be conducted in two phases over the next three years:

(I) Phase I will focus on the meteorological capability research on some weather elements which are commonly considered to bring significant impacts to high density airport/airspace, such as convection, winter weather, wind change, low visibility and ceiling, etc., depending on each airport's characteristics. The preliminary findings of Phase I will be reported and discussed in mid 2016.

(ii) Following the completion of Phase I, Phase II will focus on the translation of meteorological information into ATM-specific parameters and the associated ATM impact validation. This phase will end in 2018.

A kick-off meeting for this project was held in Shanghai in June 2015. From December to March, convective weather events affecting the aviation industry will be documented and investigated to assess how current and future nowcasting tools can be utilized to improve nowcasting at OR Tambo International airport.

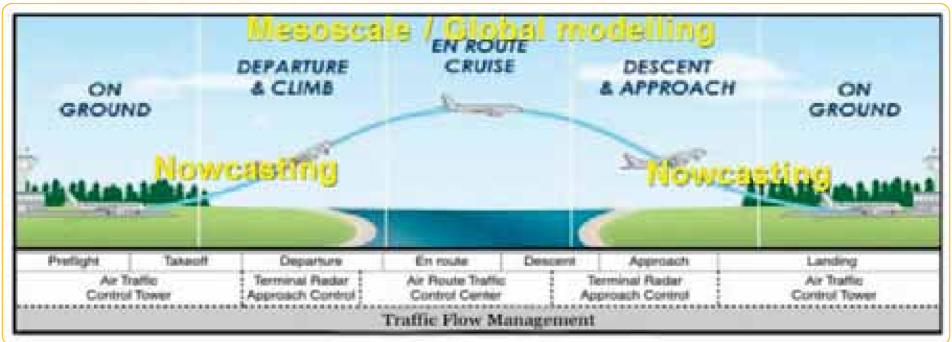


Figure1: *Seamless meteorological information required under the Trajectory Based Operation (TBO) concept*

AFRICAN SATELLITE METEOROLOGY EDUCATION AND TRAINING (ASMET) 8 MODULE

– Ms. Lithakazi Mkatshwa and Ms. Lee-Ann Simpson: Regional Training Centre

The South African Weather Service (SAWS) has been involved with the African Satellite Meteorology Education and Training (ASMET) project since the ASMET 5 project was launched in 2007. The latest edition to the ASMET learning modules, module 8, was published on the MetEd website (https://www.meted.ucar.edu/communities/asmet/) in October 2015. This latest ASMET project is a collaboration between SAWS, the Kenya Meteorological Department, the Moroccan Meteorological Department and the Meteorological Department of Niger. The ASMET project is managed by EUMETSAT and is supported by staff at EUMETSAT and COMET. The material produced by the ASMET projects is aimed at supplementing learning material for meteorologists in Africa, with a focus on satellite meteorology.

The ASMET module 8 comprises four different learning modules, each published by the respective countries collaborating in the team. The South African team comprised Ms. Shine Lithakazi Mkatshwa and Ms. Lee-ann Simpson from the SAWS Regional Training Centre (RTC). The project was launched in June 2014 and the topic of the SAWS module is: Using ASCAT wind and other data in marine forecasting. This online module can be found at:

https://www.meted.ucar.edu/training_module.php?id=1204

This case study lesson demonstrates the use of scatterometer wind and, to a lesser extent, altimeter significant wave height products in marine forecasting. A brief introduction to cold fronts and their impact on weather and sea state conditions sets the stage for the main part of the lesson, the case study.

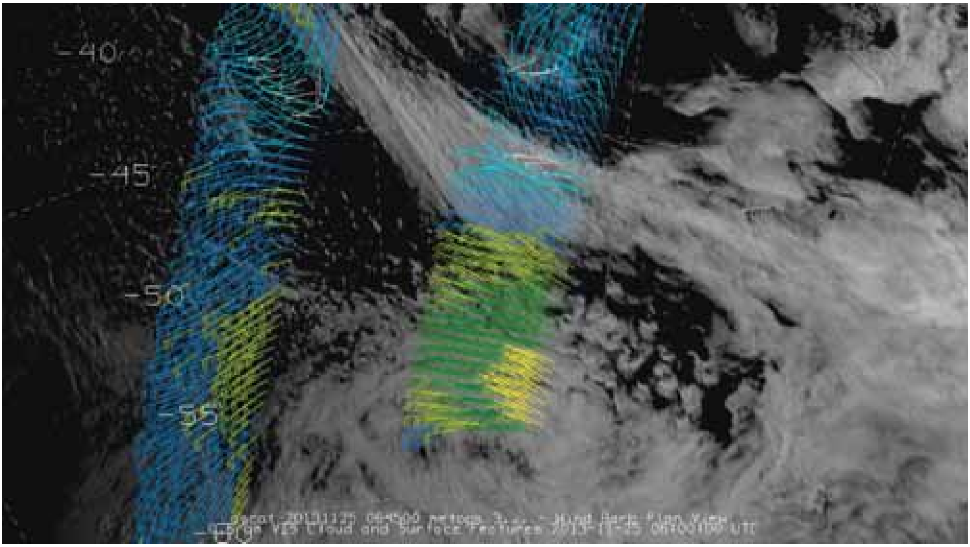


Figure 1: *ASCAT wind data overlaid with the VIS 0.6 MSG satellite image, valid for 25 November 2013 at 0600UTC*

The case follows the passage of a cold front over the South Atlantic Ocean on 23 and 24 November 2013 when the Polarstern research vessel was transiting the area. Learners use ASCAT wind and Jason-2 significant wave height data to help determine current conditions and evaluate GFS and WAVEWATCH III analyses and forecasts. The lesson is intended for operational marine forecasters, meteorologists, meteorological technicians at coastal stations as well as meteorology students. Note that the lesson has been developed with funding from EUMETSAT for the ASMET project.

The objectives of the learning module are:

- Describe cold fronts and their impact on sea surface conditions
- Describe the uses and advantages of scatterometer sea surface winds and altimeter significant wave heights in marine forecasting
- Interpret scatterometer wind data
- Use scatterometer winds and other observations to determine current weather and sea state conditions, adjusting marine NWP analyses and forecasts as needed

The topics of the modules published by the other countries in the project are:

From East Africa: Forecasting heavy rains and landslides in Eastern Africa

From North Africa: Extreme high swell events on the Moroccan Atlantic coast

From West Africa: Satellite - derived climatology products for monitoring convection over West and Central Africa

The next phase of the ASMET project will be the 9th Module, which is expected to launch early in 2016. Suggestions for the topic of the project are currently focussed around NWP data, in particular the Unified Model 4km, and the interpretation thereof.

Figure 2: *ASMET 8 Team in Darmstadt, Germany (June 2014)*

REVISION OF THE WMO INTERNATIONAL CLOUD ATLAS INTO DIGITAL FORMAT

The World Meteorological Organization is in the process of updating the International Cloud Atlas – Manual on the Observation of Clouds and other meteors (WMO-No. 407, Volume I and II). The international Cloud Atlas (ICA, WMO No. 407) is the international standard for the classification of cloud types used by all meteorologists and aviation users worldwide, but was last updated in 1975 (Part I) and 1987 (Part II). It is also currently only available in hard copy. This led to numerous alternative cloud atlases emerging in digital form and thus, in order for the WMO ICA to retain its role as the global standard for cloud observation, there is a clear need for a digital version of the ICA.

At its Ninth Session in Geneva on 5-8 April 2011, the CIMO Management Group proposed that a meeting be organised to discuss the way forward for the ICA. Such a meeting was held at WMO in Geneva on 23 September 2011, where it was recommended that CIMO form a Task Team to examine in detail the requirements for revision of the ICA, and the opportunities for expansion of its functionalality. In 2012 the Terms of Reference of the Task Team were finalised and specialists in cloud observation were thus invited to be part of this Task Team.

The work of the Task Team included the identification needs for new or updated imagery in preparation for a letter to interested parties to provide such imagery and metadata, the identification of terms to be included in a Glossary, the updating of the Cloud Coding Decision Aid and the development of a simplified Aid for general recognition. Review, revise, and update all the ICA text, receive, sort, categorize, and vet candidate imagery and metadata and define the web appearance, structure and functionality of the web-based ICA. Much of this work was completed during 2014, and in 2015 the focus was on developing the website for the submission of cloud photos as well as the full revision of the ICA Vol I text.

The Task Team is at that point where cloud imagery is now needed and to this end, WMO invites professional meteorologists, weather observers and cloud photographers to submit candidate images and associated metadata (if available) for consideration by a team of cloud observation experts for possible inclusion in the new ICA. A specially designed website has been created to collect images and is available at the following link: http://wmoica.org/index.php/en/

Figure 1: *The CIMO Task Team on the International Cloud Atlas. Kwong Hung Tam (Hong Kong, China), Colleen Rae (South Africa), Eliane Thuerig-Jenzer Switzerland), Mike Bruhn (Australia, Vice-Chair), Marinés Campos (Argentina), Jim Trice (UK), George Anderson (UK), Steve Cohn (USA, Chair), Ernest Lovell (Barbados).*

Solutions for a WeatherSmart South Africa

HydroNET

Reliable weather information at your fingertips because every raindrop counts

It is well documented that South Africa is a water scarce country, which is vulnerable to the impacts of climate change. Large parts of the country already have low and variable rainfall and a significant portion of our surface water resources are already fully allocated.

In addition, floods caused by excessive rainfall over a short period also cause hazardous conditions. Such hazards range from local, water-induced damage to large-scale devastation for whole communities.

South Africa is unlikely to get substantial rain in the months ahead, with local and international climate experts predicting one of the strongest El Niño weather events in more than half a century. In this situation, every drop of rainfall information counts.

To optimally benefit from the available rainfall, access to real-time weather information is essential. The South African Weather Service (SAWS) and Hydrologic, a Dutch based company, have joined forces to make, reliable historical, actual and forecasted rainfall information easily available.

On 17 November 2015, the South African Weather Service CEO, Dr Linda Makuleni, signed a cooperation agreement with Hydrologic, a Dutch-based company, to develop and implement an online rainfall management application. The signing ceremony took place in Newtown, Johannesburg in the presence of the Dutch Prime Minister Mark Rutte, who is on an official visit to South Africa.

HydroNET makes real-time monitoring and the prediction of rainfall as well as water availability easily accessible. The South African Weather Service and Hydrologic officially launched RainWatch, a set of web-applications empowering weather sensitive industries to make WeatherSmart decisions because every raindrop counts.

RainMap application

The RainMap application allows online access to historical and actual rainfall information from rain gauges, satellites and radars and automatically combines and calibrates the different sources and produces a composite via an interactive map.

Weather station

The Weather Station application allows users easy access to historical and actual rainfall time series from the SAWS automatic weather stations.

Forecast application

The Forecast application allows users to easily access the rainfall forecast from SAWS, incorporated into a geographical precipitation map.

* Users are able to personalise dashboards with relevant graphs, thematic maps, tables and model results, in order to make safe and reliable decisions at the right time.

For further information visit hydronet.co.za
or contact us on 012-3676116

South African Weather Service

ISO 9001 Certified Organisation

The South African Weather Service Logo

The South African Weather Service logo represents the movement of weather system and their interaction with the earth, sun and atmosphere. It also portrays a fresh and dynamic visual appearance that identifies South African Weather Service as a proudly South African organisation.

- The light blue represents water which is our main source of life.
- The dark blue represents the atmosphere in which all weather occurs.
- The green symbolises sustainability and life
- The red-brown represents the earth from which al life originates.
- The yellow circle represents the African sun.

South African
Weather Service

ISO 9001 Certified Organisation

Head Office

Pretoria

442 Rigel Avenue South
Erasmusrand
0181

Tel: 012 367 6000

Regional Offices

Bloemfontein - Weather Office

Maselspoort Road
Bran Fisher International Airport
Private Bag X20562
Bloemfontein
9300

Tel: (051) 433 3281

Cape Town International - Weather Office

ATNS Tower, Tower Street
Cape Town International Airport
P.O. Box 21
Cape Town International Airport
7525

Tel: 021 934 0749/0831

King Shaka International - Weather Office

Ground Floor
ATNS Building King Shaka International Airport
P.O. Box 57733
King Shaka International Airport
4407

Tel: 032 436 3820/3812

OR Tambo International - Aviation Weather Centre

Room Nl61, 3rd Floor
OR Tambo International Airport
P.O. Box 1194
Kempton Park
1627

Tel: 011 390 9329/9330

Port Elizabeth - Weather Office

Roof Top, Departures Hall
Port Elizabeth Airport
Private Bag X5991
Walmer
Port Elizabeth
6065

Tel: 041 581 0403/8587

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