UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

AON BENFIELD

AON BENFIELD
Natural Hazard Centre
Africa

ISSUE 01

Qhaphela

The Newsletter of Aon Benfield Natural Hazard Centre, Africa

Contents

Editorial

A name is an entity in itself. It transcends core identities in an attempt to reconstruct new realms formed when influential conglomerates merge to form something new, dynamic and relevant within this cutting-edge era. At the end of last year, Aon Re Global merged with Benfield to form Aon Benfield. With the newly co-constructed state of being, came a need for a new identity which transcends the past to reflect upon the unified, strengthened identity formed by the best in industry. Thus, Aon Benfield Natural Hazard Centre, Africa was born.

The Aon Benfield Natural Hazard Centre, Africa incorporates a multidisciplinary approach to serve as a one-stop contact where information is generated and managed amongst engineering, disaster management and insurance industries. It works closely with the Aon Benfield Analytics Natural Hazards team in London. The Centre, which is located in South Africa, at the University of Pretoria's main campus, prides itself as having a wide network of expert associates who have extensive skills in natural hazard assessing and modelling and can offer independent advice, opinion and analysis on all aspects of African natural perils. It is without any reservations that we express our contentment at being part of the new entity of Aon Benfield, the premier reinsurance intermediary and capital advisor.

Regards,
Professor Andrzej Kijko
Director: Aon Benfield Natural Hazard Centre, Africa

Seismotectonic Models for South Africa

Synthesis of Geoscientific Information, Problems and Way Forward

Seismological Research Letters Volume 80, Number 1 January/February 2009

Mayshree Singh(1), Andrzej Kijko(2), Ray Durrheim(3)
(1) Council for Geoscience, South Africa
(2) University of Pretoria, South Africa
(3) University of Witwatersrand, South Africa
Private Bag X112, Pretoria, 0001, South Africa

In South Africa the demand for energy resources, water, and infrastructure has grown significantly in recent years. Furthermore, many coal reserves that are currently being exploited will be depleted within the next 20 years. Consequently, plans to provide alternative sources of energy are underway. Energy providers are slowly moving away from traditional coal-fired stations to gas-powered facilities, nuclear power plants, and portable pebble bed modular reactor (PBMR) units. Several dams within the country have also been constructed to accommodate the growing demand for water. In South Africa, no regulatory guidelines for seismic design of such critical facilities exist; hence engineers make use of international guidelines such as Regulatory Guide 1.208, published by the U.S. Nuclear Regulatory Commission (U.S. Nuclear Regulatory Commission 2007). Engineers also need to assess the seismic risk to formulate emergency evacuation procedures and for insurance assessment purposes. The first step in assessing the seismic hazard and risk for any site is to develop a seismotectonic model. The area under investigation is divided into smaller zones/regions of similar tectonic setting and similar seismic potential (Cornell 1968). These zones are then used in a seismic hazard assessment model to determine return periods of certain levels of ground motion at a given site in the area in question. For example, U.S. Nuclear Regulatory Guide 1.208 (U.S. Nuclear Regulatory Commission 2007) states that regional seismological and geological investigations should be undertaken to identify seismic sources and describe the Quaternary tectonic regime.

The investigations should include a comprehensive literature review (including topographic, geologic, aeromagnetic, and gravity maps, as well as aerial photos), plus focused geological reconnaissance based on the results of the literature study. Once the regions of active faults have been identified, more detailed explorations such as geologic mapping, geophysical surveying, borings, and trenching should be undertaken. Finally, the Quaternary history should be reviewed; surface and subsurface investigations of the orientation, geometry, sense of displacement, and length of ruptures should be conducted; and the possibility of multiple ruptures ought to be assessed. Seismotectonic models have not yet been developed for South Africa.

The delineation of seismotectonic zones of Africa as part of the Global Seismic Hazard Assessment Program (GSHAP) in 1999 was based on an analysis of the main tectonic structures and a correlation with present-day seismicity. Because of the large scale of the GSHAP project, only regional structures were accounted for in the preparation of the source zones.
Our study was initiated to remedy this knowledge gap. We have completed four steps, which are described in this paper.

1. Compilation of a catalog of earthquake activity that has been documented in historical records or instrumentally recorded.
2. Synthesis of geological mapping, magnetic, and gravity surveys, and evidence of neotectonic activity.
3. Correlation of the seismicity data with the geological, geophysical, and neotectonic data.
4. Identification of any other data that could help to better define the boundaries of seismotectonic provinces.

Weather Events

in South Africa from October 2008 to December 2008

This report was compiled by Aon Benfield from information provided by the South African Weather Service

This spring period was marked by a late onset of rainfall over the summer rainfall regions and exceptional wet conditions over the Western Cape. The worst losses, estimated at 1 billion ZAR were caused by flooding experienced between 11 and 13 November over the Cape Winelands and Overberg. Extensive damage to road infrastructures resulted and one person sadly drowned. Insurers in general did not suffer large losses as the events unfold mainly in agricultural districts. Rainfall records fell for November over the region with more than 100 mm recorded in Kleinmond in one day.

Kwazulu-Natal was affected by severe thunderstorms on 26 and 27 December causing damage to more than 600 homes and leaving several thousand residents homeless over a widespread area. The victims were mainly supported by the government disaster management structures. This event happened shortly after severe storms previously struck on 14 October that led to the death of 9 people in the Durban area.

Bushfires affected the Western Cape on 10 December damaging 8 homes and thousands of hectares of fynbos. Several new maximum temperatures records were broken during December, with Vredendal hitting 45 ºC and Richards Bay 41.6 ºC. Viooldrif on the Namibia border recorded a new record temperature of 46.6 ºC.

For the period October to December 2008 the insurance industry in South Africa has been fortunate in that most severe weather events occurred outside highly concentrated exposure postal codes.

Other significant events during this period were:

DATE	EVENT	LOCATION	DAMAGE
17 October 2008	Hailstorm	Nelspruit Schoemansdal	Orange orchards of 40 million ZAR , windows
5 November 2008	Thunderstorm	Marikana	350 low cost homes destroyed, 39 persons injured
9 November 2008	Hailstorm	Thaba Nchu	11 deaths, Houses flooded.
12 November 2008	Tornado	Reddersburg	Farm stores, chicken incubators destroyed
28 December 2008	Hailstorms	Alicedale, Grahamstown	20 Houses damaged

Predicting El Niño and La Niña Events using Multi-Models

Willem Landman - affiliated with the South African Weather Service

The predictability of seasonal climate anomalies results primarily from the influence of slowly evolving boundary conditions, and most notably sea-surface temperature (SST) anomalies, i.e., during El Niño and La Niña events, on the atmospheric circulation. In many regions of the Globe, including southern Africa, the largest climate signal after the seasonal cycle is associated with SST variations of El Niño (anomalously warm surface temperatures over the central Pacific Ocean) and La Niña events (anomalously cold surface temperatures over the central Pacific Ocean). These events can be predicted with skill at lead-times spanning several seasons. In fact, a number of models have been developed for making long-range forecasts of Pacific Ocean SST anomalies because of this ocean basin's importance to inter-seasonal climate variability worldwide. Such models include simple empirical models that use to good effect the steady-state and evolutionary features of antecedent SST anomaly patterns to predict SST anomalies months ahead. Much more complicated forecasting approaches involve systems with all the components of the lower boundary, known to be of importance to atmospheric interannual variability, modelled as fully interacting. These coupled atmosphere-ocean models represent the pinnacle of complexity in climate models. Notwithstanding the development of highly sophisticated model systems, model error remains an important source of forecast error. However, this error source can be partly addressed by the simultaneous use of several models. In fact, so-called multi-models are nearly always better than any of the individual models.

The South African Weather Service (SAWS) has developed a multi-model forecasting system for SST anomalies over the central equatorial Pacific Ocean. El Niño, La Niña and neutral (neither El Niño nor La Niña) conditions, as reflected by Niño3.4 SST anomalies, are forecast here probabilistically every month. The location of the Niño3.4 region is shown in Figure 1. Forecasts are based on a multi-model approach that combines forecasts from an empirical model and from two dynamical-empirical models. The former uses the most recent 3-month season's SST anomalies (e.g., for a forecast issued in December the predictor season is September-October-November) of the Pacific Ocean (35°N-35°S) in a statistical model to predict single month and seasonal SST anomalies up to six months ahead. The dynamical-empirical models are fully coupled models of which the respective forecasts (also up to six months ahead) are statistically improved. The fully coupled models are NCEP's CFS (http://cfs.ncep.noaa.gov/) and the ECHAM4.5-MOM3 run at the IRI (http://iri.columbia.edu). The resulting probabilistic forecasts are obtained by averaging the probabilities of the three forecasts. The categories of La Niña, neutral, and El Niño are obtained so that for any month or season the climatological (historical) frequency of being in the La Niña and the El Niño categories is 25% each and the frequency of being in the neutral category is 50%.

The Niño3.4 SST probability forecasts issued in December indicate enhanced probabilities of La Niña conditions to develop during the first few months of 2009 (Figure 2). Anomalously cold SST conditions were observed at the beginning of 2009 as can be seen in Figure 3, indicating that the forecast issued in December provided excellent guidance on the likelihood of the development of the current event. The latest forecast issued early February (not shown) indicates that neutral conditions should replace the cold anomalies towards the end of autumn, and conditions may even become anomalously warm towards the end of winter. Could this be the start of the next El Niño event? Hopefully the SAWS's multi-model system will be able to inform us of the chance of such an event to occur well ahead of time.

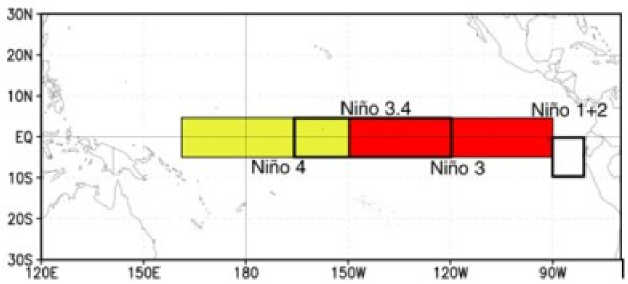


Figure1. *The location of the Niño3.4 region*

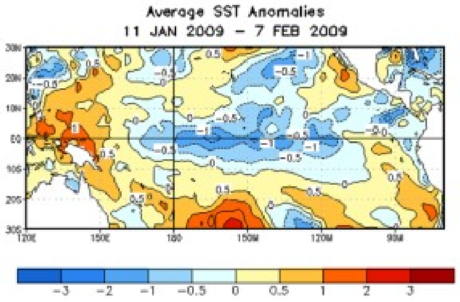
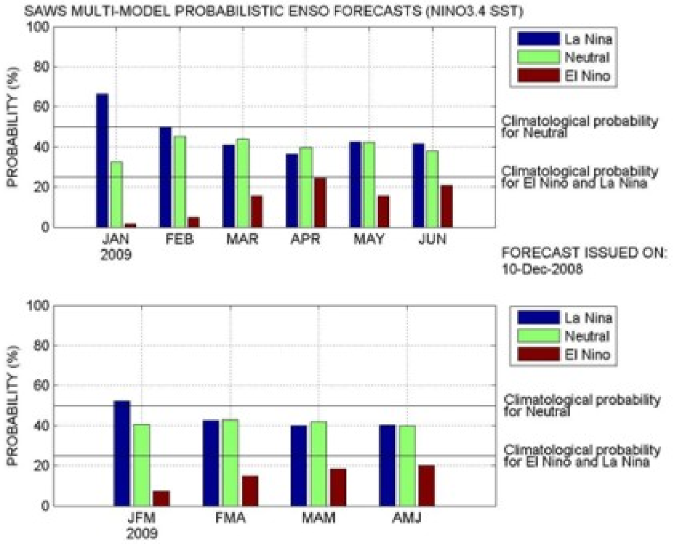

Average SST Anomalies
11 JAN 2009 – 7 FEB 2009

Figure 3. SST departures (°C) in the tropical Pacific during the 4 weeks indicated.


SAWS MULTI-MODEL PROBABILISTIC ENSO FORECASTS (NINO3.4 SST)

FORECAST ISSUED ON: 10-Dec-2008

Figure 2. *Probabilistic forecasts for El Niño, La Niña and neutral events to occur during the months and seasons indicated on the figure.*

Global Warming and Climate Change over Southern Africa

Francois A. Engelbrecht
Department of Geography, Geoinformatics and Meteorology
University of Pretoria

Despite international concern about Global Warming and associated climate change, greenhouse gas concentrations in the Earth's atmosphere are increasing at an accelerated rate. At the current rate of emissions, concentrations will have risen by about 50 % by 2030. To prevent dangerous climate change (thought to be quantified by an increase in the global average temperature of more than 2 ºC), emissions need to be reduced by about 50 % by 2050. The United Nations Conference on Climate Change is due to meet at the end of 2009 in Copenhagen, which is thought by many to be the last chance to reach a binding global treaty to prevent dangerous climate change. However, with the world's economy heavily dependent on fossil fuels, and without any powerful incentives to reduce the deforestation rates in developed countries, it seems highly unlikely that such an agreement will be reached.

A high-resolution regional climate modelling study has recently been completed at the University of Pretoria (UP), in which future climate conditions over southern Africa were projected for a world where greenhouse gas concentrations reach double their natural levels by 2050. The study was performed in collaboration with researchers from the Agricultural Research Council (South Africa) and the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia. The study employed a global circulation model of the CSIRO the only model of its kind developed in the Southern Hemisphere. The climate simulation experiment was performed at high spatial resolution over southern Africa on a powerful computer system at the UP. The project received funding from the Water Research Commission in South Africa.

The study revealed that southern Africa may be expected to become generally drier in the future. This results in principle from a strengthening of the subtropical high-pressure belt over the country which, in turn, forms part of a general strengthening of the Hadley cell circulation. In winter of the simulated future climate, frontal rainbands are displaced southwards on the average, resulting in significant decrease in rainfall over the southwestern Cape (Figure 1). Most of the summer rainfall region of South Africa is projected to become drier in spring and autumn, as a result of the more frequent formation of mid-level high pressure systems (and the subsidence associated with them) over this region.

However, during summer a strong regional forcing, namely the deepening of the continental trough in the greenhouse-gas warmed climate, becomes strong enough to overcome the enhanced subsidence of the stronger Hadley cell. The low and mid-level highs are displaced to the Indian Ocean, and more frequent cloud band formation takes place over eastern South Africa. Under such a scenario of future circulation, the more frequent formation of intense thunderstorms over the Highveld of South Africa, and the more frequent occurrence of landfalling Tropical Cyclones over Mozambique are plausible. Thus, the more frequent occurrence of severe weather events is projected over these regions within a generally drier climate.

It must be realized that there are numerous uncertainties when it comes to model projections of future weather events and rainfall patterns. For example, there exists uncertainty regarding the rate at which greenhouse gas concentrations will increase. Superimposed on this, no computer model is capable of completely describing all the complexities of the land-ocean-atmosphere system. Still, model projections are gradually starting to converge to the same circulation signals, leading to greater insight in the physics and dynamics of climate change. There is a need for more regional projections of climate change over southern Africa to be performed, so that greater insight can be gained in the range of possible outcomes of climate change over southern Africa.

Reference:

Engelbrecht F.A., McGregor J.L. and Engelbrecht C.J. (2008). Dynamics of the conformal-cubic atmospheric model projected climate-change signal over southern Africa. International Journal of Climatology. DOI: 10/1002/joc.1742.

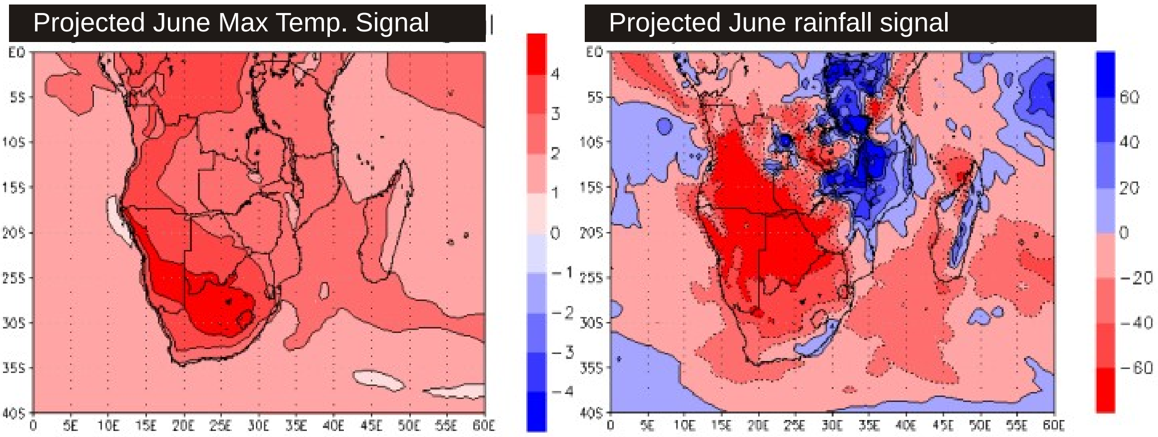


Figure 1:
Change in June maximum temperature (top, °C) and June rainfall (bottom, expressed as a percentage) relative to present-day values.