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On the co-operation between SAWS and CHPC for forecast continuity and Unified Model research in South Africa

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Weather forecasting using Numerical Weather Prediction (NWP) models is a well-established science and based on the fundamental equations of fluid dynamics. NWP is therefore an important tool for predicting weather and making climate projections. The grid spacing used in models is largely dependent on the available computational resources and processing speed required for model output availability for timeous decision making. The direct numerical simulations that are able to capture all processes explicitly are still too far from our reach for practical purposes such as NWP, seasonal forecasting and climate change studies.

The available computational resources have been improving over time, which have made possible a decrease in the grid spacing used in models. A number of meteorological organisation are now using grid spacing of 4 km or less for NWP purposes, especially over limited areas. Models used with such high resolution are called Cloud Resolving Models (CRMs) or convective scale models, and in these models clouds are thought to be resolved explicitly. Similar to other meteorological organisations SAWS runs their NWP models with a grid spacing of 4.4 km over southern Africa and 1.5 km over South Africa. Both these configurations are made four times a day, but with different lead times. These simulations are made on a CRAY XC30 machine which was procured in 2014.

The SAWS CRAY XC30 has 168 nodes with Ivybridge processors. Each model simulation (4 km and 1.5 km) utilizes 1728 cores to complete. The CRAY is also used for operational seasonal forecasting with a coupled atmosphere-ocean model and there are plans for more models on air quality, ocean wave forecasting and applications research that will be undertaken on the CRAY. With all the operational applications on the CRAY, there is limited processing time for research activities such as sub-kilometre grid spacing simulations or ensemble forecasting. Big global operational centres such as the European Centre for Medium Range Weather Forecasts (ECMWF) maintain two HPC resources, with the second one available as a backup to their operational system. Due to budget constraints and the high costs of HPC resources, SAWS does not have such a failover system in-house, resulting in no or limited support for operational NWP at SAWS to operational forecasters if the operational system fails.

In order to deal with HPC shortcomings at SAWS a cooperative partnership agreement was entered into with the Centre for High Performance Computing (CHPC) to facilitate mutual HPC activities, and training programs to meet the missions of both SAWS and the CHPC. The CHPC is one of the three national cyberinfrastructure pillars that are supported by the South African Department of Science and Technology (DST). The CHPC currently hosts a Dell cluster, with a total of 1358 nodes with Intel v3 Haswell processes, and a 4PB Lustre storage. The main objective of the CHPC is to enable South Africa to become globally competitive and to accelerate Africa's socio-economic upliftment through the effective application of high-end Cyberinfrastructure. The CHPC seeks to become an accomplished and preferred partner for High Performance Computing solutions.

The agreed areas of cooperation between SAWS and the CHPC include 1) the use of the CHPC cluster as a fail-over system for SAWS operations, 2) the use of the CHPC HPC system for benchmarking purposes to determine future operational needs of SAWS, 3) Use of the CHPC HPC system for research purposes, and 4) Training on the use of the CHPC cluster. SAWS has been using UK Met Office Unified Model (UM) as its main Numerical Weather Prediction model since 2006. As a result of the agreement between SAWS and the CHPC,

the UM has now been installed on the CHPC cluster. The CHPC cluster was used successfully for business continuity purposes when SAWS moved offices, as well as, as a failover system when there were power issues at the SAWS premises. Before now the UM had only been available at SAWS and to SAWS employees due to license restrictions, resulting in scientists only getting exposure to the UM once employed by SAWS. The installation of the UM on the CHPC infrastructure will allow SAWS and other academic and research institutions across South Africa access to the UM for research purposes.

Presenter Biography

Stephanie Landman has been working as a Meteorologist for almost 15 years. She started her career as a weather observer at the Bethlehem Weather Office (METSYS) after which she joined the short-term insurance industry for a number of years. Returning to atmospheric
sciences, she was a Scientific Consultant in Air Quality at Bohlweki Environmental before she re-joined the South African Weather Service in 2008 where she has since been appointed to Lead Scientist in Numerical Weather Prediction (NWP). She completed her MSc (Meteorology)
degree at the University of Pretoria in 2012 with the research topic of determining the skill in multi-model short-range ensemble prediction systems over South Africa. Her main area of interest is in post-processing of NWP data, including the development and implementation of prediction systems for short-range forecasting. She also teaches on a part-time basis at the University of Pretoria a BSc (Honours) (Meteorology) course in applications of NWP,
supervises BSc (Honours) students with their research projects on model evaluation issues as well as co-supervising MSc dissertations. At the Regional Training Centre (RTC) she teaches the forecast interns on the use of NWP for practical forecasting as well as applying model output statistics to forecasts.

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