Evaluation of two convective scale version of the Unified Model using two spatial verification methods

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Introduction

Since 2006 the South African Weather Service (SAWS) has been running the Unified Model (UM) as the main model for operational Numerical Weather Predictions (NWP) purposes. Ever since then different configurations of the UM has been run at SAWS at different horizontal and vertical grid spacing. Subsequently changes to the UM code has been made by scientists from United Kingdom Meteorological Organization(UKMO). To date SAWS is currently running the UM over the Southern African domain(0, 50S, 10W, 55E) with 12km horizontal grid spacing together with the two convective scale configurations of the UM, namely SA4 and SA1.5. Both subjective and objective verification methods have shown that the convective scale configurations improved the forecasting of mesoscale features.

Data and Methods

Currently the South African Weather Service is running two convective scale configurations of the Unified Model at different horizontal resolutions on a daily basis(SA4 and SA1p5.). The SA4 model is run over the Southern Africa domain (0-38S; 5-54E) with 72hr lead time and grid spacing of about 0.038 degrees. The SA1p5 configuration is run over the South African domain (36-22S; 15-34E) with 36hr lead time and grid spacing of about 0.013 degrees. In this study two spatial verification methods are used to evaluate different convective scale configurations of the UM model. The first method is the object-based verification approach Method for Object-Based Diagnostic Evaluation (MODE) which compares gridded observations with gridded forecasts. Davis et al., (2006). The other approach that will be used is the intensity scale method, as introduced by casati et al. (2003).

Results

Object Orientated Verification

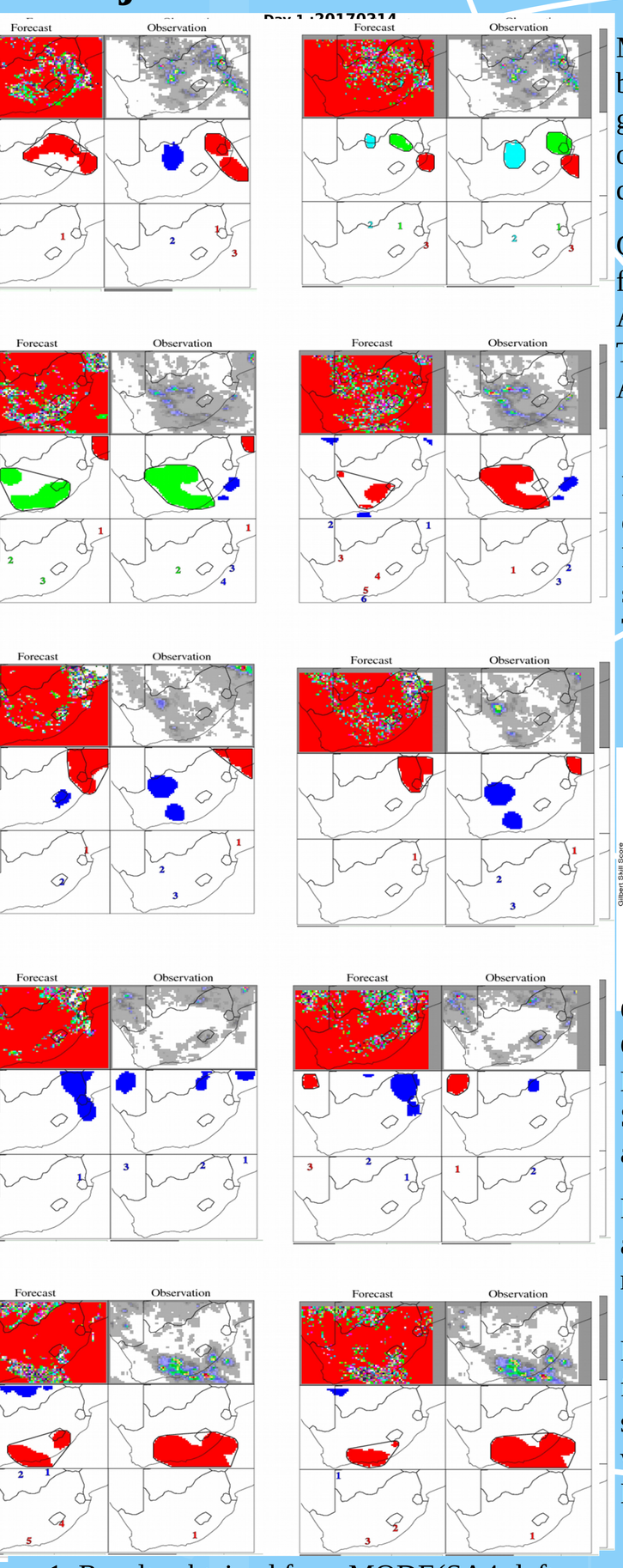


Figure1: Results obtained from MODE(SA4=left, SA1p5=right)

MODE as shown in figure 1 performs objects based verification comparing gridded forecast and gridded observations. Forecast and observed objects fields are compared based on the certain common attributes of the objects in both fields.

Case studies are based on the heavy rainfall cases following Topical cyclone Dineo in February. After the tropical cyclone a Tropical Temperate Trough caused heavy falls in most pars of South Africa.

Figure 1 depicts the results obtained from comparing SA4 and SA1p5 with the Global Precipitation Mission(GPM) data. Both models seem to have high interest values. Contingency Table Statistics(CTS) are shown in Figure 2.

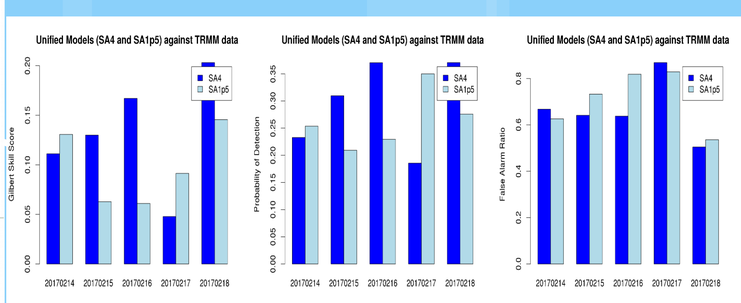
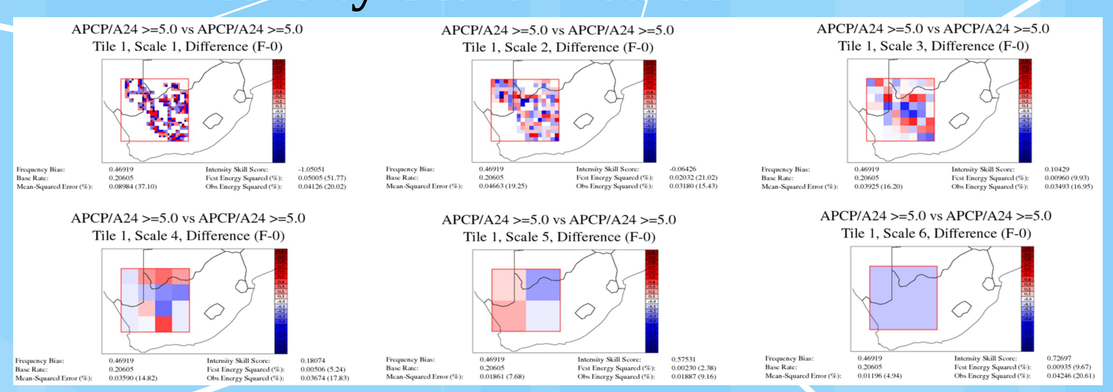


Figure 2: CTS for 5mm threshold

Out of the five case studies three have higher Gilbert Skill Score, higher Probability of Detection and lower False Alarm Ratio for the SA4 model. Both configurations seem to struggle at higher thresholds i..e (20 mm)

Results obtained from using the Intensity scale approach are shown in figure 3 and 4. The tiling methods of the IS method was used. Intensity Skill Score (ISS) statistics are shown in Figure 4. Positive values of the ISS represent skillful forecasts wheres negative values represent no skill. Low spatial components have negative ISS where as high spatial components have positive ISS values.

Intensity Scale Method



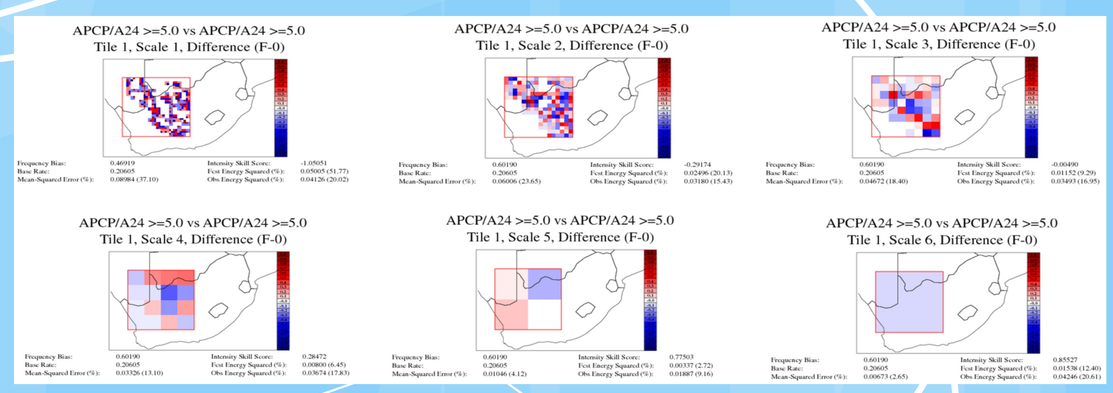


Figure 3: Spatial scale(1-6) components obtained by a 2D Haar wavelet transform(threshold=5mm) . Corresponding wavelet components are (5, 10,20,40,80,160 km) top(SA4) bottom(SA1p5).

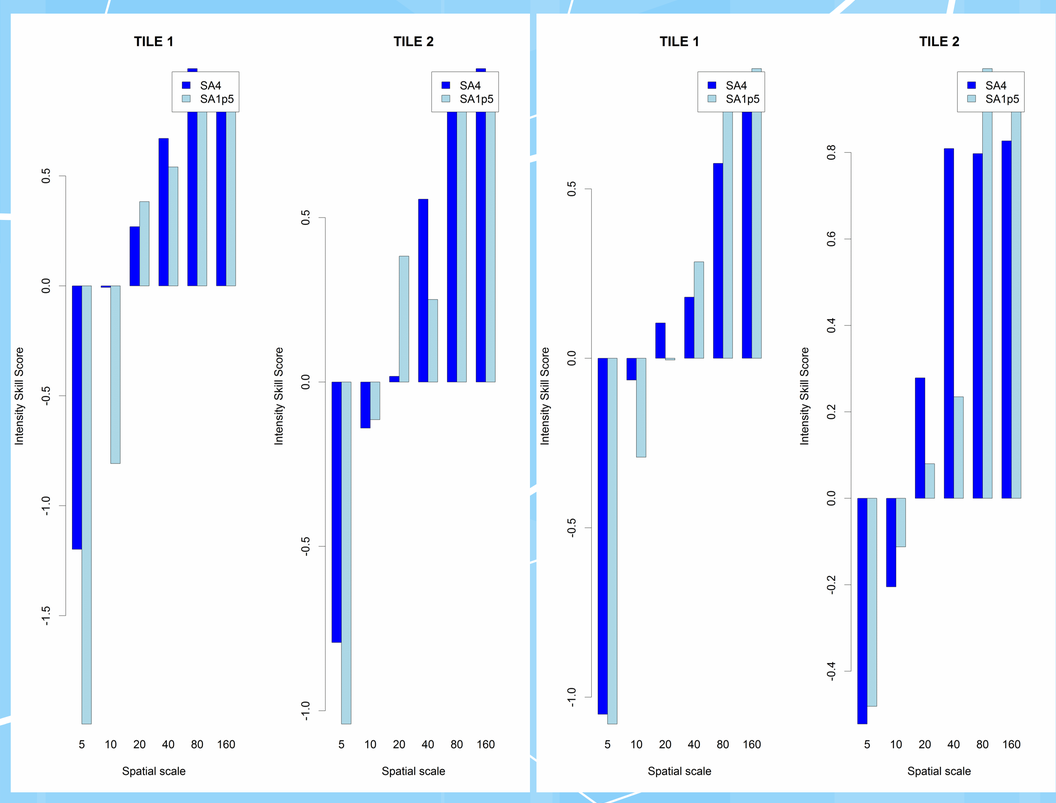


Figure 4:Intensity Skill Score for the two cases

Conclusion

Based on the case studies, there seem to be a slight difference between the two convective scale models. The SA1p5 performs slightly better that the SA4 model,

References

Davis,C.A, Brown, B.G., Bullock, R &Halley-Gotway, J. (2009). Method for Object Based diagnostic(MODE) Applied to Numerical forecasts from 2005 NSSL/SPC

Acknowledgements

I would like to extend my sincere gratitude to the South African Weather Service for funding my Trip to Berlin. Many thanks to the SMRF team for their support, Ms. Bathobile