



## Assessing the variation in the predictability of South African seasonal climate with HadRM3P ensemble spreads

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This study assesses the existence of trends and inter-annual variations in the predictability of the South African seasonal climate using a quasi-stochastic atmospheric system. The paper analyze the ensemble spread of a 50-year HadRM3P model simulations (ranging from 30 to 1000 simulations per month) with different initial conditions for monthly near surface air temperature and rainfall. It quantifies the ensemble spreads of the simulations using the standard deviation (sensitive to outliers) and the distance between 90th and 10th percentiles (Range of Possibility, less sensitive to outliers). Inter-annual variability and trends of standard deviation and range of possibility are then investigated and compared. Spatial-temporal variabilities of standard deviation and range of possibility indicate significantly negative trends in the ensemble spreads for precipitation majorly over inland provinces, from late austral spring to mid austral summer. Temperature exhibits coastal-inland provinces dichotomy, as both metrics of scale show negative trends over the coastal provinces in austral spring and early periods of austral summer. Negative trends of the spatial-temporal variations of the ensemble width implies narrowing of the range of possible predicted values, reduction in uncertainties within the prediction, and the existence of convergent systems in two or more similar states which may become progressively more similar. There exist some agreements between the standard deviation and range of possibility as  $0.55 < r < 0.96$  with p-values of more than 95%, except over Gauteng province where  $-0.3 < r < 0.3$  for surface air temperature and predominantly low positive r for precipitation; the implication is that reliable seasonal forecasts may not be possible at a very small spatial scale. The work further explore the possible factors responsible for the existence of potentially substantial long-term trends in the ensemble spreads; and how these trends may as well represent significant trends in the overall predictability and the limits to predictability of seasonal climates over South Africa.