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Stochastic Parametrisation and Model Uncertainty in the Lorenz '96 System

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Simple chaotic systems are useful tools for testing possible methods to use in numerical weather simulations due to their transparency and computational cheapness. The Lorenz (1996) toy model of the atmosphere was used in this investigation, which describes a set of coupled large and small scale variables arranged in a ring.

Stochastic parametrisation of sub-gridscale processes can be used to explore model uncertainty. For each state of the resolved, macroscopic variables there are many possible states of the unresolved variables. It therefore seems unjustified to assume a one-to-one mapping of the large scale onto the small scale variables, as is the case in a deterministic parametrisation. A stochastic scheme is able to explore other nearby regions of the attractor compared to a deterministic scheme, and an ensemble generated by repeating a stochastic forecast gives an indication of the uncertainty inherent in the parametrisation process. A number of different stochastic parametrisation schemes were investigated, including the use of additive and multiplicative noise. Skill scores were used to give a measure of the forecasting ability of different parametrisations, and their forecasting skill compared to their ability to reproduce the climatology of the full model. This concept is of great importance in a seamless prediction system, allowing the reliability of short term weather forecasts to provide a quantitative constraint on the reliability of climate predictions from the same system.

References:
Lorenz, E. N., 1996, Predictability – a problem partly solved. Proceedings, Seminar on Predictability ECMWF, 1, 1-18.