



## **Signal and noise in chaotic systems: understanding the predictability of the NAO**

Kristian Strommen and Tim Palmer

University of Oxford, Atmospheric Physics, Physics, United Kingdom (kristian.strommen@physics.ox.ac.uk)

Studies conducted by the UK Met Office in recent years reported significant skill at predicting the winter North Atlantic Oscillation (NAO) index with their seasonal prediction system. At the same time, these studies also suggested that the signal-to-noise ratio of the model is spuriously low. In other words, the real world appears to be more predictable than the model. We analyse this skill using two new toy-models aiming to capture regime-like behaviour. We show that these toy-models can easily reproduce the observed skill, suggesting that improved skill at predicting the NAO may be a result of improved regime structure in the model. It is also shown that these toy-models naturally produce a high signal-to-noise ratio simply as a consequence of model error at capturing the preferred regime behaviour. In fact, we show that a low signal-to-noise ratio is to be expected for both these regime-based toy-models as well as more simple linear-regression style models, as soon as the model has consistent, but imperfect, ability at capturing the predictable signal of the system. In particular, any model bias, including for example imperfect regime structure or poor propagation of teleconnections, can be expected to induce low signal-to-noise ratios even when the models internal variability is realistic.