EGU2020-22422
https://doi.org/10.5194/egusphere-egu2020-22422
EGU General Assembly 2020

Regime-dependent statistical post-processing of ensemble forecasts

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A number of realizations of one or more numerical weather prediction (NWP) models, initialised at a variety of initial conditions, compose an ensemble forecast. These forecasts exhibit systematic errors and biases that can be corrected by statistical post-processing. Post-processing yields calibrated forecasts by analysing the statistical relationship between historical forecasts and their corresponding observations. This article aims to extend post processing methodology to incorporate atmospheric circulation. The circulation, or flow, is largely responsible for the weather that we experience and it is hypothesized here that relationships between the NWP model and the atmosphere depend upon the prevailing flow. Numerous studies have focussed on the tendency of this flow to reduce to a set of recognisable arrangements, known as regimes, which recur and persist at fixed geographical locations. This dynamical phenomenon allows the circulation to be categorized into a small number of regime states. In a highly idealized model of the atmosphere, the Lorenz '96 system, ensemble forecasts are subjected to well-known post-processing techniques conditional on the system's underlying regime. Two different variables, one of the state variables and one related to the energy of the system, are forecasted and considerable improvements in forecast skill upon standard post-processing are seen when the distribution of the predictand varies depending on the regime. Advantages of this approach and its inherent challenges are discussed, along with potential extensions for operational forecasters.