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Representation of model error through process-based perturbations for ensemble prediction : application to turbulence and shallow convection parametrisations

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The boundary layer is the place of many complex physical processes spanning various time and space scales, part of which need to be parametrised in NWP models. These parametrisations are known sources of uncertainty in the models, due to the difficulty of accurately representing the processes, and the resulting simplifications and approximations that have to be done. Model uncertainty is part of what ensemble prediction systems seek to represent. This can be achieved in particular by using stochastic perturbation methods, where noise is introduced during model computations to change its state and produce different simulations. Well-known and widely used perturbation schemes like the Stochastically Perturbed Parametrisation Tendencies (SPPT) scheme have shown their effectiveness and their interest in building ensembles. However, part of the model uncertainty is not yet well represented in current ensemble systems, while some of the assumptions made by SPPT can be questioned. This argues for a diversity of approaches to represent model errors. In this active research field, alternative perturbation methods are investigated, such as the Stochastically Perturbed Parametrisations (SPP) method, or other methods focusing on the perturbation of particular physical processes. The work presented here focuses on the last ones. Based on two examples of methods published in the literature, perturbations have been applied to the turbulence and shallow convection parametrisation schemes of the mesoscale NWP model Arome from Météo-France. The perturbation of turbulence is based on the use of subgrid-scale variances to regulate the amplitude of an additive noise, while shallow convection is perturbed through a stochastic closure condition of the scheme. A simplified 1D framework has been used, in order to assess the ability of the method to produce an ensemble with sufficient dispersion and to compare its results with those from existing methods like SPPT.