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# A comparison of ensemble post-processing approaches that preserve correlation structures

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Despite the fact that ensemble forecasts address the major sources of uncertainty, they exhibit biases and dispersion errors and therefore are known to improve by calibration or statistical post-processing. For instance the ensemble model output statistics (EMOS) method, also known as non-homogeneous regression approach (Gneiting et al., 2005) is known to strongly improve forecast skill. EMOS is based on fitting and adjusting a parametric probability density function (PDF). However, EMOS and other common post-processing approaches apply to a single weather quantity at a single location for a single look-ahead time. They are therefore unable of taking into account spatial, inter-variable and temporal dependence structures.

Recently many research efforts have been invested in designing post-processing methods that resolve this drawback but also in verification methods that enable the detection of dependence structures. New verification methods are applied on two classes of post-processing methods, both generating physically coherent ensembles. A first class uses the ensemble copula coupling (ECC) that starts from EMOS but adjusts the rank structure (Schefzik et al., 2013). The second class is a member-by-member post-processing (MBM) approach that maps each raw ensemble member to a corrected one (Van Schaeybroeck and Vannitsem, 2015).

We compare variants of the EMOS-ECC and MBM classes and highlight a specific theoretical connection between them. All post-processing variants are applied in the context of the ensemble system of the European Centre of Weather Forecasts (ECMWF) and compared using multivariate verification tools including the energy score, the variogram score (Scheuerer and Hamill, 2015) and the band depth rank histogram (Thorarinsdottir et al., 2015).

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