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Improving weather and climate predictions by training of supermodels

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Recent studies demonstrate that weather and climate predictions potentially improve by dynamically combining different models into a so called 'supermodel'. In this study, the supermodel tendency is a weighted superposition of the time-derivatives of the imperfect models, referred to as weighted supermodeling. A crucial step is to train the weights of the supermodel on the basis of historical observations. Here we apply two different training methods to a supermodel of up to four different versions of the global atmosphere/ocean/land model SPEEDO. The standard version is regarded as truth. We demonstrate that both training methods yield climate and weather predictions of superior quality as compared to the individual model versions. Supermodel predictions also outperform statistical combinations of the predictions of the individual model versions, a common approach in operational multi-model ensemble predictions systems (MME). Furthermore we find evidence that negative weights can improve predictions in cases where all imperfect models have biases of the same sign (for instance all models warm with respect to the truth). In principle the proposed training schemes are applicable to state-of-the-art models and historical observations. Since actual historical observations are incomplete and noisy, an assessment is made of the influence of incomplete and noisy data on the training results.