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Bias correction using data assimilation

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Data assimilation has been used for decades in fields like engineering or signal processing to improve forecast models. Ensemble Kalman filters and other sequential data assimilation methods are examples of developments which reduce the uncertainty of the model by taking observations into account. The widespread interest in addressing systematic forecast model errors only arose when the advances in modelling, data assimilation and computational power had reduced random errors to the point of commensurability with systematic errors, also known as bias. We present here a new method of bias correction using data assimilation. This method is based on the stochastic forcing of a model to correct bias.

First, through a preliminary run, we estimate the bias of the model and its possible sources. Then, we establish a forcing term which is directly added inside the model's equations. We create an ensemble of runs and consider the forcing term as a control variable during the assimilation of observations. We then use this analysed forcing term to correct the bias of the model. Since the forcing is added inside the model, it acts as a source term, unlike external forcings such as wind.

This procedure has been developed and successfully tested with a twin experiment on a Lorenz 95 model. Indeed, we were able to estimate and recover an artificial bias that had been added into the model. This bias had a spatial structure and was constant through time. The mean and behaviour of the corrected model corresponded to those the reference model. It is currently being applied and tested on the sea ice ocean NEMO LIM model, which is used in the PredAntar project. NEMO LIM is a global and low resolution (2 degrees) coupled model (hydrodynamic model and sea ice model) with long time steps allowing simulations over several decades. Due to its low resolution, the model is subject to bias in area where strong currents are present. We aim at correcting this bias by using perturbed current fields from higher resolution models and randomly generated perturbations.