



Inter-annual to decadal climate prediction based on Bred Vectors (BV)

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Within the framework of the MIKLIP German National Project (www.fona-miklip.de) we implemented an ensemble generation technique for decadal predictions based on Bred Vectors. The model used is the MPI-ESM LR (T63L19/GR15) forecast system on low resolution and the background re-analysis is the pre-operational assimilation run performed at DWD. The classical Bred Vector (BV) method by Kalnay and Toth (1993) was modified such that perturbations are calculated for an almost fixed initial state representing the fastest growing modes and specifying the “errors of the month/year”. Applying a total energy norm, perturbations of the temperature, salinity and horizontal velocities are calculated and result in balanced initial perturbation fields of the hindcast. Nine BV were calculated on twelve-month looping period over five iterative steps and the 56 years forecast operated for ten years forward.

The evaluation is done on surface temperatures using probabilistic scores as cumulative frequency analysis, reliability diagrams, spread skill score and quantile score. The results showed bigger spread for the BV over the pre-operational (lagged) hindcast, decreasing reliability for the pre-operational and increasing skill for the BV with the lead years, and advantage of the BV hindcast in the calibration. The study also showed that the most sensitive regions in the ocean responsible for inter-annual to decadal variability are localized by fastest uncertainty growth rates. Although, the costs for the ensemble generation based on BV are higher than the ones dealing with e.g. lagged or random noise conditions, we consider breeding as a more sophisticated way to produce initial perturbations for climate predictions.