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Ocean Science Discussions

Interactive comment on "Enhancing temporal correlations in EOF expansions for the reconstruction of missing data using DINEOF" *by* A. Alvera-Azcárate et al.

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General comments: This paper is focused on the application of a modified DINEOF technique to get more realistic interpolated SST values over the Black Sea, starting from 3 years of quite gappy Pathfinder AVHRR data. The manuscript is clearly written and well organized. However, there are a few questions that I believe the authors should clarify before the paper is published on OS.

Specific comments: DINEOF is based on the calculation of the principal components of the timeseries of satellite images, iteratively computed as eigenvectors of its covariance matrix. This procedure simultaneously fills in the missing data and the basic idea

here is to consider a truncated EOF expansion as an analysed field. The novelty in the present formulation of DINEOF technique is to apply a filter on the covariance matrix before estimating the EOFs, in order to avoid spurious and/or too sparse observations to constrain unrealistic amplitudes of the EOF modes that are actually retained in the reconstruction. I have no major concerns here, as, in order to be able to estimate the amplitude of n modes, at least n valid/independent measurements should be present in each image, while this may not be always the case (e.g. due to the extremely low data coverage in the Black Sea, or to the coverage of the data with respect to the spatial patterns of the EOFs considered, as well as to high noise levels in cloudy images). However, I am not sure that the low-quality reconstruction examples showed are effectively due only to such problems and not also to the way the optimal number of EOF iterations is chosen. In particular, I think that the proposed cross-validation technique adopted to select the optimal number of EOF iterations might lead to an underestimation of the number of modes to be used, leading definitely to an excessive smoothing of the analyzed field, and eventually constraining unrealistic amplitudes of the first modes, in order to fit the observations. This cross-validation consists in an estimate of the interpolation error under synthetic (artificial) clouds. During the iteration required by DINEOF, the difference between the observed measurements and the interpolated field under these artificial clouds is estimated, and it is assumed as representative of the error. In this way, it is assumed that the observations are error free. At the first iteration steps, this difference decreases, but after a certain number of iterations it may start to increase. If this occurs, it is assumed that the optimal number of EOFs has already been reached and the iteration is stopped. However, in this way, the observations (assumed as error free under the artificial clouds) may result to be very different from the reconstructed field outside the artificial clouds, and truncation may thus filter out many good data and relevant processes, only because they explain a minor percentage of the variance (which does not necessarily mean they can be considered as noise). Consequently, I really think that other ways to estimate the interpolation error should be included and discussed in this paper, and, in particular, at least the rms difference between the whole original and reconstructed images should be looked at. In that case, I would expect that the number of modes to be retained would increase drastically, and I am extremely curious to see how the performance of the standard and filtered DINEOF might change. In any case, I would also suggest to compare the results from both filtered and unfiltered DINEOF truncating the EOF reconstruction at the same number of modes, just to be sure that the improvement observed is effectively related to a better conditioning and not to the higher number of modes used in the filtered case.

Interactive comment on Ocean Sci. Discuss., 6, 1547, 2009.