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On the sensitivity of field reconstruction and prediction using Empirical Orthogonal Functions derived from gappy data

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Empirical Orthogonal Function (EOF) analysis is commonly used in the climate sciences and elsewhere to describe, reconstruct, and predict highly dimensional data fields. When data contain a high percentage of missing values (*i.e.* 'gappy'), alternate approaches must be used in order to correctly derive EOFs. The aims of this paper are to assess the accuracy of several EOF approaches in the reconstruction and prediction of gappy data fields, using the Galapagos Archipelago as a case study area. EOF approaches included least-squares estimations via a covariance matrix decomposition (*EIGEN*, *SVD*), 'Data Interpolating Empirical Orthogonal Functions' (*DINEOF*), and a novel approach called 'Recursively-Subtracted Empirical Orthogonal Functions' (*RSEOF*). Model-derived data of historical surface Chlorophyll *a* concentrations and sea surface temperature, combined with a mask derived from gaps in remote sensing estimates, allowed for the creation of 'true' and 'observed' fields by which to gauge the performance of EOF approaches. Only DINEOF and RSEOF were found to be appropriate for gappy data reconstruction and prediction. DINEOF proved to be the superior approach in terms of accuracy, especially for data with a high Noise/Signal ratio, although RSEOF may be preferred for larger data fields due to its relatively faster computation time.