

Recommended Nomenclature for EnVar Data Assimilation Methods

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At the WMO THORPEX Data Assimilation and Observing Systems Working Group (DAOS WG) meeting in 2011, the group felt there was a need for a common terminology for hybrid ensemble variation methods. The issue was discussed again at the 2012 meeting. The recommendations below attempt to represent the views expressed. We have tried to select a non-ambiguous terminology based on the most common existing established usage.

1. **En** should be used to abbreviate Ensemble (not Ens), as it is in the EnKF.
2. Hyphenated abbreviations (4D-Var, 3D-Var) were standardised by Ide *et al.* (1997) (and some journals), but they are not usually used in names for EnKF methods. The hyphen may be omitted in new names.
3. **4D-Var** or **4DVAR** are so well established that, even with a prefix or suffix, they should only be used for methods using a forecast model and its adjoint. Methods not using an adjoint method should use a name which does not make them seem variants of 4D-Var. In particular we discourage the terminology En4DVAR used by Liu *et al.* (2008, 2009) to mean an algorithm designed not to use an adjoint model. Instead we recommend **4DEnVar** as being more distinct from 4DVAR, and more similar to the 4DEnKF of Hunt *et al.* (2004). A prefix to 4D-Var can qualify it as in 4 or 7 below, but it should not change the basic 4D-Var method.
4. **hybrid** should describe the covariances used, not the method. E.g. “hybrid 3DVAR” (Wang *et al.*, 2008a,b) and “hybrid 4D-Var” (Clayton *et al.*, 2012) are Var methods using a combination of climatological and ensemble covariances. Pure 4DEnVar, using only ensemble covariances, should not be described as a hybrid method.
5. **EnVar** may be used without qualification (as EnKF is), if there is no need to stress the specific details of the implementation, to mean a variational method using ensemble covariances. For example a hybrid-4DEnVar may be simply described as EnVar.
6. The **EnKF** and its specific flavours (e.g. ETKF) generate ensembles as part of their algorithm. **EnVar**, like 3D-Var or 4D-Var, may generate a single best estimate and not an ensemble. Papers should make it clear if an ensemble is generated, e.g. Bonavita *et al.* (2012) use EDA as nomenclature for an Ensemble of [4D-Var] Data Assimilations.
7. Following the style of hybrid-4D-Var, it would be natural to use En4DVar for 4D-Var using ensemble covariances; Zhang and Zhang (2012) used E4DVar for such a system. However En4DVAR was used by Liu *et al.* (2008, 2009) for something else. So until recommendation 3 is generally adopted, it may be safer to use 4D-Var-Ben or 4D-Var-Benkf (Buehner *et al.*, 2010a,b; Fairbairn *et al.*, 2013).
8. Ensemble covariances are modified to reduce sampling error for elements where the true correlation is assumed to be near zero. This localization (also spelt as localisation) is most simply defined in terms of horizontal distance (Hamill *et al.*, 2001), but can also be done in the vertical and in spectral space (Buehner and Charron, 2007). Related methods modify the observation selection for a local analysis (Ott *et al.*, 2004). A key feature of such **localization** techniques is that they leave unchanged aspects of the ensemble covariance which are not being specifically localised. It is possible to reduce the effect of the localisation so far that it has no effect; in this case the ensemble covariance is unaltered. This is in contrast to indirect use of ensemble covariances to derive coefficients in a parametric covariance model (e.g. Bonavita *et al.* (2012)). If that model happens to give local covariances then fitting it has a similar effect of removing sampling error for distant covariances, but this should not be called localisation since it changes the covariances everywhere – there is no way to recover the original ensemble covariance.

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