# Ensemble-Variational methods in data assimilation

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**Abstract**

Ensemble-Variational (EnVar) methods have been drawn attention to the Data Assimilation community over the last decade. They open an alternative way between variational adjoint-based method and filtering probabilistic-based method. One major advantage of EnVar, compared to variational methods, is that the adjoint model can be avoided. Thus the EnVar is more portable and much easier to be deployed to the operational scenario in case of change of model because it is largely model-independent. Also, EnVar is proved to be an appropriate method able to tacking nonlinear non-Gaussian problems with considerable precision under reasonable computational cost. So we believe that this method constitutes a promising approach for flow measurement problems.

We are investigating the EnVar methods, for recovering the unknown state/parameter fields of non-trivial dynamic models by assimilating different types of image data of high resolution [1, 3]. We will show the performance and effectiveness of the EnVar method on Kinect captured depth-range data combined with shallow water model as well as synthetic SST image combined with the SQG model. More specifically we establish a stochastic dynamical formulation allowing explicitly taking into account of the subgrid effects resulted from scale discrepancy and we employ an augmented EnVar to identify those uncertainty parameters [2].

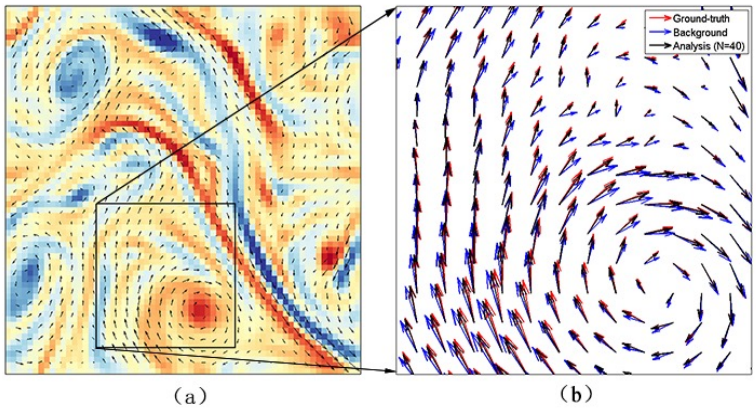


**Fig. 1** Velocity vectors at initial time: (a) the ground-truth vorticity map; (b) the motion vectors of the ground-truth (red), the background (blue) and the analysis (black) in the zoomed area [3].

## References

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[3] Cai, S., Mémin, E., Yang, Y. and Xu, C., 2017. Sea Surface Flow estimation via Ensemble-based variational data assimilation