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~~Ensemble Kalman Filter (EnKF) for~~

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data points measured during April  
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I am implementing the Local Ensemble Transform Kalman Filter (LETKF) on a ROMS model of the Chesapeake Bay. The LETKF is an advanced method for data assimilation and was developed by the Weather and ...

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"A local ensemble transform Kalman filter was used to assimilate the IASI data into the forecasting model" study first author Masataka Tada explains.

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The aim of this project is to develop novel model surrogate techniques within data assimilation frameworks for estimation of the parameters of geomechanical simulators. The focus will be on ...

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Survival distributions: age at death,  
life tables, fractional ages, mortality  
laws, select and ultimate life tables.

Life insurance: actuarial present value  
function ( $apv$ ), moments of  $apv$ , basic

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ScienceDaily. ScienceDaily, 14  
September 2021.

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“Improving Weather Forecasting by  
Assimilation of Water Vapor  
Isotopes, ” was ...

This book reviews popular data-  
assimilation methods, such as weak

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methods, ensemble filters and smoothers. The author shows how different methods can be derived from a common theoretical basis, as well as how they differ or are related to each other, and which properties characterize them, using several

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Filter 2nd Edition examples. Readers will appreciate the included introductory material and detailed derivations in the text, and a supplemental web site.

"Observing system simulation experiments (OSSEs) were performed for Nantucket Sound, Massachusetts,

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as a pilot study for the design of optimal monitoring networks in the coastal ocean. Experiments were carried out using the ensemble Kalman filter (EnKF) for data assimilation with ensemble transform Kalman filter (EnTKF) and proper orthogonal decomposition (POD) for

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selecting the optimal monitoring sites.

The singular evolutive interpolated Kalman filter (SEIK) was compared EnKF for the data assimilation efficiency. Running the unstructured grid Finite-Volume Community Ocean Model (FVCOM) with perturbed initial fields of currents, water temperature,

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and salinity show that in this shallow coastal system, the velocity and surface elevation are able to restore themselves back to the true state over an inertial time scale after perturbation without data assimilation, while the water temperature and salinity are not. This

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Filter 2nd Edition suggests that in this vertically well mixed region with strong tidal influence, monitoring should be targeted at water properties rather than velocities. By placing measurement sites at an entrance or exit or a location with the maximum signal variance (EnTKF) or at extrema

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of the dominant EOF spatial modes (POD), we evaluated the capability of EnTKF and POD in designing the optimal monitoring site for the forecast model system in this region. The results suggest that understanding the multiscale dynamical nature of the system is



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essential in designing an optimal monitoring network since "optimal" sites suggested by an assimilation method may only represent a local-scale feature that has little influence on a region-wide system. Comparing EnKF and SEIK simulations shows that SEIK can significantly improve the

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data assimilation efficiency by  
reducing the ensemble number and  
increasing the convergence rate."

Observing System Simulation  
Experiments (OSSEs) were performed  
to help design an optimal observing  
network for Massachusetts coastal

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waters. Nantucket Sound (Part 1) and  
Massachusetts Bay (Part 2) were  
selected as two pilot sites and  
experiments were carried out using  
Ensemble Kalman Filter (EnKF) data  
assimilation method.

Data assimilation is a process of

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fusing data with a model for the singular purpose of estimating unknown variables. It can be used, for example, to predict the evolution of the atmosphere at a given point and time. This book examines data assimilation methods including Kalman filtering, artificial intelligence,

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Filter 2nd Edition, machine learning, and cognitive computing.

We proposed (and accomplished) the development of an Ensemble Kalman Filter (EnKF) approach for the estimation of surface carbon fluxes as if they were parameters, augmenting

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Filter 2nd Edition. Our system is quite different from previous approaches, such as carbon flux inversions, 4D-Var, and EnKF with approximate background error covariance (Peters et al., 2008). We showed (using observing system simulation experiments, OSSEs) that

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these differences lead to a more accurate estimation of the evolving surface carbon fluxes at model grid-scale resolution. The main properties of the LETKF-C are: a) The carbon cycle LETKF is coupled with the simultaneous assimilation of the standard atmospheric variables, so

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that the ensemble wind transport of the CO<sub>2</sub> provides an estimation of the carbon transport uncertainty. b) The use of an assimilation window (6hr) much shorter than the months-long windows used in other methods. This avoids the inevitable "blurring" of the signal that takes place in long



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windows due to turbulent mixing since the CO<sub>2</sub> does not have time to mix before the next window. In this development we introduced new, advanced techniques that have since been adopted by the EnKF community (Kang, 2009, Kang et al., 2011, Kang et al. 2012). These advances include

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"variable localization" that reduces sampling errors in the estimation of the forecast error covariance, more advanced adaptive multiplicative and additive inflations, and vertical localization based on the time scale of the processes. The main result has been obtained using the LETKF-C with

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all these advances, and assimilating simulated atmospheric CO<sub>2</sub> observations from different observing systems (surface flask observations of CO<sub>2</sub> but no surface carbon fluxes observations, total column CO<sub>2</sub> from GoSAT/OCO-2, and upper troposphere AIRS retrievals). After a spin-up of

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about one month, the LETKF-C

succeeded in reconstructing the true evolving surface fluxes of carbon at a model grid resolution. When applied to the CAM3.5 model, the LETKF gave very promising results as well, although only one month is available.

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The data assimilation process of adjusting variables in a reservoir simulation model to honor observations of field data is known as history matching and has been extensively studied for few decades. However, limited success has been achieved due to the high complexity

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of the problem and the large

computational effort required by the practical applications. An automatic history matching module based on the ensemble Kalman filter is developed and validated in this dissertation. The ensemble Kalman filter has three steps: initial sampling, forecasting

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through a reservoir simulator, and assimilation. The initial random sampling is improved by the singular value decomposition, which properly selects the ensemble members with less dependence. In this way, the same level of accuracy is achieved through a smaller ensemble size. Four different

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schemes for the assimilation step are investigated and direct inverse and square root approaches are recommended. A modified ensemble Kalman filter algorithm, which addresses the preference to the ensemble members through a nonequally weighting factor, is



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proposed. This weighted ensemble Kalman filter generates better production matches and recovery forecasting than those from the conventional ensemble Kalman filter. The proposed method also has faster convergence at the early time period of history matching. Another variant,

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the singular evolutive interpolated Kalman filter, is also applied. The resampling step in this method appears to improve the filter stability and help the filter to deliver rapid convergence both in model and data domains. This method and the ensemble Kalman filter are effective

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for history matching and forecasting  
uncertainty quantification. The  
independence of the ensemble  
members during the forecasting step  
allows the benefit of high-  
performance computing for the  
ensemble Kalman filter  
implementation during automatic

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Filter 2nd Edition. Two-level history matching. Two-level computation is adopted; distributing ensemble members simultaneously while simulating each member in a parallel style. Such computation yields a significant speedup. The developed module is integrated with reservoir simulators UTCHEM, GEM and

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ECLIPSE, and has been implemented in the framework Integrated Reservoir Simulation Platform (IRSP). The successful applications to two and three-dimensional cases using blackoil and compositional reservoir cases demonstrate the efficiency of the developed automatic history matching

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Data assimilation is an approach that combines observations and model output, with the objective of improving the latter. This book places data assimilation into the broader context of inverse problems and the

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theory, methods, and algorithms that are used for their solution. It provides a framework for, and insight into, the inverse problem nature of data assimilation, emphasizing ?why? and not just ?how.? Methods and diagnostics are emphasized, enabling readers to readily apply them to their

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own field of study. Readers will find a comprehensive guide that is accessible to nonexperts; numerous examples and diverse applications from a broad range of domains, including geophysics and geophysical flows, environmental acoustics, medical imaging, mechanical and



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biomedical engineering, economics  
and finance, and traffic control and  
urban planning; and the latest  
methods for advanced data  
assimilation, combining variational  
and statistical approaches.

We proposed (and accomplished) the

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development of an Ensemble Kalman Filter (EnKF) approach for the estimation of surface carbon fluxes as if they were parameters, augmenting the model with them. Our system is quite different from previous approaches, such as carbon flux inversions, 4D-Var, and EnKF with

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properties of the LETKF--C are: a) The carbon cycle LETKF is coupled with the simultaneous assimilation of the standard atmospheric variables, so that the ensemble wind transport of the CO<sub>2</sub> provides an estimation of the carbon transport uncertainty. b) The use of an assimilation window (6hr)

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much shorter than the months--long windows used in other methods. This avoids the inevitable "blurring" of the signal that takes place in long windows due to turbulent mixing since the CO<sub>2</sub> does not have time to mix before the next window. In this development we introduced new,

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advanced techniques that have since been adopted by the EnKF community (Kang, 2009, Kang et al., 2011, Kang et al. 2012). These advances include "variable localization" that reduces sampling errors in the estimation of the forecast error covariance, more advanced adaptive multiplicative and

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additive inflations, and vertical  
localization based on the time scale of  
the processes. The main result has  
been obtained using the LETKF--C  
with all these advances, and  
assimilating simulated atmospheric  
CO2 observations from different  
observing systems (surface flask

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observations of CO<sub>2</sub> but no surface carbon fluxes observations, total column CO<sub>2</sub> from GoSAT/OCO-2, and upper troposphere AIRS retrievals). After a spin-up of about one month, the LETKF-C succeeded in reconstructing the true evolving surface fluxes of carbon at a model



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grid resolution. When applied to the CAM3.5 model, the LETKF gave very promising results as well, although only one month is available.

This book endeavours to give a

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contribution to understanding the data assimilation and related methodologies. The mathematical concepts and related algorithms are fully presented, especially for those facing this theme for the first time. The first chapter gives a wide overview of the data assimilation

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steps starting from Gauss' first methods to the most recent as those developed under the Monte Carlo methods. The second chapter treats the representation of the physical system as an ontological basis of the problem. The third chapter deals with the classical Kalman filter, while the

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fourth chapter deals with the advanced methods based on recursive Bayesian Estimation. A special chapter, the fifth, deals with the possible applications, from the first Lorenz model, passing through the biology and medicine up to planetary assimilation, mainly on Mars. This

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book serves both teachers and college students, and other interested parties providing the algorithms and formulas to manage the data assimilation everywhere a dynamic system is present.

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