Ensemble Weather Forecast Using Kalman Filter

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Abstract

An ensemble weather forecast is a set of forecasts that present the range of future weather possibilities. Multiple simulations are run, each with a slight variation of its initial conditions and with slightly perturbed weather models. Assessment of the state of environment with observational data is one of the most urgent modern issues. Such an assessment can be done using forecast models based on machine learning using ensemble Kalman filter. One of the most popular algorithms in ensemble modelling is using the Kalman filter. Kalman filter is an auto regressive process which estimates the future state with the present state using linear prediction mechanism. Parameter estimation is an important part of atmospheric Chemistry modelling .In particular pollutant emission may be a parameter to be estimated. Kalman filter is a mathematical procedure which estimates the new forecast from the existing forecast. This modelling can help in detection of pollution in the environment also to measure the climate of a particular region.

Methodology

The ensemble Kalman filter (EnKF) is a Monte Carlo implementation of the Bayesian update problem: given a probability density function (PDF) of the state of the modeled system (the *prior*, called often the forecast in geosciences) and the data likelihood, Bayes' theorem is used to obtain the PDF after the data likelihood has been taken into account (the *posterior*, often called the analysis). This is called a Bayesian update. The Bayesian update is combined with advancing the model in time, incorporating new data from time to time. The original Kalman filter, introduced in 1960, assumes that all PDFs are Gaussian (the Gaussian assumption) and provides algebraic formulas for the change of the mean and the covariance matrix by the Bayesian update, as well as a formula for advancing the mean and covariance in time provided the system is linear. However, maintaining the covariance matrix is not feasible computationally for high-dimensional systems. For this reason, EnKFs were developed. EnKFs represent the distribution of the system state using a collection of state vectors, called an ensemble, and replace the covariance matrix by the sample covariance computed from the ensemble. The ensemble is operated with as if it were a random sample, but the ensemble members are really not independent, as they all share the EnKF. One advantage of EnKFs is that advancing the PDF in time is achieved by simply advancing each member of the ensemble

Results

References

REFERENCES

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Conclusion