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Assimilating Time-Uncertain Measurements in ensemble Kalman Filtering

The purpose of this study was to propose an inferential method for determining the extent of error in reported observation times. Analysis in a previous year's study uncovered a largely significant effect of time error on overall error when assimilating in a turbulent system. The method proposed to deal with this error succeeded in decreasing overall error, but required prior knowledge of time error. Because time error is generally not known in advance, it was necessary to determine time error during assimilation. Furthermore, because the previous solution required modifications to the system model, it was advantageous to create a more elegant solution to the problem that could be easily slotted into existing assimilation schemes. The method proposed herein involves finding the time that minimizes error in space at each assimilation step, then factoring it in to a discretely defined time likelihood. This likelihood could be directly included in the state variable likelihood in order to produce similar decreases in overall error to those seen in the previous year. The inferential method functioned exceptionally well when used with Gaussian random variables for time offset, with the inferred time likelihood matching the true distribution almost exactly. Goodness-of-fit tests returned p-values upwards of 0.999 for all tests - if the assumption that the probability distribution function for time offsets was zero-valued outside of an interval was eliminated, the p-values dropped slightly. The alternative likelihood method was not significantly different in result to the previous year's method or inflation. Further improvements are in progress.