Assimilation of meteorological observations, which originated from the need of defining initial conditions for numerical weather prediction, is the process by which observations are combined together with a numerical model of the flow in order to obtain as accurate as possible a description of the state of the atmosphere.

Assimilation can be considered as a problem in Bayesian estimation. Evaluate the probability distribution for the state of the atmosphere, conditioned to all available relevant information. That information essentially consists of the observations and of the numerical model of the flow.

Standard methods for assimilation are pragmatic extensions to weakly nonlinear situations of methods that are basically linear and Gaussian. These standard methods consist of two broad classes. In variational assimilation, the assimilating model is globally adjusted to the observations available over a period of time. In sequential assimilation, the most advanced form of which is at present Ensemble Kalman Filter (EnKF), the state predicted by the model is constantly updated with new observations.

Taking into account the full nonlinear and chaotic character of the atmospheric flow raises substantial difficulties. Ensemble methods, in which the required conditional probability distribution is described by a sample of points in state space (and of which EnKF is one form), seem the most promising. Particle filters, which were originally developed for totally different applications, are capable of achieving Bayesian estimation for a nonlinear chaotic system. Their cost seems however to be prohibitive for large dimension applications such as meteorology. The perspectives for further development of assimilation of meteorological observations are discussed.

Keywords: Assimilation of observations, chaos