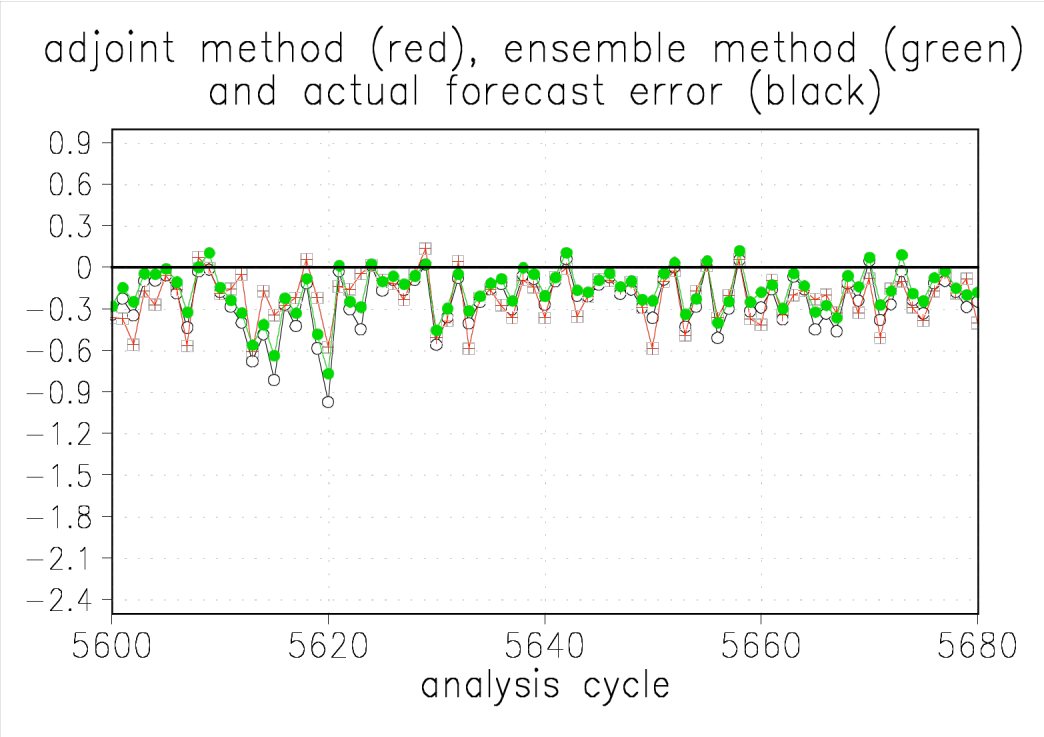
Observation impact (as in Langland and Baker 2004) within the LETKF but without adjoint

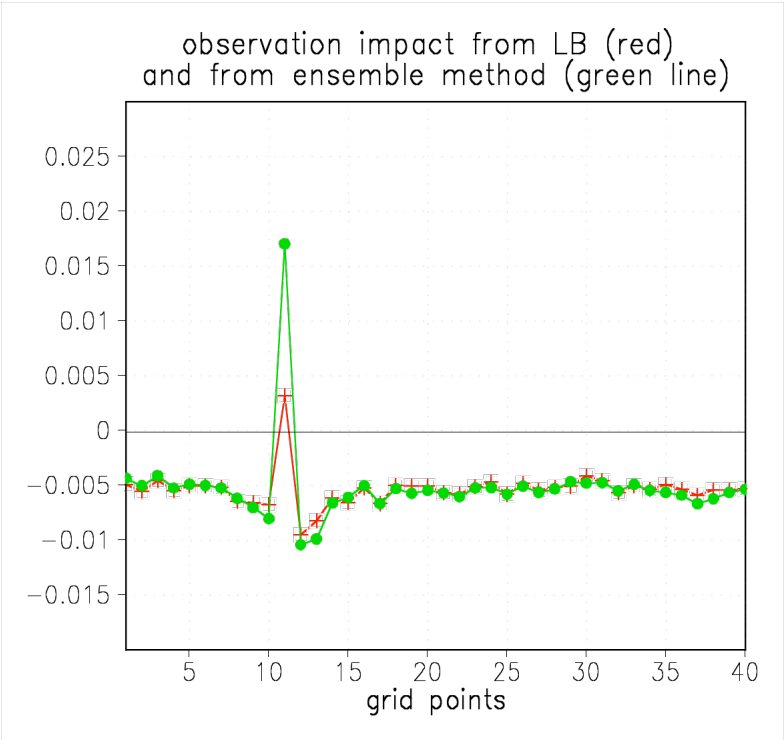
Junjie Liu and Eugenia Kalnay

Method: we applied the ensemble sensitivity method described in Liu's thesis (Nov. 16, 2007) to the Lorenz-40 variable system, for which we have the LETKF and the adjoint model. For the adjoint sensitivity we followed LB2004.

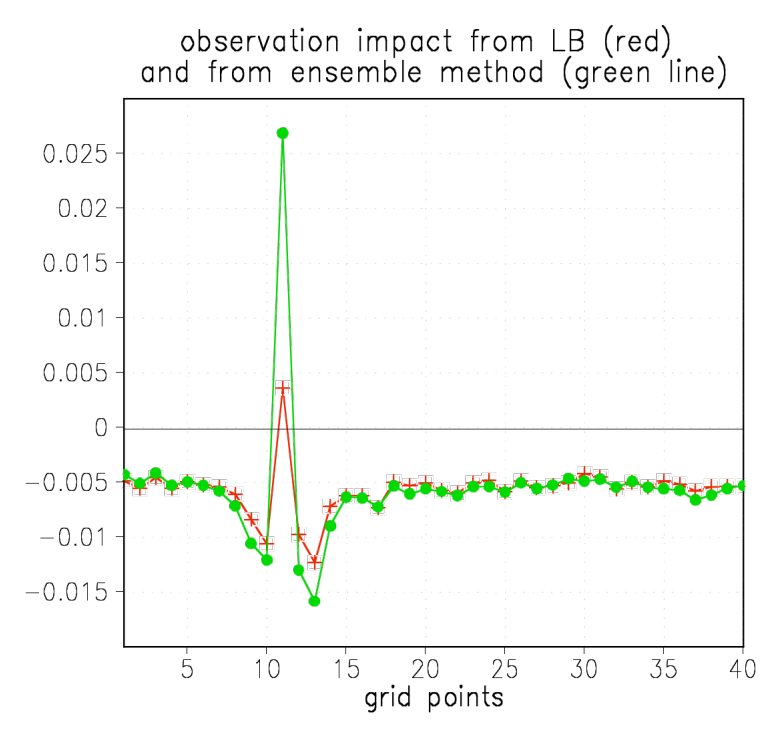
Comparison between the ensemble method and the adjoint method: total error difference due to the observations at t=0



The observations impact on the error calculated from the ensemble method (green line), adjoint method (red line) and actual forecast error difference (black). This shows that both the adjoint method and the ensemble method are able to estimate the actual average observation impacts (with obs minus without). The ensemble estimation is slightly better than the adjoint.



The observation at the 11th grid point has 4 times larger random error than at the other observation locations. As a result, both the adjoint sensitivity and the ensemble sensitivity show that, on the average, that observation increases the analysis error, rather than decreasing it. The ensemble shows a stronger signal.



The observation at the 11th grid point now has a bias equal to 0.5.

- Results show that both methods can detect the observation which has larger random error or larger bias.
- The estimated negative impact of the observation that has poor quality is larger for the ensemble than for the adjoint sensitivity method.
- Other than at this observation location and at the adjacent points, the ensemble method and the adjoint method give very similar results.
- This method is different from that of Ancell and Harkim (2007) where the sensitivity is a function of $(P^a)^{-1}$, and is calculated one observation at a time.