# A comparison of the LETKF and the equivalent weights particle filter on the barotropic vorticity model

Phil Browne | Department of Meteorology, University of Reading, UK

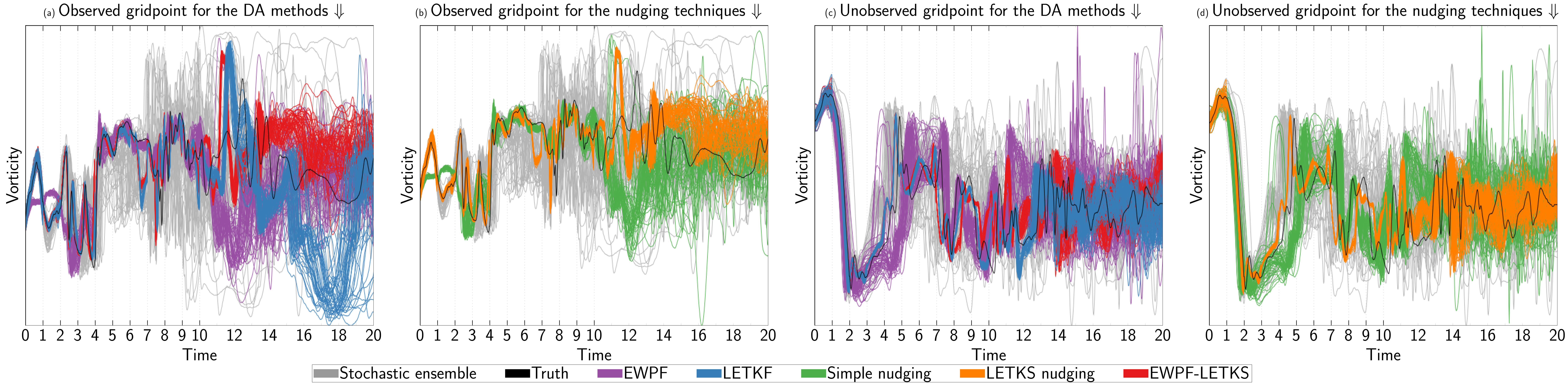


Figure 1: Trajectories of 2 different points in the domain when using the different assimilation methods with observing network 3 for a single experiment

We consider the *barotropic vorticity* model:

$$\frac{\partial q}{\partial t} + u\frac{\partial q}{\partial x} + v\frac{\partial q}{\partial y} = 0$$

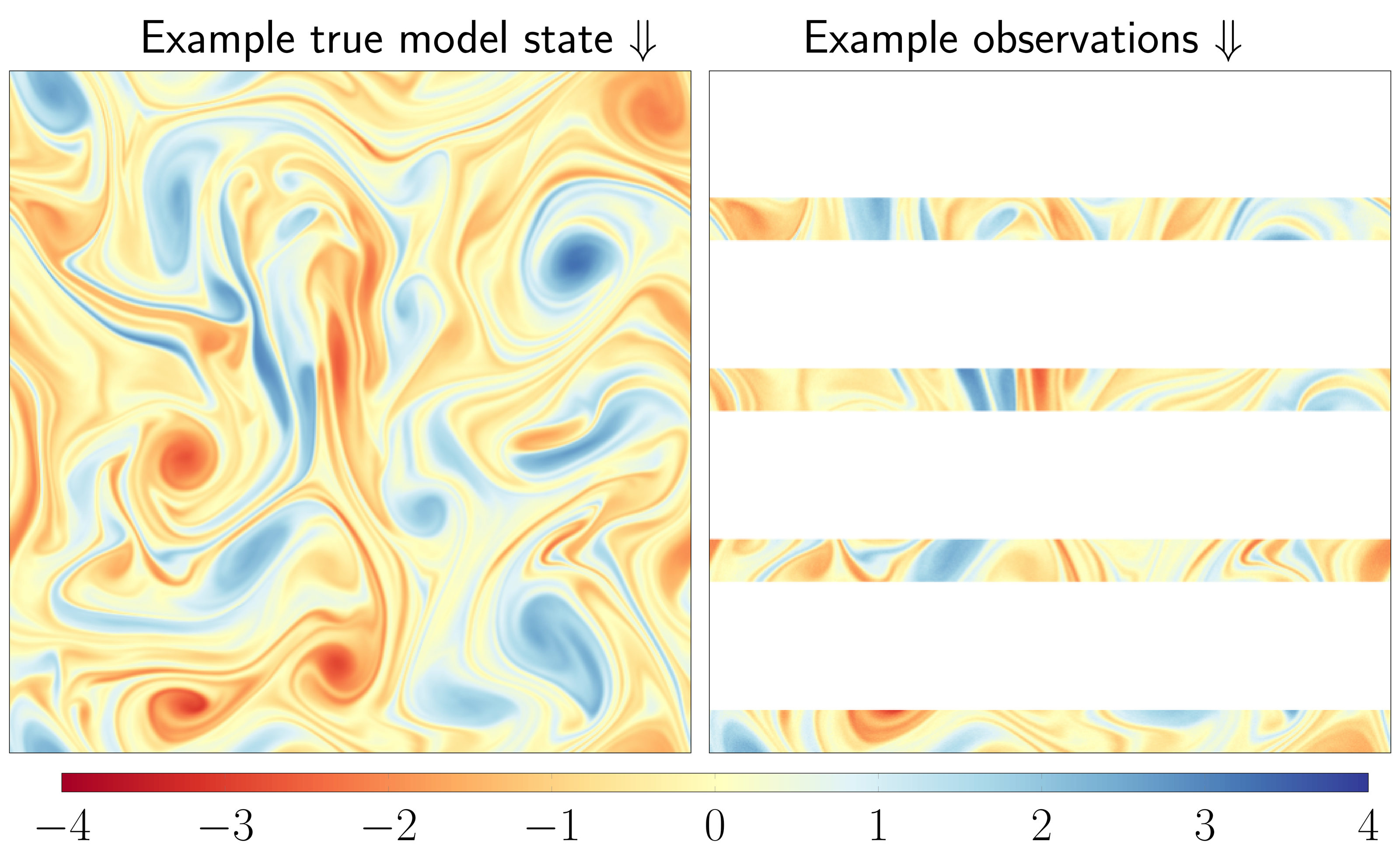


Figure 2. Plots of vorticity $q$ for the true state and the resulting observations at the $6^{\text{th}}$ analysis time

$N_x = 2^{18} = 262,144$. $N_y = 65,336$. $N_e = 48$. All the experiments used the EMPIRE data assimilation system.

The EWPF is a 2-stage filter:

1. For all timesteps before an observation, relax using $g$ s.t.

$$x_i^{k+1} = f(x_i^k) + g(x_i^k, y, z) + \beta_i^k$$

2. At analysis time, $\alpha_i$ chosen to make weights *equivalent*, s.t.

$$x_i^n = f(x_i^{n-1}) + \beta_i^n + \alpha_i QH^T(HQH^T + R)^{-1}(y^n - H(f(x_i^{n-1})))$$

For the basic EWPF, $g(x_i^k, y, z) = \rho QH^T R^{-1}(y - Hx_i^k)$

Q 1: what *should* the relaxation term look like?

Q 2: why are the trajectories for ensembles that use nudging and particle filters using the same relaxations so similar?

Answers (partially): **P.A. Browne** (2016). A comparison of the equivalent weights particle filter and the local ensemble transform Kalman filter in application to the barotropic vorticiy equation. *Tellus A*. In press

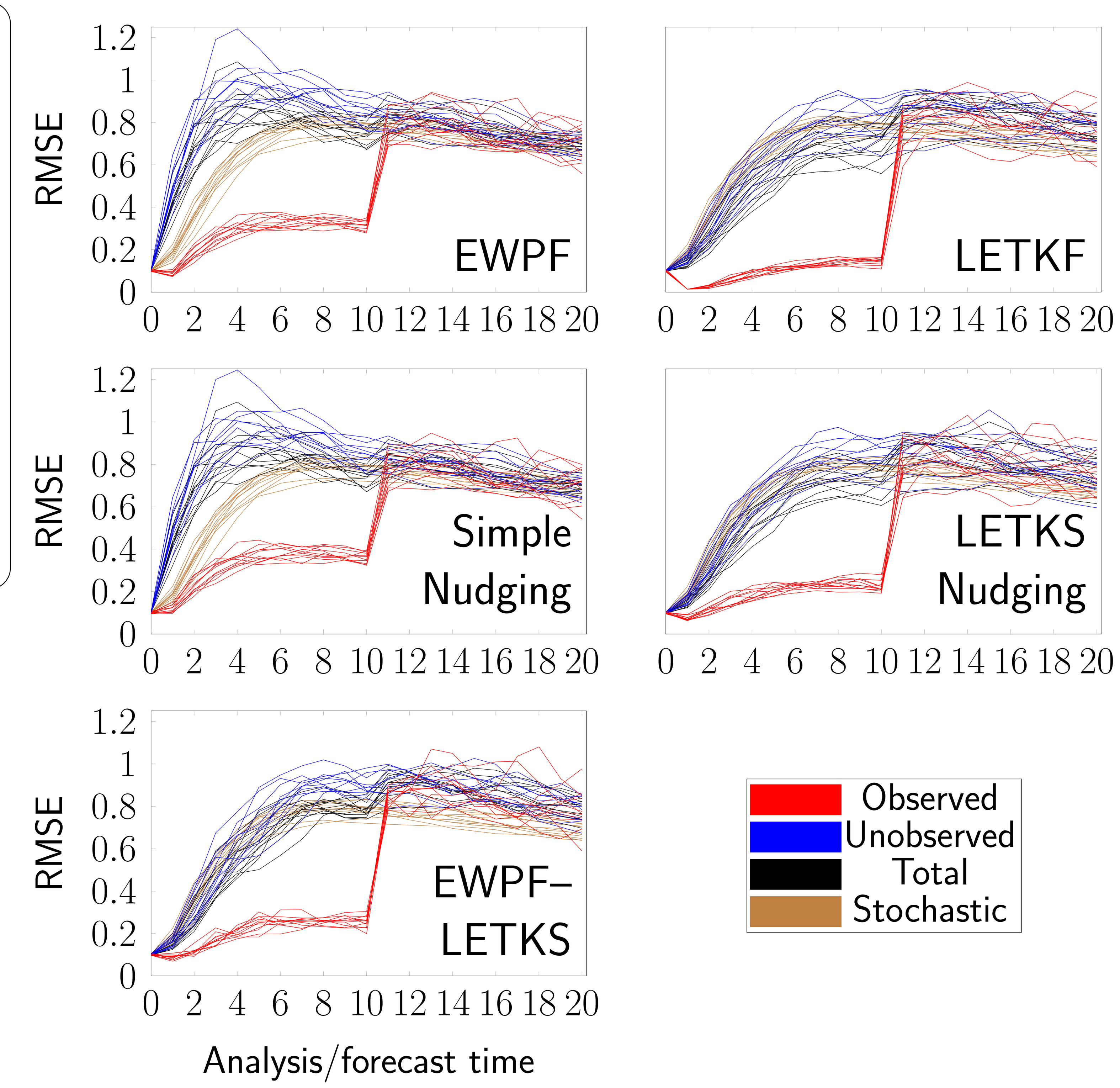


Figure 3. Root mean squared errors sampled over different parts of the domain

EMPIRE www.met.reading.ac.uk/ darc/empire

Acknowledgements: This work was inspired by a conversation on the train to the ISDA2015 dinner.

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