Review of

"Toward a multivariate formulation of the PKF assimilation: application to a simplified chemical transport model"

by A. Perrot, O. Pannekoucke, and V. Guidard.

General:

This is an interesting and original paper showing that a fairly sophisticated implementation of a Kalman filter can be done using parameters to define the local form of the evolving state error covariance instead of using a costly large ensemble. The method is exhibited using a simple chemistry transport model, with convincing success in this example. It suggests that an extension of the same technique might work also for a more complex model that includes the dynamical variables of the flow itself. At each time, and at each point in space, the covariance amongst the variables is approximately modeled by, for example, a multivariate Gaussian covariance, and it is the parameters prescribing this covariance which the PKF aims to evolve. The authors note that this becomes more burdensome in proportion to the square of the number of variables described by the local covariance, so it will be of great interest to see, in future, whether their technique remains competitive with ensemble methods in cases of greater dynamical complexity. But the paper is generally well written and convincingly argued, so I am happy to recommend that it be published after the correction of several very minor points listed by line numbers below.

Minor points:

L15 "..to the quality.."

L24: "..correct other concentrations and reduce .."

L38,39: "..needs the introduction of filtering.."

L40: "..to set correlations to zero.."

L53: What is Reynold decomposition – is there a reference you could add?

L115, L116, : "diagnoses" (plural)

L138: "..of a covariance model..", "..build a heterogeneous.."

L145: "non-obvious" (hyphenate?)

L148: "..approximation to reproduce.."

L198: "designed"

L268: replace "resumed" by "reduced"

L294: "scales"

L295: "..to attributing.."

L306: "dash-dotted"

Caption to Fig. 5: "clockwise" (not "clockwisely")

L394: "cross-correlations"

L410: "excluded"

L412: "overestimation of the true.."

L413:' replace "points of percentage" by "percentage points"

L126: "guarantee"

L441: "independent of anisotropy"

L452: "rehabilitated to quantify.."

L458: "removed to focus.."

L491: "there are no.."

L496: " ..to non-constant.."

L498: "stationary"

L499: "..anisotropy is equal.."

L500: "..stationarity.."

L510: ".. each of the terms.."

L523: ''..in the anisotropy.."

L525: " ..as they lead to.."

L575: "This leads to.."

L581: "..focuses on the forecast.."

L591: "independent"

L603: "A horizontal.."

L630: "statistics."

L647: Expand the acronym "GRS" in the main heading 4.

L675: "..observation assimilation in this.."

L680: "In terms.."

L682: "..presents"

L685: "..dynamics, and is.." (insert comma?)

L737: "..makes apparent some.."

L741: "..remain.."

L742: "we have not questioned.."

L743: "absolute"

L748: "This simplification led.."

L753: "describe.."

L774—777: It might be better to combine these lines into a single paragraph.

L787: "..studied.."

L840: "..we chose.."

L844: It is not clear what equation number you meant by "(8aa)"

L875: "..programme.."