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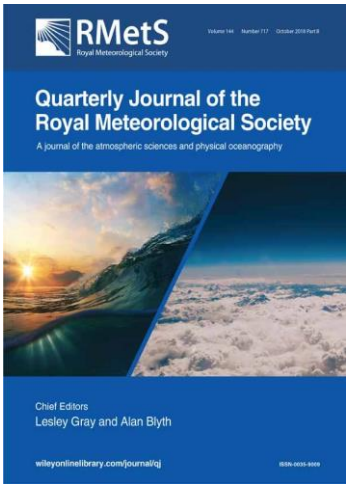

Revista: Quarterly Journal of the Royal Meteorological Society

Towards more realistic hypotheses for the information content analysis of cloudy/precipitating situations – Application to a hyperspectral instrument in the microwave

Filipe Aires, Catherine Prigent, Stefan A. Buehler, Patrick Eriksson, Mathias Milz, Susanne Crewell

Vol. 145, Number 718, January 2019 Part A.
p. 1 – 14. 15 July 2018.

Texto en inglés

Resumen:

Information Content (IC) analysis can be used before an instrument is built to estimate its retrieval uncertainties and analyse their sensitivity to several factors. It is a very useful method to define/optimize satellite instruments. IC has shown its potential to compare instrument concepts in the infrared or the microwave. IC is based on some hypotheses such as the the Gaussian character of the radiative transfer (RT) and instrument errors, the first-guess errors (Gaussian character, std and correlation structure), or the linearization of the RT around a first guess. These hypotheses are easier to define for simple atmospheric situations. However, even in the clear-sky case, their complexity has never ceased to increase towards more realism, to optimize the assimilation of satellite measurements in numerical weather prediction (NWP) systems. In the cloudy/precipitating case, these hypotheses are even more difficult to define in a realistic way as many factors are still very difficult to quantify. In this study, several tools are introduced to specify more realistic IC hypotheses than the current practice. We focus on microwave observations as they are more pertinent for clouds and precipitation. Although not perfect, the proposed solutions are a new step towards more realistic IC assumptions of cloudy/precipitating scenes. A state-dependence of the RT errors is introduced, the first-guess errors have a more complex vertical structure, the IC is performed simultaneously on all the hydrometeors to take into account the contamination effect of the RT input uncertainties, and the IC is performed on a diversified set of cloudy/precipitating scenes with well-defined hydrometeor assumptions. The method presented in this study is illustrated using the HYperspectral Microwave Sensor (HYMS) instrument concept with channels between 6.9 and 874 GHz (millimetre and sub-millimetre regions). HYMS is considered as a potential next generation microwave sounder.

DOI: https://doi.org/10.1002/qj.3315

Texto completo disponible en la biblioteca.

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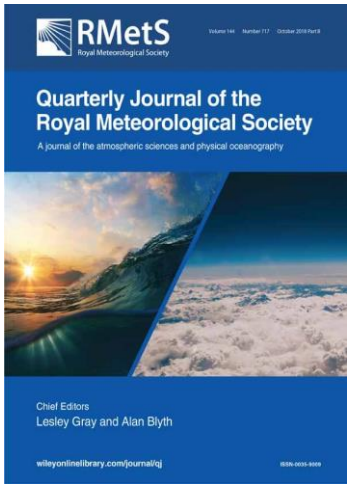

Revista: Quarterly Journal of the Royal Meteorological Society

Comparison of different representations of model error in ensemble forecasts

Chiara Piccolo, Mike JP Cullen, Warren J. Tennant, Adrian T. Semple

Vol. 145, Number 718, January 2019 Part A.
p. 15 – 27. 29 de junio de 2018.

Texto en inglés

Resumen:

The use of analysis increments to represent model error in the Met Office ensemble prediction system is compared with the use of stochastic parametrizations. Since analysis increments can take into account more possible sources of forecast error than stochastic parametrizations which only represent specific sources of error, the spread of the ensemble and the reliability are markedly improved. There is an increase in the rms error of the ensemble mean for some fields. This may be because analysis increments cannot represent state-dependent statistics, but may also result from the use of initial condition perturbations from the operational ETKF rather than ensemble data assimilation with a consistent treatment of model error.

DOI: https://doi.org/10.1002/qj.3348

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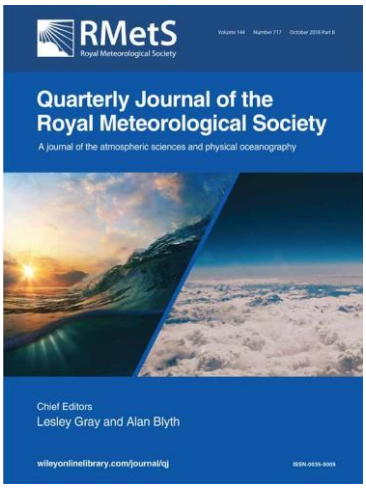

Revista: Quarterly Journal of the Royal Meteorological Society

Quantifying the predictability of a predictand: Demonstrating the diverse roles of serial dependence in the estimation of forecast skill

Alexander S. Jarman, Leonard A. Smith

Vol. 145, Number 718, January 2019 Part A.
p. 40 – 52. 24 July 2018.

Texto en inglés

Resumen:

Serial dependence in forecast skill results in misleading estimates of the quality of a forecast system when evaluated in a time-series fashion. A wide variety of impacts are possible in addition to systematic biases established elsewhere which demonstrate that sample size corrections are required to correctly interpret the statistical significance of the estimated skill. Extensions to forecast systems which display (a) no linear correlation in the predict and yet serial dependence in the prediction skill, (b) linear correlation in the predict and yet no serial dependence in skill, and (c) linear correlation in both the predict and skill are discussed; empirical approaches to estimated sample size corrections (when analytic results are not available) are introduced.

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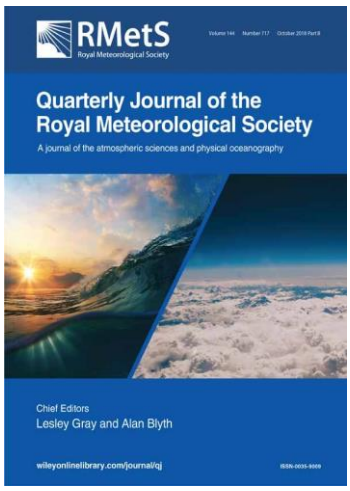

Revista: Quarterly Journal of the Royal Meteorological Society

Adaptive covariance inflation in the ensemble Kalman filter by Gaussian scale mixtures

Patrick N. Raanes, Marc Bocquet, Alberto Carrassi

Vol. 145, Number 718, January 2019 Part A.
p. 53 – 75

Texto en inglés

Resumen:

This paper studies multiplicative inflation: the complementary scaling of the state covariance in the ensemble Kalman filter (EnKF). Firstly, error sources in the EnKF are catalogued and discussed in relation to inflation; nonlinearity is given particular attention as a source of sampling error. In response, the “finite-size” refinement known as the EnKF-N is re-derived via a Gaussian scale mixture, again demonstrating how it yields adaptive inflation. Existing methods for adaptive inflation estimation are reviewed, and several insights are gained from a comparative analysis. One such adaptive inflation method is selected to complement the EnKF-N to make a hybrid that is suitable for contexts where model error is present and imperfectly parameterized. Benchmarks are obtained from experiments with the two-scale Lorenz model and its slow-scale truncation. The proposed hybrid EnKF-N method of adaptive inflation is found to yield systematic accuracy improvements in comparison with the existing methods, albeit to a moderate degree.

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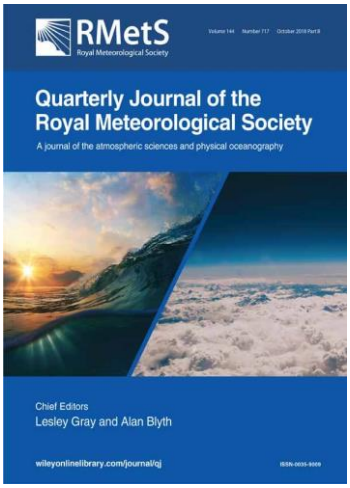

Revista: Quarterly Journal of the Royal Meteorological Society

Analysis of observed rapid increases in surface wind speed

Florian Ruff, Haraldur Ólafsson

Vol. 145, Number 718, January 2019 Part A.
p. 28 – 39. 10 July 2018.

Texto en inglés

Resumen:

A database of 21 million hourly observations from 200 weather stations in Iceland within the period from January 1993 until March 2017 is explored to assess rapid increases of wind speed. In the summer, strong winds are more frequent in the afternoon than at night, while rapid increases in wind speed are slightly more frequent at night. Westerly winds have a relatively high frequency of rapid increases in wind speed, while easterly winds have a relatively low frequency of rapid increases in wind speed. This can be explained by the form and tracks of cyclones. Rapid increases in wind speed are particularly frequent in northern Iceland. They occur in winds blowing from the central highlands and typically in stably stratified air masses. An analysis of winds at individual stations reveals a large impact of topography and that the wind direction distribution for strong wind events and rapid increases in wind speed may be quite different. However, a simple, clear and general connection between the height and distance to nearby mountains and the frequency of rapid increases in wind speed has not been found. At stations with a high frequency of rapid increases in wind speed, downslope flow is a very important contributor, while gap and corner winds are not.

DOI: https://doi.org/10.1002/qj.3377

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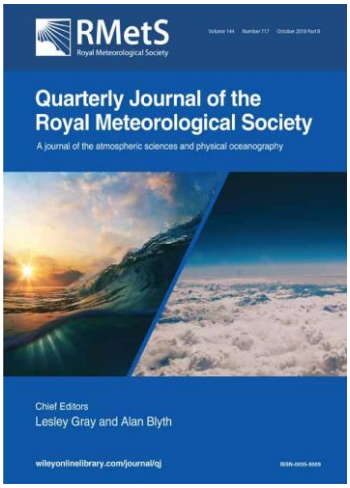

Revista: Quarterly Journal of the Royal Meteorological Society

An ensemble framework for time delay synchronization

Flavia R. Pinheiro, Peter Jan van Leeuwen, Ulrich Parlitz

Vol. 144, Number 711, January 2019 Part B.
p. 305 – 316. 13 November 2017

Texto en Inglés

Resumen:

Synchronization based state estimation tries to synchronize a model with the true evolution of a system via the observations. In practice, an extra term is added to the model equation which hampers growth of instabilities transversal to the synchronization manifold. Therefore, there is a very close connection between synchronization and data assimilation. Recently, synchronization with time-delayed observations has been proposed, in which observations at future times are used to help synchronize a system that does not synchronize using only present observations, with remarkable successes. Unfortunately, these schemes are limited to small-dimensional problems.
In this article, we lift that restriction by proposing an ensemble-based synchronization scheme. Tests were performed using the Lorenz'96 model for 20-, 100- and 1000-dimension systems. Results show global synchronization errors stabilizing at values of at least an order of magnitude lower than the observation errors, suggesting that the scheme is a promising tool to steer model states to the truth. While this framework is not a complete data assimilation method, we develop this methodology as a potential choice for a proposal density in a more comprehensive data assimilation method, like a fully nonlinear particle filter.

DOI: https://doi.org/10.1002/qj.3204
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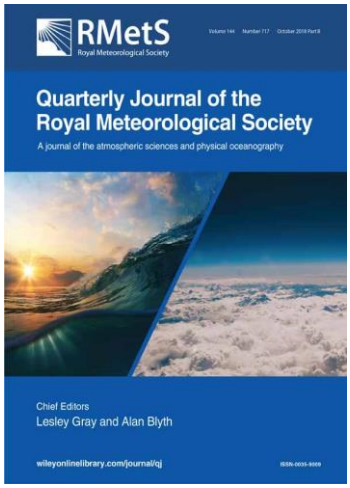

Revista: Quarterly Journal of the Royal Meteorological Society

Simulation of W-band radar reflectivity for model validation and data assimilation

M. Borderies, O. Caumont, C. Augros, É. Bresson, J. Delanoë, V. Ducrocq, N. Fourrié, T. Le Bastard, M. Nuret

Vol. 144, Number 711, January 2019 Part B.
p. 391 – 403. 24 November 2017

Texto en Inglés

Resumen:

This article describes a reflectivity forward operator developed for the validation and assimilation of W-band radar data into the regional AROME class of numerical weather prediction models. The forward operator is consistent with the AROME ICE3 one-moment microphysical scheme and is devised for vertically pointing radars. A new neighbourhood validation method, the Most Resembling Column (MRC) method, is designed to disentangle spatial location model errors from errors in the forward operator. This novel method is used to validate the forward operator using data collected in diverse conditions by the airborne cloud radar RASTA (Radar Airborne System Tool for Atmosphere) during a 2 month period over a region of the Mediterranean. The MRC method is then applied to retrieve the optimal effective shapes (i.e. the mean axis ratios) of the predicted graupel, snow and pristine ice, by minimizing the standard deviation between observations and simulations. The optimal mean axis ratio is approximately 0.7 for snow and 0.8 for graupel. It is shown that treating snow and graupel particles as oblate spheroids with axis ratios close to their optimal values leads to good agreement between the observations and simulations of the ice levels. Conversely, there is a large bias if snow and graupel particles are considered to be either spherical or overly flattened. The results also indicate that pristine ice can be approximated by a sphere, but this conclusion should be taken cautiously since the amount of pristine ice particles is probably overestimated in the ICE3 microphysical scheme.

DOI: https://doi.org/10.1002/qj.3210
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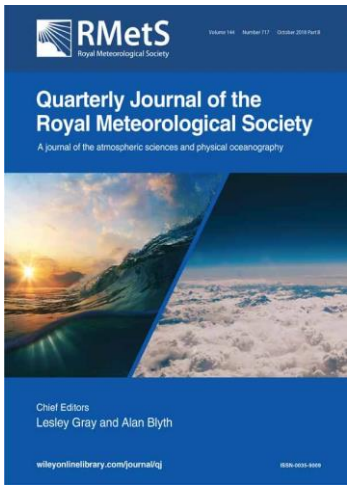

Revista: Quarterly Journal of the Royal Meteorological Society

Comparison of 3D-Var and 4D-Var data assimilation in an NWP-based system for precipitation nowcasting at the Met Office

Zhihong Li, Susan P. Ballard, David Simonin

Vol. 144, Number 711, January 2019 Part B.
p. 404 – 413. 23 November 2017.

Texto en Inglés

Resumen:

A high-resolution demonstration Numerical Weather Prediction (NWP) nowcasting system was developed and run in real time at the Met Office for the prediction of precipitation on a domain covering southern England and Wales. The hourly cycling nowcasting system, known as NDP (Nowcasting Demonstration Project), combined a 3 km resolution 4D-Variational data assimilation (4D-Var) and a 1.5 km resolution version of the Met Office Unified Model (UM) to provide hourly NWP analyses and forecasts for a period of 0–6 h. Central to the NDP was the rapid updating cycling and its timely delivery of analyses and forecasts using the latest conventional and sub-hourly novel observations. In this article the benefits of using 4D-Var assimilation compared to First Guess at Appropriate Time (FGAT) 3D-Variational assimilation (3D-Var) on forecasts of precipitation are considered by comparing model forecasts with radar-derived hourly surface accumulations for the period of June 2012, using an objective, scale-dependent verification scheme. It is shown that 4D-Var assimilation has a positive impact on precipitation forecasting skills compared to the corresponding 3D-Var assimilation for the whole nowcast period [T + 0, T + 6]. The 4D-Var assimilation systems produced forecasts with greater spatial accuracy and longer lead times with acceptable skill. By comparing 3D-Var FGAT using sub-hourly observations with 3D-Var FGAT using only the observations closest to the analysis time, the sub-hourly observations are seen to be beneficial in the hourly cycling convective-scale system in both 3D-Var FGAT and 4D-Var. The forecast clearly benefitted from the use of extra, higher time frequency observations in both 3D-Var and 4D-Var.

DOI: https://doi.org/10.1002/qj.3211
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