

Interactive comment on “Nonlinear effects in 4D-Var” by Massimo Bonavita et al.

Anonymous Referee #3

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This manuscript provides a very detailed study of possible effects of nonlinearities in the ECMWF hybrid 4DVAR system. It revisits the tests that were undertaken when the resolutions of both the nonlinear and the linearised models were a lot lower than today's operational configuration, but also the effects now of all sky radiances with the nonlinear behaviour of moisture and hydrometeors.

This a very well put together study, and I only have a few technical changes to the text and grammar.

1) Please use the notation as set out in Ide et al (1997) Nonlinear observation operators should be denoted by a bold h , the tangent linear by the H , but also that linear observations should be denoted as Hx . This became confusing in equation 7, yet you do use the correct formulation for the tangent linear model of the numerical model in equation 6.

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2) Page 2: This paragraph is far too long. Please break it up into smaller chunks. I would suggest on lines 6, 15, 20 and 24.

3) On Line 32 on the same page i would recommend starting the sentence as given the motivation above, the remainder of this paper is Also on line 34 i am not sure if the is should be an are as you have the plural of effect in the sentence.

4) There should be punctuation after every equation as they should be considered as part of the sentence.

5) Equation 3 i believe is incorrect in that Δx_0 is usually defined as $x_0 - x_b$ so that the background term is usually just expressed in terms of the increments, If this is not the case you need to define Δx_0 which is not done here.

I highly recommend that this manuscript be accepted for publication.

Interactive comment on Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2018-20>, 2018.

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