Interactive comment on “Technical Note: Four-dimensional variational data assimilation for inverse modelling of atmospheric methane emissions: method and comparison with synthesis inversion” by J. F. Meirink et al.

Anonymous Referee #1

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General comments

This technical note illustrates the possible move from analytical optimal estimation to the more sophisticated (but mathematically-equivalent) variational optimal estimation. The topic is illustrated with an example from the inversion of methane fluxes. This well-written paper should be published, provided the minor points listed hereafter are clarified.

Specific comments
p. 12025, l. 15-24: the paragraph suggests that 4D-Var does not use the adjoint technique, which is not correct.

p. 12028, l. 8: with 64-bit computations, one may expect machine precision to be much smaller than $10^{-14}$.

p. 12032, l. 19: defining the representativeness error based on model gradients makes the error increase with increasing resolution. This is not appropriate.

p. 12033: l. 23-25: does this 2.5 factor make sense? For instance, the wetland error is 80

p. 12038, l. 18-19: this diagnostic does not indicate whether the assimilation is optimal, but whether it is not optimal, i.e. measurement and prior errors have been improperly set. Last, measurement and prior errors should not be set relative to each other, they exist independently.

p. 12038, l. 25: the equivalence between Eq. (12) and Eq. (13) only holds when the system is optimal, which is not the case here.

p. 12041, l. 5-9: such an advantage can only be obtained with a non-diagonal R matrix, that has to be inverted. This is not trivial.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 12023, 2008.