Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-178-RC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "An experimental 2DVAR retrieval using AMSR2" *by* David Ian Duncan et al.

Anonymous Referee #2

Received and published: 13 July 2019

Paper Summary:

The authors develop a 2DVAR optimal estimation retrieval approach that entails explicit simulation of antenna beam pattern and use of spatial correlations on a fine retrieval grid to solve for an entire scene simultaneously. Such an approach is novel since a) deconvolution noise-introducing brightness temperature averaging methods (to achieve a constant FOV size) are not needed, and b) higher spatial resolution for the retrieved parameters are achieved due to the way overlapped satellite brightness temperature fields-of-view are accounted for. The paper is well written and was an interesting read.

Recommendation and General Comments:

I recommend major revisions.

The first reason for this recommendation is that I think this should be put into per-

spective with one of the other common retrieval approaches people take: 1. either neglecting the FOV differences in the optimal estimation, or 2. performing a Backus-Gilbert convolution/deconvolution to, perhaps, the middle-ground FOV size here (say corresponding to the $\sim$10 or 23 GHz channels here). For example, consider #1: suppose using your same forward model code, you did the retrieval one pixel at a time as the other papers cited here in the introduction do (1DVAR) – what would the surface wind, SST and simulated Tb fields look like for the same areas? Larger biases? Similar biases? Or, consider #2: if you did the B.-G. convolution/deconvolution, what would the results look like? The method here is novel, but it should be put into context with the other more common approaches so that we know what we may be gaining. What if we aren't really gaining that much for the additional expense? People widely use the Remote Sensing Systems (RSS) products at 0.25 resolution for wind and SST (which is comparable to the resolution here). Perhaps they don't go through the rigor and theory of establishing that they are really retrieving at 0.25 degrees – but, if it's close enough at a first-order level so that a more advanced retrieval achieves only second-order advances and second-order changes in biases – must we go there? For the September 21st case, maybe even RSS 0.25 deg. pixels look like what is shown here and they demonstrate similar wind and SST patterns? In such a case, a conclusion would be: "we can do what we propose here, but we can get high-res retrievals that are good enough with current passive microwave 1DVAR approaches."

So overall, we should at least know how what is done here compares to at least one other approach others often use. I realize the authors say they do not compare the retrieved parameters to other products since sensor calibration has not been validated, and so I am * not * asking them to do that here. What I am asking about is using their same forward model and retrieval code, and doing a quick 1DVAR and/or B.G.-first-then-retrieve approach. Such analysis could be added as additional figure panels adjacent to the ones already shown here for wind, SST and TBs so that we can visually compare.

Another major issue pertains to the figures. I had to stare at a number of the figures (Figs. 3, 5, 6, 7, 8) to absorb the information far longer than I do for most other papers I read. I'm wondering if it would be better to put the retrievals or simulated Tbs on separate panels, thus making a 4-panel images? It is tedious spending so much time to distinguish the fields and their heterogeneity and comparisons (and I'm still not even sure I see the contours well), perhaps so much so that it wipes out the advantages of having fewer panels per image.

A final smaller issue I am wondering about pertains to how to treat the edges of the grids. I am assuming this can't be run for an entire orbit at once. Does that mean there will be discontinuities arising near edges if this approach were executed or that distinct jumps at the seams of grids that are adjacent along the orbital track would be evident? What introduction of such artifacts that do not exist in 1DVAR be worth it to pursue a 2DVAR framework?

Specific Questions and Comments:

Sa specification: How sensitive is this to how you define off diagonal elements (spatial correlation lengths essentially)? So, this 2DVAR approach here allow us to not worry about deconvolution and how to treat overlapping FOVs in 1DVAR approaches, but then we have to newly account for spatial correlations (which must be very scene and atmosphere-feature dependent) in addition to the new issue of grid edges discussed above.

P4, line 30: I do not think 1DVAR must have a vertical dimension. A retrieval of parameters at the surface (e.g. X = [SST, surface wind, salinity]) using certain wavelengths would be a 3 parameter 1DVAR retrieval with no vertical dimension.

P5, Eq 4: This is matrix multiplication, right? Remove asterisks?

P13, lines 20-24: All of the dots look equally spaced in Figs. 5 and 6. I am not sure I understand the comment about increased density of pixels being clearly visible to the

S and W.

P13, line 25-32: I am not sure I agree with this text. And, visually, I do not see that the fits are different than expected from specifying NEdT in Sy (or, if I've read the text correctly, 2 X NEdT was specified in Sy, which would amount to 0.68K for the 6.9 GHz channels and 0.86K for the 7.3 GHz channels). The fits just follow a Gaussian with a width that is given by 2 X NEdT. Thus, 67% of the data will have fits that are smaller than 2 X NEdT (or less than 0.68K for 6.9 GHz). In other words, you should expect that many of retrievals have fits better than NEdT here (and 67% better than 2 X NEdT). I would consider it remarkable that all Tbs were matched if, simultaneously, the atmosphere is also in agreement with "truth". But, truth is not shown (or known). Retrieval algorithms are happy to swap goodness of the retrieved state (x) with goodness of the simulated radiances (and vice versa), 1DVAR included.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-178, 2019.