Reply on RC1

Sheng Li and Ke Du

Author comment on "A minimum curvature algorithm for tomographic reconstruction of atmospheric chemicals based on optical remote sensing" by Sheng Li and Ke Du, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-122-AC5, 2021

We have done more tests on the averaging kernel matrix. We find that althrough it is not much meaningful for inversion without prior information, it can be used for the regularized problem. We have added the averaging kernel matrix into the manuscript to determine whether the concentration can be independently predicted and how regularization limits reconstruction accuracy. In the 2-D tomographic reconstruction, the averaging kernel is considerably affected by the beam geometry and is better to be used as a measure to evaluate the beam configuration. But it also reflects the regularization error given the same beam geometry in this study.

A new measure based on the averaging kernel matrix have been added to the manuscript to determine whether the concentration can be independently predicted and how regularization limits reconstruction accuracy. The new fitness measure is defined as the average Frobenius distance between the resolution matrix and the identity matrix to predicate the reconstruction error. The MC algorithm shows slightly better performance than the LTD algorithm with a value of 1.3878 comparing to 1.4411. The off-diagonal elements are not zeros. The reconstructed concentration at each pixel is a weighted average of the concentration of the surrounding pixels because of the smoothness regularization. Each row of the resolution matrix can be regarded as smoothing weights. The 2-D display of the row of the averaging matrix gives a clear dependence of the beam configuration. Please see section 2.5 and 3.5 in the supplement for the detailed description.

Also, more accurate definitions of the equations and detailed descriptions of the LTD algorithm, Tikhonov regularization, variational approach, and the MC algorithm were updated in the section 2.1, 2.2, and 2.3 in the supplement.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2021-122/amt-2021-122-AC5-supplement.pdf