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Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessing snow extent data sets over North America to inform trace gas retrievals from solar backscatter" *by* Matthew J. Cooper et al.

Anonymous Referee #1

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General comments

The paper deal with a very interesting topic, often neglected in trace gas retrievals: the role of snow-covered surface. The paper evaluates several snow database to identify the most appropriate for trace gas retrievals, especially focusing on NO2 retrievals from current and future missions. The authors also point out the potential of the increased sensitivity to NO2 signal over snow-covered surfaces. I have a few suggestions for improvement that I listed below. I recommend the publication after addressing the following comments:

Specific comments

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Discussion paper

1. In the section describing IMS-dataset you might want to explain a bit more in detail what instruments the dataset is based on.

2. There is a fractional snow extent product from Globsnow/Sen3app projects that might be also worth a look and included in the comparison. For 2015 it is based on VIIRS (Suomi-NPP) data. The data and information are available here: http://www.globsnow.info/index.php?page=SE or here: http://sen3app.fmi.fi/index.php?page=Fractional_Snow_Cover_Extent_-_NH&style=main

3. In the conclusion you write: "However, the lack of confidence in snow identification has previously led many retrieval procedures to omit observations over snow. Increasing this confidence such that these observations could be included would not only improve spatial and temporal sampling, but also allow the inclusion of observations with higher quality information on the lower troposphere." It would be useful to actually demonstrate this with an example or case study, perhaps based on OMI data. I mean, showing one OMI scene/orbit of NO2 retrievals, where the added value of this improved snow information would be visible. For example, an OMI orbit with snow-cover that was filtered out or somehow incorrectly flagged and would be improved using a more accurate knowledge of the snow cover (with the right AMFs and profiles) in the NO2 retrieval.

4. Could you comment on how the increased sensitivity in the PBL might affect NO2 retrievals at relatively higher latitudes (where snow is very often present)? For example, how would those scattering weight profiles in Fig. 2 look like for higher SZA/or a different latitude? It might be less important for TEMPO but it is relevant for OMI/TROPOMI missions to improve retrieval at high latitudes in autumn-winter.

5. There is this paper by Vasilkov et al. about BRDF and OMI retrievals you might need to mention/discuss in your paper: Vasilkov, A., Qin, W., Krotkov, N., Lamsal, L., Spurr, R., Haffner, D., Joiner, J., Yang, E.-S., and Marchenko, S.: Accounting for the effects

of surface BRDF on satellite cloud and trace-gas retrievals: a new approach based on geometry-dependent Lambertian equivalent reflectivity applied to OMI algorithms, Atmos. Meas. Tech., 10, 333-349, https://doi.org/10.5194/amt-10-333-2017, 2017.

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