Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-71-RC2, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "CLIMCAPS Observing Capability for Temperature, Moisture and Trace Gases from AIRS/AMSU and CrIS/ATMS" *by* Nadia Smith and Christopher D. Barnet

Anonymous Referee #2

Received and published: 2 May 2020

This is the first review of the manuscript titled "CLIMCAPS Observing Capability for Temperature, Moisture and Trace Gases from AIRS/AMSU and CrIS/ATMS" by N. Smith and Ch. Barnet. The paper is very well written and is easy to follow. The Figures are well designed and support the reading of the paper. It has been structured to methodically investigate the optimization of the common retrieval algorithm applied to different sensors. Several important climatological products are produced and their independence is assessed from the spectroscopic and scene dependent approach. The a priori information in the retrieval is replaced by the damping factor that is a variable and dependent on the retrieved parameter and the scene. The example of the relation between the eigenvalues and damping factors is very useful for the reader.

The damping coefficient is also investigated to compare different scenes and changes in the cloud clearing algorithm. The algorithm is set to get the most information possible from each retrieval but also avoids over constraining the solution to the a priori where no additional information can be added from the observation. Many examples are provided throughout the text to demonstrate sensitivity in the retrieval of various climatological and dynamically changing parameters (i.e cloud clearing). Authors developed the quality control approach where each retrieval is assessed based on the departure from a priori, information content of the AKD, and uncertainties associated with the cloud clearing algorithm. Still, high variability in the retrieval approach can also lead to long-term and spatial changes in the vertical sampling of the atmosphere. Here are the general questions. 1) Since the damping parameter change for each scene, the AKM also changes. Can it impact the vertical smoothing and therefore alter the effective altitude of the nominal layer in the retrieved profile? Assuming that over time the scene over a particular geographical location might change (i.e. due to climate impact) and it could lead to changes in the altitude contribution to a particular layer in the retrieved profile. So, effectively the long term trends could be impacted by the change in the altitude where most of the information comes from? 2) If AK shapes are very different between instruments located at AIRS and JPSS, how are you proposing to combine records in the long-term time series? 3) If uncertainties change over each scene, are these saved for each retrieval and provided for creating the gridded products?

Specific questions. 1) Lines 248-260 – does reduction in the vertical resolution of the retrieved profiles lead to the issues with the interpolation of profiles for the iterations in the forward model that has 100 layers? Was this error investigated? 2) Lines 454-508, Section 3.2 discusses the interpretation of the informational content of profiles from adjacent scenes. The MERRA-2 is used as a priori and sometimes the RT returns the a priori. Ozone, H_2O, and temperature RTs are the only ones that use MERRA2 a priori that changes with time and space (other species are retrieved with static a priori climatology). How much could it impact on the derived ozone and H_2O trends?

AK could be the same, but a priori could change with time.... Have you assessed the trends in MERRA2 ozone a priori, particularly in the troposphere where ozone variability is limited to the differential column between assimilated stratospheric ozone from MLS and OMI total column? Is H2O a priori changing in the upper troposphere since 2002 and how it might be related to the tropopause variability? 3) Lines 517-528 – Discussion and Table 3 present a summary of the quality of retrieval results for one day. The Figure 10 shows four examples at different latitudes. A number of profiles that have high observing capability are significantly higher than for low sensitivity cases. For the profile to differ from a priori significantly or not depends on the a priori (as you mentioned). In the case of H2O the a priori is climatology and thus the retrieval wit high observing capability should have a larger departure from a priori. Can you please provide information if this result is common for any other day, and how it changes by scene, location, or time? Also, it would be good to see a priori profiles and AKD for temperature retrievals matching the H2O examples shown in Figure 10. 4) Lines 575-577 – Figures 11 and 12 show daytime and nighttime retrievals, but not over the same geographical area. Why not? IT would be of interest for the reader to learn about differences between daytime and night time observational sensitivities. Many air quality studies rely on the contrast in ozone and WV levels between nighttime and daytime.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-71, 2020.