Atmos. Chem. Phys. Discuss., 9, C1206–C1208, 2009
www.atmos-chem-phys-discuss.net/9/C1206/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Retrieval of atmospheric profiles and cloud properties from IASI spectra using super-channels" *by* X. Liu et al.

Anonymous Referee #2

Received and published: 26 May 2009

Review of "Retrieval of Atmospheric Profiles and Cloud Properties from IASI Spectra Using Super-Channels" Liu, et al.

1. Overview

This paper describes a new retrieval method for use with the IASI sensor. Retrieved products are the temperature and moisture profile, surface spectral emissivity, cloud top height, cloud optical depth, cloud particle size, and cloud phase. A linear principal components operator is applied to all IASI radiances (with the exception of some shortwave channels that are sometimes affected by solar intrusion) to reduce spectral redundancy and filter noise prior to the execution of a physical retrieval. The methodology is detailed and retrieval performance is analyzed for four days in April/May 2007 using comparisons with radiosondes, numerical weather prediction analyses, and other sen-

sors. It is claimed that the primary advantage of this retrieval scheme relative to those currently in use is the effective exploitation of all IASI channels in a physical retrieval at a fraction of the computational cost of a physical retrieval explicitly using all channels.

2. Recommendations

The manuscript is well-written and the exposition is clear. This is an interesting application with potential applicability to several current and future hyper-/ultraspectral IR sounders. The subject matter is of interest to the ACP audience, and I recommend publication after several issues are more fully addressed:

a. The authors provide little, if any, quantitative evidence that their approach is "better" than a physical retrieval with a subset (100-200, say) of hand-picked IASI channels. Sensor noise could be effectively reduced with a linear filter operating on all IASI channels prior to downselection of the relevant channels. A linear regression (also operating on all or most IASI channels) could be used as a first guess to further exploit "broadband" information content in the IASI spectrum, prior to the use of a physical retrieval on a reduced channel set. Why does the PCRTM offer any advantages to this approach, which is currently used in practice (NASA AIRS/AMSU "Level 2" retrieval, for example)? Simple, quantitative investigation of this issue should be included in the paper. For example, what happens if you simply use one of the Collard (ECMWF) IASI channel sets in a physical retrieval? Some statistical comparisons over an ensemble would greatly augment the "case-study" analysis presented in the paper – both types of analysis are required to fully evaluate high-performance retrieval systems over a variety of atmospheric conditions.

b. How is scan angle treated? Are the principal components computed at each scan angle?

c. How do you know that "about 100 super channels are adequate"?

d. Why did you calculate principal components for each of the three bands instead of

the aggregate?

e. The paper mentions matching the synthesized radiances “to the noise level.” Exactly what noise level – the native noise level or the noise level that can be achieved after spectral filtering? If the former, why not the latter?

f. The cloud parameter retrievals were presented with very little validation other than the radiances were well-fit after the retrieval (which is encouraging, but not necessarily conclusive proof of retrieval skill). The paper could be substantially strengthened if minimal quantitative validation of these products is added.

g. The black art of physical retrievals is largely contained in the treatment of regularization. This is not discussed in any detail – please add additional discussion. Same comment applies to retrieval non-convergence, that is, what do you mean exactly by “the cost function is too large?”

h. Please provide additional detail on the ARIES instrument. A few sentences would suffice.

i. Why are 29 April and 4 May not included in the discussion of surface emissivity retrieval?

j. For the retrieval comparisons of water vapor mass mixing ratio, why not normalize the error by the truth (or a mean value, etc.) for a more intuitive sense of the magnitude of the error?

k. An additional table summarizing the atmospheric (clear/cloudy, etc.) and viewing conditions (land/ocean, etc.) of each of the four cases would be helpful.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 8683, 2009.