Author Comments as a response to Referee Comments #2, M. DeLand.

Thank you for the fruitful and constructive comments. We address all the comments in the notes below.

General Discussion:

Observations of polar mesospheric clouds (PMCs) reveal substantial amounts of complex structure in both vertical and horizontal directions. Satellite measurements of PMCs typically resolve one of these directions well, while averaging extensively in the other (e.g. limb scanning can detect fine vertical structure, but averages over a long horizontal path). However, if sufficiently frequent limb scanning measurements are available, these data can in principle be inverted to determine the original 2-D field that is being sampled.

This paper uses special data sets from the OSIRIS instrument on the Odin satellite to reconstruct the PMC field for specific orbits using tomographic inversion. By limiting the vertical range of the limb scans to the PMC altitude region, the sampling frequency was increased enough that horizontal structure at a scale of 350 km could be resolved simultaneously with the vertical structure at 1-2 km resolution. In comparison, while the CIPS instrument on the AIM satellite can resolve PMC horizontal structures at finer scales, it does not retrieve any information about vertical structure.

Confirmation of the new OSIRIS results through comparisons with CIPS data, as discussed in Section 6, would be valuable. Since the measurements needed for tomographic analysis require OSIRIS to be operated in a special mode, it is suggested that further such measurements be coordinated with CIPS observations as needed to maximize opportunities for comparative studies.

Response to comment: Thank you for this discussion. You are very right in that comparisons with CIPS would be valuable. In fact, work is ongoing on just this topic and will be available in the future. However, we do not consider the comparisons to fit in the current paper since we here only address the technique and not so much of the results from using the algorithms.

Specific Comments:

1. p. 3700, line 12: The number of iterations required to get convergence for the volume emission calculations seems fairly high. Are there any concerns about the computational time required for this step? Would it be useful to loosen the convergence requirements to lower the number of iterations needed?

Response to comment: The number of iterations used is fixed to 30, instead of using a convergence criterion. The computational time is not an issue and the number of iterations has been carefully chosen from investigations of the convergence to rather be a few too many than to have errors due to a non-converging algorithm.

2. p. 3702, lines 10-14: How does the simulated noise level compare with typical OSIRIS mesospheric data? How does it compare to the special short scans?

Response to comment: Noise levels in typical OSIRIS data are 1e8-1e9 ph cm^{-2} s^{-1} str^{-1} nm^{-1}, which corresponds to about 1% of PMC peak radiances. This means that the noise levels that have been used to test the retrievals are very representative of the input data. Concerning the noise in standard scans and the short scans, there are no differences since noise is introduced by the integration time at a given altitude, and not by the scan duration.

3. p. 3703, lines 20-22: Does the MSIS climatology provide sufficient accuracy for the density profile? Would data from recent satellite missions such as SABER or ACE be more useful?

Response to comment: The "unpredictable" variability of molecular density at PMC altitudes is quite large, about 10% (see e.g. Rapp et al., 2001). However, for reasonable strong PMC the molecular Rayleigh scattering is less than 10% of the peak PMC scattering. Hence, the variability of the molecular density leads to a relative uncertainty in the Rayleigh subtraction that is less than 1%. Therefore the MSIS climatology is considered sufficient for this purpose and easier to use than data from e.g. SABER or ACE.

4. p. 3704, lines 7-11: The tomographic mode reduces the altitude range covered by a factor of 6-9, which should lead to the same change in horizontal distance between scans, assuming the same nodding speed for the Odin spacecraft. The nominal scanning speed of 0.5 km/sec corresponds to a duration of 30 seconds for the 73-88 km scans and 22 seconds for the 77-88 km scans, which gives horizontal separations of 210 km and 154 km respectively. This can be compared with a typical separation of ~500-1000 km as reported by Petelina et al (2006). Can you estimate the minimum number of scans (or maximum horizontal separation) needed for the successful use of the tomographic analysis technique? Would it be possible to apply this technique to normal OSIRIS data?

Response to comment: The restriction of this technique is that multiple overlapping of lines of sight is needed. It is very difficult to define a limit on the number of scans but we are probably at this limit already. To recover even better results we would need an imager using multiple lines of sight at the same time. It would therefore not be possible to apply this technique to normal OSIRIS data.

5. p. 3705, lines 4-6: The retrieved PMC structure appears to ignore possible false detections below 80 km that are typically an issue with limb PMC observations. The on-line figures also generally show this behavior, although those figures only cover the vertical range 80-85 km. Is this a consequence or result of using the tomographic technique?

Response to comment: This is a result and, in fact, the general idea of the tomography technique.

Technical Corrections
p. 3696, line 16: "trough" should be "through"
p. 3702, line 11: "reproduce" should be "reproducing"
p. 3706, line 15: "25 m2" should be "25 km2"

Response to comment: Thank you for noticing these type-o's.