Author Comments as a response to Referee Comments #4, anonymous referee.

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

General Comments:

This paper presents algorithms for tomographic analysis of mesospheric clouds base on maximum probability techniques. Results are shown OSIRIS measurements, both for simulated data and from special tomographic data collections. Overall the paper is shallow and does not address the fundamentals of the algorithm performance. Using simulated data, differences are shown between the "true" atmosphere and the cloud. These differences are ascribed to the finite resolution of the input measurements and the horizontal structure. There is, however, no numerical quantization of the retrieval performance for simple cases without horizontal structure. A more comprehensive analysis of the algorithm performance is needed to assure the reader that the retrieval software is performing as expected.

Specific Comments:

1. Page 3696, line 2: The OS in OSIRIS is an Optical Spectrograph and yes it does collect only one line of sight per read-out. The other part of the name, IRIS, is the InfraRed Imaging Suite (or Sensor or System, depending upon who you ask) and it collects a vertical image (multiple lines of sight) per read-out. The as written description needs to be changed to only refer to the OS part of OSIRIS.

Response to comment: Thank you for the correction. This will be clarified.

2. Section 2.1 is just a discussion about the vertical and horizontal grid used in the retrieval. I would not really call this a discussion about the model atmosphere.

Response to comment: We will change the topic of this subsection.

3. Section 3: The discussion about the best vertical scan speed is short, but satisfactory. The discussion about the difference between the model and retrieval is lacking. It is not demonstrated that the code is working correctly. Maybe the offset is due to an index error. A more simplified case with no horizontal structure should be run to demonstrate that the computer code is operating correctly. There should also be a better quantification of the differences between the data and retrieved profiles.

Response to comment: When it comes to an assessment of the retrieval quality, it is most important to judge the retrieval of cloud shapes. Difference plots between model cloud and retrieved cloud focus on comparing absolute magnitudes, which is of minor interest here. In the original manuscript, we therefore argued that "visual inspection" is the most appropriate way to judge the retrieval quality. In the revised paper, we will better quantify this by defining a "thickness of the blur" as a measure of the shape retrieval.

4. Section 3: The algorithm discussion makes no mention of the actual source of the photons received by the OS. It is written in a general sense, with no words discussing the particular details of these particular OS measurements. The OS works in the ultra-violet, visible and near IR. Any "emission" by the clouds would be in the IR. The clouds scatter sun-light. This is not directly mentioned in the text. Page 3695, line 1 does say "…PMC scattering…" but does not specify scattering of sun-light or terrestrially emitted photons. The remainder of the page (3695) mentions airglow measurements used in past tomographic studies (not of clouds), but again nothing about the source of the photons evaluated in this dataset. Not until page 2703 does the reader learn that the data is scattered sun-light.

5. Related to comment #4, is there any allowance for the solar zenith angle and the single scattering angle from the sun to the sensor (OS in this case) to change during the orbit? Is the single scattering angle in the forward direction or the backward direction? The forward direction will be much more sensitive to the scattering angle for each volume.

Response to comments: As I also wrote to an earlier reviewer, we have made a substantial revision of this in the manuscript since "volume emission rate" is not a good quantity to use when describing scattering from PMC since this involves a phase function and is not isotropic. Instead, the values have been converted into a "volume backscatter coefficient", beta, in units m^{-1} str^{-1}. Inputs to the tomography algorithm are OSIRIS limb radiances in units ph cm^{-2} s^{-1} str^{-1} nm^{-1}. In applications of tomography to airglow or auroral studies, volume emission rate in units ph cm^{-3} s^{-1} is a convenient retrieval product (Degenstein et al., 2003). This is not the case for studies of PMCs as the scattering phase function introduces anisotropy to the radiance field. Therefore, we describe local scattering from a cloud element in terms of the volume scattering coefficient β_λ in units m^{-1} str^{-1} that includes the dependence on the scattering angle. β_λ is obtained by normalizing measured radiances to the incident solar irradiance in the spectral interval of interest. The use of β_λ also facilitates comparison to lidar studies that describe local cloud properties in terms of a volume backscatter coefficient in the same units. When interpreting cloud structures as shown in Figure 7 one has to keep in mind that the absolute value of the local scattering depends on the scattering angle of the observations and that the scattering angle slowly varies along the satellite orbit. This phase function effect on the retrieved PMC structures remains minor. During the PMC season poleward of 60°N, the solar scattering angle typically only changes from 70° to 100° from the ascent to the descent part of the flight.

6. To what accuracy are the measurements fit in the retrieval process? Is it the 1% of the peak PMC radiance mentioned at the top of page 3704? Only mention of the nominal number of iterations is given (30).

Response to comment: It is a bit unclear what the question is here. 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 therefore 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.

7. Page 3706, line 15: Is the spatial resolution of CIPS 25 m^2 or 25 km^2?

Response to comment: Thank you for the correction. This should be changed to 5 x 5 km.