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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Cirrus cloud shape detection by tomographic extinction retrievals from infrared limb emission sounder measurements" *by* Jörn Ungermann et al.

**Anonymous Referee #2**

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General comments:

Passive limb sounding provides a very sensitive method to detect clouds from space. An improved algorithm, the convex hull cloud index, is presented which allows better performance than traditional cloud index methods when applied to instruments such as the IRLS concept with operational scanning modes capable of providing sufficient oversampling of airmasses along the line of sight. A 2D tomographic retrieval of cloud extinction is also presented that is applicable to IRLS type instruments and is validated with measurements from the airborne GLORIA instrument.

I have no major concerns to address and the paper would be suitable for publication in



AMT following attention to some minor revisions.

Specific comments:

/xxx/ means delete xxx

[xxx] means add xxx

L4: "is better in detecting the horizontal cloud extent". Why not say "has improved horizontal resolution"?

L25: suggest "rigorous" instead of "proper"

L26: most sensitive [passive] method ... /are/ [is]

L31: suggest "the poor" rather than "a bad"

L34-L37: Some earlier work on 2D retrievals is omitted in this discussion e.g. as cited in Ungermann (2013) ... see p16... "This is in principal similar to the concept of tomographic 2-D retrievals of satellite limb sounder data, which were first produced by Carlotti et al. (2001) and Steck et al. (2005) for the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) and by Livesey and Read (2000) for the Microwave Limb Sounder."

Massimo Carlotti, Bianca Maria Dinelli, Piera Raspollini, and Marco Ridolfi, "Geo-fit approach to the analysis of limb-scanning satellite measurements," Appl. Opt. 40, 1872-1885 (2001)

Nathaniel J. Livesey and William G. Read, "Direct Retrieval of Line-of-Sight Atmospheric Structure from Limb Sounding Observations", GEOPHYSICAL RESEARCH LETTERS, VOL. 27, NO. 6, PAGES 891-894, MARCH 15, 2000

L36: and many other instances: line-of-sights => lines-of-sight

L61-L62: Wasn't most of the MIPAS mission carried out with the reduced resolution mode?

L62: Which MIPAS operational mode does this 1.5km vertical resolution correspond to?

L75: suggest "relative" rather than "compared"

L76: airmasses [at an angle]

L82: is [a concept for] an

L86: a spectral sampling of 1.25cm-1 seems very large

L86: is this +/- 7 deg or +/- 3.5 deg in azimuth?

L104: CLaMS is not defined until L106

L128-L129: This is the only mention of aerosols in the paper. Are aerosols assumed to not exist in the simulations shown here? Are their effects assumed negligible and if so to what extent? What about elevated sulfate aerosols in volcanic plumes? What about the potential for aerosol-cloud interaction studies?

L138: It's not clear here – would the FTS produce data sampled only at the coarse resolution? Is the spectral resolution sufficient to do a good enough job with the gas retrievals? I'm assuming (from L125) that the emissivity growth approximation look-up tables are generated using high resolution line-by-line calculations and spectrally integrated to the coarse resolution. Is that the case? Some more detailed explanation seems necessary.

L145-L153: Please provide some information on the approximate optical depths corresponding to the CI values 1.1 and 4 and therefore what you mean by thin and thick clouds.

L158: suggest "usefully" rather than "meaningfully"

L172: Maybe explain the concept of a "convex hull"

L174: Maybe clarify this a bit better. What I am getting from this is that "below the



threshold" means that the CI detection method got triggered. However, the CI detects a spurious cloud at the tangent, but it was triggered by a real cloud well above the tangent.

L178: this aspect of [the] different

L181: "A common approximation of the spatial origin of a radiance measurement is assigning it to its tangent point, which is the location along its line-of-sight that is closest to the surface."

The radiance measured is the result of the integration along the refracted ray path (which may also involve scattering of radiation into the line-of-sight). The tangent height is just a convenient label to use.

L185: extinction cross-section/s/

L193: Especially [optically] thin

L197-L210: In this section (and everywhere else) it's not clear whether unrefracted or refracted tangent rays are being described. Refraction will cause the actual tangent point to be lowered and move closer to the instrument compared to the geometric (unrefracted) tangent point.

L216: The first reference to the CI being a "color-ratio" probably should be on L143.

L237:Eqn 1: The role of lambda_i is not defined. F' is not mentioned.

L245: to allow /for/ oscillations

L250: 1/2 orbit in 25 mins or 1 day (typically 14.5 orbits) in 6 hrs.

L284: What is the optical depth cut-off value?

L361: What is the clear-sky optical depth for the lowest tangent height you are considering?

L383: Brightness temperatures?

L392: I don't see how the retrieval could distinguish between spatial vs temporal evolution.

L410: is /in/ [on] the order ... in [the] flight

L426: What about evaporation?

L437: in [a] north-south

L441 in [the] nadir]

L442: units typo ... 0.1 km[-1]

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