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Atmospheric
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Interactive comment on "New perspectives on gravity wave remote sensing by spaceborne infrared limb imaging" *by* P. Preusse et al.

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First of all we want to thank reviewer Fernand Karcher for his interesting and helpful comments. We have briefly summarized the reviewers questions (highlighted in bold) before replying. New text is given italics.

Better explain the sampling geometry:

Since the sounding geometry is the essential innovation of the new instrument it will be expalined in a schematic drawing introduced as a new figure.

The corresponding figure legend reads:

Three dimensional sampling of the dsicussed infrared limb imager. In the dynamics *mode interferograms are taken every 50 km along the orbital track. The vertical extent of a single element is about 500 m. Measurements are taken in 14 columns of each 24 km width, resulting in 14 parallel tracks of altitude profiles.*

How was the across-track width of 320 km determined?:

The across-track width is limited by technical feasibility. The vertical extent of the image is about 50 km. The wider the across-track extent, the larger is the aspect ratio between width and height of the image. A large aspect ratio is technically costly since an FTS is in principle best suited for a radially symmetric acceptance angle distribution. Therefore the technical preference is to minimize the across-track width as far as scientificly justificable. Our experiences with CRISTA have shown that the wavelength distribution in the tropics can be reasonably estimated from pairs of profiles 200 km apart by phase difference methods (cf. reply to reviewer 2). In order to improve on this we have requested for at least 1.5 times this value. A brief extract of this will be included after the description of the sampling:

The sampling geometry has been chosen in acccordance with our experiences from deducing GW momentum flux from CRISTA and the conclusions drawn by Ern et al. (2004).

Is there cross-track influence in the retrievals?

The outmost traces are only 2.5 degree out-off the orbital plane and therefore the innermost 500 km along LOS around the tangent point intersect only about 20 km in the across-track direction, less than the width of a pixel-column. Therfore the influence of the across-track information is very small and neglected in this study.

How does the noise level change with spatial sampling / resolution?

We can reliably estimate the noise of retrieved temperatures for a given instrument and retrieval setup. However, the quantitative noise and resolution response to varied spatial sampling for 2D retrievals is not well understood, yet. A few findings from a preliminary study are summarized as follows. However, these results are both too complex and too preliminary to include them in the current paper and we prefer to publish them in a dedicated study after further work on this topic.

The noise level of the retrieved temperatures is about proportional to the noise of the radiance, if we keep the spatial sampling and the retrieval set-up unchanged. The spatial sampling affects the noise level in two ways: First, the radiance noise changes via instrument parameters. A finer spatial sampling means smaller integration area or shorter integration time and the noise level of a single measurement increases. In ideal case, the signal-to-noise ratio is inversely proportional to the square-root of the sampling distance in the respective direction. Second, a finer spatial resolution of the retrieved temperatures involves a deconvolution of the of the spatial ”smearing” by the radiative transfer, both in the vertical as well as in the horizontal. Therefore, even if we could maintain for every pixel the same noise level when we increase the spatial sampling (and thereby resolution), the noise level of the retrieved temperatures increases.

In the following considerations we will keep the radiance noise for each pixel constant. If we now increase the sampling this means actually an improved instrument. We add radiance measurements of the same quality and therefore have more information for the retrieval. Still, because of the spatial deconvolution the temperature noise, in general, increases. This, however, depends on the details of the retrievals and is far more complex for 2D retrievals than conventional 1D retrievals. Exemplarily this is demonstrated for the vertical sampling.

At coarse vertical sampling the vertical resolution is almost equal to the vertical sampling. For instance, if we use 2 km vertical sampling instead of 4 km, also the vertical resolution will be enhanced from about 4 km to about 2 km. Because of the finer vertical resolution we would expect a factor 2 larger noise (deconvolution effect), but since we also use twice as many measurements, the noise level increases only by roughly a factor $\sqrt{2}$. However, at the fine vertical resolution we have assumed for the ILI, the vertical resolution is not longer proportional to the sampling: the additional information by additional measurement points still improves the vertical resolution, but not to the same extent as before; instead, an increasing amount of the additional information improves horizontal resolution and noise level. This can be influenced by using vertical and horizontal correlation lengths in the retrieval set-up.

We will continue to study these effects in detail. Since 2D retrievals are just evolving, our instrument parameters were determined on the basis of 1D retrieval studies. However, our preliminary studies confirm the choice of instrument parameters.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 825, 2009.

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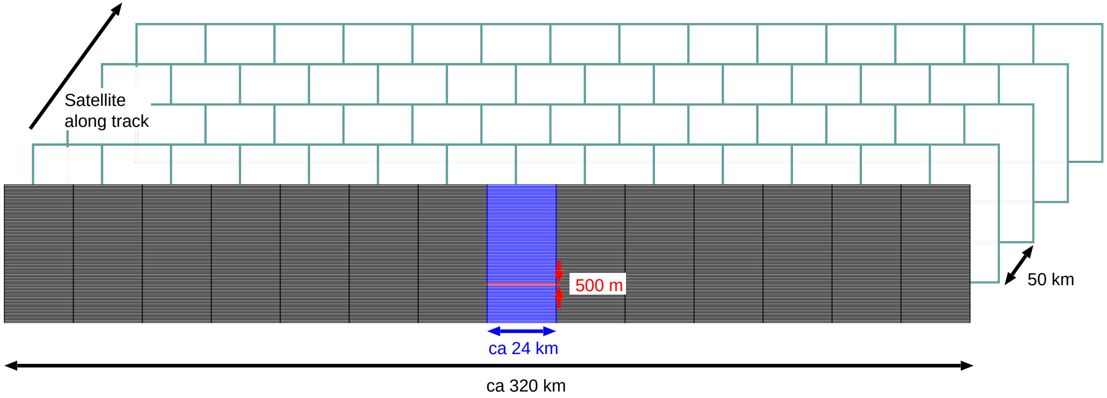

Fig. 1. Three dimensional sampling of the dsicussed infrared limb imager.