

***Interactive comment on “The MIPAS2D database of MIPAS/ENVISAT measurements retrieved with a multi-target 2-dimensional tomographic approach” by B. M. Dinelli et al.***

**Anonymous Referee #1**

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Comments on "The MIPAS2D database of MIPAS/ENVISAT measurements retrieved with a multi-target 2-dimensional tomographic approach" submitted to AMTD, Dec09

Dinelli et al.

The paper introduces a dataset based on a 2D tomographic retrieval from MIPAS measurements, spanning the full length of the mission, detailing the criteria applied in the dataset selection and usage guidelines. The 2D approach is theoretically superior to the more conventional 1D approach in that it avoids the assumption of horizontally inhomogeneous atmospheres which is known to cause errors in regions of strong gradients. The retrieved products are the same as those used in the operational ESA processor,

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with the addition of 5 new molecules just for the 2002-2004 period (at present).

General comments:

1) As a whole, this paper serves as "an introduction" to the dataset but contains neither an algorithm description (already published in Carlotti et al) nor any significant validation, except for some qualitative plots of the data and a comparison between the NOM and GRD horizontal grids. Possibly the authors plan a later validation paper, but if I were a potential user of this dataset I would at least like to see comparison with the established and validated ESA L2 products from 2002-2004, and preferably some demonstration of the superiority of this dataset (apart from the additional molecules and extended time range, in any case the ESA processor is expected eventually to be applied to the data since 2005).

2) There should be some acknowledgement of the 2D retrieval which has been employed by the Aura/MLS team since launch, which predates this work. While this is a microwave instrument rather than infrared, the principles are essentially similar.

Minor comments/queries =====

P2641, L22-24: Limb-scanning infrared instruments since the 1980s (on Nimbus 7 & UARS) have always had a sampling of around 500km, although often sideways-viewing rather than along-track direction. There have been "recent improvements" in this 500km horizontal sampling, notably by MLS and HIRDLS on the Aura satellite, but not really by MIPAS or SCIAMACHY.

P2642, L5-8: see general comment (2) regarding MLS.

P2646, L21: This is not the case, ESA have provided a limited set of L2 data from the OR mode for validation purposes.

P2643, L8: "to fade out"? I doubt if the measurements will fade out, it is more likely that the instrument will just be switched off. But you should also say what determines this end date, ie the de-orbiting of the Envisat satellite.

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P2643, L26: MIPAS IFOV is a trapezium, so \*approx\* 3km in height.

P2644, L8: the last FR observations were acquired in March 2004, not April 2004.

P2644, L21: full-time operations started in Dec 2007, not Jan 2008 (also P2665, L4).

P2644, L25: duty cycle includes 1 day "Middle Atmosphere" mode and 1 day "Upper Atmosphere" mode, not 2 days UA mode as stated.

P2645, L19: "As expected from radiometric considerations". If it was expected, you should be able to quantify the expected change in magnitude that accompanied the change in resolution rather than just say it was reduced.

P2647, L20-25: I don't see why item 3 is a "shortcoming" (or "shortage") of the retrieval method. For some applications this may be a good thing since it maximises the horizontal and vertical resolution of the retrieval.

P2650, L1: It's not so much the variations in refractive index of the atmosphere that lead to the variation in vertical grid, it's more variations in satellite pitch and the local earth radius of curvature around the orbit.

P2650, L22: "where the maximum information is expected". Doesn't this depend on the parameter retrieved? Eg HNO<sub>3</sub> is likely to be at a different altitude to N<sub>2</sub>O. Presumably you don't have different locations for different molecules. What convention do ESA adopt for geolocating their retrieved profiles: eg lat/lon at some particular nominal altitude? Is there any good reason for not using the same?

P2650, L27: the clustering around particular latitudes is not coincidental: it arises because, during MIPAS FR observations, the scan patterns within each orbit were synchronised to start at a particular latitude crossing. This is probably worth mentioning.

P2651, L3: "as used by models". The authors overstate the importance of a fixed latitude grid. Many models use data assimilation which incorporates measurements at their (arbitrary) locations - indeed this is their preference rather than using interpo-

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lated data (which introduces undesirable correlations between different profiles - this is actually be a drawback of the 2D tomographic approach compared to a 1D scheme). Other models may have particular latitude grids which are not regular, and even models with regularly spaced latitude grids are unlikely to use the same latitude grid as the MIPAS2D database, so will require an additional re-interpolation of the data anyway.

P2651, L15: "...would require the use of a regularization scheme". If you're using OE you already have a regularization scheme, even with FR mode retrievals, so this is not really an argument against changing the grid.

P2652, L6-7: It is probably worth mentioning that this sequence is the same as used by ESA's operational processor for these molecules.

P2652, L12: Do you really mean "absorption coefficients" of continuum? An absorption coefficient is usually multiplied by an absorber density but it is not clear what the "absorber" is for continuum. For this reason, continuum absorption is usually represented just as an extinction coefficient.

P2652, L12: The standard ESA retrieval also retrieves a radiometric offset for each microwindow. Is that not retrieved here, or was that just omitted from the text?

P2652, L25: Note that N<sub>2</sub>O<sub>5</sub> also has a significant diurnal variation, but you do not seem to explicitly account for this.

P2653, L7: "The sensitivity ..." I do not understand what this sentence means. Do you mean sensitivity of the CI threshold (which doesn't seem to be mentioned in 4.3) or other parameters? And isn't it the sensitivity of the retrieval to these parameters that is discussed in section 4.3, and not vice-versa?

P2653, L6: Do you include or exclude the UTLS1 mode, which was extensively used 2005/2006, in your MIPAS2D retrievals?

P2654, L15-24: Why don't you use the previously retrieved orbit, or the previous day's retrieval from GMTR as your initial guess? It would presumably be better than clima-

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tology.

P2656, L12-19: Although it is stated that these are reported in the files, it would be useful to give some indication in this paper of the leading systematic errors are for the GMTR retrieval. For example, for the ESA retrievals the impact of unmodelled horizontal gradients is often the major systematic error but presumably that disappears in a 2D retrieval. Also there is no mention of the size of the random error for comparison.

P2657, L3: I assume that the subscript  $j$  means a particular profile point in the horizontal/vertical domain of the retrieval, and not a profile of points. This could be made a bit more explicit than just saying "parameter  $j$ ".

P2657, L14-26: It seems to me that a user is more likely to want to know the a priori error ( $\sqrt{S_{aj}}$ ) assumed for each point rather than the information gain. I assume that the retrieval random error ( $\sqrt{S_{rj}}$ ) is also given in the database so, if the information gain is required, it could be easily constructed from these two numbers from the formula provided. Also, US satellite instruments (UARS and Aura) seem to have adopted the convention of attaching a negative flag to the retrieval random error to indicate where the a priori contribution is large - this conveys the same information as attaching a negative number to your information gain and avoids trying to establish a new convention here.

P2658, L23: "Since GMTR does not retrieve pointing information". Presumably it \*does\* retrieve pointing information in the sense of retrieving the tangent point pressure for each sweep and some hydrostatic constraint to provide, implicitly, relative altitudes between sweeps. The only thing that should be missing is the absolute altitude which cannot be determined independently from infrared limb sounders. So is this just saying that there is an uncertainty in the absolute altitudes assigned to the vertical grid at each horizontal location? Since the vertical grid is essentially arbitrary anyway (especially for the OR measurements) why not just use pressure as the vertical coordinate? For Fig.10 the data are in fact plotted on the 31.5hPa surface rather than 24km which is

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presumably the vertical coordinate in the database (also Figs 13-15).

P2659, L5-8: "The 2-D approach reduces the impact of the pointing error". If the pointing error is predominantly an altitude offset, which varies slowly along an orbit, then the 2-D approach doesn't help. Or are you referring to pointing errors from one scan to the next? In this case the GMTR approach only helps in the sense that it may retrieve pressure more accurately than the 1-D retrieval but I don't see how it can ever improve the absolute altitude assigned to sweeps.

P2659, L25 (& elsewhere): What is the "weighted ESD"?

P2660, L16: What does "poor" Level 1b data mean? (and again on P2661, L6)

P2660, L24: Add some reference to "normalized L2 noise weighted norm..."

P2661, L16-18: The  $\chi^2$  statistic is not a reliable indicator of the magnitude of systematic error contributions to the retrieval. It tells you that the residuals are of similar size but tells you little about the contribution of systematic errors to the retrieval. Those systematic errors which seriously affect the retrievals (eg temperature errors) don't appear in the residuals because the retrieval has adapted to remove their signatures.

P2662, L13: "about 1 hour". Presumably "about 100 minutes" is more accurate?

P2663, L12: If the data is on altitude surfaces (ie 24km) why

P2663, L3: Weighting by noise error is dangerous when constructing geographical averages. Data acquired in low temperature regions tends to have a larger noise (due to the lower radiance signal) and is therefore reduced in weight when contributing to the average.

P2663, L10: Even when the duty cycle was low, MIPAS was generally operated for full orbits rather than fractions of orbits, so it is not clear how the reduced duty cycle creates an extensive data gap.

P2663, L14/15: The antarctic ozone depletion isn't correlated with the break up of the

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polar vortex: the second event is what terminates the first.

P2664, L14-23: Perhaps add some comment on the behaviour of the minor species as depicted in Fig 16.

Table 1: Not clear whether it is the larger of these two criteria which are used or, for example, just a simple sum.

Table 2: Incomplete. What about the microwindows for the other retrieved species?

Figure 2: left axis: what is "MW noise"?

Figure 5: Is this plot for a particular atmospheric profile, or some sort of global average?

Figure 8: Too small, and seemingly of poor quality reproduction.

Figs 13-16: In the captions, give actual latitude range rather than just, say, "antarctic region".

Figure 16: Too small.

Typographical/Grammatical ===== P2641, L11: change "contest" to "context"

P2641, L14: change "permits to obtain..." to "permits us to obtain..." or "permits full geographic coverage to be obtained" or "permits the acquisition of full geographic coverage".

P2641, L15: change "However, not only obtaining observations is" to "However, not only is obtaining"

P2641, L16: change "ability of" to "ability to"

P2641, L18: change "bury inside" to "contain"

P2642, L20: suggest "combining" rather than "joining"

P2642, L22: change "enables to properly account ..." to "enables the horizontal variability"

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ity to be accounted for properly".

P2643, L20: explain "LT"

P2643, L24: change "consits" to "consists"

P2644, L1: the average distance is "about 500km", not "500km in latitude".

P2644, L1: suggest changing "5 latitude degrees" to "5 degrees latitude".

P2644, L2: suggest changing "observations were acquired" to "observations are acquired" - these special mode observations are still ongoing. Alternatively, if you are just referring to the special observations during the FR measurements, I don't think any of these were used for volcanic eruptions or used the sideways-viewing capability.

P2644, L7: suggest changing "interferometric" to "interferometer"

P2644, L13: change "3 to 70km" to "6 to 70km".

P2645, L13/14: suggest "successive processing versions" (successive seems to require a plural noun).

P2645, L20: change "(occurred ..." to "(which occurred ..."

P2645, L27: change "this discontinuities" either to "these discontinuities" or "this discontinuity".

P2646, L5: change "These implies" to "This implies"

P2646, L5: insert comma: "This implies that, ..." (to match comma after "grids")

P2646, L6-14: Does this inconsistency lead to any significant differences in the retrievals if it is not properly accounted for? I.e. is it an essential correction which anyone using MIPAS L1B data v4.65/4.67 needs to know about?

P2647, L2: Change "Micro Windows" to "Microwindows" (one word).

P2647, L10: Change "onto" to "on"

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P2647, L11: Change "shortages" to "shortcomings"

P2648, L1: Suggest changing "not uncommon" to "certain" or "particular"

P2648, L13: Change "shortages" to "shortcomings"

P2648, L20: Suggest changing "recalled" to "summarised"

P2648, L25: Change "enables to model..." to "enables the horizontal atmospheric structure to be modelled".

P2648, L27: Change "uncertainties on" to "uncertainties in"

P2648, L1: Change "and on the amount of molecules" to "and in the concentrations of molecules"

P2649, L5: Change "possibility to adopt" to "possibility of adopting"

P2649, L5: Change "in case of lack" to "in the case of a lack"

P2649, L11: Change "with LOS laying" to "with the LOS lying"

P2649, L12: Change "enables to gather" to "enables the gathering of"

P2649, L22: Change "measurements geolocation" to "measurements' geolocation" or "geolocation of the measurements".

P2649, L24: Suggest changing "that can determine" to "that can also determine"

P2650, L3: Suggest changing "during each sweep" to "during each limb scan"

P2650, L6: Suggest "complicated" rather than "challenging"

P2650, L7: Inconsistent spelling: "discretization" here and "discretised" on P2649, L18.

P2651, L1: Change "vary" to "varies"

P2651, L13: Suggest changing "makes less meaningful ..." to "makes the GMTR... grid less meaningful"

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P2652, L8: Change "non-correct" to "incorrect"

P2652, L9: Suggest changing "the additional NOM database was produced" to "the database was also produced on the NOM grid, and included ...".

P2653, L10: Change "Envisat is on" to "Envisat is in"

P2653, L13: Inconsistent spelling: "analysed" from this section onwards, but "analyzed" previously

P2653, L21: Suggest changing "several ... processings" to "different processing versions of ESA Level 1 data"

P2654, L10: Suggest "used as \*the\* initial guess"

P2656, L2: Suggest change "change for" to "change between"

P2656, L9: Suggest change "onto" to "on"

P2658, L1: Suggest changing "under" to "on"

P2658, L3: Change "in Sect. 4" to "Sect. 3.1" (presumably?).

P2658, L2: Change "non-complete" to "incomplete"

P2658, L6: Suggest change "non-negligible" to "significant"

P2659, L22: Suggest change "unfavourable" to "unfavorable" since US spelling used elsewhere in this paper. Also elsewhere. And "behaviour" to "behavior" (eg P2663, L23).

P2660, L15: Suggest changing "because of either" to "either because of"

P2660, L20: Change "enables to exclude" to "enables the exclusion of" or "enables products ... to be excluded"

P2660, L27: Suggest changing "A chi2 equal to 1" to "A chi2 value equal to 1" or "chi2 equal to 1"

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P2661, L8: Suggest changing "On the contrary" to "On the other hand".

P2661, L9: Suggest changing "in coincidence with" to "coinciding with"

P2661, L10: Change "kept into" to "kept in"

P2661, L19: Change "A part" to "Apart"

P2662, L1: Suggest change "instabilities of" to "instabilities in"

P2662, L2: Change "some parameter" to "some parameters"

P2662, L8: Change "kept into" to "kept in".

P2662, L11: Change "artic" to "arctic".

P2662, L11: Change "derive from" to "are derived from"

P2662, L25: Change "application" to "applications"

P2663, L1: Change "5 days" to "5 day".

P2663, L1: Suggest changing "figures but Fig.17" to "figures except Fig.17"

P2663, L7: Suggest changing "data shortages" to "data gaps".

P2663, L17: Change "breaking" to "breaking up"

P2663, L20: Suggest changing "that" to "which"

P2663, L26/27: Use of both "day side" and "dayside".

P2663, L28: The time series is "of" ozone values rather than "relative to"

P2664, L23: Change "potentiality" to "potential".

P2664, L28/29: Change "split up" to "split".

P2665, L5: Change "cycle is back to" to "cycle was increased back up to"

P2665, L12: Change "sets" to "set".

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P2665, L26: Change "beeing" to "being".

P2684, Fig 13 caption: Change "anctartic" to "antarctic"

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