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Atmospheric Measurement Techniques Discussions

Interactive comment on "The Impact of MISR-derived Injection Height Initialization on Wildfire and Volcanic Plume Dispersion in the HYSPLIT Model" *by* Charles J. Vernon et al.

Anonymous Referee #2

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General Comments

This review pertains to the paper entitled 'The Impact of MISR-derived Injection Height Initialization on Wildfire and Volcanic Plume Dispersion in the HYSPLIT Model' submitted for publication in Atmospheric Measurement Techniques. This paper contained a detailed analysis, investigating the effects of initialization altitude on the accuracy of modeled plume dispersion. The results of both wildfire and volcanic case studies were subsequently compared to visual satellite imagery obtained up to 96 hours from the time of initialization. This paper was generally well constructed and contained a significant review of the techniques employed and results obtained. The manuscript does

require some text revisions and further clarification in parts. Therefore, I recommend the publication of this paper following the completion of the below minor revisions.

Specific Comments

The paper is generally well constructed although further referencing is required, particularly in Section 1. Specific cases are noted within the Technical Comments however a careful review by the authors is recommended.

At times, within the text, the writing becomes extremely conversational. Some examples of these instances are noted in the Technical Comments with suggested alterations. However, a full review by the authors is recommended.

Data Sources – The methods section of this manuscript does not contain details of where the MISR data was obtained. This is also the case for the MINX and HYSPLIT analysis packages and the input source for fire radiant pixels. Please add these details to the text.

There are multiple instances of non-SI values and notations. Knots is used instead of m/s. Kilometers is typed in long form as opposed to km. These need to be addressed. I have noted those I identified but the authors should conduct a full review of the paper.

Please consider the addition of a brief summary sentence or two at the end of each case study. These sentences should sum up the importance of each analysis, reaffirming the key points stated within.

Technical comments

P2L12 – Specify the spatial extent of 'near-source'

P3L2 – D cameras are at 70.5°

P3L9 – Add reference

P3L16 – Consider revising to '. . .one coincident instrument flies aboard the Terra

satellite. . .'

P3L17 – Add the time (∼1330 local time) of the Aqua overpass

P4L4 – Add Nelson et al., 2008 to the reference

P4L13-16 – Consider rewording this sentence. It initially suggests that red band is the only one used then mentions blue band retrievals as if it is an afterthought.

P5L10 – You state 'several factors' but you only mention one example please add additional examples or alter phrasing.

P5L16 – Add reference

P5L16 – Start a new paragraph with 'In this paper. . .'

P5L18 – Delete 'can'

P6L4-6 – Consider revising this into 2 separate sentences for clarity.

P6L6 – Consider/address that high optical thickness plumes can also be featureless and difficult to analyze with MINX.

P6L8 – Consider revising to 'The six selected case studies are: (1). . .'

P6L12 – There is no mention in this section of where the MISR data was obtained/is available from.

P6L13 – Please clarify '. . .source elevation and precise location for each event. . .'. Is this based on the retrieval output and selected initiation point from MINX retrievals? Or do this details come from the inclusion of locations based on MODIS fire pixel or something similar?

P6L9 – Please add details related to the fact that wind correction are made based on the user defined wind directions.

P6L20 – Consider revising '. . .Day 1 of each respective simulation.'

P7L16 – Define/explain where the 'fire heat flux' data is obtained.

P9L1 – With respect to use of 'maximum plume height', how far from the source is this obtained? Is there a distance limit for defining the maximum, particularly if uplift occurred downwind from source? Or is it just the maximum across the entire retrieval? If it is the latter, then the 'injection altitude' used may be skewed by uplift resulting from local meteorological dynamics as opposed to representing the source driven injection altitude.

P10L1 – Add reference

P10L9-14 – Consider putting this paragraph before P8L6, or somewhere toward the beginning of this section.

P11L9 – Consider revising 'In summary, this work evaluates the inclusion of observed MINX plume heights in the initialization of HYSPLIT models and their influence on the downwind dispersion of modeled plumes.' You may also consider including a sentence about the comparison of the output with MODIS observations here.

P11L14 – Consider revising 'For wildfires, model configurations. . .'

P13L2 – Line sources are indicated here. Please include details of the possible issues relating to line sources to the maximum level e.g. not accounting for bifurcation/multiple dispersion altitudes (driven by wind shear acting on the plume column) as plume rise occurred.

P13L19 – Consider revising '. . .that our model runs are set to. . .'

P14L9 – Why were comparisons not also made with Aqua, in addition to Terra, for each day of the analyses?

P14L16 – Please specify that the contour maps display horizontal extent with no elements of vertical distribution.

P15L5 – Does 'most mass' refer to per individual scene or the single highest value from

any retrieval? Please clarify.

P15L5-12 – This sections needs reworking. All of the qualitative bin titles need to be detailed and a general description of each in practical terms that the reader can understand should also be included. This could either be in long form, or as a table if that is more appropriate.

P16L5 – Consider revision '. . .uses a uniform scale for all cases. . .'

P16L13 – Consider revising '. . .slightly higher (2 or 3) or significantly higher (>4). . .'

P16L14-15 – Delete sentence 'To be. . .or higher'

P17L4 – Consider moving the statement '. . .it does not assess vertical plume structure. . .' and associated comments earlier in the section.

P18L2 – Please detail reasons why differences exist in dispersion dynamics between PBL and free troposphere e.g. turbulence driven friction generated by interaction of the atmosphere with the underlying terrain.

P18L14 – Consider revising '. . .heights were above the PBL. . .'

P18L21 – Consider revising ' value, acquired on Day 1, and differences develop in the simulations.' This entire containing sentence is a little long and could possibly be broken up further for clarity.

P19L12 – Consider redefining the titles of supplementary figures to prevent confusion with those figures included in the manuscript e.g. Fig. S1a

P20L4-8 – In this section you define the plume altitude differences but not the actual plume heights. This complicates the reader's ability to understand how these relate to the 'PBL level at 3.1 km'.

P20L10 – Define the 'significant differences' to which you are referring – e.g. spatial extent, dispersion direction, and longevity?

P20L12 – Convert knots to m/s

P21L8 – Consider revising '. . .lacks the capabilities of the ECMWF and GFS models.'

P21L10 – Consider revising 'The overall plume extent and dimensions are. . .'

P21L11-12 – This sentence, while pointing to the plots, does not state what the 'apparent differences' are.

P21L12-17 – This section needs reworking. There is confusion resulting from the inclusion of both MISR/nominal and NAM/GDAS within a single paragraph. I suggest the separation of the results here: the MISR/nominal section should be detailed first so comparisons can be made with the other case studies; then the NAM/GDAS comparison should be made after as a separate paragraph/sub-section of the case study for clarity.

P21L17 – Consider replacing 'So' with 'Consequently'

P21L18-20 – Consider revising '. . .processes influencing simulations, plume dispersion is similar, indicating overall results are relatively independent. . .' Also, you may need to reference that while this statement is true for this case it may not hold true for other events. This sort of generalization cannot be made based on a single observation or run.

P22L1 – Consider changing 'vertical wind speed' to 'significant differences in wind speed (and direction) with altitude'. The original version suggests uplift; I assume that you actually mean the effects of wind shear causes variations in the dispersion direction.

P22L19 – Convert knots to m/s

P22L20 – Convert knots to m/s

P23L1-7 – Consider moving this paragraph to the section introduction.

P23L4 – Is your reference to the minimal difference between VAAC and MINX heights specific to your study? In a general sense the differences between these values can be up to ∼4 km (Flower & Kahn, JVGR 2017) depending on the techniques utilized by the relevant VAAC. If the comment relate to your study only please specify that.

P23L11 – Convert knots to m/s

P23L11 – Please be more specific with respect to 'nearly the same direction'

P24L3 – Delete 'also'

P24L4 – Change kilometers to km

P24L4 – Consider revising '. . .sounding (Fig. 3e).'

P24L5 – Change kilometers to km

P24L7 – Consider revising '. . .simulations are minimal, detailed in a difference plot (Fig. 8c), and do not exceed "slight" variation showing good agreement.'

P24L17 – This volcano is actually in the Kuril island chain not on the Kamchatka Peninsular.

P24L19 – Change kilometers to km

P24L20 – Consider revising '. . .near the overpass time was ∼1.3 km. Therefore, both simulations were initiated in the free troposphere. However, significant differences were observed in vertical wind shear and meteorology between these altitudes.'

P25L1 – Delete 'also'. Convert knots to m/s

P25L2 – Change kilometers to km

P25L2 – Consider revising '. . .than at 4 km. The wind direction differs by *° with the higher altitude retrieval subjected to from a more ** dispersion direction.' Where * is the directional degree difference between the wind fields and ** is the qualitative (e.g. easterly) direction change

P25L3 – Consider revising 'Differences in wind speed suggest that the near source concentrations would be lower in the nominal. . .'

P25L5 – Consider revising 'A more easterly wind trajectory, for the nominal simulation would alter dispersion direction accordingly.'

P25L6 – Consider revising '. . .prediction. The plume shape. . .'

P25L7 – Consider revising ' When comparing the plume outlines in the visible imagery, the nominal. . .'

P25L7 – Consider rearranging the section to make a comparison to the observed data (MODIS) initially and then go on to state that the MISR run more accurately represents observed characteristics.

P25L9 – Rearrange the last sentence as a definitive conclusion to this case study. Possibly along the lines of 'These retrievals indicate that inaccuracies in initialization altitude can significantly hinder the accuracy of the corresponding model, even when both retrievals are in the free troposphere'

P25L17-19 – Consider revising ' However, when discrepancies exist between nominal and MISR injection altitude, significant differences in dispersion dynamics can occur. Differences are most significant when estimations cross the PBL/free troposphere boundary.

P25L19 – Delete 'Even. . .'

P26L1 – Consider revising '. . .the height. As wind shear can exist in the free troposphere, discrepancies subject the simulated. . .'

P26L2 – Consider revising '. . .conditions and cause divergence of retrievals. Bassed. . .'

P26L9 – Consider revising '. . .are available particularly where plume heights are inaccurately derived.'

P27L14-15 – Delete ‘But even with the qualitative results presented here,’

P27L16 – Consider revising ‘. . .results. We highlighted the importance. . .’

Figures

Figure 2 – Please increase the line weight of the plume outlines on the model output figures. They are currently difficult to discern.

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