

## ***Interactive comment on “A physics-based approach to oversample multi-satellite, multi-species observations to a common grid” by K. Sun et al.***

### **Anonymous Referee #1**

Received and published: 20 September 2018

This paper describes a novel method to oversample satellite data. Instead of representing satellite pixels as polygons with sharp edges, the pixels are represented as 2-D Gaussian functions in which data exists beyond the edges of the polygons. As documented in previous literature (de Graaf et al., 2016), this is appropriate due to the physics of the optical measurements. The manuscript is very well-written and only minor revisions are needed.

The only glaring hole in this manuscript is a discussion on the computational time needed to complete this new oversampling technique. It is discussed at some length in Section 4.2, but it is brief and unclear. Based on my understanding, the satellite

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data needs to be discretized to 0.05 km resolution? I would imagine this would be very computationally demanding. Can you provide more information on this? Can you provide some comparisons? For example in Figure 8, how long does it take for various oversampling techniques? Perhaps this should be discussed in Section 5.1.

Along the same lines, under the assumption that this technique is computationally intensive, it should be made clear in the abstract (and perhaps even title) that this technique is most useful for localized studies of air pollution and not for larger regions or global studies.

Other minor revisions and suggestions:

Page 2 Line 26: “help to beat down” is not appropriate. Suggest re-word

Page 2 Line 26: This sentence is a run-on. Suggest splitting into two sentences.

Page 3 Line 23: OMI nadir spatial resolution is typically referred to as 13 x 24 km<sup>2</sup>.

Page 3 Line 24: The sentence, “An alternative...” is unclear. Suggest re-word.

Page 6 Figure 2: This figure is a bit confusing. The second sentence in the figure caption is not necessary. Also, it would be good to provide the numbers of correct oversampled pixels (presumably 97 if I did the math correctly) and to provide all three numbers (correct, false positive, and false negative) as percentages directly on the plot and in the text.

Page 7 Line 1: The word “tessellation” should be in this section title

Page 10 Figure 4: What is the grid size of these plots? 0.05 km?

Page 12 Lines 5 -11: This section is unclear. Please re-word.

Page 13 Figure 6: It is unclear what Figures 6a and 6b are representing. What is “ground truth”? What is an “ideal OMI observation”? It’s not clear what these terms mean in the context of this manuscript. The figure caption and subsequent text referring

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to this figure should be clarified.

Page 18 Line 1: Are “all” southerly/northerly winds included? Or is there a threshold (e.g., only wind speeds > 1 m/s)? Please be explicit.

Page 18 Line 1: What is “PBL temperature”? Is it the average of the temperature from the surface to the top of the PBL? Or the temperature at the top of the PBL?

Page 18 Line 5: Mention NARR spatial resolution is 32 km.

Page 18 Line 13: Remove the words “conceptually simple”.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-253, 2018.