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Interactive comment on "Characterizing the Spatial and Temporal Availability of Very High Resolution Satellite Imagery for Monitoring Applications" *by* Myroslava Lesiv et al.

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Thank you for the review of this manuscript. Overall, we think you may have misunderstood the aim of the paper. We are not seeking to provide a full list of metadata such as that available from Landsat but a critical overview of the global availability of very high resolution (VHR) imagery in Google Earth and Microsoft Bing. The main advantage of VHR scenes is the level of spatial detail that one can detect in comparison to Landsat and Sentinel imagery. Because of this advantage, researchers can use VHR scenes to collect calibration and validation data through visual interpretation for use in remote sensing applications, and more recently, researchers have used VHR imagery for im-

plementing statistical surveys for monitoring land features. In particular, the data set shared in this paper can be used to develop sampling designs for different monitoring tasks.

On this basis, we disagree with your two key points as explained in more detail below.

(1) Earth sciences researchers, at least those that publish wide ranges of data in ESSD, use imagery from Google Earth rarely (see below) and from Microsoft Bing almost never. This manuscript, which counts availability of Google Earth and Microsoft Bing scenes at various terrestrial locations of our planet, has minimal utility and relevance for ESSD readers. Separate from irrelevance, it fails substantially in the quality of its presentation.

If this paper is really not of interest to readers of ESSD, then we find it intriguing that over a very short period of time, this paper has received more views, and in particular downloads, than many other papers submitted to ESSD. We are sure that the Editor has access to the full statistics and could easily exclude views and downloads that were recorded from Austria, where we are based, and the Editor could compare these numbers to other publications in ESSD. The Editor could also examine these stats prior to the posting of your review. We consider the number of downloads as a pretty fair indication of interest.

From a more scientific content point of view, we would argue that there is a growing interest in the use of VHR imagery from Google Earth and Microsoft Bing but little is known about what is currently available temporally and spatially. This is one of the first papers that has addressed this issue. We feel that the Reviewer may have misunderstood the idea of the paper, i.e. it is not to replace other open satellite data like Copernicus or Landsat but to understand where validation and calibration data are available to train algorithms, which can then be used to classify Landsat or Sentinel type data or for visual interpretation of VHR to produce a validation or statistical sample.

A very recent paper by Bastin et al. (2017) on calculating global statistics of dry forests

(published in Science - DOI: 10.1126/science.aam6527 with 60 citations already in Google Scholar) has used Google Earth and Microsoft Bing imagery to create an independent statistical assessment that would not have been possible without this freely available VHR imagery. Moreover, both of these sources of imagery have been used to collect validation and calibration data for the production of the majority of global land cover maps, e. g. Hansen's forest cover maps, ESA CCI LC 20m, Copernicus LC time series at 100m, DLR's Global Urban Footprint, etc. although the fact that these data have been collected through visual interpretation of Google Earth and Microsoft Bing imagery is not always stated explicitly.

One might argue that such a paper may be more appropriate for a Remote Sensing journal. However, in the paper we show that these data can be of value for different monitoring applications. ESSD is an interdisciplinary journal that covers different research topics, and this paper covers a number of application areas including geosciences, agronomy, biodiversity, etc. Hence we feel the paper is of broader interest to researchers beyond remote sensing alone.

If we understood it correctly, the reasons why the Reviewer considers that the presentation of the paper is not comprehensive are given in the direct comments to the paper. These comments are addressable/manageable (see attachment) and we will take these comments into account during the manuscript revision.

(2) If VHR scenes become more available and more useful, readers will need a much more organized, systematic and compelling guide than the one provided here. At best, it seems pre-mature and not up to the quality expected for ESSD.

We will address this comment based on three aspects: availability; usefulness; and quality of the analysis.

Availability: This review paper shows that at least 64% and 70% of global land covered by VHR is available for visual interpretation in Google Earth and Microsoft Bing, respectively. Moreover we show where these scenes are available and what the dates

are. However, the Reviewer seems to see only the data gaps and focuses only on the limitations, some of which we actually discuss in the paper. We want to raise the point that exactly in those 70% of Earth's land surfaces, researchers can benefit considerably from VHR, which is available (for free) in Google Earth and Microsoft Bing. We agree that only having visual information available and not the full spectral bands is indeed limiting yet we would argue that many landscape-related and environmental monitoring applications can be undertaken using this visual information. Moreover, we observed that the main data gaps are in the northern latitudes and in areas with high precipitation where all optical sensors suffer from a lack of data, including Sentinel-2 and Landsat. We also show that there are places where there are three images available after the year 2010, which is particularly important for studies on change detection. Note that Sentinel-2 imagery is only available from 2015 onwards.

Usefulness: The main advantage of the VHR imagery reviewed in this paper is that users can visually detect much more detail about land cover than is visible from Sentinel and Landsat data; please see Figure 1 for an example that illustrates this point clearly. For example, individual trees, shrub shelterbelts, field boundaries, etc., are clearly visible from VHR imagery. This ability to distinguish these features is what makes the images extremely useful for a range of applications, e.g. such as those provided in the manuscript. We agree that there are certain limitations to the analysis, e.g. open and straightforward access to the dates in Google Earth is no longer possible with the closure of the Google Earth API, there are issues related to the positional accuracy of VHR scenes, the resolution changes when going back into the past, etc. However, from our perspective and for the range of applications discussed in the paper, the most important information is whether VHR imagery is present or not and if so, for which season, how many scenes, how frequent they are, how far they go back into the past, etc. This is the type of information that is made available through this review paper. Other data such as the viewing angle is currently not available but is less important since objects, e.g. the presence or absence of trees, can be visually detected. Viewing angle is also less important if the georeferencing has been done well. Again, in

the discussion, the Reviewer focuses only on missing information, which is not always important for the data purposes that we discuss in the paper.

Quality of the analysis: For the analysis, we used a data set that consisted of circa 15 K points using a systematic sample with 1 degree spacing. This is a sufficient number of samples to provide a global snapshot of VHR availability for readers. We acknowledge that this is not a large enough sample for doing very detailed analysis of small area objects, e.g. protected areas at the national level. However, this exploratory exercise will guide readers/users in a making a decision regarding whether to use VHR imagery in their work for a specific area of interest, and also in developing a sampling design. Or they could simply use this paper as an example and then interrogate the Bing API to create a more detailed grid of dates as a first pass. There are also ways to interrogate Google Earth, which could be implemented to extract the information needed at a finer resolution. If sufficient VHR imagery were found to be available, this could then become the subject of a separate paper, e.g. monitoring protected areas in the US. Users would still need to do more detailed studies but they could use tools such as Collect Earth, LACO-Wiki or create their own bespoke application.

We believe that if there were more users of VHR imagery and consequently more published research articles that use the imagery available in Google Earth and Microsoft Bing, then a new API for accessing the dates of imagery in Google Earth as well as other meta-information about the satellite imagery should be provided to researchers. This paper aims to draw attention to this gap while raising awareness of what VHR imagery is currently available and how it might be used.

Only with time will we be able to evaluate the impact of this review paper but we disagree that such a paper should not be considered for publication. This paper opens up an area of research that is clearly of interest to many but is still currently under scientific investigation.

Please also note the supplement to this comment:

https://www.earth-syst-sci-data-discuss.net/essd-2018-13/essd-2018-13-AC1-supplement.pdf

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Fig. 1. Illustration of the level of detail that users can detect. Figure on the left: a VHR image from Google Maps. Figure on the right: a Sentinel-2 image (natural colors) at 10 m resolution.