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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Cloud height measurement by a network of all-sky-imagers" *by* Niklas Benedikt Blum et al.

**Anonymous Referee #2**

Received and published: 19 January 2021

The Authors present and evaluate an approach to derive cloud-base height (CBH) from a network of seven upward looking all-sky imagers (ASIs). The analysis focusses on a region in NW Germany during summer and shoulder seasons. The authors demonstrate that a network approach outperforms individual pairs of ASIs.

The manuscript is generally well-written, and the figures complement the main text appropriately. I recommend publication of this article after resolving several general and few minor comments.

General Comments

The Authors motivate their work as it allows to better nowcast downwelling solar fluxes (e.g., for photovoltaic power plants) and it is said that "accurate knowledge of CBH is



required". It is not perfectly obvious why better knowledge of CBH itself improves nowcasting. I'm assuming CBH is only one piece of information - apart from knowledge of each cloud's horizontal extend, cloud-top height, and geolocation (derived from satellite?) as well as the wind vector in cloudy altitudes (from meteorological forecasts or from ASIs?). Section 1 (ll. 26-32, ll. 48-53) touches on this topic but leaves open questions of how exactly this work fits into a larger picture. It is also unclear to me if voxel carving (ll. 58-59) is a competing approach or if this work could be used for voxel carving efforts – the Authors should clarify this in Section 1.

When using a network of ASIs over an area of (100km)2 to obtain a single CBH, do the Authors inherently assume a cloud (or a field of clouds) of unique base height? The Authors should make this more explicit (perhaps in Section 3) and discuss the realism of this assumption (perhaps in Section 4.4).

To obtain CBH probabilities (Section 3.3) the Authors use a subset of available data points. It is unclear what portion of the data was excluded. Did this selection mostly affect samples of high-altitude clouds? Perhaps the Authors could add a column to Table 1 that lists the fraction of data points excluded per altitude group?

The Authors measure accuracy of their approach by using a three-month dataset, shown in Fig. 9 and elaborated in Section 4.3. From a machine-learning standpoint is would be important to know if these were "training samples" (i.e., used to prepare CBH probabilities, etc.) or whether these data points were withheld from algorithm preparation.

The Authors introduce the Maximum Likelihood Estimation (MLE) approach in Section 3.4 and – before in Section 3.3 – provide information on conditional CBH probability. This arrangement seems confusing to me and recommend that Section 3.3 follows 3.4 (or is a subsection of 3.4).

Section 3.3 lists a variety of filters that were applied (ll. 240ff). The Authors should revise Section 3.3 and reference the use of these filters - if applied in the past – and

explain their intended effect.

The Authors list high temporal and spatial resolutions (“30 s or 5 m”, l. 6) of state-of-the-art nowcasts. It is not obvious if chosen CBH intervals (“100m”, l. 231) are fine enough to provide such high resolution. Perhaps the Authors could expand on this in Section 3.3 or in their discussion to address this question.

To help the reader appreciate the scientific advance in the work, the Authors should stress wherever (in Section 3.3 or 3.4) new techniques were developed or combined.

Minor Comments

Fig. 2: The plot seems to contain redundant information (by switching perspectives between two ASIs). The Authors could color code each perspective or exclude one redundant half.

ll. 140-144: Please provide the minimum optical thickness for ceilometer detection.

ll. 145-151: Is there a maximum solar zenith angle that limits CBH retrieval?

ll. 171-173: Please substitute “most dominant in features, driven by area and optical thickness” instead of “most dominant in the sense of area and optical thickness”.

ll. 193-195: Please link to reference or plot(s) or else put “not shown”.

Equ. 1: What is “j”?

Fig. 8: Please provide performance metrics (e.g., correlation coefficient, bias, and RMSD) to each panel.

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