



PLANET'S USABLE DATA MASK

UDM 2.1 CLOUD MASK • PlanetScope • Shropshire, England • November 3, 2023

OVERVIEW

For users of earth observation data, clouds and other atmospheric interference can be quite the nuisance to have to deal with. They get in the way of the real observations happening on the ground and can result in faulty analyses and unnecessary compute/storage costs resulting from working with unusable data.

Over the years, Planet has developed a few Usable Data Masks (UDM) to help our users distinguish imagery that's suitable for use from imagery that will not meet their needs. Our latest version, UDM2.1, is designed to classify each pixel in an image as Clear, Cloud, Haze, Cloud Shadow or Snow. Every published PlanetScope or SkySat image has a corresponding UDM formatted as an 8-band GeoTIFF where each band maps to a different class, plus 2 additional bands providing additional information:

BAND	CLASS	PIXEL VALUE RANGE	DESCRIPTION
1	Clear	0,1	Regions of a scene that are free of cloud, haze, cloud shadow and/or snow
2	Cloud	0,1	Regions of a scene that contain thick clouds. You cannot see ground objects through clouds
3	Cloud Shadow	0,1	Shadows caused by clouds or haze and not by mountains, buildings, or other terrain features
4	Light Haze	0,1	Regions of a scene with thin, filamentous clouds, soot, dust, and smoke. You can see ground objects through haze
5	Heavy Haze	0,1	UDM2.1 does not support a heavy haze class, but this class name persists to support functional backwards compatibility. Pixels will never be classified as Heavy Haze with UDM2.1.
6	Snow	0,1	Regions of a scene that are covered with snow or ice
7	Confidence	0-100	This is an indication of how confident the model that powers UDM2.1 is that a given pixel's classification is correct
8	Unusable Pixels	-	Equivalent to the UDM asset. For the PlanetScope 8th Band, the bits are as follows. Bit 0: Black fill, Bit 1: Likely cloud, Bit 2: Blue (Band 2) is anomalous, Bit 3: Green (Band 4) is anomalous, Bit 4: Red (Band 6) is anomalous, Bit 5: Red Edge (Band 7) is anomalous, Bit 6: NIR (Band 8) is anomalous, Bit 7: Coastal Aerosol (Band 1) and/or Green-I (Band 3) and/or Yellow (Band 5) is anomalous. See Planet's Imagery Specification for complete details.

A Note on our Confidence Band

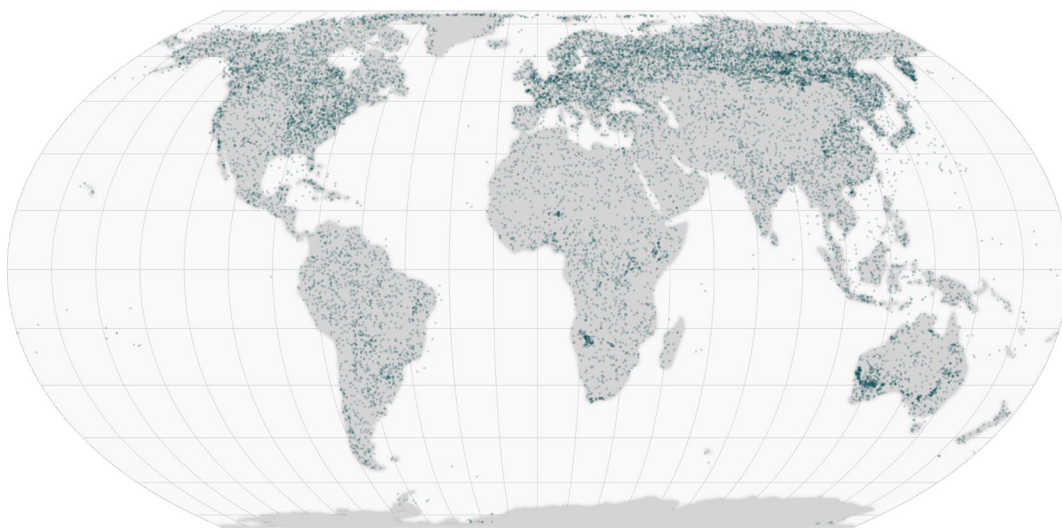
Every pixel classification has a score associated with it indicating how convinced the supervised segmentation model is that the pixel classification is correct. This can be used to help users define their own thresholds as to whether to accept a given pixel's classification or not - for example, a user that wants to make absolutely sure that a pixel is clear before analyzing it could set a high confidence threshold for pixels classified as Clear.

However, there will be times where the model is unequivocally convinced that a pixel is Clear, when in fact it is cloudy. In these cases, we need additional training data to teach the model that in these situations, it needs to adjust its classification. We encourage customers to report any issues they see to their CSM so we can continue improving the product.

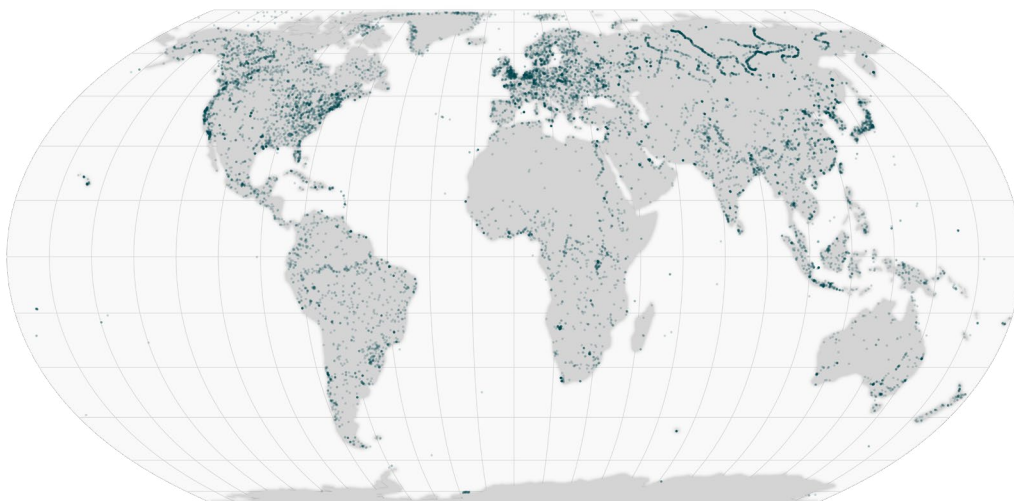
METHODOLOGY

UDM2.1 is powered by a modified UNET, a deep learning supervised segmentation model, that runs on 4-band (RGBNir) top-of-atmosphere radiance assets. This means tens of thousands of PlanetScope and SkySat images were hand-labeled to mark each pixel into one of the 5 classes noted above. The model was then trained using this labeled dataset so that it can classify new imagery into those same 5 classes.

Training Dataset Details

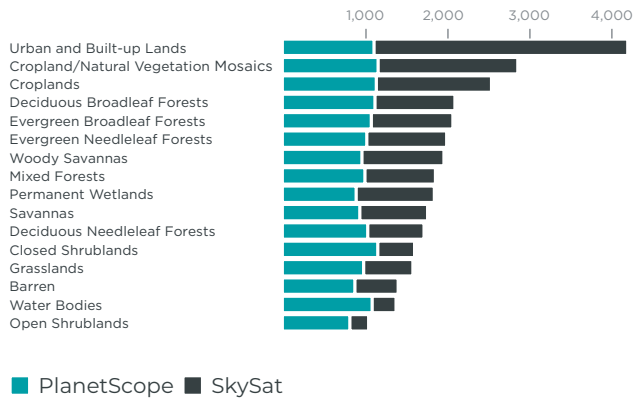


Geographic Distribution of PlanetScope Training Data

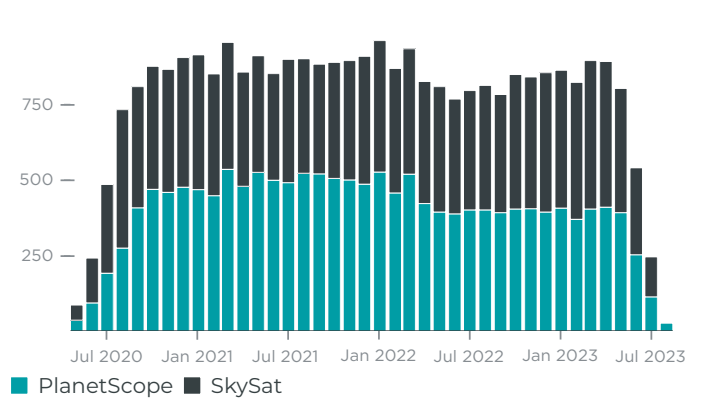


Geographic Distribution of SkySat Training Data

Capture by Land Use



Capture by Month and Constellation



PERFORMANCE

Supervised segmentation models are typically evaluated by comparing a model’s output to “ground truth” data and generating precision, recall and f1 metrics per class. For UDM2.1, we evaluated the model’s performance by evaluating each model on a hand-labeled geographically and temporally distributed ground truth dataset. Based on this analysis, we observed the following F1, Precision and Recall metrics:



PlanetScope

Class	F1	Precision	Recall
CLEAR	0.909	0.871	0.951
CLOUD	0.945	0.929	0.961
CLOUD SHADOW	0.583	0.579	0.588
LIGHT HAZE	0.592	0.563	0.623
HEAVY HAZE	n/a	n/a	n/a
SNOW	0.770	0.777	0.763



SkySat

Class	F1	Precision	Recall
CLEAR	0.848	0.816	0.883
CLOUD	0.924	0.905	0.944
CLOUD SHADOW	0.442	0.391	0.508
LIGHT HAZE	0.619	0.581	0.662
HEAVY HAZE	n/a	n/a	n/a
SNOW	0.803	0.780	0.87

Note: Planet publishes imagery all over the world and while we’ve done our best to ensure the highest quality we can, there may be anomalous behavior from time to time. If you observe poor quality, please report it to your CSM so we can address these issues with quarterly iterations of the model.

LET’S TALK

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