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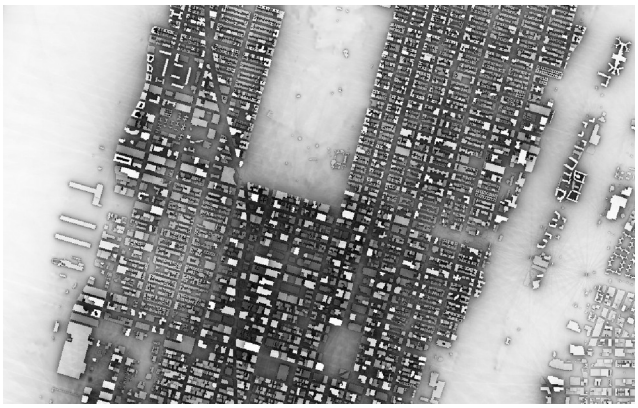
Gridded 12-direction sky view factor for the contiguous United States, 5-meter resolution with 30-meter ground-level aggregates

This dataset is available at https://doi.org/10.7910/DVN/EDLPED.



Overview

This dataset contains computed sky view factor values on a 5-meter grid, with 30-meter ground-level aggregates. The 30-meter product is aligned to the Landsat ARD grid (further details in the Dataset contents section below).

The sky view factor is the proportion of sky above the zero-degree horizon line that is visible from a point on the ground. This can be used for a variety of purposes, such as for exposure models, visualizations, or psychological studies. In this data set it is expressed as a percentage that ranges from 0 to 100, where 100 is complete and unobstructed view of the sky.

Digital elevation model

Prior to the calculation of sky view factors, we first created a 5-meter digital elevation model incorporating both building heights and ground elevation. We first rasterized all buildings within the contiguous U.S. from an Overture Maps[1] platform dump retrieved on July 16, 2025 to create a 5-meter digital elevation model for buildings. All buildings with missing height information were assigned a height of 3 meters. We then resampled the USGS 1-arc-second 3DEP product[2] to the same grid using a cubic resampling method

1 Overture Maps Foundation. (2025). Overture Maps Buildings [Data set]. Overture Maps. https://overturemaps.org

2 United States Geological Survey. (2024). 1 Arc-second Digital Elevation Models (DEMs) - USGS National Map 3DEP Downloadable Data Collection [Data set]. USGS Science Data Catalog. https://data.usgs.gov/datacatalog/data/USGS:35f9c4d4-b113-4c8d-8691-47c428c29a5b

to create a 5-meter digital elevation for the ground. The heights from these two models were added to create the final digital elevation model combining both buildings and ground.

Sky view factor

For each grid cell, we first computed the horizon angle using the *r.horizon* GRASS GIS module[3], parameterized with a 1-kilometer maximum search distance and repeated every 30 degrees from North (12 different search directions in total). To conserve memory and increase parallelization, this was done separately for each Landsat tile in parallel (150-kilometer square regions), with each tile being buffered by 1-kilometer to accommodate the 1-km search distance beyond each tile's limits. These were then cropped to the original tile extents.

Sky view factors were then computed for each pixel using the following algorithm:

$$SVF = 1 - \frac{\sum_{i}^{n} \sin(\gamma_i)}{n}$$

where i refers to each direction, n is the total number of directions, and γ are the horizon angles calculated previously[4].

30-meter ground-level aggregates

To create the 30-meter ground-level aggregates, we first used the building footprints to mask all pixels that represented buildings in order to isolate ground-level grid cells. We then downsampled these grid cells to a 30-meter resolution matching the Landsat ARD grid by averaging the values of 5-meter ground-level grid cells within each 30-meter grid cell.

This process results in missing values for 30-meter grid cells that are entirely covered by building footprints. For these grid cells, we computed the focal average of all immediately neighboring grid cells (i.e. those with a Chebyshev distance of 1) with non-missing values. This process was repeated until all grid cells with missing values within 1 kilometer of grid cells with non-missing values (by Chebyshev distance) were imputed.

Dataset contents

This dataset contains several folders of GeoTIFFs:

- *5m*: This folder contains computed sky view factors on the original 5-meter grid. The GeoTIFFs in this folder include sky view factors as computed from the tops of buildings.

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3 Huld, T., Cebecauer, T., Hofierka, J., & Suri, M. (2007). GRASS GIS: r.horizon module [Computer software]. GRASS GIS. https://grass.osgeo.org/grass-stable/manuals/r.horizon.html

4 Zakšek, K., Oštir, K., & Kokalj, Ž. (2011). Sky-View Factor as a Relief Visualization Technique. Remote Sensing, 3(2), 398–415. https://doi.org/10.3390/rs3020398

- *5m-footprints*: This folder contains dichotomous GeoTIFFs describing whether or not a grid cell represented a building (1) or the ground (0).
- *30m-ground-level-filled*: This folder contains ground-level sky view factors on a 30-meter grid aggregated from the 5-meter product.

GeoTIFFs are labeled according to the Landsat ARD tile grid. The USGS website has some helpful links to help you determine which tiles are relevant for your study if you are not analyzing the entire area:

- Map image: https://www.usgs.gov/media/images/conterminous-us-landsat-analysis-ready-data-ard-tiles
- Shapefile: https://www.usgs.gov/media/files/landsat-collection-2-us-ard-tile-grid-shapefile-conus

Limitations

Due to the 1-kilometer search distance, this data set is better suited for urban and suburban environments where the primary structures are buildings, infrastructure, or relatively small or manmade earth forms such as hills and quarries. This data set will not adequately capture far-away or large geologic features such as mountains or shallow valleys.

Additionally, this data set does not include trees which also partially block view of the sky. If tree cover is desired, we recommend merging in the NLCD Tree Canopy Cover product which is also aligned to the Landsat ARD 30-meter grid: https://www.mrlc.gov/data/type/nlcd-tree-canopy-cover

Bulk downloads

To download in bulk, use the page and links generated by the Dataverse API directory index:

> https://dataverse.harvard.edu/api/datasets/:persistentId/dirindex?persistentId=doi:10.7910/DVN/EDLPED

For example, using wGet:

> *wget --recursive --execute robots=off --no-host-directories --span-hosts --content-disposition 'https://dataverse.harvard.edu/api/datasets/:persistentId/dirindex?persistentId=doi:10.7910/DVN/EDLPED'*