The data consortium consists of Denver Regional Council of Governments members and regional partners with an interest in geospatial data and collaboration. The data consortium newsletter improves communication among local geographic information systems professionals and features updates from all levels of government as they relate to data and geospatial initiatives in our region. This newsletter is published quarterly.

Using lidar to create shade maps

Article submitted by Bob Taylor and Austin Troy from the University of Colorado Denver. Austin can be reached at austin.troy@ucdenver.edu.

In the near-term, climate change is expected to make heat waves more intense and frequent. These impacts will be severely felt in cities, where temperature extremes are amplified by the presence of large amounts of heat-trapping impervious surfaces. Consequently, urban extreme heat has been recognized as a looming public health crisis. Trees are among the most effective tools for mitigating urban heat for two reasons: they provide shade, which reduces direct solar exposure; and they cool the air by exchanging heat when they release water vapor through evaporation and transpiration. Artificial shade structures, including buildings, also mitigate heat through shade, but this is partially counteracted by the fact that their hard surfaces also absorb and re-radiate heat. Studies have found that shade can significantly reduce ambient temperature and human thermal comfort. This effect is even more pronounced in arid and semi-arid locations like Denver, where low humidity results in a noticeable improvement in thermal comfort when people move from sun to shade.

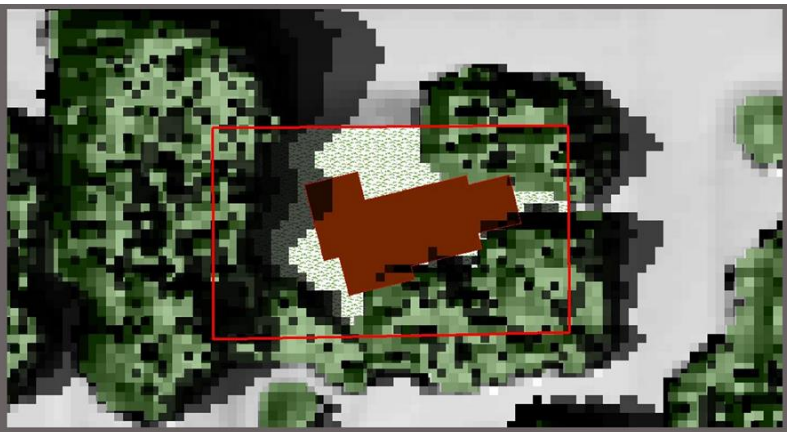
Understanding which locations have adequate or inadequate shade and tree cover, then, is an important planning issue, one that requires spatial data and technologies to operationalize. While we have accurate depictions of where buildings and trees are, precisely mapping shady locations is far more difficult. This is because shade cast at a particular location depends on the physical dimensions of the objects casting the shade, the position of the object relative to the sun at any given time of day, and the change in the diurnal shade pattern over the course of the year as the solar angle changes.

Thankfully, the data and technology exist to do just this. Light detection and ranging data, just collected in 2020 for DRCOG's entire service region, is the basis for this analysis. Lidar is created by sensors mounted on aerial platforms that take laser altimetry readings of the terrain below. Taking the form of millions of points, each with geographic coordinates and a height value, Lidar data can be used to generate three-dimensional models of both the bare ground and of the objects over the ground, including buildings and trees. Trees can be easily distinguished from other "above-ground" objects because, unlike buildings, laser beams can penetrate trees and so a tree will register height values or "returns" at multiple vertical locations throughout a tree.

Once 3D representations are built of aboveground objects, geographic information system software can be used to model the shade these objects would cast at any given time of day and year. That shade is represented as pixels on the two-dimensional ground surface (it can also be modeled on the vertical surface of three-dimensional objects, such as the façade of a house, but doing so is much more complicated). Those shade pixels can be overlaid with thematic features, such as sidewalks or building footprints. In this way, we can measure how shade strikes individual features with great precision.

Our team of researchers at the University of Colorado Denver, College of Architecture and Planning, succeeded in using an earlier generation of the Denver regional lidar data set to map out shade, categorized by whether it was generated by trees or buildings, for all of Denver. We also created a similar map for the city of Baltimore. For each pixel in the resulting maps, one meter in resolution, we generated an aggregate measure that summarizes the average number of shade hours across the hottest seven hours of the statistically hottest day of the year in mid-July. We were then able to overlay the shade maps with building footprints, allowing us to calculate which homes receive shade and for how long during the day. Such information could be extremely valuable in targeting where to plant more trees or where energy efficiency or cooling assistance measures might be needed. It could also be useful in determining suitability for rooftop solar, among many other applications.

Currently, as we prepare to process DRCOG's newly released lidar data set, follow-up analyses are about to begin that illustrate the wide range of applications of lidar-based shade analysis. This includes a plan to study which Regional Transportation District transit stops are shaded or not and at what times of day, a significant issue for thousands of people who rely on transit and often have to face exposure to high temperatures in the summer months. Understanding where the high-exposure transit stops are could help strategically prioritize investments in more trees and shade structures. Beyond that, many more potential applications will be explored, from looking at the shading of pedestrian routes and sidewalks to parks and public gathering spaces.



3 PM Shade Area

High-frequency transit service data brief

Article submitted by Geoffrey Chiapella, Senior Planner at DRCOG. Geoffrey can be reached at 303-480-5644 or gchiapella@drcog.org.

DRCOG recently published a data brief on the COVID-19 pandemic's impact on high-frequency transit service in the metro Denver region in 2020 and the number of housing units proximate to this high-quality transit service. DRCOG's Metro Vision plan identifies high-frequency transit stops as those with 96 or more departures on a typical weekday, or an average of one bus every 15 minutes or less. High-frequency service tends to result in improved ridership because it reduces wait time, makes connections between lines faster and supports reliable service. For purposes of proximity analysis, this data brief defines a "nearby catchment area" as a quarter-mile distance from a transit stop.

Some of the key findings from this data brief include:

- In 2014, the Denver region had 835 transit stops with high-frequency service, serving a nearby catchment area of 134,800 housing units.
- Service cutbacks in 2020 due to the COVID-19 pandemic reduced the number of transit stops with high-frequency service to below 300 (a 65% reduction), serving a nearby catchment area that includes just 78,900 housing units. This represents a 41% reduction in the number of housing units in the quarter-mile catchment from 2019 to 2020.
- Service levels rebounded in 2021, resulting in 550 stops with high-frequency service in 2021. This led to a 50% increase in the number of housing units proximate to high-frequency transit services compared to 2020.

Staff accessed data from the General Transit Feed Specification for RTD transit service for years 2014 to 2021, as well as data from DRCOG's Master Housing dataset for years 2014 to 2020. Housing unit information for 2021 was not yet available for this analysis, so 2020 housing unit figures were used along with 2021 transit service levels.

DRCOG launches regional shared micromobility data dashboard

Article submitted by Emily Lindsey, AICP, transportation technology strategist at DRCOG. Emily can be reached at 303-480-5628 or elindsey@drcog.org.

DRCOG, in partnership with local governments, Colorado Department of Transportation, operators of shared micromobility services and Ride Report, recently launched a regional shared micromobility data portal that summarizes information about shared micromobility trips and usage throughout the Denver area.

In an effort to help local agencies support transparency and data sharing about their programs, city-specific open data portals were also part of this project. These open data portals show information about shared micromobility programs across the Denver region. Check out the local Shared Micromobility Open Data Portals here:

- City of Arvada.
- City of Aurora.
- City of Boulder.
- City and County of Denver.
- City of Littleton.

For more information about shared micromobility in the Denver region, check out our Shared Micromobility page here. Want to get involved in DRCOG's Micromobility Work Group (which meets quarterly)? Reach out to Emily Lindsey at elindsey@drcog.org.

DRCOG data acquisition updates

Article submitted by Ashley Summers, GISP, PMP, information systems manager and Josh Pendleton, GIS Specialist at DRCOG. Ashley can be reached at 303-480-6746 or asummers@drcog.org. Josh can be reached at 720-480-6780 or jpendleton@drcog.org.

Denver Regional Aerial Photography Project 2022

Contracts are in place with Sanborn and Nearmap to provide imagery to DRCOG's project partners in 2022 and 2023.

Sanborn is flying custom imagery of our 6,000 square mile region. Flights to collect the front range are complete. Flights to collect the mountainous area will occur in July. Imagery will be delivered to partners in the first quarter of 2023 and will be in the public domain in early 2025.

Nearmap is offering a subscription to DRCOG partners in the metro area that includes access to four imagery captures over the next two years. This data is for internal use only.

If you are not a project partner and would like to be, reach out to me at asummers@drcog.org. Read more about our imagery projects on our website.

Regional Lidar Project 2020

DRCOG received a grant from the U.S. Geological Survey in December 2019 to collect quality level two lidar in 5,000 square miles of the region and derive contours in most of the metro area. Flights to collect the data were completed between May 26, 2020, and Sept. 7, 2020, and quality control performed by USGS was completed in December of 2021.

Point clouds and bare-earth digital elevation models are available to download from DRCOG's Regional Data Catalog by tile. Data is available for areas in both State Plane Colorado North and Central projections. Data from the two projection areas overlap, but also include data exclusive to each individual projection. The North and Central areas are also divided into areas covered by Quality Level One and Level Two data. You can also download the index by going to "Get Data/Shapefile" and the metadata by going to "Get Data/Supplemental Information."

- https://data.drcog.org/dataset/2020-ql1-lidar-index-in-co-sp-central
- https://data.drcog.org/dataset/2020-ql1-lidar-index-in-co-sp-north
- https://data.drcog.org/dataset/2020-ql2-lidar-index-in-co-sp-central
- https://data.drcog.org/dataset/2020-ql2-lidar-index-in-co-sp-north

Lidar can also be downloaded from the National Map and the Colorado Water Conservation Board.

If you would like a hard drive to be filled with the entire dataset, you can send an empty one to the Governor's Office of Information Technology. For requests small enough to be transferred another way, please use this form or this email.

Elevation contours developed from the 2020 lidar data are now available for download. Contours at one-foot intervals are currently available for the metro area. Contours at one-foot intervals are available for the metro area. They are also available in the western and mountain areas, as a mixture of one and two-foot intervals. From the preview window on the Regional Data Catalog page, you can zoom to and click on an individual area to get a download in geodatabase feature class format. The 2013 contours are also available in shapefile format, downloadable in the same fashion from their Regional Data Catalog page. Visit the Regional Data Catalog here to see a list of the contours data.

For more information, visit our website and read a project summary.

Do you have an interesting use case for lidar data? Tell us about it by emailing me at asummers@drcog.org.

Planimetric Data Project 2020 & 2022

Planimetric data derived from DRCOG's biennial Aerial Photography collection has been released to the public (from 2014, 2016, 2018 and now 2020). The full package of Regional Planimetric datasets include nine different layers: building roofprints, paved driveways, edge of pavement line features, edge of pavement polygon features, paved parking lots, sidewalk centerlines, sidewalk polygons, sidewalk ramps and trails. By downloading the extent shapefile from the Planimetrics Extent 2020 Regional Data Catalog page, you can see the coverage areas for the datasets. By visiting each individual dataset's Regional Data Catalog page, you can download the data in various formats and see more detailed descriptions. You can also zoom in on each Regional Data Catalog page's preview window to simply view the data. Download the latest data and read a project summary.

Planning for the 2022 project is underway. If you are not a project partner and would like to be, reach out to me at asummers@drcog.org.

Regional Land Cover Project 2020

Land cover data derived from 2020 DRCOG Aerial Photography project is now available for the entire region. All features on the ground were given one of nine classifications: structures, impervious surface, water, grassland/prairie, tree canopy, irrigated lands/turf, barren rock, cropland and scrubland/shrubland. A smaller pilot area was completed in 2018 and that data is now available. The data is available for both years in raster and vector format. From the preview window on each Regional Data Catalog page, you can click on the extent to get a download of the data. The 2018 vector data is broken up into smaller parts. Download data from the Regional Data Catalog.

Engage with us

- This quarterly newsletter reaches more than 400 people, has a higher-than-average open rate, and is written by professionals like you. It is the perfect place to show off your projects, highlight your work and contribute ideas to the GIS community in the Denver region. Newsletter release dates are the 15th of January, April, July and October (or the next business day). Please contact Ashley Summers at 303-480-6746 or asummers@drcog.org to contribute.

- Did you miss a newsletter or a meeting? Visit our website for past newsletter issues and Data Consortium meeting materials.

Denver Regional Council of Governments
1001 17th St., Suite 700, Denver, CO 80202