OPEN EARTH MONITOR

Accessing Big Vector Data on the Cloud using Arrow Parquet

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APACHE ARROW

Parquet

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Outline

1. The data
2. Apache Arrow & Parquet
3. Cloud Setup
4. Notebook examples

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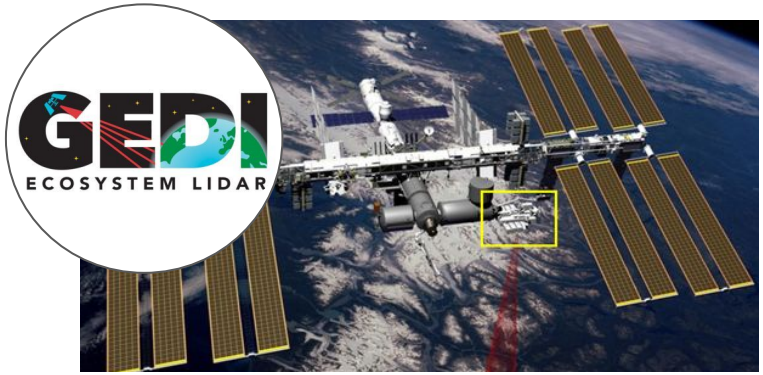
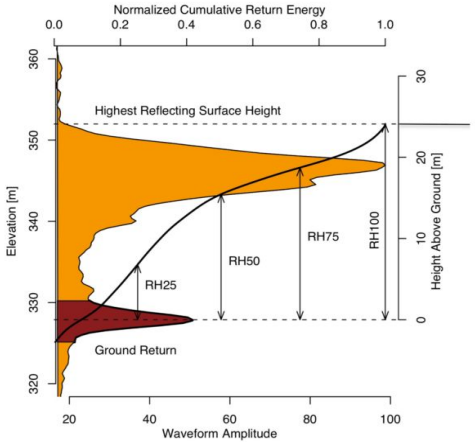
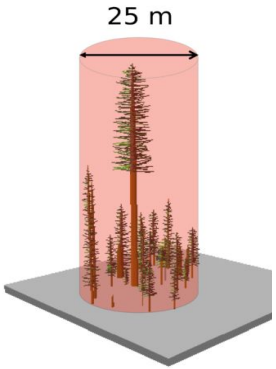
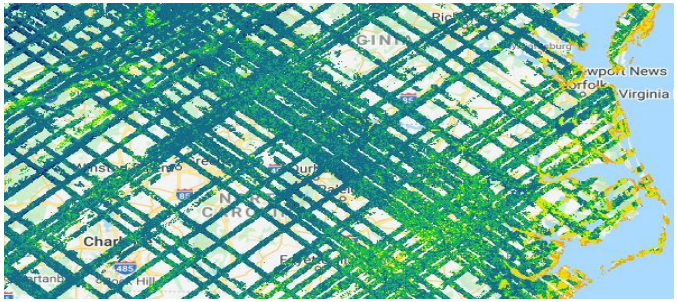


- Full-waveform LiDAR system
- Data since 2019
- N ~ 5.4 billion points
- Level 2A+B data, 94 variables
- Point geometries (lon/lat)





Sampling pattern



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In this example of a Version 2 Level 01B product, the filename **GEDI01_B_2019110110221_O01997_03_T03335_02_005_01_V002.h5** indicates:

- **GEDI01_B** = Product Short Name
- **2019110** = Julian Date of Acquisition in YYYYDDD
- **110221** = Hours, Minutes, and Seconds of Acquisit
- **O01997** = O = Orbit, 01997 = Orbit Number
- **03** = Sub-Orbit Granule Number
- **T03335** = T = Track, 033335 = Track Number
- **02** = Positioning and Pointing Determination Syster
- **005** = PGEVersion = SDPS Release Number
- **01** = Granule Production Version
- **V002** = Version Number
- **.h5** = Data Format

GEDI ECOSYSTEM LIDAR

NASA

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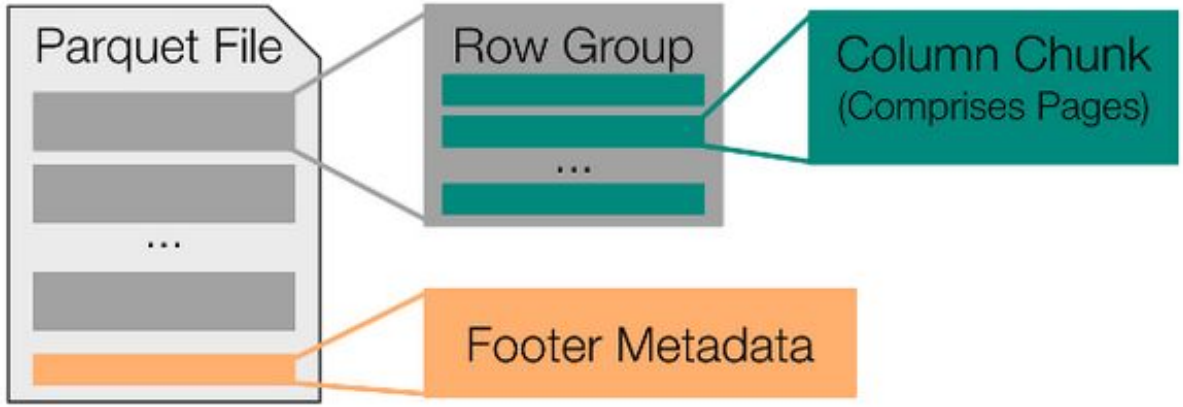


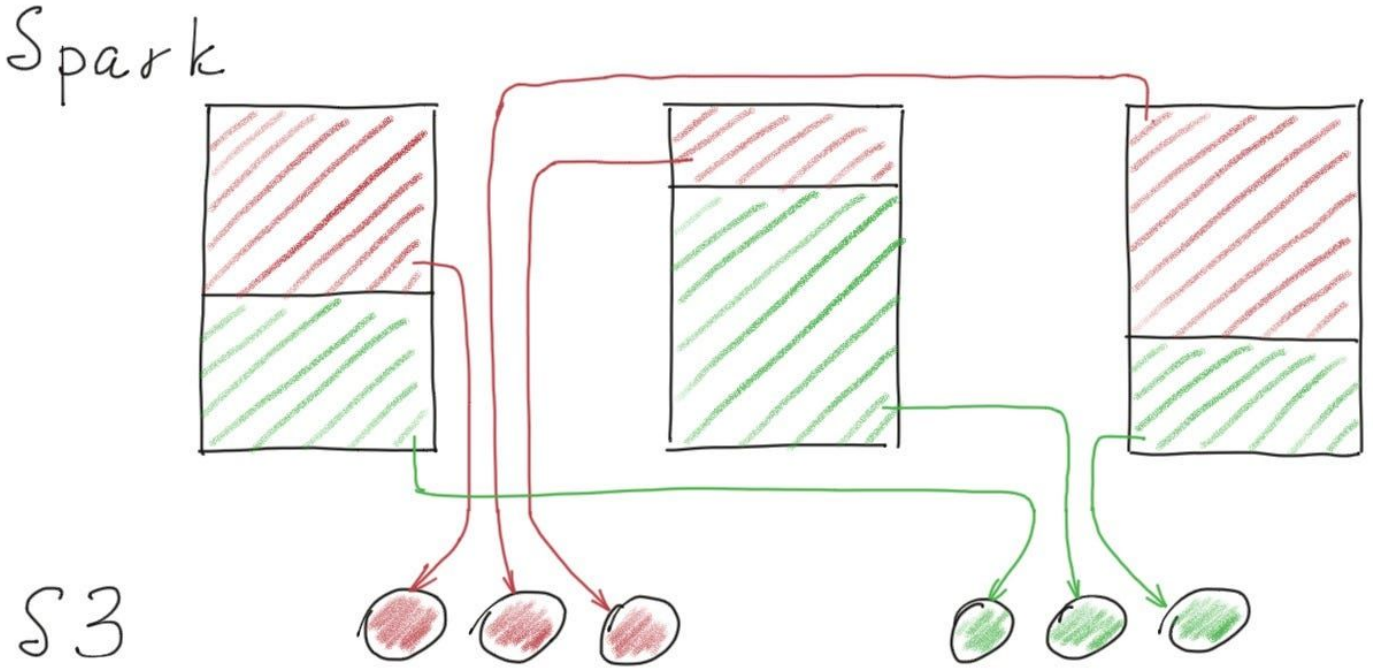
Figure 1. High-level visual representation of the Parquet file format

Dataset
|--- Partition
  |--- File
    |--- Row group
      |--- Column chunk
        |--- Page

```
httpfs = S3FileSystem(
      endpoint_url='https://s3.eu-central-1.wasabisys.com',
      anon=True
   )
pq_dataset = pq.ParquetDataset(
    path_or_paths='gedi-ard/level2/l2v002.gedi_20190418_20230316_go_epsg.4326_v20240622',
    filesystem=httpfs)
CPU times: user 634 ms, sys: 0 ns, total: 634 ms
Wall time: 1.35 s
```

Source:
(1) Optimizing Access to Parquet Data with fsspec

Accessing Big Vector Data on the Cloud using Arrow Parquet



Source:
[Spark partitioning: the fine print, Vladimir Prus, 2021]

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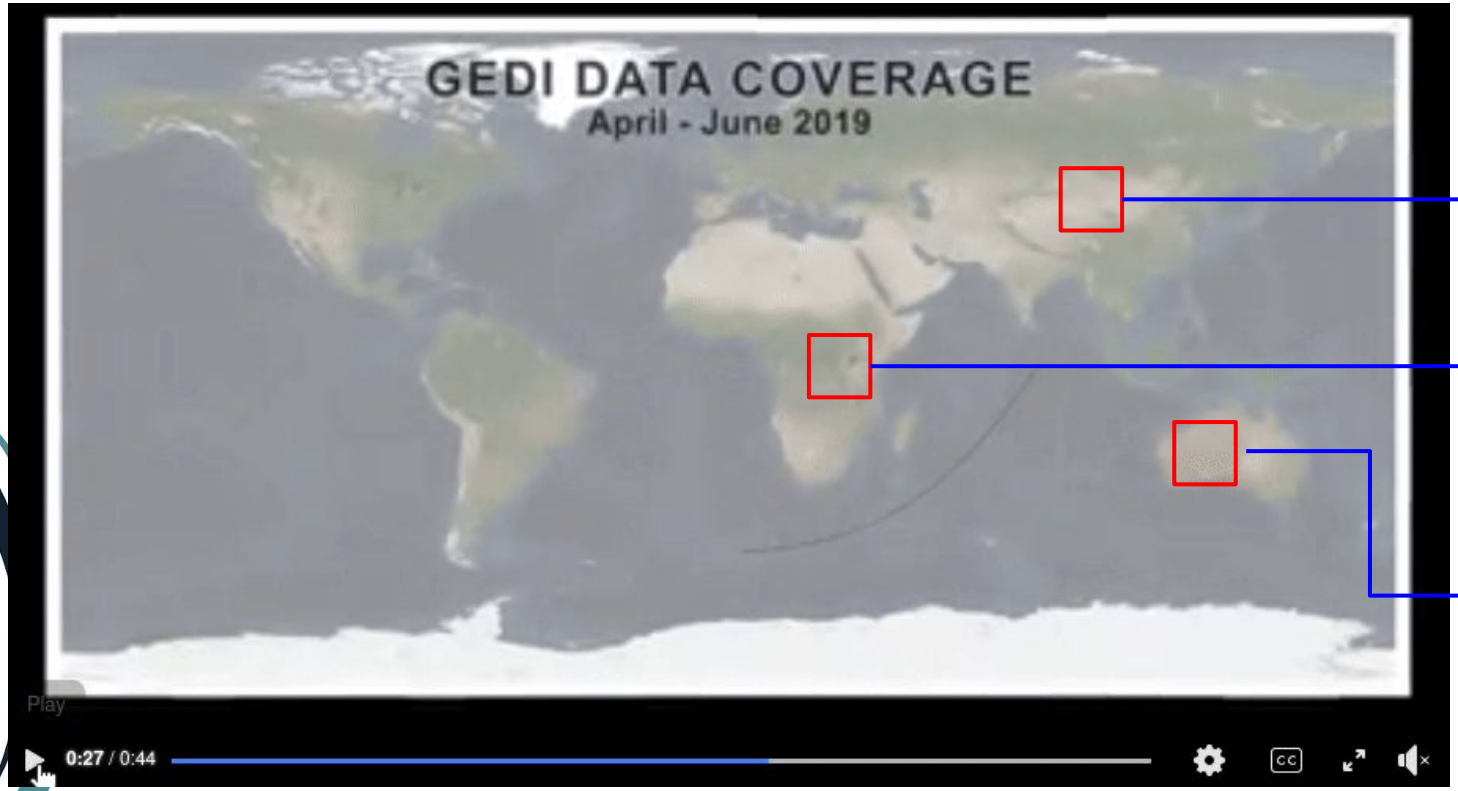

partition-1
- gedi-o1a.parquet
- gedi-o2a.parquet

partition-2
- gedi-o1b.parquet
- gedi-o2b.parquet
- gedi-o3a.parquet
- gedi-o4a.parquet

partition-3
- gedi-o3b.parquet
- gedi-o4b.parquet
- gedi-o5a.parquet

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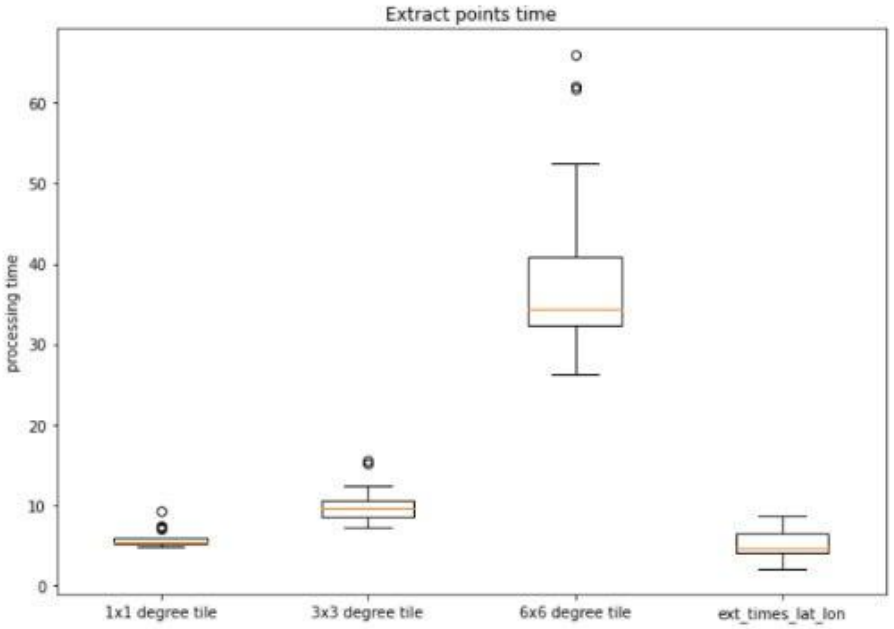

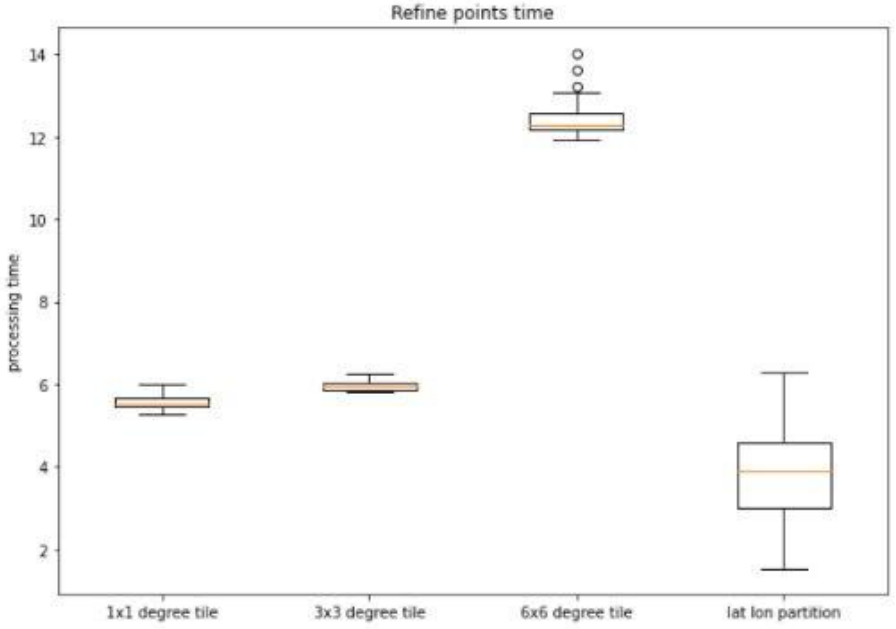

The multi depth structure(lat in 1 degree / lon in 1 degree) outperforms flattened structure (1x1 degree grid)

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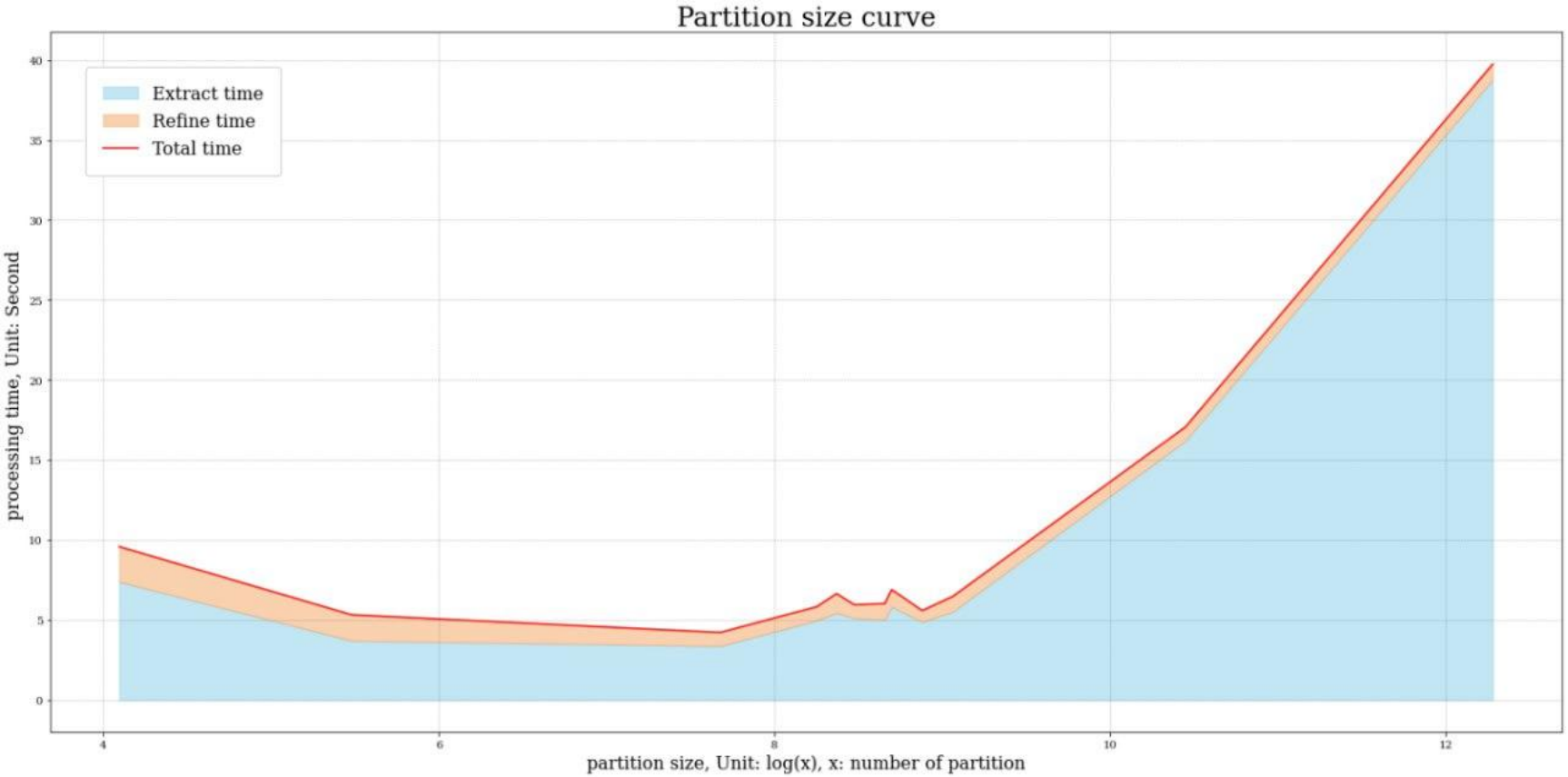

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Comparison of Python Parquet Engine in Parallelisation and Cloud Object Storage

Stats for all stories

6 min read · Dec 1, 2023

5

Lifetime

Dec 1, 2023 – Today · Updated every 24 hours

536	337	63%
Views	Reads	Read ratio

pyarrow.dataset.write_dataset

```
pyarrow.dataset.write_dataset(data, base_dir, *, basename_template=None,
format=None, partitioning=None, partitioning_flavor=None, schema=None,
filesystem=None, file_options=None, use_threads=True, max_partitions=None,
max_open_files=None, max_rows_per_file=None, min_rows_per_group=None,
max_rows_per_group=None, file_visitor=None, existing_data_behavior='error',
create_dir=True)                                                    [source]
```

Write a dataset to a given format and partitioning.

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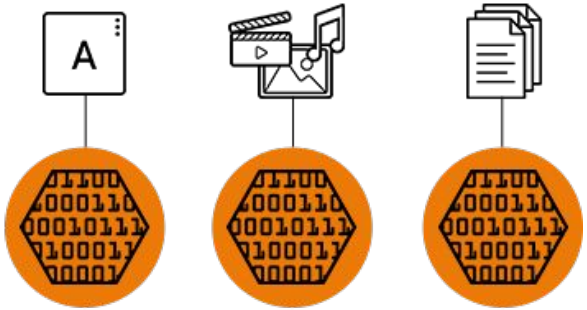

Cloud Object Storage

```
        url = 'http://s3.eu-central-1.wasabisys.com/gedi-ard/level2/l2v002.gedi_20190418_20230316_go_epsg.4326_v20240614/lon=15/lat=5/
year=2021/gedi_l2_0.parquet'
        q =  pl.scan_parquet(url)
        if cols is not None:
            q = q.select(cols)
        q = q.filter((pl.col('longitude') >= bbox[0]) & (pl.col('longitude') <= bbox[2]) &
                     (pl.col('latitude') >= bbox[1]) & (pl.col('latitude') <= bbox[3]))
```

Source:

(1) What is object storage? and File storage, block storage, or object storage?

(2) Polars — DataFrames for the new era

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GlobalEarthPoint Public

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Python	python tutorial update	50 minutes ago
R	automatic package install	1 hour ago
.gitignore	rearrange repo structure	18 hours ago
LICENSE	Initial commit	5 months ago
Readme.md	Update Readme.md	12 minutes ago

README | Apache-2.0 license

Access the repository here:
https://github.com/Open-Earth-Monitor/GlobalEarthPoint

GlobalEarthPoint

GlobalEarthPoint is a **Open Source Data Service Library** that specializes in managing large datasets of geographical points, providing a portal to access cloud infrasturcture, subset and retrieve data efficiently.

Key Features

- **Cloud Optimization**: Data is stored using ArrowParquet in the partitioning structure, and retrieved with Lazy evaluaton.
- **High Efficiency**: Designed to handle massive datasets by Parquet format, minimizing data size, latency and maximizing throughput.
- **Easy Integration**: Compatible with popular data processing frameworks and geospatial tools, facilitating easy

About

This initiative is inclined to address global vector (point) data accessing and hosting in a cloud-native environment.

- Readme
- Apache-2.0 license
- Activity
- Custom properties
- 1 star
- 1 watching
- 0 forks

Report repository

eleases

Create a new release

Packages

No packages published
Publish your first package

Contributors 2

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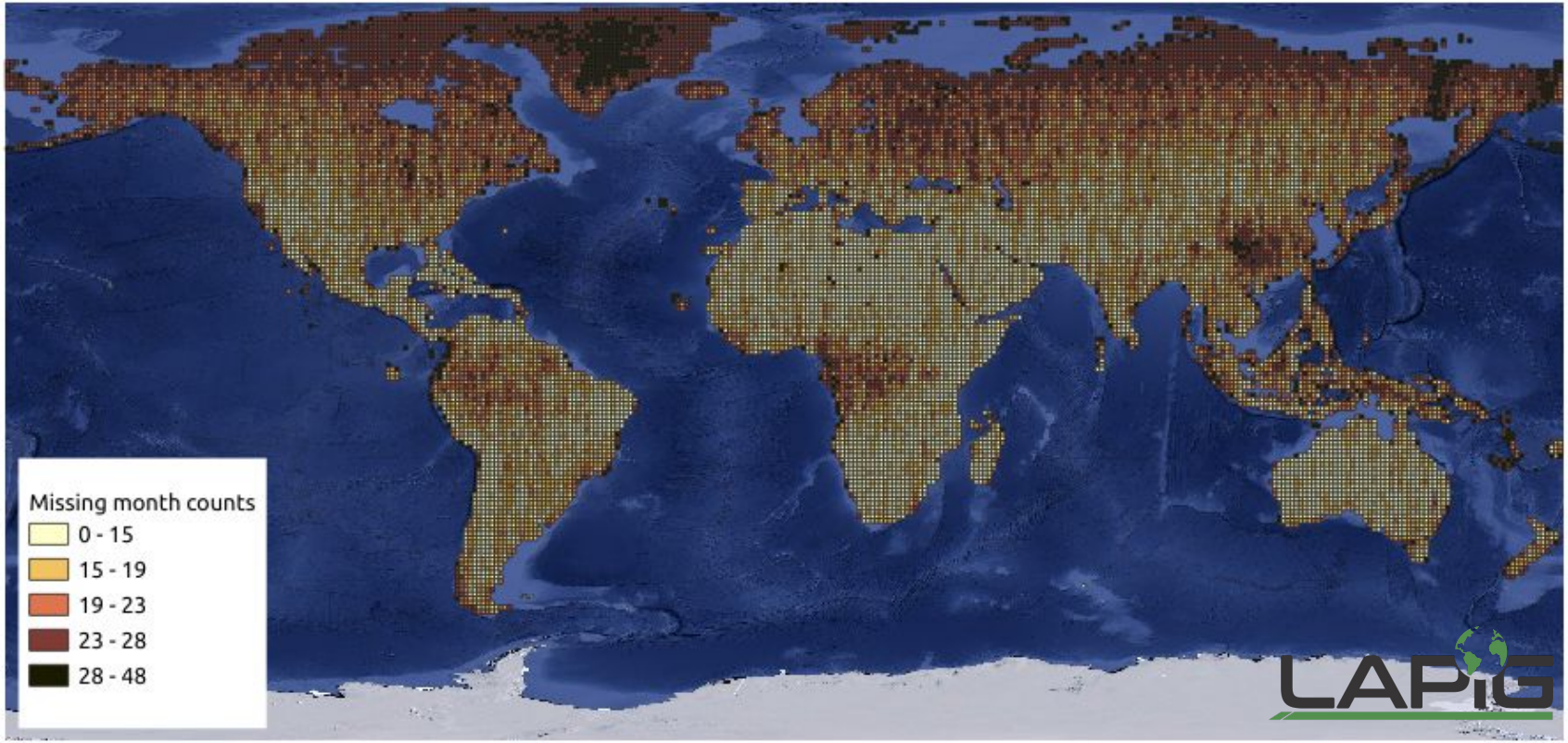
Use Cases of Big Vector Data - Short vegetation mapping



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Use Cases of Big Vector Data - Short vegetation mapping

Icesat-2 ATL08v006 in 20m segment

24.8 billions

~ 4TB

Generating extra attributes

- **n_ph_20m**: Number of photons in 20m
- **med_ht**: Median of vegetation photons relative height

Filter

By:

- **n_ph_20m >= 3**: number of photons in 20m greater than or equal to 3
  *separate segments with valid data
- **med_ht <= 5**: median less than or equal to 5m
  *focus sample on areas dominated by low vegetation
- **night_flag == 1**: data acquired at night
  *reduction in RMSE of more than 1m

Processing in 2 hours with a HPC 96 cores

Icesat-2 ATL08v006 in 20m segment for Short Vegetation Mapping

4.9 billions

Production Process

LAPIG

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Questions & Feedback

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