Project Use Cases Document

PlanetScope-py Python Library

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Project:	PlanetScope-py Core Library
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Objective:	Define comprehensive use cases for PlanetScope satellite imagery analysis workflows with technical implementation details

A comprehensive specification of the primary use cases for PlanetScope-py, detailing complete scene inventory and metadata analysis workflows, and spatial-temporal density analysis capabilities with advanced computational methods for professional satellite imagery analysis applications.

1 Document Information

Document Title	PlanetScope-py Project Use Cases Specification
Version	1.2
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Status	Enhanced
Classification	Internal Use

Table 1: Document Information

1.1 Revision History

Version	Date	Author	Description
1.0	May 26, 2025	Ammar & Umayr	Initial version with basic use case definitions
1.1	May 27, 2025	Ammar & Umayr	Enhanced Use Case 1 with sub-options for footprint clipping and user scene selection. Expanded Use Case 2 to include comprehensive temporal analysis and integrated spatial-temporal capabilities
1.2	May 28, 2025	Ammar & Umayr	Added preview/quicklook image capabilities to Option B. Enhanced Use Case 2 with advanced grid specification options, multiple computational methods for spatial analysis, and comprehensive technical considerations for performance optimization

Table 2: Revision History

2 Project Use Cases

2.1 Use Case 1: Complete Scene Inventory and Metadata Analysis

2.1.1 Input

- ROI polygon (drawn on map or uploaded shapefile)
- Time frame (start date and end date)
- Optional cloud cover threshold
- **User Choice:** Select output type:
  - **Option A:** Scene footprint polygons (with choice of clipped to ROI or full footprints)
  - **Option B:** Scene selection and download (applicable only if license allows)

2.1.2 Process

- Query Planet API for all intersecting PlanetScope scenes
- Retrieve scene footprints and comprehensive metadata
- **If Option A:**
  - Generate scene polygons with embedded metadata
  - **Sub-option:** User selects clipped footprints (ROI boundary) or full footprints (complete scene extent)
- **If Option B:**
  - Display scene inventory with metadata and preview/quicklook images (if available via API - implementation subject to API capabilities) for user review
  - **User selects specific scenes** based on coverage, cloud cover, dates, visual inspection, etc.
  - Download selected imagery and clip to ROI

2.1.3 Output

For Option A (Polygons Only):

- **GeoPackage File:** Scene footprint polygons with complete metadata in attribute tables
- **QGIS Visualization:** Scene coverage boundaries overlaid on ROI

For Option B (Selected Images):

- **Image Collection:** User-selected, downloaded and ROI-clipped PlanetScope scenes
- **GeoPackage File:** Scene footprints with metadata + links to corresponding images
- **QGIS Visualization:** Scene footprints with ability to load actual imagery

Common Outputs (Both Options):

- **Metadata Summary:** Statistical analysis of all scene parameters
- **Coverage Reports:** Percentage coverage of ROI by each scene

2.2 Use Case 2: Spatial and Temporal Density Analysis

2.2.1 Input

- ROI polygon (drawn on map or uploaded shapefile)
- Time frame (start date and end date)
- Optional cloud cover threshold filtering
- **Grid specification options:**
  - **Fixed 3m Grid:** Native Planet resolution
  - **User-defined Grid:** Custom cell size (e.g., 10m, 30m, 100m, 1km)
  - **User-imported Grid:** External grid compatibility (e.g., Sentinel-2 tiles, administrative boundaries) (lower priority - implementation subject to development timeline)

2.2.2 Process

- Query Planet API for all PlanetScope scenes intersecting the ROI
- Calculate spatial overlap using one of three computational methods due to high computational cost of simple grid-polygon intersection:
  - **Rasterization Method:** Convert polygons to raster format and perform array operations
  - **Vector Overlay Method:** Use spatial database operations with optimized indexing
  - **Adaptive Grid Method:** Start coarse, progressively refine high-activity areas
- Analyze temporal patterns of scene availability across the region
- Generate integrated spatial-temporal statistics

2.2.3 Output

Spatial Density Analysis:

- **Density Map:** Heat map showing number of available scenes at each grid cell within the ROI
- **Spatial Statistics:** Summary of coverage distribution (high-density vs low-density areas)
- **Coverage Insights:** Identification of data-rich and data-sparse zones within the region

Temporal Analysis:

- **Time Interval Statistics:** Analysis between consecutive scenes (varies spatially based on scene intersections)
- **Temporal Density Patterns:** Acquisition frequency analysis across different areas of the ROI
- **Temporal Coverage Maps:** Showing how temporal availability varies across space within the ROI

Integrated Spatial-Temporal Analysis:

- **Combined density** maps showing both spatial coverage and temporal frequency
- **Optimal sampling recommendations** based on spatial-temporal data availability patterns

2.2.4 Technical Considerations

- **Computational efficiency:** Method selection based on ROI size and target resolution
- **Grid flexibility:** Support for multiple grid types and resolutions including user-imported grids for cross-platform compatibility (e.g., Sentinel-2 integration)
- **Performance optimization:** For large ROIs (50km $\times$ 50km) at 3m resolution, simple grid intersection would require approximately 1GB output files and excessive computation time

2.3 Combined Result

Users get complete scene inventory with flexible output options for data acquisition, plus comprehensive spatial-temporal density understanding for optimal analysis planning within their ROI and timeframe.