

MRD 146- Satellite Light Curves

Data Product Overview

One sentence executive description of product

The Lightcurve data product is a list of time sequence photometry of any detected natural satellite(s) of Bennu and parameters describing the shape and period of the lightcurve(s).

Overview

Data type (image, spectrum, data table, map format etc.)

data table

What does it measure at what scale

unresolved/point source

What observations are required to provide the input data needed to make the data product?

Natural lightcurve observations will consist of MapCam L2 images in 5 filters (pan,b,v,w,x) taken during multiple dates in the Approach phase. Each observations window will span ~4.5 hours.

When in the DRM are the observations that make the data product scheduled to be taken?

Natural satellite observations are contingent on the discovery of any natural satellites of Bennu. Lightcurve observations will take place at an opportune time (when distance to the satellite, distance from Bennu, SPE angle, phase angle, apparent magnitude, and sky plane motion is conducive for observation) during any of the Encounter phases

How long does it take to produce the data product?

Each lightcurve observation will be obtained over a 4.5 hour period.
Reduction will take 3 days worth of work for each lightcurve observing period.

Is this product used of sample site selection, science value, or long-term science?

Long-term science

Data Product Structure and Organization

What is the structure of the data product (e.g. FITS file with 4 extensions)

ASCII

How is the product organized (e.g. one data set per mission phase, one file per Earth Day, etc.)

two files (one containing the lightcurve photometry and the other containing the parameters describing the shape and period of the lightcurve)

Data Format Descriptions

Header information (metadata) included with data product. For example:

ASCII table including the following: mid-point of observation (UT and julian date), exposure length, name of image, filter, photometric flux, magnitude, rotation phase, phase angle, OREx-Sun distance, OREx-satellite distance

Detailed Description of data format. For example:

Table

Data Type

ASCII

Field name, Field Description, Field Length, Field Format

ASCII table including the following for the lightcurve photometry file: year of mid-point of observation (UT), month of mid-point of observation (UT), decimal day of mid-point of observation (UT), exposure length, filter, photometric flux, apparent magnitude, absolute magnitude normalized distances of 1 AU between the satellite and Sun and satellite and spacecraft, rotation phase, lightcurve photometric correction, phase angle, OREx-Sun distance, OREx-satellite distance

ASCII table include the following for the lightcurve period file: rotation period (hours), rotation period error (hours), amplitude of lightcurve (magnitudes), order of Fourier fit, epoch of zero rotation phase (modified julian date)

Example format (for lightcurve photometry file):

```
2018 10 11.123456 100.000 b 123456 10.123 20.123 0.1234 -0.123 123.456
0.12345 123456.123
```

Fortran format (for lightcurve photometry file):

```
I4,1X,I2,1X,F9.6,1X,F7.3,1X,A1,1X,I6,1X,F6.3,1X,F6.3,1X,F6.4,1X,F6.3,1X,
F7.3,1X,F7.5,1X,F10.3
```

Example format (for lightcurve period parameter file):

```
4.29256 0.00001 0.123 8 2456789.5
```

Fortran format (for lightcurve period file):

```
F8.5,1X,F7.5,1X,F5.3,1X,I1,1X,F9.1
```

Data Product Generation

How and by whom is the product generated?

What are the input products needed to produce the product?

MapCam images of natural satellites, MapCam photometric calibrations, s/c ephemeris position, natural satellite ephemeris position, MapCam image filter, MapCam image exposure time, MapCam image exposure duration

Are there format expectations for the input products?

Yes. MapCam image headers need to use the standard FITS header format. A list of FITS keywords and their meanings is required for reading these values into the photometry software.

What algorithms and/or calibration data is used to generate products?

Are there format expectations for the inputs?

Has a specific Science Team Member been assigned to produce this product?

Carl Hergenrother

Will multiple versions of the product be generated?

No

How will they differ?

On what cadence will they be delivered?

N/A

Data Product Validation

How will the product be vetted to ensure contents and format are correct?

Software to be tested on real ground-based lightcurve data of asteroids analogous to Bennu and synthetic MapCam image data. Analogous asteroids will have well determined rotation period and lightcurve parameters.

Data Flow

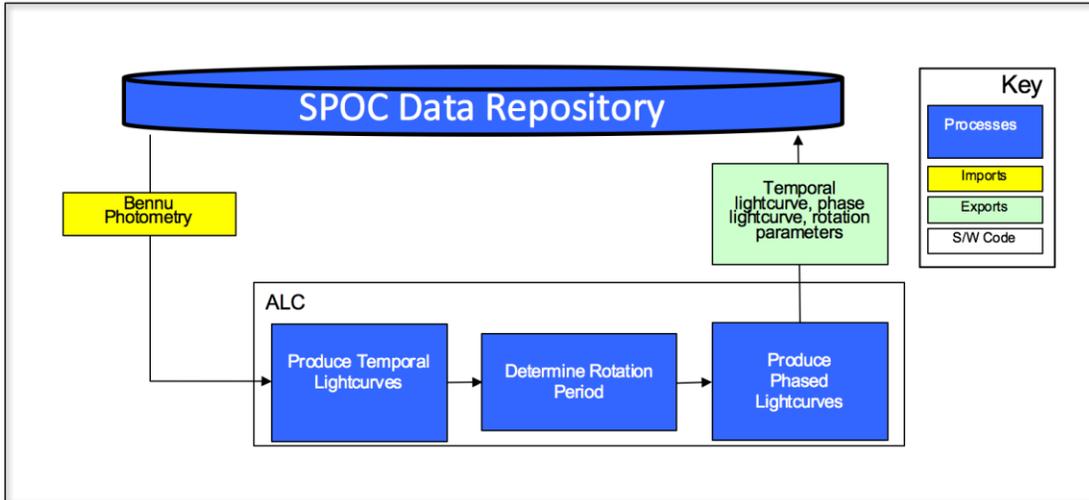
Update Data flow diagrams with more detailed based on current processing configuration.



Rotation Period Determination

List functions of Rotation Period Determination:

1. Retrieve Bennu photometry from SPOC Data Repository
2. Produce temporal lightcurve
3. Determine rotation period via Fourier analysis
4. Produce phase lightcurve
5. Archive rotation state products (temporal lightcurve, phase lightcurves, rotation parameters) to SPOC Data Repository



Describe the sources, destinations, and transfer procedures for data products.

State the size of an individual data product and the total size of all the data products generated over the course of each mission phase. Can you make an estimate here for the Baseline?

Data products are relatively small ASCII files (size < 1 MB)

State the time span covered by a product, if applicable, and the rate at which products are generated and delivered.

Products will be produced at the end of the Approach phase

Standards used to generate data product

Time (e.g. times are all converted to UTC)

UTC

Coordinate System

astronomical photometric system (b,v,w,x,monochrome v)

Data Storage Conventions (i.e. byte order, compression, machine dependence)

Lightcurve photometry and parameter files to be saved to SPOC repository.

Product to be retrieved via WebQuery based on data product type (name) or date observation was made. For example, I do not foresee a request to download one photometric point but do foresee downloading all photometry taken on a single date.

Relevant ICD Data Products:

- Temporal and Phased Light Curve Photometry (AP-12)
- Light Curve Parameters (AP-13)