SFD MAPS DPD

Executive description of product

Size-frequency Distribution Maps are maps of the areal distribution of boulders and cobbles of the surface of Bennu. The maps show the SFD of boulders, cobbles fines at various points on the surface of Bennu.

Overview:

• The product will be a map with SFD values indicated

• This data product satisfies MRD-116

• SFD . The observations need to cover 80% of the surface of the sample site and must have a minimum resolution of 5-cm over 5-pixels. Images of the surface will be needed at ± 22.5° and 0° viewing angles.

• The observations that make the data product are taken during the Orbital B phase of the mission.

• The quick-look product will be generated over 2-3 weeks.

• This product will be used as input to the sample site selection and science value maps. The product may also be used to support long-term science.

Data Product Structure and Organization

Data product structure: a map

Data product organization: Maps can be generated for any location and size on the surface of Bennu.

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

• Start/End time of observations that makeup data product

• Lat/lon or other geometric parameters

• Map scale/ resolution

• Map projection

• Instrument parameters or housekeeping data needed to process data

• Calibration files used in processing

Detailed Description of data format. For example:

• Table

• Data Type – Binary, ASCII, UTF-8

• Field name, Field Description, Field Length, Field Format

• Arrays

• Storage and Index Order

• Axis Meaning

• Axis name, number of elements, sequence number, units

• Display orientation

Data Product Generation
Input products needed to produce the product:

• Radiometrically corrected PolyCam images

• Images will be single extension FITS images with standard OCAMS header data

• Images of the same surface area will be collected at at ± 22.5° and 0° viewing angles to support creation of stereo images

• SPICE kernels

• The SPICE kernels will include the most up-to-date set of OSIRIS standard SPICE kernels, including a reconstructed SPK (Ephemerides and Trajectory kernel) for the spacecraft maneuver used to collect the OCAMS images.

• Stereo images and a Digital Terrain map of each sample site; used to determine feature heights, and to improve knowledge of length and width dimensions

• Black and White maps of the sample site using and equal-area map projection

• The maps will be an OCAMS image mosaic as a basemap with a gridded overlay on a 5-mx5-m scale; the mosaics will be ISIS data cubes, the projected maps will be jpeg images.

• Shaded relief maps of the sample site displaying objects that are greater than 5-cm in height

• The maps will be an OCAMS image mosaic as a basemap with contour lines delineating different height information; the mosaics will be ISIS data cubes, the projected maps will be jpeg images.

Algorithms and/or calibration data used to generate product:

• Software and hardware to generate and view stereo images will be needed

• Software to generate view DTMs will be needed; this software should also be able to mark and measure feature height and write the results to the PSFD database

• Software to manual mark and measure boulders and cobbles will be needed; the software will need to write the results to the PSFD database

• Software generate PSFD graphs will be needed

• Software to generate contour maps of areal populations of different PSFD slopes will be needed.

Science Team Members assigned to produce this product:

• At least 2 independent team members will be needed to analyze each sample site

• Several team members will need to be trained to analyze the sample sites

Multiple versions of the product be generated:

• A quick-look version of the data will be generated as input to the sampleability and science value maps; Output product will be prioritized to concentrate effort on the most promising sample sites. Analysis of inferior sites will be suspended if more time is needed to analyze more promising sites. The Sample Site Selection Committee will update the sample sites priorities during the analysis of the sites and give feedback to the IPWG on relative priority of the sample sites.

• This will be delivered on a 2-3 week timeline

• A through analysis of each sample site will be conducted as input to long-term science products.

• This will be delivered on a ~ 12 month timeline for all sample sites.

Data Product Validation

• Team members involved with the Particle-Size Frequency Distribution analysis will undergo a training period using test data sets with know frequency distribution characteristics. Test data may come from:

• Sample site simulant surfaces provided by Bill Boynton and Eric (look-up Eris' last name)

• Images from past asteroid missions (i.e. Haybusa (check spelling), find others sets)

• Artificial images created by Bob Gaskell's SPC software and Freespace images generated by GSFC.

• Validation of Stereo images and DTMs will be conducted by generating products using the Test data sets described above.

• All mission-critical or time-sensitive products (i.e inputs to safety and sampleabilty maps) will include "human in the loop"

• Each sample site will be counted independently by at least 2 different people or groups

• Algorithm for automated boulder and feature detection will be investigated during phase C/D and tested in the test data sets described above.

Data Flow
Update Phase B data flow diagrams with more detailed based on current processing configuration. [Insert or reference data flow diagram here.]
Describe the sources, destinations, and transfer procedures for data products.

• Input data will be retrieve from the SPOC database and processed on each investigator's computer or on workstations provided by the SPOC.

• Output data will be reviewed and once it has been approved for distribution, transferred to a data drop when it will be ingested into the SPOC database.

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

Standards used to generate data product

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

• Coordinate System

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

SFD GRAPHS

Overview

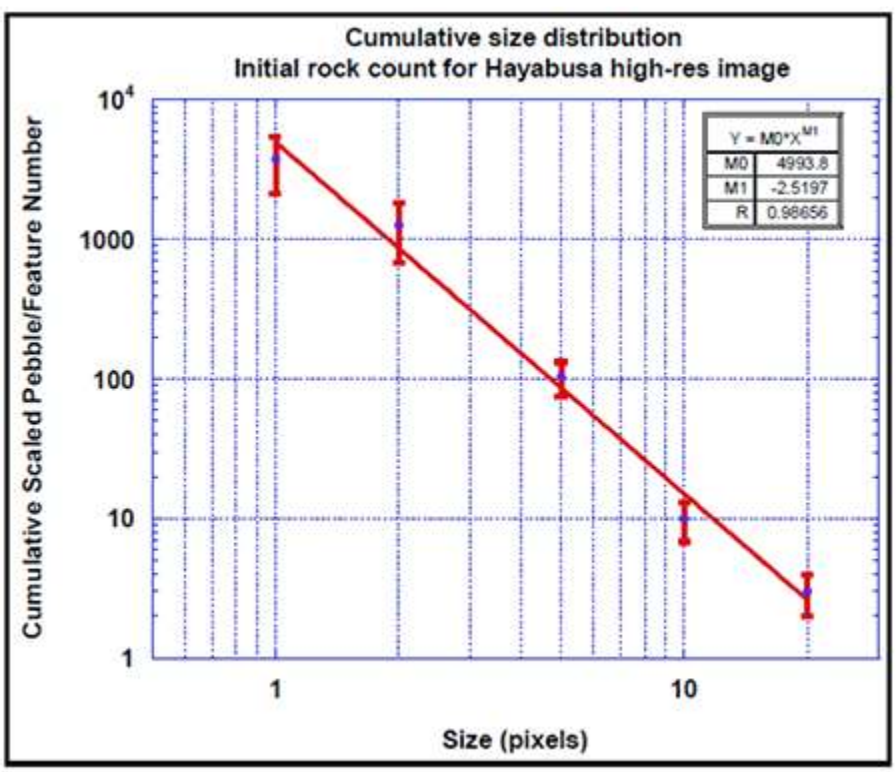
The PSFD graphs are created using standard graphing packages.

History

Initial version - 3 Dec 2013

Algorithm Description

This algorithm uses standard graphing packages to create PSFD graphs from a table of PSFD measurements extracted from the SFD database. PSFD graphs are histograms based on the diameter of the shortest dimension of each boulder, cobble or pebble vs the Cumulative number of features counted for a given size bin. The axes of the cumulative SFD are generally plotted on a log-log scale. An example PSFD graph from asteroid Itokawa is shown below.



Parameters

Input Parameters

- Data extracted from the SFD database (as a csv file)

Output Parameters

- a graph (in PDF format)

SFD PRODUCTS DPD

Executive description of product

The Size-frequency Distribution Database is a table in the SPOC database. It contains the locations and dimensions of boulders and cobbles of the surface of Bennu at 1-m, 21-cm, 5-centimeter and 2-cm resolution. The database will also include center location and boundaries of boulder piles, regions of interest and Regions of unresolvable material.

Overview

• The product will be a table in the SPOC database

• The SPOC database will import cvs files created by the boulder counting tool that contains the information to be recorded by the database.

• The database will record the location and size of all boulders greater than 1-m in diameter (in the largest dimension) for 80% of the area of Bennu.

• The database will record the location and size of all boulder piles for 80% of the area of Bennu.

• The database will record the location and size of all boulders greater than 21-cm in diameter (in the largest dimension) for all regions of interest identified during Detail Survey.

• The database will record the location and size of all boulder piles greater than 21-cm in diameter (in the largest dimension) for all regions.

• The database will record the location and size of all cobbles greater than 5-cm in diameter (in the largest dimension) for each Candidate Sample Site Identified during Orbital B.

• The database will record the location and size of all cobbles greater than 2-cm in diameter (in the largest dimension) for each Candidate Sample Site Identified during Reconnaissance.

• The size dimensions will include length of the feature in the longest dimension, width in the direction perpendicular to the length.

• This data product satisfies MRD-116

• OCAMS MapCam images from the Baseball Diamond maneuvers campaign of Detailed Survey (3.5-km range) are needed of the entire surface of Bennu.

• OCAMS PolyCam images from the safe-home orbit (range ~0.75-km) are needed of each candidate sample site. The observations need to cover 80% of the surface of the sample site and must have a minimum resolution of 5-cm over 5-pixels. Images of the surface will be needed at ± 22.5° and 0° viewing angles.

• The observations that make the data product are taken during the Baseball Diamond maneuvers campaign of Detailed Survey, Orbital B and the Reconnaissance phases of the mission.

• The quick-look product will be generated over 2-3 weeks following each mission phase. This product will be used as input to the Global Terrain Map, Regional Terrain Maps, Sample Site SFD Maps

• The product may also be used to support long-term science.

• The database will allow multiple entries for each object located and will use data quality flags, timestamps and accuracy and precisions fields allow the analysts to filter entries.

Data Product Structure and Organization

Data product structure & organization: a database table.

Data Format Descriptions

Header information (metadata) included with data product

• None

Detailed Description of data format

• Table

• Data Type – ASCII

Data Product Generation

Input products needed to produce the product

• Radiometrically corrected PolyCam images

• Images will be single extension FITS images with standard OCAMS header data

• Images of the same surface area will be collected at at ± 22.5° and 0° viewing angles to support creation of stereo images

• SPICE kernels

• The SPICE kernels will include the most up-to-date set of OSIRIS standard SPICE kernels, including a reconstructed SPK (Ephemerides and Trajectory kernel) for the spacecraft maneuver used to collect the OCAMS images.

• Global Black and White maps of Bennu using and equal-area map projection

• The Global map and Regional Maps will be an OCAMS image mosaic from the 21-cm resolution images as a basemap; the mosaics will be ISIS data cubes, the projected maps will be jpeg images.

• Black and White maps of the sample site using and equal-area map projection

• The Sample Site maps will be an OCAMS image mosaics from the 5 & 2-cm resolution images as a basemap; the mosaics will be ISIS data cubes, the projected maps will be jpeg images.

Algorithms and/or calibration data used to generate product

• Software to manual mark and measure boulders and cobbles will be needed; the software will need to write the results to a csv file that can be imported by the SPOC database

Science Team Members assigned to produce this product

• At least 2 independent team members will be needed to analyze each sample site

• Several team members will need to be trained to analyze the sample sites

Multiple versions of the product be generated

• A quick-look version of the data will be generated as input to the sampleability and science value maps; Output product will be prioritized to concentrate effort on the most promising sample sites. Analysis of inferior sites will be suspended if more time is needed to analyze more promising sites. The Sample Site Selection Committee will update the sample sites priorities during the analysis of the sites and give feedback to the IPWG on relative priority of the sample sites.

• 4 versions of the database will be delivered to the SSS committee

• The first version will be delivered 2-3 weeks after the Detail Survey Baseball Diamond maneuvers campaign for input to the Safety & Deliverability Maps. It will contain locations and dimensions of all boulders > 1-m over 80% of the asteroid and locations and dimensions of all boulders > 21-cm in regions of interest

• The second version will be delivered 2-3 weeks after Orbital B for input to the Safety & Sampleabilty Maps. It will contain locations and dimensions of all cobbles > 5-cm over 80% of each candidate sample site.

• The third version will be delivered 2-3 weeks after Reconnaissance for input to the Safety, Sampleabilty & Science Values Maps. It will contain locations and dimensions of all cobbles > 2-cm over 80%(or possibly less) of prime and back-up sample site.

• A through analysis of each sample site will be conducted as input to long-term science products.

• This will be delivered on a ~ 6 month timeline for all sample sites.

Data Product Validation

• Team members involved with the Particle-Size Frequency Distribution analysis will undergo a training period using test data sets with know frequency distribution characteristics. Test data may come from:

• Sample site simulant surfaces provided by Bill Boynton and Eric Sahr.

• Images from past asteroid missions (i.e. Haybusa (check spelling), find others sets)

• Artificial images created by Bob Gaskell's SPC software images generated by GSFC.

• All mission-critical or time-sensitive products (i.e inputs to safety and sampleabilty maps) will include "human in the loop"

• Each sample site will be counted independently by at least 2 different people or groups

• Algorithm for automated boulder and feature detection will be investigated during phase C/D and tested in the test data sets described above.

Data Flow

Update Phase B data flow diagrams with more detailed based on current processing configuration. [Insert or reference data flow diagram here.]

Sources, destinations, and transfer procedures for data products

• Input data will be retrieve from the SPOC database and processed on each investigator's computer or on workstations provided by the SPOC.

• Output data will be reviewed and once it has been approved for distribution, transferred to a data drop when it will be ingested into the SPOC database.

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

Standards used to generate data product

- Time (e.g. times are all converted to UTC)
- Coordinate System
- Data Storage Conventions (i.e. byte order, compression, machine dependence)