

# Global Reflectivity Map Algorithm Description Document

## Overview

This data product supports the Safety Map requirement SM. ALG.04: “SPOC shall generate a global reflectivity input map of Bennu indicating the reflectivity at 1064nm for each element of the GSM.” The reflectivity of each facet within the sampling site is calculated to determine spacecraft safety for TAG approach. This map calculates which candidate TAG sampling sites on the global shape model contain surface facets with reflectance values within the designed range for the GNC LIDAR to satisfy the mission requirement for spacecraft safety.

## Inputs

- Global Shape Model (GSM)
  - Nominally 1m resolution
- Global Deliverability Map (GDM)
- Sampling site radius (circular)
- Global 1064nm Reflectance Map
- G\_brdf\_min – parameter for minimum acceptable reflectance
- G\_brdf\_max – parameter for max acceptable reflectance
- R\_brdf\_min – parameter for unacceptably low reflectance
- R\_brdf\_max – parameter for unacceptably high reflectance

## Outputs

- Global Reflectance Safety Map
  - Referenced to the GSM

## Algorithm

The ‘sampling area’ centered about each facet in the GSM is defined by the Global Deliverability Map (GDM). Since the GDM is not at the same resolution as the GSM, the size of the sampling area is defined by the semimajor and semiminor axes of the nearest-latitude GDM site. If there are multiple GDM sites with the same latitude, then the nearest longitude GDM site is selected from the remaining options. The semimajor and semiminor axes of the sampling area should be converted 3-sigma values, assuming a Gaussian error distribution (the GDM input is currently 1-sigma). Alternatively, the user can input a single scalar for the sampling site area radius instead of the GDM. The sampling area in this case for every facet is a circle with the specified radius.

For each facet within a sampling area:

1. Calculate the reflectivity of the facet using Global 1064nm Reflectance Map.
  - a. The reflectance must be calculated from the BRDF with 0 degree incidence angle.
  - b. The reflectance map must be sub-sampled to the resolution of the GSM, if necessary.

For each sampling area (centered on each facet of the GSM)

2. Find the reflectivity representing the 98.2 percentile and 1.8 percentile of all reflectances within the sampling area.

**Commented [MS1]:** The statistical evaluation of the LIDAR safety bounds is still TBD

3. The TBD percentile reflectance value of the surrounding sampling area and a color coded safety rating will be assigned to the each facet of the GSM. The location will be color coded to the lowest rating according to the 98.2 or 1.8 percentile value (Green>Yellow>Red):
  - a. Green if the 98.2 percentile value is less than or equal to G\_brdf\_max and the 1.8 percentile value is greater than or equal to G\_brdf\_min.
  - b. Red if the 98.2 percentile value is greater than R\_brdf\_max or the 1.8 percentile value is less than R\_brdf\_min.
  - c. Yellow if the value is anything else.

The values G\_brdf\_min, G\_brdf\_max, R\_brdf\_min, and R\_brdf\_max will be supplied.