

# Global Thermal Map Algorithm Description Document

## Overview

This data product supports the Safety Map requirement SM. ALG.03: *“SPOC shall generate a global thermal input map of Bennu indicating the temperature for each element in the thermal map. The global temperature map (~40m resolution) shall be calculated for the predicted local time-of-TAG and solar range for the expected TAG date.”* The temperature 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 sufficiently low temperature facets at the local time of TAG to satisfy the mission requirement for spacecraft safety.

## Inputs

- Global Shape Model (GSM)
  - Nominally 1m resolution
- Global Deliverability Map (GDM)
- Sampling site radius (circular)
- Bennu Thermal Model
- Planned TAG date
- G\_temp – parameter for acceptable facet temperature
- R\_temp – parameter for unacceptable facet temperature

## Outputs

- Global Thermal 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 temperature of the facet using the Bennu thermal model.
  - a. The temperature must be calculated for the predicted TAG date and local solar time of TAG. The local solar time of TAG is defined by the TAG site latitude.
  - b. The thermal map must be sub-sampled to the resolution of the GSM.

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

2. Find the temperature representing the 98.2 percentile of all temperatures within the sampling area.
3. The 98.2 percentile temperature 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 according to the 98.2 percentile value:
  - a. Green if the value is less than or equal to G\_temp
  - b. Red if the value is greater than R\_temp
  - c. Yellow if the value is anything else.

The values for G\_temp and R\_temp will be supplied.