

## MRD 133- Asteroid Mass Model

### Data Product Overview

The "Asteroid Mass Model" data product contains the estimate and associated uncertainty of the mass of Bennu.

### Overview

This data product is a data table that contains the estimate and associated uncertainty of the mass of Bennu.

This data is produced as a part of the estimation process carried out with the GEODYN II software, which was created at NASA Goddard Spaceflight Center. This process is discussed [here](#). (See Geodyn Algorithm)

The following input is needed to execute the estimation process:

- DSN doppler, ranging, and Delta-DOR data.
- DSN input data including Earth orientation parameters, tracking station locations, and media calibration data in the standard DSN formats.
- Optical navigation data from the image processing team. Format of this data needed is TBD to align with GEODYN II opnav processing which is being developed now.
- Altimetry measurement information (should be contained in requested SPICE kernels).
- FDS SP kernel containing previous navigation solutions.
- RQ36 spin state.
- S/C E kernel.
- C kernel.
- Previous Radio Science SP kernels.

The observations (DSN, images, and altimetry) used to create this data product are made during the Survey, Orbital, and Reconnaissance phases of the DRM.

The time needed to generate this data product can vary from an hour to days, depending on the volume of data to be processed and the length of time that data covers.

This product is used for science value and long-term science.

### Data Product Structure and Organization

This data product is delivered as an ASCII file.

There will be one file per mission phase that is updated as new input data is made available and processed.

There may be another indicator (ie version number) used to track the updated version within each phase as different or more information is used to create a new estimate.

### Data Format Descriptions

The header information will contain the timespan covered in the estimation arc, as well as the specific input data used to generate this data product.

The data will follow the header lines. In this case, the data will be one line containing two numbers: the mass estimate, and the 1-sigma uncertainty of this estimate.

The data file format is described in the RSWG [SIS](#).

An example of the data format is shown below:

```
TTYPE1 = 'MASS' /Name of table column 1
TBCOL1 = 1 /Starting byte of column 1
TFORM1 = 'E19.12' /Number format of column 1
TUNIT1 = 'kilograms' /Unit of data in column 1
TTYPE2 = 'MASS UNCERTAINTY' /Name of table column 2
TBCOL2 = 20 /Starting byte of column 2
TFORM2 = 'E19.12' /Number format of column 2
TUNIT2 = 'kilograms' /Unit of data in column 2

/Input Files
ISCSPK = 'SC_SPK_100.DAT' /Name of SC SPK input file
ISCKK = 'SC_CK_100.DAT' /Name of SC CK input file
IASTSPK = 'BENNU_SPK_100.DAT' /Name of Bennu SPK input file
ISPIN = 'SPIN_STATE_100.DAT' /Name of Spin State input file

IGEODYN = 'GEODYN_INPUT_DECK_100.TAB' /Name of GEODYN input deck listing observations used

/Time span of arc covered (will use whatever standard formats are desired)
TIME_START = 'time string' /Time epoch of a priori information
TIME_END = 'time string' /Time of final observation used

/Start of fake data
6.200000000000e+10 1.600000000000e+10
```

## Data Product Generation

This data product is generated by the Radio Science Working Group.

Input products are listed in the Overview section, above. There are not currently assumptions about the format of the input products. GEODYN does expect data in certain formats, however there is already a variety of preprocessing scripts available from our Goddard team members to reformat the data as necessary. New scripts will be written as necessary.

As mentioned several times above, the processing algorithm is the GEODYN II software. This process is discussed in [here](#).

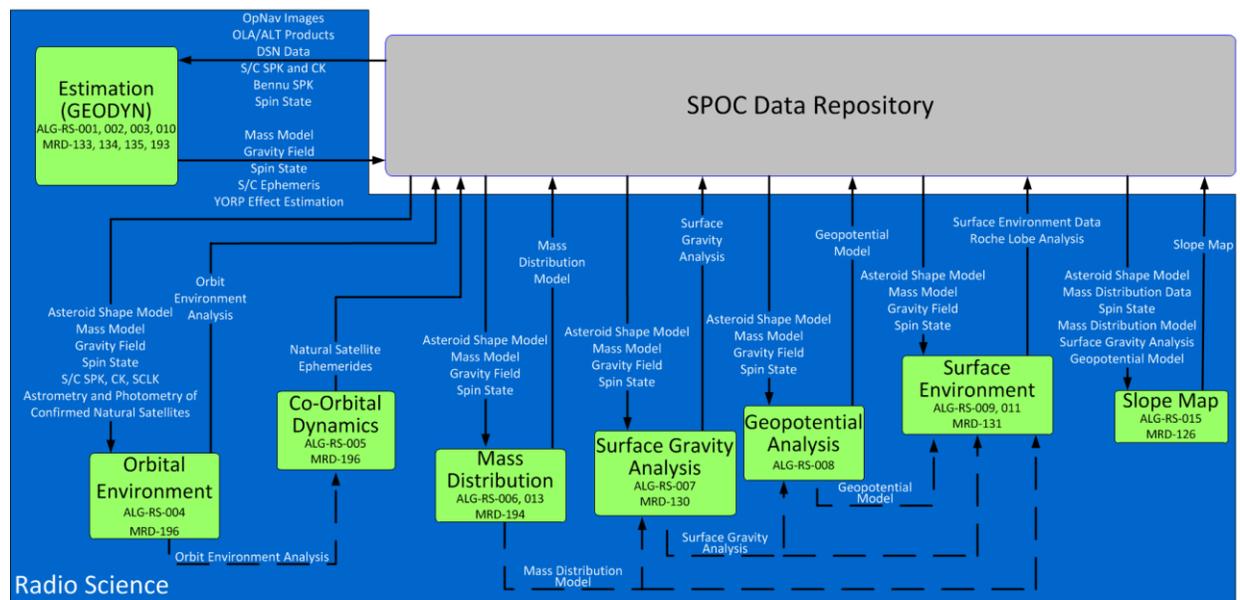
Multiple versions of the product will be generated as more/new inputs become available, and as time passes. At any given time, however, there will be one official version of the data product. The cadence will vary as it depends on when new data appears, and how long it takes to process said data.

## Data Product Validation

The data product will be produced by copying the data from GEODYN output files into the data product file. The values printed in the data product will be compared to the values in the GEODYN output. Format can be verified by using a MATLAB script to read the ASCII text in as numeric values to ensure appropriate numbers are in the data product file. Values will also be compared with estimates from other algorithms at the University of Colorado.

## Data Flow

In the current RSWG data flow diagram, shown below, the generation of this data product can be found in the box on the top left.



Data flow for this data product is simple: inputs come from the SPOC, go through our algorithm, and the data product is produced.

The file size for this product is very small - on the order of 10 K.

Standards used to generate data product

No particular standards for this data product. Mass is frame independent. Data is stored as ASCII.