OSIRIS

Optical, Spectroscopic, and Infrared Remote Imaging System

OSIRIS Georeferenced Data Products

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Prepared by:
Carsten Güttler

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D / -	08/03/2018 C. Güttler	all	First draft
1 / -	25/04/2018 C. Güttler	1, 2, 4	Several clarifications: - level counting (internal vs. CODMAC) - emission / incidence / phase angle unit -.fts and .log files - shape model filename
1 / a	22/10/2018 C. Güttler	Sect. 2.2 & 3	- added explanation of dataset completeness - .SUM files and shape model now in Cheops frame

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1 General aspects

1.1 Scope

This document describes the OSIRIS georeferenced Level 4[1] (CODMAC L5) data products and their creation.

1.2 Introduction

OSIRIS Level 4 (CODMAC L5) data products are .IMG files with nine layers. The first layer repeats the Level 3 (CODMAC L4) calibrated image data, while the other layers contain pixel-precise information on distance, emission angle, incidence angle, phase angle, (shape model) facet index, and *x*/*y*/*z* coordinates. These images are a subset of Level 3 (CODMAC L4) since not all images could be georeferenced.

Section 2 describes the products on a user level while Sect. 3 provides the technical details of the product generation.

1.3 Reference Documents

no.	document name	document number, Iss./Rev.
RD1	Software Interface Specification for OSIRIS Science Products	RO-RIS-MPAE-ID-023, 1/e
RD2	OSIRIS calibration pipeline OsiCalliope	RO-RIS-MPAE-MA-007, 1/g
RD3	Rosetta-OSIRIS To Planetary Science Archive Interface Control Document	RO-RIS-MPAE-ID-015, 4/g
RD4	OSIRIS Archive Completeness Report	RO-RIS-MPAE-RP-352

1.4 Acronyms and Abbreviations

CODMAC	Committee on Data Management and Computation
LAM	Laboratoire d'Astrophysique de Marseille
MPS	Max Planck Institute for Solar System Research
NAC	(OSIRIS) Narrow Angle Camera
OSIRIS	Optical, Spectroscopic, and Infrared Remote Imaging System
PSA	Planetary Data System
PSI	Planetary Science Institute
SPC	Stereo-Photo-Clinometry (shape reconstruction method)
SPG	Stereo-Photo-Grammetry (shape reconstruction method)
WAC	(OSIRIS) Wide Angle Camera

[1] Note that OSIRIS levels and CODMAC levels are shifted by one [RD3]. OSIRIS levels are used internally and converted to CODMAC levels for public data delivery to PSA.

2 Product Description

2.1 Data Structure and Content

The OSIRIS Level 4 (CODMAC L5) data products are derived data products that include pixel-precise georeferencing information. The data are organized in nine layers with their PDS OBJECT names and content are listed in Table 1. Note that the incidence-, emission-, and phase angle are provided in radians and not degrees.

Table 1: Image layers of OSIRIS Level 4 (CODMAC L5) data product.

PDS OBJECT Name	Unit	Description
IMAGE	W m^{-2} sr^{-1} nm^{-1}	Copy of the Level 3 (CODMAC L4) radiometric calibrated and geometric distortion corrected image layer.
DISTANCE_IMAGE	km	The distance per pixel from the camera to the target surface.
EMISSION_IMAGE	rad	The emission angle per pixel.
INCIDENCE_IMAGE	rad	The incidence angle per pixel.
PHASE_IMAGE	rad	The phase angle per pixel.
FACET_IMAGE	integer	The facet ID per pixel, related to the shape model used for the product generation.
X_IMAGE	km	The *x* coordinate per pixel in the target body fixed frame.
Y_IMAGE	km	The *y* coordinate per pixel in the target body fixed frame.
Z_IMAGE	km	The *z* coordinate per pixel in the target body fixed frame.

Visual examples of the nine layers of an OSIRIS Level 4 (CODMAC L5) product are presented in Figure 1 (image) and Figure 2 (georeferencing layers).

The georeferencing data are generated through raytracing, based on a 3D digital terrain model. The accuracy of the data are thus limited by (a) the precision of the relative spacecraft-comet orientation, which was determined in the SPC shape reconstruction process and (b) the resolution of the utilized shape model.

The HISTORY section of the .IMG attached headers contain the necessary information to reproduce the data, in particular the name of the shape model with the PDS tag GEO_SHAPE_MODEL. The specified filename is likely not the same as the publicly delivered shape model filename but contains the model name (e.g., SHAP5, SHAP7, …) and number of facets such that it can be related. The PDS OBJECT names of the layers are defined in the OSIRIS SIS [RD2].

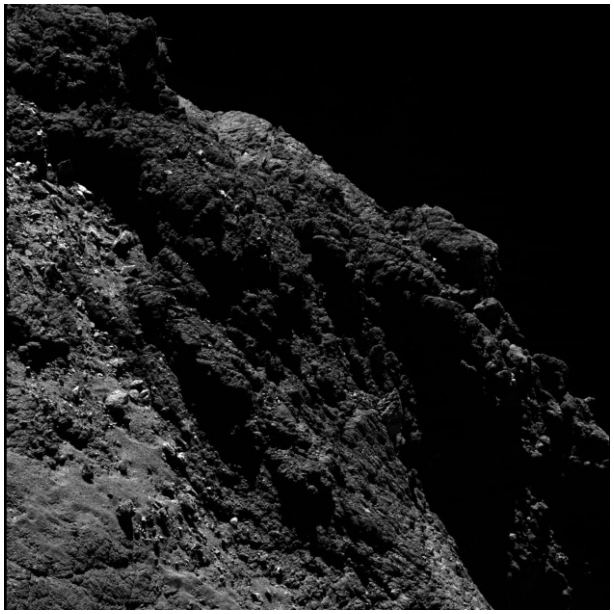

Figure 1: Image layer of the sample product NAC_2016-06-01T08.50.37.949Z_ID40_1397549600_F22 (displayed in Rosetta standard orientation, see [RD2]).

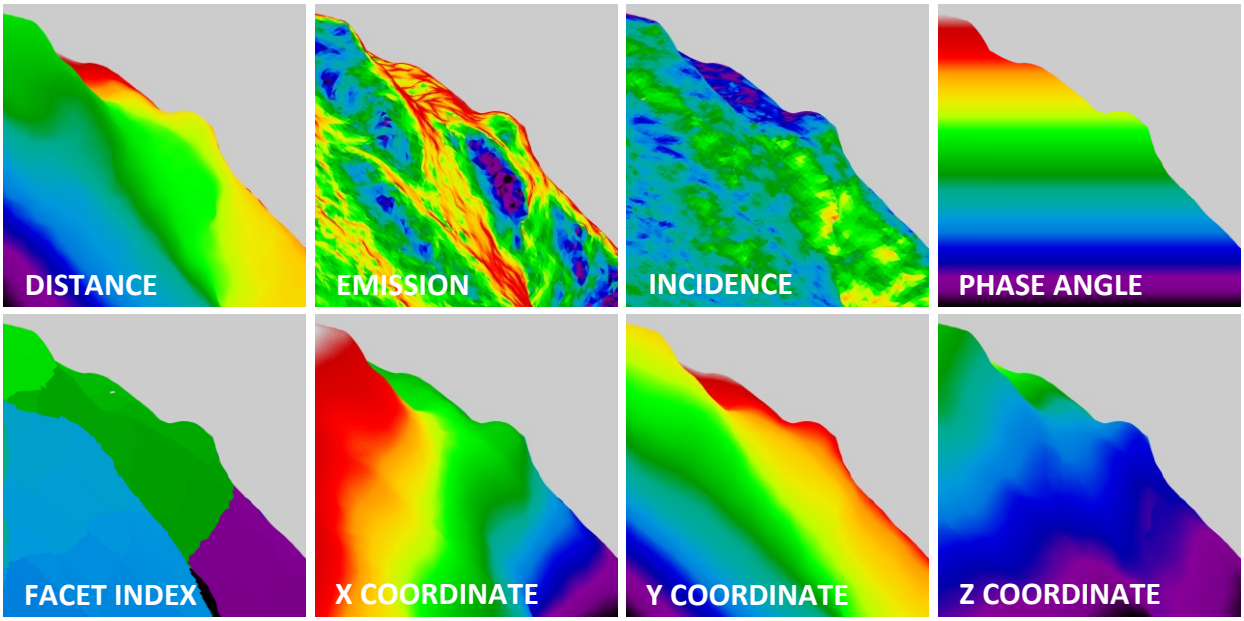

Figure 2: Eight geometry layers for the sample product NAC_2016-06-01T08.50.37.949Z_ID40_1397549600_F22.

2.2 Completeness of the Dataset

The dataset of OSIRIS Level 4 (CODMAC L5) products is created for a subset of lower level images. Out of the approx. 77,000 OSIRIS Level 3 (CODMAC L4) images[2], approx. 38,000 could be georeferenced and produced as Level 4 (CODMAC L5). The procedure for generating these products – as described below – relies on the availability of .SUM files provided by Bob Gaskell (PSI). The initial set of .SUM files covered images that were used for SPC shape reconstruction

[2] The numbers are approximate and intended for illustrative purpose. Exact numbers are maintained in [RD4].

of comet 67P. This implies that no Level 4 (CODMAC L5) data are available for the pre-comet phase of the Rosetta mission.

After the usefulness of these files was recognized in the team, .SUM files were also produced from additional images, which were not initially used for shape model generation. These are preferentially non-saturated images, showing a large fraction of the comet nucleus in the field of view. However, since this data cannot be generated in an automated pipeline, the dataset is not and will not be complete in these terms.

3 Product Generation

The data are generated using the sumxgeo.exe from June 2016, provided by Laurent Jorda (LAM). The software is based on the following input:

- Set of SUM files, provided by Bob Gaskell (PSI) during shape model reconstruction:
  - One .SUM file per image in a non-OSIRIS naming scheme.
  - The file make_sumfiles.in, providing the list of .SUM files and the translation to their internal OSIRIS filename [RD1].
  - The file PICTLIST.TXT, providing a list of bad .SUM files, which are to be ignored.
- Shape model in SPC coordinate system. It is possible to use the SHAP7 SPG model, if it is converted to the SPC coordinate frame.

The software is run on a Linux system, through the Python script sumxgeo.py. The script is parsing the required input files above to run and monitor sumxgeo.exe per image file. The output is one .log file per image with metadata and runtime data and – in the case of success[3] – eight .fts files with the 32-bit georeferenced data. These are copied into the .\geo\ subfolder per observation activity on the OSIRIS internal data server.

The filenames are:

- Logfile: .[level_1_image_filename].log
- Distance: [level_1_image_filename]-d.fts
- Emission angle: [level_1_image_filename]-e.fts
- Incidence angle: [level_1_image_filename]-i.fts
- Phase angle: [level_1_image_filename]-p.fts
- Facet index: [level_1_image_filename]-t.fts
- X coordinate: [level_1_image_filename]-x.fts
- Y coordinate: [level_1_image_filename]-y.fts
- Z coordinate: [level_1_image_filename]-z.fts

The .fts and .log files in the .\geo\ folder are used by the OSIRIS calibration pipeline OsiCalliope [RD2] to create PDS compliant .IMG files with 9 layers as described above in Sect. 2. Since .fts and .log files are intermediate products and all information is covered in the resulting .IMG files, these are not delivered to PSA.

[3] At the time of writing this document, 185 out of 38601 images produce errors in the sumxgeo.exe run. The status is followed on the OSIRIS CVS server, under .\Archiving\Comleteness\geoStatus.txt.