

JAXA ASTEROID DATA EXPLORER (JADE) FOR ACCESSING AND RETRIEVING HAYABUSA2 ONC IMAGE DATA WITH 2D/3D SWITCHABLE MAPS IN A WEB BROWSER. H. Kikuchi¹, M. Yamamoto¹, Y. Yokota¹, H. Sato¹, H. Otake¹, R. Honda², S. Sugita³, T. Morota³, R. Hemmi³, H. Miyamoto³, Y. Yamamoto¹, N. Hirata⁴, N. Hirata⁵, S. Sasaki⁶, G. Komatsu⁷, H. Demura⁴, C. Honda⁴, M. Yamada⁸, S. Kameda⁹, E. Tatsumi¹⁰, S. Murakami¹, Y. Cho³, K. Yoshikawa³, H. Sawada¹, N. Sakatani⁹, M. Hayakawa¹, M. Matsuoka¹¹, T. Kouyama¹², H. Suzuki¹³, K. Ogawa¹, ¹JAXA, Sagami-hara, Japan. ²Kouchi Univ, Kochi, Japan. ³Univ of Tokyo, Tokyo, Japan. ⁴Univ of Aizu, Aizu, Japan. ⁵Kobe Univ, Kobe, Japan. ⁶Osaka Univ, Osaka, Japan. ⁷IRSPS, Università d'Annunzio, Pescara, Italy. ⁸Chiba Tech, Narashino, Japan. ⁹Rikkyo Univ, Tokyo, Japan. ¹⁰Univ. of La Laguna, Santa Cruz de Tenerife, Spain, ¹¹Observatoire de Paris, Paris, France. ¹²AIST, Tsukuba, Japan. ¹³Meiji Univ, Tokyo, Japan. (kikuchi.hiroshi@jaxa.jp)

Introduction: Recent asteroid missions, including Hayabusa, Hayabusa2, and OSIRIS-REx, have obtained various datasets of asteroidal surfaces, which are of great value for scientific analyses and future explorations (e.g., Lucy, DESTINY+). For increasing the availability and applicability of these data, it is crucial to develop a user-friendly system in which image data, metadata, and individual information (e.g., image position) are linked. It is desirable to develop a system that easily allows users to browse and search data according to their requirements.

There are several two-/three-dimensional (2D/3D) visualization interfaces (both in application software and web-based systems) for viewing and searching datasets: for example, the PILOT (U.S. Geological Survey) at <https://pilot.wr.usgs.gov>, Small Body Mapping Tool (Johns Hopkins University) [1], JMARS (Arizona State University) at <https://jmars.mars.asu.edu/>, Solar System Trek (NASA) at <https://trek.nasa.gov/>. As a data retrieval system for existing small celestial bodies, a

2D-3D switchable display is the most desirable interface, which helps research activities (e.g., researchers can browse and study images overlaid on a 2D map and a 3D shape model similar to the way terrestrial geologists investigate a specific area horizontally and vertically). However, the existing systems for browsing image data of small celestial bodies are limited to either a 2D or 3D display. Here, we develop a JAXA Asteroid Data Explorer (JADE) web system that can switch between 2D and 3D map displays of small celestial bodies in the same system (Fig. 1).

Overview: JADE is developed mainly by JAXA's Lunar and Planetary Exploration Data Analysis group (JLPEDA). Its front end is implemented with the standard web technologies and supports major PC web browsers. It uses CesiumJS for 3D visualization.

JADE provides a search interface to Hayabusa 2 ONC images hosted in Data Archives and Transmission

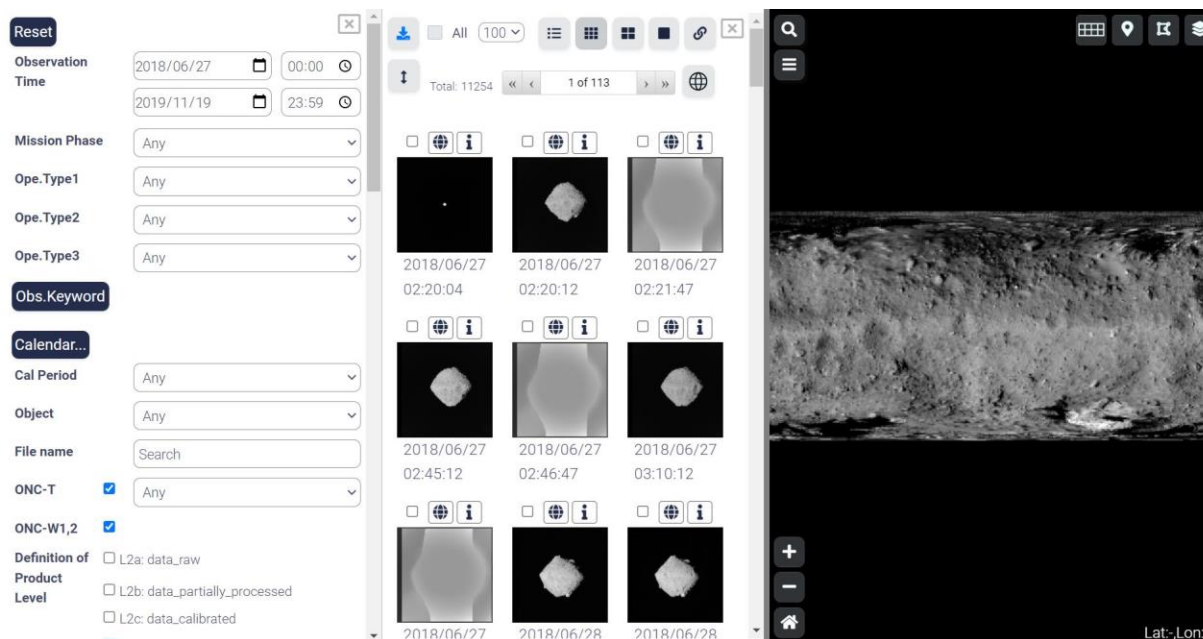


Figure 1. The initial JADE display. JADE is divided into three sections: Search Menu (left), Search results Menu (middle), and Map display (right).

System (DARTS). Users can specify various search criteria. Spatial filtering is supported, and users can specify images with their footprints that are included/intersected with user specified area on the maps. Its back end uses PostGIS to provide such capabilities.

Available data: We used the ONC image datasets of the asteroid Ryugu. Hayabusa2 spacecraft has acquired a vast amount of ONC image data of the asteroid Ryugu, which is the highest level of quality and quantity among all the data explored thus far. The ONC image datasets are well organized, and all of these data will be publicly available widely, which is helpful to demonstrate the system.

The following data have been obtained from the ONC camera of Hayabusa2. The ONC of Hayabusa2 provides detailed information on the data acquisition, such as the imaging time, the distance between the imaging position and the spacecraft, and the solar phase angle at the imaging point. A variety of product-level data have been generated [2]. Characteristic topology types on the surface of Ryugu have been named with the location of the places. Various maps have been obtained by combining high-resolution images or images with several filters [3-5].

Usages: JADE has detailed sorting and filtering functions. It allows users to browse and download the image data they want, arranged according to their preferences.

By switching between 2D and 3D maps, users can specify the polygon or latitude and longitude of any point on Ryugu they want to focus on and obtain image data, including that area (Fig. 2).

Future work: We plan to improve and enhance the existing functionality and support more geometry models and data sets acquired from other missions. Researchers interested in JADE are invited to contact the authors. The following links (<https://jlpeda.jaxa.jp/>) will provide the latest information on JADE.

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References: [1] Ernst C.M. et al. (2018) *LPS XLIX*, Abstract #1043. [2] Honda R. et al. (2020) *LPS MMXX*, Abstract #2685. [3] Sugita S. et al. (2019) *Science*, 364(6437), eaaw0422 [4] Morota T. et al. (2020) *Science*, 368(6491), 654-659. [5] Yokota Y. et al. (2021) *Planet. Sci. J.* 2, 177-209.

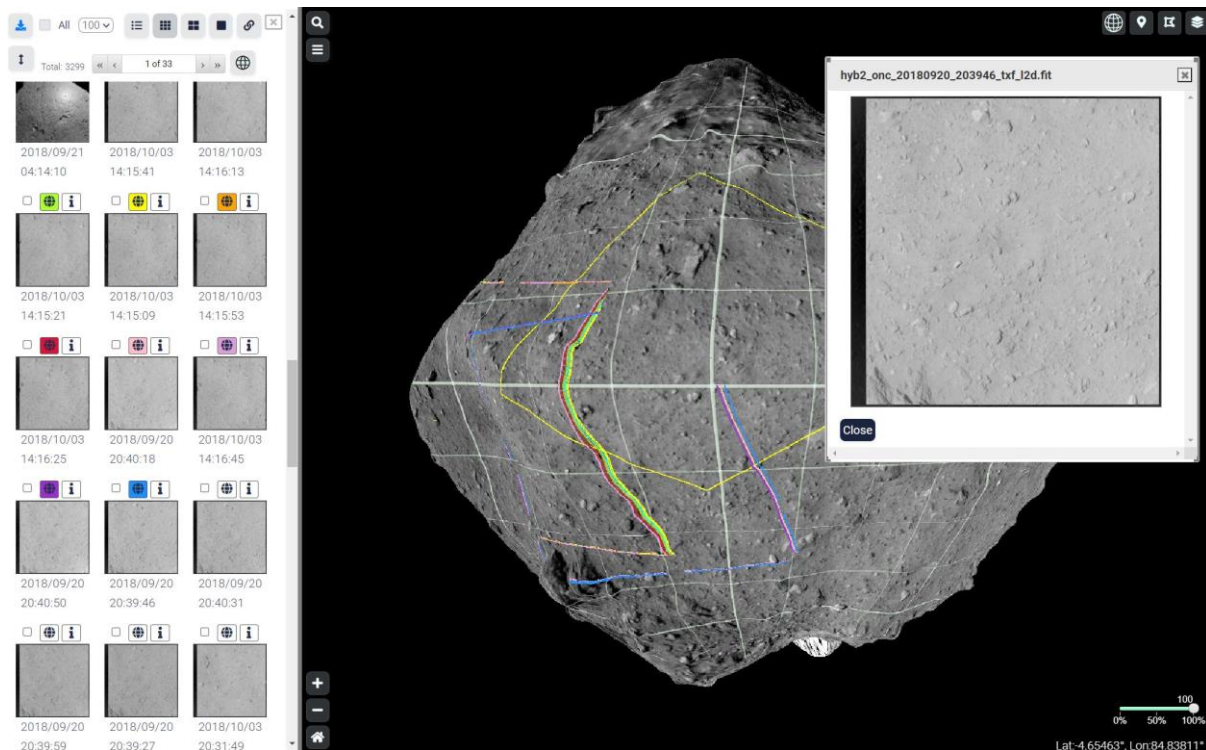


Figure 2. Selection area and search results. The data containing the footprint of the image is displayed in the area specified by the user (yellow). Footprints of some data are shown.