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A Web-GIS for the Kaguya/Spectral Profiler data, "GEKKO" (moonlight in Japanese): toward comprehensive mapping of the surface minerals on the Moon

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Abstract

The "GEKKO" is a Web-GIS to exhibit the reflectance spectra of the Moon observed by the Spectral Profiler (SP) onboard Kaguya satellite. The client can access the system via a web browser and select any area of the whole Moon. The client can view, plot and download the SP data observed at the corresponding location on the referenced lunar image just by mouse-clicks. The system also provides some basic analysis functions. The operation and service of "GEKKO" started in August 2014 for the Japanese lunar science community. We now plan to cultivate the potential users internationally. We are implementing new functions and extending the system. Our final goal is comprehensive mapping of the surface minerals on the Moon.

1. Introduction

The Kaguya satellite, a Japanese lunar orbiter, observed the whole Moon during 2007-2009. The Spectral Profiler (SP) onboard Kaguya is a visible and near - infrared (VIS-NIR) spectrometer and observed the continuous reflectance spectra of the Moon [1].

The lunar minerals characteristically have their substantial absorption bands in VIS-NIR wavelengths which are fully covered by SP instrumental specifications. By using and analyzing the SP data, we can constrain the characteristic quality of the o observed absorption bands in the observed spectra and then identify the surface minerals on the Moon [e.g. 2].

The SP observation spots (footprints) distribute on the lunar surface globally. The total number of the footprints amounts to about 70 million. Each single SP spectrum consists of 296 reflectance components.

Our aim is to comprehensively understand the mineral distribution on the Moon by using the Kaguya/SP data. This study introduces the "GEKKO" which is positioned as a preliminary step for that. The GEKKO system handles all the observed SP data extensively, simply and conveniently. The system is a Web-GIS, therefore, all the client needs is an internet access via a web browser. "GEKKO" is a Japanese term meaning moonlight.

2. Data

We installed the complete data set of SP Level 2C (SP L2C) data product in the GEKKO system. SP L2C data is currently the highest level in the processing phase. SP L2C data includes the latest version of the calibrated SP spectral data [3], ancillary data and the simultaneously observed image data from Multi-band Imager or Terrain Camera both onboard Kaguya satellite. Such simultaneously observed image is indispensable for confining and finding the exact spots of SP observation.

The GEKKO prepares more than10 kinds of base maps of the Moon. The default base map is MI mosaic image [4] and the data is installed in the system as well as SPL2C data set. The other base maps supported in the GEKKO system are the shaded relief map based on the Clementine/UVVIS image [5], the topography map from LRO/LOLA, and the image mosaic from LRO/LROC-WAC which are referred to the Planetary WMS service [6].

3. How to Use this System; Equipped Functions

The client accesses the system by via a web browser and logs-in. The base map of the Moon appears. The client can choose and change the base

map among more than 10 options. The client selects any area on the preferred base map of the Moon controlling zooming-in or -out. Then the footprints of SP observation in that area are marked on the lunar base map image. The clients select a particular SP footprint and then the SP spectrum observed exactly at the corresponding spot is plotted with the graph. At the same time, the text table is shown too, which describes the ancillary data at the time of the observation. The client can register the plotted spectral graph with the observation footprints so that he/she could compare the spectrum observed on the other spots. Every step of the procedure is very simple and completed just with mouse-control.

In addition, the GEKKO supports optional functions. First are the basic analysis functions commonly used for the general spectral analysis, such as running-average and stacking procedure. Second is the continuum-removal function which is useful for detecting the absorption band feature. The system also prepares a function peculiar for the lunar VIS-NIR spectral analysis, which is to multiply coefficients to SP reflectance. By using this last function, the matching of the reflectance of SP at the Apollo 16 site with that of Lunar sample No. 62231 [7] is assured, which means that the direct comparison of SP data with other mission data is possible.

The GEKKO provides download function, too. The clients can download the SP spectral data and also the data after the analyses.

The system configuration and technical details are described in [8].

5. Service Plan

We started the service and operation of GEKKO in August 2014 first for the Japanese lunar science community. We ask the clients to accept the general agreements and keep a single account for one client.

We now plan to extend the service to international use. We are preparing English descriptions and plan to release it this fall. We would like to cultivate the potential users.

6. Summary and Future Works

The “GEKKO” is a Web-GIS to view and analyze the SP data. The client accesses the system via a web browser, and can view and download the SP spectra in very simple steps.

We plan to apply Modified Gaussian Model analysis (MGM) [9] extensively to SP data and archive all the output data in the GEKKO system. The deconvolutioned parameters resulting from MGM-analysis describe the absorption features of the observed spectra which directly link to the uniqueness of the each mineral. We also plan to extend the GEKKO system by implementing a new framework where the client would be able to perform the spectral analysis dynamically, not in a predetermined manner [10].

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