PLANETSERVER: TOWARDS ONLINE ANALYSIS OF INTEGRATED PLANETARY DATA. J. H. P. Oosthoek[1], J. Flahaut[2], A. P. Rossi[1], P. Baumann[1], D. Misev[1], P. Campalani[1,3], V. Unnithan[1], [1]Jacobs University Bremen, Germany, Email: j.oosthoek@jacobs-university.de, [2]Institut d'Astrophysique Spatiale (IAS), CNRS/Université Paris XI, 91405 Orsay, France, [3]ENDIF, Via Saragat 1, 44122 Ferrara, Italy.

Introduction: PlanetServer (www.planetserver.eu), developed at Jacobs University Bremen, is part of the European Union funded EarthServer project [1]. EarthServer, consisting of 6 Lighthouse Applications (climate, ocean, geology, cryosphere, airborne and planetary), each targeted to host 100+ TB, creates infrastructure enabling online access and analysis of exascale Earth and Planetary Science data.

The core of this infrastructure is the rasdaman [2,3] Array Database System. Data ingested in rasdaman can be accessed through Open Geospatial Consortium (OGC) web standards via simple HTTP requests. Service interfaces supported include OGC Web Coverage Service (WCS), Web Coverage Processing Service (WCPS), and Web Mapping Service (WMS).

Within the EarthServer project emphasis is given to use the WCPS standard which provides a database-style query language to access, filter, and process data subsets. WCPS queries have been formulated by the Lighthouse Application developers enabling access to the various datasets. The technology is being advanced to enable easy data ingestion using Web services, or to work on existing data archives directly, without ingest. Further, coordinate reference system (CRS) support is being extended to allow non-EPSG (European Petroleum Survey Group) CRSs such as planetary coordinate reference systems.

PlanetServer infrastructure: We installed the open source *rasdaman community* version 8.3 on a 12-core machine running CENT OS with 128 GB RAM and several tens of TB available storage.

PlanetServer currently focusses on the hyperspectral Compact Reconnaissance Imaging Spectrometer (CRISM) data from Mars [4]. As a demonstration we ingested two 18 m/pixel CRISM Full Resolution Target (FRT) datasets surrounding the NASA Curiosity rover landing site in Gale Crater. Before ingestion the data were 1) photometrically and atmospherically corrected and map projected using the CRISM Analysis Toolkit (CAT) for IDL/ENVI [5] and 2) converted, using GDAL, to a geographic CRS for Mars defined by a 3396190 meter sphere [6].

We also ingested a 5 m/pixel CTX and 12.5 m/pixel HRSC mosaic of Gale crater (see acknowledgements) and a 0.25 m/pixel HiRISE image into rasdaman. Those were made available for visualization through WMS.

Various WCPS queries were created to access (subsets of) the CRISM spectral bands. To allow referencing of data sets, the CRS extension mentioned above was fed with a Mars CRS put into an (unofficial) PS namespace rather than EPSG and identified by a CRS URL as normal, for example: http://my-crsserver/def/crs/PS/0/1.

An OpenLayers-based [7] WebGIS has been developed which uses WCPS queries to enable both spatial and spectral analysis of the CRISM data.

Online CRISM analysis: The current PlanetServer CRISM analysis demonstration WebGIS (Figure 1) consists of an OpenLayers map, zoomed in to a chosen CRISM observation. A CTX mosaic of Gale crater is shown as a background.

A 'Table of Contents' window shows the various layers loaded into the WebGIS. For the CRISM data it shows all the available bands. When selecting a single band, a grayscale image can be visualized using the 'Grayscale' button. RGB combinations can be created by selecting 3 bands and using the 'RGB' button.

A Diagrams window displays either CRISM spectra, laboratory reference spectra (for comparison) or band histograms. CRISM spectra or spectral ratios can be calculated using the 'Spectrum' and 'Spectral ratio' buttons in the toolbar. A pixel is selected by clicking inside the CRISM data extent on the map, and is shown by a dot, colored as its corresponding spectrum.

A Console window has been added which allows for performing band math and spectral math. Various CAT summary products have been converted from IDL to WCPS and can be calculated on-the-fly using pre-defined javascript functions. These calculations allow the mapping of a spectral feature, which is commonly used to identify the presence of a given mineral. An example is *olindex()* which calculates the pre-defined CAT olivine index, and indicates the possible presence of olivine in the scene.

A detailed tutorial on how to use PlanetServer is provided at http://tutorial.planetserver.eu.

Outlook: PlanetServer is currently in development and we are planning to advance the following parts:

CRISM data ingestion: There is currently (December 2012) 13.8 TB CRISM Full Resolution Target (FRT) and 5.9 TB CRISM nadir data available on the NASA Planetary Data System (PDS) archives. We are planning to download, CAT process and ingest all CRISM FRT and nadir data this year. Priority will be

given to regions of interest of the parallel work described in Oosthoek et al., this volume #2565.

WebGIS: The WebGIS spatial and spectral analysis tools will be further developed. This includes adding all the CAT summary products and allowing for the creation of arbitrary band depth images using the Diagrams window.

Rasdaman: Support for generalized CRSs will move on, which is particularly helpful for our Mars data. Reprojection from one CRS onto another as well as some other interesting features suggest switching to the commercial variant, *rasdaman enterprise* [6].

HRSC level 4 data ingestion: EarthServer partner COMETA has downloaded all HRSC level 4 data. Through GDAL the nadir, red, green and blue channels have been combined to create a pansharpened dataset. The next step is rasdaman ingestion allowing for online visualization through WMS.

Online SHARAD visualization: There is currently (December 2012) 3.8 TB of SHARAD (Shallow Radar, MRO, 2005) RDR radargram data available in the PDS. Together with EarthServer partner Fraunhofer we are planning to enable online 3D visualization of this dataset. This will encompass work on data-specific WCPS queries and advancing an X3DOM [9] javascript client. A demonstration is planned for the end of 2013 after which full ingestion can commence.

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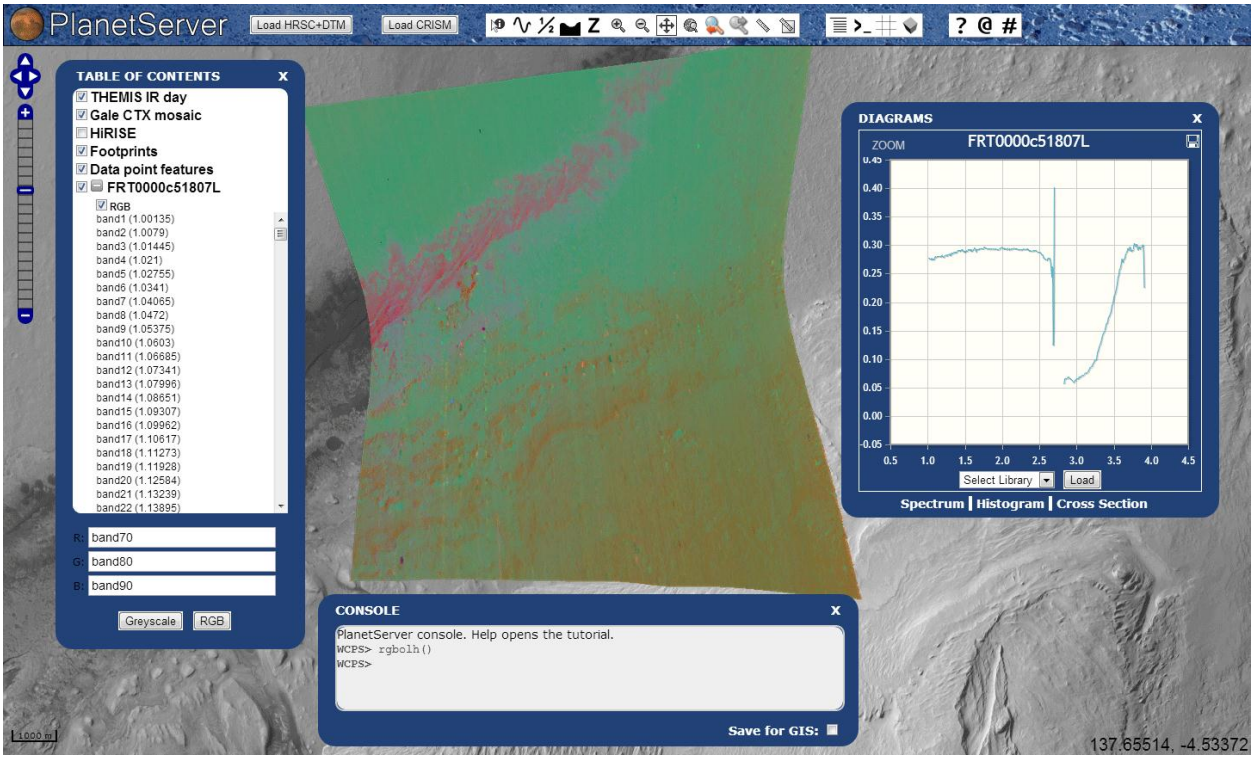

Figure 1. Screenshot showing the current PlanetServer CRISM analysis demonstration WebGIS.