PLANETARY COORDINATE REFERENCE SYSTEMS FOR OGC WEB SERVICES. A. P. Rossi[1], T. Hare[2], P Baumann[1], D. Misev[1], C. Marmo[3], S. Erard[4], B. Cecconi[4], R. Marco Figuera[1]. [1]Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany (an.rossi@jacobs-university.de), [2]United States Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ, 86001 (thare@usgs.gov), [3]GEOPS, Univ. Paris-Sud, CNRS, Univ. Paris-Saclay, Rue du Belvédère, Bât. 509, 91405 Orsay, France, [4]LESIA, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universités, UPMC Univ. Paris 06, Univ. Paris Diderot, Sorbonne Paris Cité.

Background: Recent developments in planetary Geographic Information Systems (GIS) have been discussed across several recent workshops (USGS Planetary Data Workshops [1], ESAC GIS Workshop 2015 [2]), and the state of the art is evolving very rapidly.

Increasingly large amounts of planetary higher level data are available through a variety of Open Geospatial Consortium (OGC) web services [e.g. 3, 4, 5]. A large majority of these web services support the Web Map Service Interface Standard (WMS) [e.g. 6, 7], with a growing availability of service and portals based on the Web Coverage Service (WCS) and Web Coverage Processing Service (WCPS) standards [8, 9, 10]. In all these cases, the use of standards is highly desirable for ease of use and interoperability [e.g. 6].

Coordinate Reference Systems: A fundamental requirement for accurate mapping is the use of a suitable Coordinate Reference System (CRS). In the early 2000s, efforts started to support planetary CRSs within existing services [11]. In 2006, a proposed method to support coded planetary CRSs for OGC web services was published using the "IAU" namespace [6]. This was named after the International Astronomical Union Working Group on Cartographic Coordinates and Rotational Elements (WGCCRE) who standardize the preferred rotation rate, spin axis, prime meridian, and reference surface for planetary bodies. The proposed namespace was created due to the fact that the OGC standardized on a finite numeric set of codes defined by the European Petroleum Survey Group (EPSG). Unfortunately, the EPSG code-set was established for Earth-based applications and does not currently cover planetary needs, therefore an alternative solution had to be found.

OGC CRS Resolver: Even for Earth-based applications, the EPSG coded system has known limitations for the narrow set of predefined CRS systems. To address this, the OGC has begun an effort to extend the EPSG codes with a parametric URL-based CRS scheme called SECORE (Semantic Coordinate Reference System Resolver) [12]. Such a system catalogues and accepts URLs parameterizing CRSs as input and returns CRS definitions formatted using a verbose Geography Markup Language (GML) definition (Figure 1).

To date, the current official OGC resolver [13] does not include planetary projections. Fortunately, there are no technical concerns within the current implementation to limit the support for planetary CRSs.

IAU2000 Updates: At the time the IAU CRS code-set (also known as IAU2000) was created in 2006 [11], we defined the most popular map projections and the current radii values as recommended by the WGCCRE in their 2000 publication [14]. Since then, other map projections have been used for web services and several bodies have been redefined by the WGCCRE (e.g. Enceladus, Iapetus, Mimas, and others). Lastly, the IAU code-set currently only supports the major planetary bodies and their known moons. There is now a need to support asteroids, also known as minor-planets or planetoids, like Vesta, and dwarf planets.

First, to support parameter updates in body sizes and related parameters, we recommend that the IAU2000 namespace can be augmented by simply changing the year in the name. The most recent WGCCRE publication is from 2009 [15]. As an example, all the bodies that have been updated since the 2000 publication will be available with their updated parameters (e.g. radii) using the IAU2009 namespace. Since a new WGCCRE publication is imminent, we may skip the IAU2009 namespace in favor of the most recent publication.

Second, two new map projections, Mollweide and Robinson, will be added to the current IAU code-set. Mollweide is already being used by the Lunaserv WMS server created by Arizona State University [6] and the Robinson map projection has gained favor for displaying global products like the latest global geologic map of Mars [16]. Other projections will be considered if needed.

Lastly, to support asteroids within the IAU namespace, we recommend using the same coded asteroid values as defined by the Navigation and Ancillary Information Facility (NAIF) [17]. To adapt these NAIF codes for use within the IAU namespace, the Vesta coded value would be 200000400. Like other IAU codes, this would represent the original NAIF value of 2000004 * 100 to allow for 100 map projections. For more information on the derivation for these IAU codes please see [10].

Plans: We plan to extend and implement IAU code-set and commonly used planetary CRS within SECORE. Once ingested, these definitions can also be dynamically converted to other formats, such as Proj4 [18] or the "well known text" (WKT) map projection standard. Our test bed will be existing OGC services making use of SECORE, such as the EU-funded project EarthServer for its Planetary Science Data Service [19], as well as those developed within the EU-funded EuroPlanet-2020-RI VESPA [20, 21]. The working planetary CRS SECORE resolver will be linked from [22]: the repository will also include examples and documentation.

Once a reasonably complete list of CRS suiting most needs of web services and portals in use and development is achieved, we would make it available on an informal SECORE instance publicly accessible instance on [18], documented on [19] and instrumental to a more formal, long-term supported solution for the planetary community at large.

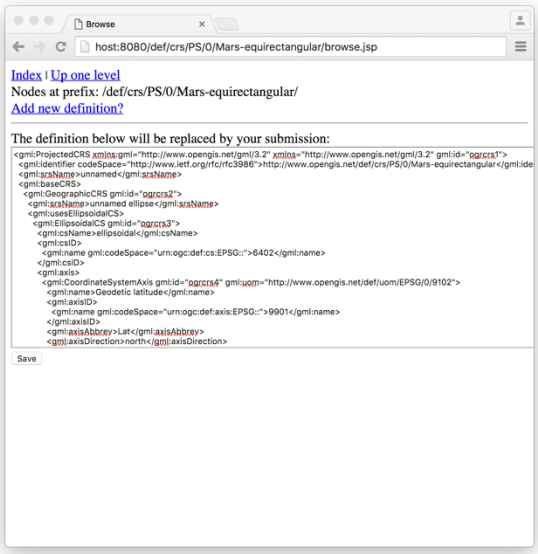

Figure 1: Sample view of SECORE CRS visualized within a web browser window.

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