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Meteorological Data in Concept Based Semantic format Access through Thematic Environmental Distributed Data Server

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Abstract – Several satellite data receiving and distributing centers across the world support data storage, processing and retrieval based on satellite, sensor, product, latitude, longitude, data and time, tec. These systems address queries on satellite products that are mostly high level concepts. A more sophisticated retrieval system that supports ontological concepts, sub concepts and concept hierarchical queries delivers refined results that broaden the scientific horizon of the application domain. This paper deals about the meteorology data deployment in thredds server, ontology management system for meteorology data.

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1. INTRODUCTION

Meteorological information get to focuses stores diverse satellite and sensor information in various organization. The most essential logical information record groups are HDF, NetCDF, GRIB, and so forth the information get to focuses stores, recover, oversee and trade immense volume of information in this configuration. The getting to of this information depends on satellite sensor, date, time interim, longitude, and so on here the idea based information getting to isn't utilized. The question framework reacts according to the parameter perception like, wind profile, Temperature profile. On the off chance that we use idea for each perception parameter, the whole framework moves toward becoming idea based semantic condition. Area explicit idea based getting to upgrades the space information to the clients. Semantic innovation upgrades the space idea bases framework get to. It additionally improves the question based access of the framework like find sea tempest as opposed to finding wind profile. Each perception parameter has determined with its idea, so the end client can without much of a stretch comprehend the parameter with its idea and its association with different ideas. Characterizing idea for each parameter perception, the extremely popular innovation called metaphysics is utilized here. Metaphysics is one of the vital semantic innovation that used to characterize idea and its relationship among ideas for an explicit area. It upgrades the execution of the current framework one stage ahead. Predominantly semantic space – idea based upgrades satellite information recovery. This is a three-overlay innovation which makes the question framework more viable than prior one. Additionally, this framework fills the hole between network logical information and area explicit ontologies through semantic appropriated condition. The constant circulated information server assumes essential job to scatter space explicit idea based information access among different gathering of clients. It gives metadata and information get to administrations to the clients. In this exploration the scientists utilize THREEDS information server to store, get to and oversee satellite information.

2. SATELLITE DATA FILE FORMAT

The satellite data file is available in two main format namely satellite images and observation parameter like temperature, wind, humidity etc. in gridded data file format. The mostly used data file formats are ASCII, HDF5, Binary and GRIB. Hierarchical Data Format (HDF5) is a unique open source technology suite for managing data collections of all satellite data file. HDF5 files are self-describing and allow users to specify complex data and its relationship.

The Hierarchical Data Format (HDF) implements a model for managing and storing data. The model includes an abstract data model and an abstract storage model (the data format), and libraries to implement the abstract model and to map the storage model to different storage mechanisms. The HDF5 Library provides a programming interface to a concrete implementation of the abstract models. Fig 2.1 show the HDF5 file structure format.

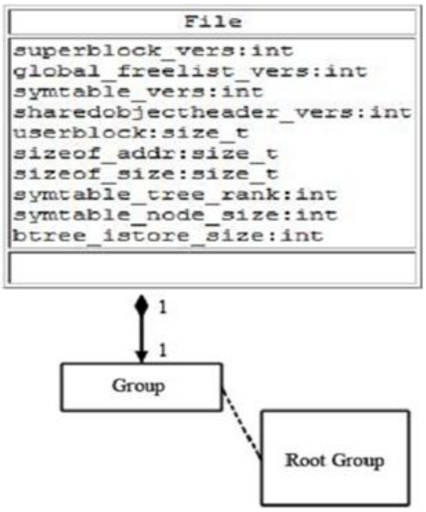

Fig 2.1 The HDF5 File

Some organization like ISRO, AEC, inc- In satellite meteorology (NPOESS), Aqualinc Research Ltd- In field of groundwater hydrology, Australian Nuclear Science and Technology Organization- In field of Neutron and X-Ray Scattering, Cardiff University-Division of Engineering at Cal Tech, is using HDF5 in the field of Ferroelectric materials and C.I.R.A**-** In field of Computational Aero Acoustics uses HDF5 data file format for accessing their scientific data. INSTA-3A and Kalpana satellite data are in HDF5 file format. Fig 2.2 show various components of satellite data in HDF5. The HDF5 Technology suite includes tools and applications for managing, manipulating, viewing, and analyzing data in the HDF5 format.

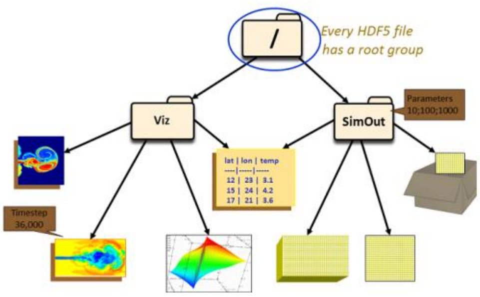

Fig 2.2 Components of HDF5 with respect to Satellite data

HDFView allows viewing of specific HDF-EOS objects, such as Grid, Swath, Point, and Za (Zonal Average for HDF-EOS5), as well as other HDF-EOS metadata. Fig 2.3 show the satellite data viewed by HDF View tool.

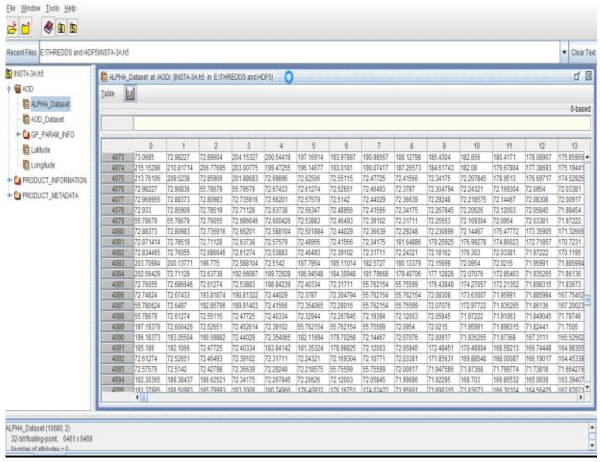

Fig: 2.3. The File Structure of INSTA-3A Satellite

3. SEMANTIC REPRESENTATION OF SATELLITE DATA

Satellite data query system provides search and query option on satellite data based on sensor, date, time span and location. Getting concept based result from huge amount of satellite data is very challenging task. Querying more specific concept based data like gale, wind, freeze, etc. is very tedious. To make the query system more concept based to meet the scientific user needs, the query system should use the semantic technology. Semantic technology and tools enhances the scientific querying system more effective and meaningful. The current system of satellite data retrieval is based on parameter observations and it is in heterogeneous format of data, since data collections from different sensor and satellite. So the heterogeneity among the data is the major bottleneck of the existing system. In this proposed research there exists a research task to create homogeneity in the data products, which enable the data more reusable and sharing, etc. among various applications.

To create homogeneity of satellite data, the current research work uses ontology concept. Ontology define common standard vocabulary at international standards. The weather forecast, or reanalysis of meteorological fields are collections of meteorological parameters that characterize the state of the atmosphere. During the reanalysis of a meteorological data parameters corresponding to measurements at weather stations are usually taken into ontology. All large meteorological data center uses original meteorological models for calculation of climate and meteorological parameters, which can differ both in the level of detail and set of calculated values of physical parameters. These data are represented by common formats, e.g., grib, netCDF, HDF5. The ontology for meteorological data collections in the form of a simplified formal OWL-ontology. OWL is for processing information on the web. This form was created for the selection of data collections

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within system. The OWL DL developed the ontology for climate and weather information resources. The OWL DL describes the collections of data arrays of the data processing environment.

RDF is a framework for reporting resources on the web. The RDF language is a part of the W3C's Semantic Web Activity RDF information can easily exchange between different types of operating systems and application languages. These are used in various satellite data parameter. RDF describes the things using Web identifiers (URIs), and define resources with properties and property values. Here the example of RDF document could describe the resource of satellite: "http://www.satellite.com/RDF":

```
<?xml version="1.0"?>
<RDF>
<Description
about="http://www.satellite.com/RDF">
<Latitude>0000456</latitude>
<Longitude>100532</Longitude>
<Date> 08/07/1988</Date>
<Time> 05:20:40</Time>
<homepage>http://www.satellite.com</homepage>
</Description>
```

RDF is a data model used for metadata is a web resource, and then discover the satellite data parameter. In RDF model, the base element is a triple. Here triple is used for one resource which is associated to another resource. Using RDF schemas new resources can be specify as specialization of old data(satellite data) .Schemas also confine the context in which specified resources may be used in satellite data ,including the notation of schema validity. For example the schema notation rule in RDF format of INSTA -3A is follows:

s,p1,o, p2 T (s,p1,o) Λ T (p1,rdfs:SubPropertyOf,p2) => T(s,p2,o).

Property – It denotes the relationship between resource data. For example, if "**Temperature**" is sub property of "**Sea surface Temperature**" and triple having "**Temperature**" as predicate must also considered as having "**Sea surface Temperature**" as predicate.

4. ONTOLOGY AND ONTOLOGY MANAGER

Meteorological conceptual data pertaining the atmospheric data, such as wind, temperature, air density and other phenomena that affect the operations. Meteorological parameter normally caused by air movements within the atmosphere. All meteorological data are influenced by satellite directly or indirectly and this results in daily or weekly or monthly or yearly trends.

The ontology forms a vocabulary and axioms that can be used to express knowledge base and that can be used for sharing knowledge between different systems. Semantic web is an enhancement to current web so that computers can process the information presented on WWW, interpret and connect it, to help researchers and other organization peoples those who required knowledge about meteorology domain easily. In other words, it is a project that should provide a common framework that allows data to be shared and reused across application.

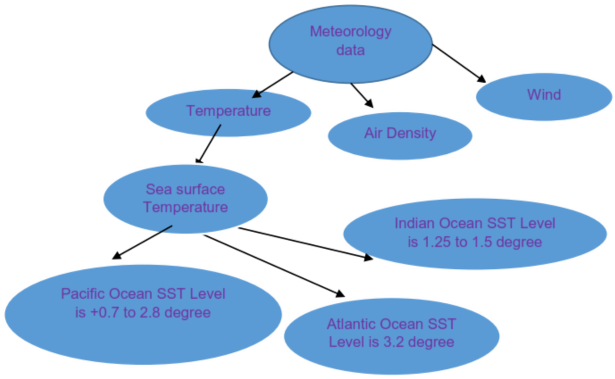

Fig 4.1 Ontology for Meteorology data

The figure 4.1 shows the ontology description of meteorology data.

Defining a Basic Weather Data Ontologies:

► **Geo Location ontology:** First define a common location models then proceed to show how they can be formally defined within the framework of ontology and applied to the integrated management of heterogeneous location information. The location information has been used the geo position and defining a mapping between the relationship like,

Ocean: located in and wgs86_pos: location.

► **Date and Time ontology:** The ontology provides a vocabulary for expression about topological relations among instants and intervals, together with information about durations, and about temporal position including date- time information.

Ontology representation of time consist of four things:

- **Time-interval:** The Constant amount of time can be determined.

- **Time-duration:** The length of the time interval is used to determine time duration.

- **Time-point:** The position in temporal coordinate system which has no duration and is useful in locating event on the time-congress.
- **Time-dimension:** Time is examined a physical dimension such as length, mass or voltage, with unit, and physical effects.

OWL (Web Ontology Language):

OWL is a part of the "Semantic Web Vision". OWL comes with a big vocabulary and heavy syntax than RDF. OWL and RDF are much of the same thing, but OWL is a heavy language with most important machine intelligible than RDF. The Set of technologies and frameworks that enable the Web of Satellite Data. Desirable features identified for Web Ontology Language are; Extends existing Web standards such as XML, RDF, RDFS and Easy to understand and use.

Example: Defining Terms and a Subclass Relationship of Meteorology Data in OWL Language;

Define the term “**Meteorology Data**”

<owl: Class rdf: ID=” Meteorology Data”>

Define term “**Temperature**” and state that Temperature is a type of Meteorology Data.

<owl: Class rdf: ID=”Temperature”>

<rdfs: SubClassOf rdf: resource=”#Meteorology Data”/>

Ontology Editor Tool:

Protégé is one of the Ontology editor tool**. It** is a free, common ontology editor and schema for framework systems. Protégé is used by a various organization like academic, government, and corporate users, researchers who use Protégé as a conformation knowledge-based solutions. Protégé is a Graphical user interface to support ontologies creation, modification, reasoning, debugging. In Protégé the user need to add:

√ Object properties

√ Relations between classes

√ Definable classes

In Protégé, the constructed class hierarchy is called the asserted hierarchy. It is automatically computed by the tool is called the inferred hierarchy. Computing the inferred class hierarchy is known as classifying the ontology. An OWL ontology consists of Individuals, Properties, and Classes, which correspond to Protégé frame Instances, Slots and Classes. An important difference between Protégé and OWL is that OWL does not use the Unique Name Assumption (UNA).

Fig 4.2 shows the structure of Temperature Classes and Object Properties using Meteorology Ontology structures:

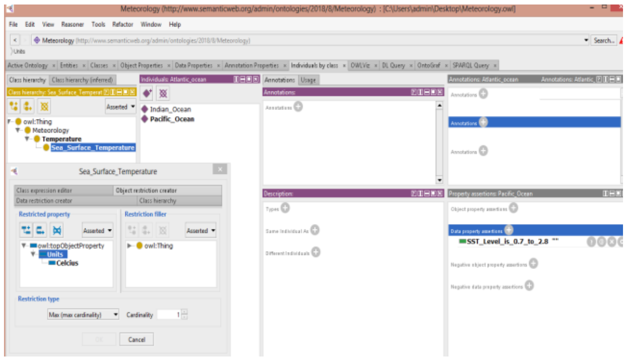

Fig 4.2 Temperature Classes and objects Using Protégé

5. HANDLING ENVIRONMENTAL DATA SERVER (THREEDS)

The handling of meteorological data in server is very difficult because the server having the issues like, arising network problem, system busy, bad configuration and FTP warning. Simultaneously run the web server and data server is big challenge. But distributing meteorological data to end users through OGC, we need to run both the servers. First we have to configure the THREDDS with Java Development Kit - 8 (For JRE), Apache Tomcat - latest version, THREDDS .war file - latest version. Install JDK, tomcat, then deploy the thredds war file in the apache tomcat server. Once the servers installed successfully installed, we can start the server and deploy our scientific data in the Thredds server. Fig 5.1 shows the data server after deployed our data.

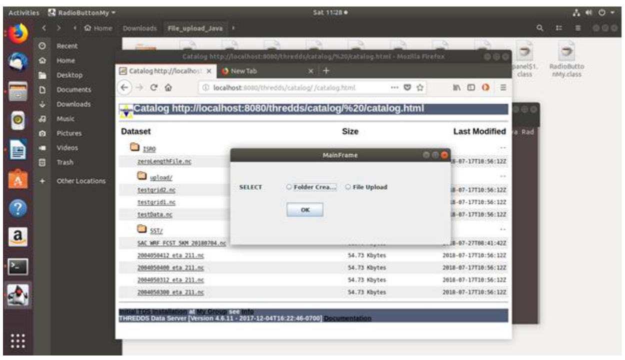

Fig 5.1 Data Deployed in Thredds Server

Once the data deployed in the server, we have to enable the data access services. There are three kinds of services we can enable in the server, Open access service, Catalog service and web content services through thredds server configuration files. After enabling data access

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service, the data file will open as shown in the fig 5.2. Here we are using OpenDAP protocol.

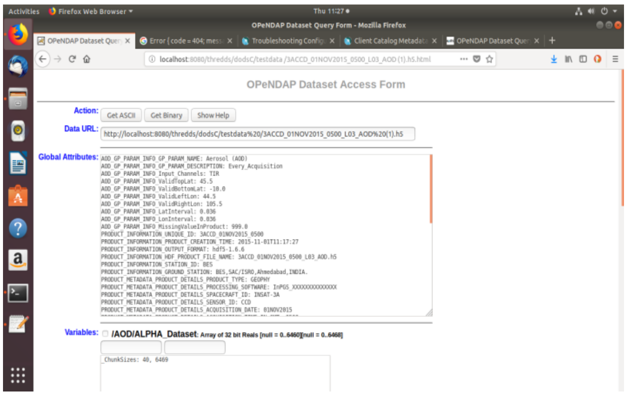

Fig 5.2 Enabled OpenDAp Protocol in Thredds

In this work, we are getting data from MOSDAC. This data is in the format of .h5, which cannot be directly access by the end users. So we are deploying the data in the thredd server, defining Ontology for each parameter of meteorology data so that the users can understand the terms with respect to its parametric range.

6. CONCLUSION

This work concentrated on another strategy introducing a nonexclusive methodology speaking to sensor information items with global standard Sensor Parameter Ontology vocabulary supporting information trade, data interoperability among different logical plans of server farms. This exploration work has tended to the need emerging out of complex multidimensional multi-parameter sensors and frameworks in centering and overseeing exceptionally heterogeneous voluminous information. This has consequently, empowered the straightforwardness for interoperability in defining consistent semantic trade of information. This examination work empowers and encourages the interface among different research facilities, server farms, organizations and foundations into a typical stage for simple exchange and information sharing abilities touched base through an itemized assessment of the restrictions of the condition of-craftsmanship advancements, which has been convincingly shown utilizing ongoing INSAT-3D satellite information. The approach accomplishes satellite information interoperability over the world among heterogeneous application spaces.

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REFERENCES

1. Marjan Alirezaie, Andrey Kiselev, Marjan Alirezaie, Andrey Kiselev (2017). An Ontology-Based Reasoning Framework for Querying Satellite Images for Disaster Monitoring”, 2017[Online].Available: http://www. www.mdpi.com.

2. A. Sunitha (2015). INSAT 3D Mapping”, [Online]. Available: http://mmisw.org/orr/#http://mmisw.org/ont/SunithaAbburu/

3. Voc 2RDF (2008). A web-based transform simple vocabularies into the Resource Description Framework, [Online]. Available: https://marinemetadata.org/voc2rdf.

4. A. Sunitha (2015). INSAT 3D Data Product Vocabulary”, [Online]. Available: http://mmisw.org/orr/#http://mmisw.org/ont/SunithaAbburu

5. R. A. Samina, S. R. A. Syed, K. Mei, D. Ali (2012). “An Ontology Framework for Modeling Ocean Data and E-Science Semantic Web Services,” International Journal of Advanced Computer Science, vol. 2, no. 8, pp. 280-286. [Online]. Available: http://www.ijpg.org/index.php/IJACSci/article/view/146/100.

6. O. Daniel (2014). "How Ontologies Benefit Enterprise Applications", Semantic Web – Interoperability, Usability, Applicability (SWJ), IOS Press, Vol. 5, No. 6, pp. 1-5, [Online]. Available: http://www.semantic-web-journal.net/content/how-ontologies-benefitenterprise-applications-0.

7. W3C Semantic Sensor Network Incubator Group, Semantic Sensor Network Ontology, 2005. [Online]. Available: http://www.w3.org/2005/Incubator/ssn/ssnx/ssn.

8. Motik, B., Sattler, U. Studer, R. (2005). Query answering for owl-dl with rules, [Online]. Available: https://www.cs.ox.ac.uk/boris.motik/pubs/mss04dl.

9. Klien, E. (2007). A rule-Based strategy for the semantic annotation of geo data, 2007 [Online]. Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-9671.2007.01054.x.

10. J. Yoder (2009). “Ocean colour radiometry: Early successes and a look towards the

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future," [Online]. Available:http://www.oceanobs09.net/.../Yoder_OO09PlenaryDraft_Ocean%20Colour%20Radiometry.

11. Thomas, A.C., D. W. Townsend and R. Weatherbee (2003). "Satellite-measured phytoplankton variability in the Gulf of Maine", [Online].Available: https://www.researchgate.net/

12. Rahul Ramachandran, Univ. of Alabama, Huntsville, AL; and S. Movva, S. Graves, and S. Tanner (2006). "Ontology-based Semantic Search Tool for Atmospheric Science", [Online]. Available: https://ams.confex.com/ams/

13. Álvaro Sicilia, Fatima Galan, Marco Massetti Leandro Mad Razo (2016). "Ontological Representation of Knowledge Related to Building Energy-efficiency, [Online]:Available: https://www.thinkmind.org/

14. A. Sunitha (2016). Satellite Parametric Description to Ontology Concepts and Semantic Classification of Satellite Data, [Online] Available: https://www.igi-global.com/

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