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VITMO: A Virtual Observatory for the Ionosphere-Mesosphere-Thermosphere Community

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The ionosphere, thermosphere, and mesosphere (ITM) community studies an area of the atmosphere that is a transition region between the atmosphere and space, where many important physical and chemical processes change dramatically temporally and spatially. As a result, the areas of studies within the ITM community span a wide spectrum of scientific subjects in geophysics and space physics. As the different sub-fields mature, a system-oriented approach to understand the ITM as a whole and its relationship to the sun and the surrounding geospace environment is critical. This approach requires a data system with efficient access to all data sets (present and historical) relevant to disciplines across agencies, including NASA, NSF, NOAA and others. The relevant data for the community collected during the past few decades consequently come from a variety of sources including ground and space-based instruments as well as from modeling and data assimilation. This data has a number of differences from data in other domains. We observe the ITM region using a variety of techniques and data sources, including ground based remote sensing instruments, satellite based remote sensing instruments, and in-situ satellite instruments. In addition, there are external drivers in solar radiation and the solar wind and magnetospheric particle inputs. A Virtual Observatory that covers the ITM region needs to deal with the large diversity of data types and data formats in the study of this region. We present a Virtual ITM Observatory (VITMO) implementation for such a data system that leverages current resources. The VITMO that is proposed here will sit above mission datacenters and provide outside users with the ability to find data sets across multiple datacenters and more importantly, find those datasets that overlap in time and/or space allowing coor-

dinated observations of phenomena. This will create a “true virtual observatory” that utilizes many different instruments to study a given system or phenomena. The design incorporates a modular framework that accepts distributed data and services from across the community and encourages widespread participation. Data can be added as both new missions and historical holdings become available, and services added or replaced as technologies and standards evolve. The core VITMO system is based upon a set of services: centralized browse and query/retrieval of distributed resources, access to data reader software and other tools, and integration of current data with data from previous missions and long-term data sets. The VITMO will allow vastly improved complex data search and location capabilities allowing multidisciplinary and multisatellite studies to be performed. An example of such a complex search would be something like the following: “what near Earth orbiters are observing the auroral region when Bz is negative and the solar wind speed is greater than 400 km / sec.?” Today, this would require a manual process where the researcher would first find plots of the Earth’s magnetic field component (Bz) and plots of solar wind speed from NASA’s CDAWeb (http://cdaweb.nasa.gsfc.gov). After they manually looked for overlap conditions they would utilize these time periods to search known Earth orbiters to find out if they were observing during those time periods. They would then have to manually review summary products to determine if those orbiters were viewing the auroral region during those intervals. The VITMO uses a novel approach to handle these types of queries automatically. The VITMO approach is easily extensible to future data sets and will be able to tie into Virtual Observatories in other domains as either a peer node or a service. The VITMO will also organize tools, whether plotting, subsetting, or analysis tools by the type of data they are to be applied to as well as the types of operations that are to be performed. If the user requests time series data then tools appropriate for operating on the time series will be presented to them. If they chose images then tools appropriate for images will be made available. If the data is in CDF format, then FITS format data tools will not be presented. Additionally, the VITMO will understand that model output can be treated as high level data products and that models should be available, just as tools are, to the end user. Relevant tools and models will be presented to the user through a tabbed browser interface. This interface is generated dynamically based on the metadata in the VITMO catalog that describes the data, tools, and models available through it. The VITMO will initially organize data from TIMED, AIM, C/NOFS, UARS, and SuperDARN data sets as well as CDAWeb, SSCWeb, and ModelWeb web services.