A view of International Landscape of Open Science and Research Data Sharing

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Since the G8 Science Ministers' Meeting in UK 2013, Open Science policy and practice have been intensively discussed in related countries. Many bodies have been committing this activity like academic committees ICSU-World Data System (WDS) and Committee of Science and Technology Data (CODATA), RDA (Research Data Alliance), a data consortium in connection to G8 Group of Senior Officials (GSO)'s data infrastructure working group, and recently OECD (Organization of Economic Cooperation and Development) Global Science Forum, etc. In Japan, Cabinet Office of Japan played a leading role in Japan to publish the first national guiding principle of Open Science for Japan (March 2015). In 2016 G7 Science and Technology Ministers' Meeting was held in Japan, including the Open Science session as one of its six main themes.

Open Science is rapidly becoming an important focus of international discussions for its possible big impacts on scientific research, and also citizen, the Society and its economy. Recognising our scientific knowledge basis accumulated on "print technology" basis (books, articles) for more than 300 years, advantage of digital technology and electronic information and communication (ICT) infrastructure is emphasized in terms of high-speed and huge-volume data processing although it has only a 70-year history. Accessibility, sharing, interoperability of data and infrastructure, citability, and reuse are important prerequisites. Regardless of the open or closed policy, the capacity to assess trustworthiness of datasets, to preserve and manage them in an organized way, and to enable professional and non-professional reuse to create new knowledge are important in the context of Open Science.

Long-term preservation of digital data raises questions such as the size of data we should preserve, the preservation period (50-100 years similar to academic articles?), the increasing costs of bigger size of data (at present), and so on. In the scientific research data area, an international enterprise, the World Data Centres, was established by the International Council for Science (ICSU) in 1957-58 to exchange and store important scientific data as data books and microfilms. With the unprecedented technical infrastructure available today over the world and the need for multidisciplinary data integration to solve the most pressing challenges facing humanity, ICSU decided to form the new ICSU-World Data System (WDS) in 2008 based on the strong legacy of its two data organizations in past. The International Programme Office of WDS is now hosted by NICT in Japan, Tokyo. WDS works with its member organizations—holders and providers of data—to secure trustworthy, sustainable and findable data archives.

Libraries in past have been based on the print technology mostly. They selected books, improved preservation, and built the international network of exchange and copy of books. We are now on the starting line to construct a similar infrastructure for electronic data resources in academic fields. These efforts to support and promote best practices, will lead to building a new layer on top of the current ICT technology layers. This change has potential to lead to wide reuse of datasets with greater interoperability. Experiences and best practices in past academia are indispensable important legacy for us to help designing a new academic information infrastructure in this new era.

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Challenges and Motivations for International Coordination of Open Science Data Infrastructures

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Modern scientific research is an increasingly global endeavour and sharing common resources and instruments is becoming the norm. Scientific progress is built on the exchange of knowledge and practice—literature, data, and other research artefacts—amongst researchers in the scientific community. Data are widely recognized as a foundational and essential element of research and their availability, sharing and reuse are at the core of the Open Science paradigm.

Scientific communities have long come together to coordinate their research activities internationally including the management and stewardship of data. Taking advantage of the new information and communication technologies, they also enabled the physical networking of research data infrastructures which led to the emergence of large-scale regional and global research data infrastructures supporting science. These global data infrastructures became a reality in pioneering research domains such as astronomy, genomics, and Earth sciences resulting in more efficient research and revolutionizing the conduct of research.

However, these international networks face many challenges because they cut across national boundaries, (scientific) cultures, and sometimes disciplines. Their success is heavily dependent on the convergence and synergies between diverse national (data) policies and funding schemes. Furthermore, these international networks are largely focussing and serving specific domains, thus re-creating silos of data infrastructures when the challenges facing society require multi- and transdisciplinary data infrastructures.

This presentation will review several examplars in the Earth and Space sciences, analyze common practices and approaches to derive lessons learnt and identify key issues that require policy actions, and the types of actions that might be appropriate.

Keywords: Global Data Infrastructure, Open Science, International Coordination

Recent activity of DOI-minting to solar-terrestrial physics data

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Data-DOI, data publication, and data citation will promote "Open Science". Recognizing their importance, solar-terrestrial physics (STP) data centers in Japan have been working to mint DOI to their database. We participated from October 2014 in a 1-year pilot program for DOI-minting to science data launched by Japan Link Center, which is one of the DOI registration agencies. In the pilot program, a procedure of the DOI-minting for STP data was established. As a result of close collaboration with Japan Link Center, the first case of data-DOI in Japan (doi:10.17591/55838dbd6c0ad) was created in June 2015. The first case of data citation in Japan was also made. As of February 2017, there are 16 data-DOIs for the STP data in Japan. In the International Association of Geomagnetism and Aeronomy (IAGA), STP domain scientists who are working for data centers or observatories started discussion about DOI-minting to their data and a task force was formed in August 2013. The next IAGA (joint) assembly that will be held at Cape Town in August 2017 provides a special session entitled "The referencing of geophysical data products: The role of DOIs". The international effort will be continued for DOI-minting to scientific data in STP.

Toward Open and Beyond! Sharing Data in the Earth Sciences

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The paradigm of Open Science is recognized as a powerful and essential catalyst for the advancement of science in the 21st century, and as a necessary and guiding principle for the integrity and validity of research to ensure trust in the scientific process and its results. One of the primary requirements of Open Science is the open sharing of data, code, and other research materials on a global scale. This is especially relevant in the Earth Sciences, where urgent societal problems such as climate variability, effective prediction of natural hazards, and sustainable management of the natural resources cannot be answered with locally constrained datasets and where society must have confidence in the basis for impacts and decisions that can have large economic and societal effects. Over the past few years, publishers, repositories, and funders have developed a number of best practices around presenting, linking, and curating these related research products. Our presentation will focus on these best practices for sharing data, code, and samples and on developing the broader infrastructure that can support such data sharing in a sustainable manner. We will report on progress made in the Earth Sciences over recent years towards the open sharing of data in the Earth Sciences, reporting on US-based and international initiatives such as EarthCube and COPDESS. We argue that the concept of ‘open’ is not a sufficient and adequate goal; instead open data must be FAIR –findable, accessible, interoperable, and re-usable. This requires additional support by the community so that data can be explored and interpreted with confidence and in new multi-disciplinary perspectives.

Keywords: Open science, Data sharing, Research infrastructure

Development status of the metadata server and data archives at Tohoku University for collaborative studies using planetary radio and spectroscopic data

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Data archive of Jovian radio emissions in decametric wavelength range (DAM, 20-40 MHz) measured at ground stations of Tohoku University was started in 2004. Metadata services for IUGONET (Inter-university Upper atmosphere Global Observation NETwork, supported by the Special Educational Research Budget, and the Special Budget Project from MEXT (the Ministry of Education, Culture, Sports, Science and Technology), Japan in 2009-2014) and EuroPlanet/VESPA (Virtual European Solar and Planetary access) were also started in 2009 and 2015 in collaboration with IUGONET-member organizations, and Paris Observatory team. In 2016, we developed data archives of solar radio waves in VHF/UHF range obtained by IPRT (Iitate planetary radio telescope), and planetary spectroscopic data obtained by Hisaki spacecraft, and started providing their metadata for VESPA with support of JSPS France-Japan Bilateral Joint Research Program "Coordinated observational and theoretical researches for Jovian and Kronian auroral radio emissions". We are planning to add metadata of Jovian radio wave data from observatories of Kochi National College of Technology, and Fukui University of Technology, planetary spectroscopic data from Tohoku University observatories in Hawaii, and solar wind parameters from Tao's model.
Ground-based observations with multi-longitudinal stations enable us 24-hour continuous track of the activity variation of the Jovian auroral radio emissions. By using Spectrograms of Jovian decametric radiation obtained at Nancay and Iitate observatories, and spectroscopic data from Hisaki spacecraft, we are performing analyses of the effects of the Io's volcanic activity in 2015 on the occurrence timing of the arc structures in the spectrogram of Jovian decametric radiations. Source identification method of the Jovian decametric radiation was developed based on Nancay data [Marques et al., 2016]. We are going to apply the method to dataset including Iitate data, and utilize for statistical analyses. Another merit of the ground-based observations is that we can use facilities such as large antenna array, high time/frequency resolution receivers, high-speed networks, and large amount storages, which are difficult to use in the spacecraft observations. We participate Juno ground support team and exchange the information on support observation schedules.
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キーワード：木星デカメータ電波、IUGONET、Europlanet/VESPA
Keywords: Jovian DAM, IUGONET, Europlanet/VESPA

Science Services: Examples of Opening Research Data to the Scientific Ocean Drilling Community and General Public

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The IODP is a wildly successful example of a long-term, international, collaborative science research program. Once solely managed by a US consortium, operating one ship, it now includes three international agencies/science operators working together, each operating/contracting their own vessels. The data and samples resulting from these collaborative efforts now reside in three regional core repositories, with each region also operating it’ s own database. While standards and policies regarding the treatment of data and samples are extremely mature, each region has approached data management differently.

With the recent momentum behind open data and open access to science data and samples resulting from public investment increasing, it’ s important to ensure that these important scientific ocean drilling resources are readily available to the science community and the general public.

I examine the current status of each drilling database, and discuss the efforts to improve data services among the three science operators.

Keywords: scientific ocean drilling, international ocean discovery program, open data

Digital Typhoon and open science - a trans-disciplinary platform for typhoon-related data

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Digital Typhoon is a transdisciplinary platform for typhoon-related data. It is the database of not only research data, but also society and citizen derived data such as news text and social media. It covers not only current data, but also past data to make comprehensive data archives, such as 40 years of satellite and ground observation data and 100 years of weather chart data. A variety of typhoon-related data is not only stored in silos, but also linked with other data across domains, and indexed using data-driven algorithms to make them findable. In short, Digital Typhoon offers the collection of best practices about how data can be integrated and indexed to make them findable, accessible, interoperable and reusable (FAIR). As a result, Digital Typhoon has been used not only by scientists but also by citizens for a variety of purposes such as for research, work, and hobby, with annual page views of 10 to 20 million for more than 10 years since 2003. In the context of Open Science, we share our experience on more than 10 years of operating this platform, and our challenges to make this platform sustainable against internal and external problems.

キーワード：台風、デジタル台風、オープンサイエンス、超学際的プラットフォーム、コミュニケーション、気象
Keywords: typhoon, Digital Typhoon, open science, transdisciplinary platform, communication, meteorology

VESPA: a community-driven Virtual Observatory in Planetary Science

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The VESPA data access system is intended to apply Virtual Observatory standards and tools to Planetary Science. Building on a previous EU-funded Europlanet program, it has reached maturity during the first year of a new Europlanet 2020 program (started in 2015 for 4 years). The infrastructure has been upgraded to handle many fields of Solar System studies, with a focus both on users and data providers. This paper describes the broad lines of the current VESPA infrastructure as seen by a potential user, and provides examples of real use cases in several thematic areas, together with hints for future developments.

Keywords: Virtual Observatory, Solar System, GIS

System architecture enabling runs on request for a Transplanet model of magnetosphere-ionosphere coupling at Earth, Mars, and Jupiter

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Under Horizon 2020, the Europlanet 2020 Research Infrastructure (EPN2020-RI, http://www.europlanet-2020-ri.eu) includes an entirely new Virtual Access Service, "Planetary Space Weather Services" (PSWS) that will extend the concepts of space weather and space situational awareness to other planets in our Solar System and in particular to spacecraft that voyage through it. PSWS will provide at the end of 2017 12 services distributed over 4 different service domains –1) Prediction, 2) Detection, 3) Modelling, 4) Alerts. These services include in particular a Transplanet model of magnetosphere-ionosphere coupling at Earth, Mars, and Jupiter that enable the users to made runs on request of the model, archive and/or connect the results of their simulation runs to various tools developed in the Virtual Observatory. The present paper will first describe the Transplanet model, and then present the system architecture developed by the Space Plasma Physics Data Center (http://www.cdpp.eu) in France in order to make the service operational (http://transplanet.irap.omp.eu).
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Keywords: Planets, magnetosphere, ionosphere, runs on request, Virtual Observatory, Data archive

Recent science developments of the French Plasma Physics Data Centre (CDPP)

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The French Plasma Physics Data Centre (CDPP, http://www.cdpp.eu/) addresses for nearly 20 years all issues pertaining to natural plasma data distribution and valorization. Initially established by CNES and CNRS on the ground of a solid data archive, CDPP activities diversified with the advent of broader networks and interoperability standards, and through fruitful collaborations (e.g. with NASA/PDS): providing access to remote data, designing and building science driven analysis tools then became at the forefront of CDPP development. Today the CDPP tool AMDA helps scientists all over the world accessing and analyzing data from ancient to very recent missions (from Voyager, Galileo, Giotto, ... to Maven, Rosetta, MMS, ...) as well as results from models and numerical simulations. Other tools like the Propagation Tool or 3DView allow users to put their data in context and interconnect with other databases (CDAWeb, MEDOC) and tools (Topcat). This presentation will briefly review this evolution and demonstrate technical and science use cases. The presentation will ultimately show how CDPP activities will serve future missions (BepiColombo, Solar Orbiter, THOR, ...).

Keywords: data centre, analysis tool, archive, plasma data