Benefits and Challenges of Developing Standards for Earth Observations

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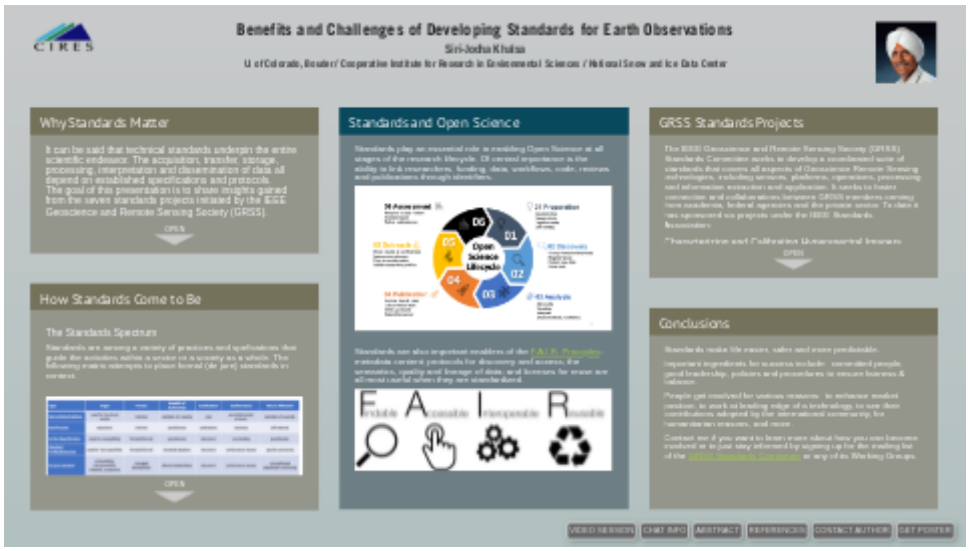
Abstract

Data is the lifeblood of the geosciences. The acquisition, processing and interpretation of data all depend on established specifications describing the systems and procedures that were used in producing, describing and distributing that data. It can be said that technical standards underpin the entire scientific endeavour. This is becoming ever truer in the era of Big Data and Open, Transdisciplinary Science. It takes the dedicated efforts of many individuals to create a viable standard. This presentation will describe the experiences and status of standards development activities related to geoscience remote sensing technologies which are being carried out under the auspices of the IEEE Geoscience and Remote Sensing Society (GRSS). While the value and viability of community-developed principles and specifications have been amply demonstrated, a Standards Development Organization (SDO) exists to provide the environment, rules and governance that are needed to ensure the fair and equitable development of a standard, and to assist in the distribution and maintenance of the resulting standard. The GRSS sponsors projects with the IEEE Standards Association (IEEE-SA), which, like other SDOs such as ISO and OGC, has well-defined policies and procedures that help ensure the openness and integrity of the standards development process. Each participant in a standards working group typically brings specific interests as a producer, consumer or regulator of a product, process or service. Creating an environment that makes it possible to find consensus among competing interests is a primary role of an SDO. This presentation will include highlights and insights gained from the seven standards projects that the GRSS has initiated. These projects involve hyperspectral imagers, the spectroscopy of soils, data from synthetic aperture radars and GNSS reflectometry, calibration of microwave radiometers, and the characterization of radio frequency interference in protected geoscience bands.

Benefits and Challenges of Developing Standards for Earth Observations



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PRESENTED AT:

WHY STANDARDS MATTER

It can be said that technical standards underpin the entire scientific endeavor. The acquisition, transfer, storage, processing, interpretation and dissemination of data all depend on established specifications and protocols. The goal of this presentation is to share insights gained from the seven standards projects initiated by the IEEE Geoscience and Remote Sensing Society (GRSS).

Watch a 3 min introduction to this poster:

[VIDEO] https://res.cloudinary.com/amuze-interactive/video/upload/vc_auto/v1639679240/agu-fm2021/1C-F4-D5-77-2B-B8-64-3F-95-47-C8-9B-38-D1-F4-5F/Video/AGU_FM_ePoster_3min_summary_lower_res_je0npa.mp4

HOW STANDARDS COME TO BE

The Standards Spectrum

This presentation is part of the session titled *Adopting Principles to Enhance Capabilities for Using Earth Science Data*. Principles, when made explicit, are specifications or guidelines for doing something in a certain way, so actually what we're talking about is standards.

In the most general sense, a standard is something established by custom, general consent or authority as a model to be compared against, a rule for measuring the quantity, weight, extent, value or quality of something. When we speak of technical standards, we're speaking of published documents that establish specifications and procedures designed to maximize the reliability, interconnectivity, interoperability, and performance of materials, products, methods or services.

The table below attempts to place formal (*de jure*) standards in the context of many other types of standards. *De jure* standards are distinguished mainly by the fact that they were created under processes managed by a standards development organization (despite the name, this doesn't mean *de jure* standards necessarily have the force of law). The benefit of working under an SDO is that it provides the rules and governance that are needed to ensure fairness and transparency, and the mechanisms to assist in the distribution and maintenance of the standard. Working with an SDO can also attract broad stakeholder representation and provides a means to assess conformance to the standard.

There are also *de facto* standards, which can be just as rigorous as *de jure* standards, and have influence by virtue of their widespread adoption. A best practice can come to be recognized as de facto through widespread adoption but may be more loosely documented, e.g. through a journal article or technical report. Nearly all types of standards can be initiated through community activities (i.e. bottom-up) or through the needs of an industry, organization or government (i.e. top-down).

Type	Origin	Process	Breadth of Authorship	Codification	Conformance	Who is Affected?
Norm/ethic/tradition	need for functional society	informal	members of a society	oral	parental/societal pressure	members of a society
Best Practice	experience	informal	practitioners	publications	voluntary	self-selected
Ad hoc Specification	need for compatibility	formal/informal	practitioners	document	non-binding	practitioners
Standard Profile/Extension	need for more specificity	formal/informal	standards adopters	document	conformance clauses	specific community
De jure standard	compatibility, interoperability, reliability, acceptance	managed development	affected stakeholders	document	conformance clauses	narrow/broad stakeholder community
Code	need for safety, reliability	needs survey	local jurisdiction	document	law enforcement	local jurisdiction
Policy/Law	public interest	lawmaking	lawmakers	document	law enforcement	jurisdiction
Treaty	international relations	negotiations	nations	document	military	nations

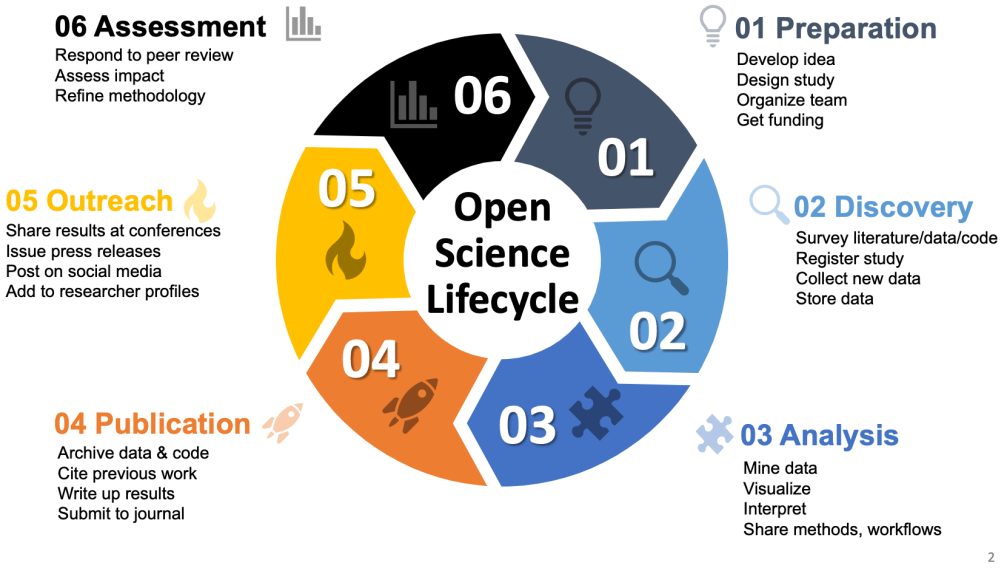
Open standards priciples emphasize the importance of giving all views due consideration and that no one interest is prioritized over all others. Records of decisions and the materials used in reaching those decisions should be made available to everyone. The public should also be given an opportunity to provide comments before a standard is approved and adopted.

Reaching Consensus

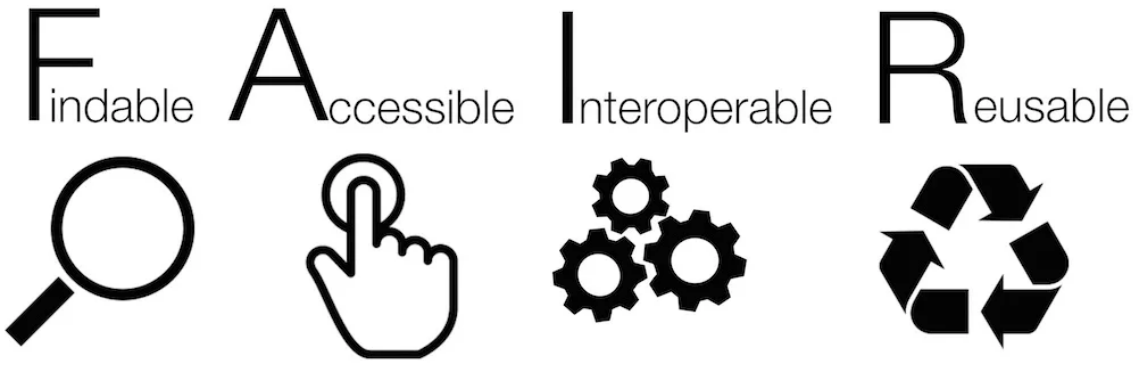
Often there are conflicting views and interests present in the standards development process. Ideas are proposed, discussed, documented and then voted upon within the group. It may take many iterations of this cycle before final agreement is reached through consensus (not majority rule). It took the P4001 project (see right panel) six months to arrive at precise definition of "hyperspectral imaging" that everyone could live with.

STANDARDS AND OPEN SCIENCE

Standards play an essential role in enabling Open Science at all stages of the research lifecycle. Of central importance is the ability to link researchers, funding, data, workflows, code, reviews and publications through identifiers.



Standards are also important enablers of the F.A.I.R. Principles (https://doi.org/10.1038/sdata.2016.18): metadata content; protocols for discovery and access; the semantics, quality and lineage of data; and licenses for reuse are all most useful when they are standardized.



GRSS STANDARDS PROJECTS

The IEEE Geoscience and Remote Sensing Society (GRSS) Standards Committee works to develop a coordinated suite of standards that covers all aspects of Geoscience Remote Sensing technologies, including sensors, platforms, operations, processing and information extraction and application. It seeks to foster connection and collaborations between GRSS members coming from academia, federal agencies and the private sector.

The standards efforts that are described below all began by working with the stakeholder community to determine:

- What aspects of a technology would benefit from being standardized?
- What existing standards, if any, are relevant?
- What is a reasonable scope for the project, i.e. what can realistically be accomplished in the allotted timeframe?

To date the GRSS has sponsored six projects under the IEEE Standards Association, all specifications for the description, calibration or operation of instrumentation used in geoscience remote sensing. They are:

Characterizing and Calibrating Hyperspectral Imagers (P4001)

- Procedures and terminology for the absolute characterization of hyperspectral imagers to ensure proper performance for the intended application
- Subgroups on Terminology, Characterization, and Metadata
- Developed around Industrial, Laboratory and Geoscience use cases

Metadata Model for Synthetic Aperture Radar Data (P4002)

- Arose from need to support generic SAR processing tools that can work with data from multiple sensors having different formats
- A member of the US National Geospatial intelligence Agency (NGA) leads the working group
- The standard will combine ISO and NGA SICD metadata attributes

Describing GNSS Reflectometry Datasets (P4003)

- Participants came mostly from academia with some private sector
- The draft standard was ready for balloting after only 2 years of work
- Standard is now published, available on IEEExplore (https://ieeexplore.ieee.org/document/9594781)

Calibration Procedures for Microwave Radiometers (P4004)

- Grew out of interests from space agencies, academics
- Co-sponsorship with IEEE Theory and Techniques Society is pending

Protocol and Scheme for Measuring Soil Spectroscopy (P4005)

- Based on strong need to make soil spectral libraries intercomparable
- Members of the Working Group come from many different nations and UN Food and Agricultural Organization

Remote Sensing Frequency Band RFI Impact Assessment (P4006)

- Procedures to be followed in assessing the impact of spurious emissions on the operation of active or passive remote sensors
- ESA, NASA involvement

CONCLUSIONS

It's been said that standards make life easier, safer and more predictable. The standards that GRSS has sponsored aim to make remote sensing data more FAIR, i.e. findable (through standardized terminology and schema for describing instruments and the data they product), accessible, interoperable and reusable.

It is typically a long journey to develop formal standards – requiriong persistence and long-term vision. Important ingredients for success include: committed people, good leadership, and policies and procedures to ensure fairness & balance.

At the same time committing time to a standards development project can be very rewarding. It is an opportunity to meet and interact with dedicated, knowledgeable and generally wonderful people, giving you the opportunity to learn and appreciate the perspectives of others, to work at leading edge of a technology, and to see your contributions adopted by the international community.

So, if you're interested in being part of something that educates, informs, standardizes, and is genuinely useful to the remote sensing community, contact me if to learn more about how you can become involved. I you just want to stay informed sign up for the mailing list of the GRSS Standards Committee (https://www.grss-ieee.org/about/society-operations/ahc-standards/).

ABSTRACT

Data is the lifeblood of the geosciences. The acquisition, processing and interpretation of data all depend on established specifications describing the systems and procedures that were used in producing, describing and distributing that data. It can be said that technical standards underpin the entire scientific endeavour. This is becoming ever truer in the era of Big Data and Open, Transdisciplinary Science. It takes the dedicated efforts of many individuals to create a viable standard. This presentation will describe the experiences and status of standards development activities related to geoscience remote sensing technologies which are being carried out under the auspices of the IEEE Geoscience and Remote Sensing Society (GRSS).

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(https://agu.confex.com/data/abstract/agu/fm21/2/9/Paper_857492_abstract_797930_0.png)

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