Conference paper

NSIDC's cryospheric data and information: Supporting science and society for 40 years

Summary
The National Snow and Ice Data Center (NSIDC) was established in 1976. NSIDC supports research into our world’s frozen realms: the snow, ice, glaciers, frozen ground, and climate interactions that make up Earth’s cryosphere. NSIDC manages and distributes scientific data, creates tools for data access, supports data users, performs scientific research, and educates the public about the cryosphere. Through projects like the Exchange for Local Observations and Knowledge of the Arctic (ELOKA), NSIDC is now making significant contributions to social sciences research, supporting community-based observing projects, and linking our knowledge of the human and physical domains of the polar regions.

NSIDC is an organization with its roots as the World Data Center for Glaciology. Its role as a leading node in the global system has evolved over the past 40 years. A broad and active communications and education program develops products that are informing the global community. Mature data dissemination mechanisms combined with constantly evolving interoperable web service systems are making data available to end users around the globe and these resources are being used to develop a variety of different applications at NSIDC and elsewhere. Much has been learned from these activities in the areas of promoting and enabling accessible, open data; linking data, information and knowledge across disciplines and different end users; and bridging scales from local to global.

Promotion of open information connecting global audiences
With nearly 83,000 data downloads across 140 countries in 2015, NSIDC has recognized the need to develop and promote data in more accessible forms across a broadening cryospheric user community.

NSIDC’s Arctic Sea Ice News and Analysis (ASINA) blog in an example of successful communication of sea ice science to a more general global audience. It is based on the uniquely “easy-to-use” and popular Sea Ice Index data. This nearly 40-year satellite record of Arctic and Antarctic sea ice is invaluable for the study of climate change. Presented in a simple way, the information is accessible to a range of audiences including scientists, press, policy makers, and educators. As a result, the ASINA blog averages over 2.5 million visits per year.

The Satellite Observations of Arctic Change (SOAC) application is another example of presenting the satellite record of the Arctic in a way that is accessible and meaningful to research communities beyond the cryosphere. It provides an interactive map-based interface that lets users explore trends and changes in the Arctic by visualizing satellite data. SOAC
also provides an interpretation of the data visualization, and links to the actual satellite data itself, so that even educators can use the site as a basis for classroom research.

![Satellite Observations of Arctic Change, National Snow and Ice Data Center](image)

**Figure 1**: Satellite Observations of Arctic Change, National Snow and Ice Data Center

**Establishing interoperable systems for global audiences**

Early in NSIDC’s history, global distribution of data included paper format. Dissemination of digital data included shipping of digital media before the advent of the Internet as a mechanism for data exchange. For more than two decades, NSIDC has been disseminating data globally through the provision of an online search interface supporting data set discovery, data evaluation and data download. In the past decade, we have placed greater emphasis on continuously improving our search and download functionality in order to improve the global community’s access to metadata and data.

The metadata used as the basis for NSIDC’s data discovery features also allows us to contribute to federated data discovery tools such as the Arctic Data Explorer (ADE), offering a single-query search for international, interdisciplinary, digital Arctic data. The content of our metadata web services are consumed by the ADE as it harvests metadata from more than a dozen polar metadata catalogs.

NSIDC is contributing to other initiatives based on data interoperability, such as The Big Earth Data Initiative (BEDI). This is an effort being undertaken by Federal Agencies to standardize and optimize the collection, management and delivery of Earth observation data. In support of the related NASA effort, the NSIDC DAAC has initiated a project to provide consistent services across interdisciplinary data sets at NSIDC to enhance overall user experiences. A key component of this work is to make data accessible through OPeNDAP.

NSIDC is actively updating our data offerings available via OGC (Open Geospatial Consortium)-compliant service endpoints. One such example is the Atlas of the Cryosphere. It’s Web site and services allow for interoperable and customizable data access to the atlas maps and source data, enabled via OGC Web protocols. NSIDC is currently exploring alternative technology options, including the open source GeoServer. The features of GeoServer will make it easier to deploy new and manage existing services. This effort will make a significant contribution to the Open Geospatial Consortium Arctic Spatial Data Pilot.
Challenges in making global connections
As new applications and systems evolve at NSIDC, new challenges emerge. Data and information are now being shared with many different user types using a variety of tools. Developing usable and useful tools requires an extensive knowledge of users’ requirements and preferred methods of interaction. This has resulted in the development of expertise at NSIDC in the area of user-centered design and evaluation to meet the challenges of serving a diverse set of audiences.

As seen in the development of applications like ADE and SOAC, there are challenges in building systems based on relatively early implementation of metadata standards. Although more data providers are distributing metadata records formatted according to ISO 19115 specifications, the flexibility of the specification has resulted in differing interpretations of the content requirements. This variability added significantly to the configuration efforts.

NSIDC has evolved to work with more than numerical data of the cryosphere. We have partnered with Indigenous people of the Arctic and their representative organizations to better understand how to effectively and appropriately share data and information derived from documenting Indigenous observations and knowledge. The ELOKA project has been contributing through the co-development of technology, methods, and theory to provide a more holistic understanding of the Arctic. Figure 2 illustrates how different perspectives on sea ice can encourage dialogue between Indigenous experts and scientists around the world.

Figure 2. Johnassie Ippak’s knowledge was mapped and superimposed on a MODIS satellite image. There is a difference between the definition of “floe edge” between Mr. Ippak and interpretation of the satellite. The difference stems from the safety-oriented focus of his definition: i.e. the ice must be safe to use rather than simply exist.
Where the satellite and in-situ missions are often in the public domain with unrestricted access, social science data can be highly sensitive and require adherence to ethics protocols. Through other initiatives like the Gateway for Polar Social Sciences (GaPSS) and CyberNABO, the broader community is addressing the challenges of working with arctic social science data and information.

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**Competing Interests**
The authors declare that they have no competing interests.

**Notes**

**References**

