Arctic Spatial Data Infrastructure (Arctic SDI)

Arvo KOKKONEN, Jani KYLMÄAHO and Heli URSIN, Finland

Key words: SDI, Arctic, Geoportal

SUMMARY

Understanding and responding to the impacts of climate change and human activities in the Arctic, a unique area among the Earth's ecosystems, requires accessible and reliable data to facilitate monitoring, management, emergency preparedness and decision making. Often it is difficult and costly to find, access and combine useful datasets for a project since they are collected and managed by many different organizations.

The Arctic Spatial Data Infrastructure (Arctic SDI), was established to address the need for readily available spatial data in the northern areas of the globe. The Arctic SDI is working with stakeholder organizations to make their key data accessible, with a focus on the Arctic Council and its working groups.

The Arctic Spatial Data Infrastructure is a collaboration between the 8 National Mapping Agencies of Canada, Finland, Iceland, Norway, Russia, Sweden, USA and Denmark. The initiative is based on a voluntary multilateral cooperation and focused on accessible authoritative geospatial reference data. There is a signed Memorandum of Understanding towards collaborative development of the Arctic SDI.

The Arctic SDI Geoportal is based on Oskari (http://www.oskari.org), which is an open source framework - originally developed in the National Land Survey of Finland - for browsing, sharing and analyzing of geographic information, utilizing in particular distributed spatial data infrastructures. The framework is used as a basis of the Arctic SDI Geoportal as well as a significant number of other geoportals, Web GIS applications and eGovernment services.

Arctic Spatial Data Infrastructure (Arctic SDI)

Arvo KOKKONEN, Jani KYLMÄAHO and Heli URSIN, Finland

1. ARCTIC SPATIAL DATA INFRASTRUCTURE

Arctic SDI provides access to reliable, authoritative reference data and facilitates stakeholders' development and delivery of standardized, interoperable geospatial data that can be made accessible via the Arctic SDI Geoportal and other geomatics enabled tools and portals. The Arctic SDI harmonized basemap is rendered using a common Arctic cartographic specification to provide unified topographic view over the entire Arctic.

Arctic SDI provides methodology for data sharing at all levels: local, national, regional and global. It documents and applies information management best practices, based on open international standards, to build communities of practice to share data. Adoption of Spatial Data Infrastructure (SDI) best practices builds interoperability that breaks down data silos in support of multi-disciplinary ecosystem-based research.

The Arctic SDI is an infrastructure that provides a web portal with easy access to:

- geoportal for geospatial data viewing and discovery
- openly searchable metadata catalogue
- authoritative reference map as a Web Map Tile Service (WMTS)
- gazetteer search API
- thematic data from various organizations operating within the Arctic Region
- easy-to-use tools for data dissemination

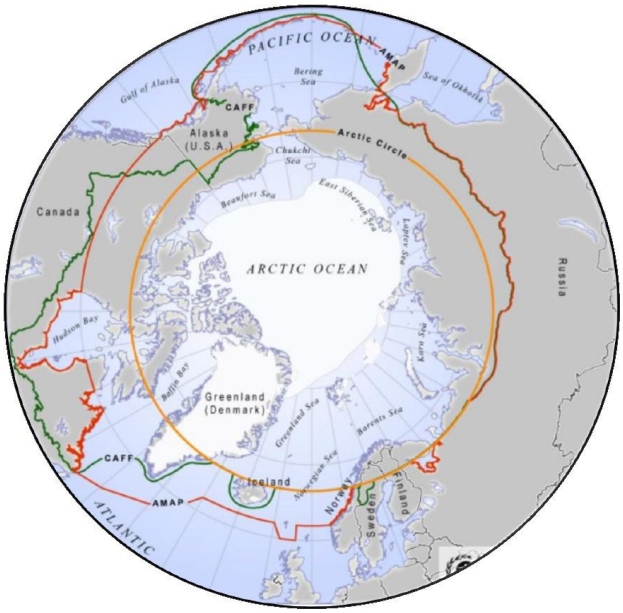

Figure 1: There are several different definitions on the Arctic. In Arctic SDI each participant organization decides which area of the country is included in Arctic SDI.

1.2 Participants and stakeholders

The Arctic Spatial Data Infrastructure is a collaboration between the 8 National Mapping Agencies of Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and USA:

- Earth Sciences Sector of the Department of Natural Resources Canada
- Danish Agency for Data Supply and Efficiency
- National Land Survey of Finland
- National Land Survey of Iceland
- Norwegian Mapping Authority
- Federal Service for State Registration, Cadastre and Mapping of the Russian Federation
- Swedish Mapping, Cadastral and Land Registration Authority
- U.S. Geological Survey

Arctic SDI is based on a voluntary multilateral collaboration and focused on accessible authoritative geospatial reference data. The participant organisations have signed a Memorandum of Understanding towards collaborative development of the Arctic SDI. The Arctic SDI is working with stakeholder organizations to make their key data available, with a focus on the Arctic Council and its working groups.

In 2009 the Senior Arctic Officials of the Arctic Council gave formal support to the Arctic SDI. Arctic Council Working Group on Conservation of Arctic Flora and Fauna (CAFF) 2015-2017 Work Plan in the SAO Report to Ministers identified the Arctic SDI as a partner in the CAFF Arctic Biodiversity Data Service (ABDS) and highlighted the importance of a Pan-Arctic digital elevation map (Pan-Arctic DEM).

Arctic SDI provides methodology to achieve data sharing at all levels: local, national, regional and global. It documents and applies information management best practices, based on open international standards, to build communities of practice to share data. Adoption of Spatial Data Infrastructure (SDI) best practices builds interoperability that breaks down data silos in support of multi-disciplinary ecosystem-based research.

2. ARCTIC SDI GEOPORTAL

The Arctic SDI Geoportal is based on Oskari (http://www.oskari.org), which is an open source framework - originally developed in the National Land Survey of Finland - for browsing, sharing and analyzing of geographic information, utilizing in particular distributed spatial data infrastructures. The framework is used as a basis of the Arctic SDI Geoportal as well as a significant number of other geoportals, Web GIS applications and eGovernment services.

Arctic SDI Geoportals supports utilizing all Arctic SDI services, such as the WMTS basemap, gazetteer search, metadata catalogue and thematic data sources. Supported APIs are currently OGC WMS, WMTS, WFS and CSW along with ESRI rest API.

Key functionalities include possibility to search for metadata, place names and coordinates, map marker tool, map legend display, user guide and a quick start guide along with common map GUI tools.

Registered users can take advantage of more tools: ability to save map views and create embedded maps. Embedded maps are a powerful tool for disseminating the information from SDIs without any programming skills. Geoportal users can combine map layers to visualize the phenomena of their choice and choose from a variety of tools to be added on the map. The fully functional map client can be placed on any website with context-related information by copy-pasting the map URL into the website content management system. If any data source gets updated, the latest data is readily shown on in the embedded map without user intervention.

Oskari software is currently in incubation to become an Open Source Geospatial Foundation (OSGeo) project. The Oskari collaboration network actively facilitates various projects extending the software and creating new innovative e-Government services. The network consists of 32 member organizations, of which 12 are private companies. The software is under constant development by National Land Survey of Finland as well as a number of other organizations.

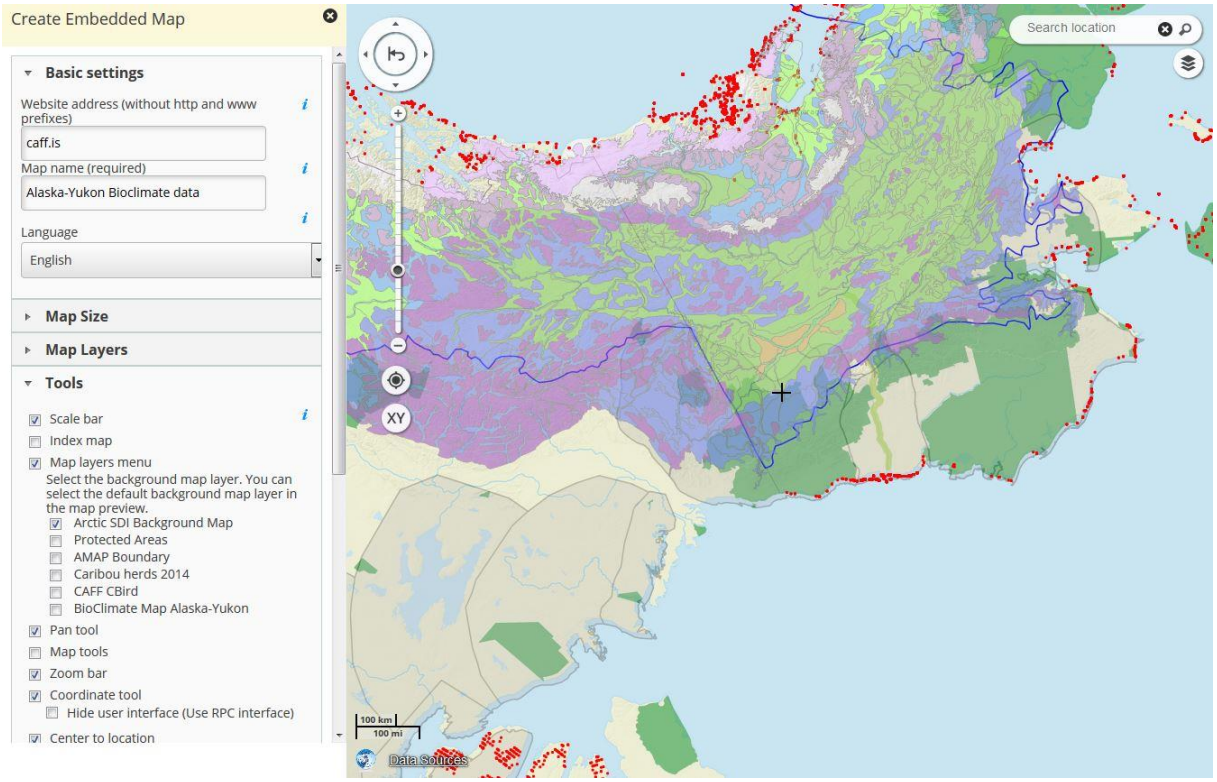

Figure 2: The Arctic SDI Geoportal can be used to create embedded maps on other websites without programming.

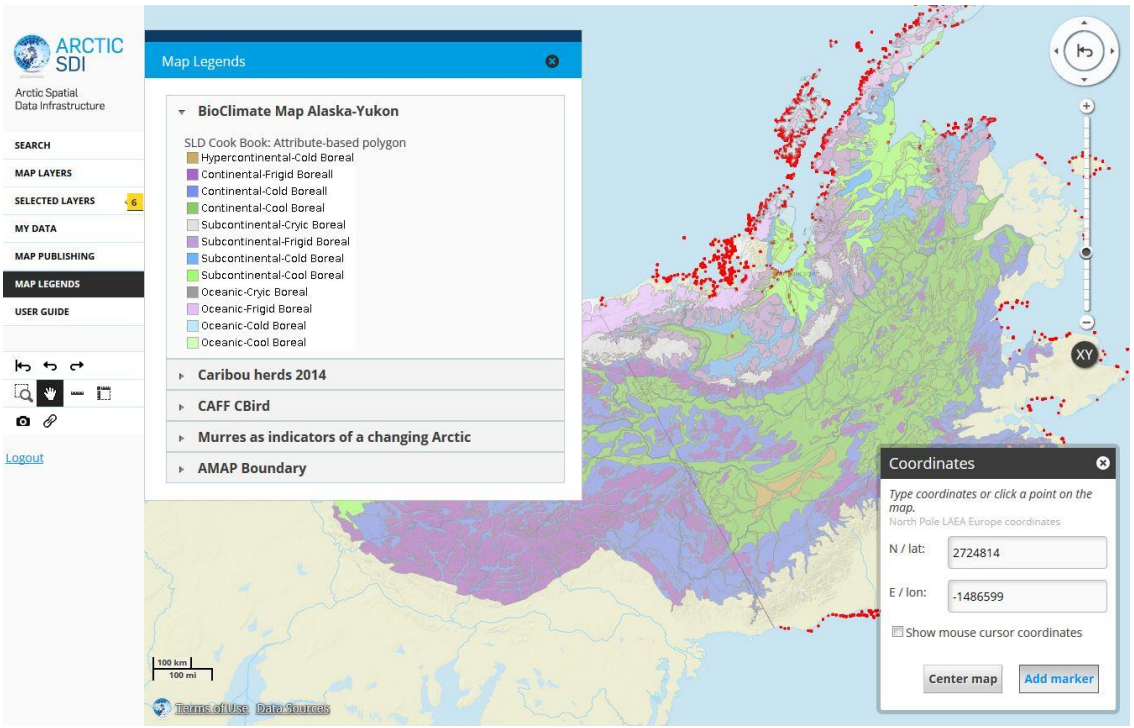

Figure 3: BioClimate Map Alaska-Yukon with a legend of Bioclimate zones. Distribution of some Arctic fauna has been visualized on top.

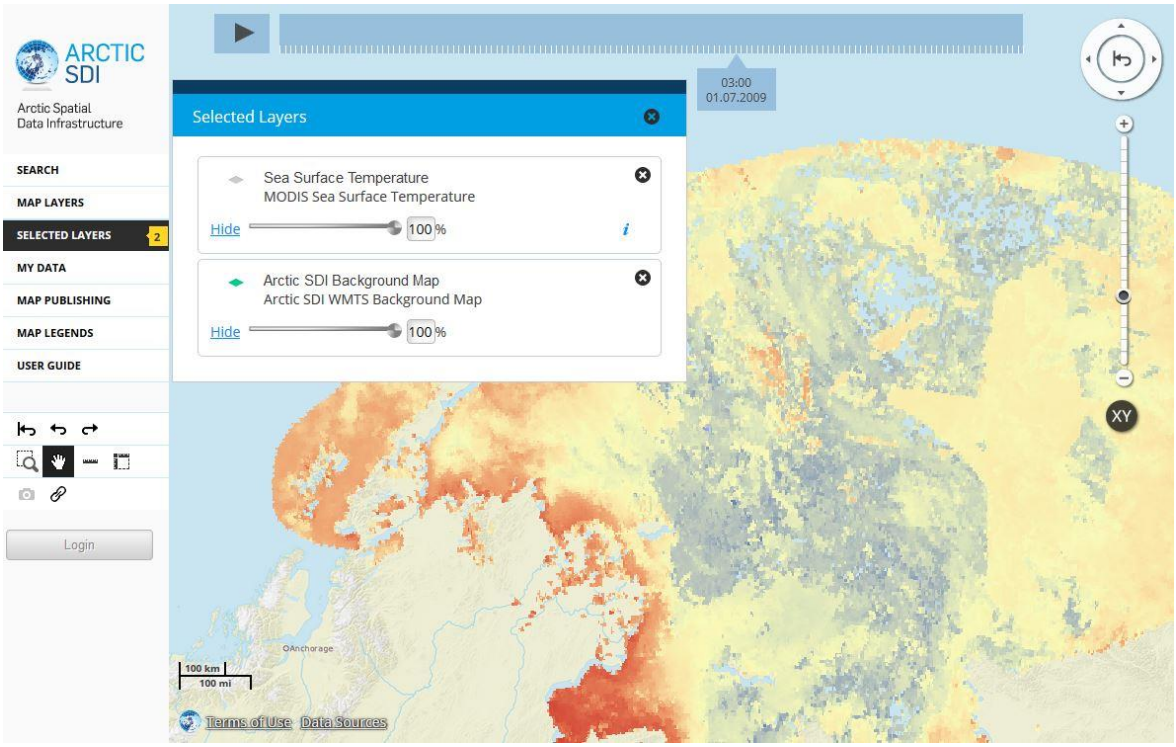

Figure 4: The Geoportal features a Time Series tool, which can be used to visualize how several phenomena, e.g. Sea surface temperature change over time in the Arctic.

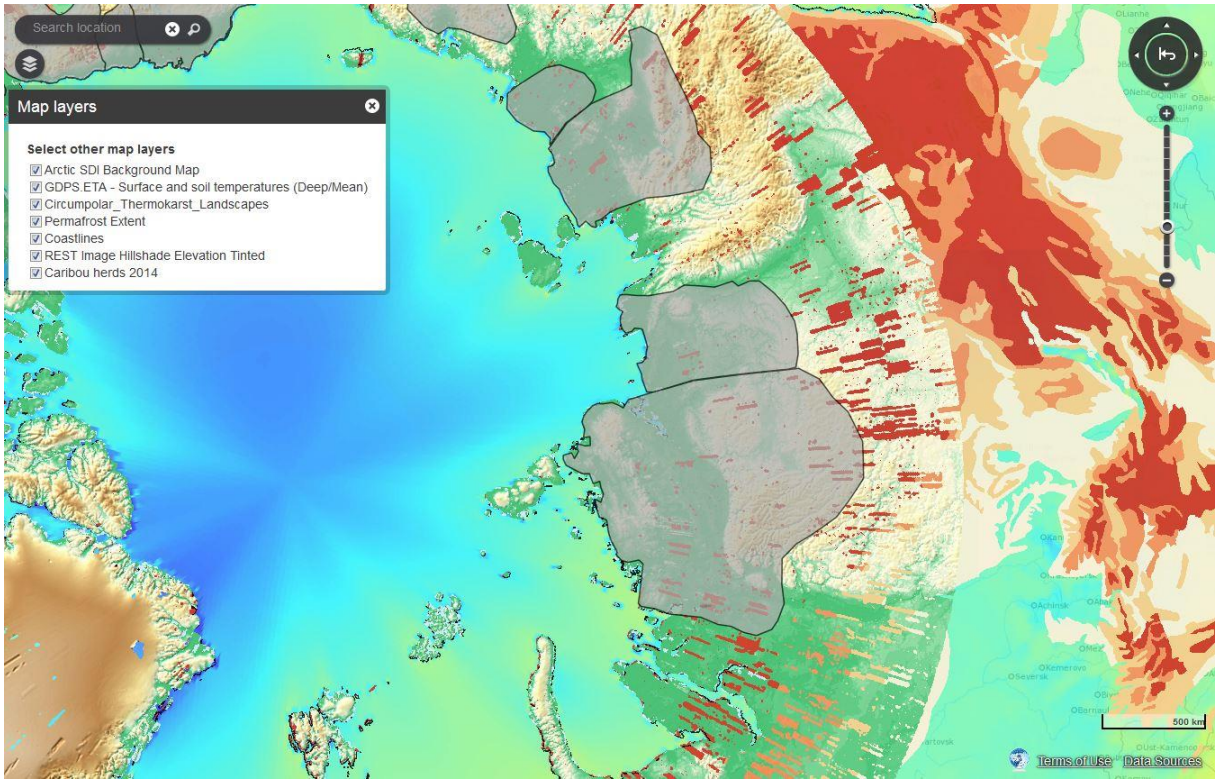

Figure 5: An embedded map showcasing the impact of Surface and soil tempearatures, Circumpolar Thermokarst and Permafrost extent on habitat of Caribou herds.

3. PAN-ARCTIC DIGITAL ELEVATION MAP (Pan-Arctic DEM)

Pan-Arctic Digital Elevation Map (Pan-Arctic DEM) -project is a response to the need for high quality elevation data in remote locations, the availability of technology to process big data, and the need for accurate measurement of topographic change.

Pan-Arctic DEM is an activity under the U.S. Arctic Council Chairmanship, implemented through the Polar Geospatial Center (PGC) at the University of Minnesota. It is a USA National Geospatial-Intelligence Agency (NGA) - National Science Foundation (NSF) public-private initiative to automatically produce a high-resolution, high quality, digital surface model (DSM) of the Arctic using optical stereo imagery, high-performance computing, and open source photogrammetry software.

When ready, the Pan-Arctic DEM will cover the entire Arctic. As of December 2016, data for Alaska, Iceland, Baffin Island (Canada), Svalbard (Norway), and Franz Josef Land and Novaya Zemyla (Russia) have been completed. In the first quarter of 2017, PGC anticipates delivering the western half of Greenland, Kamchatka, Ellesmere Island (Canada), and the Faroe Islands (Denmark). Work will then focus on processing and delivering the remainder of Canada and Russia, followed by processing and delivery Sweden, Finland and Norway. Data users should anticipate quarterly deliveries through the summer of 2017 until initial project delivery is complete.

All Arctic DEM data are available free to the public for any use. Links to download Arctic DEM data are found on PGC's ArcticDEM website located at http://pgc.umn.edu/arcticdem.

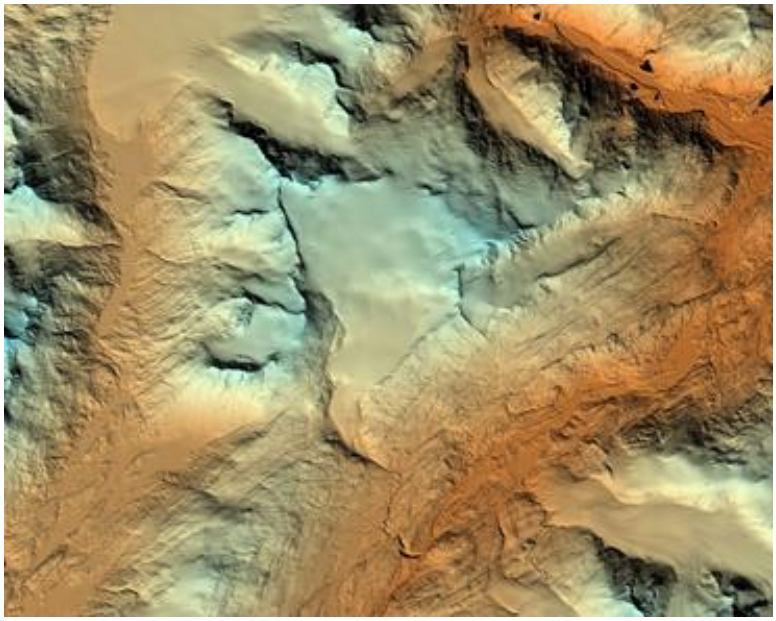

Figure 6: Pan-Arctic DEM

4. CAPACITY BUILDING

The Open Geospatial Consortium (OGC) led Arctic Spatial Data pilot and SDI Manual for the Arctic both provide guidance on the planning, management, development and maintenance of the Arctic SDI to the various involved groups.

4.1 The Arctic Spatial Data Pilot

The Arctic Spatial Data Pilot (Arctic SDP) was initiated to demonstrate the diversity, richness and value of providing geospatial data using International Standards in support of Spatial Data infrastructures.

Started on December 3, 2015, the Arctic Spatial Data Pilot is sponsored by US Geological Survey and Natural Resources Canada, in collaboration with the Arctic Spatial Data Infrastructure Participants. This pilot demonstrates the value of standards in an environment that is principally built as a system of systems, i.e. an Arctic Spatial Data Infrastructure that integrates a number of existing systems as well as individual services and data repositories.

Results are to be communicated via tutorials, technical documentation, and a story-based video. http://www.opengeospatial.org/projects/initiatives/arcticsdp

4.2 The SDI Manual for the Arctic

The goal of the SDI Manual for the Arctic is to provide information and guidance on the planning, management, development and maintenance of the Arctic SDI to the various involved groups, to provide best data management practices, to identify policy and guideline requirements and to demonstrate the value and benefits of using a SDI for efficient monitoring and decision making in the Arctic. The manual addresses the needs of three different audiences: high-level strategic decision makers, Arctic data providers and distributors as well as end users of Arctic data.

The key components of a SDI include institutional arrangements and collaboration between participating organizations, data (including framework and thematic spatial data), technologies covering all aspects of the SDI, standards allowing for diverse data sources, services, applications, and systems to operate with each other, and policies covering the whole spatial data lifecycle and enabling users to exchange data effectively and efficiently. These components are described in detail in the manual. Additional considerations such as the open SDI concept, community engagement, communications, and monitoring and measuring impacts and benefits of the SDI are also discussed.

The SDI manual (version 1.0) is a dynamic document, which is expected to be continually edited and updated to reflect the evolution of SDI components and also the changing information requirements of the Arctic stakeholders. It does not necessarily reflect all policies of each of the participating national mapping agency.

REFERENCES

Arctic SDI http://arctic-sdi.org/
https://arctic-sdi.org/index.php/strategic-documents/

Arctic Biodiversity Data Service http://www.abds.is/

The Arctic Spatial Data Pilot http://www.opengeospatial.org/projects/initiatives/arcticsdp

The SDI Manual for the Arctic https://arctic-sdi.org/index.php/strategic-documents/

https://www.youtube.com/watch?v=VtlTedwelAk

BIOGRAPHICAL NOTES

Arvo Kokkonen is Director General in the National Land Survey of Finland since September 2012. He has also worked as a cadastral surveyor and Survey Counsellor in the Ministry of Agriculture and Forestry. He has experience in international projects and organizations, e.g. being member of UNECE Working Party on Land Administration and EULIS. Likewise, he has participated in the activities of EuroGeographics, PCC, UN-GGIM and FIG. He is member of the Board of the Arctic SDI (Chair of the Board from 1. June 2017).

Heli Ursin works as Head of International Affairs in the National Land Survey of Finland. She has MSc degree in Geography, University of Helsinki. She is active in international cooperation at regional Nordic/ European level and also globally. She has been project manager of international data projects focusing on SDI, in early days such as Map of the Baltic Sea Region and later for EuroGlobalMap (EGM). She has also been involved in European Location Framework and currently is the National Contact Point for Arctic SDI in Finland.

Jani Kylmäaho gained an MSc degree in Geography from the University of Helsinki, Finland. He is currently employed at the National Land Survey of Finland, where his position is Head of Development for topographic data production. He has been active in a number of international initiatives and projects focusing on spatial data infrastructures, including INSPIRE, European Location Framework and Arctic SDI.

CONTACTS

Mr. Arvo Kokkonen
National Land Survey of Finland
Opastinsilta 12C
00520 Helsinki
FINLAND
Email: arvo.kokkonen@nls.fi
Web site: http://www.maanmittauslaitos.fi/en

Ms. Heli Ursin
National Land Survey of Finland
Opastinsilta 12C
00520 Helsinki
FINLAND
Email: heli.ursin@nls.fi
Web site: http://www.maanmittauslaitos.fi/en

Mr. Jani Kylmäaho
National Land Survey of Finland
Opastinsilta 12C
00520 Helsinki
FINLAND

Email: jani.kylmaaho@nls.fi
Web site: http://www.maanmittauslaitos.fi/en