THE OPEN GEOSPATIAL CONSORTIUM (OGC®)

AND

REQUEST FOR QUOTATION & CALL FOR PARTICIPATION

FOR THE

ARCTIC SPATIAL DATA PILOT PHASE 2

Annex A

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1 ARCTIC SPATIAL DATA PILOT SCENARIOS[1]

The Arctic region is warmer than it used to be and it continues to get warmer. Over the past 30 years, it has warmed more than any other region on earth. Most scientists agree that Arctic weather and climate are changing because of human-caused climate change. Arctic warming is causing changes to sea ice, snow cover, and the extent of permafrost in the Arctic. In the first half of 2010, air temperatures in the Arctic were 4° Celsius (7° Fahrenheit) warmer than the 1968 to 1996 reference period, according to NOAA. Satellite data show that over the past 30 years, Arctic sea ice cover has declined by 30 percent in September, the month that marks the end of the summer melt season. Satellite data also show that snow cover over land in the Arctic has decreased, and glaciers in Greenland and northern Canada are retreating. In addition, frozen ground in the Arctic has started to thaw out. Scientists first started to see changes in the Arctic climate in the 1970s and 1980s. Changes in the Arctic climate are important because the Arctic acts as a refrigerator for the rest of the world. The Arctic region gives off more heat to space than it absorbs from outside, which helps cool the planet. So changes in the Arctic climate could affect the climate in the rest of the world (NSIDC).

Climate change serves as the overarching theme for both ArcticSDP scenarios that shall be implemented. The first scenario addresses the actual situation as well as historic and future changes in the terrestrial environment of the Arctic. The second scenario focuses on the marine environment. Both scenarios shall implement a holistic view on climate change in the Arctic environment. Implementing the scenarios includes the setup of Web services and data loading where appropriate services are not externally provided, making use of externally provided Web services as much as possible, and demonstrating the flow of data and information between client applications and Web services. Client applications may allow data analysis and processing. The scenarios defined in this RFQ are based on initial discussions with Sponsors and Arctic Council Conservation of Arctic Flora and Fauna Working Group (CAFF) and are based on available data sets. Both scenarios shall be further refined at the Kick-off meeting. Ideally, RFQ respondents make suggestions on possible refinements in their RFQ responses.

1.1 SCENARIO 1: THE TERRESTRIAL ENVIRONMENT

The first scenario focuses on (partly regulatory aspects of) the terrestrial environment. ArcticSDP Phase-1 report, section 9 identifies a number of aspects relevant to the terrestrial environment, e.g.

[1] *Note: The stories provided in section 1.1 and 1.2 of this document (terrestrial and maritime) are application descriptions in the domain terminology. It is OGC's practice to call application descriptions in domain terminology by the term "scenario". We are aware that this term has different connotations in other communities. Here, it is not meant to address projections exclusively, though projections might be part of the story. For further information, please consult the Wikipedia entry for "scenario", which is defined as is "a narrative of foreseeable interactions of user roles (known in the Unified Modeling Language as 'actors') and the technical system, which usually includes computer hardware and software."*

- **Regulatory Use Cases:** Challenging real world situations often involve crosses or overlaps of multiple jurisdictions. Data needs to be integrated that is produced and maintained in different systems following heterogeneous approaches. Here, wildlife applications (particularly related to Caribou or other important terrestrial mammals) such as habitat management may be of particular interest (an application focusing on aspects of the Boreal Caribou Recover Strategy for example). Applications related to emergency response and multi-agency response could also demonstrate value. Finally, transboundary management issues such as water sheds and cumulative impact of human induced and naturally occurring ecosystem changes provide good cases for demonstration. Those scenarios could be extended with additional elements such as the monitoring of the status of feeding areas for migratory birds, or the changes on Arctic biodiversity including the northward movement of more southern species, shrubbing and greening of the land, etc.

- **Geohazards & Weather:** Geohazard risk assessments: Combining knowledge about geohazards (in this case earthquakes and/or floods) and the built environment and demographics, a risk assessment examines the potential losses and consequences that could be generated, and allows for cost benefit analyses of mitigation. This could be of particular interest in an area of frequent hazards or potential development.

- **Climate change** is one of the most prominent scientific fields of research in the Arctic. A typical scenario would include aspects such as the monitoring of sea level rise, including evaluation of areas that are suffering the worst impacts and the estimation of damage to infrastructure; the tracking of glacier movement including the estimation of potential impact to shipping lanes or coastal infrastructure and the projection of future conditions; or the monitoring of the status and condition of the permafrost layer, including the evaluation of impact to existing infrastructure with projections of future conditions.

- **Linking Indigenous and Scientific Knowledge:** One of the open challenges is the effective integration of indigenous and scientific (observation driven) knowledge. A scenario could, working in collaboration with indigenous peoples, communities and their representative organizations, establish effective methods for linking indigenous knowledge with scientific and operational knowledge.

- **Low bandwidth**: There are a number of aspects that are independent of the concrete scenario. Instead, they are often universally applicable. One very important aspect in this context is the low to no Internet bandwidth availability in some areas, which needs to be mitigated by providing offline resources and synchronization capabilities.

The scenario demonstrates the integration of geospatial data served by SDI components into client applications with the goal to better understand the effects of climate change on the terrestrial environment. These include the historic, current and future climate situation, its development, and potential consequences for the Arctic fauna and flora as well as arising business opportunities. The goal is to overlay many datasets to generate a holistic view of the Arctic. Ideally using a target area in North America between Prudhoe Bay in Alaska and the Mackenzie River in Canada, data shall be collected and overlaid to demonstrate aspects such as:

- **Fauna**: US and Canada have an agreement regarding the Porcupine Caribou Herd which migrates across the Canada/United States border. The agreement promotes international cooperation and coordination to conserve the herd and its habitat so that the risk of irreversible damage or long-term adverse effects as a result of use of caribou or their habitat is minimized. The Conservation of Arctic Flora and Fauna (CAFF) also has a Caribou expert group that could provide data - http://carma.caff.is/carma-interactive-map. Other data that will be made available includes Polar Bear and waterfowl nesting data.

- **Boreal vegetation**: the US and Canada have recently produced a boreal vegetation map for the Alaskan-Yukon region

- **Remote Sensing:** CAFF has been working with Arctic SDI on remote sensing and have a dataset from 2001-2012 for the CAFF region which contains indicators e.g. sea surface change, land cover change and others http://caff.is/indices-and-indicators/land-cover-change-index

- **Monitoring**: CAFF has a dataset showing locations for monitoring being conducted in terrestrial, marine and freshwater ecosystems to demonstrate where scientific activities across the Arctic occur

Further data sets shall be identified during the pilot and loaded either from available Web services or from Web services operationalized as part of this pilot.

1.2 Scenario 2: The Marine Environment

The second scenario focuses on the marine environment. Annex A, ArcticSDP Phase-1 report, section 9.3 identifies a number of aspects relevant to the marine environment, e.g.

- Habitat mapping and heritage assessment
- Conservation assessment and designation
- Site selection (e.g. renewable energy and oil and gas extraction)
- Route optimization for ships
- Vessel location and disposal monitoring
- Homeland security and defense
- Aggregates extraction
- Fisheries regulation
- Coastal protection and shoreline management
- Licensing and consent evaluation
- Emergency planning and management

- Survey planning and execution

Of particular interest in the marine environment are **Ecologically or Biologically Significant Marine Areas** (EBSAs). The Convention on Biological Diversity (CBD) agreed in 2008 on the need to identify Ecologically or Biologically Significant Marine Areas (EBSAs) in the world's oceans to focus future conservation and management efforts. The EBSAs are special areas in the ocean that serve important purposes, in one way or another, to support the healthy functioning of oceans and the many services that it provides.

In 2008, the ninth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 9) adopted the following scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats.

- Uniqueness or Rarity
- Special importance for life history stages of species
- Importance for threatened, endangered or declining species and/or habitats
- Vulnerability, Fragility, Sensitivity, or Slow recovery
- Biological Productivity
- Biological Diversity
- Naturalness

In 2010, COP 10 emphasized that identification of EBSAs should **use the best available scientific and technical information** and integrate the traditional, scientific, technical, and technological knowledge of indigenous and local communities, and requested the Executive Secretary to facilitate availability and interoperability of the best available marine and coastal biodiversity data sets and information across global, regional and national scales. The integration of these data sets is a very time consuming and rather manual process. The Arctic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas (EBSAs) took place in Helsinki, Finland, March 2014. The final report is available online.

Currently, there are 11 EBSAs defined in the Arctic. Their geographic extent is available online. This pilot scenario shall demonstrate how the data integration required during the EBSA development process can be simplified and made more efficient through data served at standardized SDI interfaces and explore the role of metadata in this context.

Any emergency scenario will likely include a marine aspect, as the Guardian emphasizes[2]. The receding ice in the Arctic has been leading to increased maritime traffic and resource exploration in areas that are not well surveyed and remote. In addition, many areas of the Arctic can only be reached by air or water. This increases the risk for incidents such as vessel groundings, oil spills, danger to wildlife, or even human catastrophe (disease). Each of these scenarios will require marine data in order to make informed decisions.

[2] The Guardian: A new Titanic? US and Canada prepare for worst as luxury Arctic cruise sets sail. Coast guard officials are training for catastrophe as melting sea ice opens up Northwest Passage allowing liner to cruise with 1,700 from Alaska to New York

In 2016, the Allianz GCS stated in the Safety & Shipping Review 2016 that international shipping transports approximately 80% of global trade by volume and over 70% of global trade by value according to the United Nations Conference on Trade and Development. Though the maritime industry saw the number of total losses remained stable during 2015, declining slightly to 85, casualties in the Arctic increase. Compared to 2014, there were 71 reported shipping incidents in Arctic Circle waters during 2015, up 29% year-on-year and the highest in a decade. In 2006 there were just 8 incidents and only 3 incidents have been reported a decade ago.

Machinery damage/ failure (46) was the cause of 65% of incidents, driven by the harsh environment. Though the low oil price leads to a lower number of Arctic sea route transits, Kinsey believes a reduction in shipping activity in Arctic waters is temporary as the need for passages through this route will intensify when oil prices recover.

A non-hazard scenario might address the combination of available space based imagery and Automatic Identification System (AIS) messages that would allow tracking of sea ice and commercial vessels operating within the Arctic. Analysis of imagery data to track ice would allow projection of future ice movement into shipping lanes indicated by regular AIS routes.

Another use of AIS data is for intrusion detection and identification into environmentally sensitive areas. An agency associated with the SDI would request monitoring of vessel traffic intruding on an area defined as environmentally sensitive. The agency would define the area of interest for that region.