Concept development for a Virtual Arctic SDI

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Outline

- Context
  - Requirements, audience
  - Operational ingredients
  - Data versus maps
- Prototype project: Catalog and display of Arctic mapping services
- Issues of geographic coverage, content, representation, and gaps
- Observations and next steps

Spatial Data Infrastructures

- To paraphrase: “The data, people, services, and networks required to publish, discover, and apply geospatial data within a diverse community using common standards...”
- Established typically by various levels of government, but may also apply to other communities and corporate environments to promote enterprise access to geo-information across traditional stovepipes

Suggested Requirements

- Requirements are inferred in the Arctic:
  - to facilitate access to general and specialized geographic information and maps, scientific and socio-economic
  - to develop a standards-based framework for trans-boundary analysis for multiple domains of application
  - to promote maximum re-use of data and services
  - to integrate diverse information sources across traditional political and boundaries
  - to provide an Arctic ‘view’ that reflects the unique needs of constituent Arctic member communities

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Why a Virtual Arctic SDI?

- An Arctic SDI should be composed of existing resources (data and services) and not created from scratch
- Existing SDIs exist in most of the Arctic region, spatial data coverage is becoming ever more global
- Frameworks enabled through OGC Web Mapping Services (WMS) and globe/geo-browsers can visually federate diverse geo-information resources

Audience

- The audience anticipated for an Arctic SDI (as publishers and consumers) may include:
  - Scientists and professionals
  - General citizens
  - Governmental users
  - Students
  - Commercial entities
- Baseline information, design, services, operations, and maintenance would be achieved through international coordination of governments – this becomes a framework for others to contribute and apply

Operational ingredients of ASDI

- Data
  - Base and thematic data should be developed in forms that can be readily and consistently mapped and downloaded (e.g. KML, GML)
  - Data must be documented with metadata, including a data dictionary, where datasets are publicly available for download or direct access
- Services
  - OGC Web Map Services should provide views of base and thematic data, hosted by contributing organizations
  - OGC Web Coverage and Feature services should be promoted to provide direct access to raster and vector data, where publicly available from contributing organizations
  - OGC Catalog Services should be used to support search on available data and services through a common or federated Arctic geospatial resource catalog
- Portal/Common view
  - A map and data viewing environment is required to organize all contributed data and map contributions in an Arctic context
  - Access to all services through standard interfaces enables other application clients to find and integrate data and maps

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Data versus maps

- The Arctic SDI may not be able to provide access to all data, free-of-charge, but it can provide map views of the data so they may be applied and visually integrated
- ASDI should promote unrestricted access to scientific and socioeconomic data ***and*** maps to the maximum extent possible, and to preserve intellectual property rights

Virtual Arctic SDI Prototype

- USGS supported GMU in the development of a catalog and viewer for existing WMS resources with coverage in the Arctic
- This allows for the identification of coverage, gaps, and differences that could be harmonized to create a more consistent Arctic view
- The approach respects the rights and responsibilities of data publishers by promoting access to data and maps that they serve, and the needs and applications of end-users who benefit from the synthesis afforded by a common geographic view
- http://eie.cos.gmu.edu/WMSUniPortal/arctic.jsp

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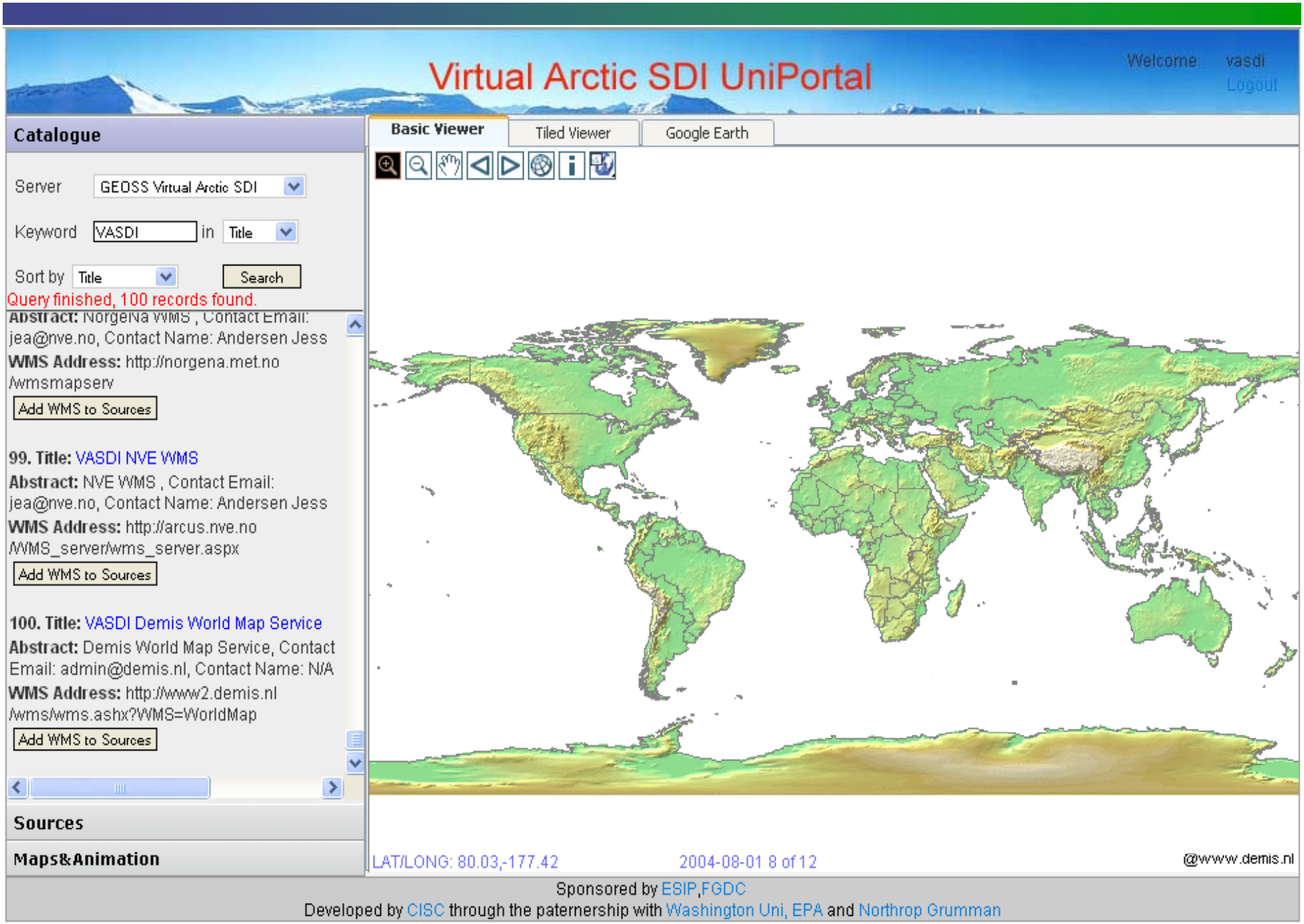
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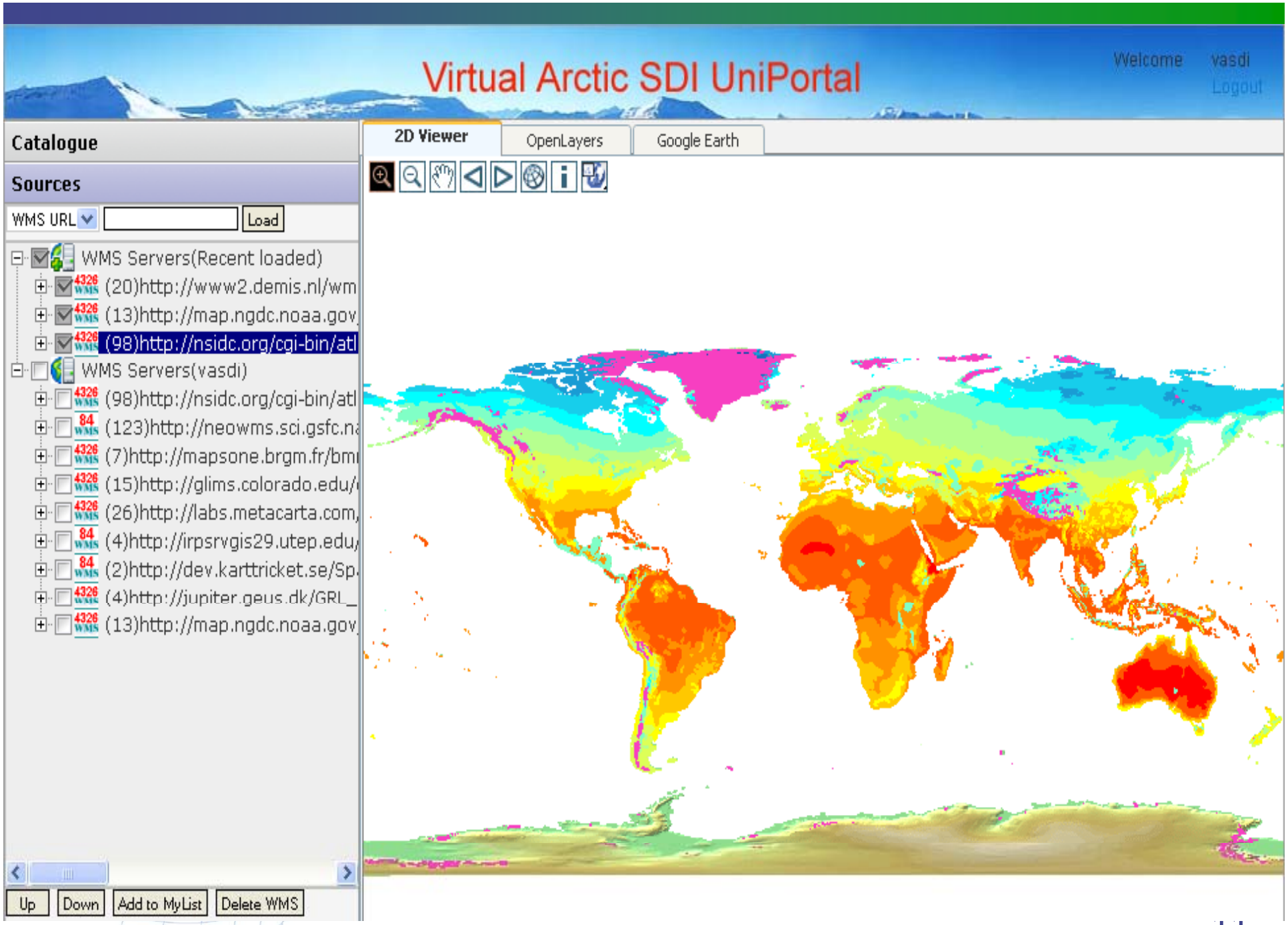
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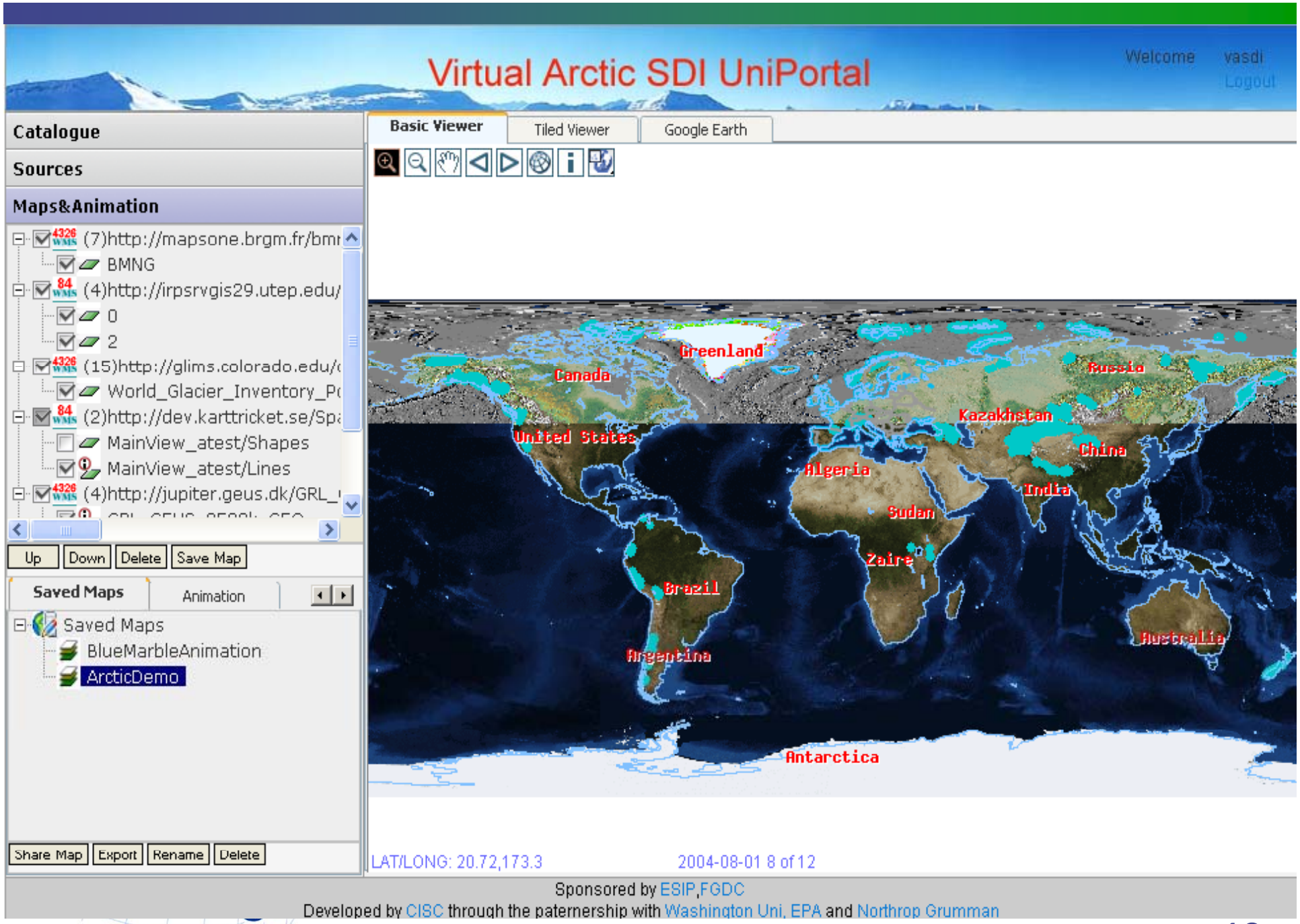
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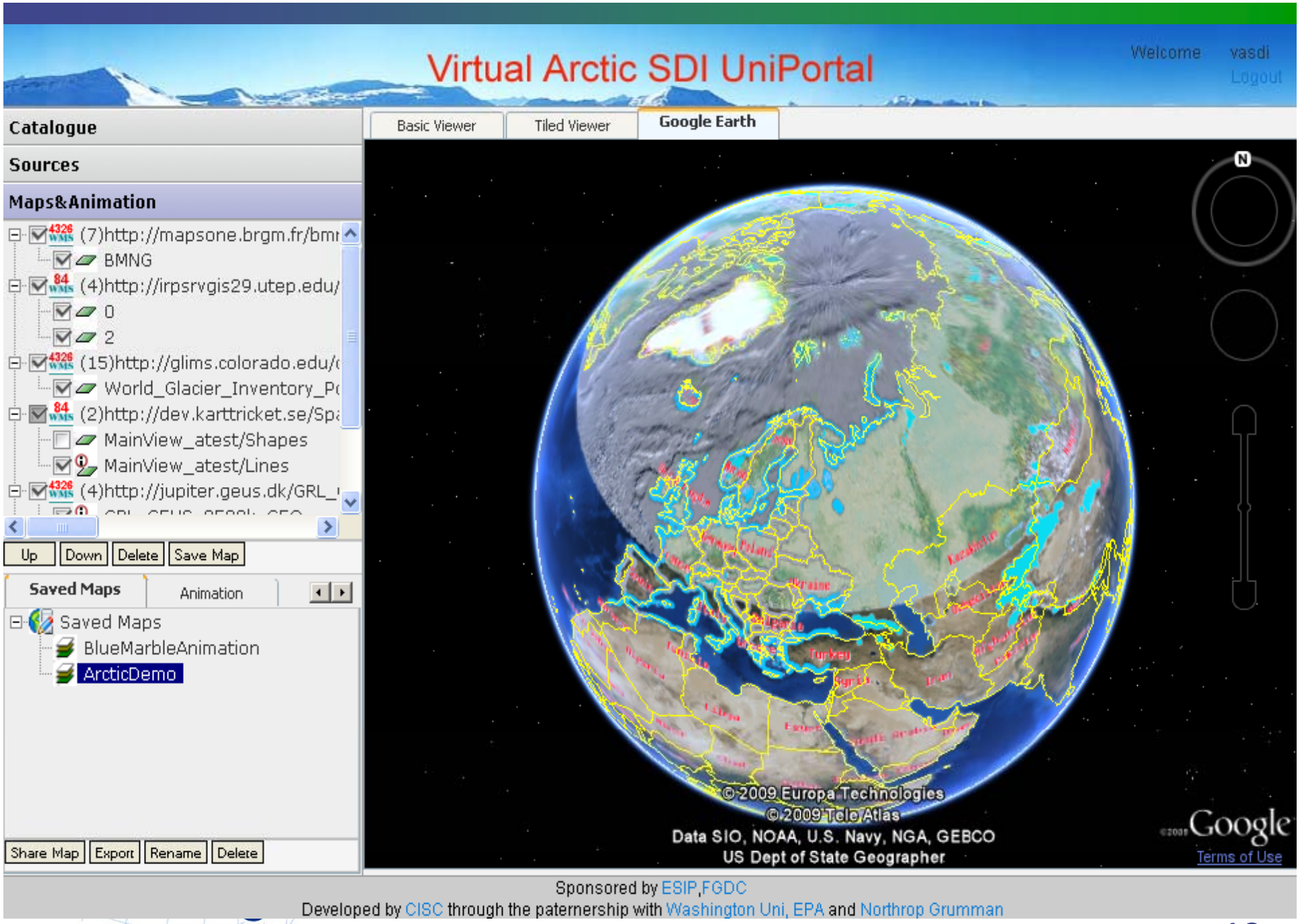
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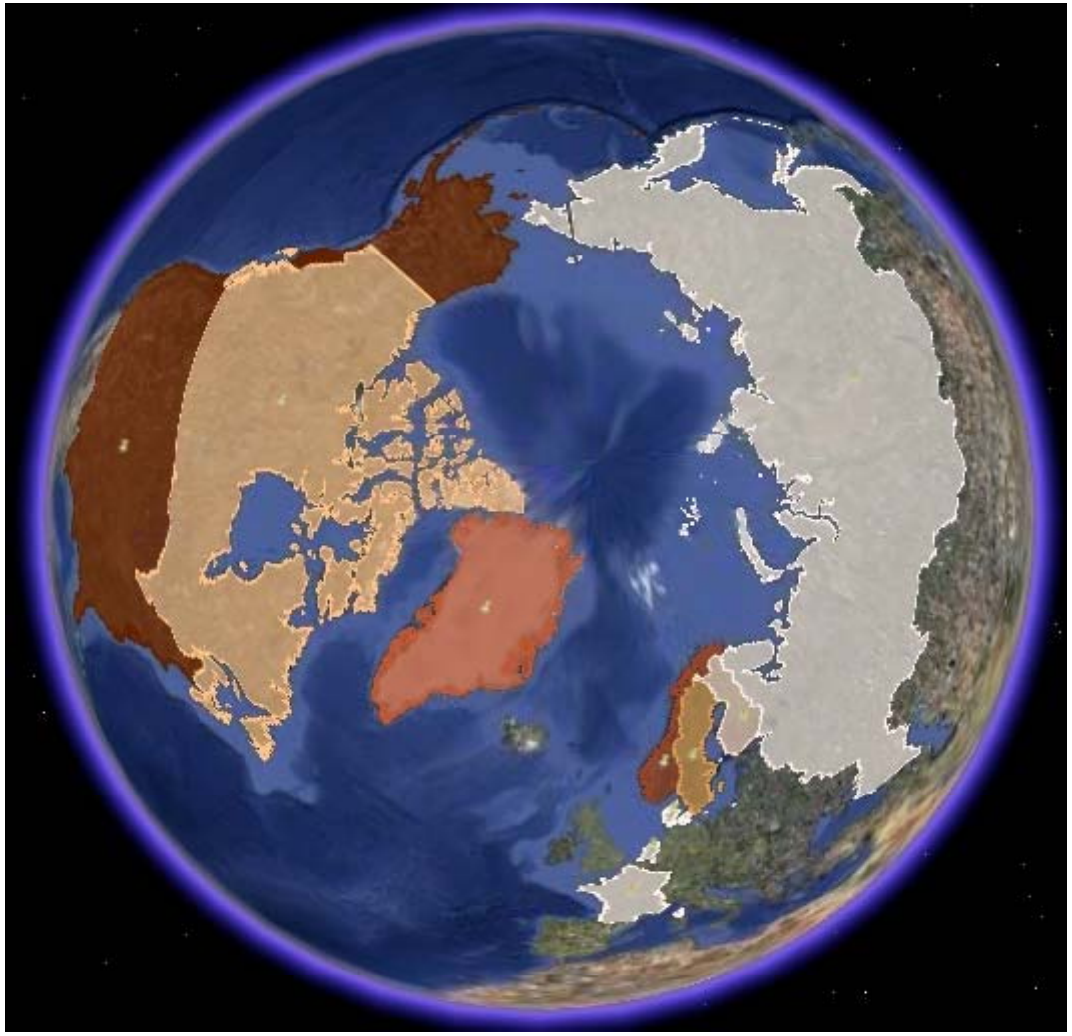
Distribution of Identified WMS Services

- Arctic WMS Distribution
  - United States WMS- 57
  - Norway WMS - 37
  - Greenland WMS - 7
  - Sweden WMS - 6
  - Canada WMS - 5
  - Finland WMS - 2
  - Netherland WMS -1
  - France WMS -1
  - Denmark WMS -1
  - Russia WMS 1

Denmark Netherlands Russia France
Finland Canada
Sweden Greenland
Norway United States



Web Distribution of Arctic WMS Services

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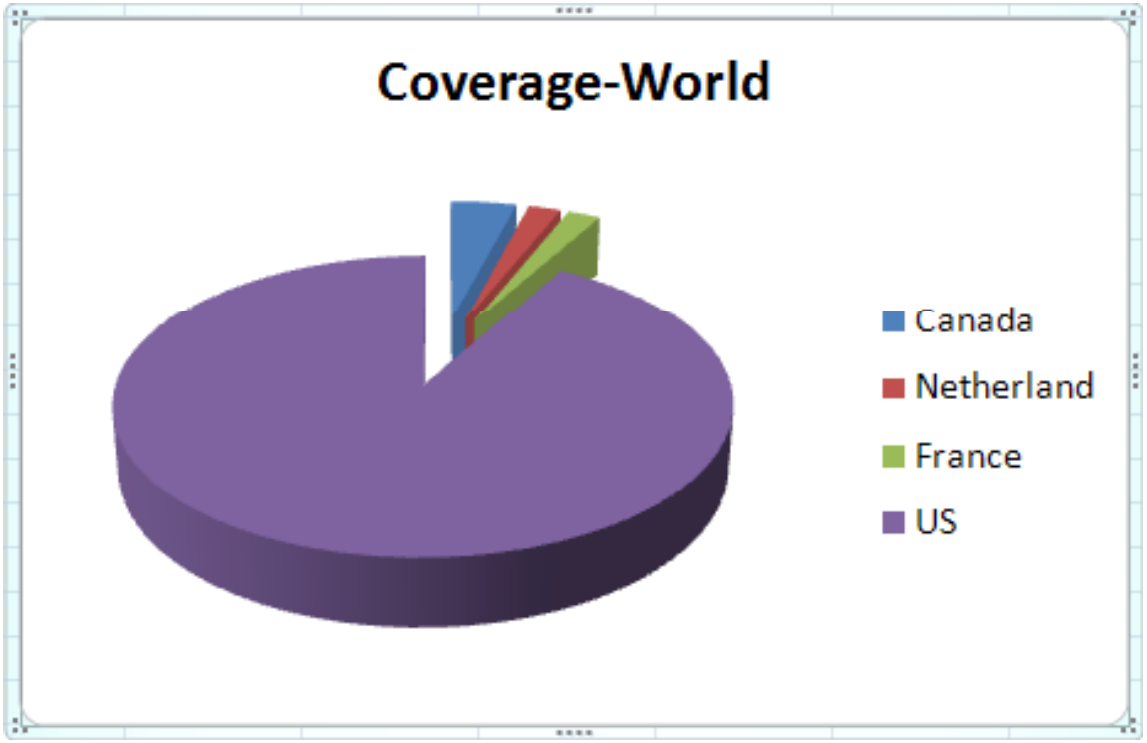
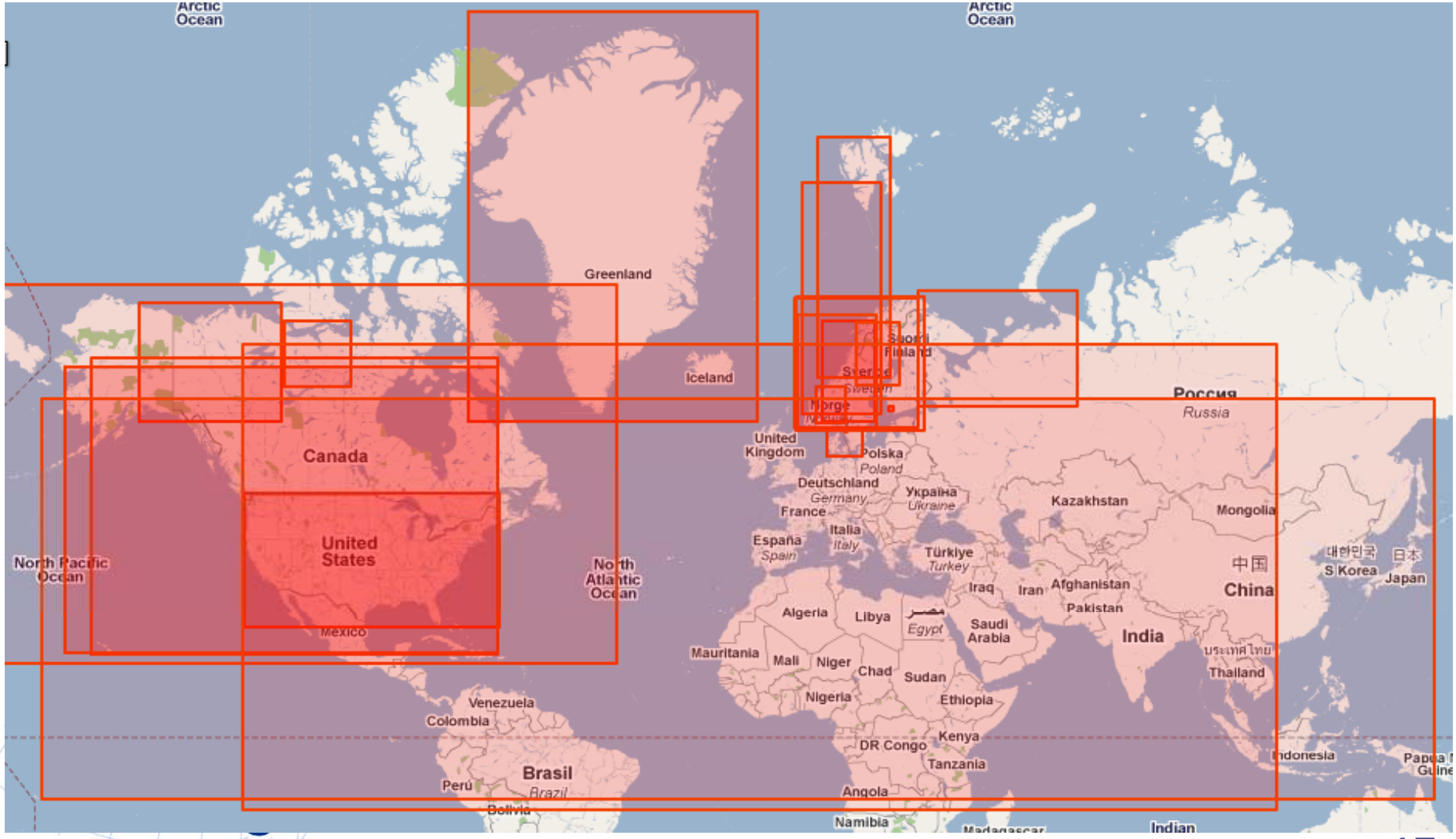
Basic Carto Data Coverage- World

- 49 identified WMS provide full Arctic coverage (covering [-180,180] and 50+)



Regional Data Coverage and Gaps



Regional Data Coverage and Gaps (Cont.)

Coverage density comparison:

- US, Canada, Norway and Sweden has good data coverage.
- Denmark and Finland also have full data coverage.
- Russia has part of coverage.
- Still lack data coverage for iceland.

Comparison of Supports for Map Projection

	Sample WMSs	Total SRS Supported
US	55/57	66
Canada	3	222
Norway	35/37	21
Sweden	6	136
Denmark	7	3180
Russia	1	193
France	1	2
Finland	1/2	2
Netherland	1	1

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Comparison of Supports for Map Projection

	US (55)	Canada (3)	Norway (35)	Sweden (6)	Denmark (7)	Russia (1)	France (1)	Finland (1)	NL (1)
EPSG:4326	54	3	33	6	1	1	1	0	1
EPSG:4269	28	3	30	1	0	1	0	0	0
EPSG:4267	26	1	30	1	0	1	0	0	0
EPSG:269**	8	1	0	0	1	1	0	0	0
AUTO:42***	1	0	1	0	0	1	0	0	0
EPSG:32633	0	1	35	6	0	1	0	0	0
EPSG:326**	0	1	8	6	1	1	0	0	0
EPSG:WGS84	0	1	0	0	2	0	0	0	0
EPSG:34**	2	1	0	0	1	0	0	0	0
EPSG:267**	7	1	0	0	1	1	0	0	

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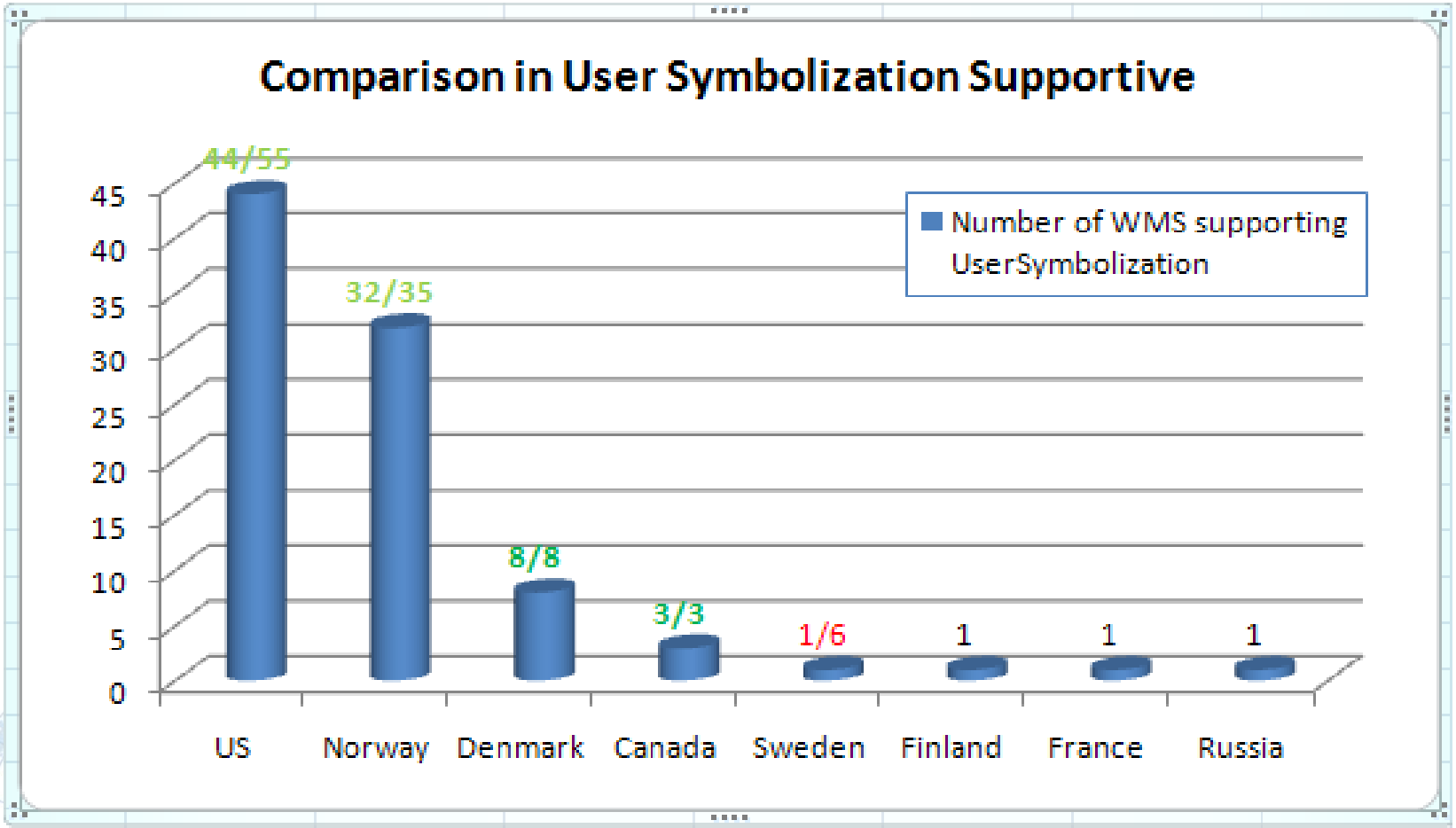
Summary for Map Projection

- Most of the WMS from the Arctic countries support EPSG:4326, (54/55 in US, all for Canada, France, Sweden and Netherland, 33/35 for Norway, 3/7 for Denmark), except service identified in Finland.
- EPSG:4269 and EPSG:4267 are also popular projections.
- EPSG:32633 is well supported by services from Norway and Sweden

Supports of User Symbolization



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Observation: Data Quality Issue

- Data missing in some layers of WMS service (service is up and no GetMap exception). This is hard to be detected automatically.
- Examples:

  http://hazards.fema.gov/wmsconnector/wmsconnector/Servlet/NFHL?REQUEST=GetCapabilities&SERVICE=WMS (layer “lake”)

  http://maps.gnwtgeomatics.nt.ca/wmsconnector/com.esri.wms.Esrimap?VERSION=1.1.1&REQUEST=GetCapabilities&SERVICE=WMS&SERVICENAME=bm_lam_p&
- Test GetMap to be sure it is functional in a number of WMS clients.

Observation: Map projection Related

- It's a good practice to include bounding boxes expressed not only in decimal degrees, but also in the other supported coordinate systems (SRS)
- Good examples(complete definition):
  - http://www.terraservice.net/ogccapabilities.ashx?request=GetCapabilities&service=WMS
  - http://irpsrvgis29.utep.edu/arcgis/services/ArcticBaseMap/MapServer/WMSServer?request=GetCapabilities&service=WMS
  - http://dev.karttricket.se/SpatialAceWMS/OGCWMSInterface.axd?view=atest_europa.MainView_atest&request=GetCapabilities&service=WMS

Observation:
Accuracy of Coverage definition

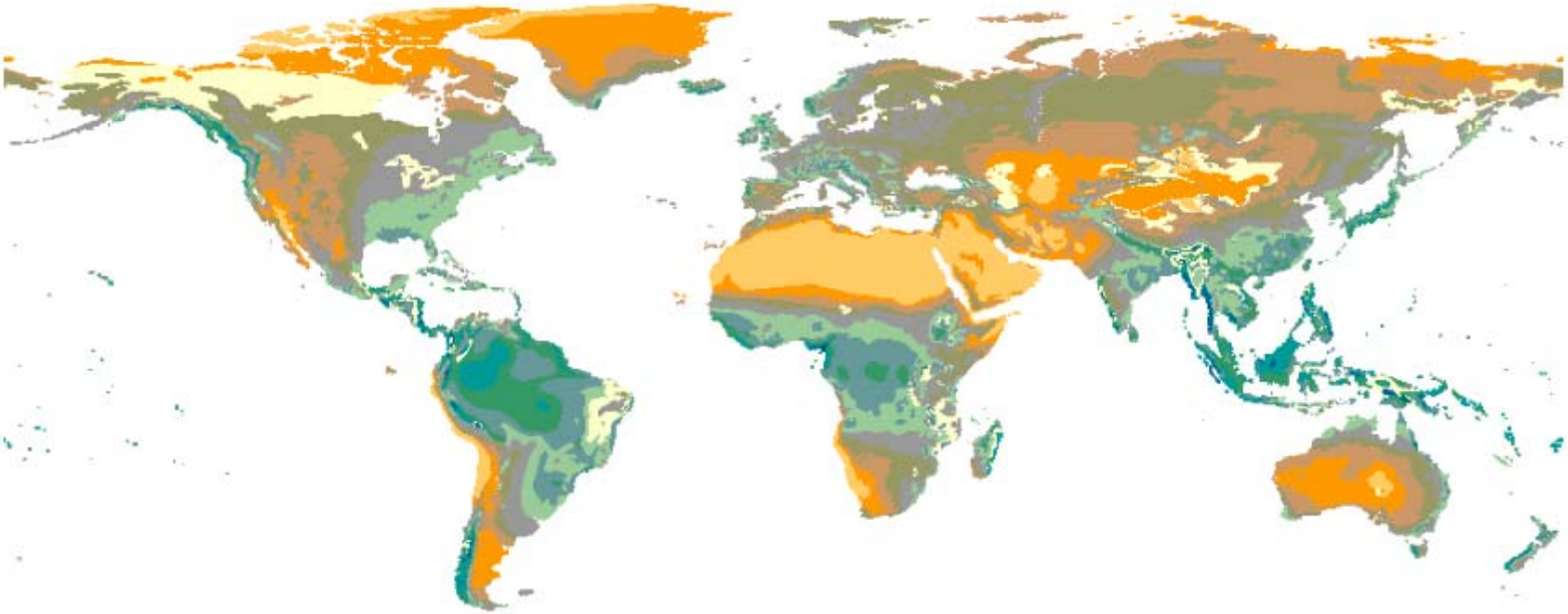
- Be sure that your bounding box adequately represents the extent of the data coverage. Use of larger bounding boxes will produce 'false hits' where data are expected to be mapped, but are not actually there.
- Example:
  - http://wms.alaskamapped.org/ series

Observation: Correctness of Capability information

- URL defined in <OnlineResource> tag should be the same as WMS URL. As some WMS viewers like Gaia will use value from that field to send GetMap request, the inconsistent info will lead to errors.
- http://map.ngdc.noaa.gov/wmsconnector/com.esri.wms.Esrimap/ series
- Meaningful titles (in English) for WMS layers is important. They should include information on the content, source, and date where appropriate.

Observation: Legend issue

- Provide legend information through *GetLegendGraphic* request.

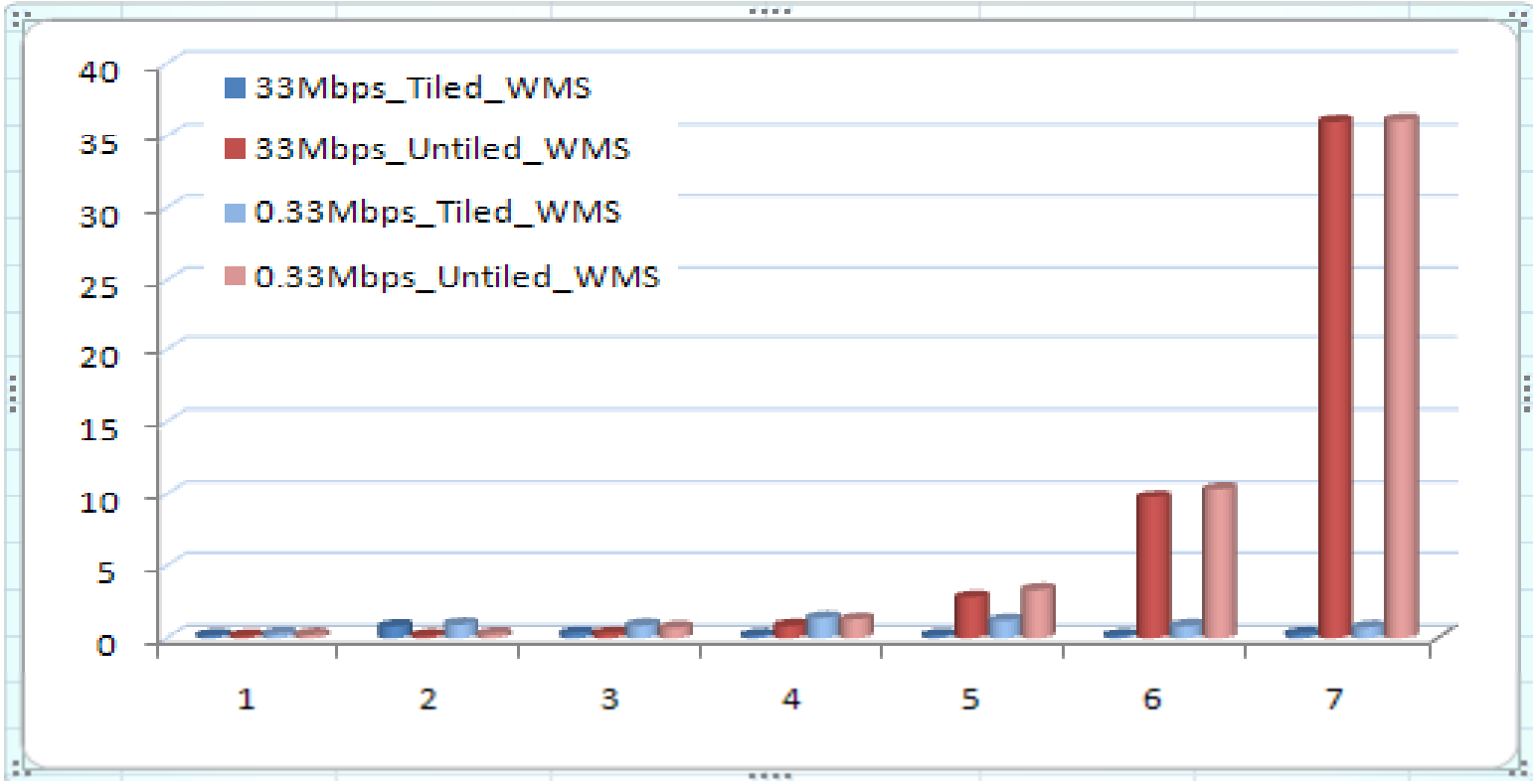


Average annual precipitation(mm)

Observation: Performance Issue

- Comparison of Tiled/unTiled Server
  http://testbed.gmu.edu/web/guest/7
- Under Various Internet Speed and Requested Data (33Mbps Vs. 0.33Mbps)
- Under Different data requested amount (7 different levels)

Observations-Performance Issue (contd.)



- Summary: Tiled WMS server maintains fast and stable access speed regardless of internet speed; performance of Untiled WMS server heavily relies on requested data amount and internet speed.
- We suggest WMS providers to utilize tile strategy for Arctic WMS server

Next Steps Towards Building a universal view of Arctic WMS

- Establish a proxy WMS that can convert an image from polar projection to/from 4326 for interoperation and visualization
- Work with Arctic WMS operators to improve the performance of service by different strategies.
- Improve VASDI prototype.

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