Hydroclimatological Data Rescue, Data Inventory, Network Analysis, and Data Distribution

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University of Alaska Fairbanks

International Arctic Research Center and

Institute of Northern Engineering

Year 2 Collaborators: Horacio Toniolo, Bill Schnabel

Ongoing Agency Partners at USGS, BLM, USFWS, ADF&G, UAF, etc

Outline

- Motivation
- Objectives
- Phase 1
  - Creating a Database
  - Acquiring and Inventorying Metadata
  - Disseminating information – project website
- Phase 2
  - Data rescue and ingestion
  - Network Analysis

Project Motivation

- WILDREACH Report & NSSI Emerging Issues
- Establishment of the Arctic LCC
- Agency and researchers need
- Conveyance of institutional knowledge and field data to new generations of stakeholders

WILDREACH report: scientific priorities

- How reliable are the projections for **increasing precipitation and evapotranspiration**?
- How will the **annual precipitation** input on the Coastal Plain and Foothills be allocated **between winter (snow pack) and summer**?
- How will **changes in precipitation, evapotranspiration, and active layer depth** alter summer **surface water availability** in shallow-water and mesic/wet tundra habitats?
- How will **changing patterns of seasonal runoff affect stream flow**?
- What is the **contribution of groundwater in various systems**, and is it sufficient to maintain year-round flow?
- Will **drought conditions and changes in drainage patterns decrease water body connectivity**?
- **Which Coastal Plain lakes are susceptible to tapping** (rapid drainage) and on what time scale?
- What are the expected **changes in snowpack characteristics (depth, density, presence of ice layers)** and how might these vary on a regional and local scale?
- How much change will occur in the **timing of snow melt and snow onset**?
- How will the **frequency of rain-on-snow and severe winter storm events** change?

WILDREACH report: species that may be impacted negatively by changes in climate and hydrology

	Warming temperature	Decreased connections between waterbodies	Drying of aquatic habitat	Change in ice-free/growing season	Increase in winter precipitation	Increase in summer storm events	Increase in rain on snow events
Yellow Billed Loon	X						
Pectoral Sandpiper			X				
Red Phalarope			X				
Shorebirds				X			
Common Eider						X	
Broad Whitefish	X	X					
Dolly Varden	X	X					
Arctic Char		X					
Lake Trout		X					
Musk Ox						X	X
Caribou						X	X

NSSI Emerging Issues Papers

Highlights for <u>Weather and Climate:</u>

- Weather data collection is currently ad hoc
- Need a systematic approach to equipment maintenance and data collection, storage, management, and dissemination to assess patterns accurately.
- Agencies and other entities need to work together to inventory existing weather stations, undertake a gap analysis, and invest in an improved well-coordinated system.
- Need for improved weather data collection and management cannot be overemphasized.

NSSI Emerging Issues Papers

Highlights for <u>Hydrology and Lake Drying:</u>

- With ongoing industrial development and environmental change, information from hydrological and meteorological networks in the Arctic is critical to management.
- Information needs apply to rivers, streams, lakes, ponds, and wetlands.
- Remote sensing technologies useful for understanding and monitoring hydrology have yet to mature, but warrant further research and development.
- Status and trends of hydrological processes are poorly understood.
- Changes expected to occur due to climate change are difficult to predict and, given the current paucity of information, may be difficult to document.

NSSI Emerging Issues Papers

Management questions for <u>Hydrology and Lake Drying:</u>

1. What kind of **network of long-term stream gauging stations** is needed on the North Slope of Alaska?
2. Is the Arctic **hydrologic cycle undergoing significant and rapid change** in response to climate change and is it well understood how this will **affect cycle complexity** (floods, drought, etc.)?
3. Are **alternative technologies** for **better quality data collection** being developed? If so, will they **lead to alternative regulatory requirements**?
4. Hydrologic data for individual **small headwater hydrologic systems (streams and lakes)** are severely lacking, but might these systems, collectively, be very **important**?

NSSI Emerging Issues Papers

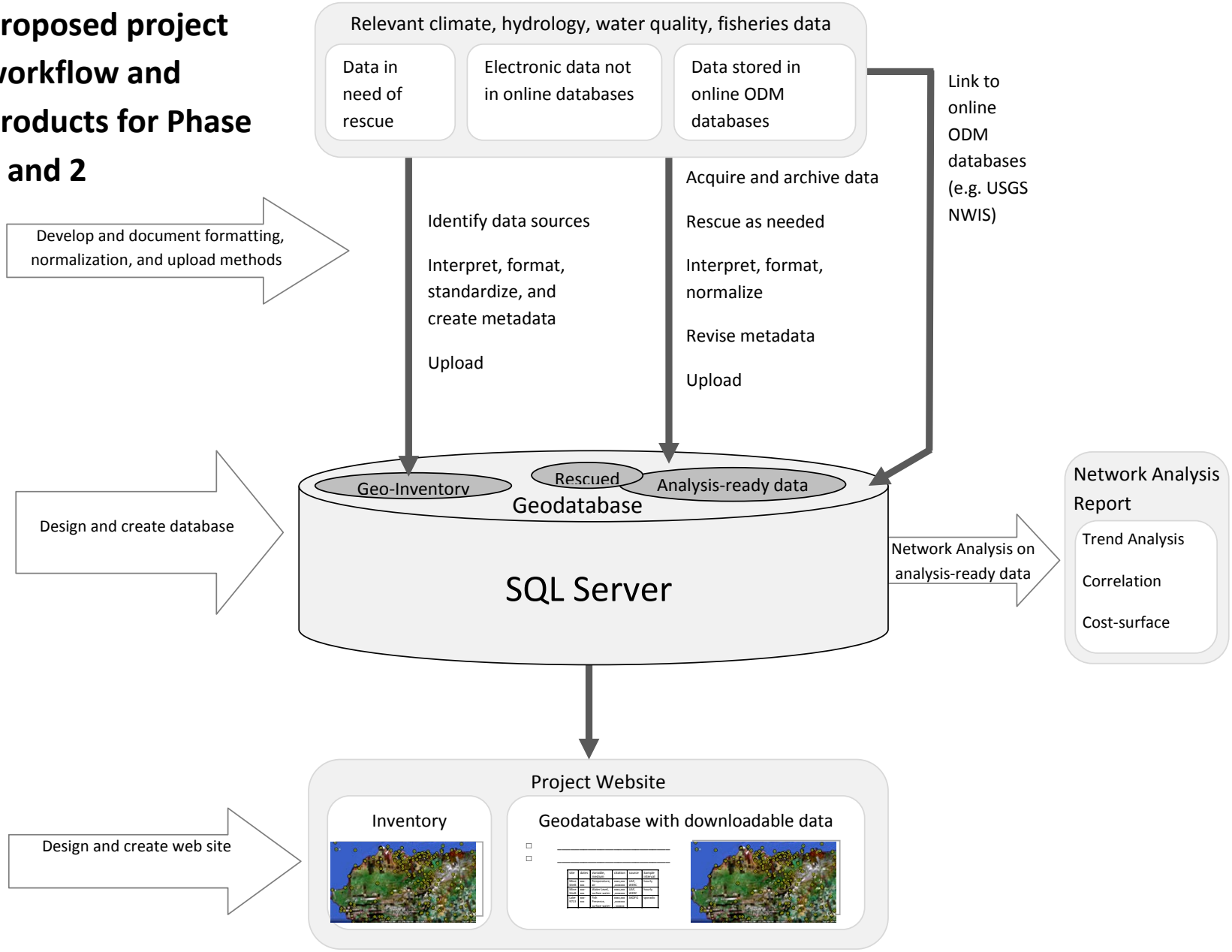
Management questions for <u>Hydrology and Lake Drying:</u>

5. Are there **significant data gaps** in relating **annual surface runoff** to **annual precipitation**?
6. How does **snow water equivalent** (SWE) **vary on a local scale**? How accurately can we determine **how much water is available in the snowpack at the watershed scale**?
7. Spatially and temporally, **how does water availability vary** on the North Slope? Will energy exploration and development be able to move forward in water challenged environments?
8. How **important are ephemeral streams to fish**?

Objectives

- Improve data availability and dissemination
- Inventory and acquisition of hydrologic and related data held by state and federal agencies, and the private sector.
- Design a public database to house data and metadata related to hydrology and climate in arctic Alaska and begin to populate with metadata.
- Design and host a simple webpage with metadata, project description, and access to a GIS file with the station locations from the inventory.
- Use retrospective analyses to aid the Arctic LCC and partners in efforts to assess sampling designs for hydrologic monitoring networks.

Proposed project workflow and products for Phase 1 and 2



Phase 1 -- So let’s get started

- We need a container to hold the data
- We need an interface for people to do simple queries
- We need to be able to do simple visualizations online
- We need the user to be able to download the data in their favorite format
- We need to acquire and ingest metadata

Phase 1 -- So let's get started

- **We need a container to hold the data**
  - **Want to coordinate with other efforts**
- We need an interface for people to do simple queries
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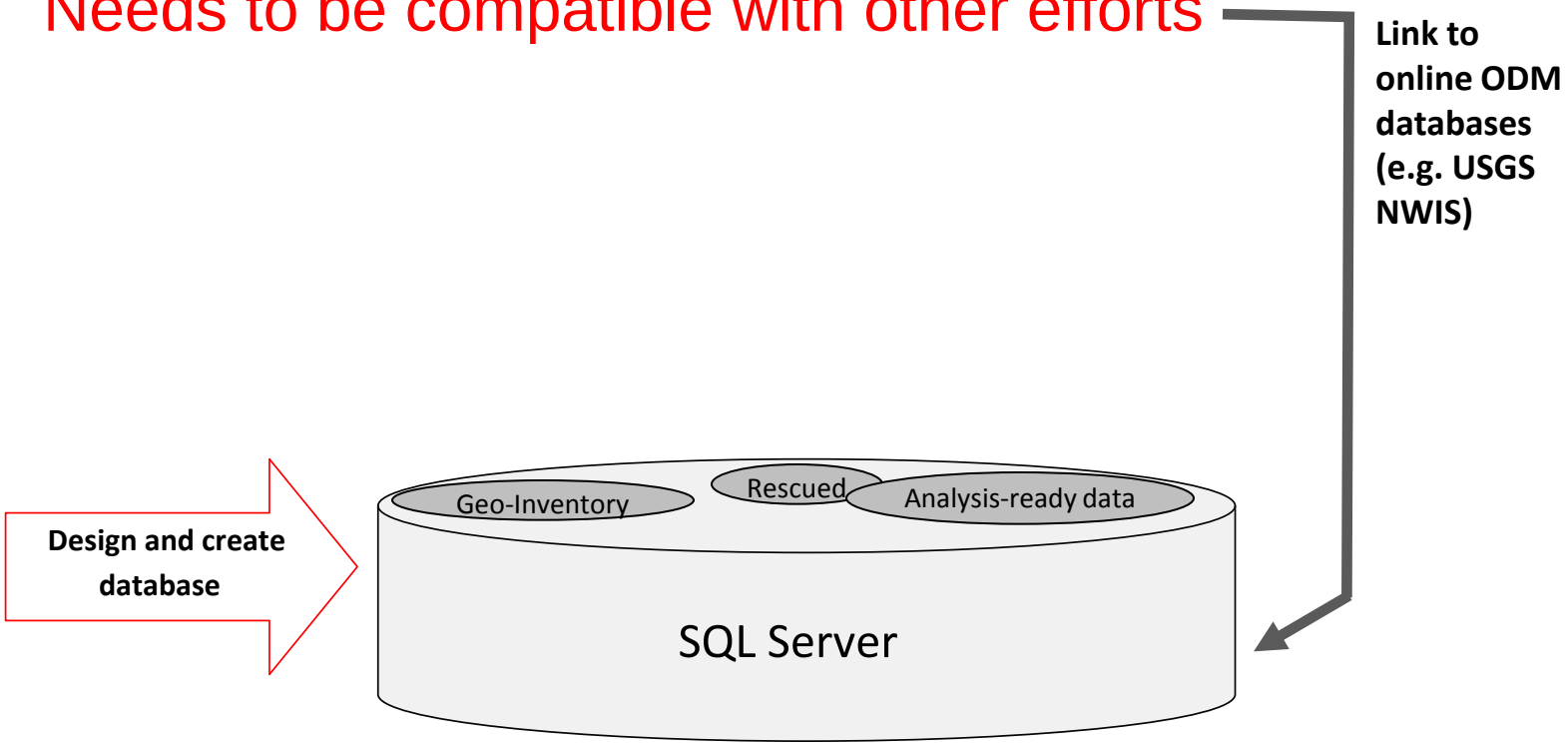
We need a container to hold the data

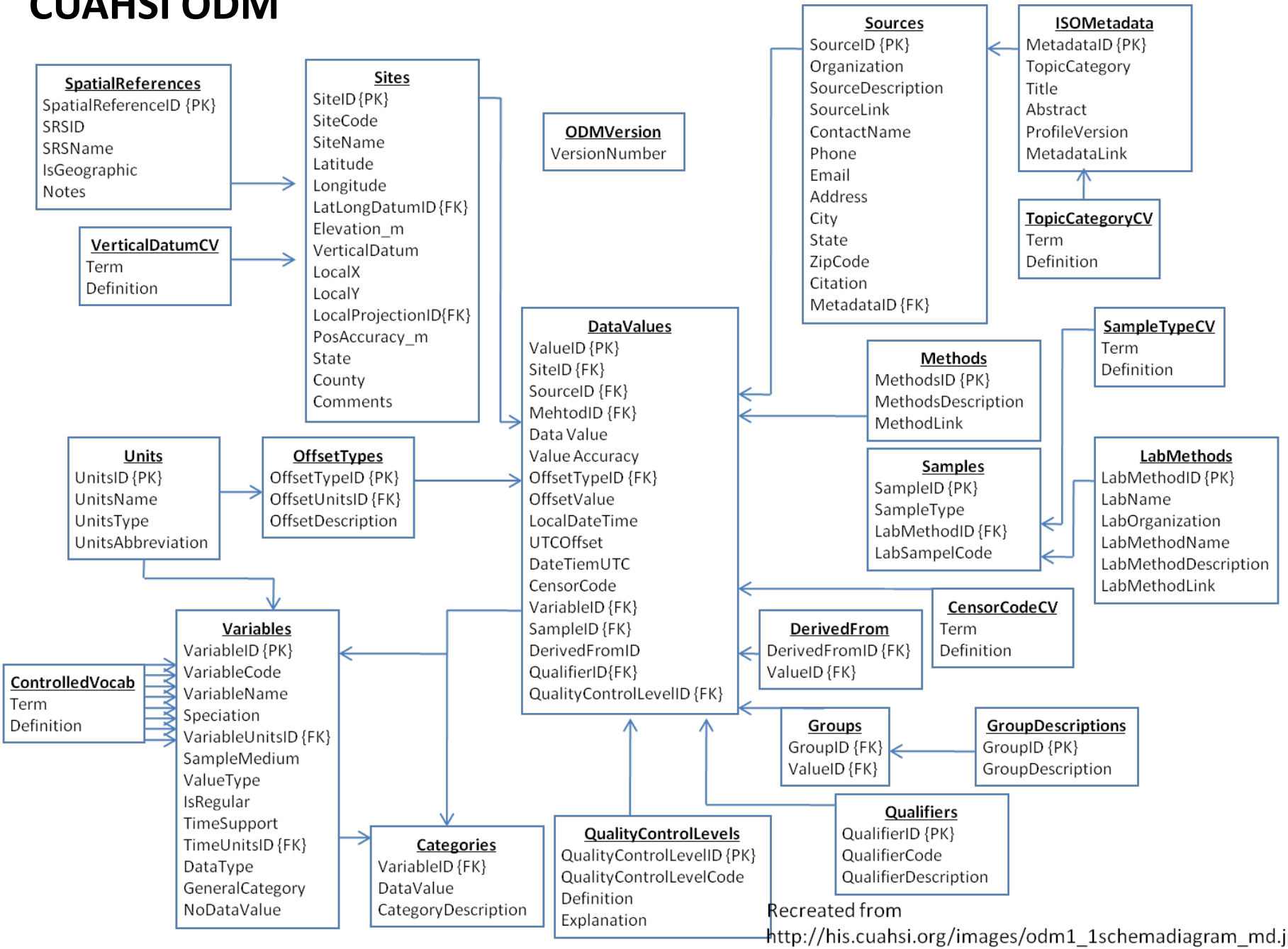
- Needs to be compatible with other efforts



The Container – available models versus needs

	CUAHSI ODM	Berkeley Sensor	SciScope	ArcticLCC Hybrid
Support hydrologic network analysis				X
Link to other databases (WERC, USGS, STORET, etc)	X	X	X	X
Store point observations	X	X	X	X
Store polygon, gridded, and transect observations			X	X
Store hydrology, climate, and, potentially, biological data	P	P	X	X
Tables to prioritize processing of inventoried data				X
Store ISO 19115 metadata standards	X		X	X
Link each observation with traceable dataset heritage, including appropriate **citation** and QA/QC information	X	X	X	X
Restrict access when necessary		X	X	X

CUAHSI ODM



Recreated from
http://his.cuahsi.org/images/odm1_1schemadiagram_md.jpg

Berkeley Sensor

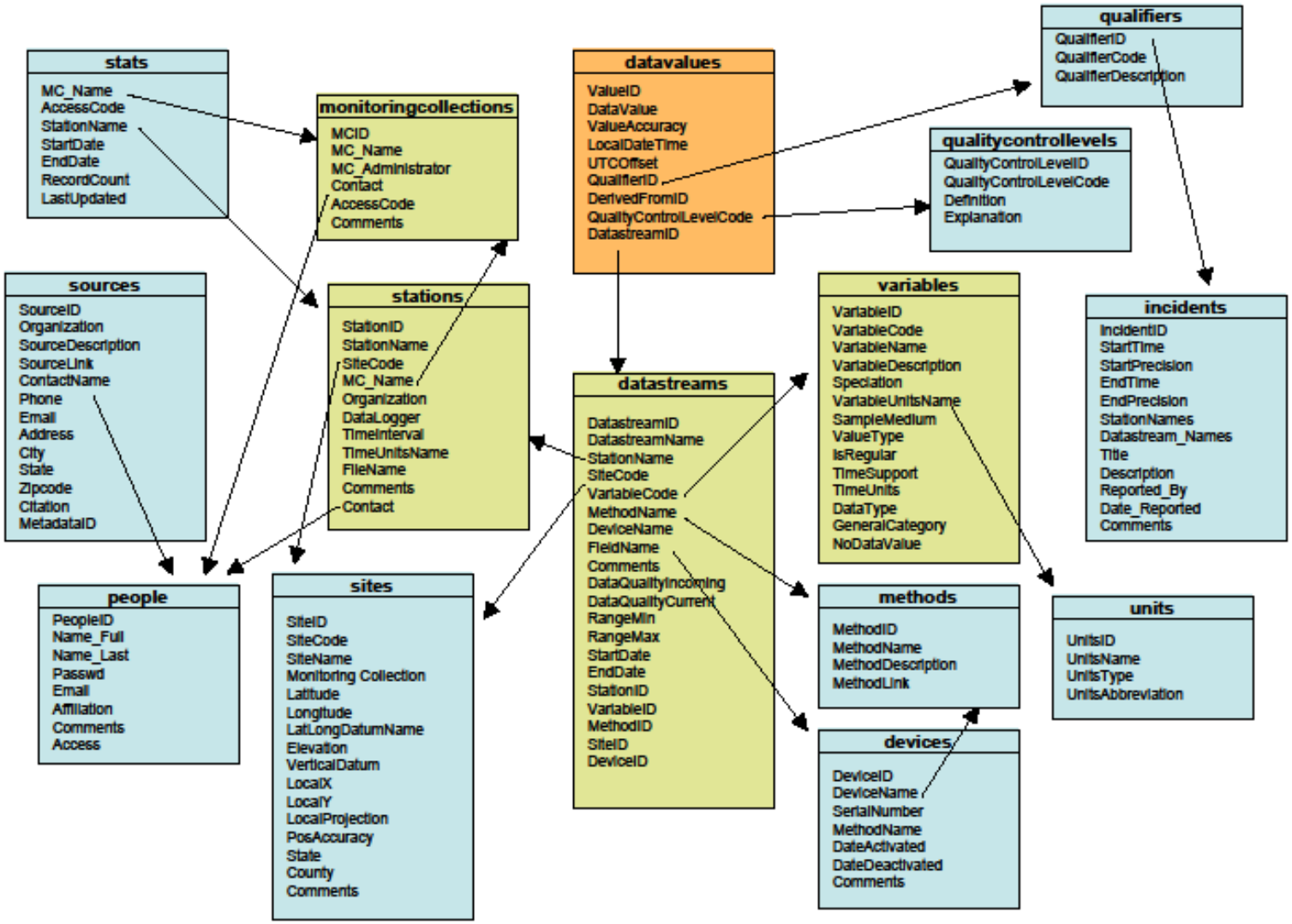
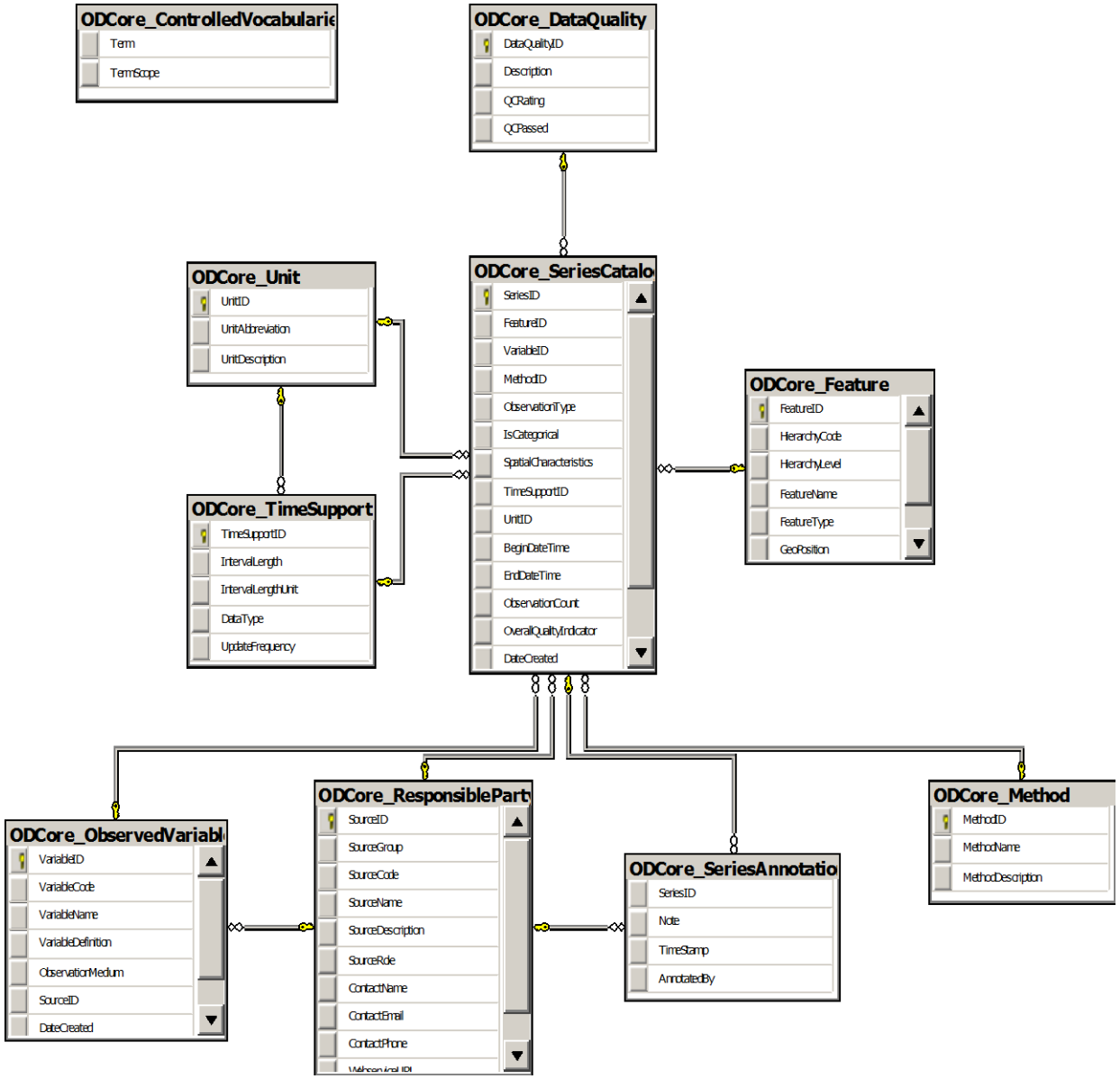
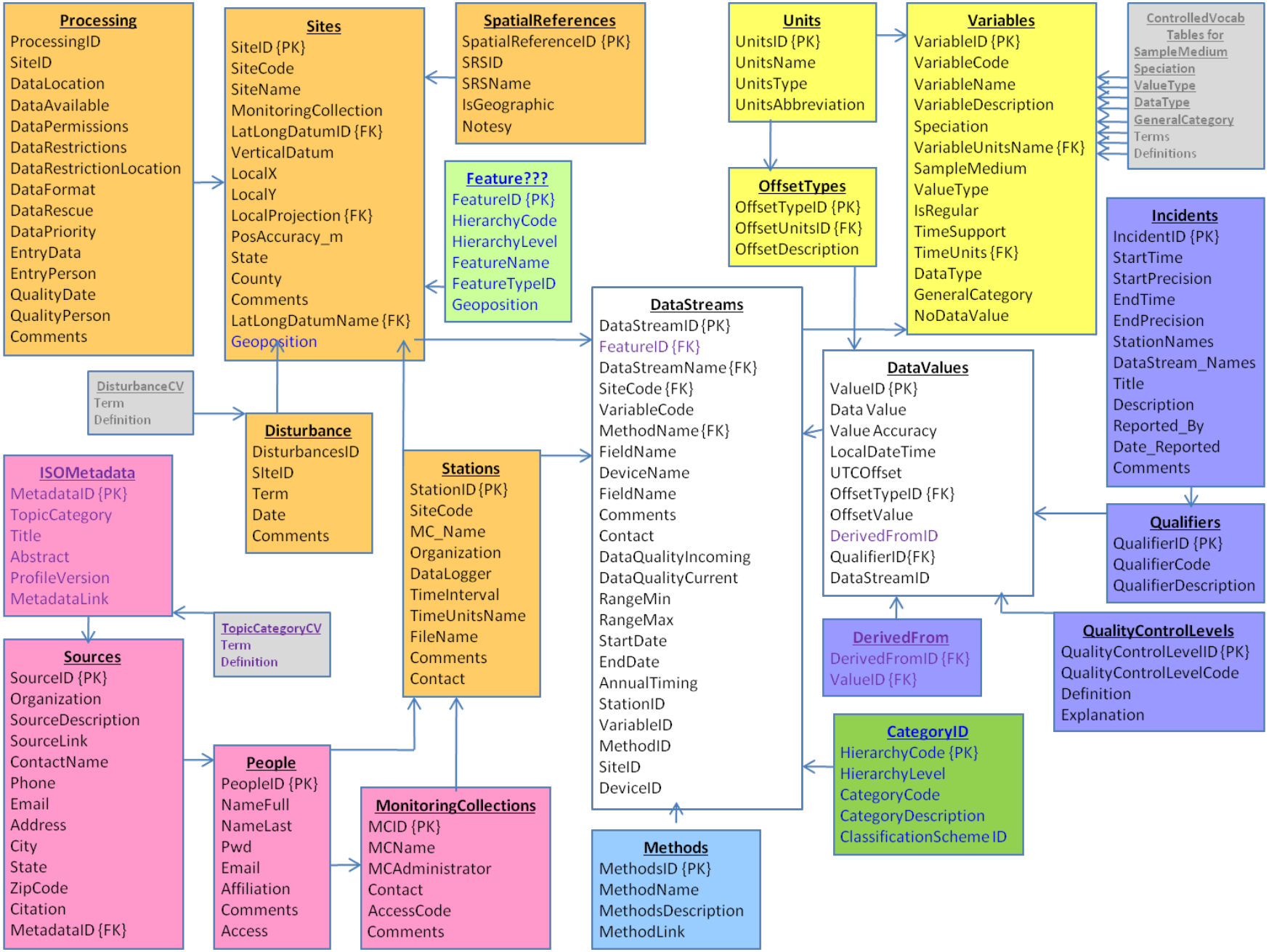


Diagram from http://sensor.berkeley.edu/SensorDB_Schema.pdf

SciScope (core only)



Evolving Arctic LCC hybrid model



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What type of queries are needed for network analysis and answering WILDREACH/NSSI report questions?

1. Return all fish/hydrology/climate stations within bounding box (example: 70N 68N 150W 155W)
2. Which parameters are sampled by the above stations and for what period of time?
3. Return all stations that sample x parameter (i.e. temperature) within bounding box y for time period z (example: 1940-present, winter only)?

Potential Queries
Phase 1

Time

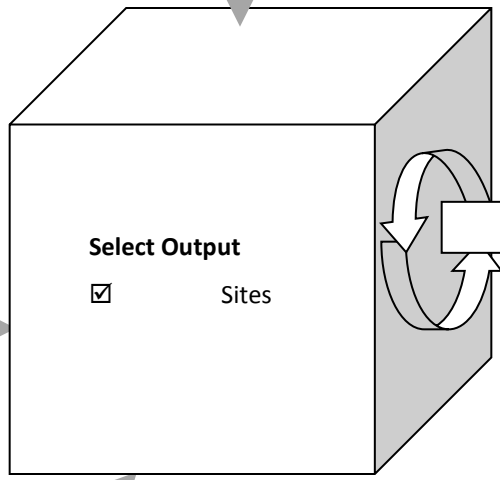
*Measured between time X and Y (e.g. X = 1 Jan 1900, Y = 10 Sept 2010)
*Measured during ≥ X consecutive years (e.g. X = 10 consecutive years)
*Measured during ≥ X years, total (e.g. X = 10 years, total)

Space

Site Name from list (FishCreek)
Entire extent / all sites
Bounding Box (e.g. 70N 68N 150W 155W)
Bounding polygon drawn by user
Bounding circle drawn by user
Land Management Unit (e.g. NPRA)

Variables/Categories (select from list)

Variable M and **Sample Medium** N (e.g. temperature, discharge, precipitation)
General Category M (e.g. Climate, Biota, etc)
Value Type (e.g. derived, observed, model simulation result, report, etc)

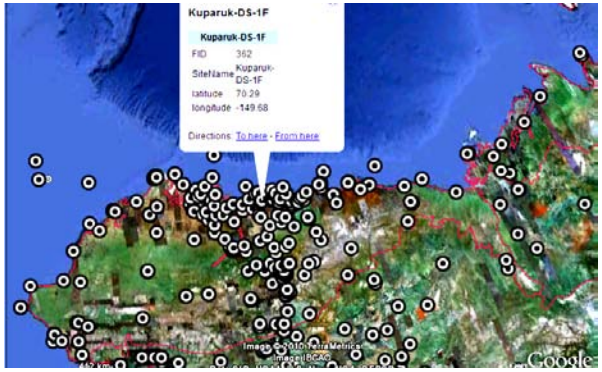


Source (select from drop down list)

Organization (BLM)
Source Description (Federal Agency)
Contact Name (Rickard Kiemnitz)

Potential Query Output

All **sites** with observational data for particular variables or for all variables in a **General Category** collected by a particular organization.



Bold text indicates name of existing table or field in inventory/database

* requires additional table or field for inventory

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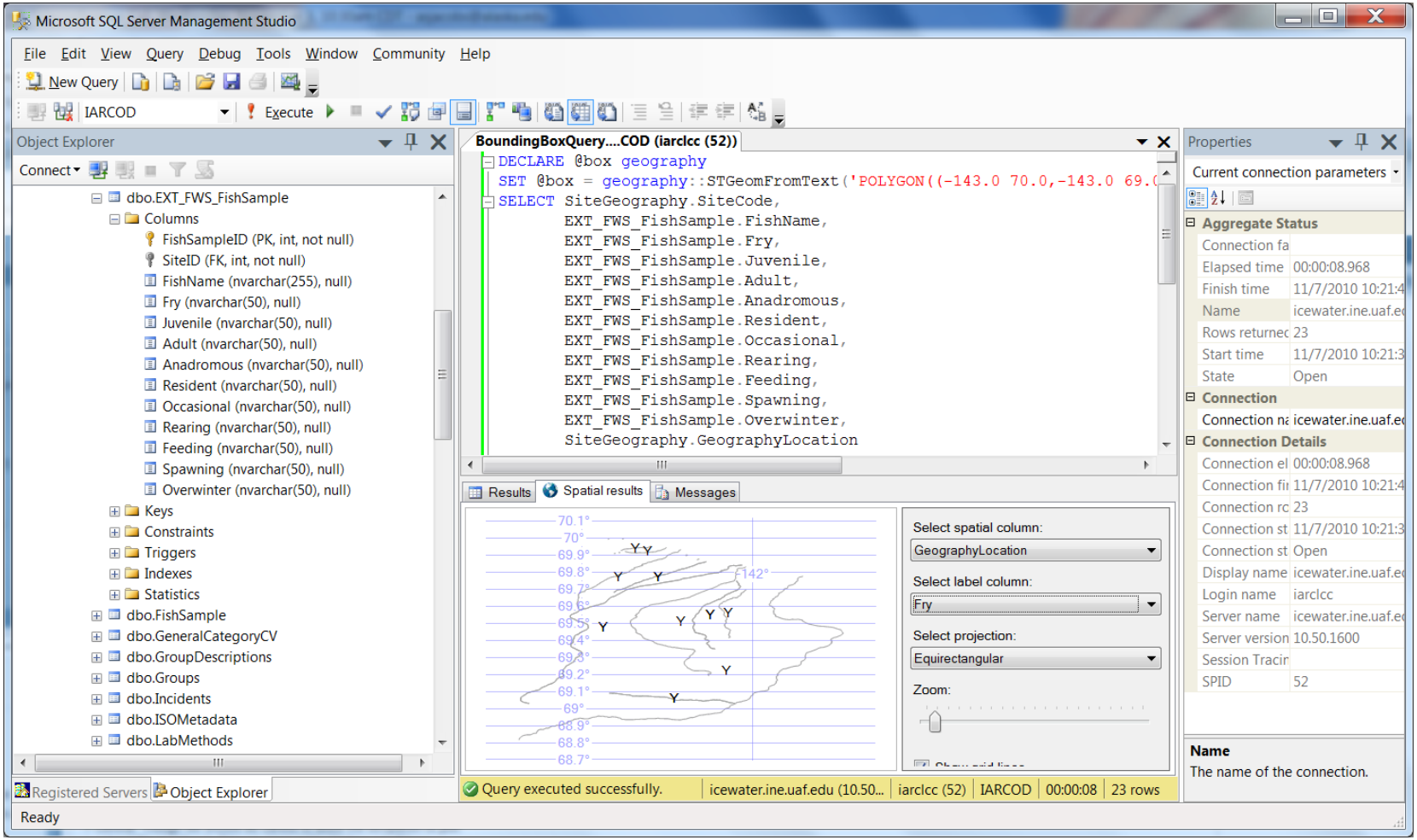
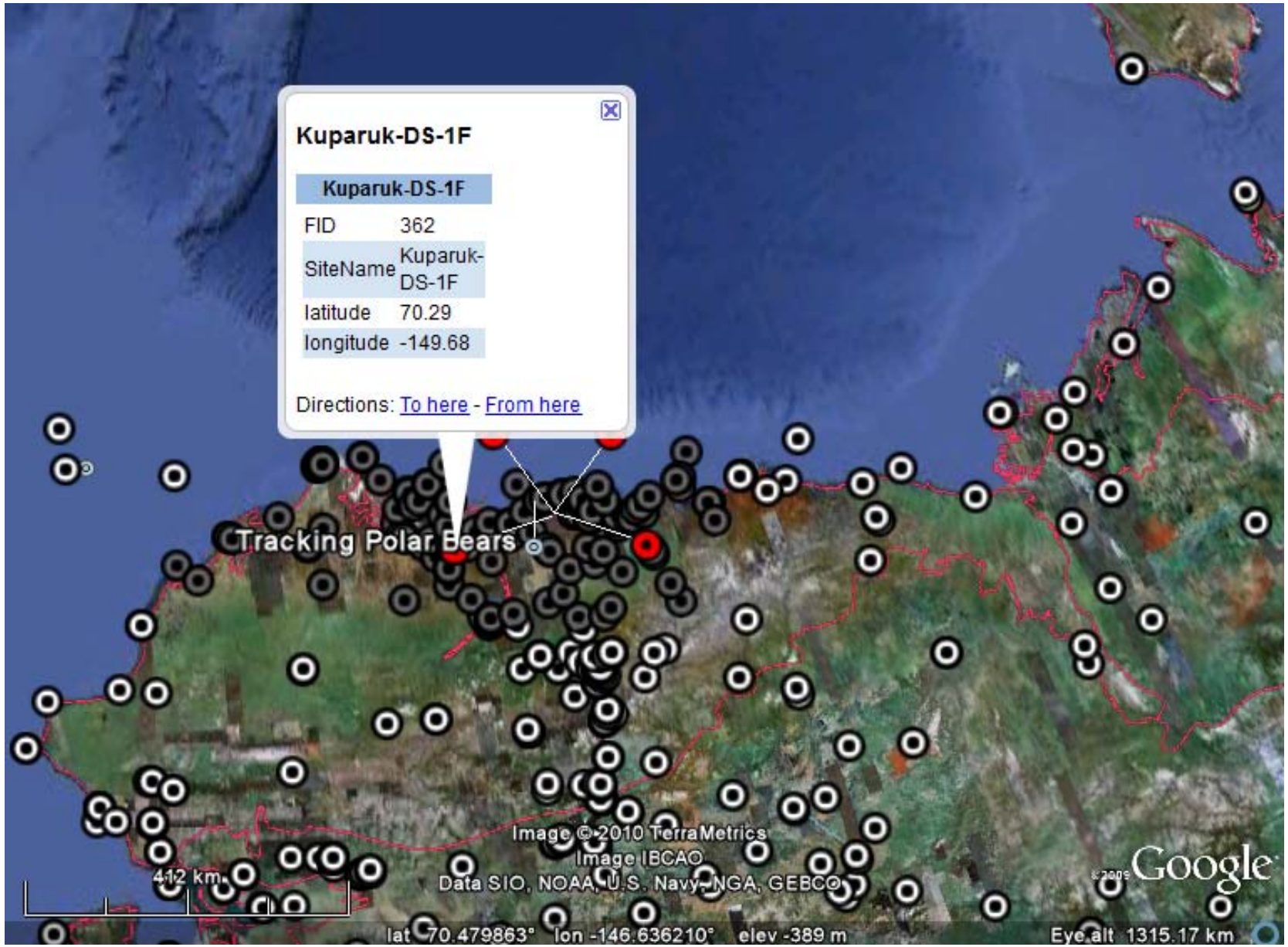
Data Visualization

Trying to go with off-the-shelf freeware such as SQL Management Studio:




Kuparuk-DS-1F
Kuparuk-DS-1F
FID 362
SiteName Kuparuk-DS-1F
latitude 70.29
longitude -149.68
Directions: To here - From here
Tracking Polar Bears
Image © 2010 TerraMetrics
Image IBCAO
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
412 km
Google
lat 70.479863° lon -146.636210° elev -389 m
Eye alt 1315.17 km

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Example of output in users favorite format

Time

*Measured between time X and Y (e.g. X = 1 Jan 1900, Y = 10 Sept 2010)

*Measured during ≥ X consecutive years (e.g. X = 10 consecutive years)

*Measured during ≥ X years, total (e.g. X = 10 years, total)

*Measured at irregular or regular intervals ≤ Z (e.g. Z =sporadic, annual, monthly, weekly, daily, hourly, 15-minute, etc)

Combinations:

*Measured at irregular or regular intervals ≤ Z from interannual date A to B between years X to Y (e.g. regular intervals, ≤ hourly, 1 May – 1 Jun, 1980 – 2010)

Space

Site Name from list (Lake 9713)

Entire extent / all sites

Bounding Box (e.g. 70N 68N 150W 155W)

Bounding polygon drawn by user

Bounding circle drawn by user

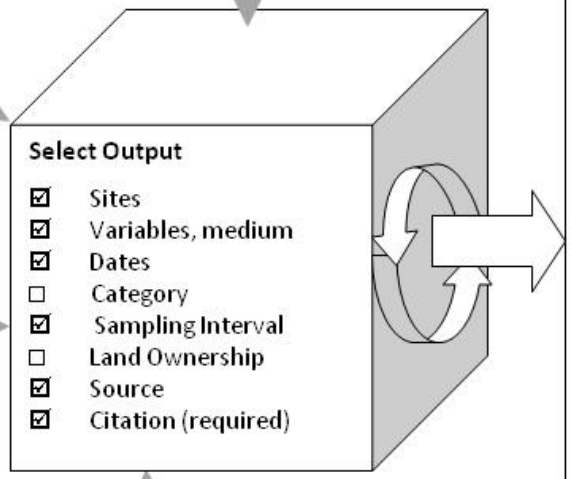
Land Management Unit (e.g. NPRA)

Variables/Categories (select from list)

Variable M and **Sample Medium** N (e.g. temperature, fish presence, snow)

General Category M (e.g. Climate, Biota, etc)

Value Type (e.g. derived, observed, model simulation result, report, etc)



Source (select from drop down list)

Organization (Fish and Wildlife Service)

Source Description (Agency)

Contact Name (Joe Smith)

Potential Query Output

All **sites**, dates, **variables**, suggested **citation**, and information about **source** and sampling interval for variables in a **Category** collected at regular intervals ≤ Z at specified location, between specific dates, and with ≥ X consecutive years of data.

site	dates	Variable, medium	citation	source	Sample interval
Mine SiteB	xx-xx	Temperature, air	xxxx,xxx ,xxxxxx	UAF, WERC	hourly
Mine SiteB	xx-xx	Water Level, surface water	xxxx,xxx ,xxxxxx	UAF, WERC	hourly
Lake 9713	xx-xx	Fish Presence, surface water	xxxx,xxx ,xxxxxx . xxxxx	AKDFG	sporadic

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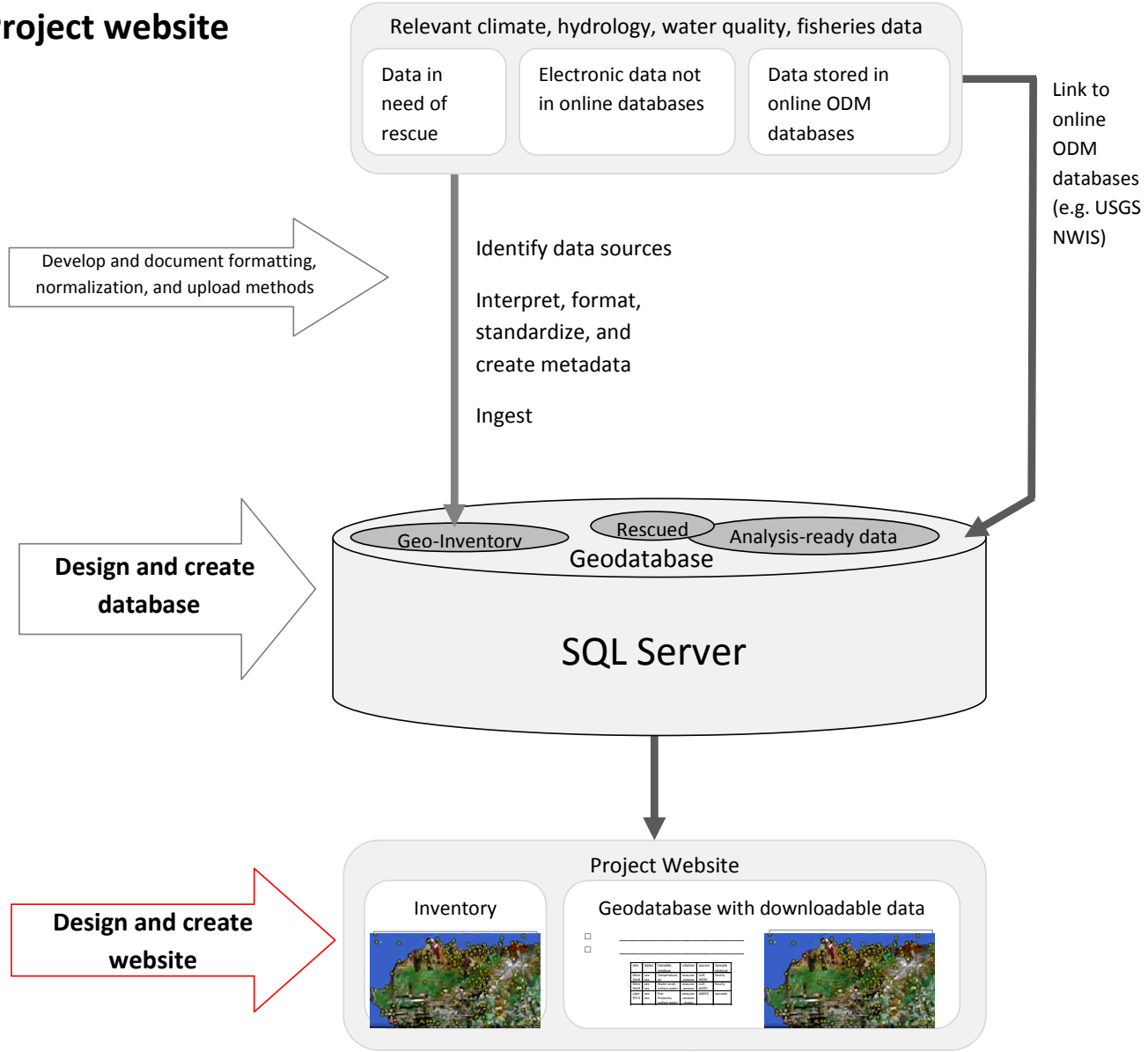
Project website



International Arctic Research Center
and Water and Environmental Research Center

ArcticLCC Data Rescue and Inventory
of Hydrology-Related Data in Arctic Alaska

Home | Project Description | Project Documents | Contributors | Contacts

Home

Welcome

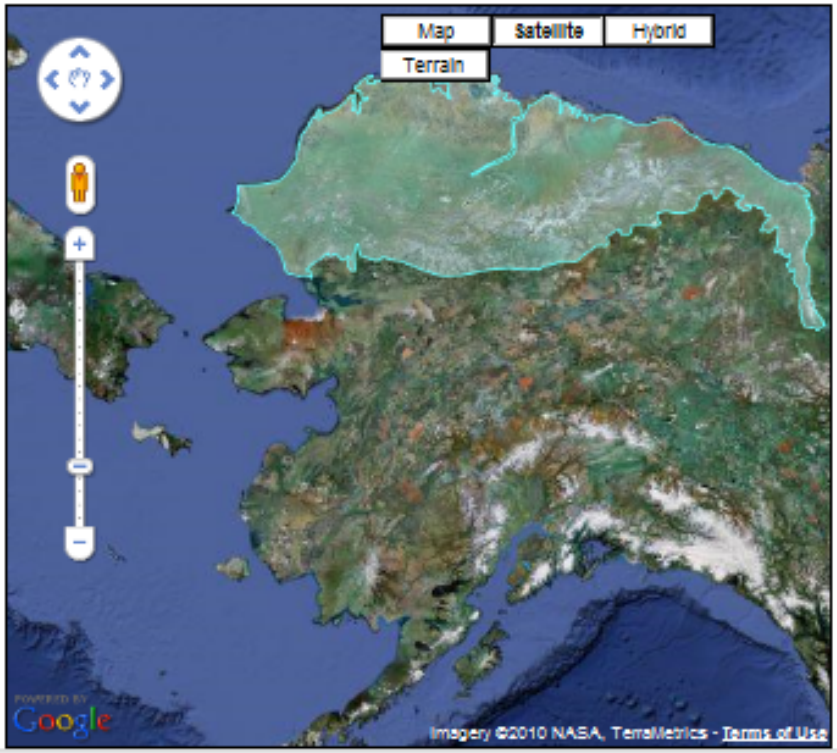
Welcome to the ArcticLCC Data Rescue and Inventory of Hydrology-Related data in Arctic Alaska.

Search by keyword or data type:

Submit | Clear Map

OR

View Catalog



If you have any questions or comments about the project, contact:

Dr. Jessica Cherry (jcherry@iarc.uaf.edu)

Water and Environmental Research Center
University of Alaska Fairbanks
441 Duckering Bldg. P.O. Box 755860

International Arctic Research Center
University of Alaska Fairbanks
930 Koyukuk Dr. PO Box 757340

Phase 1 -- So let's get started

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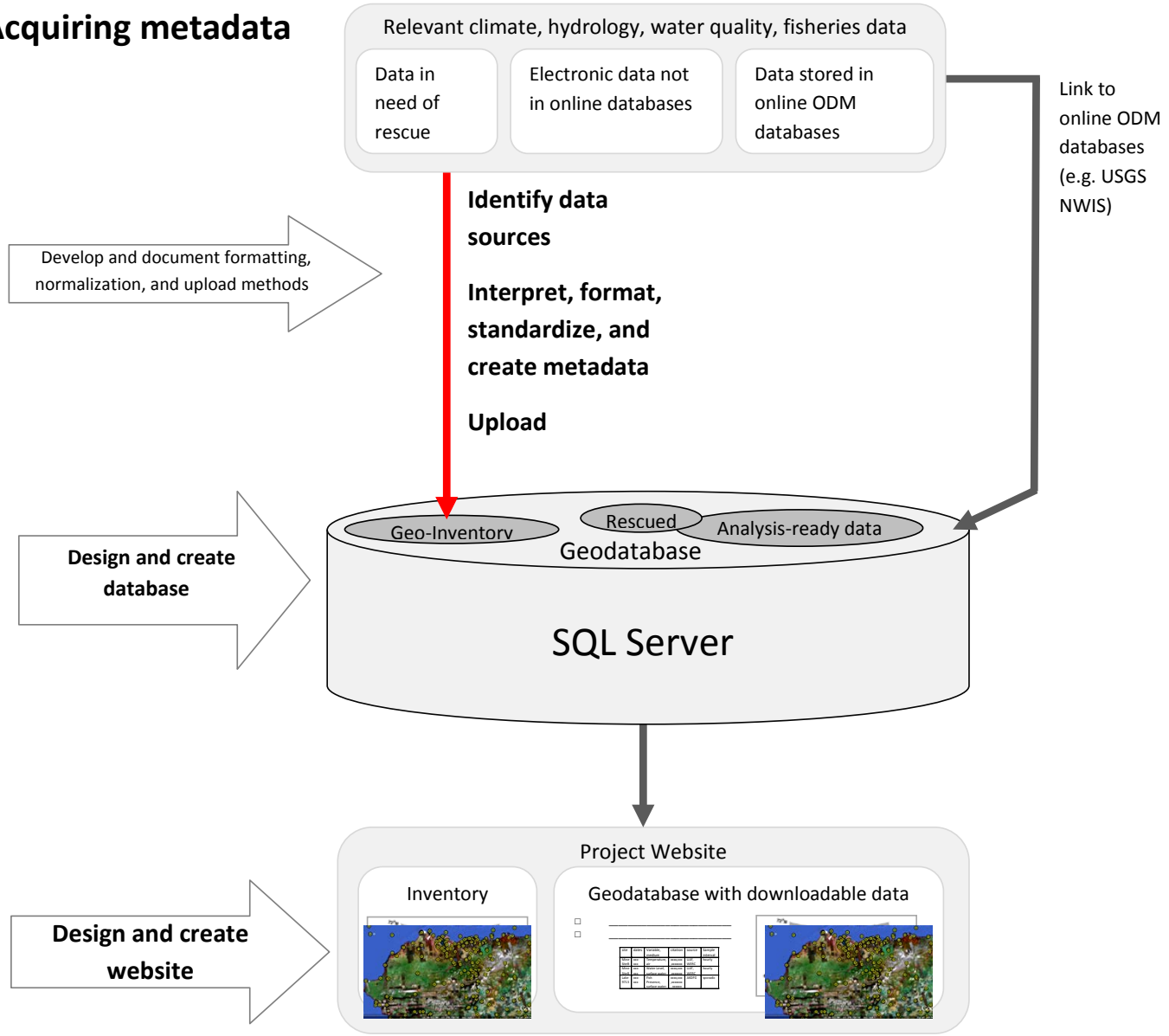
- **We need to acquire and ingest metadata**

Acquiring metadata



Acquiring metadata

INTERNATIONAL ARCTIC IARC RESEARCH CENTER

Jane Researcher
Research Institute
Fairbanks, Alaska 99709

2 December 2010

Dear Jane:

As partners of the Arctic Landscape Conservation Cooperative (Arctic LCC), we are creating a geodatabase of **meteorological, hydrological,** and **aquatic ecosystem** data from Arctic Alaska and Northwestern Canada (Figure 1). The Arctic LCC will use products generated from this effort to refine conceptual models, guide future research and monitoring efforts, and aid in informed and coordinated management of populations of fish and wildlife. More information about the Arctic LCC can be found at fws.gov/science/shc/pdf/DOIArcticLCCNarrative.pdf .

Our first step is an inventory of existing data. We will gladly accept any information regarding your dataset. If you have data or metadata to contribute, know of a potentially relevant database, are working toward a similar goal of data compilation, or have started to compile datasets, we would love to work with you to increase the availability of existing arctic datasets. To contribute information about your data to this inventory, please see Appendix A, call us, or send (arcticdata@gmail.com) the following information: **your contact information, brief description of variables, approximate dates** over which data was collected, and a **brief description of spatial extent (or shapefile)**. A finalized version of this inventory will help us determine where to focus additional database efforts.

Our second step is to request and archive datasets, perform data rescue efforts, create standardized metadata, populate a geodatabase that can be accessed online, and link datasets to existing platforms. By contributing data, you will not only help the Arctic LCC, you will also increase citation of the valuable datasets you have collected and ensure that they are archived for the future! Citation information for contributed data will be linked to datasets and proper citation of data will be required. Our team includes dedicated data rescue experts who are eager to turn daunting stacks of field notes, hand drawn maps, photos, slides, digital files and raw datasets into user-friendly, streamlined datasets! Please see Appendix B for instructions on contributing data. If you would like to restrict access to your data, please let us know. We cannot promise to rescue and include all datasets in the final database, but at the very least we will document the need for rescue of your dataset.

See below to view potential database categories and to see more details on contributing to the Arctic LCC inventory and database. Please let us know if you have any questions or comments. Thank you for your time.

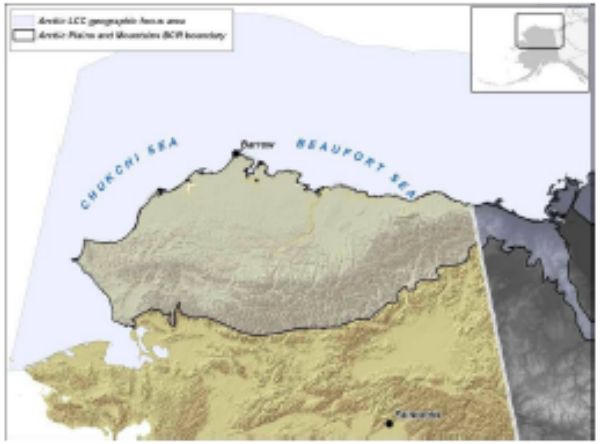
Sincerely,

The Arctic LCC Hydrologic Database Team:
Jessica Cherry PhD
Greta Burkart PhD
Jennifer March MS
Amy Jacobs MS

Phone 907-474-5730 • Fax 907-474-2643 • e-mail: arcticdata@gmail.com
Jessica Cherry • 930 Koyukuk Drive • PO Box 757340 • Fairbanks, Alaska 99775-7340
UNIVERSITY OF ALASKA FAIRBANKS UAF

INTERNATIONAL ARCTIC IARC RESEARCH CENTER

Figure 1. Map of the Arctic LCC focus Area



Appendix A

Phase 1: Data Inventory -- tell us about your data

To contribute information about your data to the initial Arctic LCC inventory, please call us or send (arcticdata@gmail.com) any of the following information (target date for data inventory: September 2010, though we will happily accept information at any time):

- **Your contact information and affiliation.**
- **Description of datasets and variables (be as brief or detailed as you have time to be).**
- **Format data is currently stored in (e.g. notebook, spreadsheet, database, 8 track, HDF, slides, photos, etc.).**
- **Time over which data was collected (if collected over multiple years, indicate which seasons)**
- **Spatial extent of data using one of the following formats: your own preferred format, brief narrative description of general location, coordinates, shape file, kml file, or annotated map (e.g. creating and sharing a Google Maps using 'my maps').**
- **Other relevant information you might want to include about your data. This initial inventory will be updated and finalized at a later date.**

Phone 907-474-5730 • Fax 907-474-2643 • e-mail: arcticdata@gmail.com
Jessica Cherry • 930 Koyukuk Drive • PO Box 757340 • Fairbanks, Alaska 99775-7340
UNIVERSITY OF ALASKA FAIRBANKS UAF

Source Contact List – continues to expand

Agency/Project/Division	Starting Contact Point	Contact
AK DOT	michael.knapp@alaska.gov	X
AK DOT	paul.janke@alaska.gov	
Barrow researchers	Jerry Brown, Kim Peterson, Mike Miller, Larry Hinzman, etc	
BLM	Matthew Whitman	X
BLM	Richard Kemnitz	X
Concoco Philips / MJM research	Karen Rae / Larry Moulton	
NPS - ARCN	Scott Miller (database manager)	X
Toolik LTER	Chris Luecke	X
Toolik LTER	Anja Kade	X
Toolik LTER	John Hobbie and Gaius Shaver	
UAF -- GINA	Dayne Broderson	X
UAF -- IARC	Bob Busey	X
UAF -- IARC	Jessica Cherry	X
UAF - WERC	Amy Tidwell	X
UAF - WERC	Bill Schnabel	X
UAF - WERC	Sveta	X
US FWS	John Trawicki	X
US FWS	Jenn Jenkins and Dave Daum	X
US FWS	other sources	
USGS	Ben Jones	X
USGS	Molly McCammon	
USGS	Chris Arp	X
USGS	Steve Frenzel	X
AK DFG	Joe Buckwalter, Ryan Snow, Skip Repetto	X
AK DFG	Bill Morris	X
AK DEC	charley.palmer@alaska.gov	
AK DFG	J Johnson	
AK DNR	terence.schwarz@alaska.gov, ted.deats@alaska.gov	
AK DNR	_	
Alaska DGGS		
BLM - Fire		
Arctic Slope Regional Corp	Sieberg, Stuart (recommended by Joe Buckwalter)	
North Slope Borough		
BLM	Shane Walker	X
Toolik LTER	Sally MacIntyre	X
Water Survey of Canada	WSC@ec.gc.ca	X

Agency/Project/Division	Starting Contact Point	Contac
AK DFG	joe.klein@alaska.gov	
AK DNR	gary.prokosch@alaska.gov	
BLM	Lee Koss	
Bureau of Indian Affairs	KLKahklen@gci.net	
GWS	mlilly@gwscientific.com	
NOAA	Aaron.Jacobs@noaa.gov	
NOAA	edward.plumb@noaa.gov	
NOAA	jeanne.hanson@noaa.gov	
NOAA	robin.radlein@noaa.gov	
NPS - ARCN	Amy Larsen (recommended by Scott Miller)	
NPS - ARCN	Dave Swanson (recommended by Scott Miller)	
NPS - ARCN	Jennifer Allen (recommended by Scott Miller)	
Parks Cananda		
Tribal Health Consortium		
TETRATECH	christy.miller@tetratech.com	
Toolik researchers	Steve Oberbauer, George Kling	
UAA -- ENRI	John Zufelt	
UAF	ffdmw@uaf.edu	
UAF	Jay.Jones@alaska.edu	
US Army Corps of Engineers	Crane.Johnson@usace.army.mil	
US EPA	north.phil@epa.gov	
US FS	rweaver@fs.fed.us	
US FS	wamacfarlane@fs.fed.us	
US FWS	william_rice@fws.gov	
USACE	Harlan.M.Legare@poa02.usace.army.mil	
USACE	Jon.E.Zufelt@erdc.usace.army.mil	
USDA NRCS	richard.mcclure@ak.usda.gov	
USDC NMFS	Eric.Rothwell@noaa.gov	
USDC NWS	Larry.Rundquist@noaa.gov	
USGS GTNP	Frank Urban and Gary Clow	X
USGS	dfmeyer@usgs.gov	
USGS	rhost@usgs.gov	
USGS	egneal@usgs.gov	
AK DOCC	taunnie.boothby@alaska.gov	
US CRREL		
Dept of Military & Veterans Affairs		

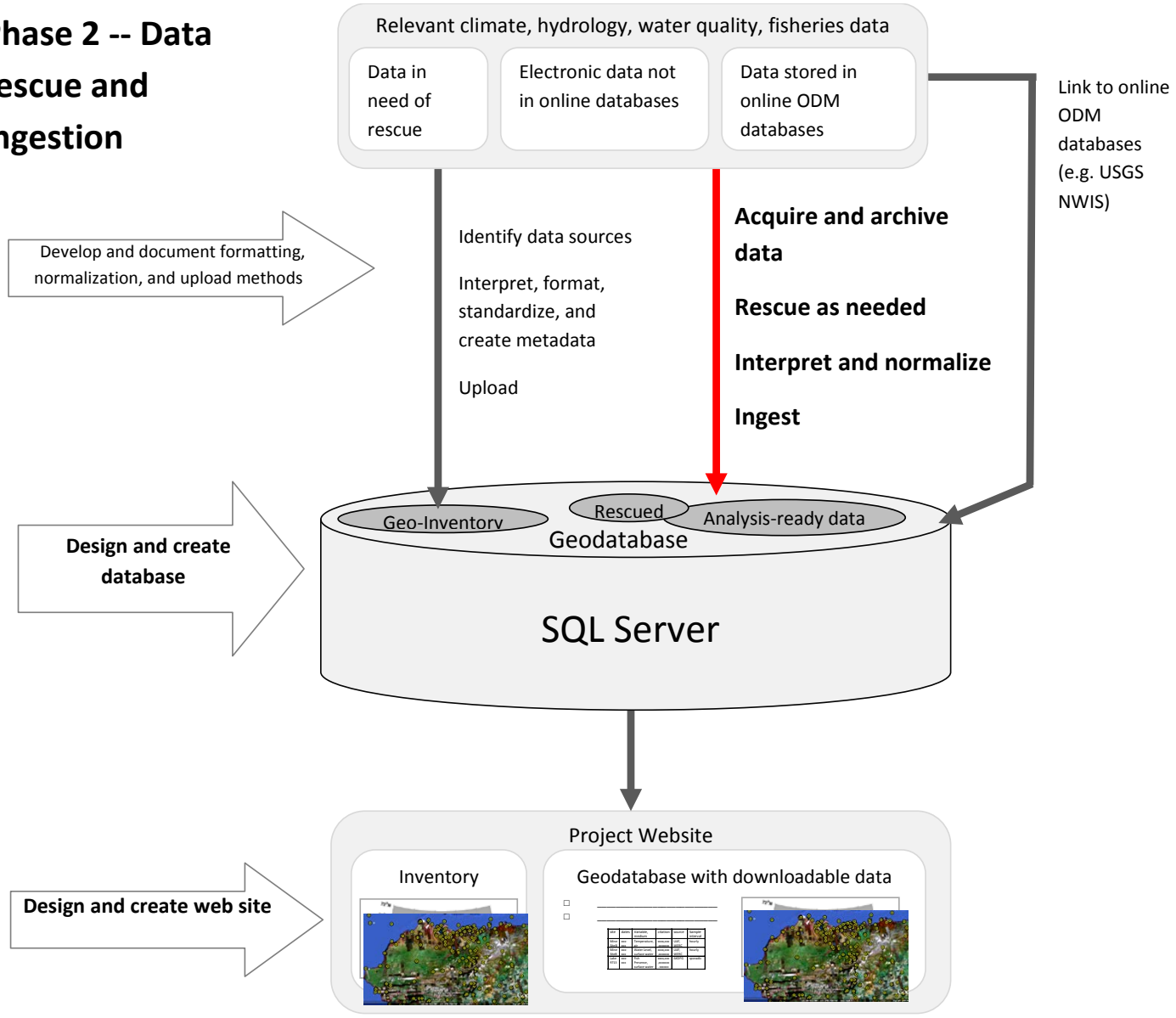
Metadata that we have acquired via contacts, reports, online sources

Data Type	Organization
Bathymetry	AK Division of Fish and Game, Fairbanks Field Office (Morris)
	US Fish and Wildlife Service Water Resource Branch (Trawicki)
Climate Stations	Bureau of Land Management, Fairbanks Field Office (Kemnitz)
	Department of Energy -- Atmospheric Radiation Measurement (ARM)
	Geo-Watersheds Scientific
	International Arctic Research Center, University of Alaska-Fairbanks
	MMS Stations
	National Atmospheric Deposition Program
	National Climate Data Center
	Toolik Lake Long Term Ecological Research Station
	USGS Real-Time Permafrost and Climate Monitoring Network (Urban & Clow)
	Water and Environmental Resource Center, University of Alaska-Fairbanks
	Western Regional Climate Center
Stream Gaging Stations	Bureau of Land Management, Fairbanks Field Office (Kemnitz)
	Geo-Watersheds Scientific
	International Arctic Research Center, University of Alaska-Fairbanks
	Toolik Lake Long Term Ecological Research Station
	USGS Alaska Science Center Water Office (Frenzel)
	US Fish and Wildlife Service Water Resource Branch (Trawicki)
	Water and Environmental Resource Center, University of Alaska-Fairbanks
Ice Thickness	Water and Environmental Resource Center, University of Alaska-Fairbanks
	International Arctic Research Center, University of Alaska-Fairbanks
	Water and Environmental Resource Center, University of Alaska-Fairbanks
Soil Moisture, Temperature and/or Active Layer Depth	Circumpolar Active Layer Monitoring Network (n=40)
	USGS Real-Time Permafrost and Climate Monitoring Network (Urban & Clow)
	International Arctic Research Center, University of Alaska-Fairbanks
	Water and Environmental Resource Center, University of Alaska-Fairbanks
	USDA NRCS
Lake Water level	US Fish and Wildlife Service Water Resource Branch (Trawicki)
	Water and Environmental Resource Center, University of Alaska-Fairbanks
Water Quality	AK Division of Fish and Game, Anchorage (Buckwalter)
	AK Division of Fish and Game, Fairbanks (Morris)
	Toolik Lake Long Term Ecological Research Station
	USGS Alaska Science Center Water Office (Frenzel)
	Water and Environmental Resource Center, University of Alaska-Fairbanks

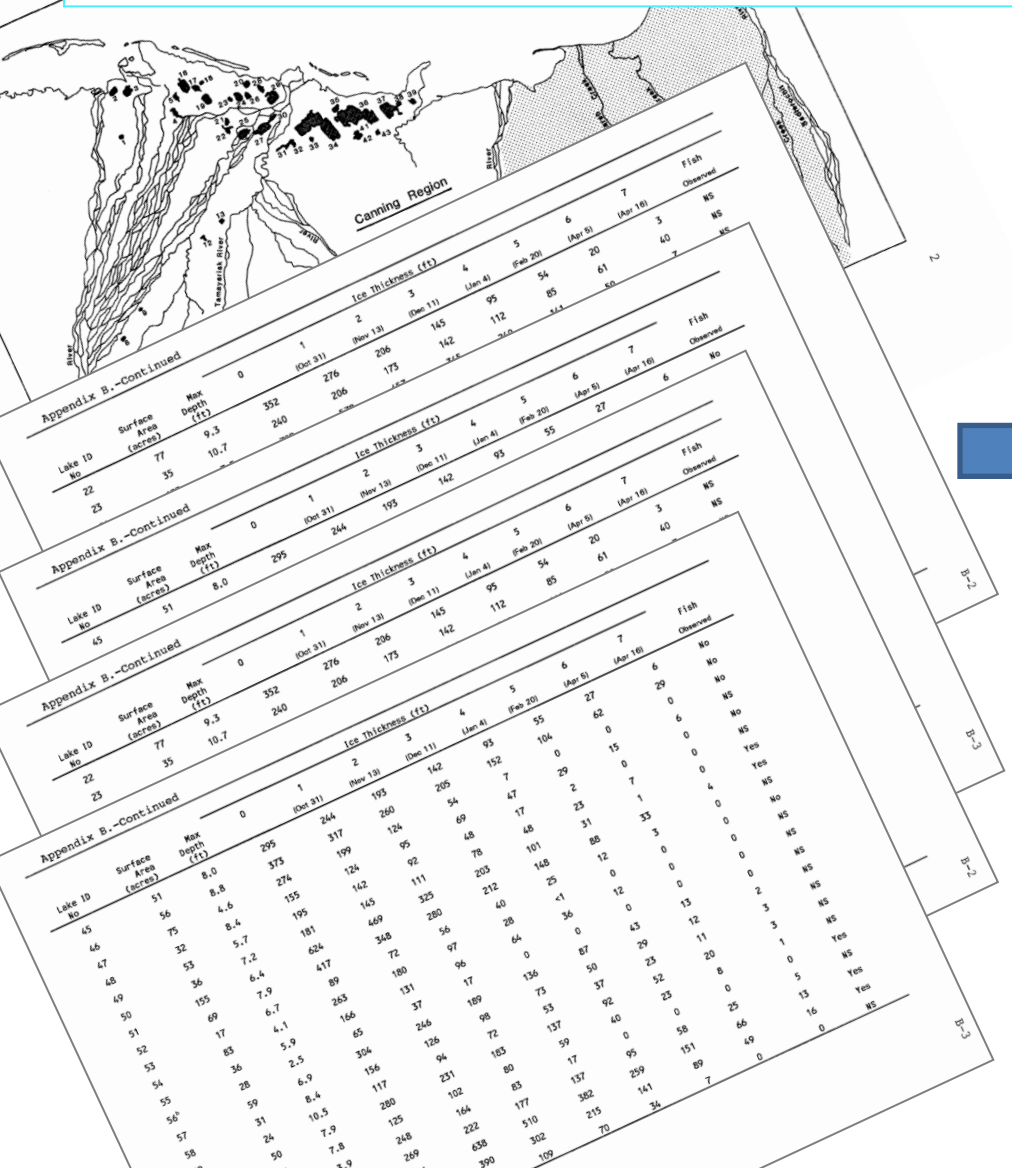
Phase 2

- Data rescue and ingestion
- Network analysis

Phase 2 -- Data rescue and ingestion

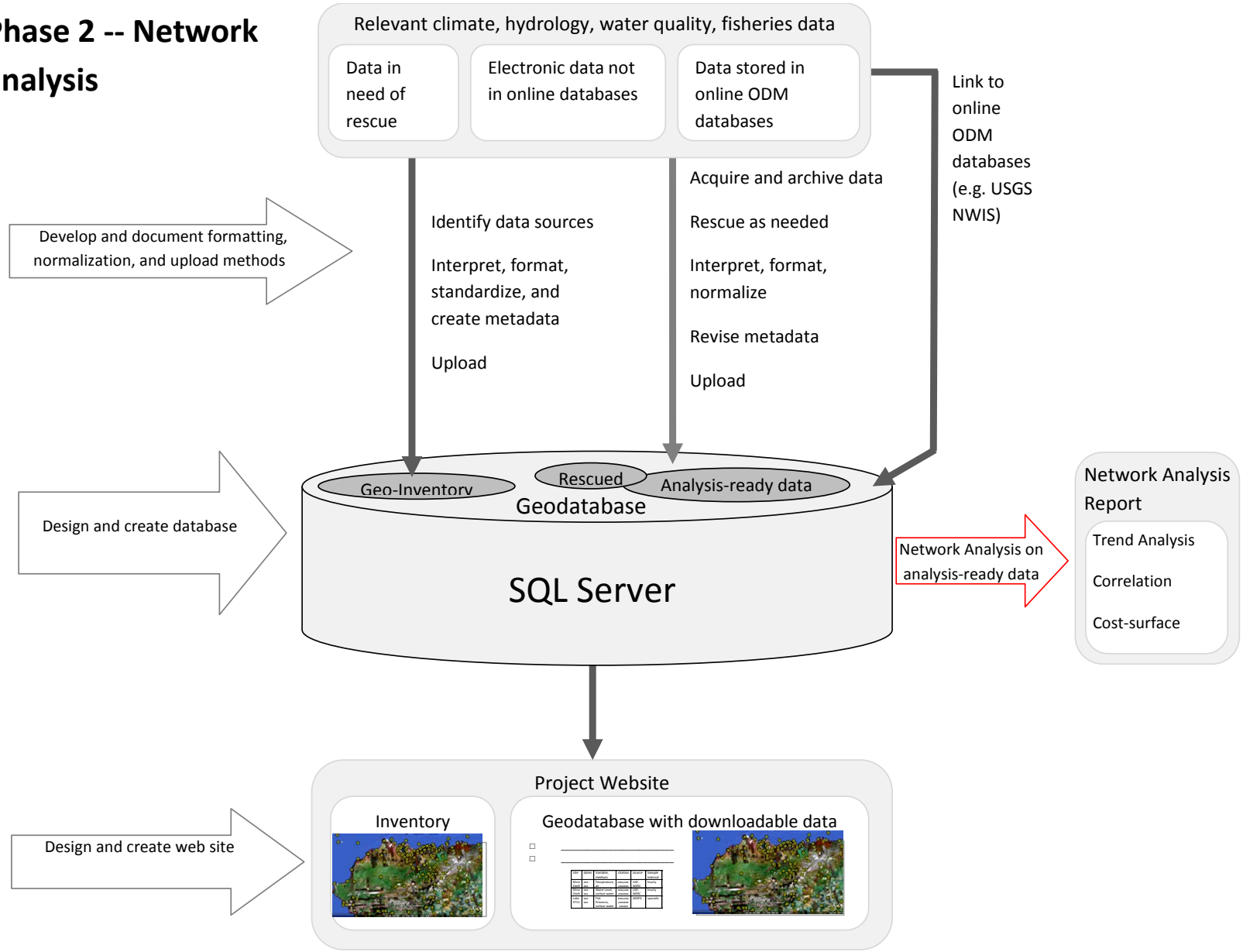


Phase 2 -- Data rescue and ingestion



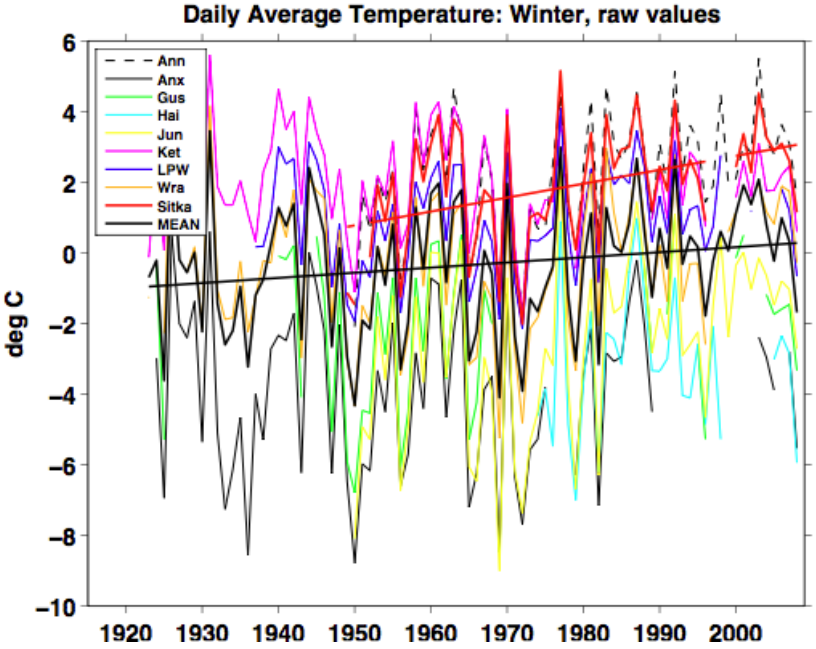
1	33	1.5	57	24	0	0	0	0	0	
2	131	13.1	912	784	668	564	465	372	284	20
3	0	0	0	0	0	0	0	0	0	
4	100	4.8	235	143	67	16	1	0	0	
5	58	6.8	279	222	167	117	72	34	9	
6	94	12.1	824	730	637	543	449	353	272	19
7	113	10	720	607	494	381	273	171	89	3
8	44	3.8	93	55	25	4	0	0	0	
9	23	2.9	44	22	4	0	0	0	0	
10	32	5.1	120	89	57	29	8	<1	0	
11	22	4.3	75	53	31	11	<1	0	0	
12	31	7.7	122	91	60	34	17	8	3	<
13	40	3.1	85	45	11	<1	0	0	0	
14	46	13.4	321	282	236	190	146	111	79	5
15	96	8.2	379	283	187	97	37	9	3	<
16	257	3.8	668	427	221	67	0	0	0	
17	100	7.4	342	246	162	95	46	16	2	
18	32	2	74	42	18	0	0	0	0	
19	181	2	419	238	102	0	0	0	0	
20	81	9.2	457	377	301	230	167	110	59	1
21	56	4.2	128	77	37	10	0	0	0	
22	77	9.3	352	276	206	145	95	54	20	
23	35	10.7	240	206	173	142	112	85	61	4
24	133	7.5	709	578	457	345	240	141	50	
25	131	2.3	182	67	3	0	0	0	0	
26	64	8.3	321	258	199	144	94	50	13	
27	303	17.9	3212	2009	1706	1414	1138	878	639	43
28	79	3.4	216	141	72	14	0	0	0	
29	300	7.5	1190	914	688	497	321	162	36	<
30	0	0	0	0	0	0	0	0	0	
31	104	8.7	557	452	348	249	161	90	39	1
32	34	10.9	208	174	142	112	84	59	36	1
33	29	6.3	94	66	39	17	5	1	0	
34	1533	9	9285	7753	6220	4756	3416	2220	1169	34
35	89	8.4	523	435	351	273	200	131	69	1
36	1316	11	9198	7882	6565	5305	4138	3067	2097	128
37	342	8.3	1804	1462	1120	793	500	245	70	1
38	44	7.8	250	206	164	124	85	50	19	
39	58	4.9	224	167	112	62	23	0	0	
40	26	3.5	58	33	9	<1	0	0	0	
41	30	5.9	116	85	56	28	2	0	0	
42	96	5.9	441	346	250	159	79	20	0	
43	0	0	0	0	0	0	0	0	0	
44	21	2.7	44	25	8	0	0	0	0	
45	51	8	295	244	193	142	93	55	27	
46	56	8.8	373	317	260	205	152	104	62	2
47	75	4.6	274	199	124	54	7	0	0	
48	32	8.4	155	124	95	69	47	29	15	
49	53	5.7	195	142	92	48	17	2	0	
50	36	7.2	181	145	111	78	48	23	7	
51	155	6.4	624	469	325	203	101	31	1	
52	69	7.9	417	348	280	212	148	S3	33	
53	17	6.7	89	72	56	40	25	12	3	
54	83	4.1	263	180	97	28	<1	0	0	
55	36	5.9	166	131	96	64	36	12	0	
56	28	2.5	65	37	17	0	0	0	0	
57	59	6.9	304	246	189	136	87	43	13	
58	31	8.4	156	126	98	73	50	29	12	
59	24	10.5	117	94	72	53	37	23	11	
60	50	7.9	280	231	183	137	92	52	20	
61	24	7.8	125	102	80	59	40	23	8	

Phase 2 -- Network analysis



Phase 2 -- Network Analysis

- Start to answer some of the WILDREACH/NSSI questions that pertain to trends and monitoring networks
- May look for input from Arctic LCC advisory groups
- Will publish our recommendations based on historical data density and practicality (i.e. maintaining priority watersheds, where are major gaps, cost surface analysis)
- Wrap up in February 2012



Some examples of how this database will help users address NSSI emerging issues and WildREACH questions

Questions related to improving capabilities of remote sensing tools

Question	General Query
What ice thickness and lake bathymetry data is available to calibrate SAR data collected in the Upper Kuparuk River Region between December and May 2010.	Ice thickness and lake depth data for a certain area during select years
What climate and hydrology data is available to compare to lake surface areas estimated from remote sensing imagery obtained near Barrow in 1982 and 2006?	All variables under the general categories of hydrology and climate for a specific area during a certain time.

Questions related to management

Management Question	General Query
What winter precipitation data is available for areas that had unusually low musk ox survivorship during 199X, 200X, and 200X?	All winter precipitation data for specific areas during selected years.
What data is available to understand fluctuations in water level in lakes where ice roads are planned?	All variables under general category of inland waters for all lakes in certain area.
What lakes are deep enough to have fish?	All lake depth data for specific area.

Questions, Comments?

Cherry, 2010

Data Rescue and Inventory of Hydrology-Related Data in Arctic Alaska

Overall Project Objectives (Phase 1)

- Inventory and acquisition of hydrologic and related data held by entities such as the USFWS, BLM, USGS, NSF, DOE, MMS, UAF, ADNR, ADFG, ADEC, other state and federal agencies, and the private sector. The focus of this inventory will be datasets that can be used to model how hydrologic processes may change and potentially affect fish and wildlife habitat under different climate scenarios.
- Design a public database that will house data and metadata related to hydrology, water quality, climate and aquatic ecosystems in arctic Alaska and begin to populate with metadata.
- Design and host a simple webpage with metadata, project description, and access to a geodatabase with station locations from the inventory.
- Participate in FWS-or agency discussions on North Slope hydrology and hydrologic data.

Overall Project Objectives (Phase 2)

- Improve data availability and dissemination of arctic climate, hydrology and ecosystem data
- Use retrospective analyses of network data to aid the Arctic LCC and partners in efforts to refine conceptual models, select climate change indicators, and develop dynamic predictive models
- Prioritize the locations and parameters for future watershed monitoring efforts that most efficiently answer management questions and reduce the uncertainty associated with predictive modeling

ArcticLCC Data Rescue and Inventory
of Hydrology-Related Data in Arctic Alaska

ArcticLCC Documents

Table: Documents

Document	Date Generated
ArcticLCC Narrative	April 2010
Data Request Document	22 Nov 2010
Progress Report	23 Sept 2010
Report Diagrams	22 Nov 2010
LCC Hydro Com Presentation	22 Nov 2010

If you have any questions or comments about the project, contact:

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ArcticLCC Data Rescue and Inventory
of Hydrology-Related Data in Arctic Alaska

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Contributors

Table: Contributors

Data Type	Organization
Bathymetry	AK Division of Fish and Game, Fairbanks Field Office (Morris)
	US Fish and Wildlife Service Water Resource Branch (Trawicki)
Climate Stations	Bureau of Land Management, Fairbanks Field Office (Kemnitz)
	Department of Energy -- Atmospheric Radiation Measurement (ARM)
	Geo-Watersheds Scientific International Arctic Research Center, University of Alaska-Fairbanks MMS Stations
	National Atmospheric Deposition Program
	National Climate Data Center
	Toolik Lake Long Term Ecological Research Station
	USGS Real-Time Permafrost and Climate Monitoring Network (Urban & Clow)
	Water and Environmental Resource Center, University of Alaska-Fairbanks Western Regional Climate Center
Stream Gaging stations	Bureau of Land Management, Fairbanks Field Office (Kemnitz) Geo-Watersheds Scientific
	International Arctic Research Center, University of Alaska-Fairbanks
	Toolik Lake Long Term Ecological Research Station
	USGS Alaska Science Center Water Office (Frenzel)
	US Fish and Wildlife Service Water Resource Branch (Trawicki)
	Water and Environmental Resource Center, University of Alaska-Fairbanks
Ice thickness	Water and Environmental Resource Center, University of Alaska-Fairbanks International Arctic Research Center, University of Alaska-Fairbanks
Soil/Active Layer	Circumpolar Active Layer Monitoring Network (n=40)
	USGS Real-Time Permafrost and Climate Monitoring Network (Urban & Clow)
	USDA NRCS
Lake Water level	US Fish and Wildlife Service Water Resource Branch (Trawicki)
	Water and Environmental Resource Center, University of Alaska-Fairbanks
Water Quality	AK Division of Fish and Game, Anchorage (Buckwalter) AK Division of Fish and Game, Fairbanks (Morris) Toolik Lake Long Term Ecological Research Station
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International Arctic Research Center
and Water and Environmental Research Center

ArcticLCC Data Rescue and Inventory
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WILDREACH report: potential effects of changes in climate and hydrology on fish and wildlife habitat

Theme	Habitat Change Pathway	Affected Species Groups
Water: Precipitation, water balance, and distribution of surface water	Lake drainage due to development of new drainage networks	Birds, Fish
	Drying of shallow-water and mesid/wet tundra habitats	Birds
	Changes in flow regimes, as influenced by water source	Fish
	Drought-related loss of connectivity between water bodies	Fish
	Change in snowpack characteristics, e.g., depth and density	Mammals
	Change in the length and timing of the snow season	Fish, Mammals
	Change in the frequency and timing of extreme events, i.e., rain-on-snow events and major winter storms	Mammals
	Changes in aquatic trophic systems, including potential shift from benthic to pelagic production in lakes	Birds, Fish

	Specific question	General Query
Network analysis, general management, and refining conceptual models	What variables were sampled on Lake 9817 or within bounding box (example: 70N 68N 150W 155W)?	All variables for all time for all space within a specified geographic extent (basin, reach, river, site)
	What snow water equivalent data are available on BLM land in the Arctic LCC?	All data for one variable for all time for a certain area.
	Where has ice thickness been measured?	Sites (space), identified by variable.
	What variables under the general category of climate were measured at which sites within the bounding box, a particular land management unit, or entire Arctic LCC?	All variables under the General Category of Climate for all time for all space within a specified geographic extent (basin, reach, river, site)
	What reports or articles are available for Lake 9312?	All documents by specified geographic extent (basin, etc).
Management questions	What winter precipitation data is available for areas that had unusually low musk ox survivorship during 199X, 200X, and 200X?	All precipitation data for specific areas during selected years.
	What data is available to understand fluctuations in water level in lakes where ice roads are planned?	All variables under general category of inland waters for all lakes in certain area.
Improve utility of remote sensing data	What ice thickness and lake bathymetry data is available to calibrate data from SAR imagery collected in the Upper Kuparuk River Region between December and May 2010.	Ice thickness and lake depth data for a certain area during select years
	What climate and hydrology data is available to compare to lake surface areas estimated from remote sensing imagery obtained near Barrow in 1982 and 2006?	All variables under the general categories of hydrology and climate for a specific area during a certain time.

WILDREACH report: scientific priorities

Vegetation Community Composition and Phenology

- How will **changes in the length and timing of the growing season** influence plant phenology, including seasonal changes in nutritional quality?
- How will plant species composition shift in response to **long-term climate change**, and what are the implications for habitat structure and quality of the prevalent available forage (i.e., digestibility, nutrient content)?
- What is the time scale of expected shrub increase, and how will this vary by species/growth form (low vs. tall shrub) and ecoregion?
- What is the likelihood of widespread conversion from sedge and sedge-shrub meadow to bog meadow (paludification) and how would this affect herbivore and detritus-based trophic systems?
- How will changes in the **seasonality of stream discharge** and **occurrence of flood events** influence development of riparian vegetation communities?

Abundance and Phenology of Invertebrates

- How does **earlier spring thaw affect** timing of life cycle events and peak availability to predators?
- How does **temperature** affect growth and development of aquatic insects?
- What **climate-related changes** are likely in community composition of macroinvertebrates in stream, lake, and saturated soil environments?
- How will **changes in the distribution and quality of surface waters** and shifts from pelagic to benthic productivity in deep lakes affect availability of macroinvertebrates to fish and wildlife?
- How will **warming and changing seasonality** affect abundance and peak activity periods of biting insects and what are the bioenergetic consequences for caribou in particular?
- How will **warming and changing seasonality** affect the prevalence of parasites and disease vectors (e.g., nematode parasites of muskoxen and Dall's sheep)?

Coastal Dynamics

- Will higher water temperatures, sea level rise, and retreat of summer sea ice cause degradation of the barrier island systems of the Beaufort and Chukchi seas?
- Will **alluvial deltas continue to build** or will rising sea levels outpace potential increases in sedimentation rates?
- How quickly will **shoreline retreat** result in newly breached lake basins?
- To what extent will coastal erosion, in combination with sea level rise, cause salinization of low-lying coastal areas?
- Will coastal wet sedge meadows establish at a rate equal to loss of this habitat through **erosion and inundation**?
- Will **increased fogginess/cloudiness** exert a negative or positive feedback effect on **air temperature** in the coastal zone? What is the expected spatial extent of this effect?