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DIGITAL MAPPING TECHNIQUES 2018

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Lexington, KY)

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2018)

http://ngmdb.usgs.gov/info/dmt/

Status of GeMS-compliant enterprise database model and Alaska GeMS maps

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Abstract

The Alaska Division of Geological & Geophysical Surveys (DGGS) is leading the creation of a multi-map, multi-user "enterprise" database model based on the single-map Geologic Map Schema (GeMS) developed by the USGS and state geological surveys (https://ngmdb.usgs.gov/Info/standards/GeMS/). The enterprise database model is intended for use by state and federal geological survey programs, as is a pilot data-sharing protocol to be developed with the model. Ultimately the work on this project and resulting model will help facilitate the creation of a national geologic database and provide standardized geologic data that can be easily ingested into that system. DGGS and other stakeholders in the geologic community determined specifications for the enterprise database model and continue to provide technical feedback during development. To date, the database structure, in a PostgreSQL-ArcGIS Enterprise environment, is ready to be populated for more extended testing. The project is currently in its second year of a three-year grant awarded by the U.S. Environmental Protection Agency (EPA) – Environment Information Exchange Network. Interested persons are encouraged to contact DGGS for information about this collaborative project.

Slide 1. Since about 2000, DGGS has looked toward an enterprise geologic database to increase the survey's overall business efficiency. Recent advances in GIS, information technology (IT), and in-house staff expertise have set the stage to realize this goal. Along with the push for an enterprise database, the survey is also developing the ability to collect digital data in the field, overhauling general data management practices, and implementing other means to provide quality data and maps in a reasonably short timeframe.

For example, several years ago, DGGS management adopted the GeMS standard for geologic data management and delivery at the survey. Basing the enterprise geologic database model on the GeMS data standard will allow DGGS to more efficiently create uniform products that can be easily used by our customers and others in the geologic community. Prior to GeMS, DGGS did not have an agency-wide digital data standard. Therefore, implementing the GeMS standard in our business practices has involved (and continues to involve) significant education and discussion to ensure that the staff understands and utilizes the GeMS standard.

Slide 2. Development of a multi-map, multi-user enterprise geologic database and pilot data-sharing protocol are one piece of a three-pronged approach to better understand the potential for radon generation by Alaska rocks and sediments. The grant's funding began in October 2016 and sunsets on September 30, 2019.

Slide 3. The EPA funded the geologic objectives of the project with the expectation that the work would be aligned with the national-scale goals of the EPA Exchange Network and the National Geologic Map Database, the federal program which is referenced in the geologic spatial data theme in Office of Management and Budget (OMB) Circular A-16. Consequently, the geologic objective is being conducted collaboratively with input from the members of the geologic community and with the intent of producing deliverables that will be available to and assist other geologic organizations.

Slide 4. Two years into the project, it is clear that the working group is developing a geologic mapping system that facilitates the geologic process from data collection in the field to publication, rather than a standalone database model. We also note that many geologists continue to think of geologic data as information on a traditional, cartographically correct map, rather than as feature-level spatial data in a database. Currently, most GIS databases are designed to facilitate the creation of a paper- or PDF-based map, while for this project, **the database is the goal.**

Slide 5. DGGS is implementing additional strategies to conduct our business more efficiently. For example, by providing routine educational opportunities and through discussions with staff, we hope to gain staff approval for the GeMS standard and new ways of managing geologic data. It's critical that the staff is engaged in the process and prepared for new methods of accessing, creating, analyzing, and sharing information.

Slide 6. In the current design, DGGS stores data in three main content areas within a Unix-based, high availability infrastructure utilizing Esri products and PostgreSQL: Geologic maps (maps and the data behind them in the central GeMS-DGGS geologic database) in the "Map Production & Management System" being developed through the grant, field data in the "Field Geology Support System," and everything else (basemap data, analytical data, document archives, etc.) in separate PostgreSQL databases.

Slide 7. In 2018, we added ArcGIS Enterprise (ArcServer, Portal, Data Store) to DGGS' infrastructure. Portal will help facilitate discoverability of and access to DGGS' GIS assets and allow offline digital field data collection with the Esri Collector application. We are now also able to collaborate among several State of Alaska departmental portals and the Alaska Geospatial Council umbrella portal.

Slide 8. Beginning with the "everything else" content area, DGGS recently changed its database philosophy. For the advantages listed and the cost factor, we decided to move away from the design of one large, all-encompassing, normalized Oracle database to multiple, free PostgreSQL databases with more of a flat structure. The PostgreSQL databases are grouped logically and data among the databases are related by universally unique identifiers (UUID).

Slide 9. Using UUID's allows the relationships among the data to be exposed. In this screenshot of a live proof-of-concept example, the Alaska Geochemistry application webpage for sample 69-ASt-232 contains links to another database and application with related data.

Slide 10. The link directly connects the user to the Alaska Geologic Materials Center inventory database and shows information about the physical sample 69AST232 in storage. With the ability to relate geologic data in multiple databases, we gain the ability to dig deeper into the data to find answers and ask new questions.

Slide 11. The Field Geology Support System is based on a portable, wireless, high availability, failover cluster to connect field devices to a server where no internet connection is available. The wireless connection to Portal & ArcGIS Server replaces the internet connection for syncing data in and out of Portal or ArcGIS Online via the Esri Collector field data collection application. Geologists are able to work collaboratively in the field, seeing each other's data once they sync at the end of the field day. At the end of the field season, new and edited data are incorporated back into the office infrastructure.

Slide 12. The Map Production & Management System in development has two main PostgreSQL databases, Geologic Maps and Geologic Data. Once a dataset is published, it is loaded into the Geologic Maps database in its own PostgreSQL schema (although the datasets are in one database, their files remain separated and in their original datum and projection). The Geologic Maps database can house archive versions of the datasets and serve as a "quarantine" area where datasets are tweaked to conform with the GeMS standard and outfitted with tables, fields, and data necessary for the multi-map Geologic Data database.

The Geologic Data database is meant to be a true multi-map database, where all similar map objects or data tables from multiple maps are in one feature class. Most of the work on this project is currently focused on the best way to organize the data and preserve relationships in this database.

Slides 13, 14, and 15. DGGS and the working group are identifying challenges and possible solutions to a multi-map implementation. The next phase of the project will concentrate on testing various solutions to known database issues to find the best-case scenario. We will start testing with the following parameters and intentions:

- Coordinate system: NAD83 datum, Alaska Albers (WKID 3338);
- Field characters length ~4000: Test PostgreSQL "TEXT" field;
- Feature-level UUIDs for Joins/Relates: Test v4 UUIDs;
- Field and table name format: Test lowercase text with underscores;
- Track data sources: Test many-to-many relationship;
- 3-D Features: Test without 3-D enabled at first;
- Work on project and product tracking; and
- Work on on-the-fly metadata generation

Slide 16. Testing of the multi-map Geologic Data database will largely occur in fall of 2018.

Slide 17. DGGS continues to publish geologic maps in partial GeMS format, and these maps will be used to test the databases. DGGS is currently documenting discrepancies between our use of the GeMS standard and the official draft standard. We are also documenting how we use certain tables and fields to remain consistent from map to map.

Slide 18. As the geologic database project moves forward, the next steps are to continue work on the database model and have more discussions about the data-sharing protocol. An update on the project will be provided at the Digital Mapping Techniques (DMT) workshop in 2019.

Slide 19. If you are interested in participating in the project, please contact me at jennifer.athey@alaska.gov or 907.451.5028. We also have a public wiki that chronicles the project at http://137.229.113.30/jamwiki/. Monthly tele-meetings are open to the geologic community and generally scheduled on the second Monday of the month at 2pm Eastern Time. Upcoming meetings and meeting notes are posted on the wiki.

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DIGITAL MAPPING TECHNIQUES 2018, LEXINGTON, KENTUCKY, MAY 20-23
PRESENTED BY JENNIFER ATHEY, MAY 20, 2018

Overview of EPA Exchange Network project

Objective 1

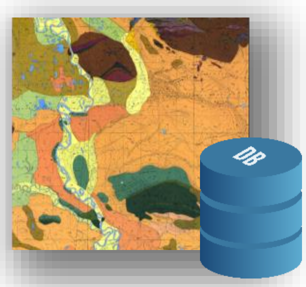
Develop radon database for Alaska and data-sharing schema

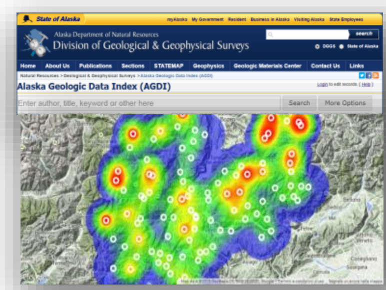
Objective 2

Develop multi-map version of GeMS and data-sharing protocol

Objective 3

Create predictive geology-radon web application





3-year project, Oct 2016 – Sep 2019

Project goals

- Share model, schema, and tools
- Promote standardized data sharing
- Increase data accessibility for non-geologists
- Work toward compilation maps and national database

Collaborative Database Effort for Geology (CDEFG)

Research project to extend the GeMS schema to support geologic data from multiple maps at various scales and purposes within a modern enterprise geodatabase.

Collaborators

AK	Jen Athey (PI)	USGS	Dave Soller
	Mike Hendricks		Amber Wittner
	Trish Gallagher		Charlie Cannon
IL	Mark Yacucci		Dan Doctor
IN	Becky Meyer		Evan Thoms
	Jenna Lanman		Ralph Haugerud
ME	Chris Halsted		Ric Wilson
MO	Trevor Ellis		Tracey Felger
MT	Jeremy Crowley	GSC	Christine Deblonde
NH	Greg Barker		Étienne Girard
NM	Phil Miller		Sean Eagles *(prev.)*
OR	Lina Ma	LDEO	Steve Richard
WY	Phyllis Ranz		
	Suzanne Luhr		

Enterprise database

A spatial database with versioning, defined user roles, and stored procedures built on a relational database structure.

Important Themes

1) Enterprise database needs to support the process by which geologic maps are made

Field collection -> analysis -> interpretation -> map production -> data storage and accessibility -> further analysis

- Process is similar across organizations
- Data management is different in every organization

2) Organization of geologic data, not geologic maps

DGGS data management

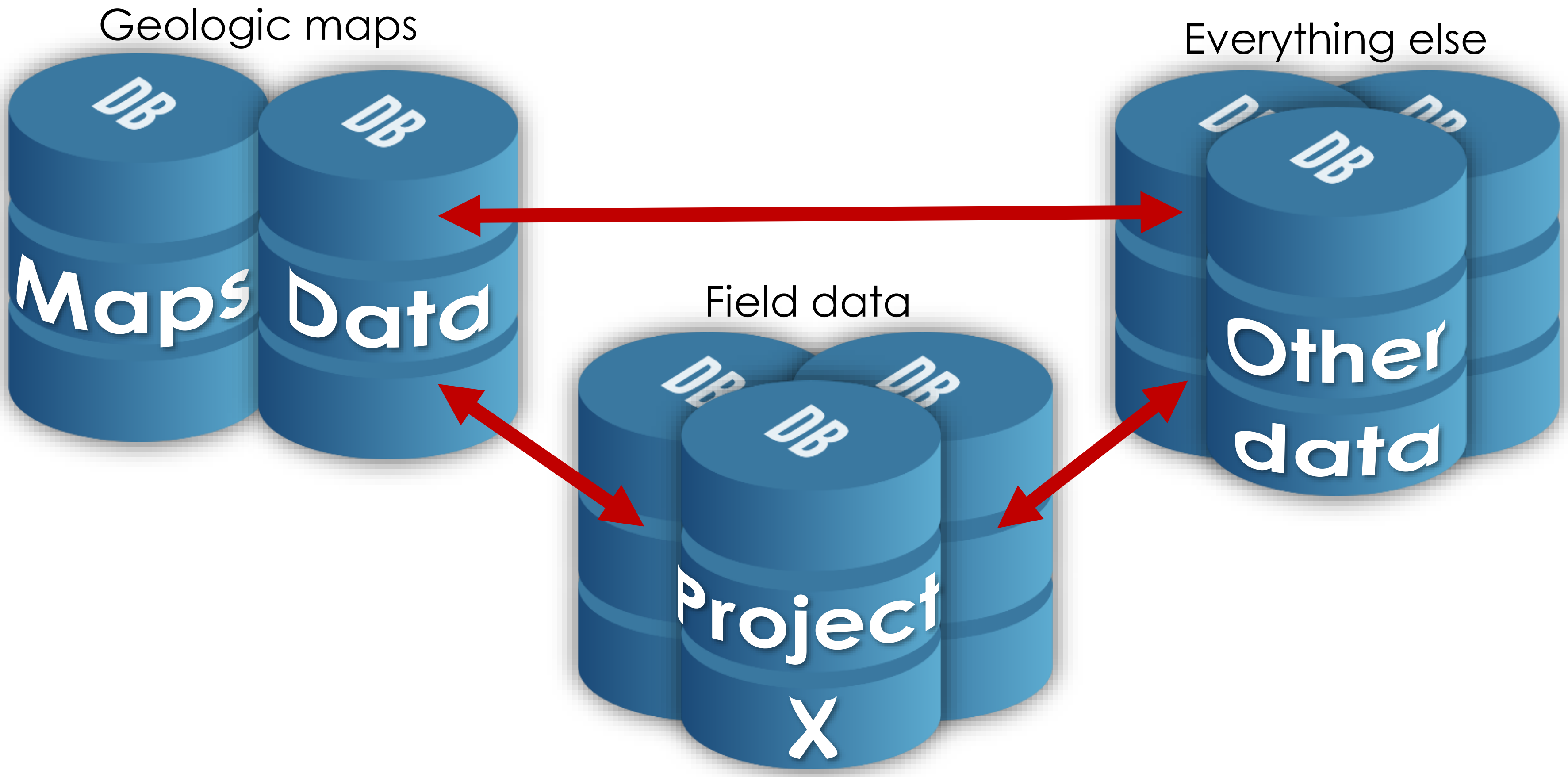
Thoughtful data management will save time and money later

Making things easier for geologists will help DGGS adopt an enterprise database

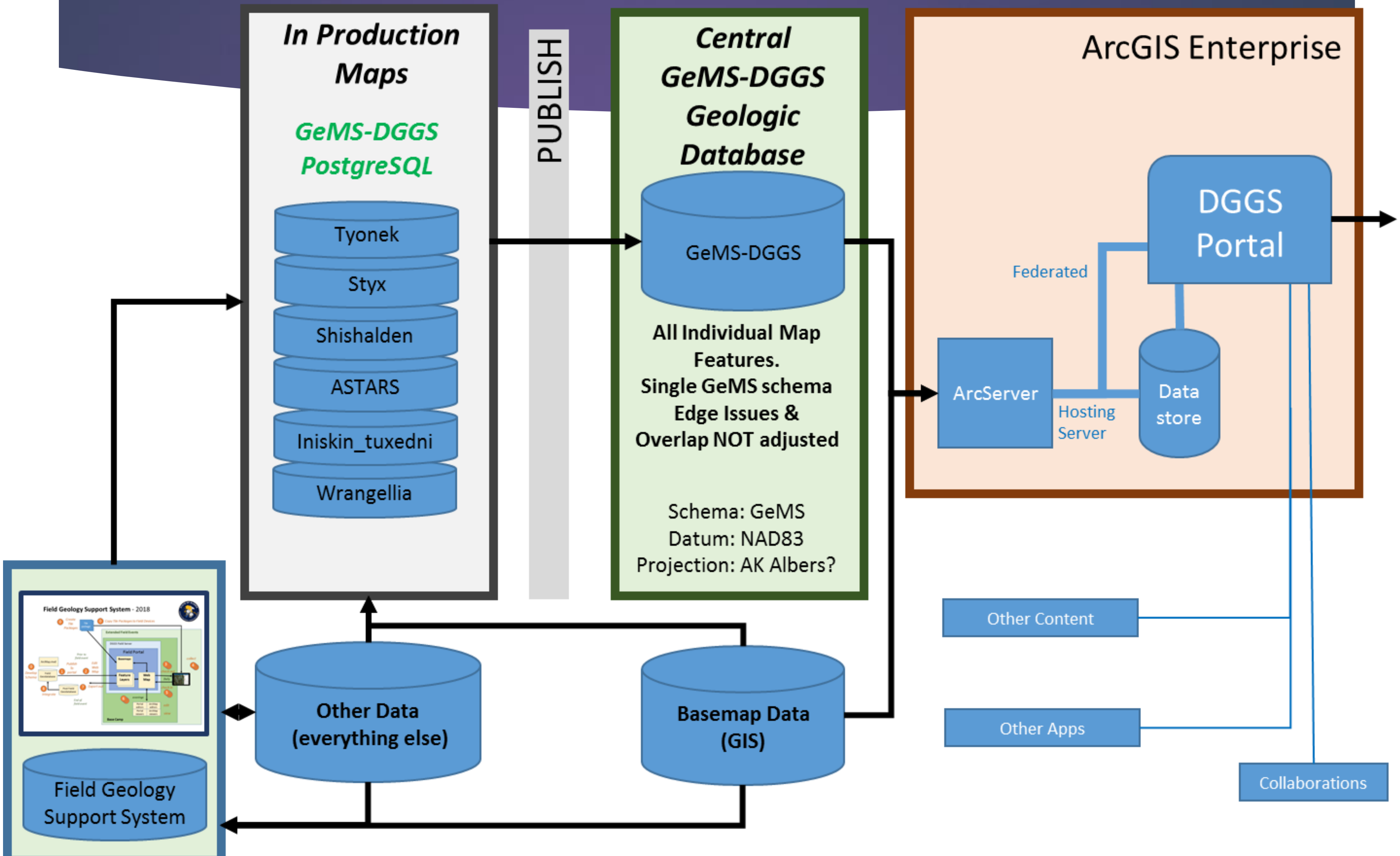
- Streamlining agency-wide data management
- Building field data collection scenario for no internet connectivity
- Documenting GeMS process and maps to date
- Investigating automation and other ways to save time
- Weekly Arc training and data management classes

DGGS Data Management System

IN DESIGN



Simplified IT infrastructure



Why separate databases?

More flexibility and easier data management

- Manage fewer relationships
- No single dominant table
- Add database servers horizontally
- Logical data groupings
- Relate data with UUIDs

Everything Else:
Migrating previous "GERILA" Oracle database to PostgreSQL

- Projects, publications, contacts
- Field stations & samples
- Analyses
- Data sets
- Sample Inventory
- Document archive

Sample Detail

Sample Number 69-ASt-232

Sample Documentation

Datum	NAD27
Accuracy	100 m
Latitude	63.15
Longitude	-147.2
Sample Description	theralite
Field Station Number	69-AST-232

Related

Geologic Materials Center Inventory (raw, hand sample)Geologic Materials Center Inventory (raw, hand sample)Geologic Materials Center Inventory (raw, hand sample)

Analyses [Download All]

Reference Number	GR60_MO_Table1
Reference Date	1969-09-01
Citation	GR 60
Laboratory	U.S. Geological Survey - Elmore, P. J. D.
Description	Rock samples were crushed then pulverized so that the material passed through a -100 mesh screen. Sample preparation was not documented for trace element analyses. Samples were analyzed for major and minor oxides, H2O+ and H2O-, and CO2 following methods outlined in USGS Bulletin 1144A by Shapiro and Brannock (1962). Samples were also analyzed for trace elements using Atomic Emission Spectroscopy.
Sample Type	rock

SiO2 pct	TiO2 pct	Al2O3 pct	Fe2O3 pct	FeO pct	MnO pct	MgO pct	CaO pct	Na2O pct	K2O pct	P2O5 pct	CO2 pct	H2O [+] pct	H2O [-] pct	Total pct	B ppm	Ba ppm	Be ppm	Co ppm	Cr ppm	Cu ppm	Ga ppm	Ni ppm	Pb ppm	Sc ppm	Sr ppm	V ppm	Zr ppm	Y ppm	La ppm	Yb ppm
46.6	0.67	9.9	1.5	5.7	0.02	14.6	13.8	0.41	3.7	0.14	0.05	2.3	0.27	100	-1	1500	-1	70	1500	3	10	290	-1	150	500	200	20	10	-1	1

UUID-related Databases

State of Alaska | Login | Search Help

Geologic Materials Center Inventory

Alaska Division of Geological & Geophysical Surveys

State of Alaska > Natural Resources > Geological & Geophysical Surveys > Geologic Materials Center > Inventory

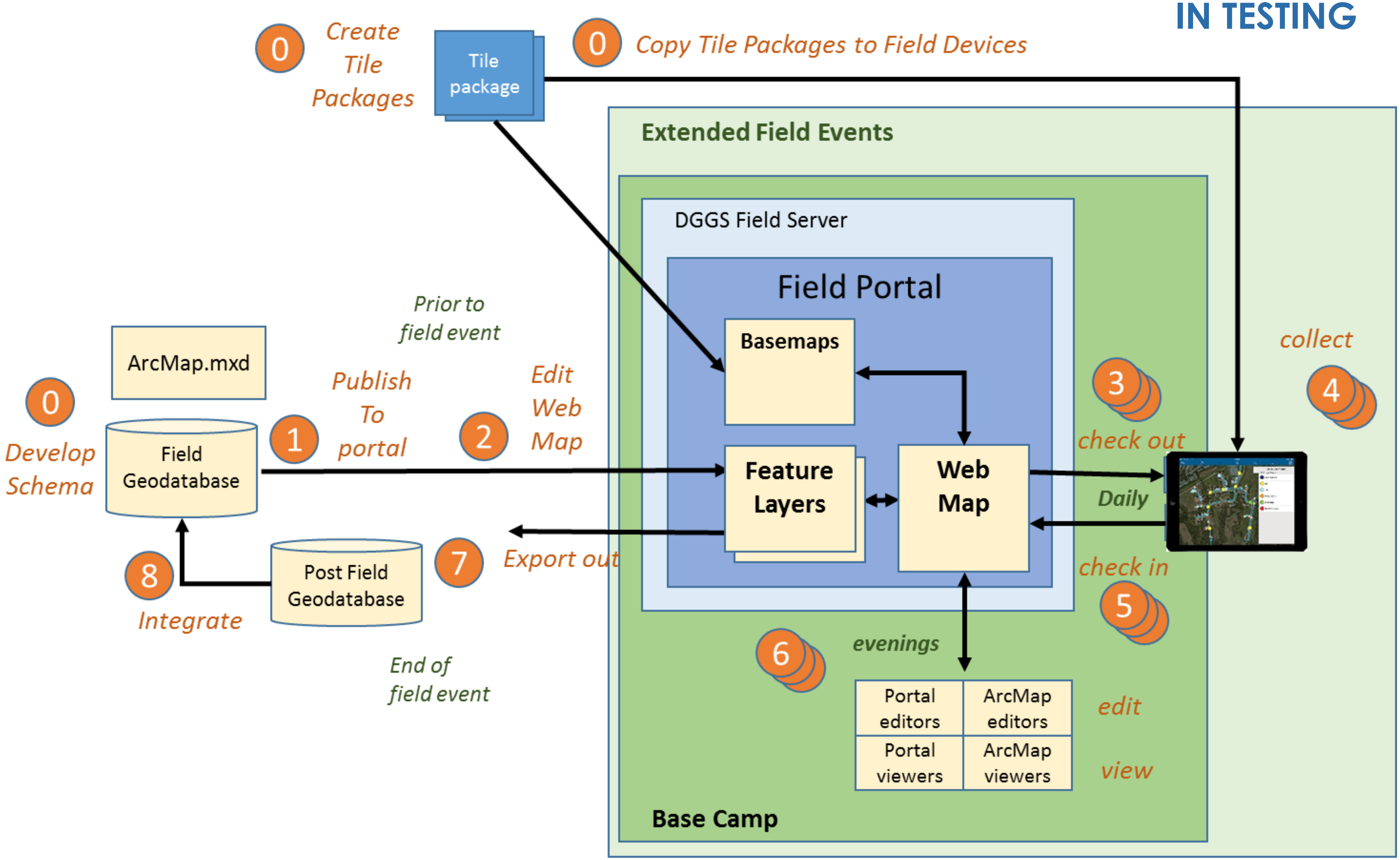
ID	334690
DGGS Sample ID	48407
Sample Number	69AST232
Published Sample No.	69ASt232
Published No. Suffix	No
Collection	DGGS
Box Number	10
Remark	Vials
Keywords	raw, hand sample

Related 1 | URLs 0 | Files 0

Outcrop Name	69AST232
Outcrop Number	44528
Outcrop Year	

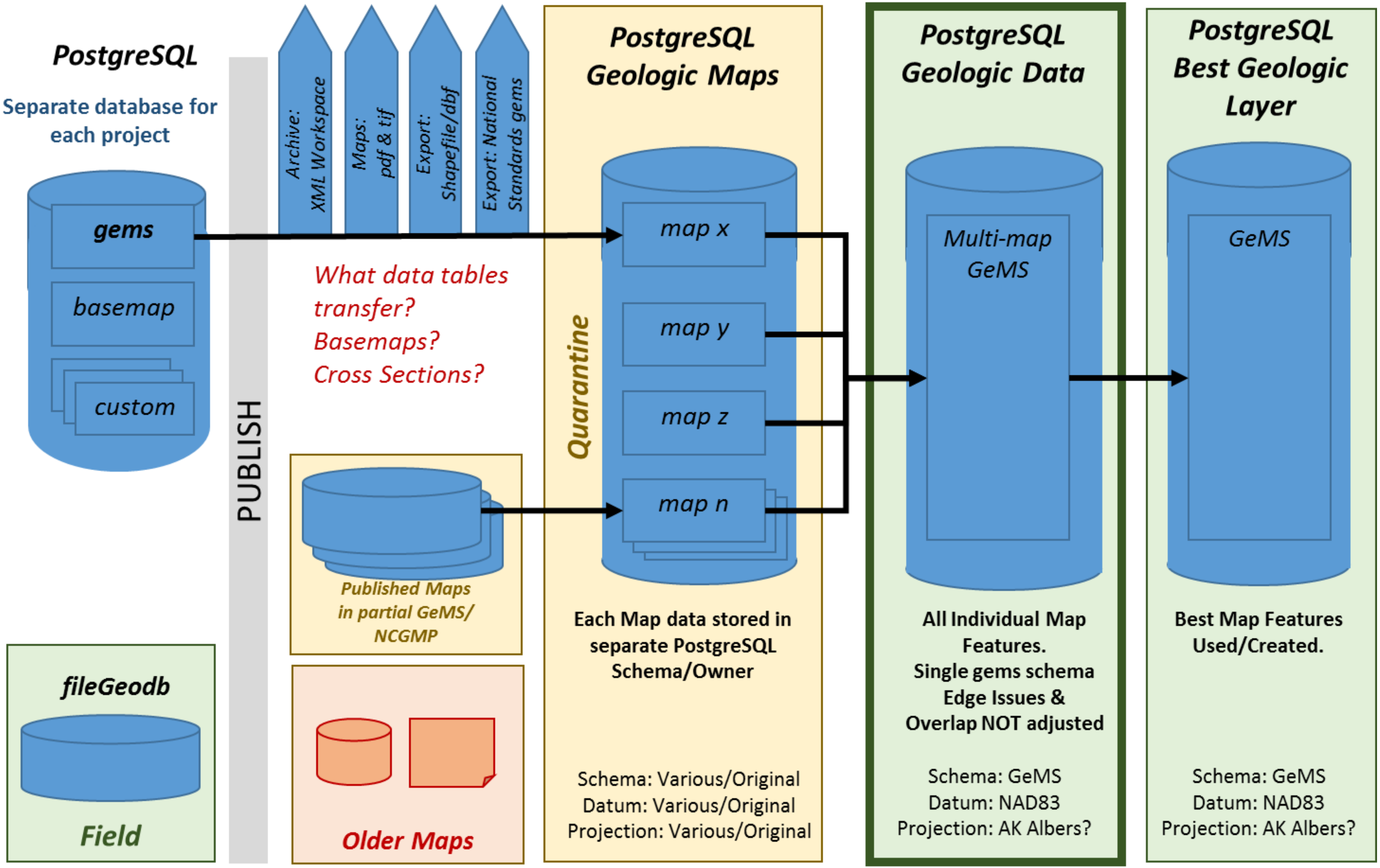
Field Geology Support System

IN TESTING



Map Production & Management System

IN DEVELOPMENT



Current thoughts for testing

- Geometry spatial type (spherical) supported in ArcGIS 10.6
- Field characters lengths <4096
  - Impacts Notes, Source, Definitions, Descriptions, etc.
  - Use blobs or split fields for longer text?
- Use of feature-level 128-bit UUIDs for Joins/Relates
  - GeMS table name prefix + number (example "con001") will not be unique
  - UUID Example *{5AF0BED8-4AEC-4314-A7FC-6EEA6C1E809E}*
- ArcGIS aliases for tables and fields will cause confusion
- Add project and product tracking to database

Outstanding questions

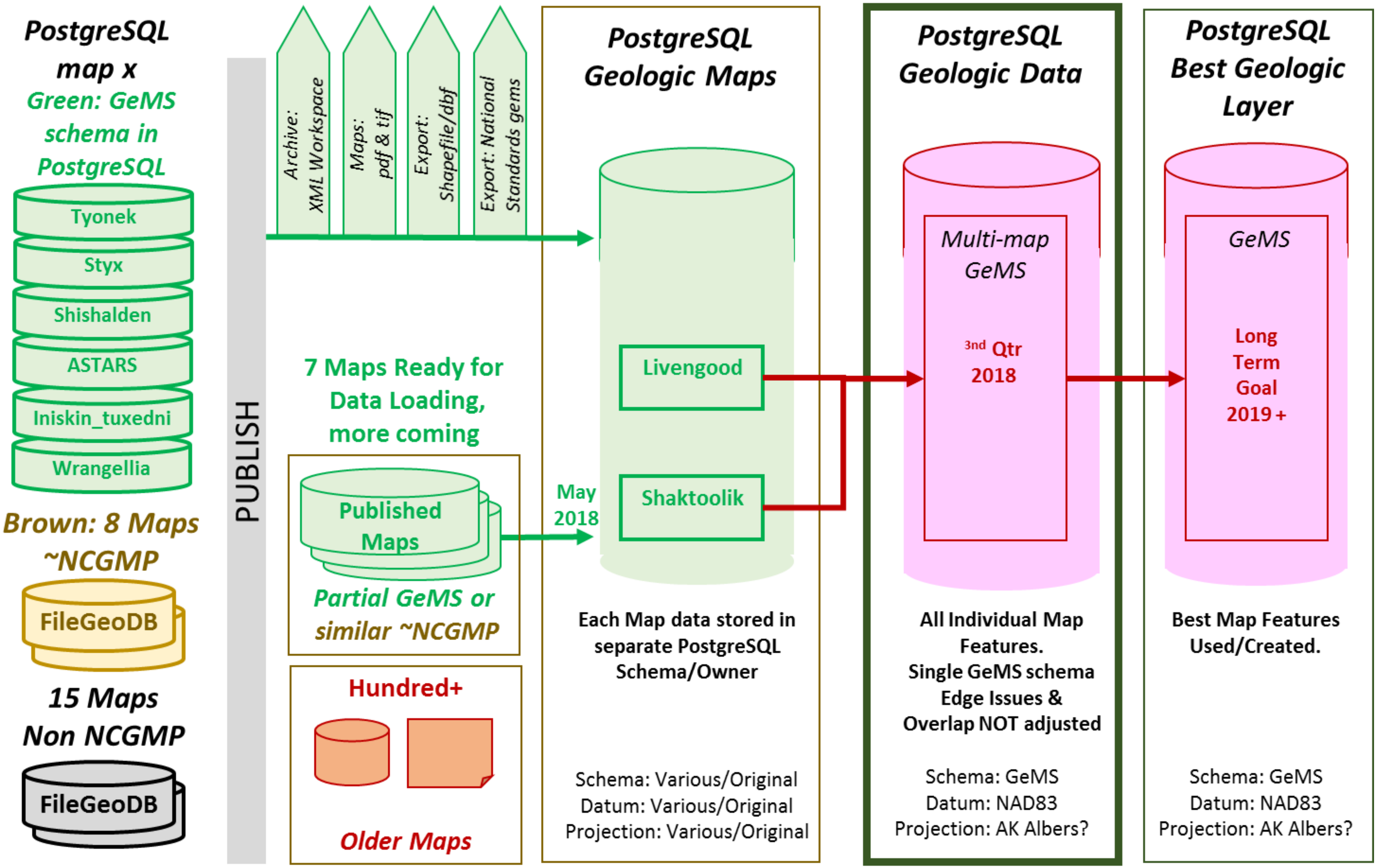
- Coordinate system for various databases: NAD83 datum, unprojected or Alaska Albers (WKID 3338)?
- Uppercase/lowercase field and table name options
  - IsConcealed vs. isconcealed vs. ISCONCEALED vs. is_concealed
- What special characters should be avoided and how?
- What is a data source?
  - Previous field season, GPS point, a published map?
  - How much lineage do you capture?
- Track data sources as a many-to-many relationship?

More outstanding questions

- Enterprise data as points and lines vs. polygons
- 3D Features: Ramifications of Z-enabled geodb
- What kinds of information should be attached to features?
  - Traditional metadata, currency, scale, depth, releasability?
- Best use of domains, subtypes, and feature templates
- Basemaps: where are we going to refer to them and/or store the data generated

Map Production & Management System

Status as of April 25, 2018



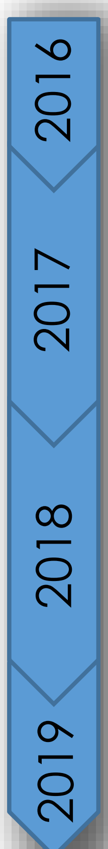
GeMS and NCGMP09 maps

- Most recent maps (top) may have:
  - DMU filled out
  - Repurposed symbols
  - DataSources and DataSourcePolys
- Older maps (bottom) may be modified or partial NCGMP09
- None have Standard Lithology or Glossary

- Geologic map of Mount Chiginagak volcano http://doi.org/10.14509/29769
- Geology of Kasatochi volcano, Aleutian Islands http://doi.org/10.14509/29718
- Surficial geologic map of the Shaktoolik area, Norton Bay Quadrangle http://doi.org/10.14509/29723
- Geologic map of the Tok River area, Tanacross A-5 and A-6 quadrangles http://doi.org/10.14509/29722
- Geologic map of portions of the Livengood B-3, B-4, C-3, and C-4 quadrangles, Tolovana mining district http://doi.org/10.14509/29665
- Surficial-geologic map of parts of the Sagavanirktok and Toolik river drainages http://doi.org/10.14509/29472
- Top Mesozoic unconformity subcrop map, Cook Inlet basin http://doi.org/10.14509/29658
- Surficial geology of the Tyonek area, south-central Tyonek Quadrangle http://doi.org/10.14509/29471
- Preliminary evaluation of bedrock potential for naturally occurring asbestos http://doi.org/10.14509/29447
- Geospatial database: Compiled geologic mapping in the area of the proposed Susitna-Watana hydroelectric project http://doi.org/10.14509/29446
- Geologic map of the Talkeetna Mountains C-4 Quadrangle and adjoining areas http://doi.org/10.14509/29470
- Surficial-geologic map of the Livengood area http://doi.org/10.14509/25179
- Geologic map of the south-central Sagavanirktok Quadrangle http://doi.org/10.14509/29138
- Engineering-geologic map of the Dalton Highway from Galbraith Lake to Slope Mountain http://doi.org/10.14509/25486

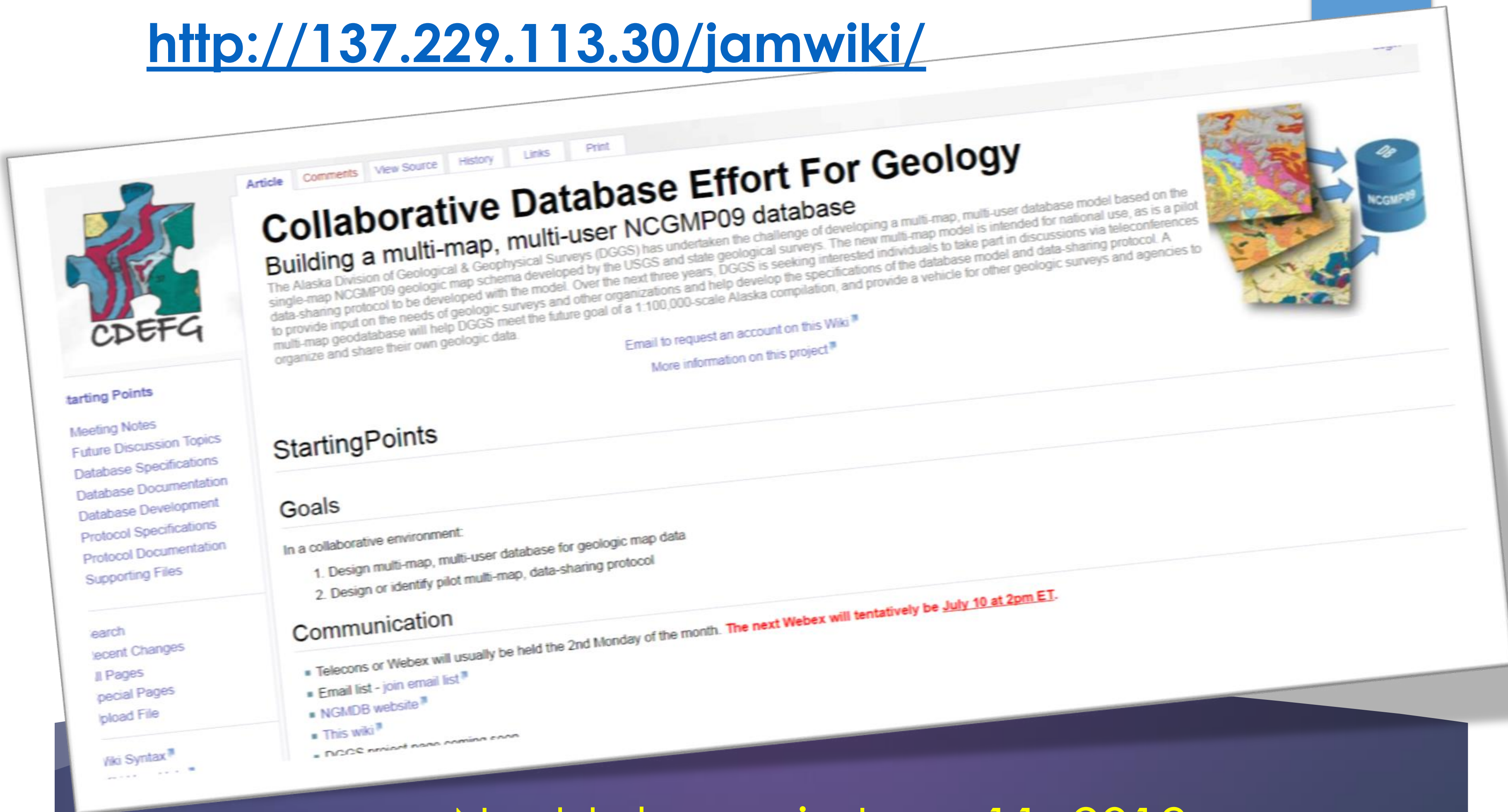
The way forward

Many heads are better than one



- 2016 DMT: Initial input and discussion
- 2016-17 Workgroup meetings: **Database model**
- 2017 DMT: Update on database model
- 2017-18 Workgroup meetings: **Database model & data-sharing protocol**
- **2018 DMT: Update on database model**
- 2018-19 Workgroup meetings: **Database model & data-sharing protocol**
- 2019 DMT: Update on project
- 2019 Code and models will be posted to EPA's repositories

http://137.229.113.30/jamwiki/



Next telecon is June 11, 2018

For questions, contact jennifer.athey@alaska.gov, 907.451.5028