APACHECON
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A case for polar data: integrating the NetCDF file type into Apache Tika

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Presented For The Apache Foundation By
LINUX FOUNDATION

Background:

PhD, Geography

Focus: Remote Sensing and Snow Hydrology

Digging snow…
and writing code.

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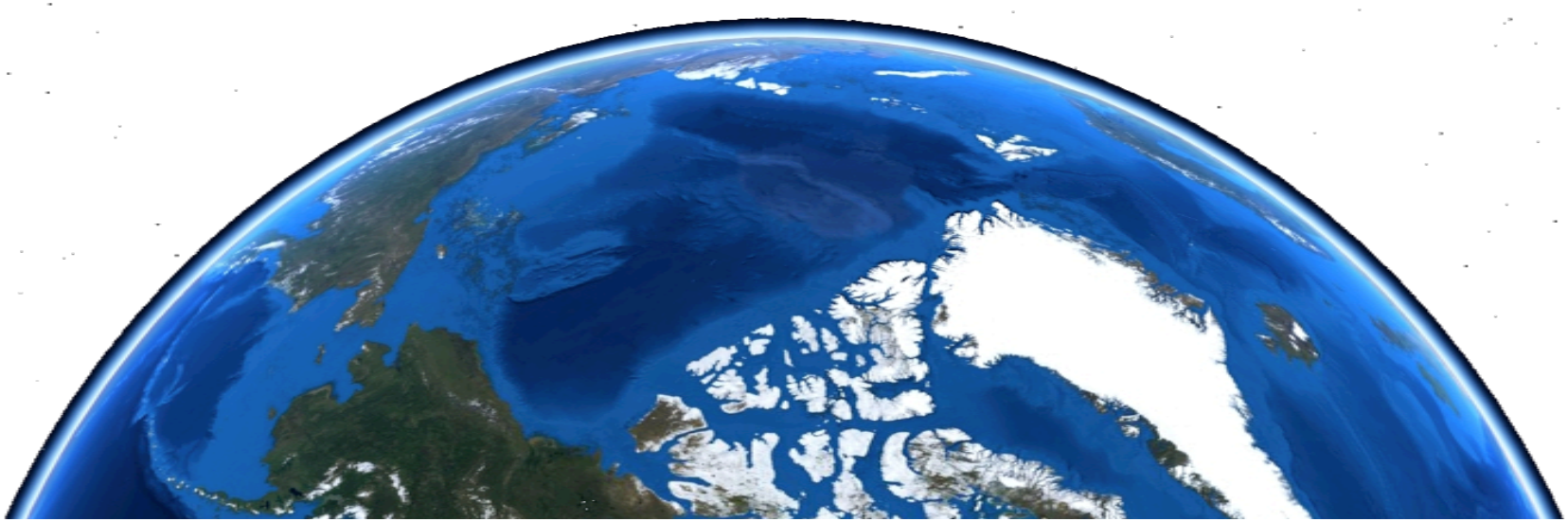
Theory and Experimentation

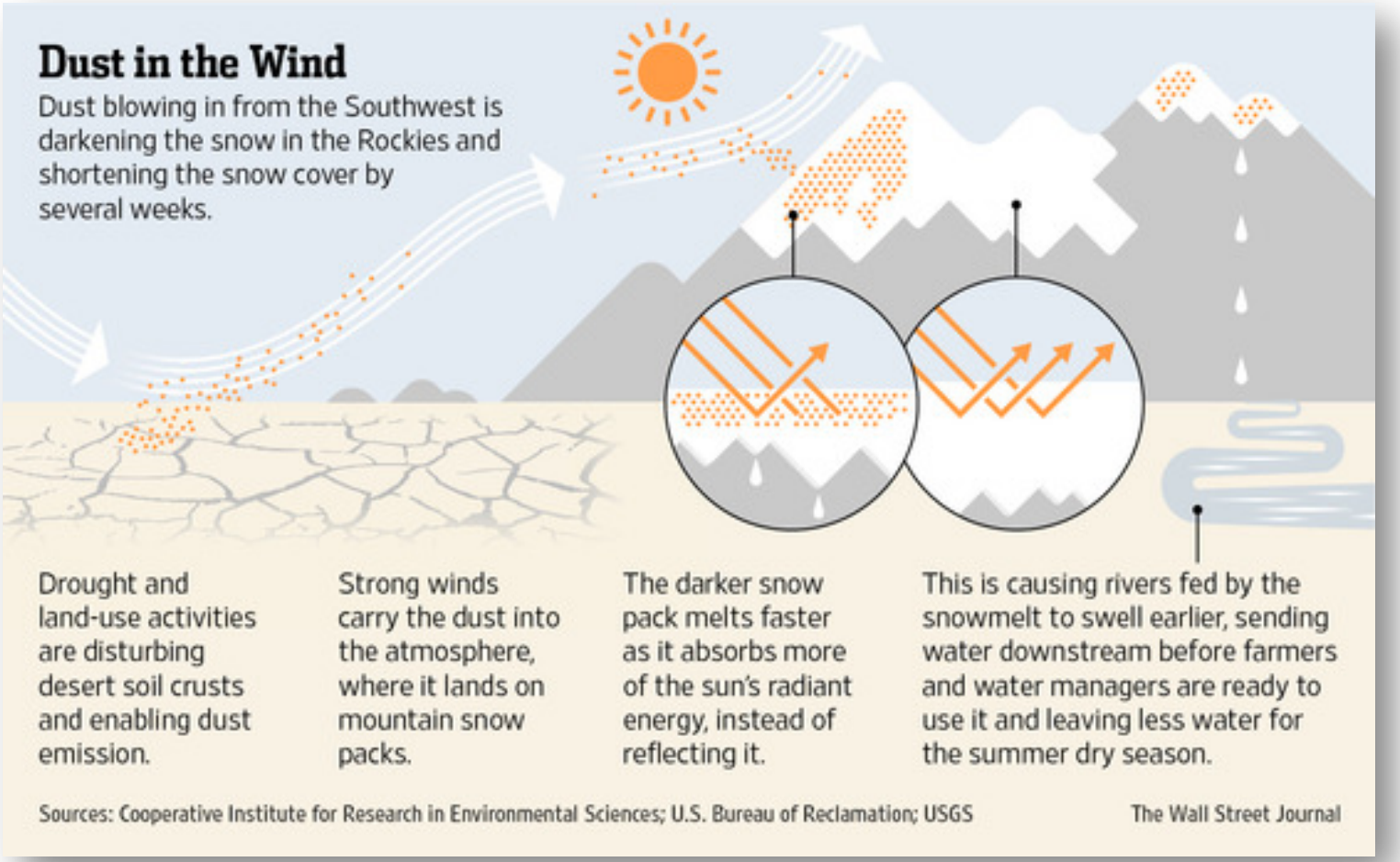
Dataset Creation

Data Dissemination

Data-Driven Science



How much extra energy is absorbed by snow when it becomes dirty?



…and why should you care!


Photo Credit: Peter McBride

From understanding physical phenomenon…

to managing a data bonanza…

How one *becomes* a data scientist.

From understanding physical phenomenon…

to managing a data bonanza…

How one *becomes* a data scientist.

Daily, how much additional energy is absorbed in W m^{-2} because the snow is dirty between 2000 - present?

12 KB of data… not quite a data scientist yet!

From understanding physical phenomenon…

to managing a data bonanza…

How one *becomes* a data scientist.

At ANY snow-covered area around the globe, how much more energy is absorbed by dirty snow daily?

> 27 TB of data… and growing

Our data have shown… These results indicate…

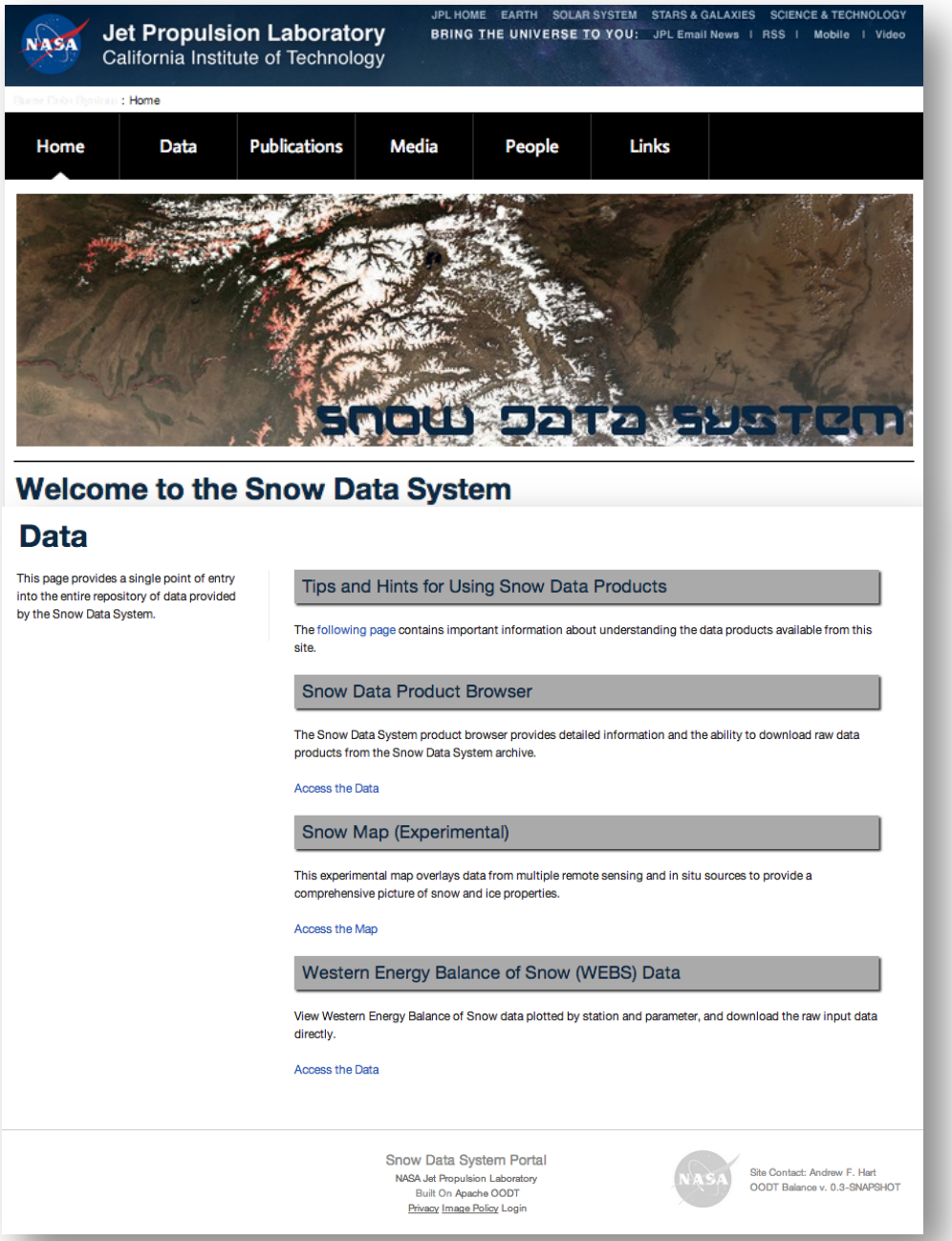
Hmm… I wonder if those data are available.

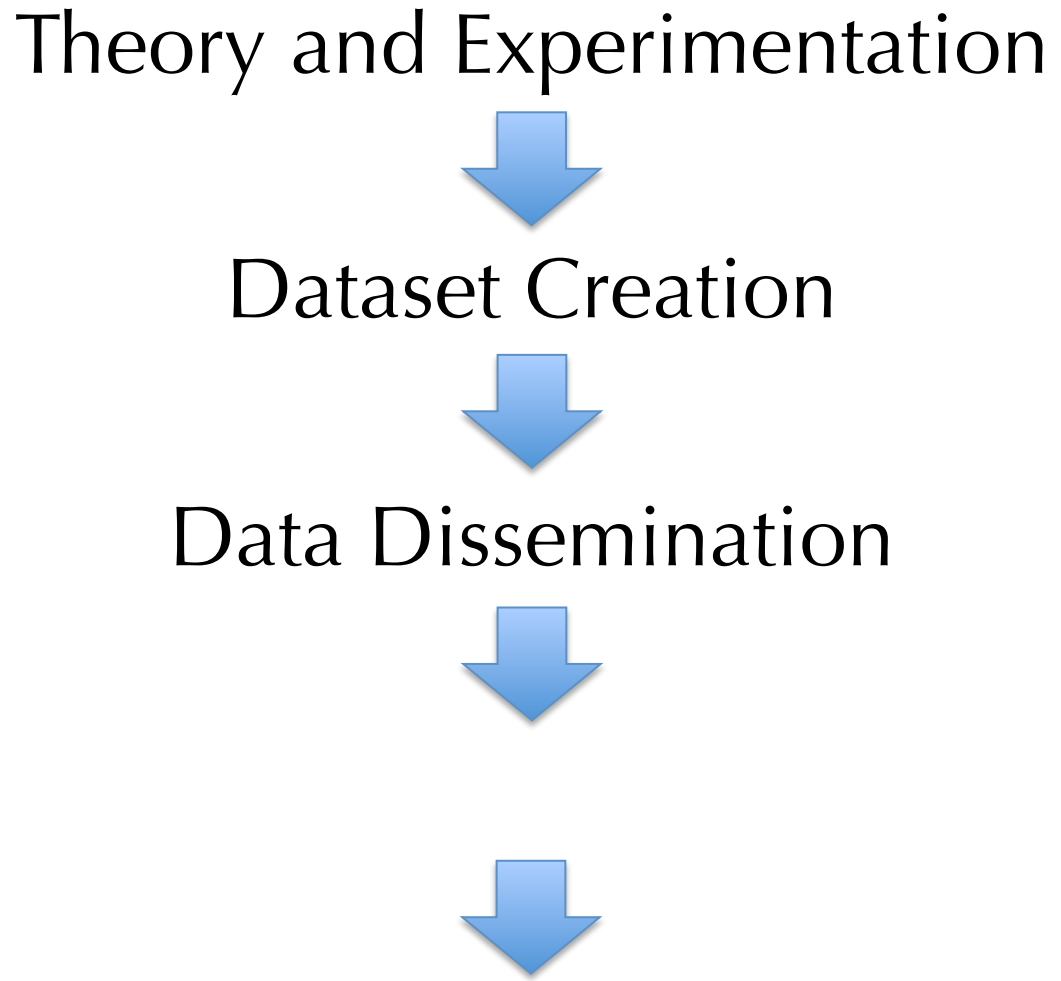
We want your data!

Data dissemination through :

NASA/JPL

snow.jpl.nasa.gov




Theory and Experimentation
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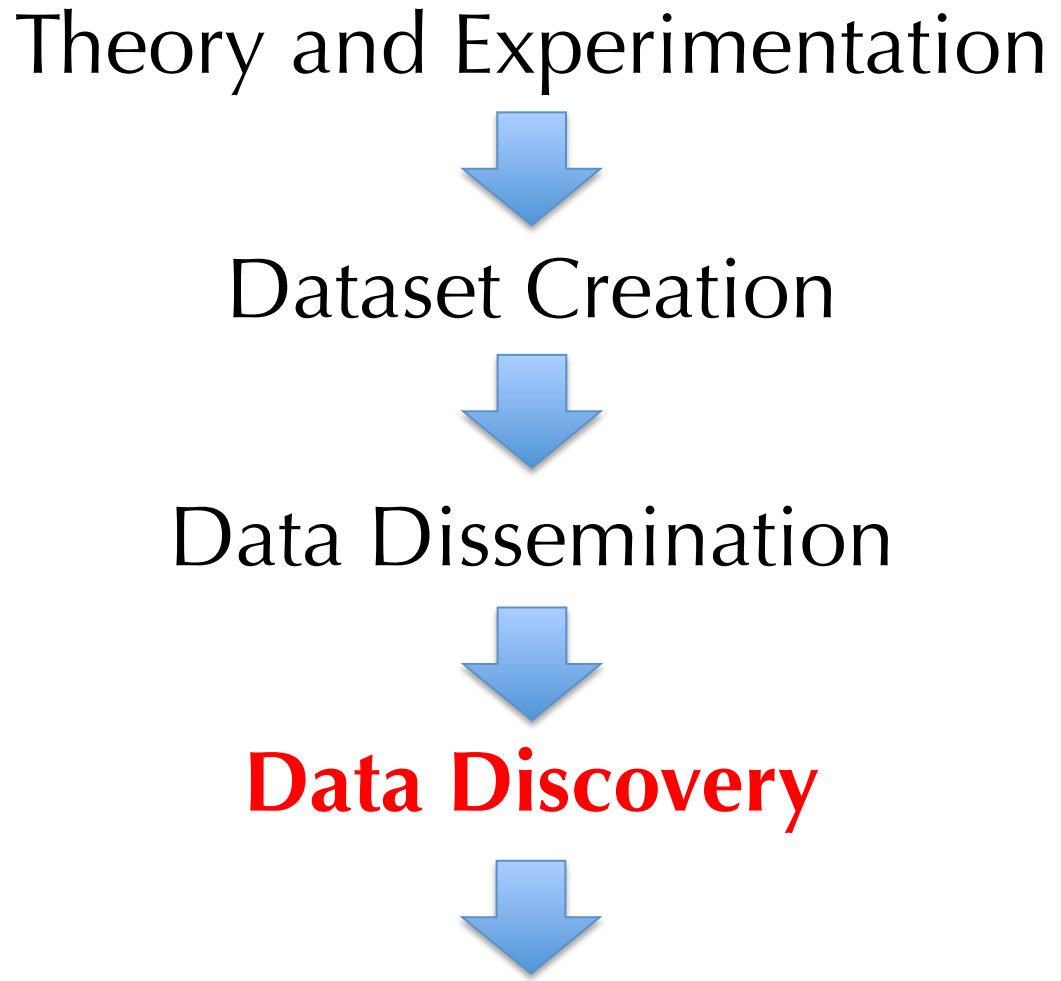
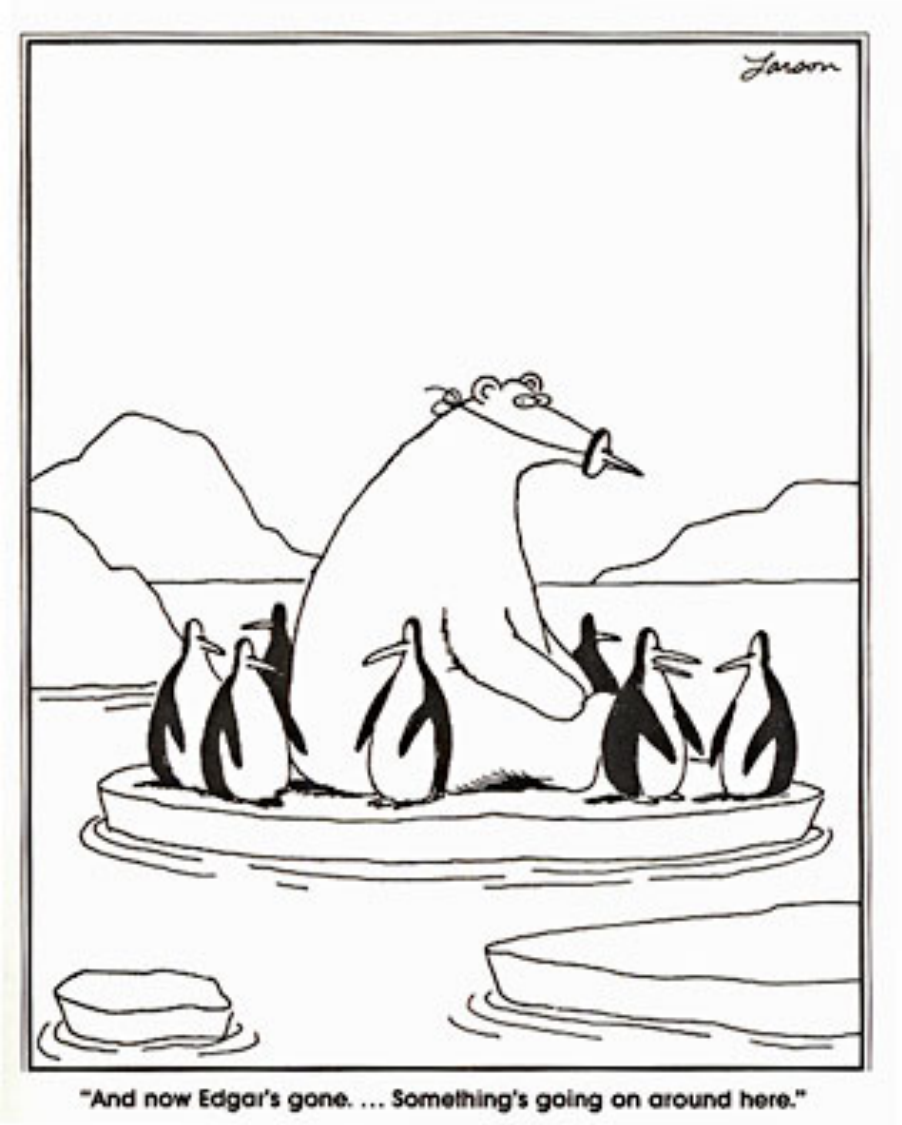
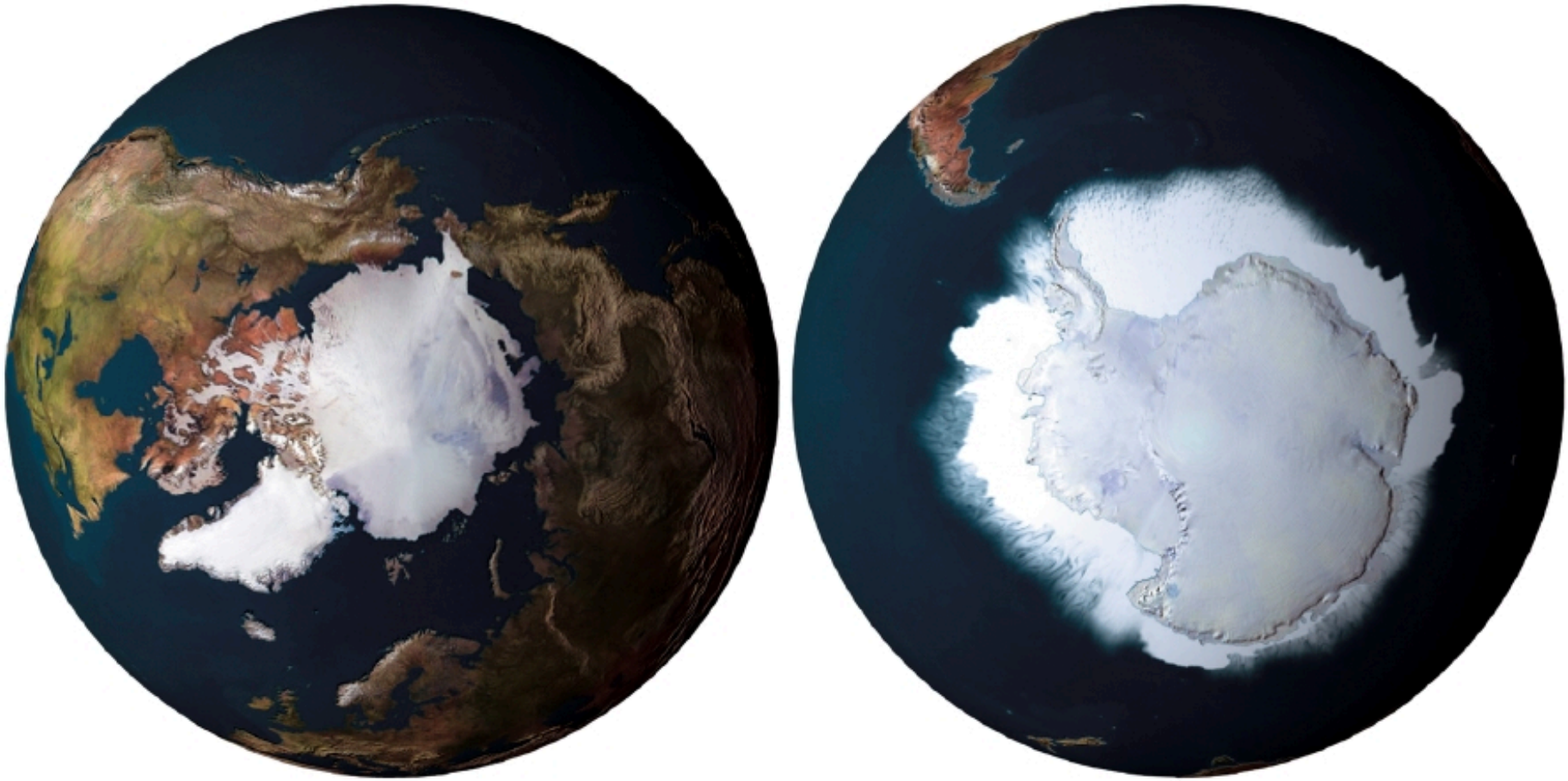

Theory and Experimentation
Dataset Creation
Data Dissemination
Data Discovery
Data-Driven Science

If my data are just in *another* data repository… are they truly discoverable?

Using Apache Tika to explore Polar Data



What are ‘Polar’ data?



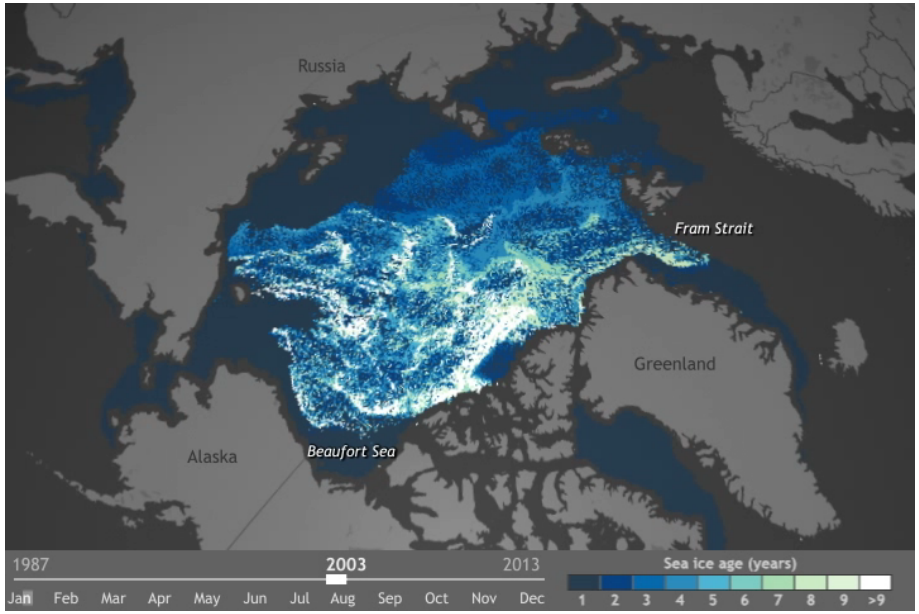
Why is polar science so important?

Rapid change – The polar regions are changing faster than any other region on Earth.

Global linkages – The polar regions have a profound influence on the global environment, particularly on the weather and climate system.

Human societies – The Arctic is home to more than 4 million people. These communities face changes to their environment and the resources on which they depend.

Sense of discovery – The polar regions are places of wonder and, even at the beginning of the 21st century, remain largely physically and intellectually unexplored.



NSIDC/NASA

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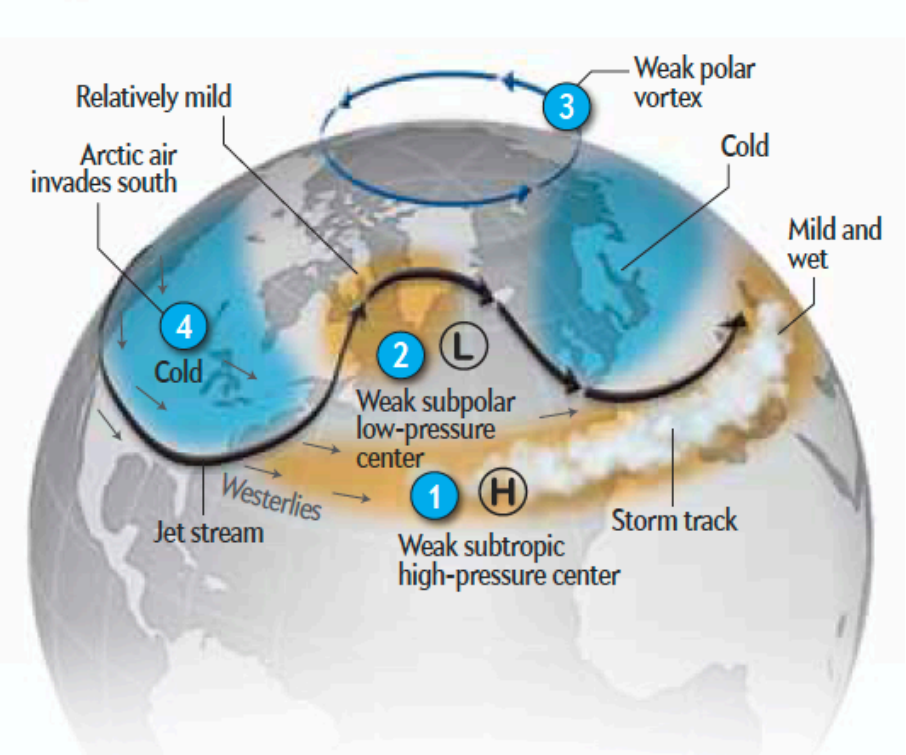

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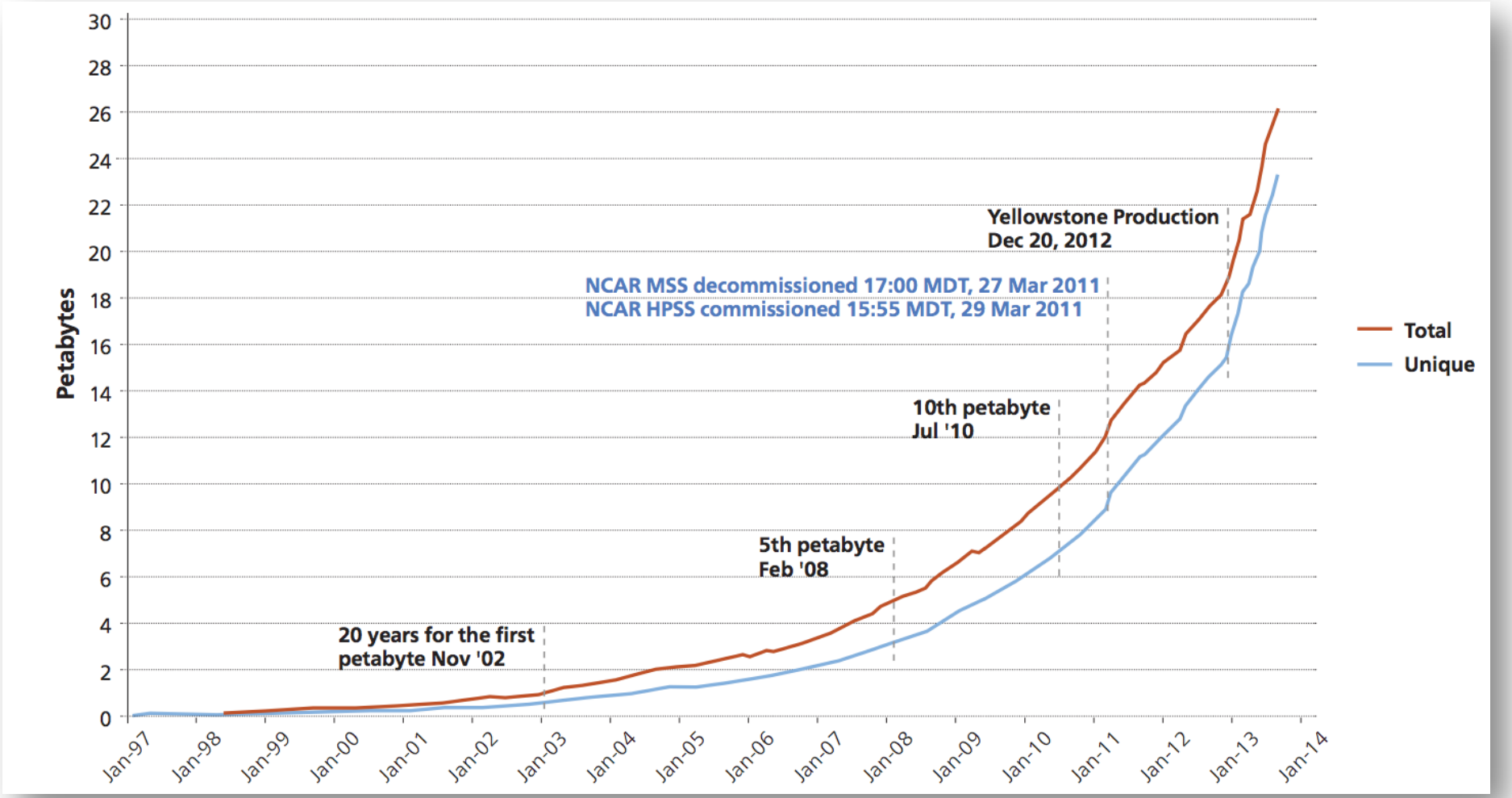
Polar scientists need provenance, content, format, and quality information to **identify** the right dataset, **evaluate uncertainty**, and **ensure the replicability** of scientific workflows. (From: *Workshop on Cyberinfrastructure for Polar Sciences*)

Data Driven **OR** **Theory and Experimentation**

Must navigate:

… AND MANY MORE!

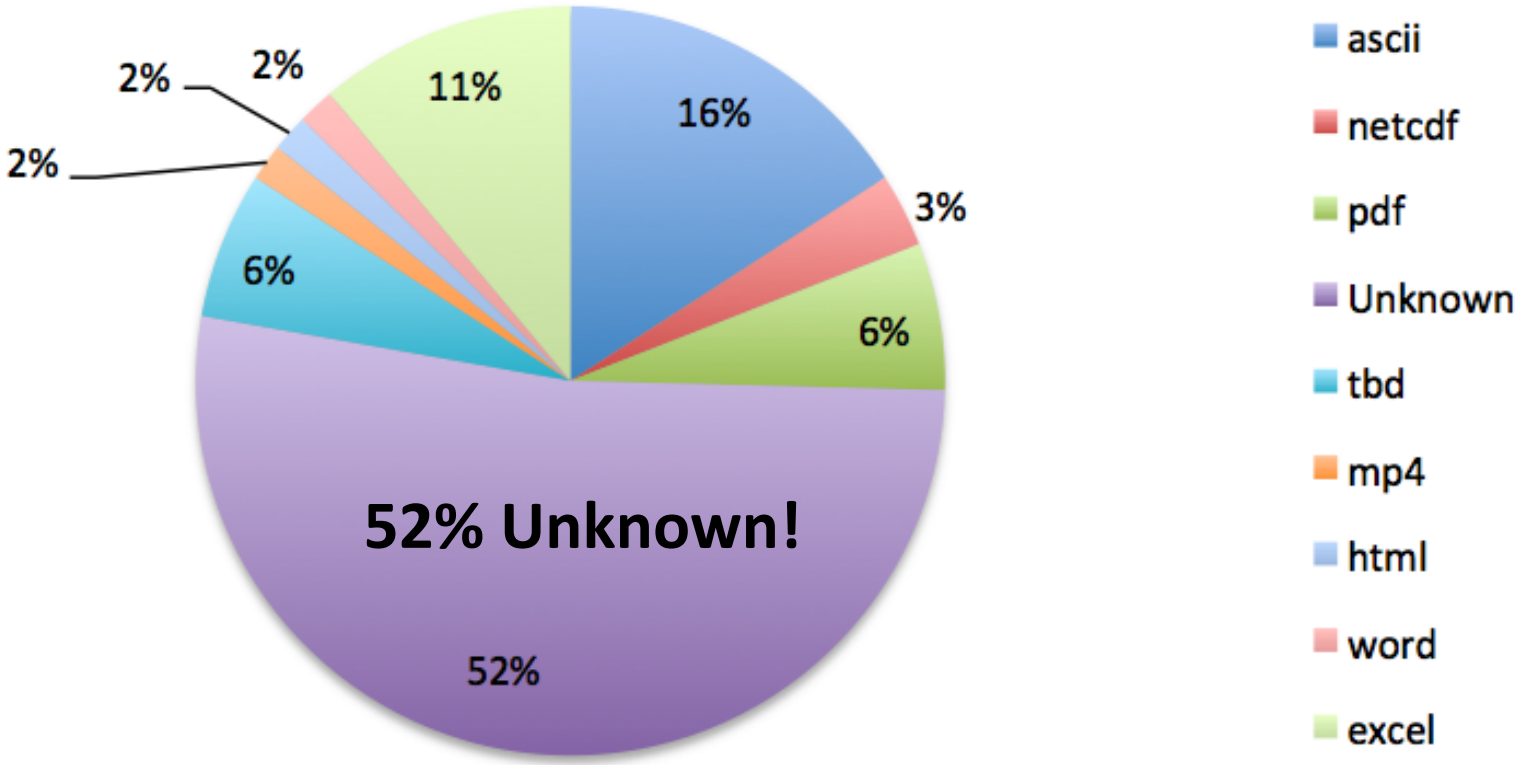
NCAR Total Data Archive



Apache Tika

- Content detection and analysis toolkit:
  - Automated MIME type identification and rapid parsing of text and metadata.
  - 1200 types of files including all major file types from the Internet Assigned Number Authority's MIME database.

File types recognized by Tika in the Antarctic Master Directory



Goal: Add file formats commonly used in polar data to Tika.

Ex: NetCDF (extend), HDF (extend), IMG, GRIB,…

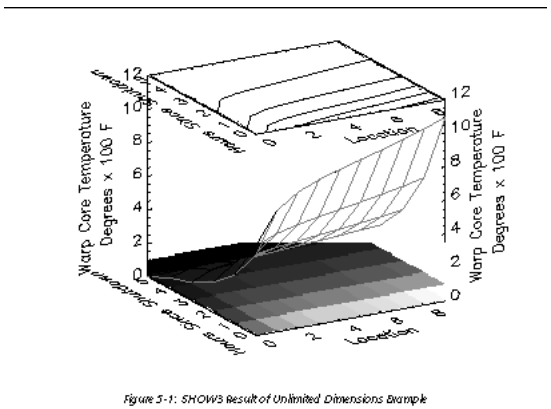
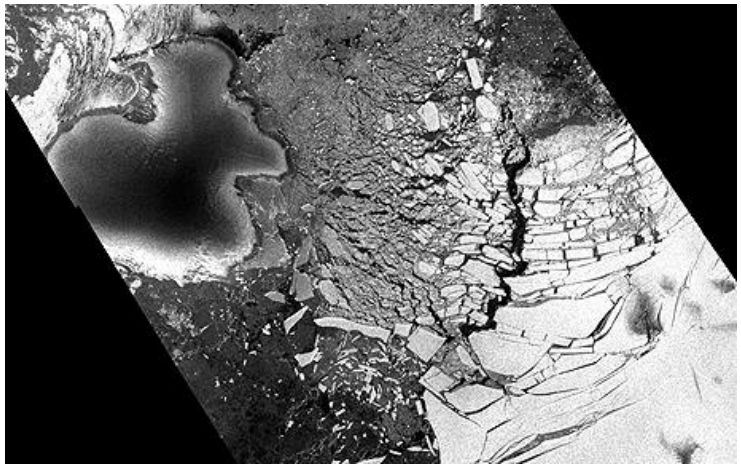


Figure 5-1: SHOW3 Result of Unlimited Dimensions Example



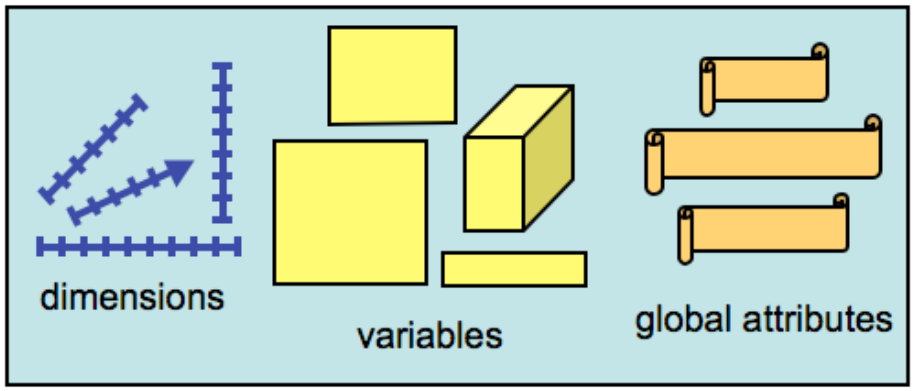
Adding new file formats

- Augment Tika's MIME detection facilities to handle the new scientific formats.
  - Add glob patterns, regular expressions, MIME "magic" or digital signatures for files, and curation of XML root namespaces and patterns.

- Create new Tika parsers and expand existing parsers.

NetCDF File Format

- Variables:
  - N-dimensional arrays of data. Variables in netCDF files can be one of six types (char, byte, short, int, float, double).
- Dimensions:
  - Describe the axes of the data arrays. A dimension has a name and a length.
- Attributes:
  - Annotate variables or files with small notes or supplementary metadata.



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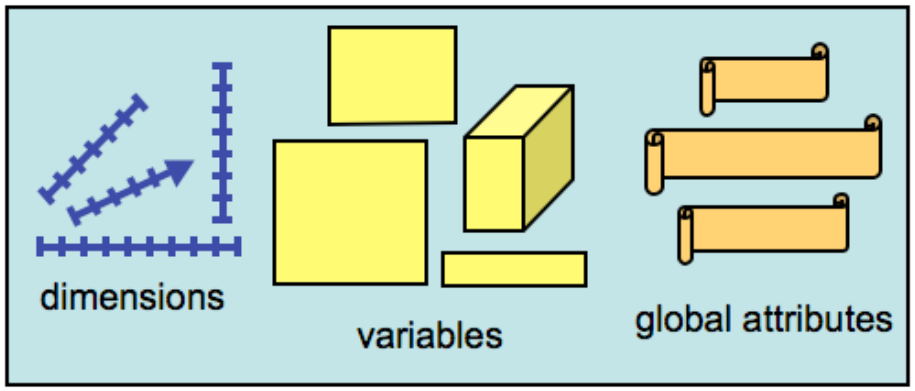


Current Tika Output

[ab:~/tika/tika] ab% java -jar tika-app-1.5.jar --metadata /NetCDF/lsmask.nc.nc

Content-Length: 106968
Content-Type: application/x-netcdf
Conventions: COARDS
Reference: http://www.cdc.noaa.gov/cdc/data.unified.html
dc:title: Unified Daily Gridded US Daily Precipitation
description: Gridded daily Precipitation
history: Thu Oct 16 16:48:20 2003: ncatted -a statistic,lsmask,c,c,Other lsmask.nc
Thu Oct 16 16:47:44 2003: ncatted -a level_desc,lsmask,c,c,Surface lsmask.nc
Thu Oct 16 16:47:23 2003: ncatted -a dataset,lsmask,c,c,CPC .25x.25 Daily US UNIFIED Precipitation lsmask.nc
Thu Oct 16 16:46:18 2003: ncatted -a var_desc,lsmask,c,c,Land-sea mask lsmask.nc
created 11/02/2000 by CAS from data obtained from NCEP
platform: Observations
resourceName: lsmask.nc.nc
title: Unified Daily Gridded US Daily Precipitation
[abryant:~/tika/tika] abryant%

[ab:~/tika/tika] ab% java -jar tika-app-1.5.jar --text /NetCDF/lsmask.nc.nc
[abryant:~/tika/tika] abryant%

Tika outputs NetCDF *Attributes*:

Content-Length: 106968

Content-Type: application/x-netcdf

Conventions: COARDS

Reference: http://www.cdc.noaa.gov/cdc/data.unified.html

dc:title: Unified Daily Gridded US Daily Precipitation

description: Gridded daily Precipitation

history: Thu Oct 16 16:48:20 2003: dataset,lsmask,c,c,CPC .25x.25 Daily US UNIFIED Precipitation lsmask.nc

created 11/02/2000 by CAS from data obtained from NCEP

platform: Observations

resourceName: lsmask.nc.nc

title: Unified Daily Gridded US Daily Precipitation

Tika *will* output NetCDF *Dimensions* and *Variables*:

Dimensions:

lon = 321;

lat = 161;

Variables:

float lat(lat=161);

:units = "degrees_north";

:long_name = "Latitude";

:actual_range = 20.0f, 60.0f; // float

float lon(lon=321);

:units = "degrees_east";

:long_name = "Longitude";

:actual_range = 220.0f, 300.0f; // float

double time(time=1);

:units = "hours since 1-1-1 00:00:00";

:long_name = "Time";

:actual_range = 0.0, 0.0; // double

:delta_t = "0000-00-01 00:00:00";

:avg_period = "0000-00-01 00:00:00";

short lsmask(time=1, lat=161, lon=321);

:long_name = "Land Sea Mask";

:valid_range = -1S, 1S; // short

:actual_range = -1.0f, 1.0f; // float

:add_offset = 0.0f; // float

:scale_factor = 1.0f; // float

:missing_value = 32766S; // short

:var_desc = "Land-sea mask";

:dataset = "CPC Gauge-Based Analysis of Daily Precipitation over CONUS";

:level_desc = "Surface";

:statistic = "Other";

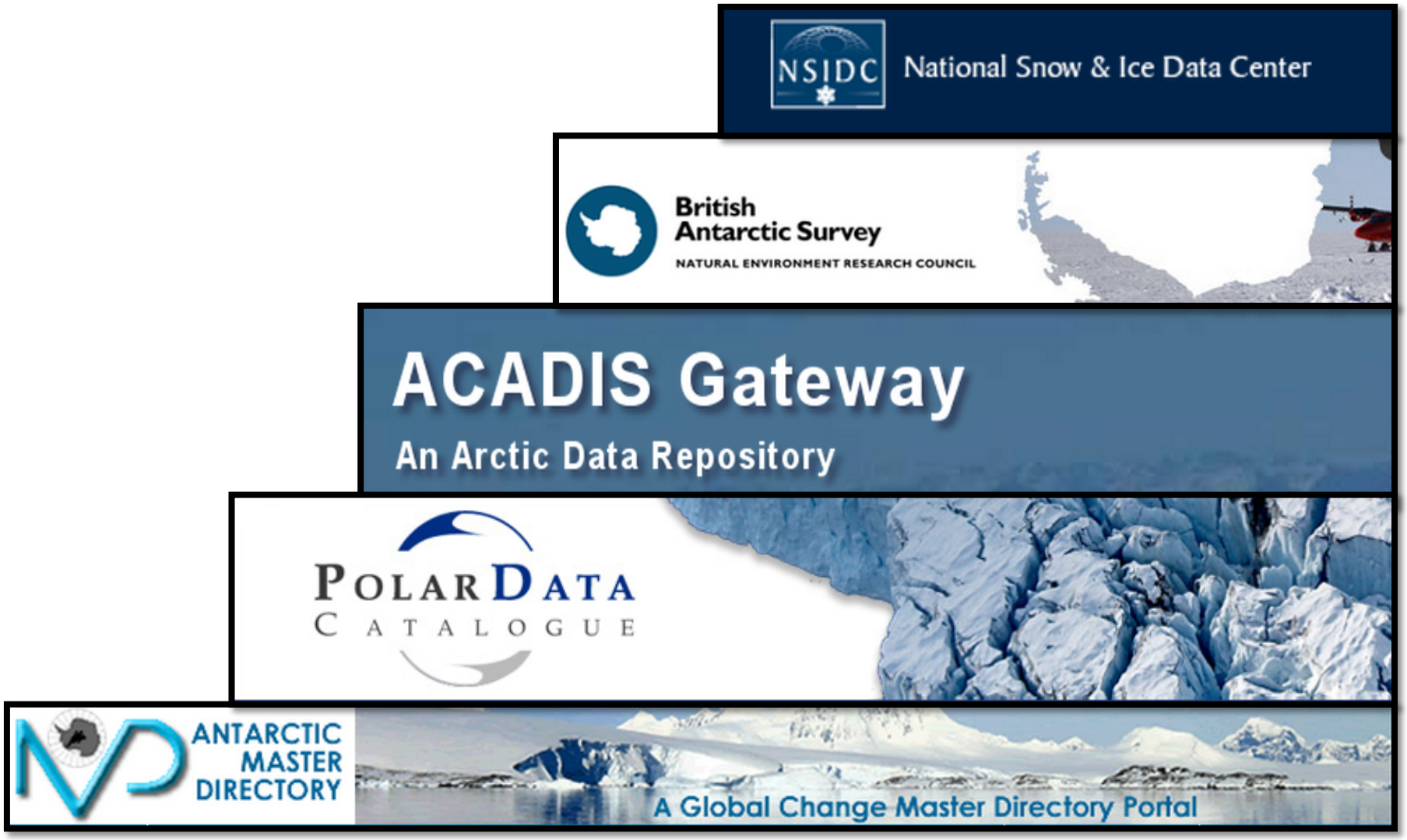
Step 1: Add NetCDF --text parsing

Step 1 re-thought: **Improve Java skills!**

Step 2: System.out.println(“Realize I’ve got to get on the Object Oriented train and OFF the Procedural”);

Step 3: Start writing code and see what Tika can do!

Integration of scientific data types will allow more…



Integration of scientific data types will allow more…

DATA DISCOVERY!

Closing Thoughts

- In scientific data, what should Tika see as ‘text’ vs. ‘metadata’?
  - i.e. in NetCDF files, should *Variables* and *Dimensions* also be considered metadata?

Questions/Acknowledgements

Thanks to:

- NSF Polar Cyberinfrastructure
- Chris Mattmann, JPL, USC
- TAC Committee for travel funding