Thoughts on Research Infrastructure Needs: Arctic Studies

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Carleton UNIVERSITY
Canada's Capital University

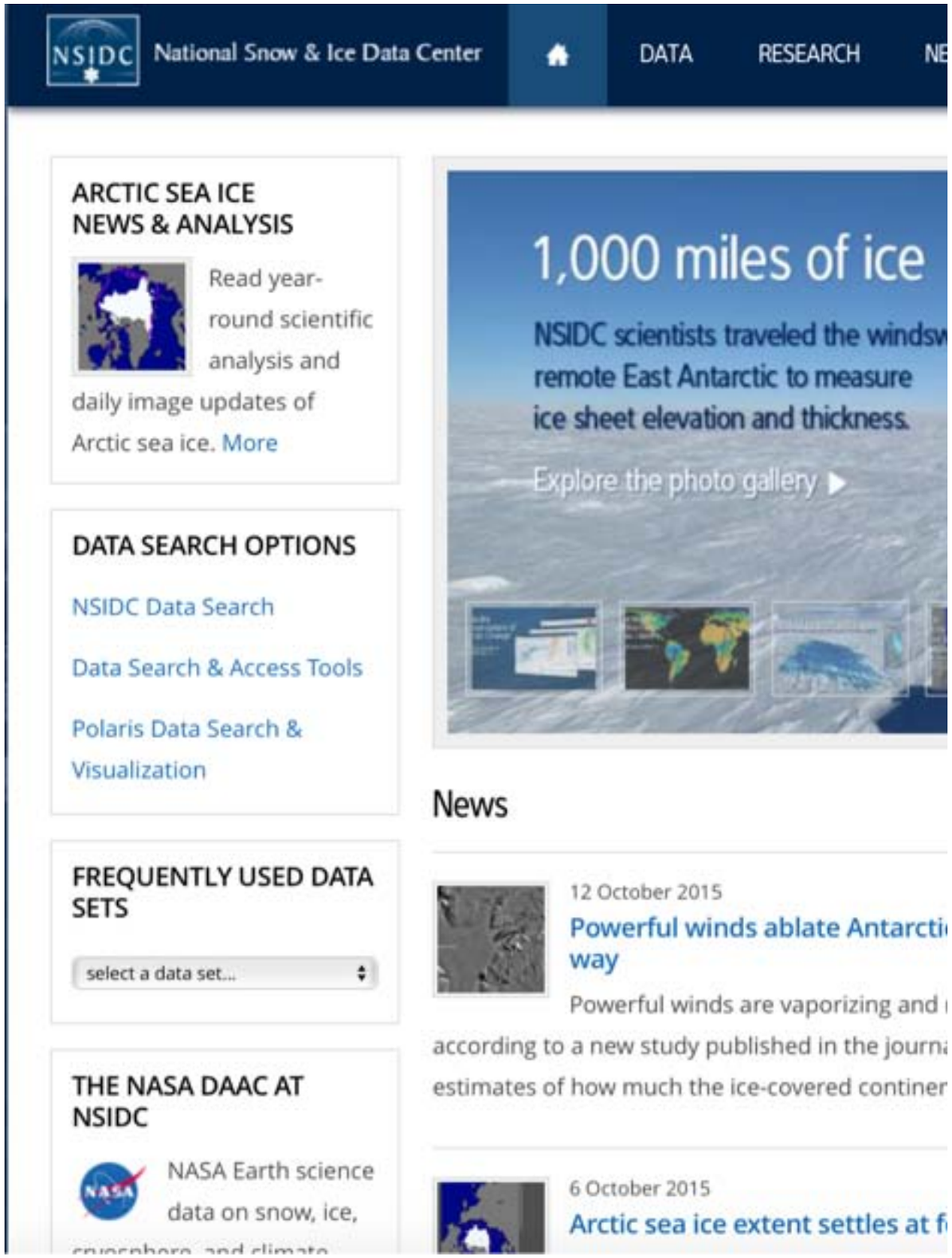
photo: Noe Flum

Arctic Centre, Rovaniemi, Finland

ITC, Enschede, the Netherlands

ITC will be welcoming a total of 120 new Master's students from a staggering 36 different countries

NSIDC



Munich Re

NatCatSERVICE

Downloadcenter for statistics on natural catastrophes

Comprising some 37,000 data records, NatCatSERVICE is the most comprehensive natural catastrophe loss database in the world. Approximately 1,000 events are recorded and analysed every year. The information collated can be used to document and perform risk and trend analyses on the extent and intensity of individual natural hazard events in various parts of the world. A selection of analyses can be accessed here. You can find annual statistics from 2004 onwards, informative maps, Focus Analyses and comprehensive basic knowledge in Touch Natural Hazards. Registration is free of charge.

Swiss Experiment and Permasense

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About SwissEx

A quote from ESA's 'The Changing Earth' elegantly describes the motivation behind SwissEx:

The latter half of the twentieth century saw full emergence of the concept that the behaviour of planet Earth can only be understood in terms of the coupling between the dynamic processes in the atmosphere, the solid Earth, the hydrosphere, the cryosphere, the biosphere and the anthroposphere. All of these components are interlinked by a network of forcing and feedback mechanisms that affect the other components. Global-scale effects can arise from regional processes, and global-scale behaviour can have widely different regional manifestations. In addition, processes acting at one time scale can have consequences across a wide range of other time scales. *The Changing Earth, ESA, 2006*

i.e. the driving motivation behind SwissEx is to provide a common, **cross-disciplinary platform where data and metadata from all disciplines at a variety of temporal and spatial resolutions are accessible**. New technologies allowing high spatial and temporal resolution measurements are also actively developed within the project such that small areas can be intensely monitored where the cost of such measurements has previously been prohibitive. SwissEx will demonstrate the use of this infrastructure to discover new processes and to exploit the combination of new, high spatial/temporal resolution sensor networks with the 'traditional' low resolution, widespread networks.

Introduction

The Swiss Experiment (SwissEx) is an initiative of the Competence Centre Environment and Sustainability (CCES). SwissEx has been created to provide a platform for large scale sensor network deployment and information retrieval and exploitation.

The original SwissEx proposal combined both examples of technology development whilst allowing the scientific section of the proposal to use these tools to receive and process the data and discover new processes through this cross-disciplinary work. This structure was split into two by CCES, to provide the SwissEx technology project (previously called SwissEx) and the the SwissEx science project, which were both funded. This wiki hosts both projects and is structured in a way that maintains their definition.

In the environmental science domain

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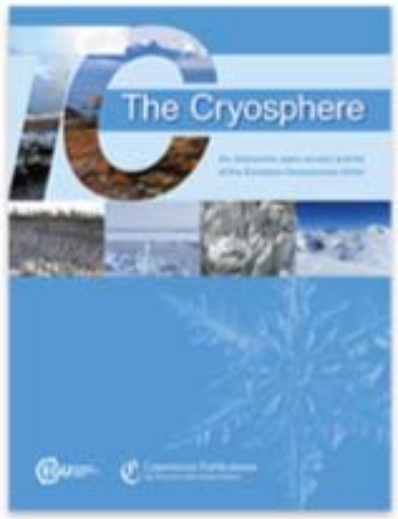

Co-editors-in-chief: Jonathan L. Bamber, Florent Dominé, Stephan Gruber, G. Hilmar Gudmundsson & Michiel van den Broeke

The Cryosphere (TC) is an international scientific journal dedicated to the publication and discussion of research articles, short communications, and review papers on all aspects of frozen water and ground on Earth and on other planetary bodies.

The main subject areas are ice sheets and glaciers, planetary ice bodies, permafrost, river and lake ice, seasonal snow cover, sea ice, remote sensing, numerical modelling, in situ and laboratory studies of the above and including studies of the interaction of the cryosphere with the rest of the climate system.

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In cooperation with the TIB|AV-Portal TC authors can now add short, citable video abstracts and video supplements to their articles.

New library and payment concept — **29 Sep 2015**
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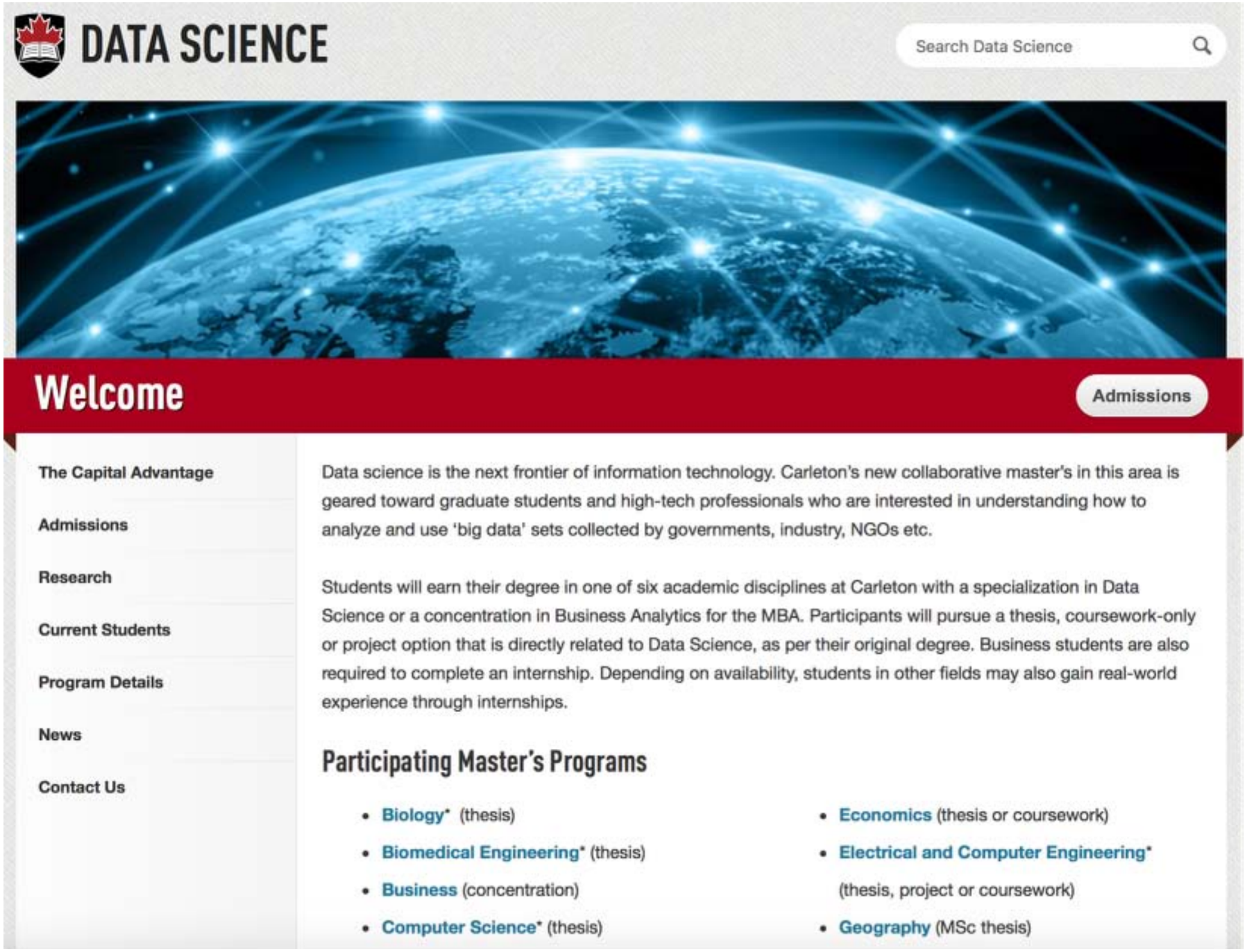
A new international study is the first to use a high-resolution, large-scale

Data Science at Carleton University



Sensor networks are nice, and at the same time…

…they produce more data than we know to handle.

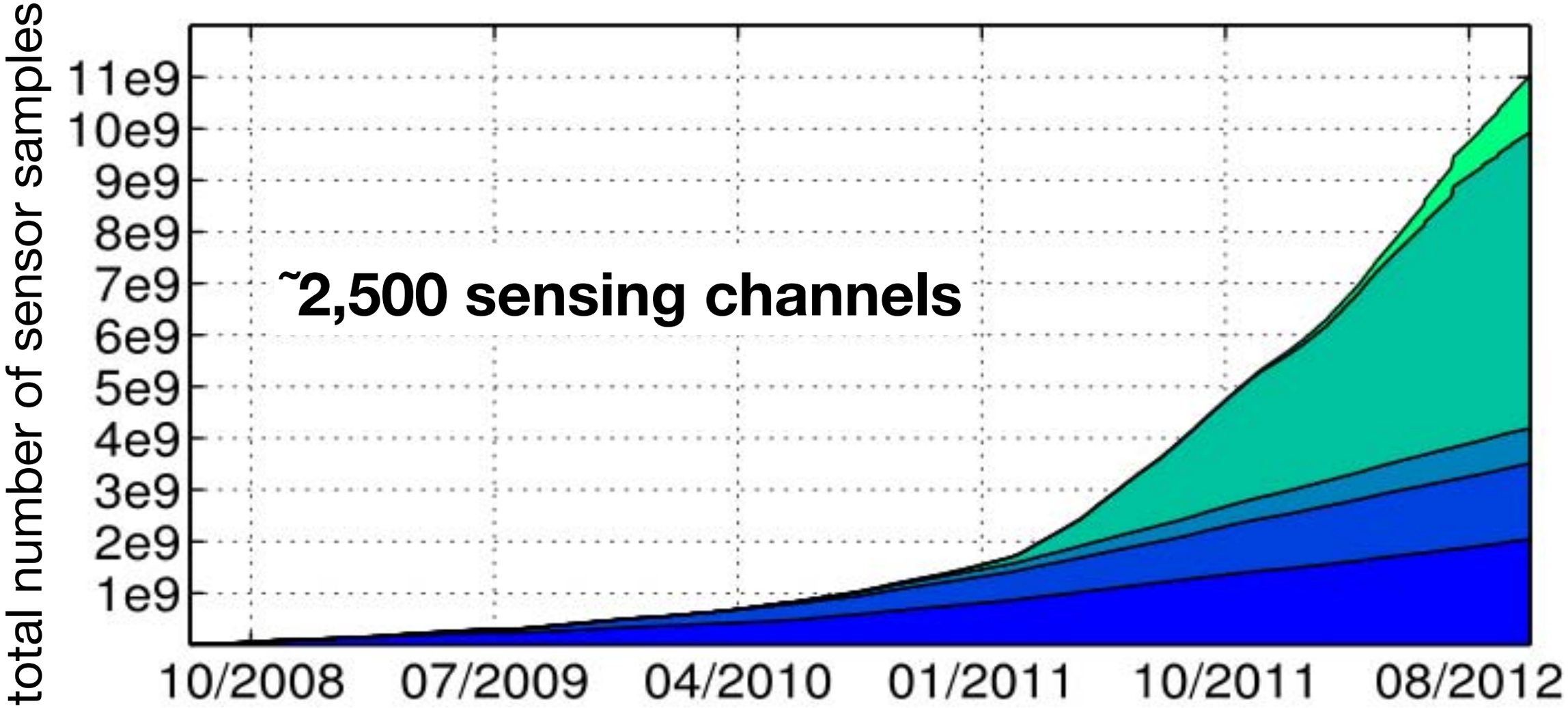
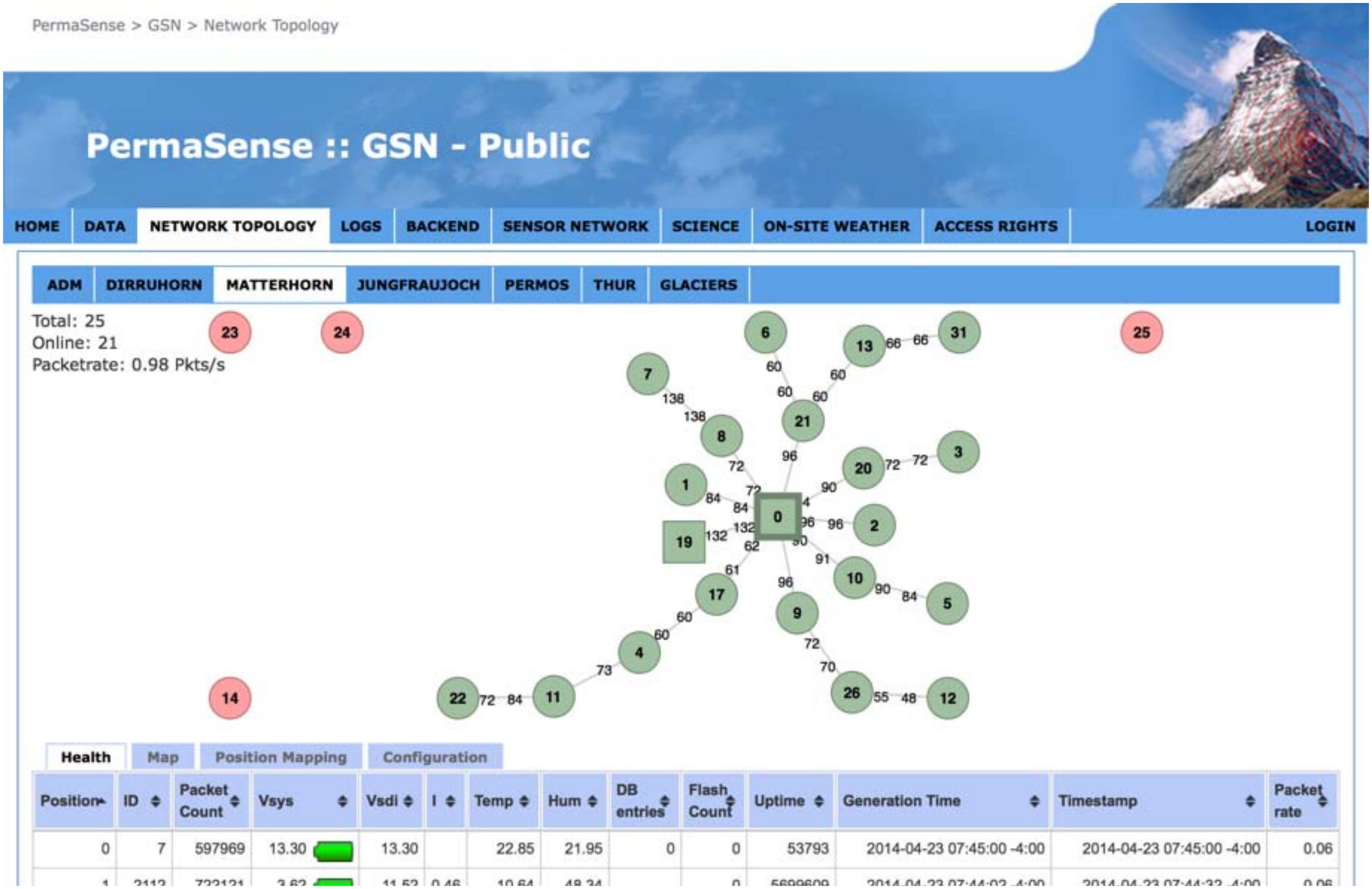
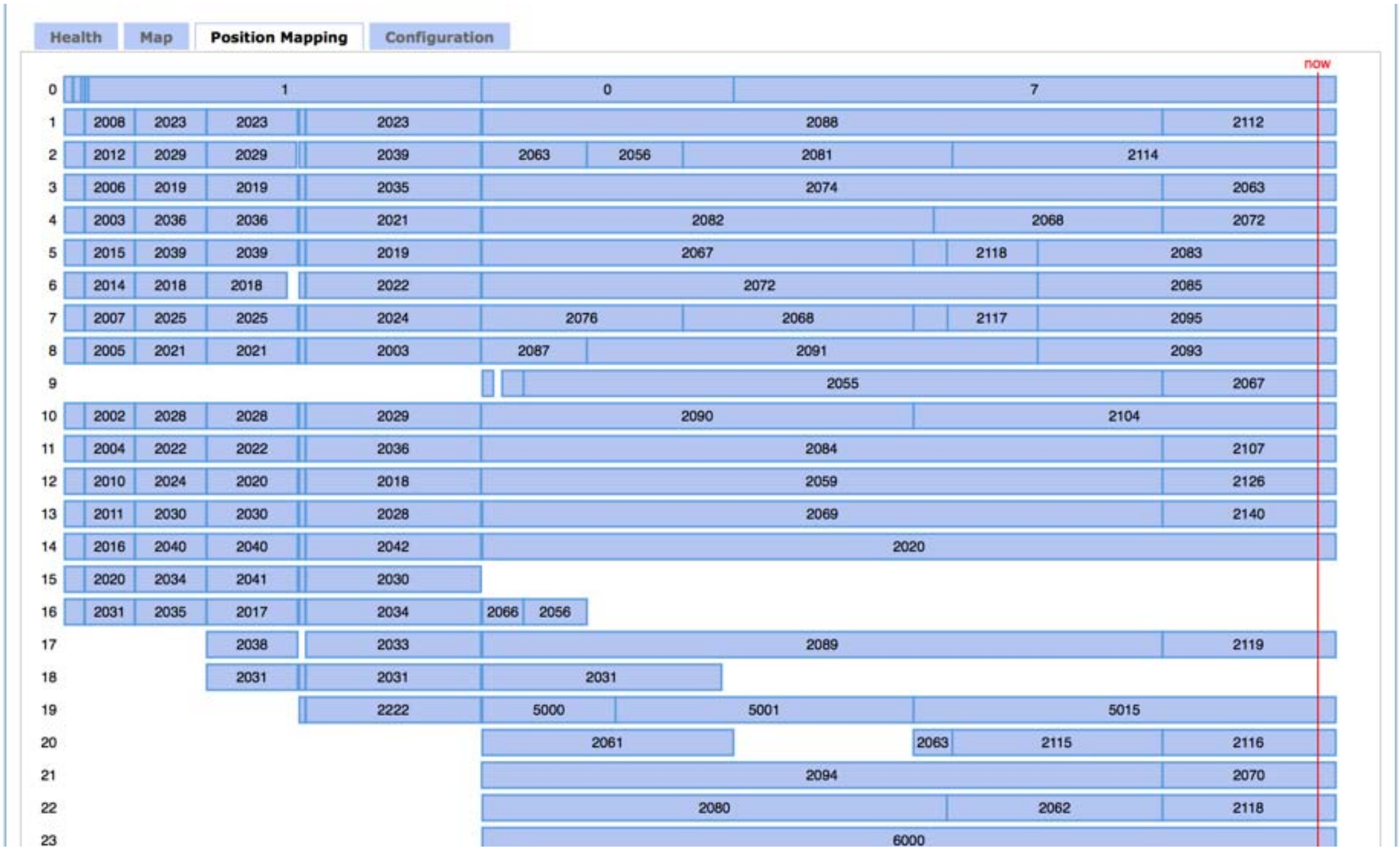


figure: J. Beutel

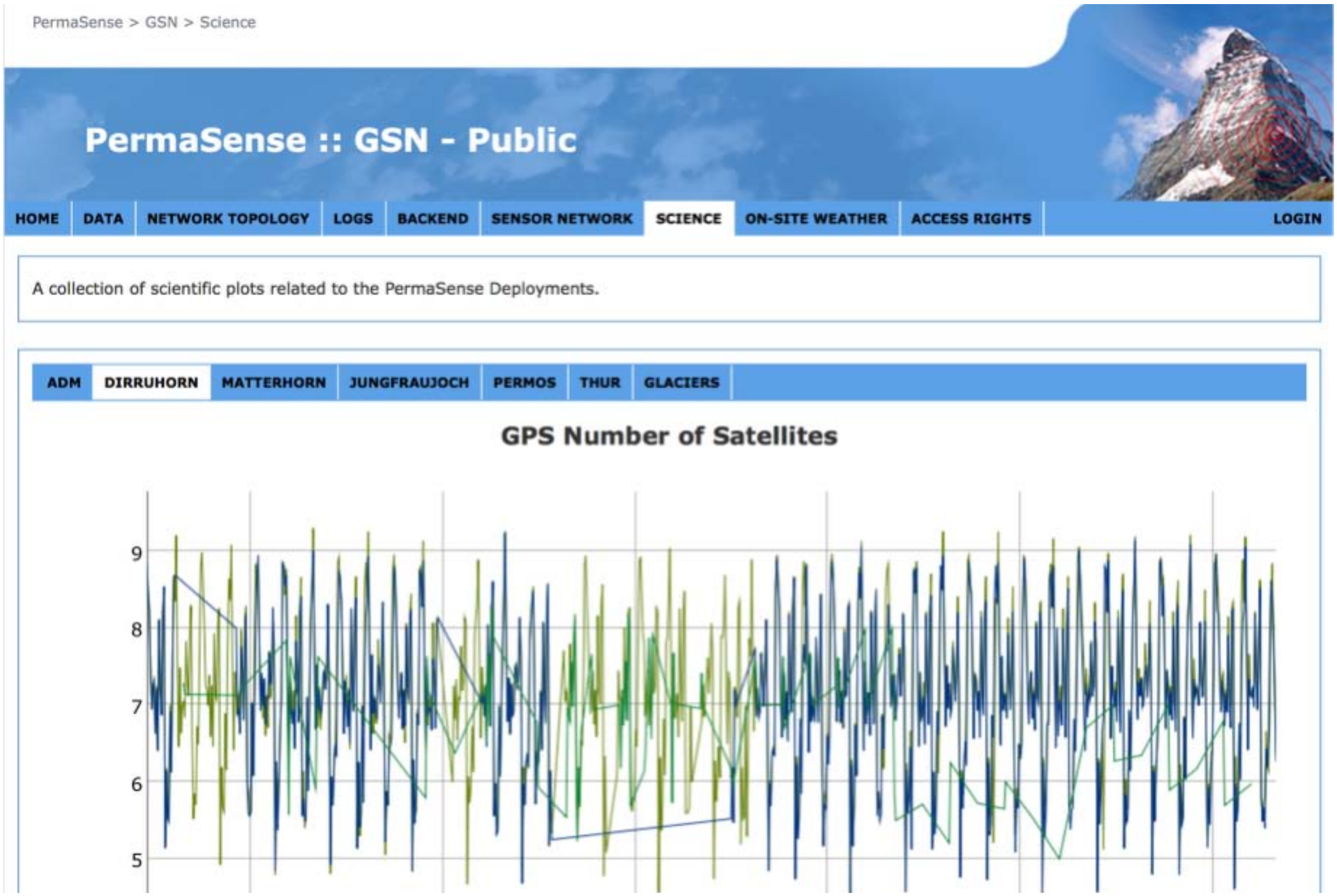
Data organization and access



Mapping locations of devices and sensors over time



Visual and interactive exploration



Efficient access for geo-scientists

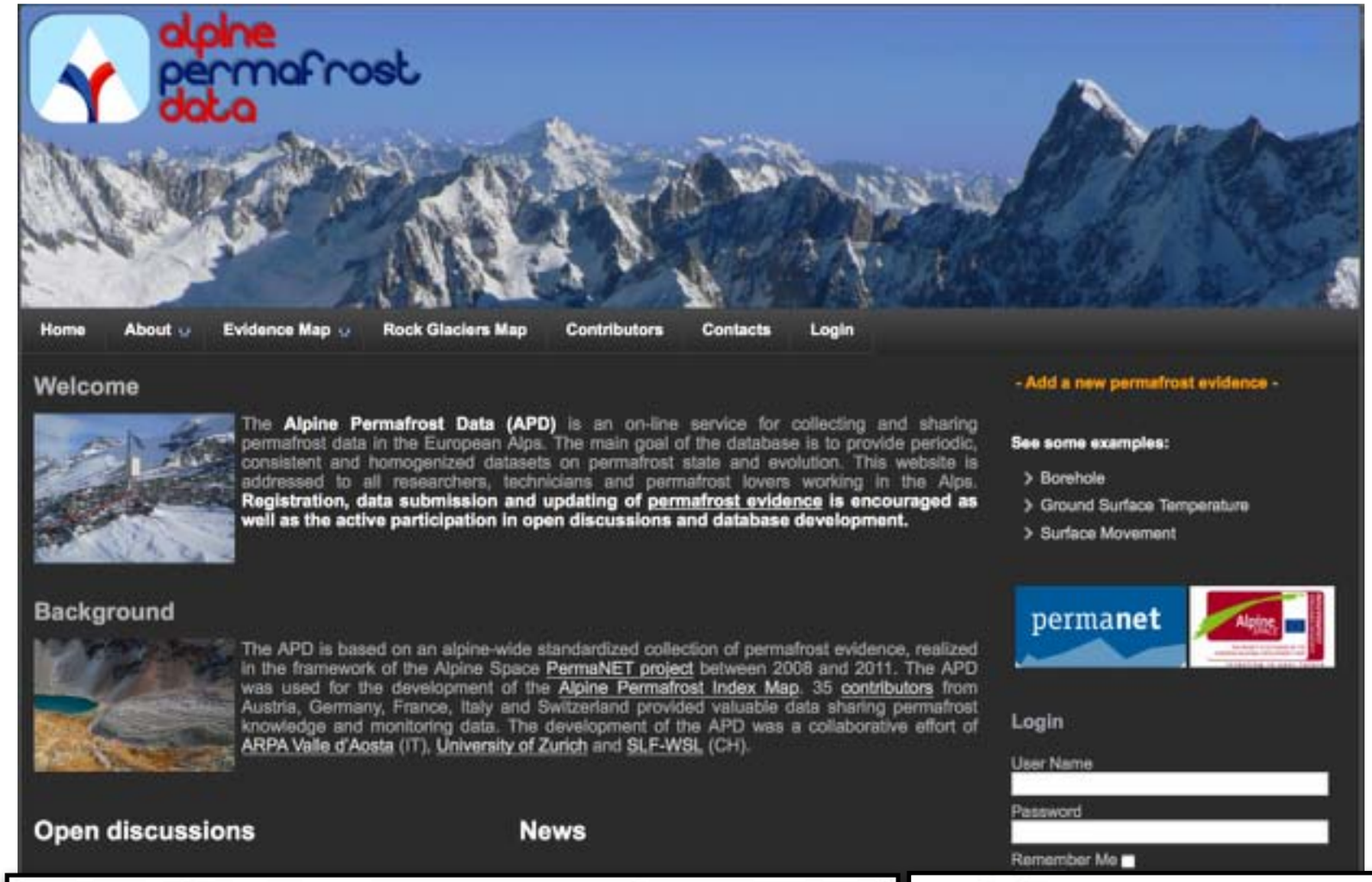
gps.utils.R

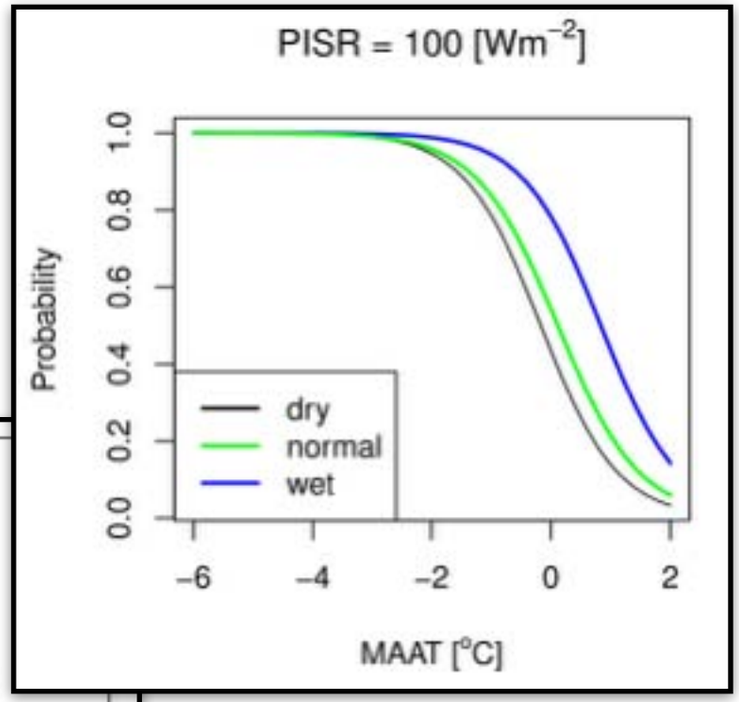
gsn.query | Help search

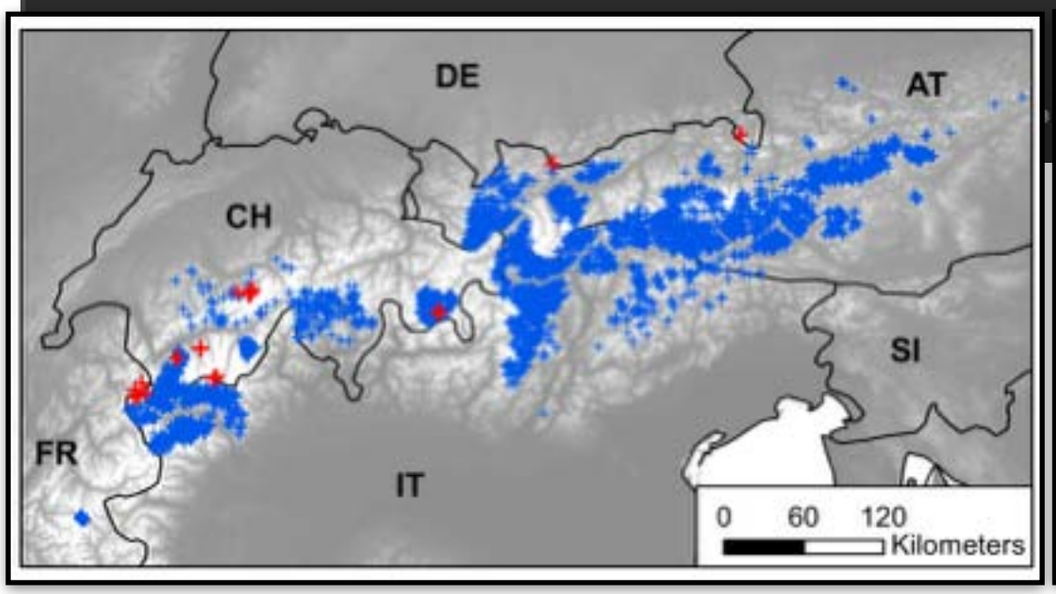
```
#=================================================================
# QUERY GSN (GENERIC FUNCTION)
#=================================================================
#
# Generic function to read data from a GSN table.
# GSN syntax: http://sourceforge.net/apps/trac/gsn/wiki/web-interfacev1-server
#
# INPUT
#   - virtual_sensor (example: "dirruhorn_dozer_adccomdiff__mapped")
#   - position       (example: 1)
#   - fields   (default: "All", example: "position,device_id,generation_time")
#   - server   (default: "http://data.permasense.ch")
#   - time_beg (default: "01/01/2010+12:00")
#   - time_end (default: "01/01/2050+13:00")
#   - aggregation [h] (default: 0, i.e. no aggregation)
#
# OUTPUT: data frame of results, generation_time (etc.) converted to POSIXct
#         if exists
#=================================================================
gsn.query<-function(virtual_sensor, position, fields="All",
          server="http://data.permasense.ch", aggregation=0,
          time_beg="01/01/2010+00:00:00", time_end="02/01/2050+00:00:00",
          verbose=TRUE) {

     #aggregation by time in hours
     if (aggregation > 0) {
          aggregation<-"&agg_function=avg&agg_unit=3600000&agg_period="&aggregation
     } else {
          aggregation<-""
     }
     #print(time_beg)
     #print(time_end)

     #make request-------------------
     request<-server&"/multidata?"&
               #table/virtual sensor
               "vs[0]="&virtual_sensor&
               #fields
               "&field[0]="&fields&
               #aggregation
               aggregation&
               #select position
               "&c_vs[0]="&virtual_sensor&"&c_field[0]=position"&
               "&c_join[0]=and&c_min[0]="&position-1&"&c_max[0]="&position&
               #restrict time
               "&from="&time_beg&":00&to="&time_end&":59"&
               #sorting and format
               "&timeline=generation_time&download_format=csv&time_format=unix"
```

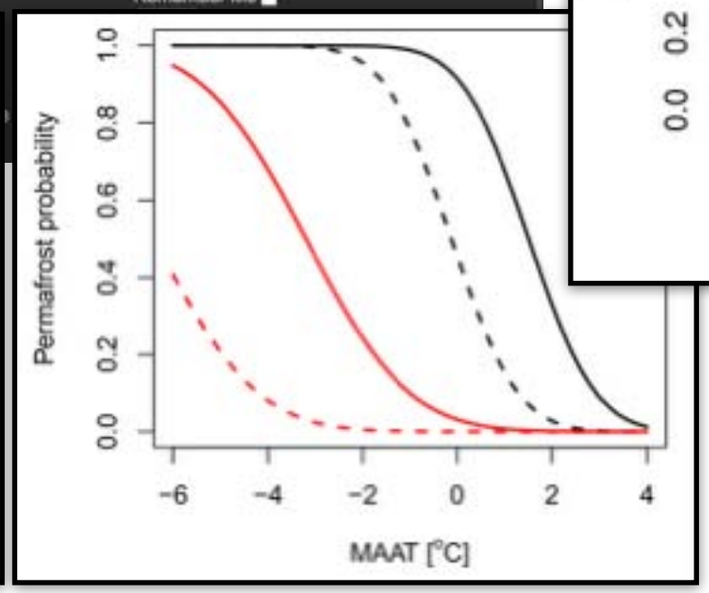
- data and metadata
- common format and organization
- publicly available (reproducibility)
- query data base via http request
- simple interfaces in R, Matlab, etc.
- (gates to hell open, temporarily)

Pan-Alpine permafrost database



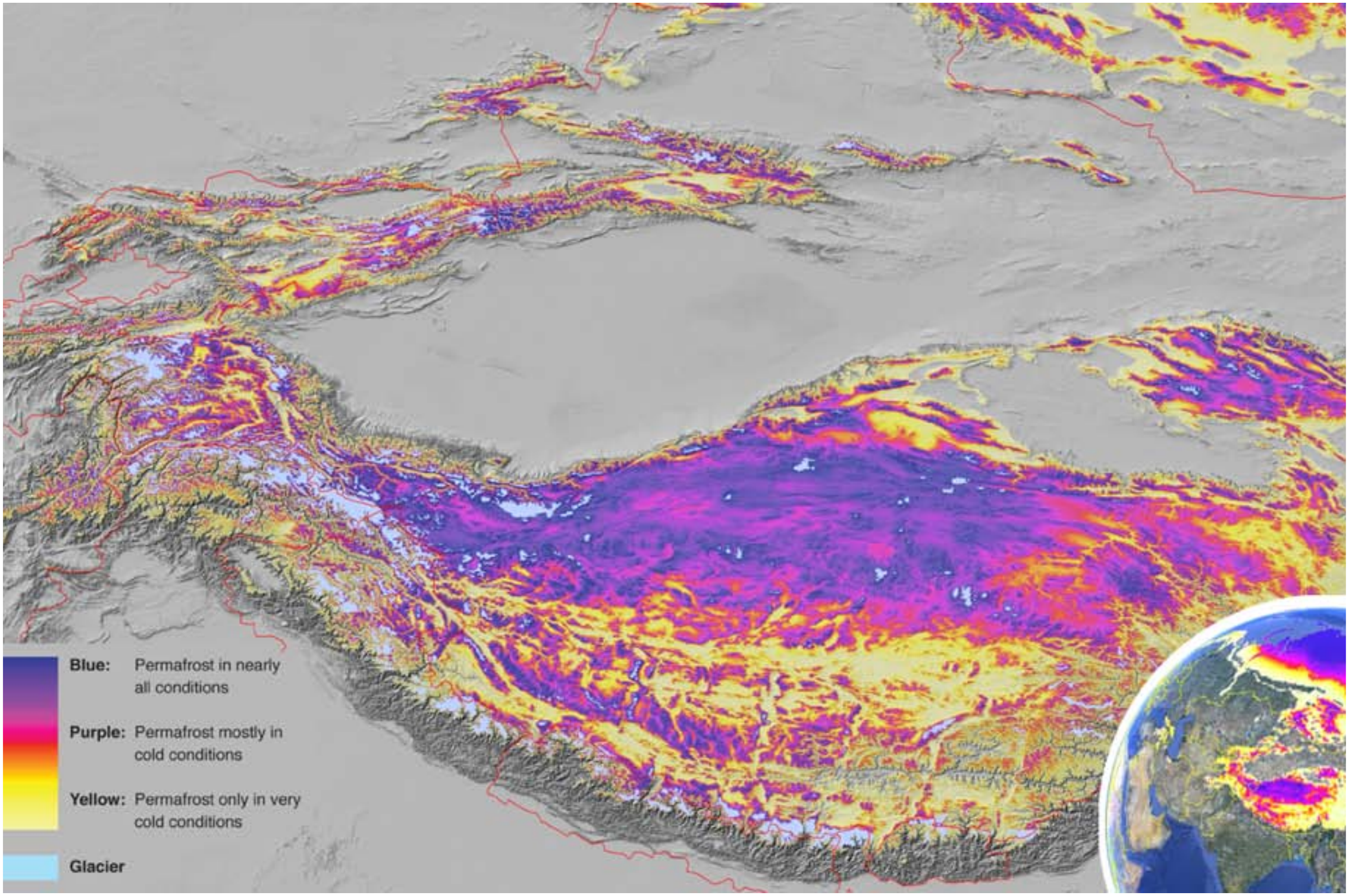






Alpine map, 30m, WMS and Google Earth

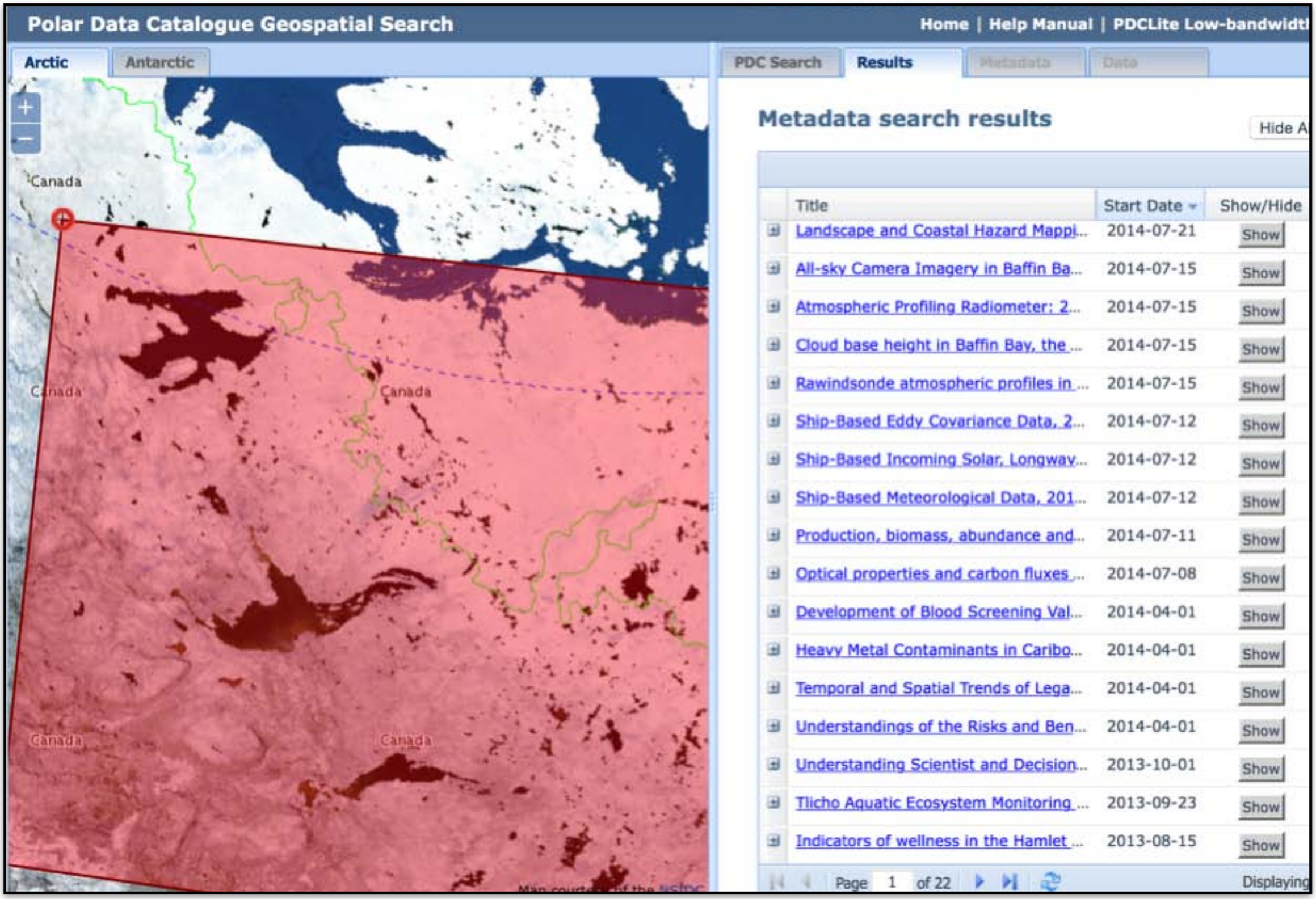
Global map, 1km, WMS and Google Earth



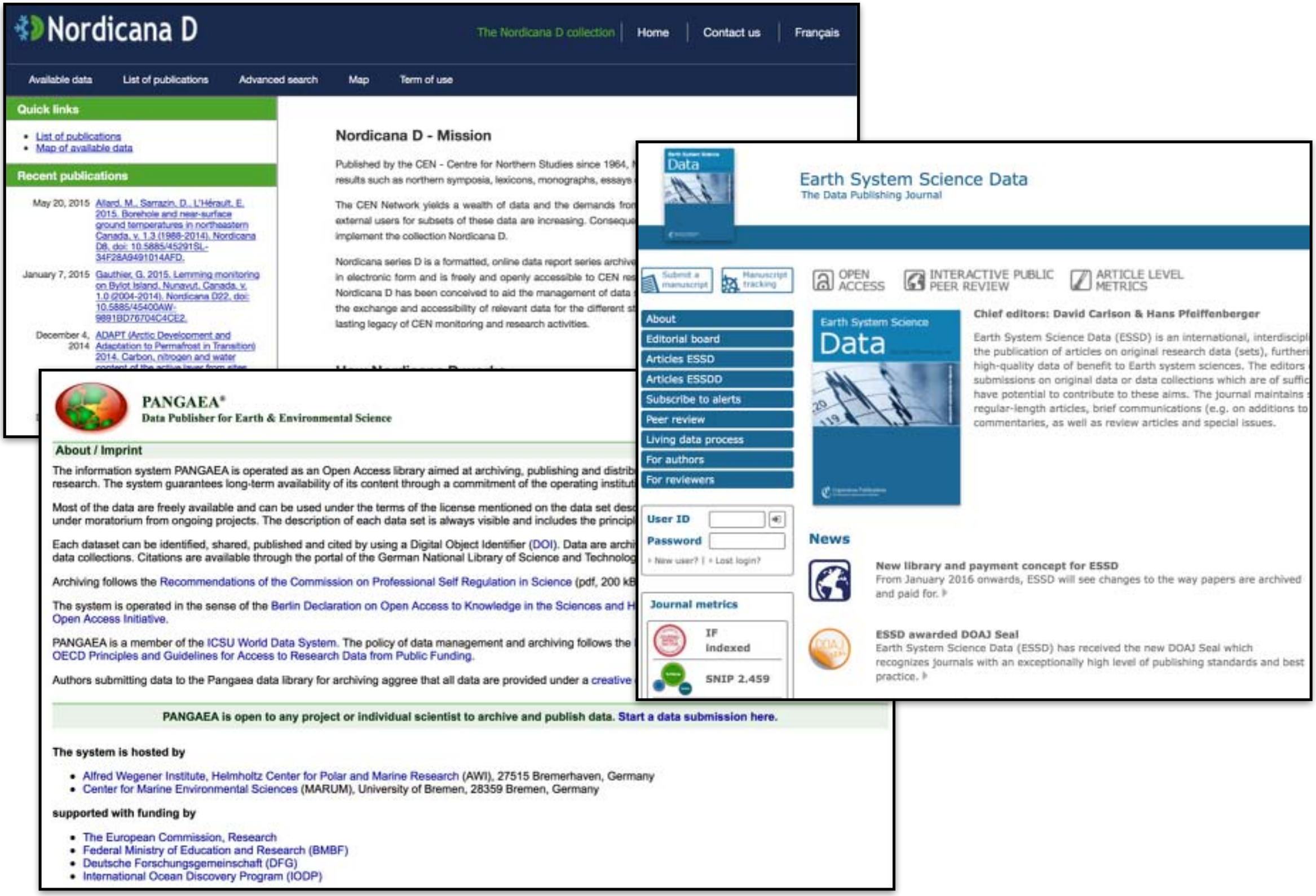
Thesis project vs. monitoring

- Researchers makes measurements to learn specific things, usually on a time scale of 1–5 years.
- Monitoring (traditionally) is aimed at long-term baselines enabling recognition and warning of change
- Selected variables deemed worthy of long-term funding
- Complementary interests, agility, and roles of:
  - researchers
  - libraries
  - governmental & inter-governmental organizations
- As more data becomes available more easily, new modes of data sharing are possible and attractive

Inventorying of meta data

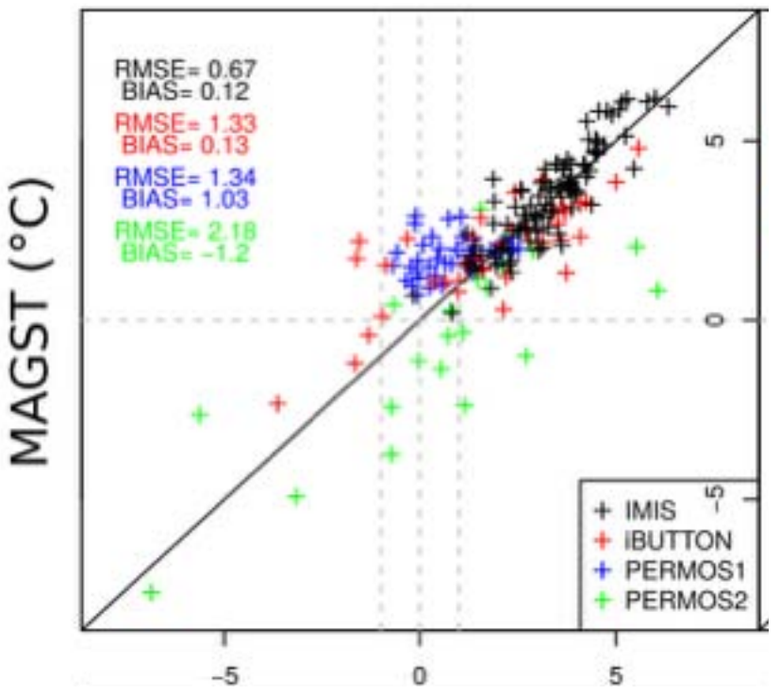


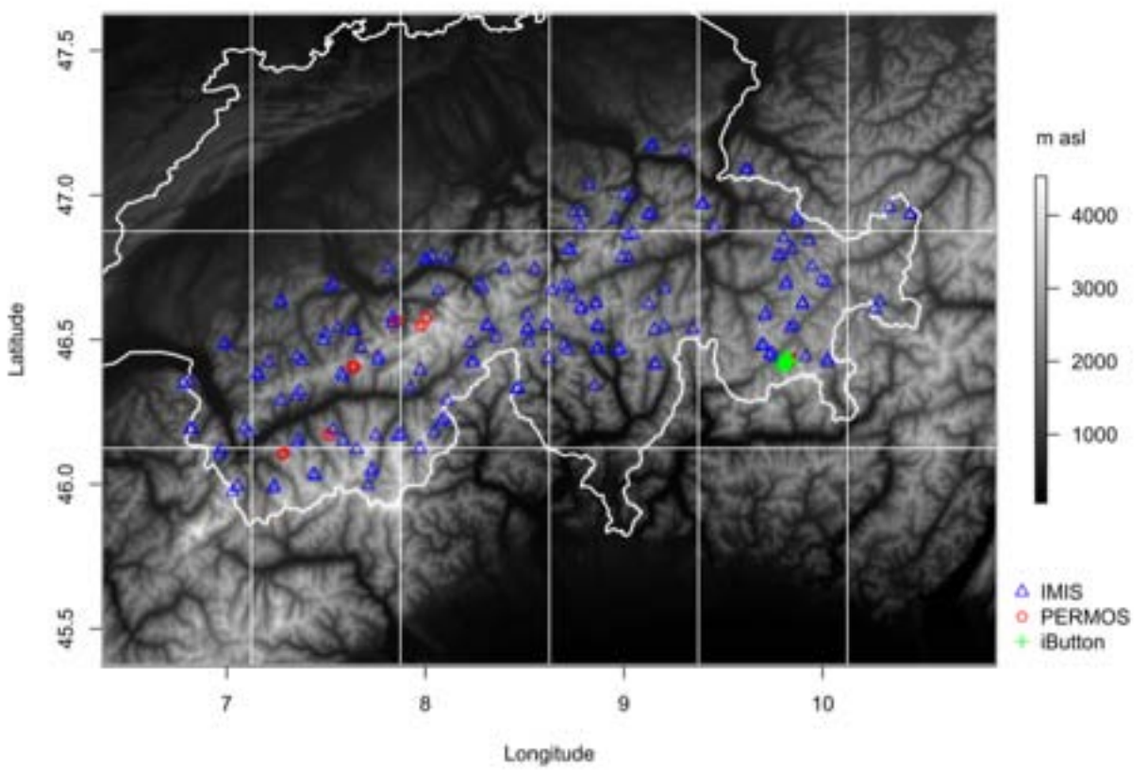
Access to individual data sets



Access to individual data sets

Coherent large data sets are valuable





- Efficiency (not possibility) of access is relevant
- Suitable for testing simulation (credibility & cherrypicking)
- Maximize value of data collected
- Motivation: input efficiency, added value, legal framework

Help researchers to work with information

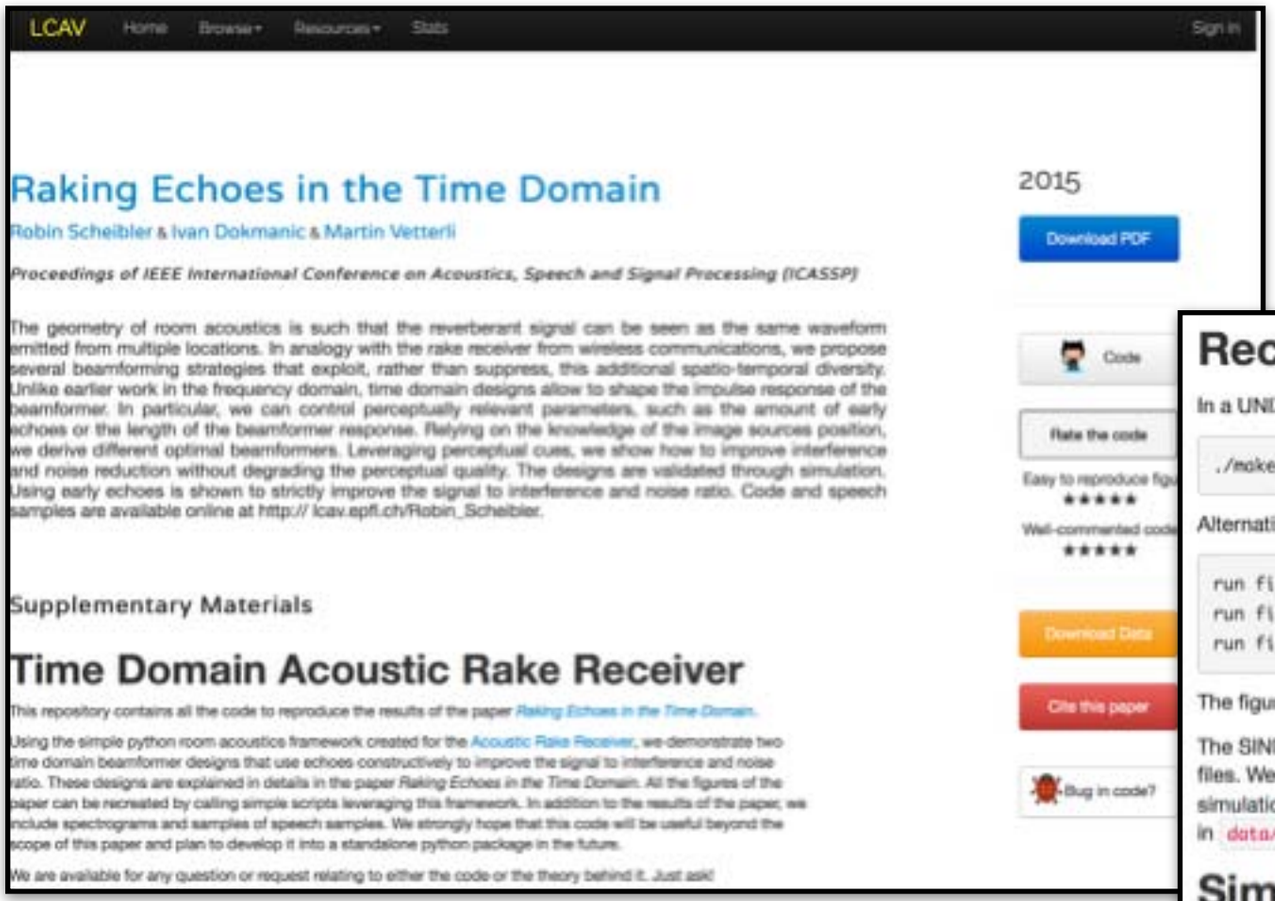
Provide infrastructure (tested and future proof):

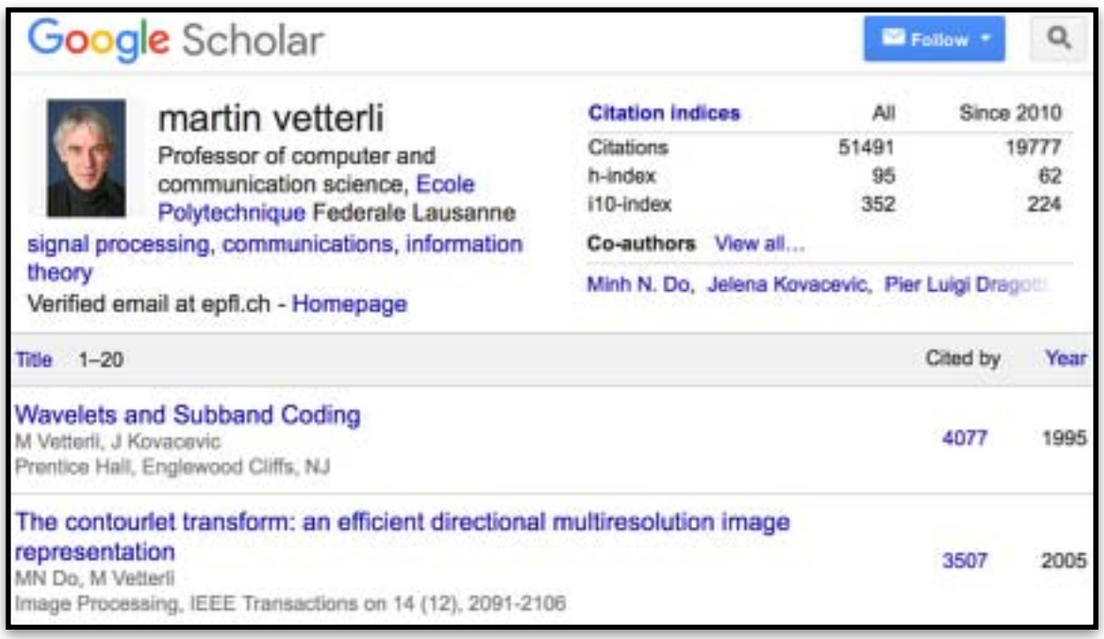
- Working disks, backup, archiving (whole lifecycle)
- Technology to interact with data
- Revision control (Git, SVN,…)
- Document & citation management (Mendeley, Zotero…)
- Documentation of methods (wiki…)
- Virtual machine and historic software archive
- Reproducible research repositories

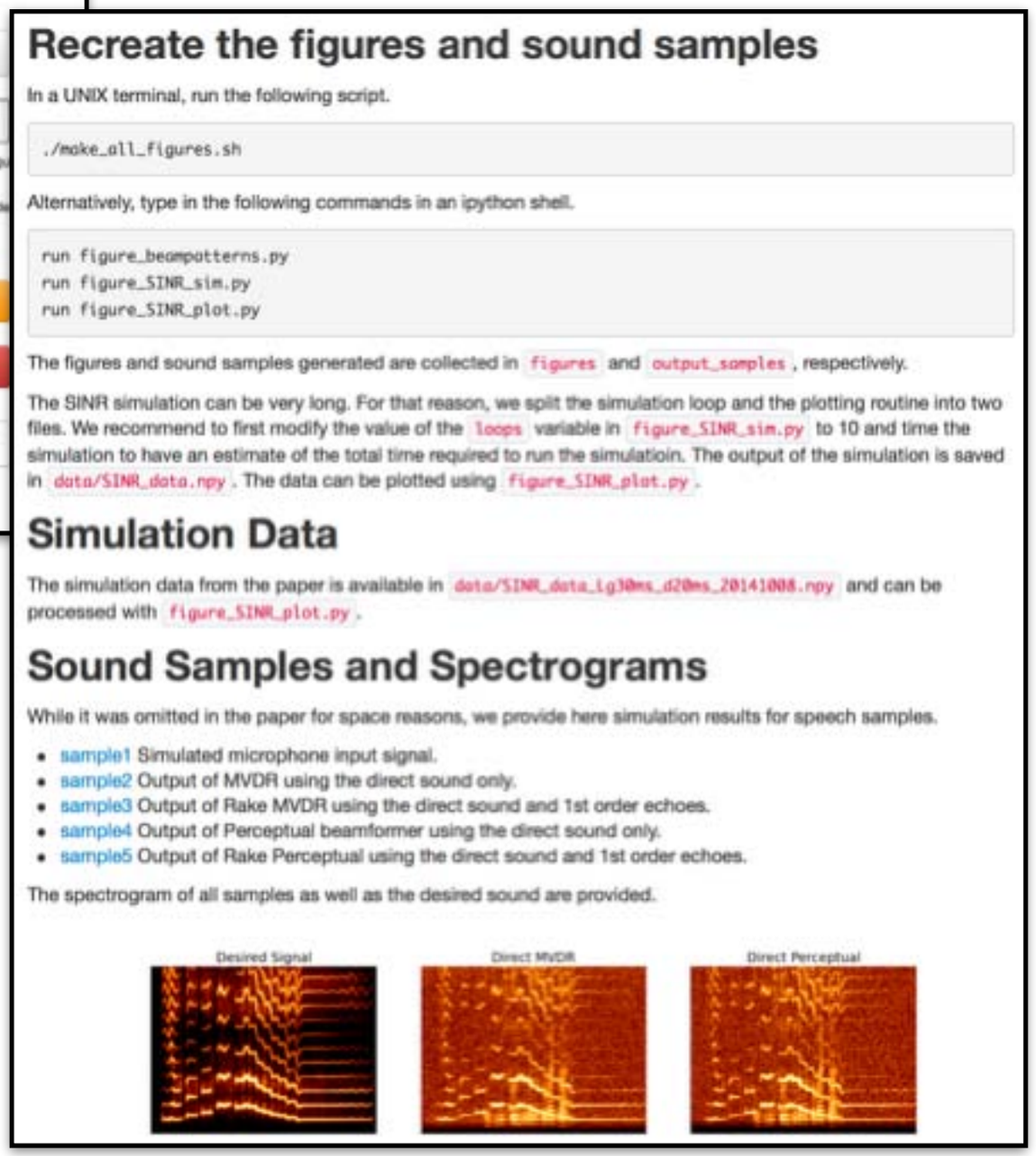
Provide training:

- Generating relevant and small data
- Using technology
- Strategy for research campaign (data management, publishing, making products available)

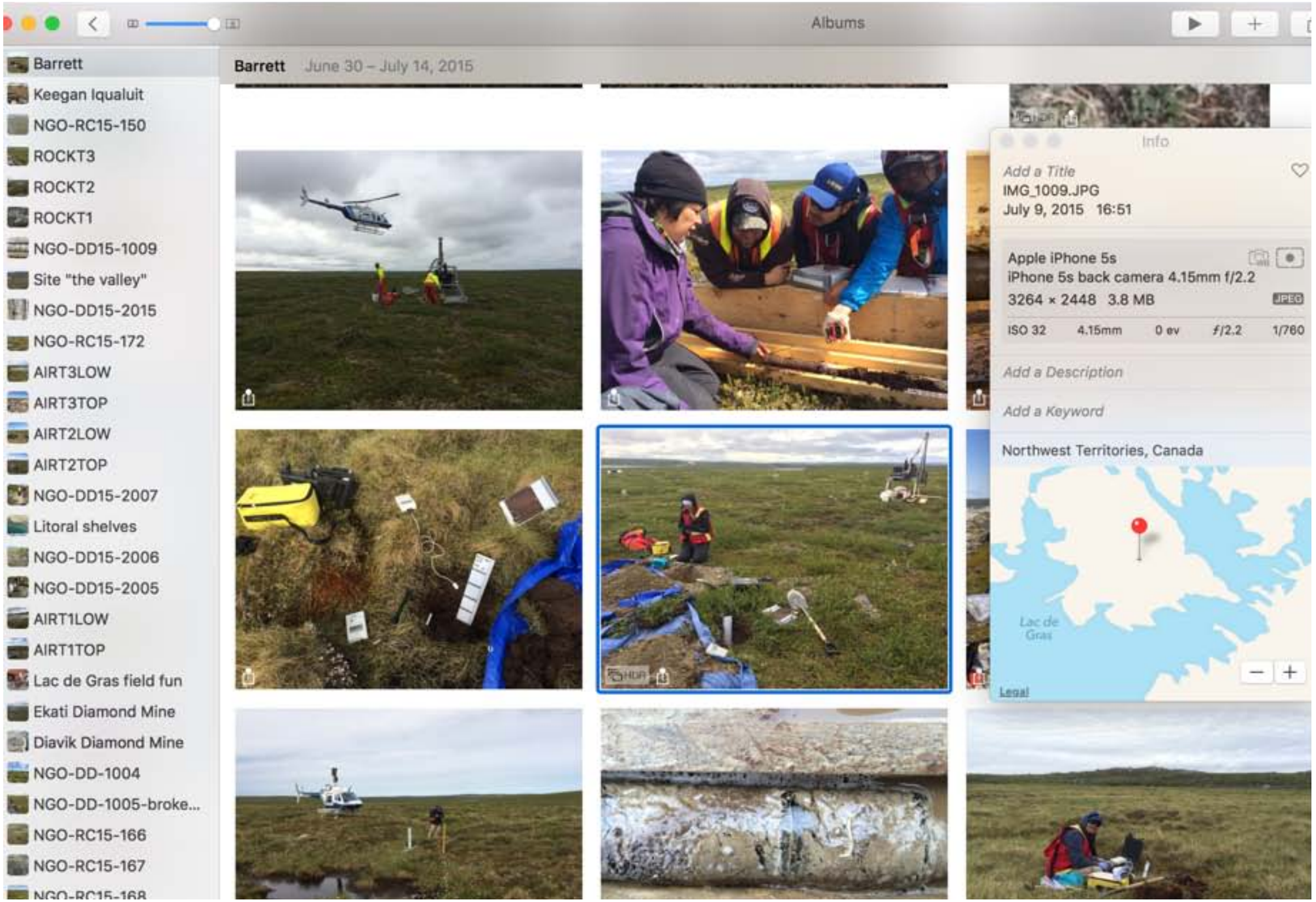
Reproducible Research

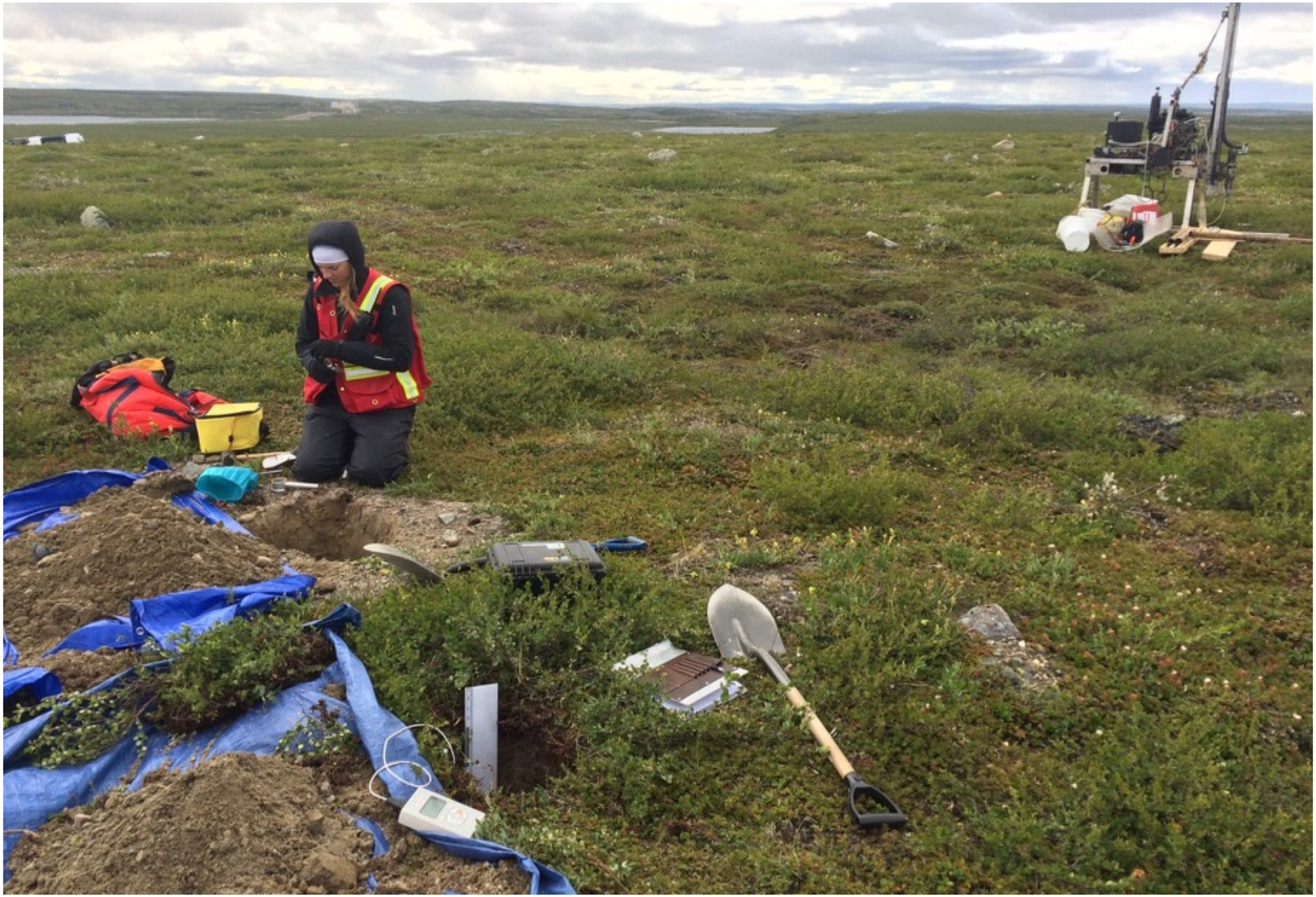






Handling field photographs



Technology to interact with data

Thank you