eScience and Computer Science

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Sensor Networks Summer School @ Semiahmoo

eScience: What is it?

- Synthesis of information technology and science.
- Science methods are changing.
- Science is being codified/objectified. How represent scientific information and knowledge in computers?
- Science faces a data deluge. How to manage and analyze information?
- Scientific communication changing.

How We Engage With An Area

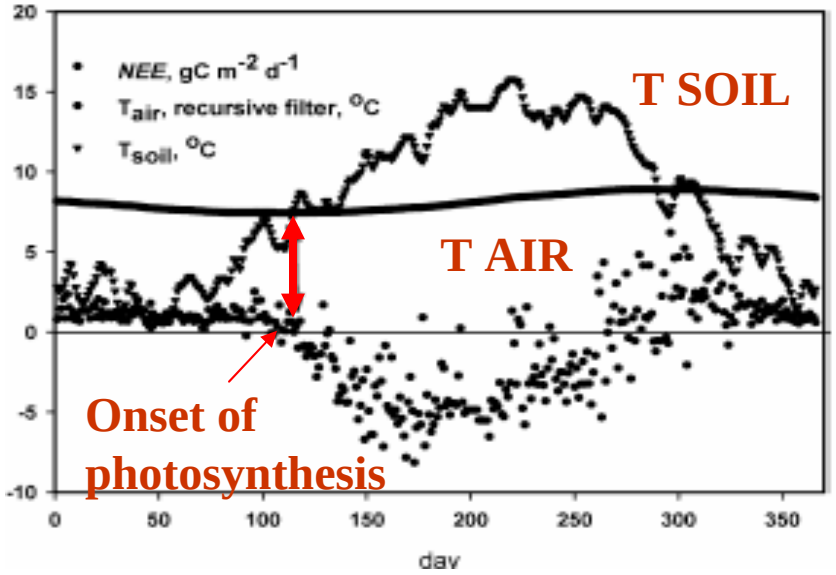
- eScience is inter-disciplinary
- We bring informatics expertise
- Process:
  1. Find someone who is desperate.
  2. Start with requirements: 20 questions
  3. Help build systems to:
     - Answer those questions faster
     - Answer new questions.
  4. Long-term and deep collaborations

Water is Different

- Water crosses disciplines
  - Engineering, geology, natural resources, physical science, climate,
  - USBR, USGS, Army Corps, DWR, 200+ local water boards
  - “we only see water through the salmon lense”
- Water data is widely distributed
  - All of the above agencies take some sort of data (including overlap, including cross hiring)
  - Lots of small (perhaps cleaned) data sets on the internet
- Water data may not be “data”
  - Water planning done at many levels with different inputs, outputs, and data terms – comparisons aren’t easy
  - Existing data often piecemeal
    – nice pictures, but not science

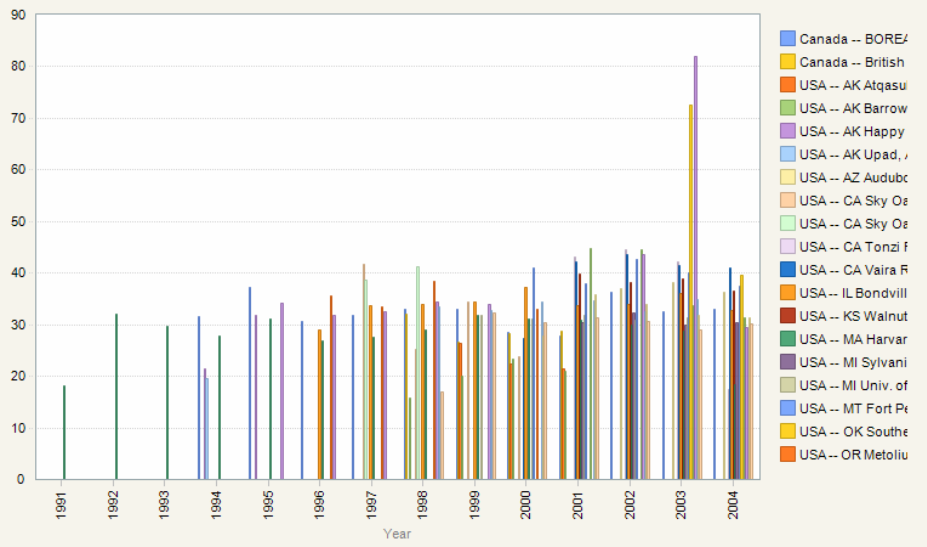
Water Collaborators

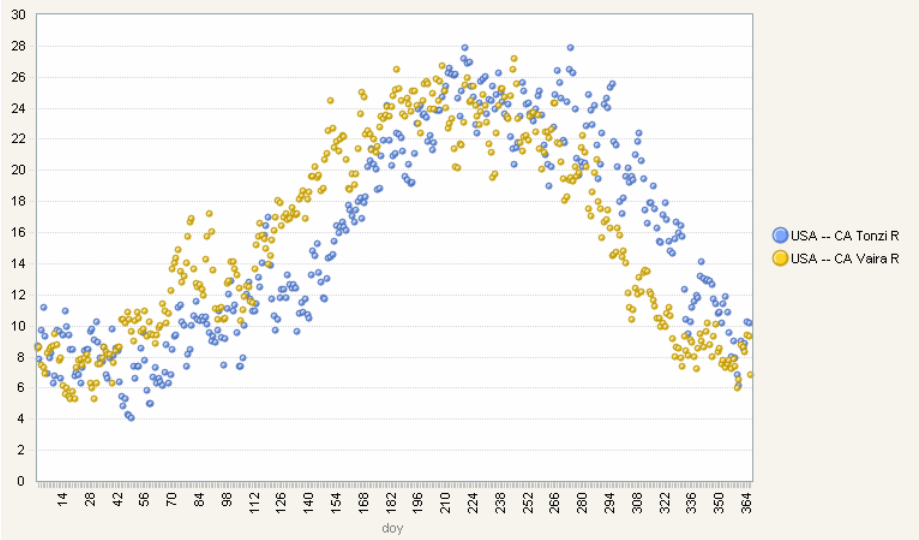
- Collaborating with Berkeley Water Center
  - Prototyping portal for Ameriflux carbon flux data
  - Now selecting water data for second generation portal
- Emerging collaboration with CUASHI HODM
  - Leverage their thinking
  - Can we come up with a common schema to allow datasets to be curated and merged at will?



What's Wrong In These Pictures?

- Visualization allows simple quality assurance sanity checks
  - We started with "clean" data after all
- Shopping for other visualization tools now to address initial science questions





Kati Szlavecz

From Raw Data to Useful Quantities

Calibrations in the Lab

Mote Resistor Calibration

Temperature Sensor Calibration

Temperature sensor
A/D units

Voltage

Resistance

Soil Temperature

Reference voltage
A/D units

Voltage

Moisture Sensor Calibration

Moisture sensor
A/D units

Voltage

Resistance

Water Deficit
Soil Matrix Potential

Light Intensity
A/D units

Air Temperature
A/D units

Temperature Conversion

Soil Water Potential-> Volumetric Conversion

CPU clock

UTC DateTime

Air Temperature
Celsius

Water Content
Volumetric

Kati Szlavecz

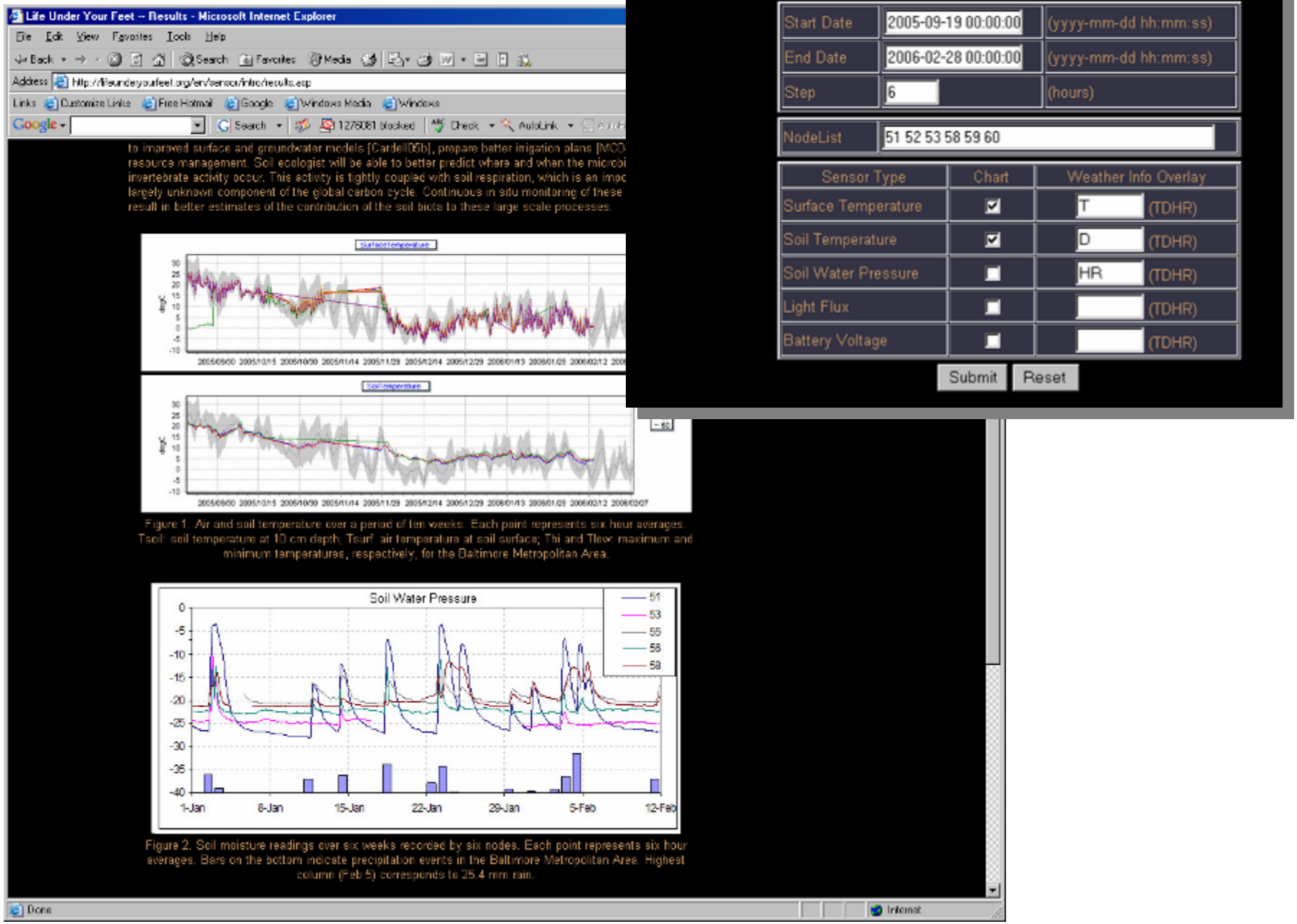
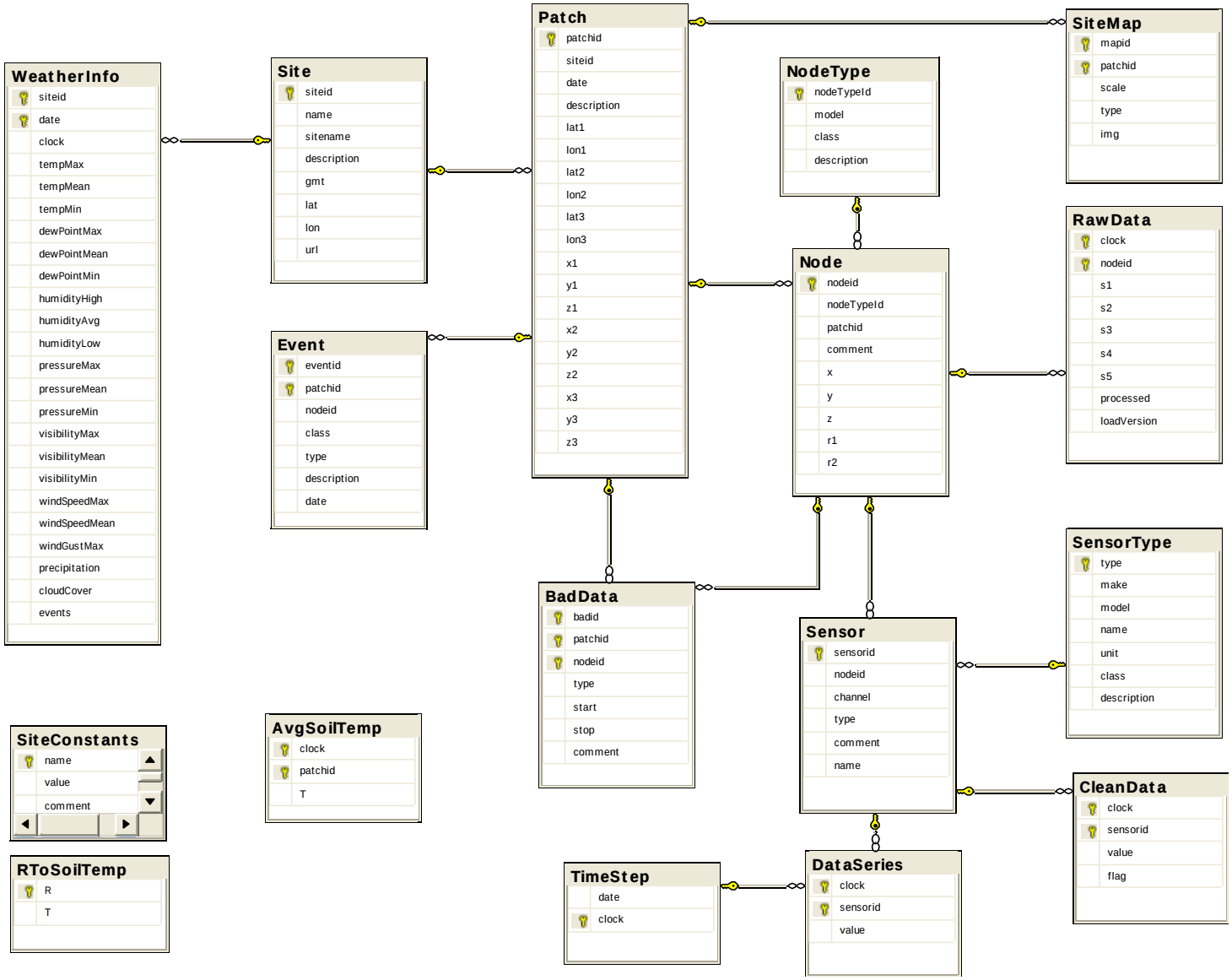
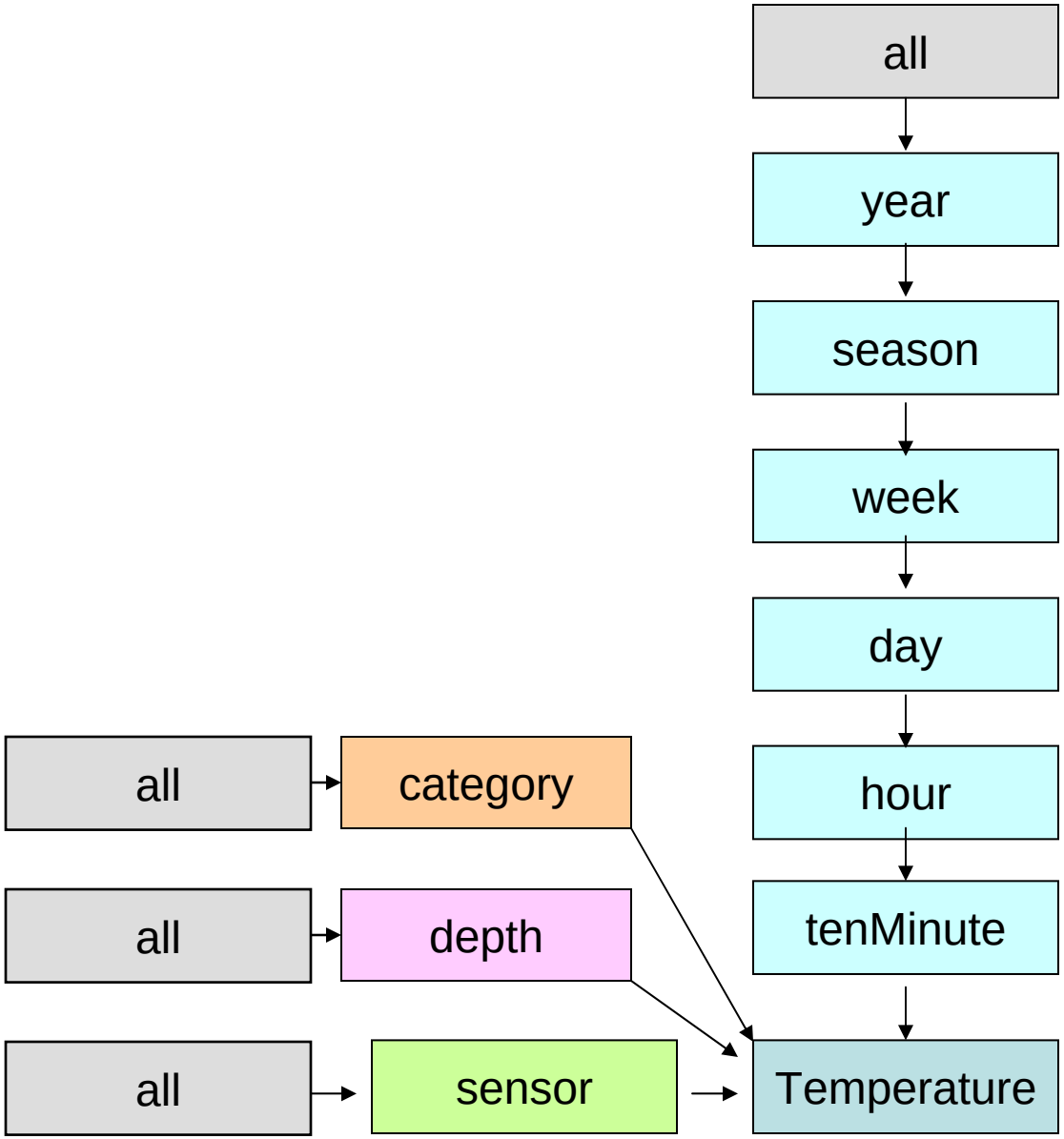


Diagram 3/6/2006



Sensor Dimension Model



Standard Sensor Queries

1. Temperature (average, min, max, standard deviation, standard error, count-missing)
   for a particular time or interval (e.g. when animal samples are taken)
   10-minute, hour, day, week, season, year, all
   (s1) for one sensor
   (s2) for a patch (sensor and its immediate neighbors
   (s3) all sensors at the site
   (s4) all sites

   vs depth (air, surface, 10cm, 20cm, 50cm)

   vs time
   (t1) 10 minute
   (t2) hour
   (t3) day
   (t4) week
   (t5) season
   (t6) year
   (t7) all time

   or vs By Day
   (d1) 10 minute
   (d2) hour
   (d3) day
   (d4) allDay

   or vs By Season
   (s1) 10 minute
   (s2) hour
   (s3) day
   (s4) week
   (s6) allSeason

   vs category
   land use,
   land cover,
   age of vegetation,
   crop management type,
   upslope, downslope,
   etc
2. Look for unusual patterns, outliers: a mote behaving differently, unusual spike, etc.
3. Look extreme events: e.g. rainstorm, people watering their lawns, etc.
   And show data in time-after-event coordinates
4. Correlate with another dataset (e.g. with weather data, the CO2 flux tower data, runoff data, etc)
5. Visualizethe habitat heterogeneity, preferentially in 3-D integrated with maps (e.g. 3-D with LIDAR maps, 2-D with vegetation data, animal density data, etc.)
6. Notify me if the data has unexpected values (this is the “real time” thing),
   sensors might be damaged, and need to be checked, etc.