SensorBase.org

A Centralized Repository to Slog Sensor Network Data

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Outline

- SensorBase.org overview
- User interface and implementation
- Applications of SensorBase.org repository data
- Future of SensorBase.org

SensorBase.org overview

- Similar to blogging sites, SensorBase.org is a *slogging* site that allows users to log sensor network data.
- Blog user interfaces (e.g. Blogger, WordPress) are very user-friendly; users can publish, delete, and set permissions on entries with little effort. We wish to create a similar interface and backend for slogging.
- Blog entries can be categorized and RSS is generated on the fly for easy notification and syndication.
- This is much the aim of SensorBase.org-- to be a user-friendly slogging tool for publication of data that makes it easy to share, collaborate, and notify via a variant of RSS, Numerical RSS (NRSS, nrss.org).

User interface and implementation

- To publish data, a user first creates a *sensor network project* which is a bit like categories in blogs.
- Data can be uploaded via XML and published to a project.
- Published data can be searched for with the SensorBase search engine; the search engine accepts queries that are a cross between natural language and SQL.
- Data can be retrieved as easy-to-parse XML or as a user-favorite, comma-delimited text.

Almighty Root [root] | Personal Info | Sign-out

Create a new sensor network project

creating a new proj -> create a new table -> create key(index) -> create relationships -> publish data

Short project name (to be used in search):

Project Description:

USPS address:

North/west bound coordinate ("top left" in lat,long or y,x): ,

South/east bound coordinate ("bottom right" in lat,long or y,x): ,

Min/max true MSL altitude in **meters**: to

Data read permission for any user: Allow Deny

Data write permission for any user: Allow Deny

Data read permission for all users in the group: Allow Deny

Data write permission for all users in the group:: Allow Deny

Submit

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Publish sensor data using XML

1. Local Data File: Choose File no file selected
2. Overwrite existing data with the same primary key: Yes No, skip
3. Output verbose warnings: Yes No
4. Return status format: Text HTML
5. Publish data

(click here to upload binary directly)

Sample data file format:

```
<sensorbase_xml>
 <project project_id="5">
  <!--data datetime="fufu" location_id="203"/-->
  <data datetime="2003-01-01" location_id="202"><celsius></celsius></data>

  <data datetime="1136945702" location_id="202">
   <relative_humidity>17</relative_humidity>
   <raw_humidity>38254</raw_humidity>
  </data>
  <data datetime="1136945702" location_id="202"><celsius>18</celsius></data>
  <data datetime="1136945702" location_id="202"><raw_voltage>2323</raw_voltage></data>
  <!-- unparsed human readable comments here -->
  <location location_id="5"><x>33.232</x><y>-118.2325</y></location>
  <location location_id="203"><x>33.235</x><y>-118.2388</y></location>
 </project>
</sensorbase_xml>
```

Nathan Yau [nyau@stat.ucla.edu] | Personal Info | Sign-out

Manage projects

Project Name (project_id)	Details
the greatest project ever (8) this is the absolute greatest project ever created Modify	**Project tables (2):** data, location **Unique attribute types (12):** celsius, datetime, description, elevation, humidity, location_id, raw_humidity, raw_temperature, raw_voltage, voltage, x, y **Address:** 1603 Granville ave, 90025
second greatest project (9) this is the second greatest project ever, second only to the first. Modify	**Project tables (4):** another_test, data, location, testing **Unique attribute types (15):** blah, celsius, datetime, description, elevation, humidity, id, location_id, raw_humidity, raw_temperature, raw_voltage, voltage, whatever, x, y **Address:** ucla, 90095

Project Summary

< View my other projects

the greatest project ever (8)

this is the absolute greatest project ever created

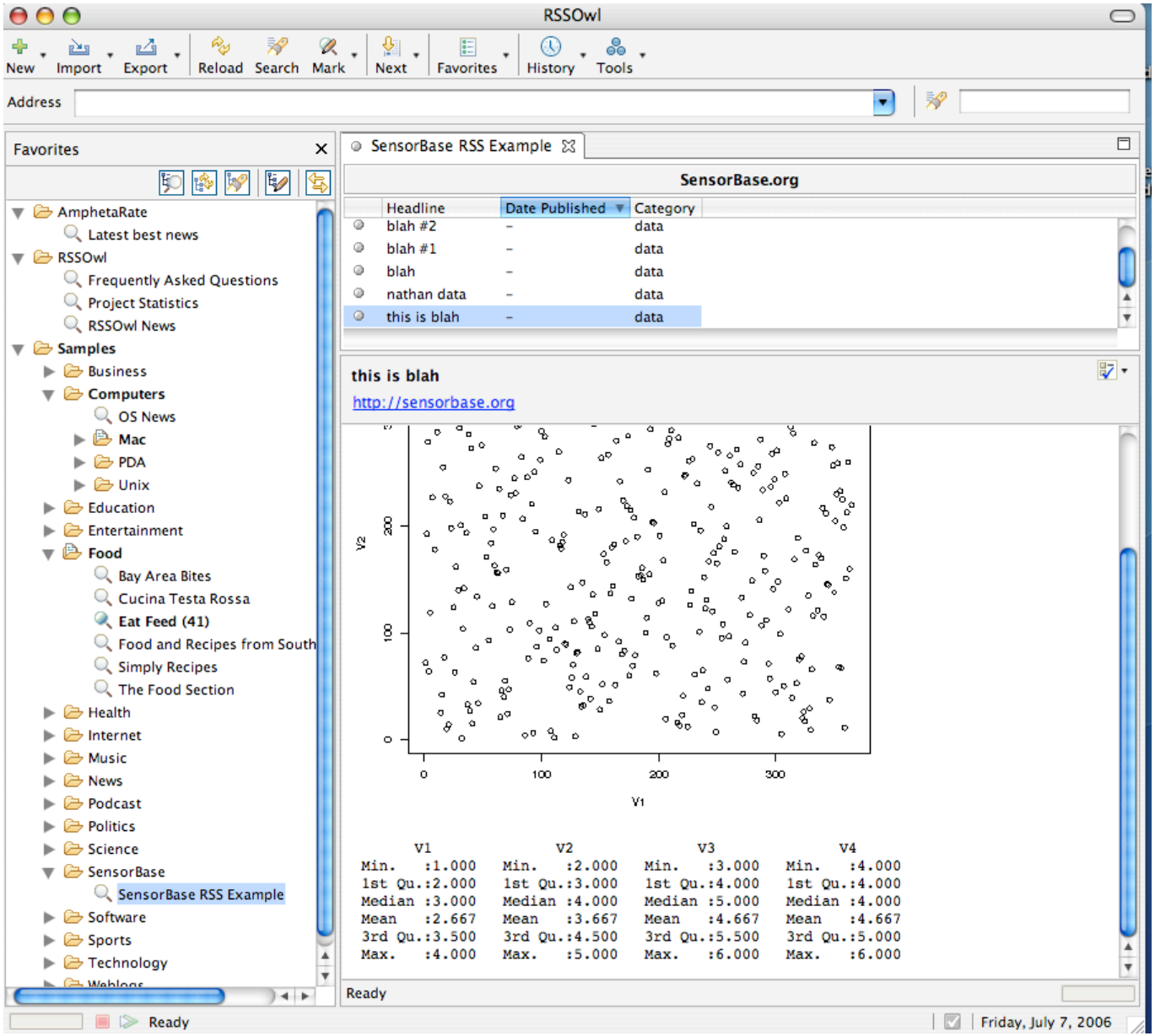
[Tags]

This project is centered at **1603 Granville ave, 90025**.

Project members can read and can write project data.
Those who are not project members can read but cannot write project data.

RSS DATA

Table name	Attributes
data the greatest data that ever existed.	**datetime** (`datetime`) This is the *measurement* date and time **location_id** (`int`) This 'links' back to location.location_id **raw_temperature** (`int`) Raw temperature **celsius** (`float`) Actual celsius value **raw_humidity** (`int`) Raw uncalibrated humidity **humidity** (`float`) Calibrated humidity **raw_voltage** (`int`) Raw uncalibrated voltage **voltage** (`float`) Calibrated voltage PRIMARY KEY (`datetime`,`location_id`)
location greatest locations in the world.	**location_id** (`int`) Unique identifier of the location **description** (`text`) my apartment **x** (`float`) GPS x **y** (`float`) GPS y **elevation** (`float`) Elevation in meters PRIMARY KEY (`location_id`)



SensorBase.org

User interface and implementation

- Not getting into too many details, SensorBase.org is powered by PHP and a MySQL database.
- A new table(s) is created in the database each time a new sensor network project is created.
- User-defined tables removes the problem of attempting to create a universal data table that could hold all types of data.
- “Natural language” queries are parsed using regular expressions and corresponding SQL statements are sent to the database to find data sets.

XML

```
<fieldList>
 <field><name>_datetime</name><type>datetime</type></field>
 <field><name>_user_id</name><type>int</type></field>
 <field><name>datetime</name><type>datetime</type></field>
 <field><name>location_id</name><type>int</type></field>
 <field><name>raw_temperature</name><type>int</type></field>
 <field><name>celsius</name><type>real</type></field>
 <field><name>raw_humidity</name><type>int</type></field>
 <field><name>relative_humidity</name><type>real</type></fiel
 <field><name>raw_voltage</name><type>int</type></field>
 <field><name>voltage</name><type>real</type></field>
</fieldList>
<result>2006-06-16 16:30:55,1000,2006-05-10 00:01:13,78,2629,
<result>2006-06-16 16:30:55,1000,2006-05-10 00:02:49,68,2445,
<result>2006-06-16 16:30:55,1000,2006-05-10 00:03:40,9,2590,6
<result>2006-06-16 16:30:55,1000,2006-05-10 00:03:43,158,2589
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<result>2006-06-16 16:30:55,1000,2006-05-10 00:13:40,9,2591,6
<result>2006-06-16 16:30:55,1000,2006-05-10 00:13:43,158,2582
<result>2006-06-16 16:30:55,1000,2006-05-10 00:13:54,10,2573,
<result>2006-06-16 16:30:55,1000,2006-05-10 00:16:14,78,2636,
<result>2006-06-16 16:30:55,1000,2006-05-10 00:18:41,9,2595,6
<result>2006-06-16 16:30:55,1000,2006-05-10 00:18:43,158,2590
<result>2006-06-16 16:30:55,1000,2006-05-10 00:21:14,78,2636,
```
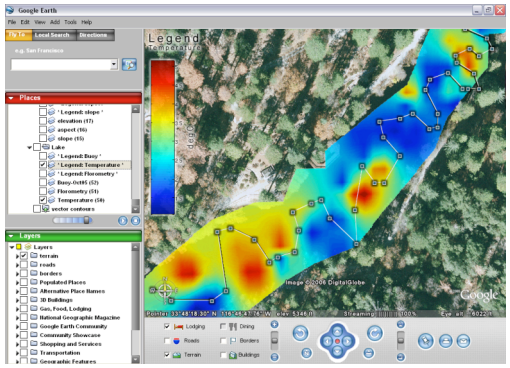
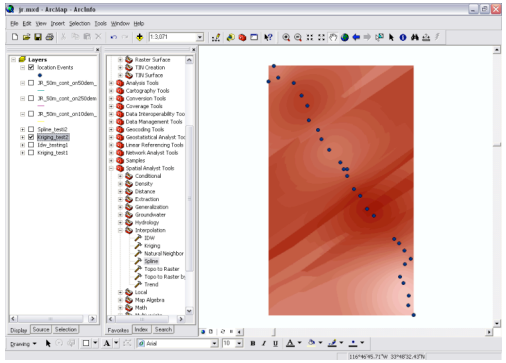

Text

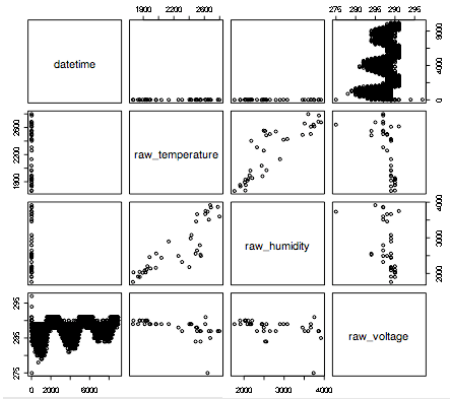
```
field:
 name:celsius
 type:real
field:
 name:raw_humidity
 type:int
field:
 name:relative_humidity
 type:real
field:
 name:raw_voltage
 type:int
field:
 name:voltage
 type:real
result:2006-06-16 16:30:55,1000,2006-05-10 00:01:13,78,2629,
result:2006-06-16 16:30:55,1000,2006-05-10 00:02:49,68,2445,
result:2006-06-16 16:30:55,1000,2006-05-10 00:03:40,9,2590,6
result:2006-06-16 16:30:55,1000,2006-05-10 00:03:43,158,2589
result:2006-06-16 16:30:55,1000,2006-05-10 00:03:54,10,2572,
result:2006-06-16 16:30:55,1000,2006-05-10 00:06:14,78,2630,
result:2006-06-16 16:30:55,1000,2006-05-10 00:08:40,9,2595,6
result:2006-06-16 16:30:55,1000,2006-05-10 00:08:43,158,2589
result:2006-06-16 16:30:55,1000,2006-05-10 00:08:54,10,2576,
result:2006-06-16 16:30:55,1000,2006-05-10 00:11:14,78,2635,
result:2006-06-16 16:30:55,1000,2006-05-10 00:13:40,9,2591,6
result:2006-06-16 16:30:55,1000,2006-05-10 00:13:43,158,2582
result:2006-06-16 16:30:55,1000,2006-05-10 00:13:54,10,2573,
result:2006-06-16 16:30:55,1000,2006-05-10 00:16:14,78,2636,
```

Applications of repository data

- Google Earth
- Mapping data with ArcGIS
- Images as data
- Analysis and visualization with R







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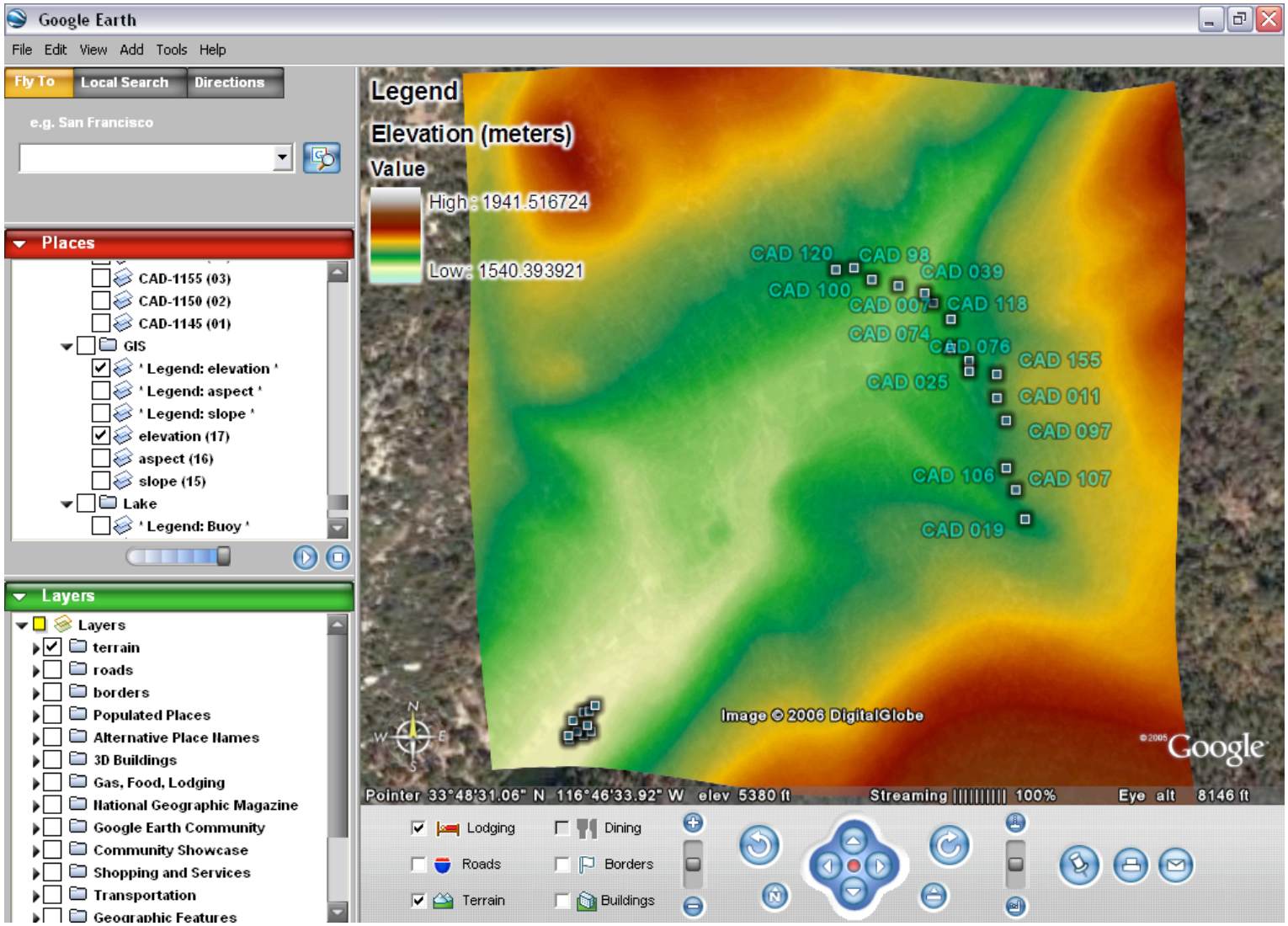

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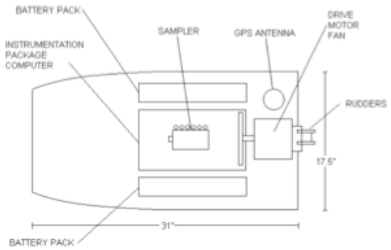
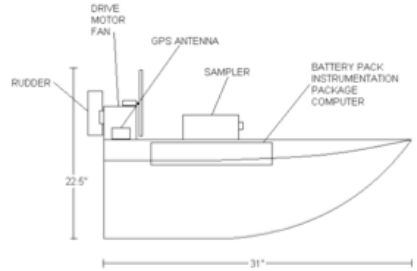
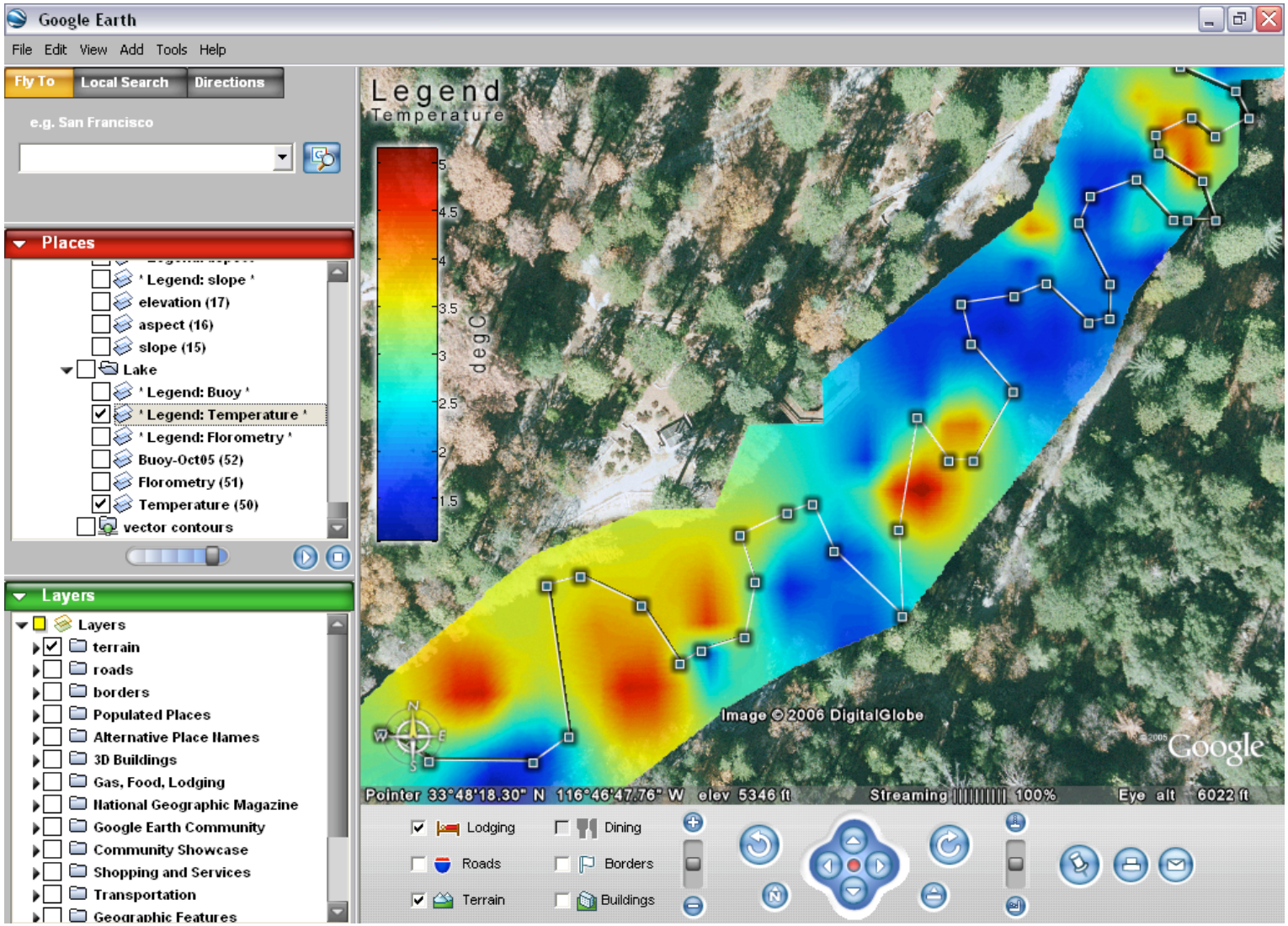
Google Earth and Roboducks

- Roboduck (robotic air boat) networks were deployed with a goal to track brown-tide algal blooms and follow their migration over time.

- Additional features which govern their abundance and survival in an area include temperature, nutrient concentrations, etc. which were monitored over time (Gaurav Sukhatme, USC).







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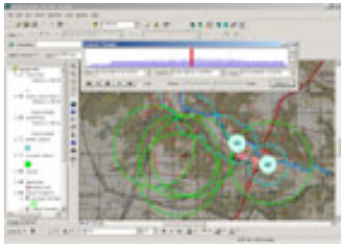
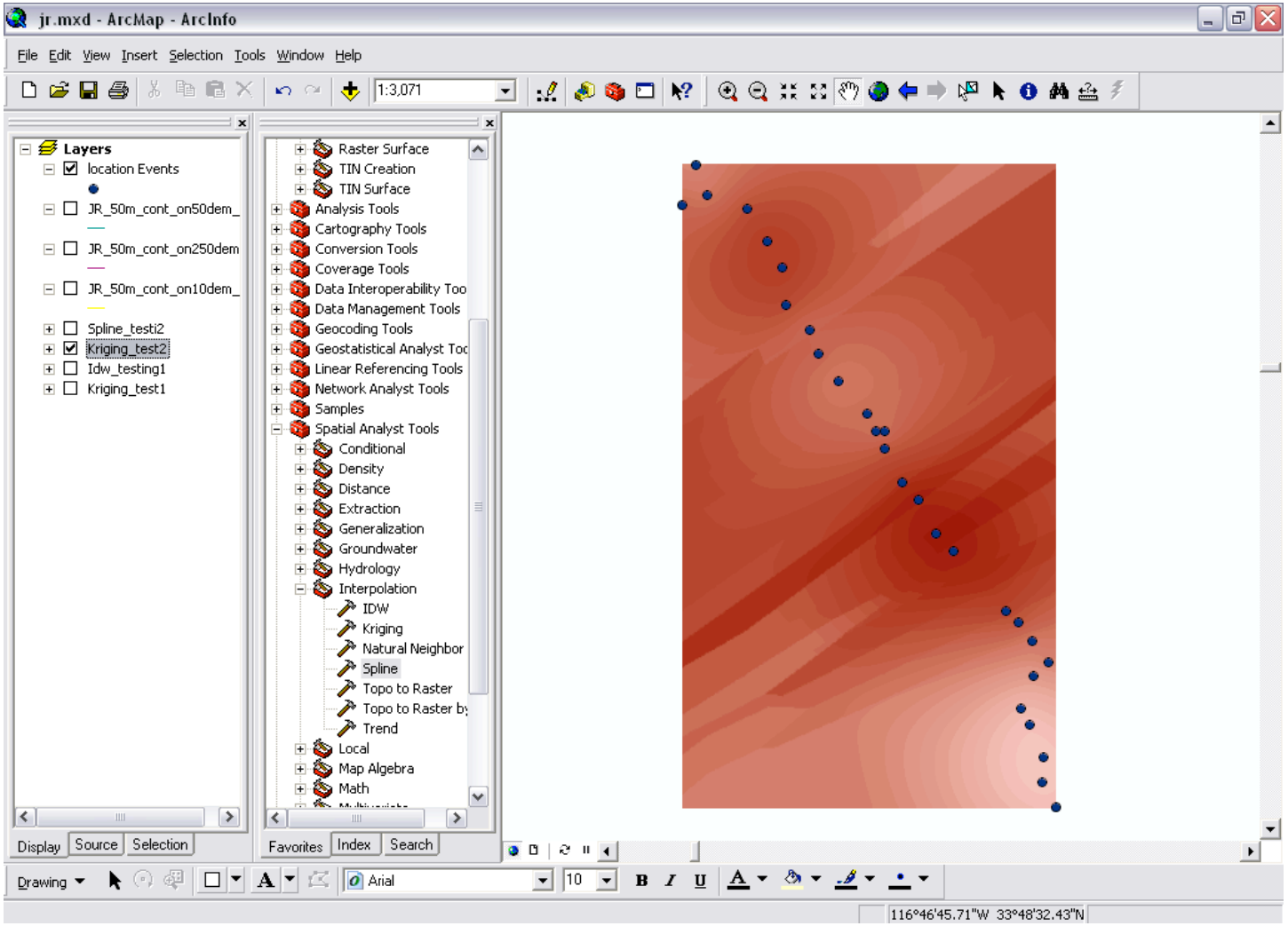
Mapping data with ArcGIS

- ArcMap is a powerful mapping tool by the Environmental Systems Research Institute (ESRI) with 3D, spatial, and tracking analysis extensions.





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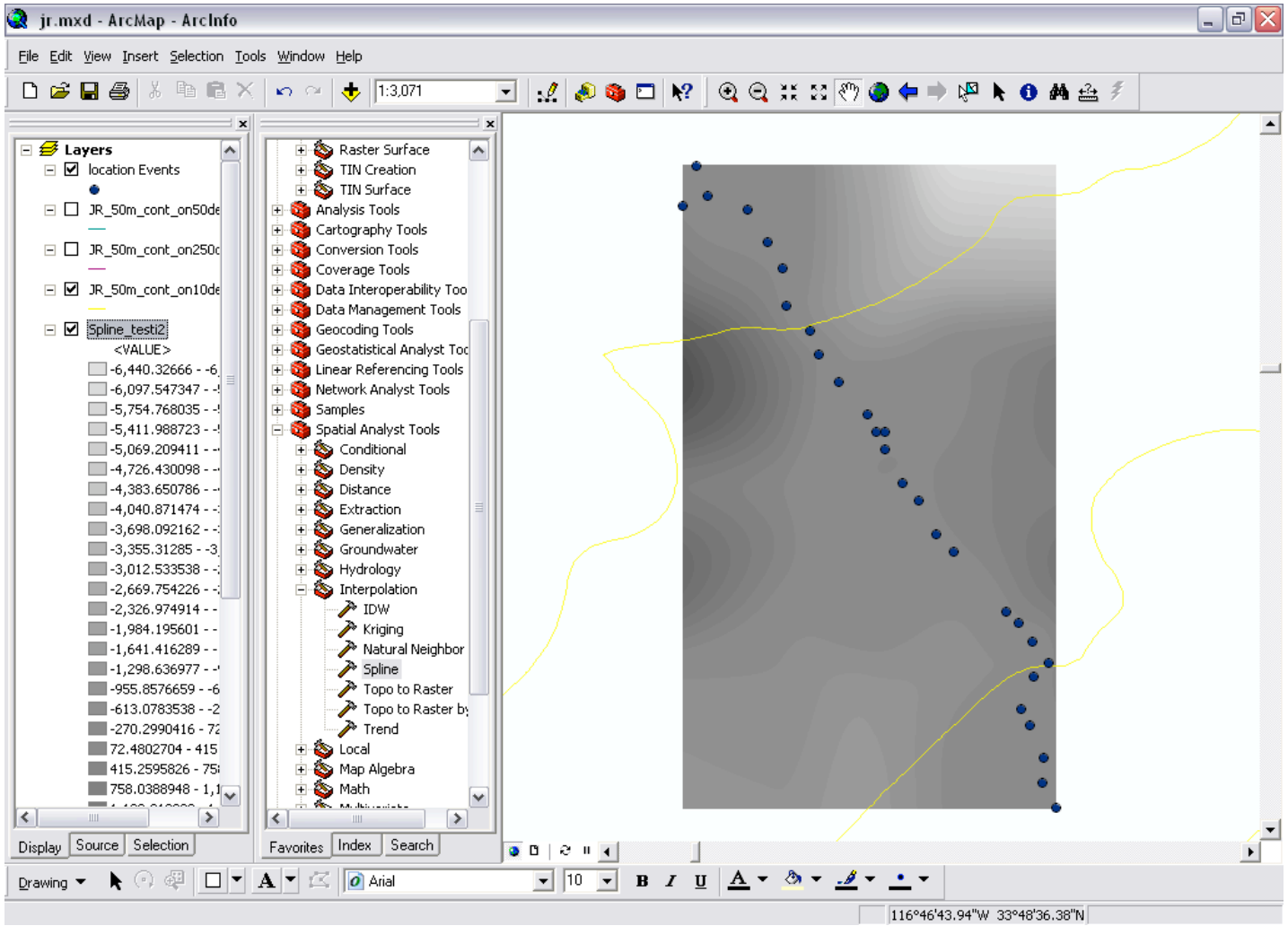
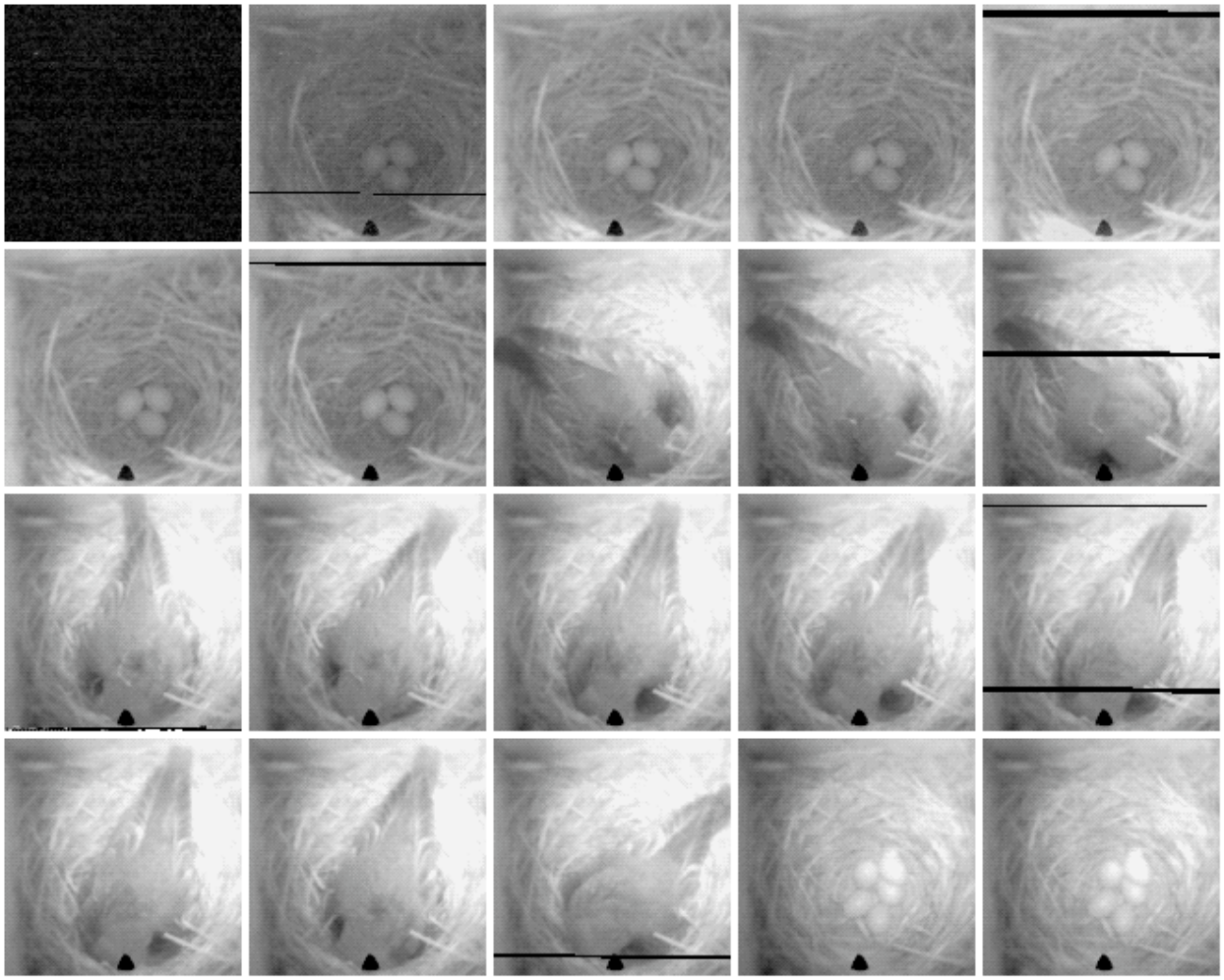
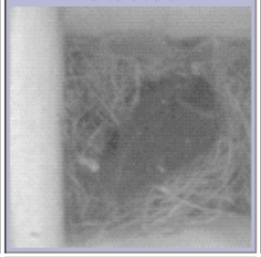
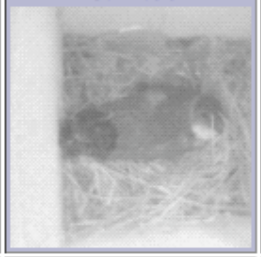
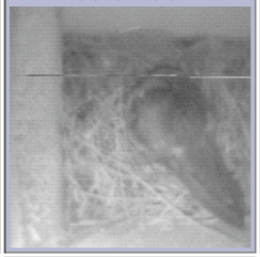
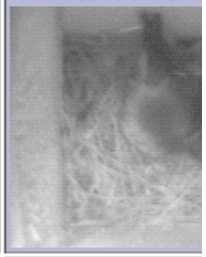
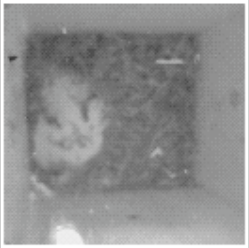
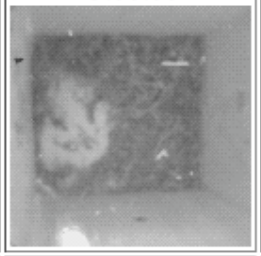
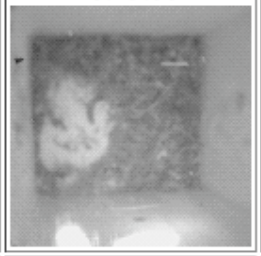
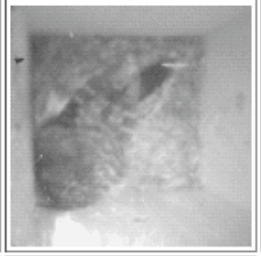
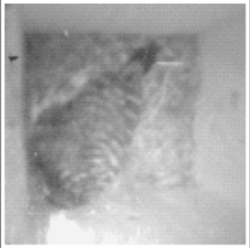
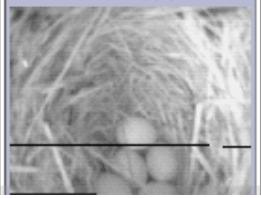
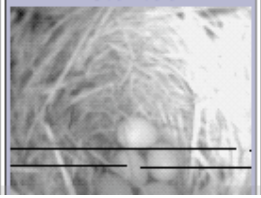
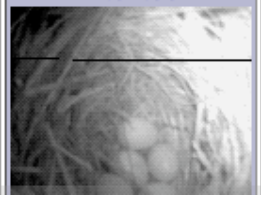
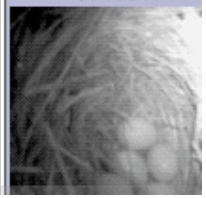


SensorBase.org



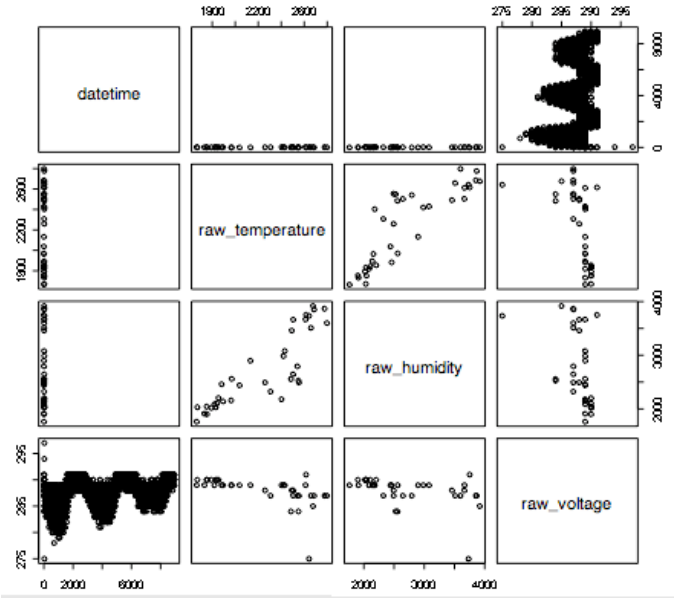
Mohammad Rahimi

Average celsius / relative humidity / voltage from JR CAD	22.15C 34.31% 2.83v	21.77C 30.68% 2.81v	15.47C 66.18% 2.78v	8.94C 74.83% 2.78v	7.22C 72.04% 2.79v	6.37C 67.63% 2.78v
location_id = **2**	2006-06-14 12:04:00 	2006-06-14 15:00:00 	2006-06-14 18:12:00 	2006-06-14 21:08:00 	2006-06-15 00:04:00 	2006-06-15 03:00:00 
location_id = **4**	2006-06-14 12:04:00 	2006-06-14 15:00:00 	2006-06-14 18:13:00 	2006-06-14 21:09:00 	2006-06-15 00:05:00 	2006-06-15 03:01:00
location_id = **10**	2006-06-14 12:14:00 	2006-06-14 15:16:00 	2006-06-14 18:01:00 	2006-06-14 21:02:00 	2006-06-15 00:04:00 	2006-06-15 03:05:00 

Analysis and visualization with R

- R is a language and environment for statistical computing and graphics. It is a GNU project which is similar to the S language which was developed at Bell Labs by John Chambers (R-project.org).

```
                datetime    raw_temperature
2005-07-05 21:33:49:   3   Min.   :1665
2005-07-05 23:16:22:   3   1st Qu.:1852
2005-07-06 02:46:22:   3   Median :2356
2005-07-06 10:05:53:   3   Mean   :2237
2005-07-06 11:38:40:   3   3rd Qu.:2551
2005-07-06 12:07:58:   3   Max.   :2798
(Other)            :9982   NA's   :9964
 raw_humidity   raw_voltage
Min.   :1763   Min.   :275.0
1st Qu.:2132   1st Qu.:287.0
Median :2511   Median :289.0
Mean   :2719   Mean   :288.1
3rd Qu.:3473   3rd Qu.:289.0
Max.   :3919   Max.   :297.0
NA's   :9964
```



Future of SensorBase.org

- Rule-based NRSS notifications using the R language.
- Refined query-handling for a more powerful data search engine.
- Applications built on top of SensorBase.org using such tools as Google Maps, ArcIMS.
- More extensive and useful visualization of environmental data.

Thank you.