Wireless sensor networks North East Research NEtwork (NERC) And LTER SensorNIS

1. temp acoustic sound optical specific ion detectors
2. Acute detection early warning
3. education and outreach
4. goals
   1. NERC
      1. web clearing house for WSN info
      2. Regional WSN for early detection of environmental change
   2. white paper: best practices
   3. MUTUAL
      1. Manuscript streaming
5. Safety:Ian
6. Talks session 1
   1. NY Adirondak ecological center like hubbard brook. 100 years. Some USGS stuff All Campbell
   2. Dave Hollinger forest service 17 towers measuring mostly carbon flux Mostly Campbell
      1. flux tower sensor->datalogger->loggernet (Originally RS232 and PC208 software)
      2. Tower moiunted 802.11 access point and wireless bridges. the bridges go ~2km 5 pc computers 9 dataloggers webcam MISC:!!! Network Timebase \*\*\* to keep them in synch

.

* + 1. connection: Originally, satellite... Starband, switched to Hughsnet 3g coverage is now available from Verizon

Comnputers remote accessed using TEAMVIEW (formerly UltraVNC)

FLING: Windows freeware. JMW MUST HAVE for vicky Kelly

* 1. Will Wollheim Aquatic sensors at PIE
     1. urban storm signal channel floodplain attenuation of signal
     2. N inputs to an N impaired bay
     3. Urban watershed - suburban Boston
  2. LTER: Don Henshaw AND snow depth temperature gage height 1995 Campbell radio 151mH sow but worked then 900mH stuff for tower experiments acoustic recorders then a grant to move the ethernet out into the forest (doesnt say what equipment) 5.8gH backbone with 900mH links up and down it what's teh distance to Roswell mountain tower???
  3. LTER: Porter data path:
     1. Wells-> relay tower->ethernet->ireless->
     2. how to improve? Sensor management gap filling range checks compare with nearby systems
  4. LTER: Colrinna NTL Wisc buoys with sensors 140 sensor streams when you add them all up buoys times sensors
     1. components summary sensors on buoys data loggers comm between loggers/station middlewae for streaming sys mon tools databases data access tools
     2. data streaming Ziggy - custom built for GLEON Data turbine - not custom
     3. sensors->data transmission->data turbine->storage

1. Talks session 2
   1. NEON Jeff Taylor Otter airplanes with LIDAR, spectrometer and cameras 3 planes. One reserved as a "target of opportunity" use 10 mobile deployment platforms. Towable to a specific location
   2. CUASHI Rick Hooper Whisky/Kisters BES is using them Why build custom software if its available off the shelf Point Observations Information Model
   3. USGS: Pete Murdoch Losing gages we have a new congress USGS climate effects network terminated this April NOAA Climate services slated to be eliminated
      1. What can we do? Think about co-location of sensors
      2. Solving the data chalklenge Need: linked interdisciplinary data (ten more bulets) people retire, stations gert shut off. Data gets lost. Filing cabinets moved to the barn. "Integrate the integration efforts" EG Cuashi/NEON doing same thing, danger od data sets being disparate...
2. talks session 3 Sensor Science hosted by Lindsay Rustad
   1. Sensor Science: Emery Boose
      1. Provenance for sensor networks
      2. how to make data reproducible
      3. data derivation graph audit trail of a single execution of a proess
      4. how to get different workflow programs to talk to each other. e.g. Kepler, Little JIL, Taverna
   2. Dan Dickenson FCE - Long term acoustical and meteorologicla monitoring
      1. We want this guy for the link between art and science in urban ecology Happy to help host
      2. Glades box

measues one year of sound in the Everglades. Alerts you to sound events athat are out of the ordinary (so you dont have to listen to it all)

Thermometer microphones anemometer wind vane light sensor humidity sensor

* + 1. Analysis is done by graphing "Novelty" curve using RMS and central centroid
    2. Tell Jonathan the third derivitive is the novelty of the novelty
  1. Survey results and analysis

1. Talks Session 4 (Day 2)
   1. Michael Necrasov from UCSD DATA TURBINE
      1. Middleware for sensor aquisition and deliver to database Reliable buffered Can use an Android phone as the sensor! Serial to bluetooth->cel phone
      2. ESPER Event stream correlation - if a query is met Like an "upside down database"
      3. Take a video camera and a tiny netbook running data turbine connected to the Campbell datalogger - If the laptop dies no problem, it's buffered

Sensort networks for early flood warning

* + 1. contact his group because I missed a lot of this talk and it's COOL
  1. Jeff Taylor NEON - Info flow, matrix of data, etc
     1. information/hardware flow
     2. demonstrates/explains the whole flow including construction of the towers, chips with metadata built into the connectors...
     3. GRAPE data acquisition box

modular

plug and play

POE power ofver ethernet

flash memory

centralized location controller

softwaare managed

every bit as gfood as a Campbell datalogger

* + 1. NEON CyberInfrastructure diagram
    2. AUTOMATED QC sigma check delta check null test gap test spike/step test

1. I'm in working group 1
   1. Breakout group 1
   2. Task 1 - Success stories
      1. USGS data
      2. data levels - 0, 1, 2, 3, 4 what are they? Different from EML metadata complexity
      3. recent climate synthesis for plain old air temperature data

generally difficult to get at the data

data are disparate

Posted warnings, provisional...

* + 1. huntington forest

been up for 7-8 years

stage height

climate

* 1. Needs for each step: collection streaming qa/qc archiving access level 1
     1. collection

Porter

simple stuff: HOBO - so simple

buuuut, now a campbell data logger, you HAVE to know how to program

Corinna - challenges

fresh water has challenges - feezing

Subtopic

need to use existing systems/instrumentation at our field station

Motes? Low cost sensors

need an in-houise engineer to interface the sensor

size: There's big Campbell dataloggers and small motes, nothing in the middle in terms of size

Who makes the decision on what sensors to use. Info managers? scientists?

Coweeta: Techs do it Info mgrs and techs recommend. IT works "upward"

John astrophysist: It's a science-driven decsion. The accuracy etc are what drives the decision. Can't use a sensor just becuase it's lying around, or because a vendor recommended it.

often no documentation showing "weer're using thse types of radios" - actual part numbers, etc XYZ is collecting nice data, but what sensors are they using? What challenges di they have too?

need more documentation, need more meetings, need more communication

online forums are helpful

some sensing abilities ar not available off the shelf

* + 1. streaming... you've got dataloggers, how do you get the information back to the computer in the lab

depends on the domain

EXAMPLE - Gastil not in the contiguous USA and not entitled to use standard sensor frequencies.

Power

battery

solar

line

wind

water

fuel cells

power over ethernet

microwave

satellite

LOW bandwidth

use GOES if on-way-only needed

telephone

Linda is on a National Park - LARGE - might need satallite, park wont allow towers, need tons of permits to use satellites

David Hughes - that's a success story - the sensor guy from snowbird with the cowboy hat. Big help for John Porter

need something on site to buffer the data

need some network

some transmission means

radio

900 Mhz units

ethernet units e.g. Freewave

wire - e.g. MD45 unit

cellular technology

* + 1. Access

access to the raw data should be granted

not according to everybody

EMPACT data .. EPA wanted to stream it live, but EPA prevented that stream from being published.

where in the pipeline do you insert the qa/qc

changed values must be flagged

what is the feedback mechanism as to "this is/is not the data you were supposed to provide?"

need to know who is using the data

* 1. Needs:

1. Breakout Group afternoon group 2
   1. QC
      1. level 1 - streaming

Range min/max

Temperature

Compare to historic

Not other sensors - that would be level 2!!!

how often do we update ranges

keep comparing highs and lows to readings

have a lookup table of historic data from THIS sensor so you can detect drift

variances too high/too low

what time interval?

some data loggers do this automatically

increased variance as indicator of fouling

compare to historic

Spikes (Diff bet pairs too big)

Step (stuck at one value

Missing Data (Large gap)

Insufficient data (e.g. hourly records for a day)

flags

flag vs remove

review flags vs permanent flags

at what level is our organization? How do we standardize flags, or DO we standardize flags with each other? How to we share flag meanings

surpassed documented calibration scheduled date

frequency standards? Should we all sample to the same frequency?

precision standards - same deal as frequency standards

* + 1. Level 2 - Gap Filling

look for drift

Deploy some sensors for the sole purpose of determining the drift characteristics of THAT sensor. e.g. leave a radiation sensor out for years and dont calibrate it, just measure it.

level 1 is level 1. This IS the data. If there are missing points, they dont get filled in in level 1.

* + 1. Flags in general

are flags another column, yes. But it is a MULTIVARIATE column! Perhaps there should be a column for each flag!

need some sort of header in the file for missing data, because, with missing data, there's nothing to flag!

flags and comments need a start time and an end time

* 1. Data Qualifiers
  2. Data documentation
     1. we're talking about metadata here
     2. flags that are part of the header
     3. users guide
     4. implementation
     5. anything that affects the data e.g. calibration
     6. data headers
     7. linked files
     8. time
     9. location
     10. expected format/size/checksum
     11. hardware configuration

1. Breakout group 3 Morning Day 3 MANAGING SENSORS BEST PRACTICES
   1. general considerations checklist
      1. sensors proper

cost

access

maintenance

platform

ease of calibration

ease of deployment

reliability

compatibility

software - do you use an older one because an onramp is already written for it

accuracy

precision

HOUSING???????? Where to put it?

* + 1. documentation needs

glossary

wiki or blog

* 1. process flow and components
     1. collection

sampling frequency

buffer period

buffer method

buffer at sensor?

buffer at logger?

streaming

communication method

cel phone

satellite

wire

getting from the central station to the internet.

NOT the same as collection

measurement frequency

motes

SITE: enclosure, building, power

buoy

tower

shed

satellite

aircraft

visibility

vandalism

permits

Smart sensing - power saving circuitry, turns sensors and uplink off to save power

* + 1. transmission

Plug in the discussion Lindsay got from the group yesterday

mention onramps

* + 1. Date integration/aggregation

Middleware can happen here

Home grown

data turbine

R

Kepler

SPAN

proprietary

GCE Data Toolbox (MAtlab)

Johnson/Honeywell

YSI Econet

Campbell Loggernet

some level of filtering could happen here

some level of QA/QC could happen here

* + 1. filtering, QA, QC
    2. distribution to public

quick view

download

* + 1. archiving and publishing

opportunity for public to download archives

can public grab raw data?