ENGAGING THE PUBLIC IN CLIMATE SCIENCE

EXPLOITING CROWDSOURCING TO DIGITIZE AND ANALYZE CLIMATE DATA

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Board on Research Data & Information (BRDI)
OUTLINE

- Challenges of Monitoring Climate Change
- Recruiting Internet Citizen Scientists
- Partnering with Citizen Science Alliance
  - Project 1: Data Rescue for Surface Temperature Databank
  - Project 2: Tropical Cyclone Reanalysis
CHALLENGES OF MONITORING CLIMATE CHANGE

Reducing Uncertainty to Improve Public Understanding

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Three temperature time series are displayed relative to the 1961-1990 normals (°C). The paleoclimate reconstruction from Mann et al. (2008) is for Northern Hemisphere land, while U.S. Historical Climatology Network v. 2 dataset from Menne et al. (2009) and U.S. Climate Reference Network temperature departures are for the continental U.S. only. A major goal is to provide consistent time series across paleoclimate and instrumental networks.
Global Historical Climatology Network (Monthly) 
Stations Reporting Mean Temperature, 1961-1990

- GHCNv3 has about 2700 reliable stations
- Rapid increase during WWII
- Gradual decrease in 80s, 90s as stations close

Few data still not in digital form
- Rescuing data has been first priority
- Critical to understanding regional climate change
Reduction Uncertainty in Global Trends

More observations needed to reduce uncertainty in historical record.
MAKING DATA ACCESSIBLE FOR DISCOVERY & ANALYSIS

- NOAA On-line Foreign Data Library
  - Over 75 countries and former colonies
  - Covers from 1830 to 1970s
- Digitally imaged through Climate Database Modernization Program (CDMP)
  - Millions of images; more accessible
  - Data is still essentially inaccessible

- Additional 2000+ boxes of international data in NCDC physical archives
  - Similar numbers of data held elsewhere
  - None of it is usable without digitization

http://docs.lib.noaa.gov/rescue/data_rescue_home.html

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LIMITS TO OPTICAL CHARACTER RECOGNITION (OCR)

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RECRUITING INTERNET CITIZEN SCIENTISTS

We need carbon-based computing for imagery analysis.
Citizen Science and Crowdsourcing

- Exploits the cognitive abilities of Human Computation!
- Novel mode of data collection:
  - Citizen Science = Volunteer Science = Participatory Science
  - e.g., VGI = Volunteer Geographic Information (Goodchild ’07)
  - e.g., Galaxy Zoo @ http://www.galaxyzoo.org/
- Citizen science refers to the involvement of volunteer non-professionals in the research enterprise.
- The Citizen Science experience …
  - must be engaging,
  - must work with real scientific data/information,
  - must not be busy-work (all clicks must count),
  - must address authentic science research questions that are beyond the capacity of science teams and enterprises, and
  - must involve the scientists.

Reference: Kirk Borne, Reference: Reaching Out with Eventful Astronomy, George Mason University
EXAMPLE: ReCAPTCHA

WHAT IS reCAPTCHA
GET reCAPTCHA
PROTECT YOUR EMAIL
MY ACCOUNT
RESOURCES: DOCS & PLUGINS

LEARN HOW reCAPTCHA WORKS

USE reCAPTCHA ON YOUR SITE

STRONG SECURITY
ACCESSIBLE TO BLIND USERS
30+ MILLION SERVED DAILY

NEW See how accurate reCAPTCHA is at digitizing content!

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EXAMPLE: ZOONIVERSE

About the Zooniverse

The Zooniverse is home to the internet's largest, most popular and most successful citizen science projects. Our current projects are here but plenty more are on the way. If you're new to the Zooniverse, we suggest picking a project and diving in - the same account will get you into all of our projects, and you can keep track of what you've contributed by watching 'My Zooniverse'.

The Zooniverse and the suite of projects it contains is produced, maintained and developed by the Citizen Science Alliance. The member institutions of the CSA work with many academic and other partners a round the world. Their efforts and ability of volunteers to help advance science is central to coping with the data that confronts them.

The Zooniverse began with a single project in 2007. The Galaxy Zoo team had expected it to be overwhelmed by the response to the project and the server was buckling under the strain, they set about building a platform.

Galaxy Zoo was important because it had produced many unique scientific results, ranging from those using classifications that depend on the human eye to those using classifications that depend on other methods. This commitment to producing real results with your time - is at the heart of everything.

Recent Zooniverse activity

Total Volunteers: 430,804
EXAMPLE: GALAZXYZOO.ORG

- ~260,000 participants (and growing)
- ~1 million galaxies have been labeled (classified)
- ~180 million classifications have been collected
EXAMPLE: OLDWEATHER.ORG

Old Weather: Our Weather’s Past, the Climate’s Future

- Follow vessels
- Digitise pages
- Get promoted

Project Statistics
Old Weather transcriptions so far

68% of the logs completed
517217 pages done
118 ships complete
EXAMPLE: OLD WEATHER

HMS Teutonic
Active: Atlantic convoys

Armed Merchant Cruiser - Learn more

Map and timeline
Lessons learned from astronomy applied to climatology.

"It's black, and it looks like a hole. I'd say it's a black hole."

PARTNERING WITH CITIZEN SCIENCE ALLIANCE

EXPLOITING CROWDSOURCING TO DIGITIZE AND ANALYZE CLIMATE DATA
INTERNATIONAL CROWDSOURCING COLLABORATION

- Establishing a long-term partnership with Citizen Science Alliance (Zooniverse)
  - Effort led by scientists from the Cooperative Institute for Climate and Satellites in North Carolina (CICS-NC)
- In short-term, developing prototype capabilities
  - International exchange of scientific expertise and technology transfer
- Long-term goal of joining the CSA and developing climate crowdsourcing applications
- Two initial projects are proposed
  - Date Rescue for Surface Temperature Databank
  - Tropical Cyclone Reanalysis
PROJECT 1: DATA RESCUE FOR SURFACE TEMPERATURE DATABANK
Society expects openness and transparency in the understanding of the (un)certainty on how climate has changed and how it will continue to change.

The UK Meteorological Office (UKMO) proposed a new International Analysis of Land-Surface Air Temperature Data.

- Endorsed by World Meteorological Organization (WMO) Commission for Climatology, February 2010

The International Surface Temperature Initiative:
- Established at workshop in Exeter, UK in September, 2010
- NOAA/NCDC is leading in establishing and potentially hosting the data bank
- Data rescue is a priority of the initiative

Check http://www.surface-temperatures.org for more information.
DATA DIGITIZATION THROUGH CROWDSOURCING

- Proposed method similar to oldWeather.org
  - Multiple redundant keying of historical images
  - Similar to ReCAPTCHA, use human to refine OCR results

- Digitized data placed in The Databank
  - Retain the redundant values as valuable metadata
  - Full provenance and version tracking – anyone can go back to the raw data value at any time

- Finding the right motivation is challenge
  - Citizen scientist must understand the impact they’re making
PROJECT 2: TROPICAL CYCLONE REANALYSIS
Tropical Cyclone Reanalysis

- Historical intensity records of tropical storms are based on regional methods, leading to basin-to-basin differences
  - Methods have also changed with time and even differ by forecaster
- Since the late-1970s we have archived satellite images
- Use the ‘crowd’ to create a consistently analyzed historical record across the globe.
- Dvorak (intensity) classification is well-suited because it can be easily translated to a GalaxyZoo-type analysis and is the world-wide standard
Subjective estimate of tropical cyclone (TC) intensity based solely on visible and infrared satellite images.

TCs of similar intensity tend to have certain characteristic features, and as they strengthen, they tend to change in appearance in a predictable manner.

A "T-number" and a Current Intensity (CI) value are assigned to the storm:
- 1 - minimum intensity
- 8 - maximum intensity

Developed in 1973 by Vernon Dvorak.
The Galaxy zoo community has provided over 250 million classifications through the galaxy zoo website. Hurricanes like galaxies are still best classified by humans, the citizen science community can produce an equally valuable dataset for meteorologists and climatologists to help them understand these extreme events.
SUMMARY

- Critical environmental data has been digitally "rescued" for long-term preservation, but essentially remains "lost" to scientific inquiry
- Crowdsourcing offers tremendous potential to not only leverage online "cranial capacity", but also to engage the public in science
- NOAA is collaborating with Citizen Science Alliance, which is leading the way in crowdsourcing, to fill climate data voids and enable climate science
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