

# Bringing Data & Research into the Classroom

Josh Galster

Earth & Environmental Studies Dept.  
Montclair State University

Laura Rademacher

Geology and Environmental Science Dept.  
University of the Pacific

# Our backgrounds

- **Josh:** Taught at Montclair State (public university in NJ) for 8 years
  - Interdisciplinary department that has undergrad through PhD students
  - Variety of courses from Intro courses for non-majors up through graduate course
  - Specializes in hydrology and watersheds
  - Attempts to use data in about 1/3 of all class meetings
- **Laura:** Taught at Pacific for 10 years
  - Primarily undergraduate institution
  - Intro/GE, major/upper division, and freshmen seminar courses
  - Specializes in critical zone hydrology and low temp geochemistry
  - Most courses include research projects, many classes include data
- **Your** level of experience with data/research?

# Why incorporate data/research into the classroom?

- Think of and then pair up and generate a quick list of the benefits

# Why incorporate data/research into the classroom? (example responses)

- Cognitive growth
  - gains in knowledge and skills
  - more able to think and work like a scientist (if made explicit)
  - communicate effectively
  - think analytically and critically
  - increased retention in the course and/or discipline
- Personal growth
  - gain confidence
  - more independent
  - more self-motivated
- Professional growth
  - interests in a science career are validated or enhanced
  - develop ties to the scientific community

# Objectives for this session

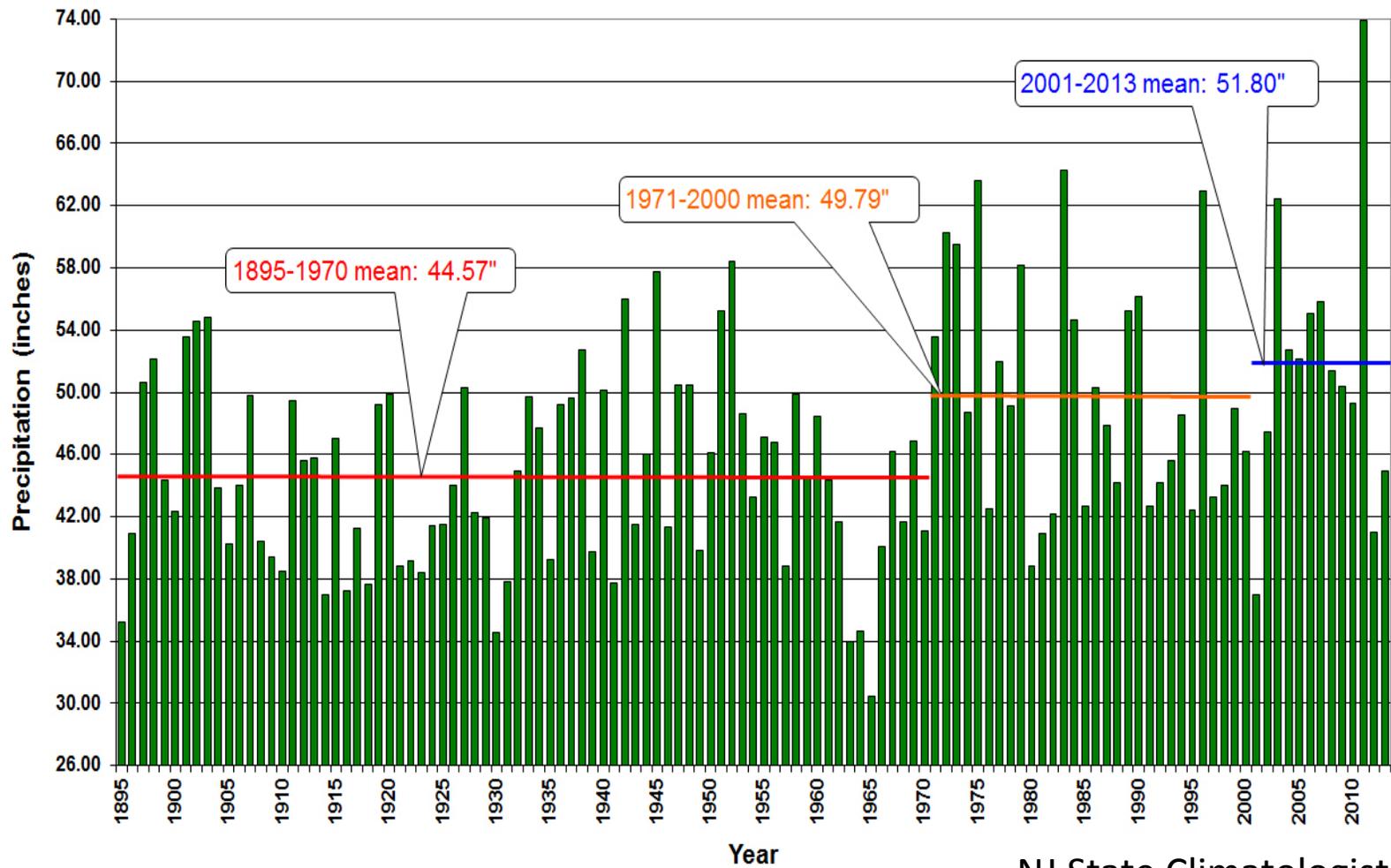
- Make the case for using data and conducting research in the classroom.
- Give examples at a variety of scales.
- Have you generate exercises that incorporate data/research into your teaching.

# Scale of Classroom activities

- Data & Research
  - Using data as a piece of the research process
- Time involved: 10 minutes, a class/lab, a semester?
- Individual vs. group
- Outcome: thinking (TPS), writing, presentation, homework...

# Data example: Trends in Precipitation

Northern NJ Annual Precipitation (1895-2013)



NJ State Climatologist

# Data example: Images

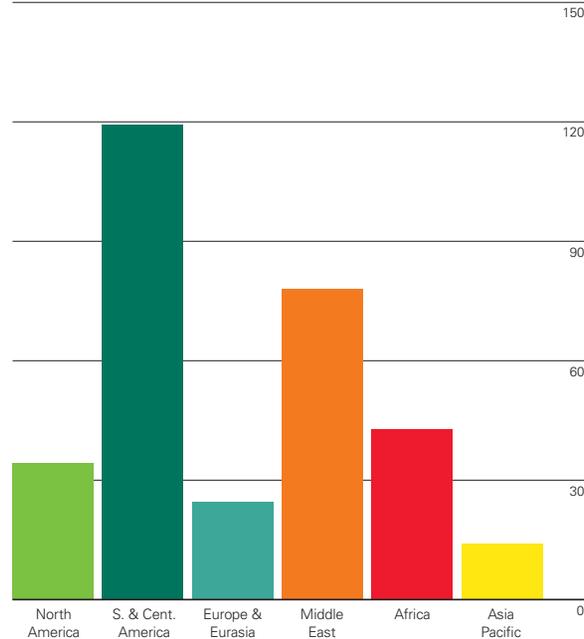
<http://earthobservatory.nasa.gov/IOTD/view.php?id=86041>



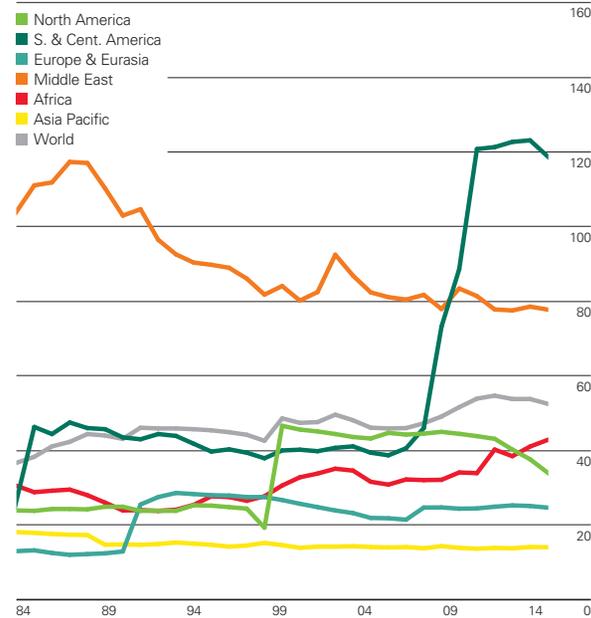
# Data Example: Energy

## Reserves-to-production (R/P) ratios Years

2014 by region



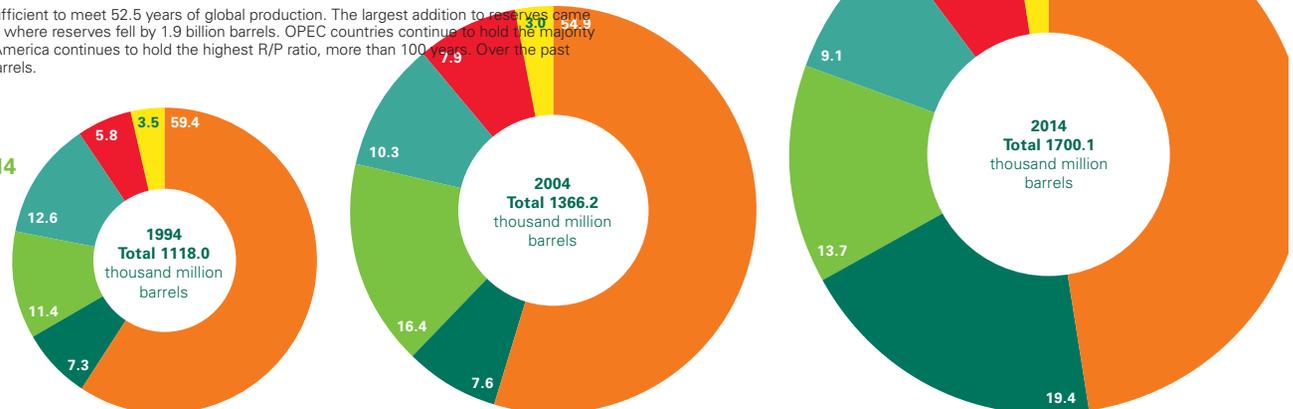
History



Total world proved oil reserves reached 1700.1 billion barrels at the end of 2014, sufficient to meet 52.5 years of global production. The largest addition to reserves came from Saudi Arabia, adding 1.1 billion barrels. The largest decline came from Russia, where reserves fell by 1.9 billion barrels. OPEC countries continue to hold the majority of the world's reserves, accounting for 71.6% of the global total. South & Central America continues to hold the highest R/P ratio, more than 100 years. Over the past decade, global proved reserves have increased by 24%, or more than 330 billion barrels.

## Distribution of proved reserves in 1994, 2004 and 2014 Percentage

- Middle East
- S. & Cent. America
- North America
- Europe & Eurasia
- Africa
- Asia Pacific



BP Statistical Review of World Energy 2015

<http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>

# Research example

- Long-term study of AMD impacts (ES & Geochem)



**PUBLIC NOTICE**  
CITY OF OAKLAND

COMMUNITY AND ECONOMIC DEVELOPMENT AGENCY

**COMMUNITY MEETING: Leona Mine and Creek Cleanup (Summer 2014)**  
February 27, 6:30pm, 4444 Mountain Blvd.

**What is the Problem?**  
Mining waste and tailings are present on the creek bed and in the stream. This is why the creek is orange.

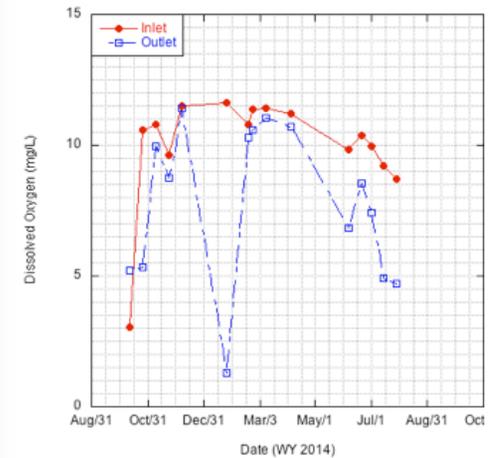
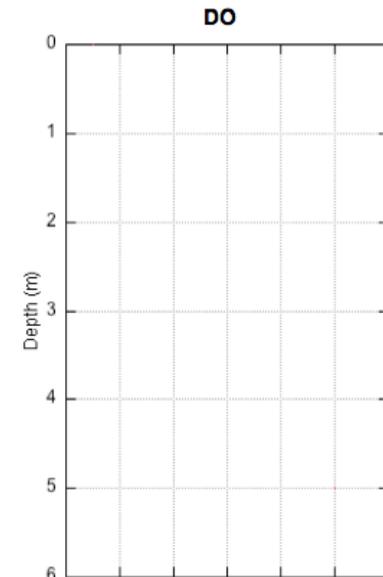
**What is the Solution?**  
Mining waste will be installed from water with a liner. These will be vegetated over time.

**How will the cleanup project Affect You?**  
• **Other Creek:** Other creek will be installed to divert water. This will be installed in 2014.  
• **Construction:** 8-9 months.  
• **Benefits:** Less sediment in creek. Less erosion. Less turbidity. Less odor. Less noise. Less impact on wildlife. Less impact on water quality.

**Help us minimize your inconvenience!**  
Come down about the project and provide your feedback at the COMMUNITY MEETING on Thursday, February 27, 6:30pm, at the Leona Mine (4444 Mountain Blvd.).

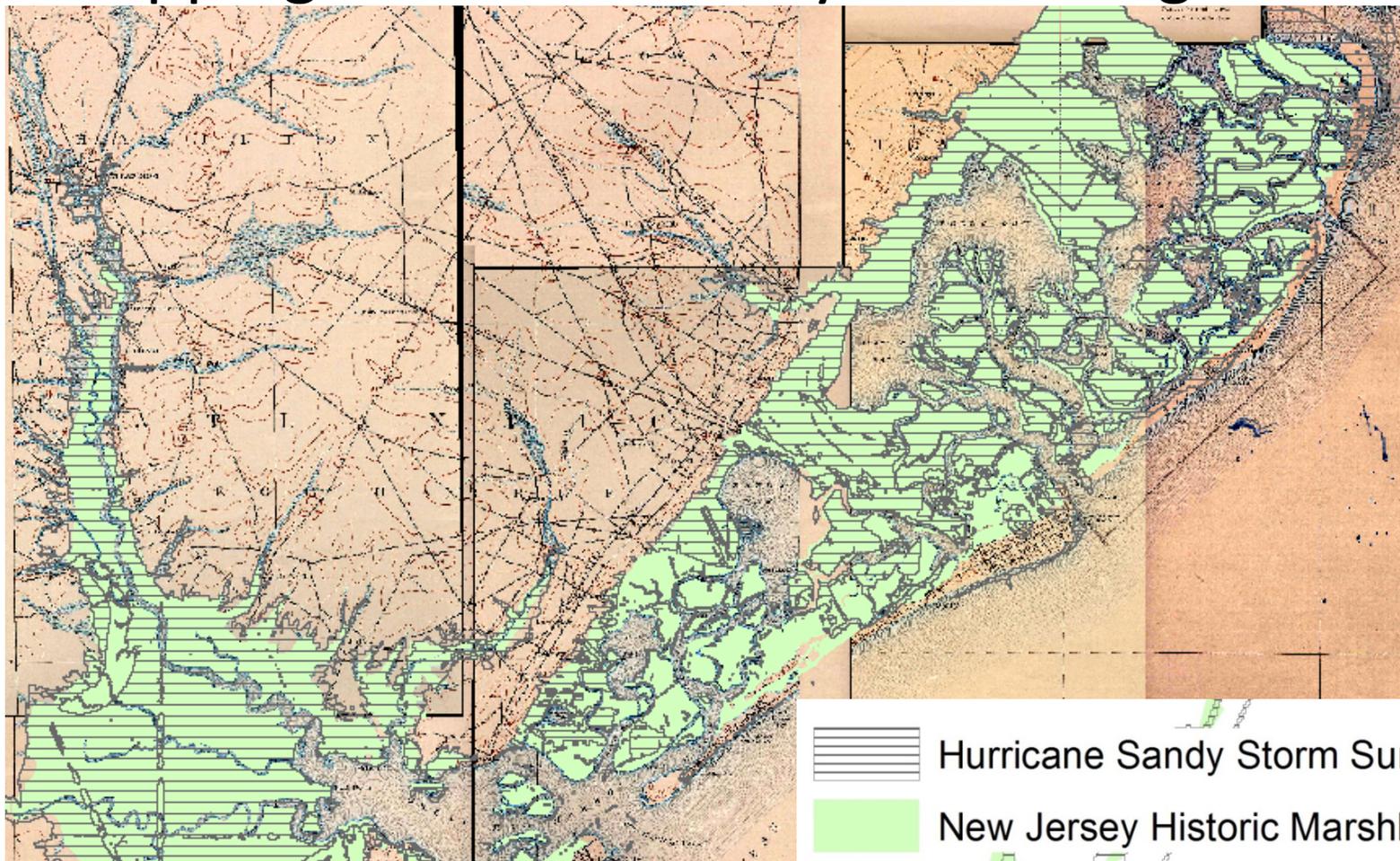
121 May Regional Water Quality Control Board and City of Oakland

SIGN NUMBER: \_\_\_\_\_ IF SIGN OR INSERTS ARE MISSING OR DAMAGED, PLEASE CALL ZONING AT (510) 238-3011. FOR BLIGHT NOTICES, PLEASE CALL (510) 238-4462



# Research example

- Mapping Hurricane Sandy storm surge in GIS



# Tips and Recommendations for Data

- Set the tone early: begin on the first day of class
- Start with the basics: define axes, look at units, trends, etc.
- Be sure students are prepared to do what you're asking them to do
- Ensure students see the relationship between the topic and course content.
- Incorporate group work.
- Make it clear how the use of data fits into the process of science.
- Use local examples.

# Tips and Recommendations for Research

- Give detailed and clear directions at the beginning of the research experience.
- Frequent deadlines are necessary and important.
- Make clear the purpose of each component within the project and within the course.
- Build in time for flexibility.
- Give students freedom to choose a topic, with guidance.
- Ensure students see the relationship between the topic and course content.
- Peer review is helpful to provide formative feedback.
- Students should communicate results beyond the professor.
- Incorporate group work.
- Prepare students by using data in the classroom

# Individual reflection

- Think of examples datasets to present in class
- Think of possible research projects to incorporate in a classroom
  - What level of class?
  - How long for discussion?
  - What will the students actually do? Will they write, do homework, share something

Develop something that will work best for you!

# Additional Resources

- On the Cutting Edge Undergraduate Research as Teaching Practice (  
[http://serc.carleton.edu/NAGTWorkshops/undergraduate\\_research/index.html](http://serc.carleton.edu/NAGTWorkshops/undergraduate_research/index.html))
- Council for Undergraduate Research (CUR);  
On the Cutting Edge Teaching with Data, Simulations, and Models (  
[http://serc.carleton.edu/NAGTWorkshops/data\\_models/index.html](http://serc.carleton.edu/NAGTWorkshops/data_models/index.html))