Enabling Science Breakthroughs Using Computer Science

Speaker: Deb Agarwal
Host: Gail Murphy

Virtual Town Hall
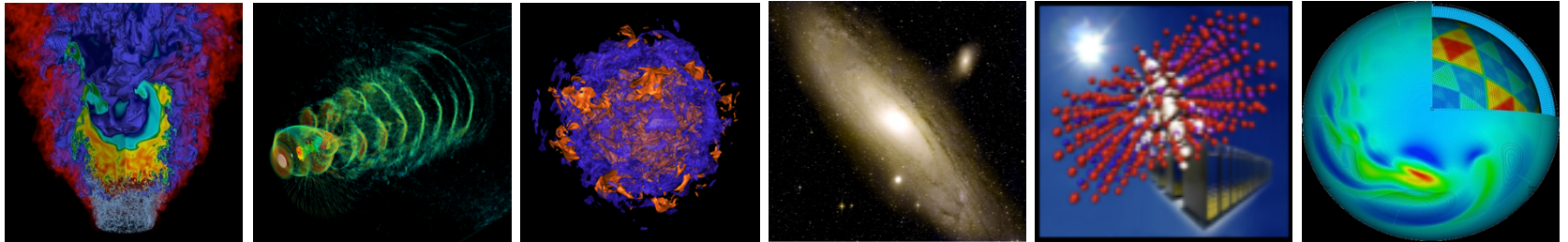
October 13, 2016

Speaker & Moderator

Deb Agarwal

Deb Agarwal is the Data Science and Technology Department Head at Lawrence Berkeley National Laboratory (LBNL). Dr. Agarwal's research focuses on scientific tools which enable sharing of scientific experiments, advanced networking infrastructure to support sharing of scientific data, data analysis support infrastructure for eco-science, and cybersecurity infrastructure to secure collaborative environments. Dr. Agarwal leads a team developing data server infrastructure to significantly enhance data browsing and analysis capabilities and enable eco-science synthesis at the watershed-scale to understand hydrologic and conservation questions and at the global-scale to understand carbon flux. Dr. Agarwal received her Ph.D. in electrical and computer engineering from University of California, Santa Barbara and a B.S. in Mechanical Engineering from Purdue University.

Gail Murphy

Dr. Gail Murphy is a Professor in the Department of Computer Science and Associate Dean (Research & Graduate Studies) in the Faculty of Science at the University of British Columbia. She is also a co-founder and Chief Scientist at Tasktop Technologies Incorporated. Her research interests are in software engineering with a particular interest in improving the productivity of knowledge workers, including software developers. Dr. Murphy's group develops tools to aid with the evolution of large software systems and performs empirical studies to better understand how developers work and how software is developed.

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Deb Agarwal

Senior Scientist
Lawrence Berkeley National Laboratory

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What is a Researcher?

^{1}research 🔊

noun | re·search | \ri-ˈsərch, ˈrē-ˌ\

Simple Definition of RESEARCH

Popularity: Top 1% of lookups

: careful study that is done to find and report new knowledge about something

: the activity of getting information about a subject

Source: Merriam-Webster's Learner's Dictionary

• **A person performing research to solve a problem that has not been solved before**

Lawrence Berkeley National Laboratory

Lawrence introduces big team science 1931   LBNL the first National Lab

from LBL image archive

Lawrence Berkeley National Laboratory


Golden Gate Bridge

from LBL image archive

Lawrence Berkeley National Laboratory

- **Solve the most pressing and profound scientific problems facing humankind**
  - *Basic science for a secure energy future*
  - *Understand living systems to improve the environment and energy supply*
  - *Understand matter and energy in the universe*
- **Build and safely operate world-class scientific facilities**

- **Train the next generation of scientists and engineers**

Advanced Light Source – Particle Accelerator
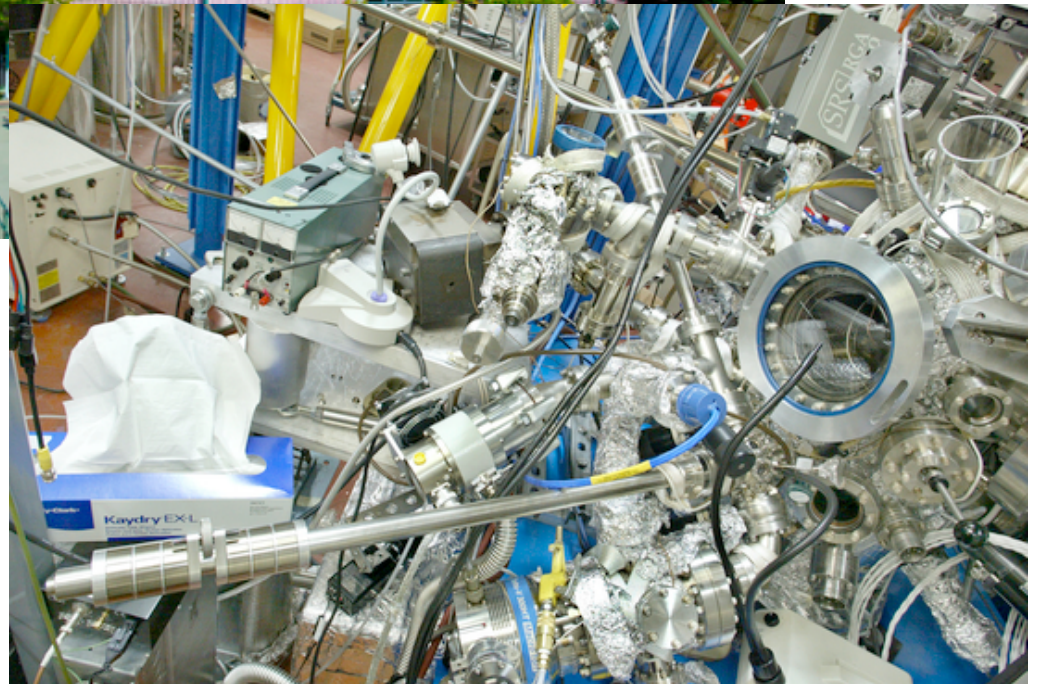
Energy Efficiency

Science is Becoming More Compute-Intensive

Science Paradigms

- Thousand years ago:
  science was **empirical**
    describing natural phenomena

- Last few hundred years:
  theoretical branch
    using models, generalizations

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{4\pi G p}{3} - K\frac{c^2}{a^2}$$

- Last few decades:
  a **computational** branch
    simulating complex phenomena

- Today: **data exploration** (eScience)
    unify theory, experiment, and simulation

  – Data captured by instruments
    or generated by simulator

  – Processed by software

  – Information/knowledge stored in computer

  – Scientist analyzes database/files
   using data management and statistics

Credit: Slide from Jim Gray and included in the 4th Paradigm book

What Does Computing Have to Do With Science?

- **Every science field is becoming limited by their ability to run models, store data, and analyze data**
  - Climate model data - 140 terabytes
  - LSST Telescope - largest digital camera ever constructed 3.2 gigapixel/2 sec (1 pixel = 16 bits)
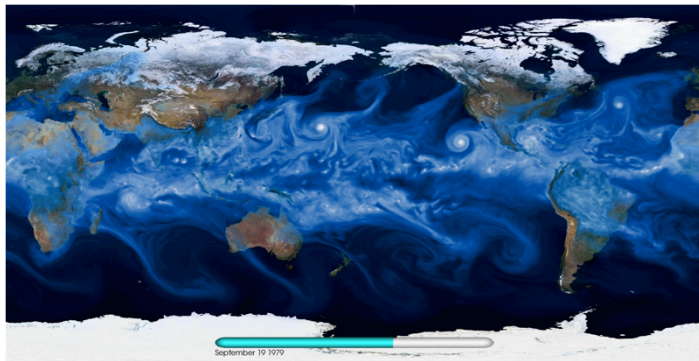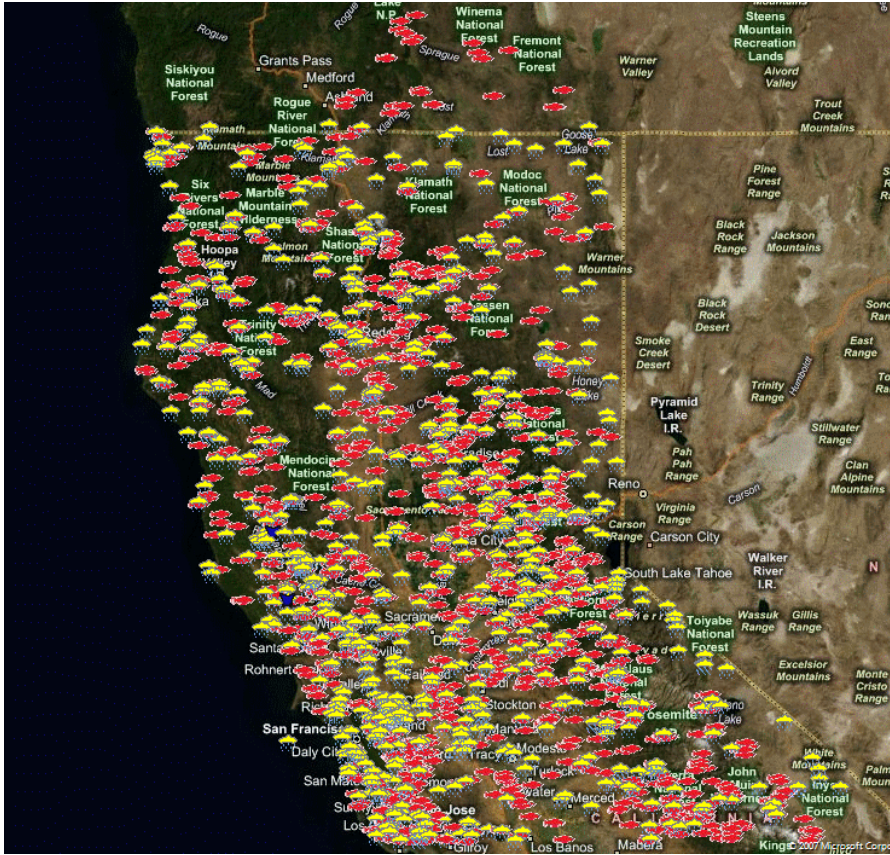
KBase: An integrated data model across the tree of life
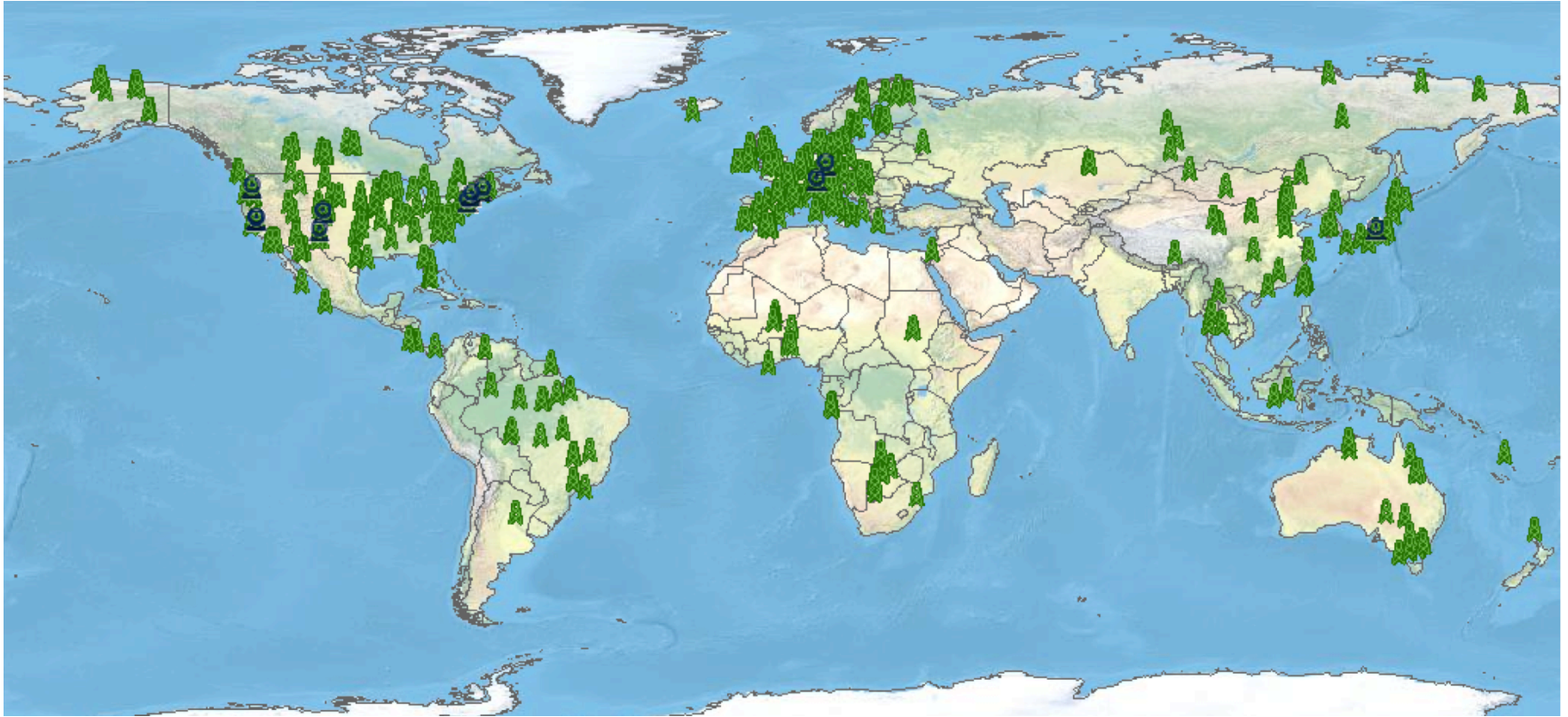
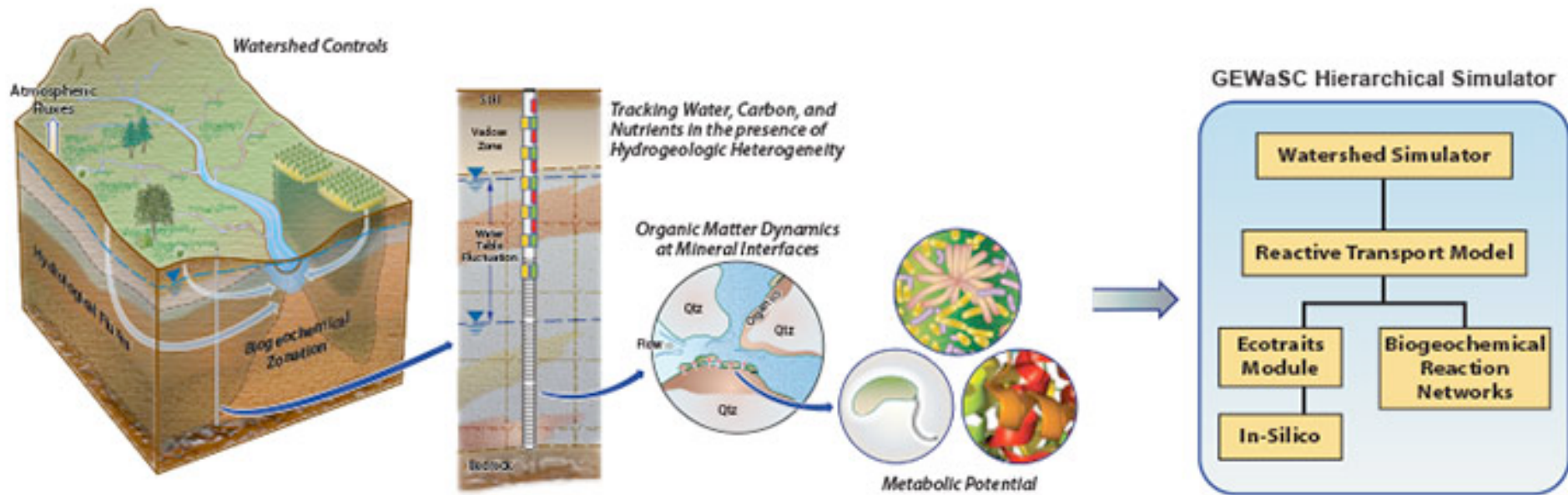# A Few of My Recent Projects

Decide on Stream Recovery Actions - NMFS

AmeriFlux Carbon Flux Understanding

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FLUXNET – Global Carbon Flux Towers

Understanding Watershed Function

Carbon Capture for
Coal-Fired Power Plants

Travel for Work

Mentoring & Leadership

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Leadership and Management

- **What defines a leader?**
  - Being the person enabling a team to succeed

- **How do you become a leader?**
  - Gain the trust of a team

Advice that has served me well

- **Do a good job on each project you undertake**

- **If you are not going to do a good job, don't take it on**

Build a reputation for quality work and attention to deadlines

Advice that has served me well

- **Share credit generously**
- **Celebrate the achievements of others around you**
- **Take responsibility for your failures**

If everyone is following you, you are a leader

Advice that has served me well

- **Don't make enemies.**

- **Learn how to be assertive**

- **Learn good communication skills**

Vision can only inspire others if they understand it

Advice that has served me well

- **Take advantage of serendipitous opportunities when they come to you**

Find ways to make whatever you do enjoyable

Advice that has served me well

Learn to lead without power. The skills you develop will serve you well when you have power

Innovation in your Career

"Well behaved women seldom make history"

Laurel Thatcher Ulrich