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Berkeley Lab Researchers at AGU

Impacts of Climate Change, Subsurface Energy, Understanding Drought and Monitoring Permafrost Among Many Talks

Berkeley Lab scientists will present on a number of topics including climate modeling challenges, projects on Arctic permafrost, induced seismicity, cloud physics, Amazon forests, hydraulic fracturing, melting ice sheets, cool roofs, and more. And meet some of our scientists! They will be in the exhibit hall all week at booth #705.

Monday, Dec. 12

9:15 - 9:30

Moscone West- 2020

Mapping Drought Sensitivity of Ecosystem Functioning in Mountainous Watersheds

Mountainous watersheds in the Upper Colorado River Basin play a critical role in supplying water and nutrients to western North America. Ecosystem functioning in those regions – including plant dynamics and biogeochemical cycling – is limited by water availability. Under climate change, early snowmelt and increasing temperature are expected to intensify the drought conditions in early growing seasons. The objectives of this study are to map the regions where the plant dynamics are relatively more sensitive to drought conditions based on historical satellite and climate data, and to identify the environmental controls on drought sensitivity.

Haruko Wainwright

11:35 - 11:50

Moscone West-2000

Topological Methods for Pattern Detection in Climate Data

Atmospheric rivers are narrow filaments of concentrated water vapor in the atmosphere whose presence has been connected to major flooding events along the West Coast of North America (California) and Western Europe (the UK). How to detect extreme weather phenomena like atmospheric rivers in climate datasets? The purpose of this research is to analyze large, high-dimensional climate datasets using Topological Data Analysis (TDA). The researchers are interested in the application of topological methods to other problems: extending similar concepts for extracting three-dimensional jet streams in the upper atmosphere, with the goal of characterizing activity and effects on storm systems.

Grzegorz Muszynski

11:35 - 11:50

Moscone West- 3022

Uncertainty in Extreme Precipitation Representation in Numerical Simulations and Hydrological Datasets

Understanding extreme weather is imperative to society, particularly given the growing body of evidence suggesting that the characteristics of weather extremes are changing. Thus it is crucial that climate models accurately simulate such extremes. Towards quantifying uncertainty in the extremes

Monday, cont.

of precipitation, researchers examine the correspondence between a variety of data sources, including datasets from land-based and satellite measurements. They describe how results from their analysis can be used to quantify uncertainty in the extremes, and thus how model fidelity can be assessed.

Ben Timmermans

14:40 - 14:55

Moscone West-3018

Enhanced Characterization of Faults and Fractures at Enhanced Geothermal Sites by CO2 Injection Coupled with Active Seismic Monitoring, Pressure-transient Testing, and Well Logging

Faults and fractures in geothermal systems are difficult to image and characterize because they are nearly indistinguishable from host rock. Researchers are investigating the use of CO2 injection and production (push-pull) in faults and fractures for better characterization by active seismic, well logging, and push-pull pressure transient analysis. CO2 injected for push-pull well testing has a preference for flowing in the fault and fractures. Research results suggest that CO2 can be best imaged using time-lapse and wireline well-logging tools that measure electrical conductivity. These multiple complementary characterization approaches are being used to develop working models of fault and fracture zone characteristics relevant to energy recovery.

Curtis Oldenburg

16:00 - 16:15

Moscone West- 2000

Classification and Localization of Extreme Weather Patterns with Deep Learning

Extreme weather events pose great potential risk on ecosystem, infrastructure and human health. Analyzing extreme weather and characterizing changes in extremes in simulations of future climate regimes is an important task. Researchers propose a new approach: machine learning to solve this problem. This talk will touch upon Deep Learning: the most powerful machine learning method at this point in time. Researchers will report compelling results from the successful application of Deep Learning to classify tropical cyclones, atmospheric rivers and weather front events. Can we train networks in a semi-supervised, or completely unsupervised manner?

Mr. Prabhat

Tuesday, Dec. 13

10:20 - 10:35

Moscone West- 3005

Permafrost in Earth System Models: Recent Progress and Future Challenges

Permafrost is a crucial component of the Earth system yet has been poorly represented in Earth system models. None of the Earth system models of the CMIP5 generation included permafrost carbon dynamics, and many had poor representation of soil thermal dynamics. A number of key improvements have been made to address these shortcomings, including strategies for including permafrost carbon dynamics in models, as well as methods and datasets for benchmarking both the physical and biogeochemical components of the models. Koven will discuss recent progress and

Tuesday, cont.

outstanding challenges that remain in understanding and quantifying the role that permafrost soils may play as feedback agents in the Earth system.

Charles Koven

11:05 - 11:20

Moscone West- 2008

Mineralogical Controls on Carbon Cycling in a Floodplain Environment

With the overarching goal of understanding mineral-organic-microbe interactions on carbon and nutrient cycles, researchers are developing a model to better understand the impact of mineralogy on carbon turnover, among other things, in a floodplain site in Rifle, Colorado. Detailed characterization of the soil organic matter in sediments at the Rifle site, including radiocarbon dating and extraction and chemical characterization of mineral-bound pool of organic matter, is used to inform the modeling. Researchers will describe the development of a coupled unsaturated-saturated flow and biogeochemical reactive transport model of the Rifle site. Results suggest that soil mineralogy constitutes a dominant control over organic carbon stocks and residence times.

Bhavna Arora

12:05 - 12:20

Moscone West- 3003

Enhancing the Global Carbon Sink: A Key Mitigation Strategy

Earth's terrestrial ecosystems absorb about one-third of all anthropogenic CO₂ emissions from the atmosphere each year, greatly reducing the climate forcing those emissions would otherwise cause. This puts the size of the terrestrial carbon sink on par with the most aggressive climate mitigation measures proposed. Moreover, the land sink has been keeping pace with rising emissions and has roughly doubled over the past 40 years. But there is a fundamental lack of understanding of why the sink has been increasing and what its future trajectory could be. Better scientific understanding of the sink provides more options for policy design, enables mitigation strategies that capture co-benefits, and increases the chances that global mitigation commitments will be met.

Margaret Torn

14:55 - 15:10

Moscone South- 305

From Pore Pressure Modeling to Seismic Risk Assessment – a Fully-integrated Modeling Approach

Increased subsurface fluid injection accompanying oil, gas, and geothermal exploitation and carbon dioxide sequestration, among other fluid injection applications, has increased the potential impact of injection-induced seismicity over the last few years, escalating the need to model the underlying physical processes and to assess potential seismic hazard and risks. Researchers are developing a method to assess the seismic impact of proposed fluid injection projects combining fluid flow modeling and earthquake simulation with probabilistic seismic hazard analysis. Researchers present an application of an integrated approach to hypothetical CO₂ sequestration injection scenarios based on a simplified model of a faulted reservoir at King Island in the northern Sacramento Valley, California.

Corinne Elisabeth Layland-Bachmann

Tuesday, cont.

15:10 - 15:25

Moscone West- 3024

Using Distributed Fiber Optic Sensing to Monitor Large Scale Permafrost Transitions: Preliminary Results from a Controlled Thaw Experiment

In a warming world, permafrost landscapes are being rapidly transformed by thaw. The same transformations pose a threat to arctic infrastructure and can induce catastrophic failure of roads, runways, and pipelines. Scalable solutions to monitoring permafrost thaw dynamics are required to both quantitatively understand biogeochemical feedbacks as well as to protect built infrastructure from damage. Unfortunately, permafrost alteration happens over the time scale of climate change, years to decades, a decided challenge for testing new sensing technologies in a limited context. Researchers will present preliminary results from a large-scale controlled permafrost thaw experiment designed to evaluate the utility of different geophysical approaches for tracking the cause, precursors, and early phases of thaw subsidence.

Jonathan Ajo Franklin

Wednesday, Dec. 14

8:00-8:15

Moscone West 3006

A Case for Missing Cloud Physics in Climate Models

Precipitation extremes have impacts across a wide swath of natural and human systems. There has been quite a lot of work to understand how human activity (greenhouse gas emissions) has impacted extremes, but huge uncertainties remain. The representation of cloud processes, and resulting extreme precipitation, in climate model simulations is a huge source of uncertainty. A key uncertainty originates in the strong dependence of cloud processes on model resolution. Understanding, and ultimately improving such resolution dependence, would go a long way toward reducing uncertainty.

Travis Allen O'Brien

8:45 - 9:00

Moscone West- 3007

Millennial-scale Vulnerability of the Antarctic Ice Sheet to Localized Subshelf Warm-water Forcing

The Antarctic Ice Sheet (particularly the West Antarctic Ice Sheet [WAIS]) is potentially vulnerable to modes of thinning driven by climate forcing. As warm circumpolar deep water intrudes into the cavities under the ice shelves, it thins and weakens the ice shelves, compromising their ability to buttress the flow of their feeder ice streams. Both models and observations have borne out the idea that reduced buttressing can lead to rapid upstream thinning and even the onset of Marine Ice Sheet Instability. Researchers present a systematic examination of millennial-scale Antarctic vulnerability to scenarios of extreme ice-shelf melting.

Daniel Martin

Wednesday, cont.

9:45 - 10:00

Moscone West-2008

Enhanced Terrestrial Carbon Uptake Linked to a Recent Pause in the Growth Rate of Atmospheric CO₂

The terrestrial carbon sink is increasing, yet the mechanisms responsible for its long-term enhancement, and implications for the growth rate of atmospheric CO₂, remain unclear. Here, using global carbon budget estimates, ground, atmospheric and satellite observations, researchers examine the causes and consequences of the enhancement of the terrestrial carbon sink. They show that over the past century the enhanced sink is largely due to the effect of elevated CO₂ on photosynthesis dominating over warming induced increases in respiration. The slowdown in global warming since the start of the 21st century is shown to have increased the sink, leading to a pause in the growth rate of atmospheric CO₂. The effect of enhanced terrestrial carbon uptake on the atmospheric CO₂ growth rate highlights the need to protect both existing carbon stocks and those areas where the sink is growing most rapidly.

Trevor Keenan

15:25 - 15:40

Moscone West-3011

The State of Well Stimulation in California: Analyses of Data Submittals

Over the past four years California has developed and instituted the most comprehensive regulation of well stimulation in the world. Analyses of the data submitted for a few hundred stimulations under the final regulations that went into effect July 2015 provides further insight into stimulation practice, which was almost entirely hydraulic fracturing during the period, as well as what regulations are working and what could be improved with regard to the required submittals. The data indicate 22 constituents are typically used in each stimulation, which is essentially the same as indicated by analysis of data sources available two years ago. However, while most of the stimulation constituents reported under the final regulations had been reported previously in other data sets regarding California, 53 constituents were reported for the first time, indicating the value of mandatory disclosure requirements.

Preston Jordan

16:00 - 16:12

Moscone West-2004

Amazon Storm-driven Tree Mortality

While intrinsic factors such as tree competition and soil nutrients have commonly been proposed to explain the observed patterns of tree mortality in Amazonia, researchers show in this study that windthrows, or blowdowns, act as important contributors to those observed patterns. Windthrows are more frequent in areas with no dry season, but are spatially and temporally variable across the basin. Over the next century, projected increases in extreme rainfall events may produce a dramatic increase in windthrows across the basin.

Jennifer Holm

Wednesday, cont.

16:45 - 17:00

Moscone West-3020

Monitoring CO₂ Intrusion in Shallow Aquifer Using Complex Electrical Methods and a Novel CO₂ Sensitive Lidar-based Sensor

While subsurface storage of CO₂ in geological formations offers significant potential to mitigate atmospheric greenhouse gasses, approaches are needed to monitor the efficacy of the strategy as well as possible negative consequences, such as leakage of CO₂ or brine into groundwater or release of fugitive gaseous CO₂. Researchers will present results using surface electrical resistivity tomography (ERT) and a novel CO₂ sensitive Lidar-based sensor to monitor a controlled CO₂ release at the Zero Emission Research and Technology Center (Bozeman, Montana). The experiment suggests how a range of geophysical, remote sensing, hydrological and geochemical measurement approaches can be optimally configured to detect the distribution and explore behavior of possible CO₂ leakages in distinct compartments, including groundwater and atmosphere.

Emmanuel Leger

Thursday, Dec. 15

11:34 - 11:52

Moscone South-102

Climate Modeling and Analysis with Decision Makers in Mind

There is a growing need for information about future climate conditions to support adaptation planning across a wide range of sectors and stakeholder communities. However, our principal tools for understanding future climate – global Earth system models – were not developed with these user needs in mind. Here, researchers highlight some of the barriers to communication and collaboration that must be overcome to improve the dialogue among researchers and climate adaptation practitioners in a meaningful way and present a vision for advancing the science of model evaluation in the context of predicting decision-relevant hydroclimate regime shifts in North America.

Andrew Jones

14:25 - 14:40

Moscone West-2006

Interactions between Cool Roofs and Urban Irrigation: Do Cooling Strategies Reduce Water Consumption in the San Francisco Bay Area?

In this study, for the first time, researchers assess the overarching benefits of cooling strategies on urban water consumption. They employ a satellite-supported regional climate-modeling framework over the San Francisco Bay Area to assess the effects of cool roofs on urban irrigation. Their analysis shows that widespread incorporation of cool roofs would result in a mean daytime cooling of about 0.7° C, which in turn results in roughly 4% reduction in irrigation water. They further investigate the critical interactions between cool roofs, wind, and sea-breeze patterns as well as fog formation, in the San Francisco Bay area.

Pouya Vahmani

Friday, Dec. 16

8:00 - 8:15

Moscone South- 307

Distributed Fiber Optic Sensing of Earthquake Wavefields

Seismic hazard strongly depends on local site response, which is rarely captured by even the densest seismometer arrays. Using laser-based Rayleigh scattering with fiber optic telecommunication cables, seismic wavefield information can be recorded with a technique known as distributed acoustic sensing (DAS). Recent active and passive DAS experiments confirm trade-offs in directionality and sensitivity compared with standard seismic sensors, however the possibility of using inexpensive fiber optics and a single instrument to characterize and monitor entire earthquake-prone regions with field-scale accuracy could represent a complimentary new direction for array seismology, seismic hazard analysis, and earthquake early warning.

Nate Lindsey

8:15 - 8:30

Moscone West- 2010

Similar Microbial Communities Found on Two Distant Seafloor Basalts

The oceanic crust forms two thirds of the Earth's surface and hosts a large phylogenetic and functional diversity of microorganisms. While advances have been made in the sedimentary realm, our understanding of the igneous rock portion as a microbial habitat has remained limited. Researchers present the first comparative metagenomic microbial community analysis from ocean floor basalt environments at the Lo'ihi Seamount, Hawai'i, and the East Pacific Rise (EPR). Basalt communities from Lo'ihi and the EPR show considerable metabolic and phylogenetic overlap down to the genus level despite geographic distance and slightly different seafloor basalt mineralogy.

Esther Singer, Berkeley Lab, DOE Joint Genome Institute

**Berkeley Lab's Earth & Environmental Sciences Presents
*Meet the Scientists: Booth #705, Moscone Center***

Tuesday through Friday, Berkeley Lab scientists will be available at the Earth & Environmental Sciences booth for conversations about their research. Berkeley Lab is developing 21st century approaches and scientific understanding relevant to both energy and the environment, including geothermal, nuclear waste, and geosciences, as well as fundamental research in climate studies, hydrogeology, and microbial ecology. A hallmark of the Lab's research is considering process interactions occurring within and across many Earth system compartments and scales.

For a complete list of scientists, stop by booth 705.