

PLENARY PROGRAM: SCIENCE AND AEROSPACE FRONTIERS

SUN
05:50 PM
PACIFIC TIME

The Dark Oxygen Research Initiative (DORI) Project - Investigating Dark Oxygen Production in the Deep Sea

Prof. Andrew K. Sweetman
The Scottish Association for Marine Science (SAMS), Oban, UK



Deep-sea seafloor organisms consume oxygen as part of a global balance between photosynthesis and respiration, but direct observations of oxygen consumption rates from the abyssal seafloor are scarce relative to its vast extent and the diversity of seafloor habitats. In 2024, Sweetman et al. published research from in-situ seafloor incubators from previously unexplored megahabitat (dike structures) in the eastern equatorial Pacific Ocean where they found more oxygen was being produced at the abyssal seafloor than was being consumed. In 42 incubators of the seafloor, they found oxygen levels increased in 80% of their incubated chamber experiments, rising to more than 3-times background levels over 48 hours. Dark oxygen production (DOP) occurred exclusively in the presence of manganese nodules. It is presently unclear what the mechanism behind DOP is, but the close link to polymetallic nodules and increase in interest in deep-sea mining necessitates further investigations. With funding provided by the Nippon Foundation, SAMS is embarking on a multi-year research program to fully characterize DOP in different deep-sea habitats and developing the Dark Oxygen Research Initiative - the DORI project. This talk will showcase the extensive evidence for DOP as well as provide details on the DORI project.

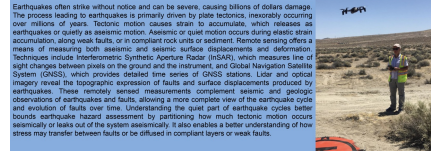


ANDREW SWEETMAN

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PACIFIC TIME

The Quiet Part: Remote Sensing and Earthquake Strain Accumulation

Dr. Andrea Donnellan
Purdue University, West Lafayette, Indiana



Earthquakes often strike without notice and can be severe, causing billions of dollars damage. The process leading to earthquakes is primarily driven by plate tectonics, inescapably occurring over millions of years. Tectonic motion causes strain to accumulate, which releases as earthquakes or quietly as aseismic motion. Aseismic or quiet motion occurs during elastic strain accumulation along weak faults or in compliant rock units or sediment. Remote sensing offers a means of measuring both aseismic and seismic surface displacements and deformation. Techniques include Interferometric Synthetic Aperture Radar (InSAR), which measures the slight changes between pixels on the ground and the instrument, and Global Navigation Satellite System (GNSS), which provides detailed time series of GNSS stations. Linear and circular interferograms reveal the topographic expression of faults and surface displacements produced by earthquakes. These remotely sensed measurements complement seismic and geologic observations of earthquakes and faults, allowing a more complete view of the earthquake cycle and evolution of faults over time. Understanding the quiet part of earthquake cycle better bounds earthquake hazard assessment by partitioning how much tectonic motion occurs aseismically or leaks out of the system asymmetrically. It also enables a better understanding of how stress may transfer between faults or be released in compliant layers or weak faults.



ANDREA DONNELLAN

MON
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Early Results from the SPHEREx Spectral Survey Satellite

James Bock
California Institute of Technology and
NASA Jet Propulsion Laboratory, Pasadena, CA



SPHEREx, a satellite in NASA's Medium Explorer program, launched in March 2025. The mission is now observing the entire sky in infrared spectroscopy, the first survey of its kind. SPHEREx is designed to probe the exotic physics of galaxies, study the origin of water and organic molecules in the form of ice in interstellar space, and chart the origin and history of galaxy formation. SPHEREx is producing four sky spectral maps in 102 infrared colors that will serve as a rich archive for the astronomy community. With over a billion detected galaxies, hundreds of millions of high-quality stellar and galactic spectra, and over a million ice absorption spectra, the archive enables diverse scientific investigations across astronomy. This talk will describe the SPHEREx science goals and present some early results.



JAMES BOCK

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The Cosmos We Take For Granted

Matthew Strassler
Harvard University, Cambridge, MA



In our busy 21st century, it is easy for many days to pass without our thinking even once about the universe we inhabit. Our senses and brains lul us into complacency, concealing how the cosmos permeates and shapes our lives. But when the most basic features of the world are examined closely, puzzles arise that reveal the universe's profound strangeness. These puzzles are simple to state and yet, despite the best efforts of physicists, they have proven extraordinarily difficult to resolve.

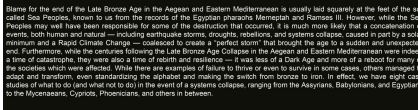


MATTHEW STRASSLER

WED
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PACIFIC TIME

1177 BC and After: Solar Minima, Rapid Climate Changes, and the Collapse of Bronze Age Civilizations

Eric Cline
George Washington University, Washington, D.C.



Stains for the end of the Late Bronze Age in the Aegean and Eastern Mediterranean is usually laid squarely at the feet of the so-called Sea Peoples, known to us from the records of the Egyptian pharaohs Merneptah and Ramesses III. However, while the Sea Peoples may well have been responsible for some of the destruction that occurred, it is much more likely that a concentration of events, both human and natural — including earthquake storms, droughts, rebellions, and systems collapse, caused in part by a solar minimum and a Rapid Climate Change — combined to create a perfect storm that brought the age to a sudden and unexpected end. Furthermore, while the centuries following the Late Bronze Age Collapse in the Aegean and Eastern Mediterranean were indeed a time of catastrophe, they were also a time of rebirth and resilience — a real life of a Dark Age and more of a rebirth for many of the societies which were affected. While there are examples of failure to thrive or even to survive in some cases, others managed to adapt and transform, even standardizing the alphabet and moving the world from barter to coin. If correct, we have eight case studies of what to do (and what not to do) in the event of a systems collapse, ranging from the Assyrians, Babylonians, and Egyptians to the Mycenaeans, Cypriots, Phoenicians, and others in between.

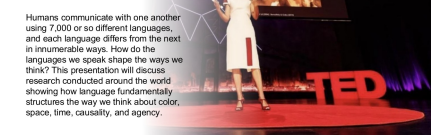


ERIC CLINE

WED
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PACIFIC TIME

How the Languages We Speak Shape The Ways We Think

Lera Boroditsky
University of California San Diego, San Diego, CA



Humans communicate with one another using 7,000 or so different languages, and each language differs from the next in innumerable ways. How do the languages we speak shape the ways we think? This presentation will discuss research conducted around the world showing how language fundamentally structures the way we think about color, space, time, causality, and agency.

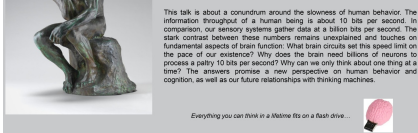


LERA BORODITSKY

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PACIFIC TIME

The unbearable slowness of being: Why do we live at 10 bits per second?

Dr. Markus Meister
California Institute of Technology, Pasadena, CA



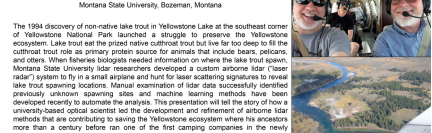
This talk is about a conundrum around the slowness of human behavior. The information throughput of a human being is about 10 bits per second. In comparison, our sensory systems gather data at a billion bits per second. The stark contrast between these numbers remains unexplained and touches on fundamental aspects of brain function. What brain circuits set this speed limit on the pace of our existence? Why does the brain need billions of neurons to process a paltry 10 bits per second? Why can we only think about one thing at a time? The answers promise a new perspective on human behavior and cognition, as well as our future relationships with thinking machines.

Everything you can think in a lifetime fits on a flash drive...

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Fishing for Invasive Lake Trout with Airborne Lidar

Joseph Shaw
Montana State University, Bozeman, Montana



The 1994 discovery of non-native lake trout in Yellowstone Lake at the southeast corner of Yellowstone National Park launched a struggle to preserve the Yellowstone ecosystem. Lake trout eat the prized native cutthroat trout but live far too deep to fit the cutthroat trout niche as primary prey source for animals that include bears, pelicans, and others. When fisheries biologists needed information on where the lake trout spawn, Montana State University lidar researchers developed a custom airborne lidar ("laser radar") system to fly in a small airplane and hunt for laser scattering signatures to reveal lake trout spawning locations. Manual examination of lidar data successfully identified previously unknown spawning sites and machine learning algorithms have been developed recently to automate the analysis. This presentation will tell the story of a university-based optical scientist led the development and refinement of airborne lidar methods that are contributing to saving the Yellowstone ecosystem where his ancestors more than a century before ran one of the first camping companies in the newly established Yellowstone National Park.





MARKUS MEISTER



JOSEPH SHAW