Scripps Student Symposium

Tuesday September 16

2014

Seaside Forum
Scripps Institution of Oceanography

Dear SIO Community,

Thank you for coming to the inaugural Scripps Student Symposium (S^3). The idea for the symposium came out of a conversation at Geotea, a weekly tea hour that the geologically-oriented graduate students have during the school year. We were discussing the fact that, outside our individual areas of study, we didn't really know about much of the really neat research that goes on at Scripps. This was especially true for the research that is student-driven. We began brainstorming ways that we might address this. That day, the idea for S^3 was born, with the goal of inspiring connections and collaborations between the different research groups, students and disciplines at SIO. To insure a diverse planning committee we recruited a few more folks from other departments. We sought support from the department, labs and the community and were please by their enthusiastic response to our idea. We're very excited about the great science that is being shared, and hope that the day helps to foster cross-disciplinary collaborations and increase graduate student communication.

It is our intent that this will be the first of many student symposia, and that this student-led tradition will carry on for many years to come.

We hope that you enjoy what we came up with.

All the best,
The S^3 Organizing Committee 2014

Kelley Gallagher
Brian House
Trevor Joyce
Robert Petersen
Nick Pizzo
Valerie Sahakian
Elizabeth Sibert
Lynn Waterhouse

Agenda

Tuesday, September 16th 2014
Keynote Speaker (Scripps alumnus 2011):
Prof. Michael Pritchard, Assistant Professor at UC Irvine in the Department of Earth System Science.

0815 - 0845	Registration Opens, Check-in.
0845 - 0900	Welcome from Prof. Lisa Tauxe, Chair and Deputy Director - Education
0900 - 1030	Oral Session 1 : Earth Wind & Fire (and Water)
1030 - 1050	Poster Session and Coffee Break
1050 - 1220	Oral Session 2 : Animal, Vegetable, Mineral
1220 - 1230	Group Photo
1230 - 1330	Lunch
1330 - 1500	Oral Session 3 : A Changing World
1500 - 1600	Judged Poster Session and Coffee
1600 - 1615	UC Ship Funds Presentation (Bruce Applegate)
1615 - 1700	Keynote Address (Prof. Mike Pritchard)
1700 - 1730	Awards Ceremony and Closing
1730 - 1830	Happy Hour and Poster Session

Oral Sessions

Earth Wind & Fire (and Water)

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Animal, Vegetable, Mineral

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1415 - 1430	Bacterial Origins of Brominated Natural Products in the Southern California Bight - Julia Busch	Page 16
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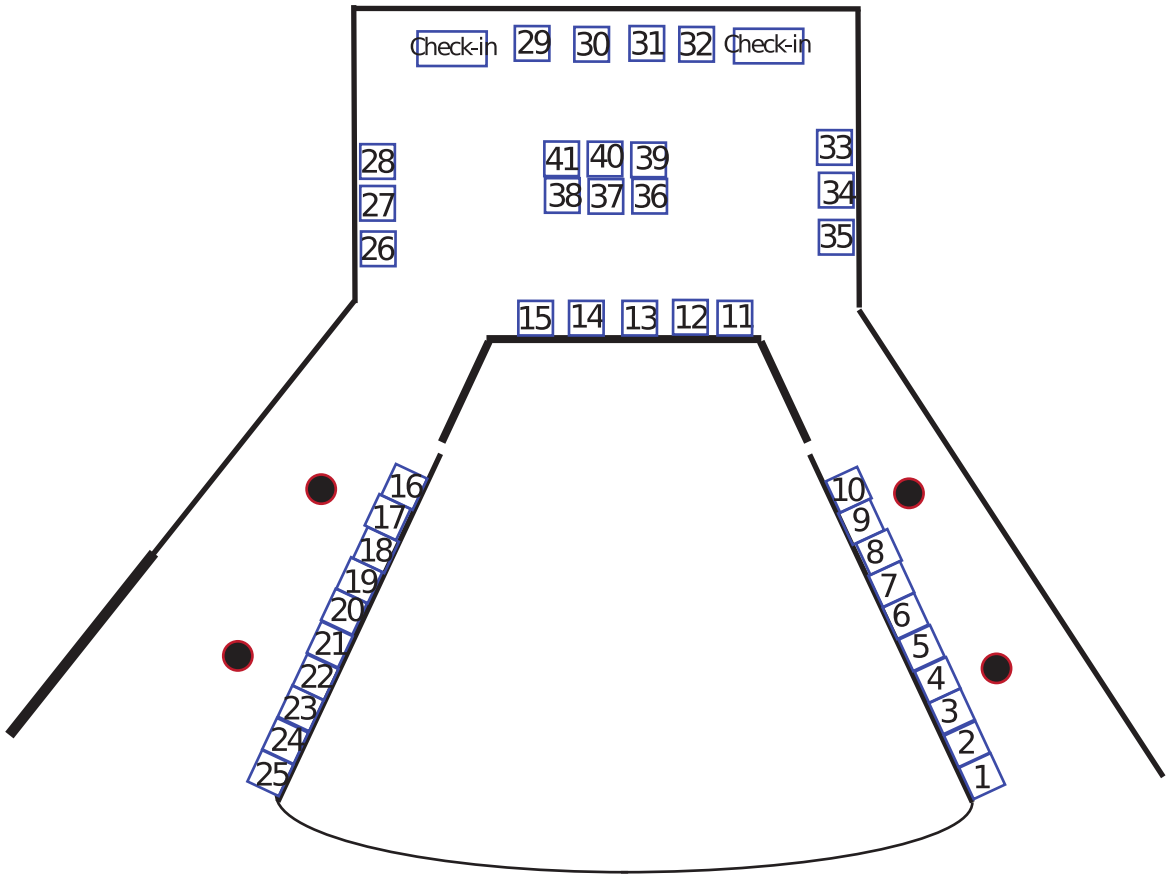

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What do marine bacterial transporters tell us about ocean chemistry?

Shane Hogle[1] †, Christopher Dupont[2], Bianca Brahamsha[1], Katherine Barbeau[1]

The ocean is a heterogeneous and complicated soup of dissolved, sort-of-dissolved (colloidal), and not dissolved (particulate) matter. Many marine chemists are interested in elucidating the chemical nature of this matter, and many marine microbiologists are interested in how marine bacteria interact with and utilize it. The study of marine bacterial transporters resides at the interface of these two disciplines, as it can provide insights to the types of chemicals in seawater with which bacteria interact as well as knowledge of specific microbial ecological strategies. By reading bacterial DNA as a type of 'blueprint,' marine molecular scientists are beginning to reverse engineer the chemical architecture of the ocean. My research efforts involve characterizing marine bacterial transporters in order to better understand what a bacterium might 'perceive' in its environment. Here I present a series of vignettes on this theme, demonstrating the computational and in vitro characterization of transporters in cultured and unculturable marine bacteria. Collectively, these findings refine our knowledge of the specific chemical compounds microbes encounter and potentially utilize in the marine environment.

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Quantifying Interactions in Dynamic Ecosystems

Ethan R. Deyle[1] †, Stephan B. Munch[2], George Sugihara[1]

In classical ecology, interactions between species are treated as constant elements of a community matrix. However there is growing evidence that many populations in nature exhibit nonlinear (state dependent) dynamics. In these systems, the strength of interactions is not constant but changes as the ecosystem evolves to new states. Despite being more realistic, analytical tools that can accommodate this paradigm are largely lacking. Here, we present a practical approach that uses time series data to measure changing interaction strength and identify causal drivers of these changes. The approach is illustrated with a model and applied to data from a marine mesocosm experiment. The results show that competition between zooplankton grazers is not fixed, but varies strongly in time and depends critically on food limitation. This empirical dynamic approach charts a feasible path for a paradigm shift toward state dependent interactions.

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Global patterns in small-scale turbulent mixing below the ocean's surface

Caitlin Whalen[1] †, Jennifer MacKinnon[1], Lynne Talley[1]

Vertical density profiles are ubiquitous in oceanography, yet the processes governing there basic shape are far from simple. Heat diffusing down from the atmosphere is not sufficient to produce this shape: turbulent mixing caused by breaking internal waves is also necessary. Here we investigate the global patterns of this turbulent mixing using Argo float profiles, and find that this mixing has substantial spatial variability. These patterns are dictated by the underlying topography, distribution of wind forcing, strength of the tides, and the eddy field. This mixing also varies temporally. We find a strong seasonal cycle along storm tracks (30-40 degrees) in both hemispheres.

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Use of time-at-temperature histograms to compare dive behavior across five species of deep-diving toothed whales (Sub-order: Odontoceti) in the northwest Bahamas

Trevor W. Joyce[1] †, John W. Durban[2], Diane C. Claridge[3], Lisa T. Ballance[1,2]

This analysis develops methods of using time-at-temperature (TAT) summaries of dive activity from five species of satellite-tracked deep-diving toothed whales to explore habitat overlap and partitioning in the deep-water (1200-3500m) channels of the NW Bahamas. Estimating vertical foraging ranges is an important component of understanding the role of these macro-predators in meso- and bathypelagic ecosystems, and is also a critical baseline in evaluating behavioral responses to naval sonar and other forms of marine anthropogenic disturbance. TAT histograms are a cost-effective and bandwidth-conserving method of conveying a long-term unbiased record of dive activity over the ARGOS satellite network. However, using temperature as a proxy for depth presents challenges in a topographically and hydrodynamically complex region. Using estimated isotherm depths and errors predicted by spatial models selected through cross-validation, we compared dive depth ranges between species and over diurnal cycles. Two delphinids, short-finned pilot whale (Globicephala macrorhynchus) and melon-headed whale (Peponocephala electra), both exhibited significantly greater nighttime dive activity within the upper 350m of the water column likely indicating a response to the diel vertical migration (DVM) of prey species. Sperms whales (Physeter macrocephalus) within this study commuted to foraging depths between 550-1000m, and a portion of tagged individuals adjusted mean foraging dive depths diurnally by 100-200m in a manner also consistent with the DVM of prey species. The foraging dive depth range (850-1600m) of two beaked whales, Cuviers beaked whale (Ziphius cavirostris) and Blainvilles beaked whale (Mesoplodon densirostris), exhibited no significant diurnal signal. However, repeated near-surface dives associated with recovering from oxygen debt and lactic acid surplus increased significantly in depth during daylight hours, suggesting an avoidance response to visual predators.

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New observations of localized and distributed shallow fault creep in Southern California

Eric O. Lindsey[1] †, Yuri Fialko[2], Yehuda Bock[1], David T. Sandwell[1], Sylvain Barbot[3], Roger Bilham[4]

In the brittle crust, faults are commonly modeled as thin planes of weakness which allow two relatively intact blocks to slide past one another. Earthquakes occur as sudden slip on this plane after a long period of no activity. During the interseismic period, faults may be locked (no slip) or creeping (slow, gradual slip). We have collected new high-resolution geodetic data across two of the most active faults in Southern California that suggest a more complex picture of faults near the surface. Near the town of Anza, CA, geodetic data across the San Jacinto fault show a several-kilometer-wide zone of anomalous deformation, but no creep on the fault itself. Using a numerical model of strain accumulation in the crust, we show that this zone likely represents distributed plastic shear in the top few kilometers of a broad fault zone, rather than along a single fault plane. To the east, the San Andreas fault in the Coachella valley is known to creep at the surface in certain locations. Here, a new geodetic dataset reveals that the creep is distributed across a several-kilometer-wide zone in some locations. We demonstrate that this width is correlated with small variations in the fault orientation, suggesting that localization is controlled by the fault-perpendicular compressive stress. These observations have important implications for studies of shallow fault properties, the shallow slip deficit observed during large earthquakes, and inferences of long-term fault slip rates based on geomorphology.

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Observing and understanding our regional marine layer clouds in a broadscale context

Rachel E. Schwartz[1] †, Alexander Gershunov[1], Sam F. Iacobellis[1], Daniel R. Cayan[1,2]

Marine layer clouds (MLCs) are a persistent regional feature of coastal California summer climate characterized colloquially as May Gray and June Gloom. The importance of MLCs ranges across fields, with many applications, some of which are not fully explored. We know MLCs regulate solar radiation, modulate coastal surface temperatures, and provide water for endemic species. A range of spatial and temporal scales govern MLC coastal manifestation. MLC spatial extent exhibits strong diurnal, intraseasonal, interannual, and decadal variability and responds to local topography, regional land and sea surface temperature (SST), and global circulation. Because some or most of these processes are likely to be altered by global climate change, MLCs may also be affected, although little is currently known about this important sensitivity. On interannual to interdecadal timescales, we find that regional southern California MLCs vary as a part of a broadscale low cloudiness pattern. Utilizing records from 20 coastal airports from San Diego all the way to the Aleutian Islands we find that summertime coastal low cloudiness since 1950 varies quite coherently over this broad coastal region and is organized by eastern Pacific SST variability. Beyond this coherent summer to summer variability, within May September differences emerge in variability of MLCs throughout coastal California. To explore this regional to local variability, we have created a novel record of MLC spatial extent for CA and the near-shore waters utilizing Geostationary Operational Environmental Satellite (GOES). This 18-summer (1996 2013) record reveals an organized progression in the timing and amplitude of seasonal MLCs as well as rich variation at synoptic to interannual timescales.

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An Underwater Microscope for In Situ Imaging of Coral Reefs

Andrew Mullen[1] †, Tali Treibitz[1], Jules Jaffe[1], Paul Roberts[1], Ben Laxton[1]

Micro-scale biological processes play critical roles in benthic ocean habitats including coral reefs, kelp forests and seagrass beds. Activities occurring at small scales such as competition, filter feeding and recruitment organize community structure and are essential to ecosystem health. It is difficult to replicate these phenomena and associated environmental conditions in the lab, yet there is a lack of means for field observations. In order fill this critical observational gap we have developed the Benthic Underwater Microscope (BUM). This is a novel diver-deployed instrument that non-invasively captures microscopic images and video of the marine benthos, at a resolution of several micrometers. Here we present the instruments design including electronic focusing with z-stacking, rapid exposures, a long working distance objective and underwater operation. Preliminary in situ results to be shown include overnight time series videos of coral-coral competition, interactions between polyps and individual zooxanthellae resolved inside corals. A discussion of future applications will examine possible studies on coral-algal competition. The BUM has potential to address important questions related to ecology, physiology and organism behavior.

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Explorations of the Antarctic subglacial environment from space, from the ice-sheet surface and by direct sampling

Matthew R. Siegfried[1] †, Helen A. Fricker[1], Sasha P. Carter[1]

Previously thought to be relatively-stagnant and in steady state, the Antarctic subglacial environment has proven in recent years to be a dynamic system with the ability to profoundly influence both the local and far-field biology, geochemistry, oceanography, and ice physics. This interface between ice, rock, and water, however, remains difficult to study as it is almost totally inaccessible, covered by, in some locations, ∼4000 meters of ice. With the goal of understanding the linked glaciological, geological, biological, geochemical, and hydrological role of subglacial water in West Antarctica, the NSF-funded Whillans Ice Stream Subglacial Access Research Drilling (WISSARD) project, an interdisciplinary collaboration of researchers at nine institutions, has explored a region of inter-connected subglacial lakes beneath the Whillans Ice Stream from space, from the ice-surface, and, in January 2013, through direct, clean access of a subglacial lake. I will briefly present biological and geochemical results from Subglacial Lake Whillans, then discuss the interaction between the subglacial water system and regional ice dynamics in greater detail. Using results from the largest continuous on-ice GPS network in Antarctica, we observed a cascading subglacial lake drainage event and the coupled ice sheet response, a relationship never previously documented with *in situ* instruments. Furthermore, the high temporal coverage of GPS, combined with the peculiar mechanism of ice motion in the area, provides unique and novel insights into the basal environment. These results also highlight the difficulty of long-term monitoring of Antarctic ice dynamics, where data are often collected only once a year.

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A framework for the marine fish microbiome

J. M. Blanton[1] †, L. M. Pieper[1], E. E. Allen[1]

Marine fishes represent incredible diversity, unique physiology, and high economic importance. Despite these facts, the host-microbiome system of these organisms remains poorly characterized. We investigate the microbiome of wild fishes by looking at specimens caught in the Southern California Bight, such as the sport fish and aquaculture target Seriola lalandi (California yellowtail) the forage fish Scomber japonicus (Pacific chub mackerel) and omnivorous Atherinops affinis (Topsmelt silverside). Using high throughput sequencing, we analyze the microbial 16S ribosomal genes from intestinal contents of individual fish. Initial results show that fish-associate communities have distinct taxonomic signatures unique from the environment, including the presence of key host-associated taxa such as segmented filamentous bacteria (SFB), the phyla Tenericutes, and the phyla Spirochaetes. Furthermore, microbial cell counts ranged widely within those published for other well-characterized vertebrate systems. Thus, while marine fish microbiomes show some commonality with patterns seen in other vertebrates, they also reflect a unique system whereby the taxonomic composition is unique and bacterial load is still to be determined. These results demonstrate initial steps and methods to characterize wild marine fish gut microbiomes within an ecological framework. Ultimately, this knowledge can be applied to understanding the importance of the gut microbiome to fish health in aquaculture and ecosystems management.

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Constraining sources of subducted and recycled carbon along the Sunda Arc, Indonesia

B. M. House[1] †, G. E. Bebout[2], David Hilton[1], B. Rodriguez[2], T. Plank[3]

Subduction-related recycling of volatiles like CO2, which is returned to the mantle in the form of either organic C or carbonate, is critical to prevent a runaway greenhouse effect and to modulate asthenospheric viscosity. However volatile cycling even in some of the most tectonically active regions remains poorly constrained. From sediment subduction rates and C contents at ODP/DSDP sites 765 and 211, we estimate the rate of C subduction along ∼2000 km of the East Sunda Arc, Indonesia to be ∼0.4 Tg C yr-1, and with new δ13C measurements of both carbonate and organic C, we present the most detailed study yet of C subduction along the arc. Our δ13C data, combined with previous measurements of carbon isotopic and CO2/3He ratios in volcanic gases, enabled us to revise C provenance estimates for volcanic CO2. As with previous estimates, the majority of volcanic C appears to originate from subducted carbonate either within hydrothermally altered ocean crust or biogenic sediments but our estimates suggest a greater influence of subducted organic C and minimal C from the mantle wedge. However the paucity of carbonate in sediments at site 211 indicates that, in contrast to most other arc systems, altered ocean crust must account for a significant fraction of sub ducted C in this region. Finally we estimate that between 80 and 90% of the C subducted escapes release in arc volcanoes and is instead transported into the mantle.

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Beyond CLAW: Direct observations of biogenic volatile organic compound (BVOC) air-sea flux

Michelle J. Kim[1] †, Mingxi Yang[2], Byron Blomquist[3,4], Barry Hubert[3], Timothy H. Betram[5]

In 1987, the influential "CLAW hypothesis" suggested phytoplankton are capable of regulating global climate by producing dimethylsulfide (DMS), a biogenic volatile organic compound (BVOC) that impacts aerosol particles ability to nucleate clouds. Though other parts of the CLAW feedback were eventually disproved, BVOCs are known today to significantly impact aerosol production, hygroscopicity and regulate the overall oxidative capacity of the marine atmosphere. Beyond DMS, there are few or no observations of BVOC in the remote marine atmosphere, further limiting our understanding of aerosol-cloud interactions and our ability to project future climate. In the Fall of 2013, we deployed a chemical ionization time-of-flight mass spectrometer to the remote North Atlantic on the High Wind Gas Exchange Study (HiWinGs) to directly measure the air-sea exchange of several BVOCs via the eddy covariance method. To our knowledge, this work represents the first direct measurement of monoterpene air-sea exchange, an extremely reactive trace gas with aerosol yields approaching unity.

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The Ruby Seadragon, a spectacular new species of seadragon (Syngnathidae)

Josefin Stiller[1] †, Nerida G. Wilson[2], Greg W. Rouse[1]

The exploration of Earths biodiversity is an exciting and ongoing endeavor. Despite the large number of species descriptions each year, the discovery of a charismatic new vertebrate is now unusual. Here we report a new species of seadragon from Western Australia with substantial morphological and genetic differences to the only two other known species. Due to its spectacular red coloration we describe it as the Ruby Seadragon, Phyllopteryx dewysea n. sp. Although the Leafy Seadragon (Phycodurus eques) and the Common Seadragon (Phyllopteryx taeniolatus) occur along Australias southern coast among relatively shallow (<50 m depth) macroalgal reefs, the new species was found slightly offshore. The holotype was trawled east of the remote Recherche Archipelago in 51 m; additional specimens extend the distribution west to Perth in 72 m. These records suggest that the Ruby Seadragon may be bathymetrically isolated. Molecular sequence data show clear divergence from the other seadragons and support a placement as the sister-species to the Common Seadragon. Radiographs and micro-computed tomography were used to visualize the skeleton of the Ruby Seadragon. The discovery raises issues for seadragon conservation, and provides a spectacular example for the surprises still hidden in our oceans, even in relatively shallow waters.

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On the relationships between subtropical clouds and meteorology in observations and climate models

Timothy Myers[1] [†], Joel R. Norris[1]

Clouds affect the energy balance of the climate system by reflecting incoming solar radiation (cooling effect) and absorbing outgoing thermal radiation (warming effect). Over the eastern subtropical oceans, abundant optically thick low-level clouds have a net cooling effect on the climate and are poorly simulated by climate models. If the horizontal coverage of these clouds decreases due to anthropogenic climate change, global warming will be amplified, whereas if their coverage increases, global warming will be dampened. Here, interannual relationships between low-level cloud properties and the large-scale meteorological environment are examined in observations and models. The observed relationships help to understand the underlying physics and suggest how the clouds will respond to perturbations in the meteorological environment expected to occur under anthropogenic climate change. It is found that climate models simulate cloud/meteorology relationships with varying magnitude and sign relative to observations. The modeled relationships help to understand the sources of inter-model spread of projections of twenty first century changes in cloudiness and hence why certain models predict less or more global warming relative to other models.

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Lunar cycles of dolphin foraging in the Southern California Bight

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Dolphins use echolocation clicks to navigate and find suitable prey. Dolphin foraging is generally limited to the upper 50 m of the surface environment, although some species present in the Southern California Bight are able to dive to depths of over 200m. Many dolphin prey species are part of the deep scattering layer (DSL), including cephalopods, small pelagic and mesopelagic fish. Portions of the DSL characteristically undergo a daily vertical migration, avoiding visually oriented predation by remaining at depth (300-400m depth) during the day and moving toward the surface (0-100m depth) at night to feed, dependent on the degree of sea surface illumination. Using periods of high echolocation rates as a proxy for foraging, daily and seasonal trends of dolphin foraging are monitored through the use of autonomous acoustic recorders in the Southern California Bight over the course of two years (2009-2010). Diel and lunar trends in species-specific echolocation activity are observed at multiple sites, which can be attributed to increased dolphin feeding activity when prey species are present within accessible depths. A zero-inflated negative binomial model was constructed to investigate the relationship between environmental parameters and foraging activity. Cloud cover is considered as a possible factor in the degree of sea surface illumination, which may influence the extent of vertical migration of the DSL. Seasonal trends in echolocation activity are also observed at some sites, likely representing the variation in local abundance of available prey.

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Sensing ocean carbon dioxide

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As sources and sinks of carbon dioxide continue to fluctuate with an intensifying anthropogenic signature, observations of the marine inorganic carbon cycleeffectively carbon dioxides movement throughout the oceansare increasingly critical. I will describe the development and deployment of sensors designed to better understand the marine inorganic carbon system. Our work comprises a range of testing, from simple component-by-component bench-top evaluations through analysis of data collected by well-characterized sensors. By shrinking the rosette to a microfluidic scale and integrating a wet-chemical analysis, we are inventing a Micro-Rosette for dissolved inorganic carbon (DIC) quantification from profiling floats. We assess pH sensor quality control protocols, a highly sought analysis in light of the attention that ocean acidification has garnered over the past few years. Finally, we discuss results obtained using an instrument suite containing fast-response pH, dissolved oxygen, temperature, and position sensors. The package is tethered to a surf platform in order to study inorganic chemical dynamics of the surf zone and near-shore region; it is also used regularly for science outreach. The combination of these tools and techniques will provide a clearer picture of ocean carbon dioxide patterns, from the Scripps coastline to the open ocean.

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Bacterial Origins of Brominated Natural Products in the Southern California Bight

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Halogenated organic compounds (HOCs) have been produced industrially as pesticides and coolants, but also occur naturally in the marine environment. Some HOCs are toxic and the presence of these molecules in the ocean is concerning due to their ability to accumulate through the food chain and the potential danger resulting from seafood consumption by humans. One group of HOCs that are of particular concern to human health is polybrominated diphenyl ethers (PBDEs), which are used as flame-retardants. These molecules can cause health problems in humans including thyroid disruption and cancer. Anthropogenic PBDEs have been found to accumulate in marine organisms but there is increasing evidence that compounds with similar structures are also naturally produced in the marine environment. Marine bacteria in the genus *Pseudoalteromonas* have been found to produce HOCs including PBDEs. The biosynthesis of these molecules is becoming more understood but little is known about the distribution of these HOC-producing bacteria in the marine environment. The *Pseudoalteromonas* phylogeny was studied and additional strains were isolated to help identify patterns of HOC production within this group. In addition, targeted detection of potentially producing strains was performed using a PCR screen for a biosynthetic gene that plays a key role in the synthesis of PBDEs and related molecules. Using these methods, PBDE-producing marine bacteria have been isolated from the local marine environment.

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Eddy generation and decay in the Southern Ocean

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In the Southern Ocean mesoscale eddies are thought to arise from the multiple Antarctic Circumpolar Current jets either via barotropic instability or via instabilities in the mean vertical shear. A significant part of the energy extracted from the mean state by the baroclinic eddies is thought to contribute toward bottom-enhanced diapycnal mixing over regions of rough topography. This work aims to identify the energy sources of eddy generation and the role of topography in the generation and decay process. We present evidence that generation and decay of eddies in the Southern Ocean occurs in highly localized regions. Areas with high probability of eddy generation occur downstream of ridges, and other areas with high topographic variance, suggesting that topographic features instigate baroclinic instability. Areas of elevated vertical buoyancy flux, calculated from an ocean state estimate, coincide with identified hot spots of eddy generation, suggesting that the main energy source is mean potential energy.

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Monitoring Antarctic ice loss from space

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Current sea level is rising significantly faster than the average rate over the past century. About half of the contribution to the present sea-level rise comes from mass loss of the polar ice sheets and mountain glaciers. The Antarctic Ice Sheet is the largest water reservoir on Earth, containing enough ice to raise global sea level by ∼60 m. The ice sheet gains mass by snowfall and loses most of it at its margin by basal melting and iceberg calving of its floating ice shelves. The only way to monitor changes in ice volume for this vast and remote ice sheet is by satellite. Here we present the challenge of detecting changes in ice-shelf thickness at the centimeter level and determine decadal trends. By combining data from three satellite radar altimeters (1994-2012), we show almost two decades of observations in the thickness and mass balance of the ice shelves around the entire Antarctic continent. Our results reveal large spatial and temporal variability in ice-shelf mass loss, which can be used to fingerprint oceanic and atmospheric causes of ice sheet mass change.

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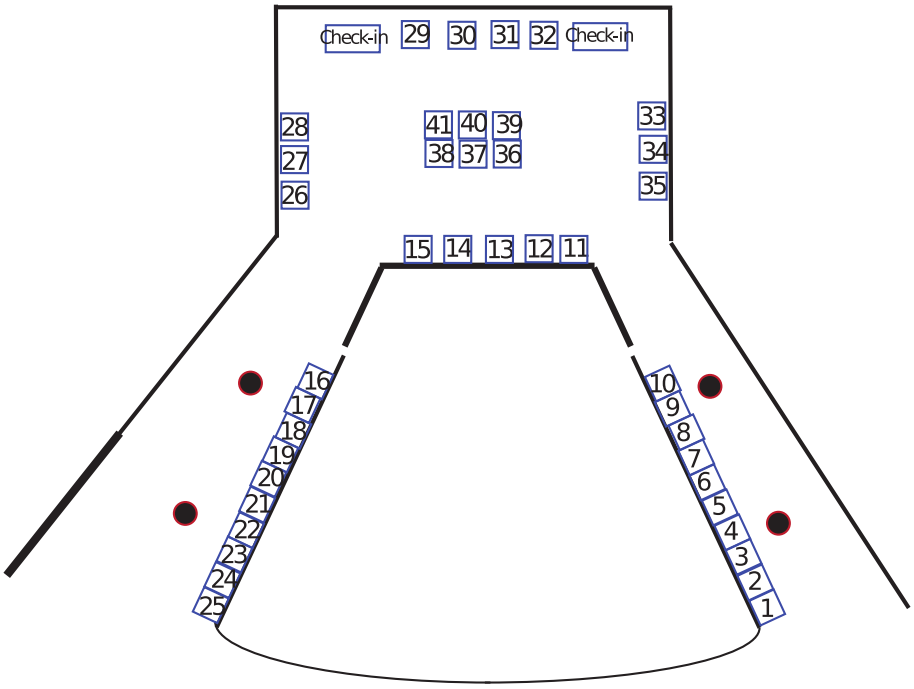
Poster Map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Cellular Physiological Asymmetries Between the Blind and Ocular Side Gills of Marine Flatfish

Yuzo Yanagitsuru[1] †, Natalya Gallo[1], Martin Tresguerres[1]

Flatfishes likely experience a different chemical environment on each side of their bodies due to their lifestyle of lying on the sediment. However, there have been no studies on potential adaptations flatfishes have developed to cope with this asymmetry. Since gills are essential for regulating the effects of environmental stressors on fishes, we quantified the relative abundance of proteins between the gills facing the water column (ocular side gills) and those facing sediment (blind side gills). Using Western blot, we quantified the relative abundance of sodium potassium ATPase (NKA) and vacuolar proton pump (VHA) between the ocular side gills and blind side gills of the marine flatfish: slender sole (Lyopsetta exilis). We found that NKA does not differ between the two sides; however, VHA is 45% more abundant on the ocular side compared to the blind side gills. This suggests that slender sole ocular side gills preferentially mediate ammonia excretion, acid secretion, or base secretion. Our study found, for the first time, an asymmetry in cellular physiology between the two sides of gills in a fish and lays the groundwork to better understand marine flatfish gill physiology.

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New High-Resolution 3D Imagery of Newport-Inglewood/Rose Canyon Fault Geometry and Deformation Offshore San Onofre, California

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The Inner California Borderlands (ICB) is situated off the coast of southern California and northern Baja. The structural and geomorphic characteristics of the area record a middle Oligocene transition from subduction to microplate capture along the California coast. Marine stratigraphic evidence shows large-scale extension and rotation overprinted by modern strike-slip deformation. Geodetic and geologic observations reported by others indicate that approximately 6-8 mm/yr of Pacific-North American relative plate motion is currently accommodated by offshore strike-slip faulting in the ICB. The farthest inshore fault system, the Newport-Inglewood/Rose Canyon (NI/RC) fault complex is a dextral strike-slip system that extends primarily offshore approximately 120 km from San Diego to the San Joaquin Hills near Newport Beach, California. The NI/RC fault system Holocene slip rate is 1.5-2.0 mm/yr to the south and 0.5 mm/yr along its northern extent based on well data from Freeman, et al (1992). An earthquake rupturing the entire length of the system could produce an event of Mw 7.0+. In late 2013, we completed the first high-resolution 3D seismic surveys (3.125 m bins) of the NI/RC fault system offshore of San Onofre as part of the Southern California Regional Fault Mapping project aboard R/V New Horizon. It is anticipated that analysis of these data volumes will lead to new constraints on fault geometry and segmentation of the fault system, with the potential of updated slip-rate estimates if suitable targets are located/dated.

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Use of FACS to Sort Bacteria with Intrinsically Fluorescent Natural Products from Seawater

Tracey Somera[1] [†], Paul Jensen[2]

This project explores the possibility of using fluorescent natural products to detect specific microbes in seawater. To our knowledge, isolation of live, unstained cells has only ever been reported for marine autotrophs containing photopigments, and not for other types of fluorescent natural products. Traditionally, flow cytometry research requires staining specific populations of cells with fluorescent dyes or probes which kill the cell because they require the membrane to be permeabalized. Isolation of individual, stained cells is then achieved by cell sorting. In this study, we focus on two different intrinsically fluorescent natural products: Violacein (C20H13N3O3) produced by Pseudoalteromonas luteoviolacea and Seriniquinone (C20H8O4S), produced by Serinicoccus marinus. By gating on the parameters of forward-angle light scatter and side-angle light scatter (fluorescence) in a cell sorter, live cultures of producer cells were added to a natural population of bacteria in seawater (<5um), re-isolated into collection tubes containing 0.02 um filtered seawater, and subsequently grown on agar plates. Current work involves using this method to selectively sort and culture new strains of P. luteoviolacea and S. marinus from seawater samples. The potential to use FACS for the live isolation of other types of marine microbes that produce medically relevant compounds but are relatively rare in seawater remains to be explored.

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Chasing Waves: Using West Coast Ocean Observing Systems to track marine debris and ocean acidification along the California Current

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Physical oceanographic processes are an important component of marine ecosystems and ocean health, and must be considered in marine management decisions. However, West Coast managers currently lack easy access to information about oceanographic features and trends that can be incorporated into ocean health policies and decision-making. The West Coast Governors Alliance on Ocean Health (WCGA) and the Integrated Ocean Observing System (IOOS) West Coast Regional Associations (SCCOOS, CeNCOOS and NANOOS) are working collaboratively to develop oceanographic data products to aid state and regional policy-makers and coastal managers in understanding and addressing the issues of marine debris and ocean acidification along the West Coast. Data products include monthly- and seasonally-averaged two-dimensional plots of ocean surface currents, winds and wave data at various spatial scales. We are also working with collaborators to increase access to pH and aragonite saturation maps for the California Current System under present and predicted future conditions. These data products are based on needs expressed by ocean managers and users, for both marine debris- and ocean acidification-specific work, and for broader efforts to track and understand West Coast oceanography. To aid marine debris cleanup efforts, these data are being analyzed for nearshore directional movements, to determine likely locations for trash congregation. Potential marine debris-specific users include NOAAs Marine Debris Program, the Ocean Conservancy and local beach clean-up organizations. The data plots can also be used by state ocean advisory committees, National Marine Sanctuaries and non-profit organizations to track ocean acidification-related trends and oceanographic movements more generally.

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Natural Variability of The Atmospheric Potential Oxygen

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The Atmospheric Potential Oxygen (APO) record combines the longterm Scripps measurements of O2 and CO2 to remove the terrestrial influence on O2, thus opening a unique observational window into ocean biogeochemical and physical processes. This unique timeseries exhibits spatial and temporal features on seasonal to decadal timescales, highlighted by an accelerating downward trend and a negative interhemispheric gradient since ∼2000 coinciding with the surface warming hiatus associated by recent studies with greater heat uptake and climate variability in the Pacific. Because of tight coupling between air-sea heat and oxygen exchange, the APO record may contain relevant physical signals driving the warming hiatus. The relation between ocean heat content and oxygen however remains poorly understood at these timescales, obscured by complex biological processes. We thus explore the natural variability of APO fluxes in a 1000 year unforced simulation of a coupled ocean-atmosphere model (POP/CAM) coupled to an ocean biogeochemical model (BGC) in CESM. Interesting signals related to ENSO and other modes of variability emerge, along with heterogeneous coupling to heat in space and time, that may explain some of the observed APO features. Comparing this analysis to other models (CMIP5) shows a considerable inter-model spread in simulating this spatial and temporal variability. Understanding the natural variability of both oceanic carbon and oxygen cycles not only provides context for recent APO observations, but is also critical to accurately assess and predict human influence on ocean biogeochemical dynamics.

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Improved Accuracy of a Global Marine Gravity Model using New CryoSat-2 and Jason-1 Satellite Data

Emmanuel S. Garcia[1] †, David T. Sandwell[1], Walter H. F. Smith[2]

A global model of marine gravity anomalies derived from radar altimeter measurements of the ocean surface can serve as a data set for investigating seafloor tectonics and predicting uncharted bathymetry. Achieving improved accuracy of this marine gravity model depends on a dense spatial distribution of satellite ground tracks and high range precision of the onboard altimeter. Two satellite remote sensing missions in particular have these required capabilities: the Jason-1 mission, which concluded in 2013, and the still ongoing CryoSat-2 mission, which was primarily designed for cryosphere monitoring but is collecting ocean data as well. We have developed methods to reprocess these newly available altimetry measurements to optimally recover the gravity-related signal in the radar estimates of sea surface slope. These recent observations from CryoSat-2 and Jason-1 were then combined with previously collected data from the Envisat, ERS-1, and Geosat missions, we were able to construct a new global map of marine gravity. When compared against shipboard gravimeter tracks, our latest model shows significant improvement in both accuracy and resolution over older gravity maps. The improved marine gravity model will enable more detailed studies of the oceans tectonic plates, including the delineation of structures buried underneath sediments and the modeling of plate deformation by bending, which occurs at deep sea trenches.

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Transcriptome effects of Low pH and Low O2 Conditions on the California Market Squid, Doryteuthis opalescens

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Embryos of the California market squid, Doryteuthis opalescens, may be vulnerable to two aspects of climate change: expansion of oxygen minimum zones and ocean acidification. To investigate how D. opalescens will respond to these conditions, embryos were harvested in La Jolla, CA and placed in replicate flow-through seawater tanks of two treatments: ambient seawater (control) and high-CO2/low-pH, low-O2 over the course of development. Embryos were flash-frozen prior to hatching and total RNA was extracted for genome-wide gene expression analysis (RNA-seq). RNA from a single adult individual was separately sequenced, assembled and annotated using a custom pipeline to obtain over 20,000 annotated genes as a reference transcriptome. The experimental embryo RNA was mapped to this novel D. opalescens reference to obtain differentially expressed genes. Preliminary results show molecular chaperones, respiratory proteins, and several KEGG metabolic pathways are significantly differentially expressed under high-CO2 and low-O2, and embryos in this condition showed delayed hatching (+10% development time). These results suggest that high-CO2 and low-O2 conditions represent a significant physiological stress for D. opalescens embryos. As D. opalescens is a semelparous species where next years catch depends entirely on survival of the previous years embryos, climate change in the California Current may affect this lucrative fishery.

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The Dry Moon: Volatile Depletion in the Lunar Magma Ocean

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The Earth and Moon are genetically linked through identical (within error) isotope compositions of O, Si, W, Ti, and Cr (Lugmair and Shukolyukov, 1998; Wiechert et al., 2001; Spicuzza et al., 2007; Touboul et al., 2007; Armytage et al., 2012; Zhang et al., 2012), but exhibit differences in isotopic compositions of volatile and moderately-volatile elements (e.g Cl, Zn; Sharp et al., 2010; Paniello et al., 2012a). There are currently a number of geophysical and geochemical models (e.g. Elkins Tanton et al., 2002; Pahlevan and Stevenson, 2007; Elkins-Tanton et al., 2011; Cuk and Stewart, 2012; Canup, 2012; Visscher and Fegley, 2013) that seek to explain the formation, differentiation and composition of the Moon. In this study, we use recent zinc isotopic data of lunar samples (Paniello et al., 2012) to explore the mechanisms and timing of volatile depletion on the Moon. We hypothesize that the uniform isotopic signature of the low-Ti and high-Ti mare basalts (δ66Zn $\sim$1.42 per mil) resulted from wholesale vaporization during the lunar magma ocean event. We assume zinc isotopic fractionation in a molten surface layer that is mixed into the bulk magma composition using an assimilation fractional crystallization model (DePaolo, 1981; Nishimura, 2012). The results suggest that it is indeed possible for the Moon to have acquired a bulk mantle composition during the lunar magma ocean event. The geochemical constraints for this scenario are robust and well-constrained, and may preclude the need for earlier models of fractionation within a proto-lunar disk (e.g. Pahlevan and Stevenson, 2007).

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Novel leopard seal (Hydrurga leptonyx) foraging behavior revealed using integrated diving, surface position, and video instruments

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Leopard seals are apex predators that can alter the community structure of Antarctic coastal ecosystems. Previous behavioral studies were limited by restricted access and/or low resolution satellite-linked tags. Consequently, foraging tactics, habitat use and social behaviors are poorly understood. Here we present the first analysis of animal-borne video footage for foraging leopard seals. Each CRITTERCAM was deployed with fast-loc GPS and time-and-depth-recorder (TDR) instruments providing fine-scale habitat context for observed foraging behavior. We analyzed seven deployments obtained in January and February of 2013 and 2014 from adult leopard seals near mesopredator breeding colonies on Livingston Island, Antarctica. 5,130 dives were recorded for 18 foraging trips. Mean deployment length was 6.36 (s.d. 3.03) days. Three independent observers scored 50 hours and 18 minutes of video footage by time of day, habitat type, behavior, feeding event, foraging tactic, and inter and intraspecific social encounters. Novel foraging behaviors were identified including food caching/scavenging, kleptoparasitism, and hunting/processing of demersal fish. Diel movement patterns and prey choices were consistent across the sample; however, there was high individual variation of prey-specific foraging tactics. Our results suggest that position-integrated video data will be vital in quantifying the ecological impact of this abundant, versatile, apex predator.

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Impacts of canonical and Modoki El Nio on tropical Atlantic SST

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The impacts of canonical and Modoki El Nio on tropical Atlantic sea surface temperature (SST) are quantified using composite analysis. Results show that El Nio Modoki fails to produce significant warming in the tropical Atlantic, in contrast to the well known warming following canonical El Nio events. El Nio Modoki instead induces significant cooling in the northeastern tropical Atlantic and near-neutral conditions elsewhere in the tropical Atlantic. It is shown that the difference in SST response stems primarily from a much stronger Pacific/North American (PNA) teleconnection pattern and stronger atmospheric Kelvin wave response during canonical events compared to Modoki. The stronger PNA pattern and Kelvin waves during canonical events generate anomalously weak surface winds in the tropical North Atlantic, driving anomalously weak evaporative cooling and warmer SSTs. Past research has shown significant decadal variability in the frequency of noncanonical El Nios relative to canonical events. If such variability continues, it is likely that the impact of El Nio on tropical Atlantic SST will also fluctuate from one decade to the next.

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The Cretaceous-Paleogene Boundary: beginning the Age of Bony Fishes

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While fishes have a long evolutionary history, the Actinopterygians (ray-finned bony fish) that dominate the modern ocean were a relatively small, insignificant group until the Late Cretaceous and early Paleogene. However, the exact timing and mechanism that drove their diversification and subsequent dominance in the marine realm is poorly constrained. Here we use a relatively untapped fossil resource, microfossil teeth and shark dermal scales (ichthyoliths) preserved in deep sea sediments, to study the changes in fish production and community structure continuously across the Cretaceous-Paleogene (K/Pg) mass extinction. We find that while other groups were decimated by the K/Pg extinction, fishes as represented by accumulation rate of ichthyoliths thrived. The K/Pg event marks a turning point in the ichthyolith community: where the Cretaceous open ocean is shark-dominated, the Paleogene pelagic ecosystem is ruled by bony fishes. While shark abundance does not change significantly across the boundary, the accumulation of bony fishes increased in the Pacific Ocean, in some cases to 2-5 times Cretaceous levels. Additionally, while Cretaceous samples have a small range of bony fish tooth sizes, with the majority <1 mm in length, Paleocene assemblages have a much wider range of sizes, and a sustained high relative abundance of large teeth (<1 mm) for 8 million years post-extinction. We interpret this as a shift to a more complex bony fish community with increased numbers of large predatory fishes in the Paleocene. The increase in Paleocene tooth size range and both relative and absolute abundance suggests that bony fish were able to take advantage of newly opened ecological niche space vacated by victims of the mass extinction. We conclude that the K/Pg extinction played an important role in restructuring pelagic marine ecosystems to favor bony fish evolution and ecological expansion, and indeed may have been the harbinger of the modern Age of Bony Fishes.

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From Species to Gene to Natural Product, And Back Again

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Taxonomy, the classification of living things, began with naturalists observing what they saw in nature. The species concept was at first descriptive, an African elephant is an African elephant because it has a trunk and tusks and big ears that look like Africa. Since the discovery of DNA as the key to inheritance, however, the species concept has shifted to a genetic definition; an African elephant is an African elephant because it has the genes that encode for a trunk, tusks, and big ears that look like Africa. This has caused a great deal of revision and ambiguity within the tree of life, particularly so within the bacterial branch. Modern classifications of bacteria focus on key housekeeping genes, those that encode for vital cellular systems, such as the ribosome, energy metabolism, and cellular structure, but these arent the systems of interest to a natural products chemist. We want to know about the secondary metabolome, bioactive compounds produced as signaling or defense molecules, that are not essential for growth or reproduction. An attempt to characterize the Gerwick library of cyanobacterial extracts provided a great deal of information about the secondary metabolomes of our strains, but also raised a great question. We understand a species as a set of genes that encode for all the biological capacity of an organism; can we go the other way, from knowing the natural products in an extract to an rigorous understanding of the species?

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Observing water mass modification in the Solomon Sea

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The Solomon Sea acts as an intersection for water masses traveling equatorwards to join the Equatorial undercurrent. These water masses must pass over the variable topography of the Solomon Sea where strong vertical mixing is required to account for observed changes in temperature-salinity relationships along water mass pathways. The spatial patterns of mixing are estimated using physical observations from two cruises and show enhanced mixing in the channels that connect the Solomon Sea to the equatorial Pacific and along the pathways of the western boundary currents. As terrestrial iron is deposited into the Solomon Sea from river run-off along the eastern coast of Papua New Guinea, quantifying the regional mixing patterns and the processes responsible may improve understanding of how iron is distributed throughout the water column. Furthermore the water masses in the Solomon Sea act as the primary source of the Equatorial Undercurrent and thus determine the properties of water upwelled in the highly productive eastern equatorial Pacific. The vertical transport of heat due to mixing may also have implications for climate as a result of this connection to water properties in the eastern Pacific.

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If you can't see, then sing: humpback whale diel cycles near Los Cabos, Mexico

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Humpback whale song is one of the most widely known acoustic behaviors in the marine ecosystem (Payne & McVay, 1971). Its biological function is still debated, but one postulation is that male humpback whale song serves in nighttime aural territory defense or mating advertisement when visual cues are not possible (Au et al., 2000). Song occurs on a diel cycle in at least three breeding grounds (the West Indies, Australia, and Hawaii) whereby peak sound levels occur near midnight and troughs occur soon after sunrise (Au et al., 2000; McCauley et al., 1996). This presentation presents evidence that a similar diel cycle exists in a fourth feeding ground: Los Cabos, Mexico. It was here that during the 2013 and 2014 humpback whale breeding seasons, bottom-mounted recorders collected acoustic data for eight weeks at three sites. As theorized, preliminary analysis of ambient noise between 100-1000 Hz was dominated by humpback whale song. Depending upon the recording site and year, the amount of acoustic energy that song introduced to the overall soundscape fluctuated between 7 to 16 dB re 1 uPa when sampled in one-hour increments. This presentation will first parameterize the diel cycle off Los Cabos and compare it to other breeding grounds. Second, it will discuss a potential method for measuring the diffuse ambient sound energy of song and how it could be used to estimate the relative abundance of humpback whales. This estimation capability is especially pertinent to a current sanctuary in Maui and a proposed sanctuary in Los Cabos.

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Measuring Site Response for Seismic Hazard in the Ohio River Valley

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Evaluating the amplification of seismic waves due to varying near-surface soil properties is expected to provide the city of Evansville, Indiana with an improved seismic hazard assessment. The goal of this work is to determine whether 1D calculations of site response based on local soil properties and bedrock depth are sufficiently accurate to represent the observed site response. The surface geology of the Evansville area can be classified into four general types: (a) outwash terrace, (b) lacustrine terrace, (c) loess and colluvium, and (d) river alluvium. The reason for dividing the area into these four units is to investigate whether the ground motion at different sites is amplified as a result of its distinct physical properties. To assess the reliability of the 1D calculations we calculate acceleration spectra from environmental noise and earthquake event recordings to show the periods where site resonances occur. Calculating the horizontal to vertical spectral ratios and the site-to-site spectral ratios are two methods for estimating site response based on different assumptions. We show the site response calculated using both methods for each of the sites and compare it with the 1D site response. We are testing a 3D wave propagation method for future investigations of whether 3D calculations are necessary for accurately modeling site response.

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Utilizing comparative molecular networking techniques to determine predation defenses in marine actinomycetes

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Numerous natural products have been isolated from marine bacteria, the majority from the order Actinomycetales. However, very little effort has focused on determining the ecological roles these metabolites provide for their hosts. Salinispora, an obligate marine actinomycete genus, has been studied extensively due to its production of numerous secondary metabolites, making this a model genus for chemical ecology experiments. The aims of this study were to determine the effects of benthic invertebrate predators on Salinispora secondary metabolite production, mainly focusing on the inducibility of secondary metabolites in response to predation. Metabolomic data generated from high-resolution tandem mass spectrometry was networked in a comparative fashion to identify induced compounds found in chemical extracts synthesized by Salinispora strains inoculated with predator chemical cues. The results indicate chemical induction in Salinispora pacifica and Salinispora tropica when inoculated with chemical cues from the polychaetes Ophryotrocha n. sp., and Ctenodrilus cf. serratus. Inoculations of Salinispora pacifica with chemical cues from Neoamphitrite robusta also resulted in the induction of compounds. Further chemical analysis on the induced compounds is being planned to identify structures as well as test the effects of these compounds on benthic predators.

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A 7-Year Climatology of Spray Glider Data along CALCOFI Lines 66.7, 80, 90

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Since 2006, Spray gliders have been continuously surveying the California Current System along CalCOFI lines 66.7, 80, 90. The autonomous underwater gliders provide repeat sections that extend 500m in depth and 350-500km in offshore distance. Measured variables include pressure, temperature, salinity, velocity and fluorescence. We have used the seven-year dataset from the CA Glider Network to create a climatology for each of the three CalCOFI lines. The climatology is comprised of objectively mapped fields, uniformly spaced in time, depth and offshore distance. An initial analysis of the climatology examines mean conditions, annual cycles and interannual anomalies, specifically ENSO signals.

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Continental shelf morphology and stratigraphy offshore San Onofre, CA: the interplay between eustasy and sediment supply

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New CHIRP seismic data acquired offshore San Onofre, CA reveal that shelf sediment distribution and thickness are primarily controlled by eustatic sea level rise and sediment supply. Throughout the majority of the study region, a highly defined abrasion platform and associated shoreline cutoff are observed from ∼72 to 53 m depth. These appear to be formed between Melt Water Pulse 1A and 1B, when the rate of sea-level rise was lower. There are three distinct sediment units observed in the seismic data: an infilling lag deposit, a midshelf lag deposit, and modern deposition. The deepest unit infills the abrasion platform formed by wave-base erosion and pinches out landward against the shore-line cutoff. The midshelf unit is material eroded from a shallower abrasion platform that thins seaward by downlap and landward by onlap. The youngest unit is acoustically transparent and records modern deposition. Faults in the study area do not appear to offset the transgressive surface (TS). The NI-RC fault system is active in other regions and offsets the TS and creates seafloor relief. Several shoals observed along the transgressive surface could record minor deformation in the study area. Nevertheless, our preferred interpretation is the shoals are regions more resistant to erosion. The Crisitanitos fault zone also causes a shoaling of the transgressive surface. This is also likely from resistant antecedent topography due to compression on the fault. The CFZ was previously defined as a down-to-the-north normal fault, but the folding and faulting architecture imaged in the CHIRP data are more consistent with a strike-slip fault with a down to the northwest dip-slip component. A third area of shoaling is observed off of San Mateo and San Onofre creeks. This shoaling has a constructional component interpreted to be a relic beach or spit structure. Legacy USGS mini sparker data were used to map transgressive surface regionally and to define the deeper shelf structure.

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Semi-direct dynamical and radiative effect of North African dust transport on lower tropospheric clouds over the subtropical North Atlantic in CESM 1.0

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This study uses a century length pre-industrial climate simulation by the Community Earth System Model (CESM 1.0) to explore statistical relationships between dust, clouds and atmospheric circulation, and to suggest a semi-direct dynamical mechanism linking subtropical North Atlantic lower tropospheric cloud cover with North African dust transport. The length of the run allows us to account for interannual variability of North African dust emissions and transport in the model. CESMs monthly climatology of both aerosol optical depth and surface dust concentration at Cape Verde and Barbados, respectively, agree well with available observations, as does the aerosol size distribution at Cape Verde. In addition, CESM shows strong seasonal cycles of dust burden and lower tropospheric cloud fraction, with maximum values occurring during boreal summer, when a strong correlation between these two variables exists over the subtropical North Atlantic. Calculations of Estimated Inversion Strength (EIS) and composites of EIS on high and low downstream North Africa dust months during boreal summer reveal that dust is likely increasing inversion strength over this region due to both solar absorption and reflection. We find no evidence for a microphysical link between dust and lower tropospheric clouds in this region. These results yield new insight over an extensive period of time into the complex relationship between North African dust and North Atlantic lower tropospheric clouds, which has previously been hindered by spatiotemporal constraints of observations. Our findings lay a framework for future analyses using different climate models and sub-monthly data over regions with different underlying dynamics.

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Meter Accuracy Seafloor Geodesy using Repeated Multibeam Surveys

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Ship-board multibeam surveys are a useful tool in measuring tectonic deformation of the seafloor, having been used to measure the ∼50 m of surface slip along the Japan trench during the 2011 Tohoku-Oki earthquake with an uncertainty of 20 m (Fujiwara et al, 2011, Science). In this study, we investigate the improvement in positioning accuracy obtainable when comparing multibeam and sidescan surveys repeated along the same track to within 1/10 of the critical baseline and taken at a slow ship speed of 1 knot. We compare two surveys of the Juan de Fuca Ridge axis fitting these criteria with two coincident surveys of the Cocos Ridge, taken at 11 knots. Both pairs of surveys were collected using a Simrad EM120 sonar system aboard the RV Roger Revelle. We find the multibeam surveys of the Juan de Fuca ridge axis sufficient to measure displacements accurate to better than 2 m, a marked improvement over the 50 m accuracy of the Cocos ridge surveys. Likewise, we can measure displacement accurate to 2 m using the sidescan data from the Juan de Fuca surveys. This accuracy is sufficient to observe meter-level horizontal movements on the deep ocean associated with large earthquakes and landslides.

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Fishing for answers about southern California yellowtail (Seriola lalandi): results from recreational fisheries data and conventional tagging.

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Designing a species-specific management approach depends upon understanding spatial and temporal patterns of both behavior and habitat usage. While spatial data are available for some exploited fish species within the Southern California Bight (SCB), yellowtail (Seriola lalandi) are not one. This is because although highly sought-after, they do not fit within existing management strategies, thus their larger ecological role within the marine community remains vague. This work represents the first examination of both fisheries data and regional/local movements for California yellowtail since the 1950s. To examine the spatial and temporal trends in the southern California yellowtail fishery, all instances of recreational yellowtail capture in southern California between 1936-2013 were retrieved from existing fishery databases, and analyzed by size, season, location, and sea-surface temperature. Catch was bi-modally distributed with peaks at both immature and mature sizes; larger fish were caught inshore (<3 mi) while smaller fish were predominantly caught offshore (<3 mi). These trends varied predictably depending on season. Additionally, fish caught during winter months were significantly larger than those caught during the remainder of the year. This defined spatial and temporal size segregation provided the motivation for a comprehensive tagging program within the southern SCB. Currently, the recapture rate stands at 21% with time at liberty for tagged fish ranging from 24 hours to 18 months and recapture distance from 3-140km. These results suggest a strong pattern of shifting space use (both location and mobility) with age, revealing novel evidence of ontogenetic changes in movement for a coastal marine fish.

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Seismogeodetic Monitoring of Engineered Structures using MEMS Accelerometers

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Building response monitoring in seismically active areas requires accurate strong motion recordings in order to reliably assess building damage after an earthquake. The drift at the rooftop (displacement divided by the height) is the criteria specified by the Federal Emergency Management Agency (FEMA) to determine the safety for occupancy. However, accelerometer data cannot be reliably integrated to absolute displacement. We use a seismogeodetic solution, which combines the analysis of low frequency GPS with high frequency accelerometer observations through a tightly coupled Kalman filter for full bandwidth estimation of seismic displacements and velocities. We compare the seismogeodetic solutions calculated using low cost MEMS strong-motion accelerometers to solutions using observatory-grade Kinemetrics Episensor accelerometers. These instruments were run in real time on a four-story structure on the University of California San Diego Large High Performance Outdoor Shake Table during testing of an inertial force-limiting floor anchorage design system to improve the buildings resistance to very strong ground motions. Testing involved three phases of building configuration: the experimental configuration with decoupled floors and walls, the traditional configuration with coupled floors and walls, and a final configuration of grouted floors and walls. Each phase involved a sequence of earthquake simulations of varying magnitudes that resemble likely events for the western United States. We compare the spectra from the MEMS and Episensor recordings to quantify the noise of the accelerometers, which we expect to be higher for the MEMS. We will show that the inexpensive MEMS alternative can be sufficient for accurately recovering the drift of large engineered structures when used in combination with the GPS solutions.

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Life history patterns and habitat use of two species of endangered marine turtles (*Caretta caretta* and *Chelonia mydas*) near a bycatch hotspot area in the East Pacific using skeletochronology and stable isotope analysis

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North Pacific loggerhead (*Caretta caretta*) and East Pacific green turtles (*Chelonia mydas*) are two species of marine turtles in the East Pacific (EP) that experience some of the highest rates of globally documented mortality. Both populations are endangered due to decades of population decline. Fisheries interactions and bycatch are known sources of mortality. The loggerheads are born in Japan and migrate as juveniles across the North Pacific, where significant numbers forage in the Central North Pacific (CNP) and the EP near the Baja California Peninsula (BCP), Mexico for many years before returning to Japan as adults. The green turtles are born in southern Mexico and spend their entire life in oceanic and neritic zones of the EP. It is unknown how long loggerheads inhabit each distinct region of the North Pacific, as well as how long green turtles remain in oceanic habitats prior to settling to neritic zones. Our research seeks to determine the length of time individuals in these populations spend in distinct habitats in order to better understand exposure to differential threats and prioritize management strategies. Particular focus is given to duration of time spent in the high-bycatch waters of the EP near the BCP. To this end, we combine skeletochronology (the study of growth and age increments in bones) with sequential stable carbon (δ^{13}C) and nitrogen (δ^{15}N) isotope analysis (SIA) of humerus bone growth layers. Naturally occurring stable isotope gradients exist in ocean systems and baseline values may differ among discrete habitats such as the pelagic CNP (lower δ^{13}C and δ^{15}N values) and the more coastal, upwelling-dominated area near the BCP (higher δ^{13}C and δ^{15}N). Given these isotope gradients, the combination of SIA with skeletochronology provides a multi-year record of location, diet, size, age, and annual growth of individual animals, allowing us to reconstruct life history and habitat use patterns.

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Searching for intermediate-scale structure in the deep Earth

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For every major earthquake since 2010, the Shake Movie project (Princeton University) has performed simulations of three-dimensional (3-D) seismic-wave propagation using global Earth model S362ANI. This model, which is based on inversions of long-period seismic data, accurately captures the large-scale (<1000 km) 3-D features of the deep Earth, but lacks structure at smaller scales. To constrain the amount of smaller-scale structure, we compare seismic-wave amplitudes of intermediate-period (17 to 150 s) waveforms with the results of the Shake Movie simulations. We find that the data systematically exhibit more power between the direct body-wave phases (e.g. P, PP, S). We claim that this difference between observed and modeled power can be explained by body-wave scattering off of intermediate-scale (50-500 km) structure that is absent from the model. To test this claim, we simulate seismic-wave propagation through Earth models that contain an increased amount of intermediate-scale structure.

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Extending cumulative impacts assessment to the open ocean: patterns and intensity of anthropogenic threats to seabirds in the North Pacific

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Cumulative impacts assessment is a developing field vital for effective management of species and ecosystems. However, to date the majority of analyses and data sources largely cover coastal systems. Where at-sea anthropogenic threats have been studied, it is almost always individually, though additive or synergistic effects are undoubtedly important. Using seabirds as an example group, we created a spatially explicit map of at-sea anthropogenic threats for the North Pacific (10S to 66N latitude). The map combines threats into a single cumulative representation of 8 threat categories. These include three categories related to fisheries: bycatch, trophic disturbance through biomass removal, and direct competition; and four categories of pollution: organic chemicals, inorganic chemicals, maritime transport pollution, and marine debris. We analyze the map to reveal the areas of highest and lowest cumulative threat, as well as regions of highest and lowest number of individual threats. In addition, we assess threat by Exclusive Economic Zones of nations, compare these across nations, and discuss these in relation to the rankings of priority countries for seabirds as reported by Croxall et al. (2012). Current and historical threats in the North Pacific appear to place some ecosystems of vital importance to seabirds at especially high risk.

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Annual cycle and destruction of Subtropical Mode Water in the western North Atlantic

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Eighteen Degree Water (EDW), the subtropical mode water of the western North Atlantic, is a voluminous, weakly-stratified upper ocean water mass. This thick layer acts as a subsurface reservoir of heat, nutrients, and CO2 as it persists throughout the year, but nearly half of its volume is dispersed or mixed away from the time of its formation until it is renewed the following winter, diffusing its properties into the thermocline. The relevant processes responsible for this large annual cycle of EDW destruction are being investigated as part of CLIMODE. CTD observations from Argo and CLIMODE profiling floats are used to observe the cycle of the seasonal pycnocline, which isolates EDW from the surface mixed layer during spring, summer, and fall, and to quantify EDW destruction rates. Using Potential Vorticity (PV) as a tracer, we infer upper bound estimates of diapycnal diffusivity ranging from O(10ˆ-5) to O(10ˆ-4) mˆ2 sˆ-1 during late winter/early spring. The highest EDW destruction rates occur during summer when the stratification of the seasonal pycnocline is increasing, while slower, steady EDW destruction is observed in early winter, as stratification weakens. Lateral dispersion of EDW is assessed using CLIMODE temperature and velocity data from 40 acoustically-tracked, bobbing profiling floats so that the seasonal cycles and relative contributions of vertical vs. lateral mixing are compared directly within the framework of the EDW PV budget.

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Clinothem Lobe Growth and Possible Ties to Downslope Processes in the Gulf of Papua

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The Gulf of Papua is fed by the large-floodplain Fly River and small mountainous rivers to the north, thus creating an ideal environment where end-member cases of river systems and their deltas (e.g. the large-floodplain Brazos River and the narrow-shelved Eel River) can be studied. Input from five rivers into the gulf has constructed a three-dimensional mid-shelf clinothem composed of three depositional lobes, with a central lobe downlapped by two younger lobes to the north and south. This geometry suggests that the three lobes are not syndepositional but rather that clinoform depocenters have shifted 60 km, thus bypassing adjacent accommodation. Newly examined CHIRP (Compressed High Intensity Radar Pulse) seismic lines and XRF analysis of piston cores from the 2004 NSF MARGINS program reveal distinct lobes offshore that exhibit increased complexity moving shoreward. Evidence of shoreward complexity and lobe interfingering cause us to question the originally proposed mechanism for depocenter shift involving circulation changes. An alternative hypothesis that stems from distinct lobe architecture farther offshore suggests that channelized downslope processes and nearshore storage may play important roles in lobe growth.

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Levels of Metals in Two Life Stages of the Trematode Euhaplorchis Californiensis and Their Respective Hosts, Namely the California Horn Snail and the Killfish

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Pollutants can accumulate through the food chain from prey to predator. Less considered is that parasites might absorb pollutants from a host and then transfer them to the next host in the life cycle. We measured metal pollutants in Euhaplorchis californiensis, a trematode species whose complex life cycle involves two aquatic hosts, the California horn snail (Cerithidea californica) and the California killifish (Fundulus parvipinnis). Snails and killifish, were collected from Carpinteria Salt Marsh Reserve (Santa Barbara, CA), a site where we had also mapped contaminants in the sediment. Infected hosts were dissected and host and parasite tissues were analyzed for a suite of metals using the inductively coupled plasma optical emission spectrometry (ICP-OES). In addition to tracing the flow of pollutants among species in an ecosystem, this cross interdisciplinary study can help identify hot spots of chemical contamination in ecological health assessments across host species and environments.

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Trace-element signatures of Runion hotspot-Central Indian Ridge interaction

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Rodrigues Island, the eastern-most island in the Runion hotspot chain, lies at the western end of an active volcanic lineament extending more than 200 km from the Central Indian Ridge (CIR) axis. Where these features intersect, mid-ocean ridge basalt (MORB) glasses host enriched trace element signatures and elevated 3He/4He ratios [1], which are primitive geochemical signatures. These characteristics provide evidence for interaction between Runion hotspot and normal MORB (N-MORB) signatures found elsewhere on the CIR. To further constrain hotspot-ridge interactions, we present major- and trace-element abundance data for basaltic lavas from Rodrigues (4.5-9.4 wt.% MgO), as well as for basalt and ultramafic lavas from the westerly islands of Mauritius and Runion (7.5-35 wt.% MgO). In addition, we present data for ultramafic dunite and harzburgite (33-46 wt.% MgO) nodules with high-3He/4He from Runion. Rodrigues lavas have more variable primitive mantle normalized trace element patterns and shallower heavy rare earth element patterns than Runion lavas. These differences reflect interaction between a more geochemically enriched Runion hotspot component and a geochemically depleted N-MORB component for Rodrigues. Ultramafic nodules from Runion have lower absolute trace element concentrations than associated lavas. shallower primitive mantle normalized rare earth patterns and positive Ti anomalies due to accumulation of spinel and olivine. These data provide unique information that may help constrain the trace element composition of Runion hotspot parental magmas. Comparison with Rodrigues lava compositions provides compelling evidence for interaction of the hotspot with the CIR as far west as Rodrigues. [1] Fri et al. (2011) JGR doi:10.1029/2010JB007609.

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Differential gene regulation underlies responses to acute heat stress and local adaptation in Tigriopus californicus

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Temperature is one of the main environmental factors that influences local adaptation of conspecific populations along the latitudinal gradients. However, the molecular mechanisms underlying local adaptation to temperature gradients are not well understood. The intertidal copepod Tigriopus californicus is a good model for studying acute heat stress response and thermal adaptation. Populations of T. californicus inhabit high intertidal rock pools along the west coast of North America from Baja California to Alaska. These pools present extreme thermal environment and previous studies have shown evidences of thermal adaption of T. californicus populations along the latitudinal gradient. Southern populations survive acute heat stress at higher temperatures than northern populations. Transcriptome studies have shown that thermal tolerance is associated with levels of expression of numerous heat shock protein (Hsp) genes. Heat shock transcription factor (HSF) is known to be activated by heat stress and it subsequently induces transcription of Hsp genes. We hypothesize that genetic variations in the HSF and its binding sites in the genome underlie differential responses to acute heat stress among different populations of T. californicus. There is one copy of the HSF gene with 529 amino acids in the T. californicus genome. For example, we found amino acid substitutions which suggest functional differences in the HSF gene among populations along the latitudinal gradient. Here we investigate differential regulations of heat stress responses by comparing the activation temperatures of HSF and variation in binding sites of HSF from different populations of Tigriopus californicus.

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Constraints on Circulation of the Interior South Atlantic During the Last Glacial Maximum Inferred from a Highly-Resolved Sedimentary Depth Transect

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Many models show that the relative intensity of deep-ocean stratification must be a primary variable governing sequestration and release of carbon from the ocean over ice ages. The observations necessary to test these model-derived hypotheses are not yet sufficient, but sedimentary depth transects represent a promising approach for making progress. Here we present results from a suite of 13 cores spanning water depths of 1500-3700 meters, collected from the Namibian margin. This is an especially suitable location to collect vertical depth transects over ice age cycles, given that it is sensitive to the intersection of the principal water masses involved in the thermohaline circulation of the Atlantic. In aggregate, these cores allow for depth transects that have roughly 100 meter vertical resolution, and steady state benthic foraminiferal proxy profiles can be compiled at various points spanning the last full ice age cycle. In this presentation, we will contrast the steady state vertical distribution of benthic foraminiferal tracers from the LGM and late Holocene. The comparison between the purely physical tracers (e.g. d18O) vs. the tracers that are sensitive to the carbon cycle (e.g. d13C and B/Ca) offers critical insight to the relationship between deep/mid-depth stratification and global carbon dynamics.

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The geochemistry of zeolites and calc-alkaline rocks from north-central Iran and its implications to fluid/rock interaction and alteration

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Major-trace element and isotopic data for Eocene alkaline/calc-alkaline rocks and secondary minerals from north-central Iran demonstrate the history of fluid/rock interaction and production of the secondary minerals during alteration. The paragenetic sequence of alteration began with precipitation of phyllosilicates on walls of veins in a ∼low fluid/rock ratio and high T (300 C) environment. At this stage Mg, K, Fe, Al, and Si leached from olivines and pyroxenes of the host rocks went into celadonite and chlorite/smectite mixed layers. Then, as the fluid/rock ratio increased and temperature decreased, the first Na-zeolite minerals (analcime, tetranatrolite and natrolite) crystallized from the alteration fluid, which was a mixture of sea- and magmatic waters enriched in Na and K. Finally, with increased pH, Ca, Cr and (CO3)2- and decreased Si, Al, Na, Mg, and Fe in the fluid, Ca-zeolites (thomsonite/natrolite, gonnardite, chabazite, stilbite, scolecite/mesolite, heulandite) and calcite precipitated. The zeolites are enriched in LREE and LILE similar to their host rocks, confirming the mobility of such trace elements during alteration. Sr, Pb and P are considerably high in the zeolites and their Sr-Nd-Pb isotopic data record compositional evolution of the fluid. Significantly, early-formed zeolites inherited Sr from volcanic materials and/or magmatic fluids, as demonstrated by the similarity of their initial 87Sr/86Sr ratios with those of the host rocks. With advanced degree of alteration, the fluid was dominated by seawater and formed the youngest zeolites that have more radiogenic 87Sr/86Sr and Pb isotopic values, similar to those of Paleogene seawater. A similar shift is observed in the Sr and Nd isotopic ratios of the altered host rocks. In summary, the geochemistry of zeolites and host rocks suggests that the alteration occurred penecontemporaneously with the Eocene volcanic eruptions in a submarine environment in north-central Iran.

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Recon from Ground Zero: The striped shore crabs (*Pachygrapsus crassipes*) physiological response to ocean acidification

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The oceans have acidified by 26% since the launch of the Industrial Revolution and this figure is expected to more than double by the year 2100. Furthermore, the three warmest years ever recorded for the oceans were measured within the past 20 years. The twin threats of warming waters and ocean acidification (OA) are often regarded as the two greatest dangers facing oceanic life, and much research has been conducted to determine how marine animals will respond to the rapidly changing seas. Yet, in spite of this increased scientific attention, little is known about how crustaceans, which are both ecologically and economically important, will respond to the forecasted changes in ocean conditions. In this study, we explored how a common intertidal shore crab species (Pachygrapsus crassipes) physiologically adapts to OA. Crabs were exposed to three seawater treatments ambient pH and temperature (pH 8.0 and 22C), decreased pH and ambient temperature (pH 7.7 and 22C), and decreased pH and increased temperature (pH 7.7 and 24C) for seven weeks. By measuring blood pH and CO2 concentrations, we found that crabs from all three treatments were able to maintain their hemolymph pH and TCO2 at normal levels. Using Western blotting, we then quantified the abundance of two proteins involved in hemolymph pH regulation: sodium-potassium ATPase (NKA) and vacuolar proton ATPase (VHA). These two proteins were upregulated in the gills of crabs maintained in warmer, more acidic water, suggesting they are responsible for secreting excess acid from the blood. We are currently examining the localization patterns of NKA and VHA in crab gills using immunohistochemistry to investigate potential shifts in the subcellular location of VHA that might allow this protein to more effectively excrete intracellular acid. Our results suggest that this intertidal crustacean can cope with the predicted changes in seawater CO2/pH and temperature; however this might come at a higher energetic cost.

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Microseism Source Direction in Cascadia Using Cross-correlation and Array Coherence

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The ongoing Cascadia Initiative (CI) is providing an increasing quantity of ocean bottom seismometer (OBS) data. These data are used to investigate the microseism source directions and to determine the surface wave tomography of the Cascadia region. Spatial asymmetry in the amplitude of cross-correlations between receiver pairs is observed in both primary microseism and double-frequency (DF) microseism bands. This asymmetry indicates that there are preferential microseism propagation directions, either because of source location and/or upper oceanic crustal structure. Ambient noise group velocity tomography was determined from cross-correlation of DF microseisms between receiver pairs. A low-velocity region oriented roughly north-south was identified, apparently associated with a thick sediment zone off the continental shelf, reflecting the strong influence of ocean bottom sediment layer thickness on DF microseism propagation. The coherence of DF microseism signals between different stations was lowest in the low-velocity thick-sediment region, consistent with the thick sediment layer strongly affecting microseism signal propagation.

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Variability in the Santa Barbara Basin Fish Assemblage in the Last Two Millennia Inferred from the Fossil Otolith Record

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The long-term variability of the entire fish assemblage, especially mesopelagic fish, off the coast of Southern California remains largely unknown. The Santa Barbara Basin (SBB) fish assemblage is examined using otoliths recovered from four sediment cores with varved chronologies from 33 to 2009 AD. We use otoliths rather than other fish remains to reconstruct the fish assemblage because otolith shape is species specific and the number of otoliths per fish is constant. Otoliths were classified to taxa using geometric and Fourier shape analyses and by direct comparison with references. Otolith elemental composition is also being explored for otolith classification. Our results indicate that mesopelagic, not pelagic, fish dominate the forage fish assemblage and that, like pelagic species, they fluctuate in abundance on decadal time scales. It is also observed that the otolith deposition rate of the taxon bathylagidae is highest in the last 150 years, consistent with recent warming.

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A high-resolution record of historical change in Caribbean reef environments from reef matrix cores

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Caribbean coral reefs have undergone dramatic declines since monitoring began in the 1980s that have been attributed to overfishing, land-based runoff, or climate change. However, precise causes of reef degradation remain unresolved due to a lack of historical baseline data. Reef matrix cores were collected from the Bocas Del Toro region of Caribbean Panama to reconstruct a timeline of natural and anthropogenic change in reef environments and ecological communities over the past 1000-2000 years. Here we present a record of historical change in reef environments at two contrasting reef sites in Bocas del Toro: one reef adjacent to the mainland and one reef adjacent to an island. To provide a historical record of land-based runoff from land clearing and natural flooding events throughout the cores, we tracked (1) the proportion of fine-grained (i.e., land-based) sediments and (2) the relative abundance of land-based elements such as barium using X-Ray Florescence (XRF) core scanning. Contrary to expectations, preliminary data suggest a decline in fine-grained sediment load over the past ∼1000 years at both reef sites. XRF results show a spike in barium around 1000 years ago at the island site, possibly resulting from a major historical flooding or land-clearing event. In contrast, the mainland site experienced a large drop in barium ∼ 900 years ago as this site transitioned from a sandy bottom to coral reef habitat. These changes highlight the dynamic nature of reef environments and provide a baseline from which to measure the effects of historical anthropogenic change.

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Acoustic evidence that harbor porpoises have learned to avoid bullying by bottlenose dolphins

Eiren Jacobson[1] †, Karin Forney[2], James Harvey[3]

Dolphins, as it turns out, are not very nice. Bottlenose dolphins (Tursiops truncatus) have been known to attack and kill harbor porpoises (Phocoena phocoena) in the United Kingdom, on the U.S. East Coast, and in California. Between 2007 and 2009 researchers witnessed three bottlenose dolphin attacks on harbor porpoises in Monterey Bay, California and between 2008 and 2009 harbor porpoise stranding levels in central California were significantly higher than normal due to bottlenose dolphin attacks. In the present study, we investigated whether this documented conflict has affected harbor porpoise behavior in the nearshore environment, where habitat overlap occurs with bottlenose dolphins. We deployed a moored echolocation click detector (C-POD) that is capable of recording both harbor porpoise and bottlenose dolphin vocalizations at a shallow nearshore station in N. Monterey Bay, California within the habitat range of both species. Using a randomization test of the resulting acoustic record, we found that harbor porpoise echolocation activity was significantly lower when dolphins were present than when they were absent. By modeling this response to bottlenose dolphin presence we determined that harbor porpoise echolocation activity is reduced by up to 82% when bottlenose dolphins are present. This suggests that harbor porpoises have learned to avoid approaching bottlenose dolphins in order to avoid being attacked. If bottlenose dolphins in California continue to torment harbor porpoises with this bullying behavior, direct mortality and habitat exclusion could negatively impact harbor porpoise populations.

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Reconstructing population trends using a state space model based on an in situ mark-resighting method to assess the abundance of spawners at fish spawning aggregation

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I will present an in situ visual mark-resighting study design that can be used to estimate total abundance of spawners at an aggregation site. I demonstrate the methods using recent findings from the Grouper Moon program, a collaborative research program between Reef Environmental Education Foundation (REEF), Cayman Islands Department of Environment, aimed at documenting the success of management actions established in order to protect Nassau grouper, and endangered Caribbean reef fish. The mark-recapture method takes advantage of the high density and approachability of aggregating grouper by SCUBA divers in order to tag a subset of aggregating Nassau grouper, and subsequently generate surveys of the proportion of tagged individuals in discrete counts. These proportions are subsequently used to estimate total population size. For a variety of reasons, including minimizing harm to the animals (i.e., short and long term tag induced mortality or tagging related changes to reproductive success), we were required balance the trade-off between number of tagged individuals and accuracy of population estimates based on resightings data. I will present estimates of the abundance of Nassau grouper at the Little Cayman spawning aggregation from a hierarchical state space model fit to 7 years of data.

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Imaging the hydrogeology of the Nicaragua margin with marine electromagnetic methods

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At converging tectonic plate boundaries, the subduction of hydrated oceanic plates is the primary process that transports water to the deep interior of the Earth. As a plate sinks, water is progressively released by compaction and chemical dehydration reactions, a significant fraction of which is released during the initial stages of subduction and escapes along the forearc seafloor. The flux of fluids in the forearc impact subduction zone seismicity by facilitating the development of excess pore pressures at the plate-interface megathrust, and alter the long-term geochemical evolution of the oceans by driving solute and volatile exchange; yet we lack geophysical observations that effectively detect and quantify fluids. In order to map the flux of fluids at the Middle America subduction zone, we collected marine electromagnetic data along a 280-km profile that spans the offshore component of the Nicaraguan margin. The presence of fluids and volatiles below the surface of the Earth decrease electrical resistivity by up to several orders of magnitude, making electromagnetic methods an ideal detection tool. We provide new constraints on the cycling of fluids with two-dimensional electrical resistivity models of the data. Our models image the complete subduction of water-rich sediments and the migration of fluids from the plate-interface to the forearc seafloor, where a high concentration of active fluid seeps and mud mounds have previously been mapped. We use our model to estimate margin porosity structure, which can be used to estimate excess pore pressures and fluid flow magnitudes with numerical simulations.

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Discovery and Structure Elucidation of Laucysteinamide A, a Hybrid PKS/NRPS Metabolite from a Saipan Cyanobacterium, cf. Hyalidium penicilliforme

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A field trip to Saipan, USA, in the South Pacific Ocean in 2013 resulted in the collection of multiple marine cyanobacteria as well as several macrophytic algae. A detailed bioactivity guided study of a cf. Hyalidium penicilliforme species led to the isolation of laucysteinamide A (1), a new thiazoline-containing alkaloid. Laucyteinamide A is a new monomer homologue of previously reported marine cyanobacterial metabolite, somocystinamide A, a disulfide dimer that was obtained from a Fijian marine. cyanobacterium. The stereostructure of laucysteinamide A (1) was determined by a detailed analysis of its NMR, MS, and CD spectra. In addition, the highly bioactive lipid, curacin D (3), was successfully dereplicated by NMR, MS and bioinformatics techniques. We now propose to apply new NMR techniques to facilitate subnanomole concentration structure elucidation of marine natural products. At the same time, novel bioinformatic techniques are developed to analyze 2D NMR spectra.

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