The Thalassic Society & the Departments of Geological Sciences, Meteorology, and Oceanography present the

4th Annual

Student Symposium

6 November, 2009

Program

Additional sponsors

Oral Session

8:30 am to 3:00 pm at the Chemistry Science Laboratory Auditorium (CSL 1003)

Time schedule

8:30 – 9:30 *COFFEE – CSL Lobby*

9:30 – 9:45 **Deng, H.**; Z. Dai; A. Wolfsberg; M. Ye; Z. Lu
Upscaling Retardation Factor of Porous Media with Multimodal Sorption Coefficient and Conductivity

9:45 – 10:00 **Bogdanoff, A.**
Aerosol Impact on Sea Surface Temperature Retrievals

10:00 – 10:15 **Todd, A. C.**
Understanding circulation dynamics and transport in the Florida Big Bend: An application to gag grouper larvae

10:15 – 10:30 **Nelson, J.**
Flux by Fin

10:30 – 10:45 BREAK

10:45 – 11:00 **Behl, M.**
Cooling or warming atmosphere due to a slowing Atlantic Meridional Cell (AMOC)?

11:00 – 11:15 **Michael, J.**
Diagnosis of ENSO Variability in Two Coupled Models: CCSM3.0 and CAM/HYCOM

11:15 – 11:30 **Tremaine, D.**; P. N. Froelich; B. Kilgore
Speleothem Paleoclimatology and Atmospheric Ventilation: Using ^{222}Rn and ^{13}C as Tracers to Reveal Mixing Pathways Inside Hollow Ridge Cave

11:30 – 11:45 **Winterbottom, H.**
Applying a Coupled Atmosphere-Ocean Model to Understand the Challenges in Forecasting Tropical Cyclone Intensity

11:45 – 12:00 **Long, D.** and S. de Putron
The impact of global climate change on the new recruits of a scleractinian coral, Porites astreoides

12:00 – 13:00 LUNCH BREAK

13:00 – 13:15 **Wilson, R. M.**
Evaluation of trophic structure changes along an estuarine gradient: Apalachicola, Florida

13:15 – 13:30 **Corbett, L.**
Using C/N ratios to investigate DOM reactivity in northern peatlands

13:30 – 13:45 **Bourgoin, S.**
Variation in growth rate and diet of early juvenile gag, Mycteroperca microlepis*, populations in two regions of the northeast Gulf of Mexico: correlations with weather*

13:45 – 14:00 **Paeng, J.**; T. Dittmar
Combustion-derived dissolved organic matter in rivers and estuaries of the sugar-cane area of Southern Brazil

14:00 – 14:15 BREAK

14:15 – 14:30 **Misra, S.**; P. N. Froelich
Isotopic Evidence for Large Scale Temporal Changes in the Cenozoic Marine Lithium Cycle

14:30 – 14:45 **Santema, M.**
Temporal Dynamics of Dissolved Oxygen of the Benthic Boundary Layer

14:45 – 15:00 **Bode, S.**
Determining when and where the leatherback sea turtles, Dermochelys coriacea*, nest on North Friar's beach, St.Kitts*

15:00 – 15:30 BREAK BEFORE POSTER SESSION

Poster Session

3:30 pm to 5:00 pm at the OSB Bldg, 3rd floor

List of the Posters (alphabetical order)

Blair, S. A.; D. K. Watkins

High-resolution calcareous nannofossil biostratigraphy of the Santonian Stage Boundary, Western Interior Basin

Canion, A.; O. Prakash; S. J. Green; J. E. Kostka

Investigation of the Ecology and Biogeochemistry of N_2-Producing Microbial Communities in Arctic Sediments

Chipman, L.

DOM decomposition in permeable coastal sediments

Coor, J. L.; J. F. Donoghue; Y. Wang; O. Das; S. A. Kish; J. B. Elsner; X. Hu; A. W. Niedoroda; M. Ye

Determining a Late Holocene Storm History for NW Florida Through Multiple Proxies

Das, O.; Y. Wang; J. F. Donoghue; J. Coor; S. A. Kish; J. B. Elsner; X. Hu; A. W. Niedoroda; M. Ye

Reconstruction of paleostorm history using geochemical proxies in sediment cores from Eastern Lake, Florida

Dimova, N.; B. Burnett; J. Chanton; R. Peterson

What we learned about the hydrologic regime of the largest submarine spring system in Florida using salinity and radon: a two-year investigation on Spring Creek Springs

Dong, J.; K. Speer

The Inverse Result of Current and Transport on the Antarctic Slope along I6S (30°E)

Easton, E.

North Pacific deep-sea sediment: environmental variables

Gouillon, F.; E. Chassignet

Diagnosing the spurious mixing in the Regional Ocean Modeling System (ROMS)

Jasrotia, P.; A. Canion; O. Prakash; S. Green; J. E. Kostka

Isolation and characterization of denitrifying fungi and bacteria from low pH, nitrate- and uranium- contaminated groundwater

Jemison, K. E.; S. Wise
Diatom biostratigraphy of RV/IB NBP0602A Shaldril II sites 3 and 4 off Seymour Island, Antarctica

Kostka, B.
Improving conservation of the American Horseshoe Crab in Florida through research, management and education efforts.

Krishnamurthy, N.
Mercury and trace metal deposition into the Pensacola Bay watershed

Rahter, B.
Observations of Turbulence in the Transition Layer

Rohal, M.
Metazoan meiofaunal abundances and ecological correlates along the west coast of the United States between 2700 m and 3700 m depth

Rycyk, A.; C. Deutsch; M. Barlas; D. Nowacek; S. Koslovsky; K. Frisch
Florida manatee behavior during vessel approaches

Tazaz, Amanda; J.P. Chanton; C. Kelley; J. Poole; B. Bebout
Methane Production in Extreme Environments

Tremaine, D.; P. N. Froelich; B. Kilgore
Speleothem Paleoclimatology and Modern Proxies: Calcite Farming In a Continuously Monitored Cave

Weihs, R.
Resolving the diurnal cycle in sea surface temperatures and its effect on surface turbulent fluxes

Oral Presentation Abstracts

Behl, Mona

Cooling or warming atmosphere due to a slowing Atlantic Meridional Cell

(AMOC)?

The IPCC predicted that it is "very likely" that the AMOC would experience a slowing during the 21st century. Most global climate models predict that Europe should *cool* in response to such an AMOC reduction. And yet, recent *nonlinear* analytical calculations (Sandal and Nof, 2008, JPO) as well as physical principles, suggest that local regions should exhibit *warming,* not cooling. The idea behind the warming is that, since the water heat capacity is much larger than that of the air, and, since the air-sea heat flux is proportional to the temperature difference between the warmer ocean and the cooler atmosphere, the heat flux can only significantly reduce when the atmosphere warms and the ocean (slightly) cools. We will invoke simple models in order to better understand this process.

We will first consider a simple analytical "hot-spring model", where a round hot bath is situated in a bell-shape bathhouse with a round horizontal window in its roof and vertical windows along the periphery near the ground. The round hot-bath, into which water from a hot spring is diverted, has a flow from its periphery to sink in its center. While flowing toward the center, the hot water releases heat to the air that, as aresult, convects, draws air into the bathhouse through the vertical windows near the ground, and escapes the bathhouse through the round horizontal window on top. The question that we wish to answer is what happens when one artificially reduces the amount of hot water going through the hot-bath. Will the atmosphere cool or warm?? Our intution says that the atmosphere will be warmed less and, therefore, will cool but this is incorrect, the atmosphere will actually warm. However, less air will be warmed so that the heat flux is reduced even though the air warms.

Since water vapor drastically affects the density of the atmosphere, we include moisture in this hot spring model. The conservation of heat, moisture and volume flux yield a set of fairly complicated algebraic equations that we are presently in the process of solving. Anticipated results are that, as the incoming water flux to the hot spring is decreased, the water temperature decreases. This leads to a decrease in the heat flux from the hot spring to the atmosphere directly in contact with it, a decrease in the atmospheric transport, and an increase in the air temperature.

The analytical results obtained from this simple hot-spring model will be later used to understand the actual air-sea heat fluxes and the role of water vapor in a more realistic atmosphere-ocean scenario.

Bode, Stephanie

Determining when and where the leatherback sea turtles, Dermochelys coriacea, nest on North Friar's beach, St.Kitts

The leatherback sea turtle, *Dermochelys coriacea***,** is the largest extant species of sea turtles, yet the least is known about their nesting locality. Females come ashore only to nest, which occurs

8-12 times per season. To properly collect data from each individual, it is crucial that one is present at the right place at the right time. The goal of this project was to determine whether a reason existed for the location and time that the turtles selected for coming ashore to nest. To accomplish this goal, environmental, climatic, and sand data was collected and analyzed. From within each nest, sand pH, conductivity, temperature, and grain size was analyzed. Environmental and climatic data were collected during the processes of emergence and egg deposition. Hopefully my findings will help future researchers better predict a turtle emergence site, allowing more data to be collected.

Bogdanoff, Alec

Aerosol Impact on Sea Surface Temperature Retrievals

Sea Surface Temperatures (SSTs) are an important measure of our current weather and climate, as well as an essential variable in both short and long term weather forecasting. Reliant on passive sensors, SST retrieval techniques are influenced by changes in atmospheric composition, including aerosols. Many empirically derived retrieval algorithms are based on matching Top of Atmosphere (TOA) Brightness Temperatures (BTs) from the Advanced Very High Resolution Radiometer (AVHRR) to buoy measurements during clear-sky conditions. As such, data is cloud-cleared to remove cloud-contaminated data. However, small, but influential Aerosol Optical Depths (AODs) data cannot be flagged as contaminated and the algorithms incorrectly calculate a cold SST due to the radiometer sensing the cooler, elevated aerosol layer temperature.

The Santa Barbra DISORT Radiative Transfer model is used to quantify the effects of aerosol contamination on retrieved TOA BTs. The calculated radiances are spectrally averaged BTs over each channel and used to calculate a SST using the Naval Oceanographic Office AVHRR algorithms. Using a radiative transfer model allows for the examination of SST changes due to varying AOD, height of an aerosol layer, and the satellite zenith angle (or viewing angle).

Daytime SST retrievals are known within 0.5°C (Kilpatrick et al. 2001). Our analysis shows that errors greater than the retrieval uncertainty are observed for AODs greater than 0.25. Based on the AERONET data from Capo Verde (16.73°N , 22.94°W), 65% of the days during the boreal summer are found to have AOD greater than 0.25. Unfortunately, this seasonal peak in dust activity coincides with the active tropical cylogensis season for the region, making accurate SSTs even more vital for prediction purposes.

This sensitivity analysis will allow us to evaluate the potential for radiance correction with aerosol forecast models as a next generation approach to SST retrieval. Beyond just SSTs, it is necessary to explore aerosol effects on other atmospheric properties retrieved from infrared instruments, including radiances, which are assimilated directly into numerical weather prediction models with no correction.

Bourgoin, Stefan

Variation in growth rate and diet of early juvenile gag, Mycteroperca microlepis, populations in two regions of the northeast Gulf of Mexico: correlations with weather

Juvenile gag grouper, *Mycteroperca microlepis*, are commercially important to the Gulf of Mexico but have recently been drastically affected by overfishing and other factors. Few studies have been conducted to determine the effects of various climatic factors on the juvenile, inshore life phase of gag. In my study I attempt to examine what effects, if any, the variable temperature and salinity of gag nursery habitats (seagrass beds) have on juvenile gag growth rates and gut contents over the course of a three-year study period. The findings from this study will hopefully prove useful in adding to gag knowledge and possibly helping predict future responses to climate change.

Corbett, Liz

Using C/N ratios to investigate DOM reactivity in northern peatlands

We investigated the difference in DOM reactivity in northern peatlands using C/N ratios of the peat, DOM, and inorganic constituents (DIC/ammonium). Previous studies have shown a difference in reactivity between the bog and fen environments using ^{14}C. In sedge-dominated peatlands, the ^{14}C content of the products of respiration, CH_4 and DIC are essentially the same, and are similar to that of DOM. In *Sphagnum-woody* plant dominated peatlands with few sedges, however, the respiration products are similar but intermediate between the ^{14}C content of the solid-phase peat and the DOM. Data indicate qualitative differences in the pore-water DOM depending on the extent of sedge cover, consistent with the hypothesis that the DOM in sedge-dominated peatlands is more reactive than DOM in peatlands where *Sphagnum* is dominant. C/N ratios were used to further test this hypothesis. The C/N ratios compared were the solid phase C/N for the peat, the dissolved organic carbon to the dissolved organic nitrogen for the DOM, and the dissolved inorganic carbon to the dissolved ammonium for the respiration products. We assume low C/N ratios suggest more lability of a compound. Results suggest a distinction between solid phase peat C/N ratios between the bogs and fens. Bog peat had a higher C/N ratio than fen peat with a median value of 39. Fen solid phase peat was lower with a median value of 20. These results were shown to have a statistically significant difference ($P = <0.0001$). Analysis of C/N ratios of the DOM between the two environments, also, yielded a difference. Overall, fen DOM had lower C/N ratios than bog DOM. The fen C/N ratio of the DOM had a median value of 45 while the bog median value was 101. The difference was statistically significant difference ($P = <0.0001$). This is in agreement with the ^{14}C data which indicates fen DOM is more labile than bog DOM. The C/N ratios of the respiration products (DIC/ammonium) showed no significant difference between the two environments.

Deng, Hailin; Z. Dai; A. Wolfsberg; M. Ye; Z. Lu

Upscaling Retardation Factor of Porous Media with Multimodal Sorption Coefficient and Conductivity

Aquifer heterogeneity controls spatial and temporal variability of reactive transport parameters and has significant impact on subsurface flow and transport. We propose a conceptual model of reactive mineral facies for reactive transport in hierarchical heterogeneous porous media with multimodal sorption coefficients and hydraulic conductivity. Based on the conceptual model, covariance of hydraulic conductivity, sorption coefficient, flow velocity, retardation factor, and cross-covariance between flow velocity and retardation factor are derived from geostatistical

characterization of a hypothetical, three-dimensional unbounded porous formation. Then with a Lagrangian approach the scale-dependent analytical expressions are developed to describe the change trend of effective retardation factors in temporal and spatial domains. When time and space scales become large enough, the effective retardation factors approximate their composite arithmetic mean. Correlation between the hydraulic conductivity and the sorption coefficient can seriously affect the patterns of change in the effective retardation factor in temporal and spatial domains. When temporal and spatial scales are relatively small in a reactive transport simulation, the variations of the effective retardation factors are relatively large. The results from this study provide a methodology to develop effective transport parameters for field-scale modeling at which risk assessment and remediation is actually conducted.

Long, Dustin; S. du Putron

The impact of global climate change on the new recruits of a scleractinian coral, Porites astreoides

Anthropogenic carbon emissions have increased since the beginning of the industrial age, causing sea surface temperatures to rise in many regions. With the ocean acting as the only true carbon sink, this excess carbon is causing the pH of the oceans to drop, causing ocean acidification. This change in ocean chemistry also lowers the saturation state (Ω) of aragonite, the type of calcium carbonate that reef corals precipitate as skeletons. These scleractinian corals are thought to be particularly threatened by ocean acidification and climate change. In this study, we investigate the effects of ocean acidification and climate change on the new recruit (spat) development of a brooding, scleractinian coral, *Porites astreoides*, with focus being given to skeletal area and zooxanthellae density. Recruits were exposed to three degrees of aragonite Ω (approx. 4.01, 2.84, and 1.41) through CO^2 bubbling along with ambient (28C) and increased (31C) seawater temperatures for timepoints up to four weeks after planulae settlement. Another experimental setup tested effects of a broader temperature range in ambient seawater. A significant drop in skeletal area was seen at ambient temperature from mid Ω to low Ω while no difference was seen at spats reared at increased temperature across varying Ω giving evidence for temperature mitigation of lowered Ω. Skeletal area was also greater in spat reared in increased temperature compared to ambient temperature under ambient Ω, indicating a positive effect of temperature on growth. Bleaching occurred after four weeks at 31C across all Ω, and at ambient Ω at 33C after one week of exposure. This evidence portends that temperature is a more accurate determinant of zooxanthellae density than Ω. Thus, a more complex relationship than previously thought exists among scleractinian corals, climate change, and ocean acidification.

Michael, J-P

Diagnosis of ENSO Variability in Two Coupled Models: CCSM3.0 and CAM/HYCOM

The CAM/HYCOM coupled model developed at the Center for Ocean-Atmospheric Prediciton Studies (COAPS), FSU differs from CCSM3.0 only in the ocean model used. The hybrid isopycnal-sigma-pressure coordinate ocean model Hybrid Coordinate Ocean Model (HYCOM) replaces the ocean model Parallel Ocean Program (POP) of the CCSM3.0.
Comparison of 300 years of model output is used discarding the first 100 years to account for spin-up issues. Both models (CCSM3 and CAM/HYCOM) are compared to observational data

for duration, intensity, and global impacts of ENSO. Based on the analysis of equatorial SST, thermocline depth, wind stress and precipitation, ENSO in CAM/HYCOM is weaker and farther east than observations while CCSM3.0 is displaced westward. CCSM3.0 also has an erroneous biennial cycle of the equatorial pacific SSTs. The results will also include detailed budget studies of the SST anomalies over equatorial Pacific from both model integrations and from an ocean data assimilation product.

Misra, Sambuddha; P. N. Froelich

Isotopic Evidence for Large Scale Temporal Changes in the Cenozoic Marine Lithium Cycle

The δ^7Li of seawater (~31.0‰) is controlled by a balance between riverine (δ^7Li_{Riv}~23‰) and hydrothermal (δ^7Li_{HT}~5.6‰) inputs and large fractionation (Δ_{SW-SED} ~16‰) during removal into marine authigenic clays (δ^7Li_{SED}~15‰). The seawater δ^7Li (δ^7Li_{SW}) is thus sensitive to changes in these sources and sinks on time scales of the Li residence time in seawatwer, τ_{Li}~2 Ma. Planktonic foraminifera faithfully record such variations in δ^7Li_{SW} [Hathorne & James, 2006]. A long-term history of δ^7Li_{SW} evolution reconstructed from planktonic foraminifera might help identify changes in seawater chemistry and those factors driving variations of oceanic silica mass balances linked to continental and sea floor/hydrothermal weathering, adding texture to the uplift-weathering paradigms evoked by records of $^{87/86}Sr$ [Hess et al., 1986; Hodell et al., 1991], $^{44/40}Ca$ [Griffith et al., 2008], and $^{187/188}Os$ [Peucker-Ehrenbrink & Ravizza, 2000]. A high-resolution Neogene record of seawater Li isotopes from super-cleaned planktonic forams (sites 758, 926 & 588) reveals that δ^7Li_{SW} rose from 26.5‰ during Mid-Miocene (16Ma) to 30.8‰ in Late Miocene (7Ma). This rise in δ^7Li_{SW} is preceded (24Ma-16Ma) and followed (7Ma to present) by long periods of almost constant δ^7Li_{SW} of 26.5‰ and 30.8‰ respectively. This quasi-linear 4‰ increase of δ^7Li_{SW} within eight Ma, which is very large and confirmed by individual species and 'bulk' forams, must reflect large changes in the balance between inputs to the ocean from riverine and hydrothermal sources and outputs via authigenic clay formation, and/or changes in δ^7Li of the sources or sinks.

A simple mass balance suggests that a 4‰ increase in δ^7Li_{SW} over eight Ma would require: (1) a shift in the average Δ_{SW-SED} (authigenic clay) from 11 to 16‰ (diagenesis); (2a) an increase in the Li-river flux from 3.2 to $8x10^9$ moles/yr; (2b) an increase in δ^7Li_{Riv} from 16‰ to 23‰; (3a) a decrease in the hydrothermal Li-flux from 15.4 to $6.2x10^9$ moles/yr, (3b) a decrease in δ^7Li_{HT} from 5.6‰ to -3.2‰, or some combination of all the above. Drastic variations in hydrothermal Li-flux (3a) or δ^7Li_{HT} (3b) are very unlikely over the last 20 Ma. An increase in Δ_{SW-SED} (1) would require a large shift in environments of silicate diagenesis from low-temperature basalt-hosted to sediment-hosted reactions, one reasonable scenario. The required increase in δ^7Li_{Riv} (2b) is also well within the observed range of published modern day river values (6‰ to 33.3‰), and a 2.5 fold increase in the riverine Li-flux (2a) is consistent with a three fold increase in river silica fluxes and doubling Ca_{SW} inferred from the $^{44/40}Ca$ record over this same period.

It seems most plausible that increases in δ^7Li_{Riv} and Li-flux are linked to increased orogeny, climatic deterioration, and a global increase in weathering rates with a decrease in weathering intensity, all leading to increasing river silica input, more sediment burial on the oceanic crust and enhanced marine silica diagenesis, and might help explain the Li, Sr, Os, and Ca isotope records. If correct, then we predict that the PETM will have very light δ^7Li_{SW} (intense

weathering intensity and sluggish marine silica diagenesis). Analyses of Paleogene foraminifera are underway to extend the δ^7Li_{SW} record across the KT boundary.

Nelson, James

Flux by Fin

Each winter millions of pounds of fish migrate from their summer home in the seagrass beds of the Florida Big Bend to over-winter and spawn nearly 100 miles away on offshore reefs. **Understanding the role this fish mediated nutrient flux plays in sustaining fisheries production is vital to proper management of this extremely valuable Northern Gulf of Mexico resource. **Data from offshore specimens suggest that gag gonad tissue is composed of material attained from inshore derived sulfur. This is an indication that seagrass derived prey are entering the offshore food web at a critical time in the gag reproductive cycle. Despite the great numbers of studies that speculate about the **importance of this type egress or "outwelling" to adjacent ecosystems, this is one of the first demonstrate and quantify it.

Paeng, Jiyoung; T. Dittmar

Combustion-derived dissolved organic matter in rivers and estuaries of the sugar-cane area of Southern Brazil

The terrestrially derived component in marine dissolved organic matter (DOM) is one of the most ill-defined factors in the global carbon cycle. Most terrestrial organic carbon is exported from rivers as dissolved organic matter (DOM) to the ocean. Previous studies suggested that combustion-derived black carbon (BC), which is produced by the combustion of fossil fuel and biomass burning, may be a major component of riverine and estuarine DOM exported to the ocean. However, the abundance and sources of combustion-derived DOM in river and estuaries have not been well constrained. The main goal of this study was to assess the contribution of BC to the DOM pool from different river systems with varying agricultural practices in Brazil. In particular, from Southeastern through Northeastern Brazil, sugar cane burning is an important type of biomass burning during the dry season from May through November. We hypothesized that the sugar cane burning could be the main responsible for the increasing of the BC concentration to the ocean during burning days. In this study, we used benzene polycarboxylic acids (BPCAs) as BC makers via high-performance liquid chromatography (HPLC) to quantify BC concentration and identify the effect of sugar cane burning in the formation of combustion-derived DOM.

Santema, Mike

Temporal Dynamics of Dissolved Oxygen of the Benthic Boundary Layer

Using multi-probe sondes (YSI 6600) dissolved oxygen and light data were recorded for weeks at a time in the benthic boundary layer at selected sites in the Northern Gulf of Mexico. We noted that there was typically a daily oxygen flux during the day when photosynthesis occurred. There would then be a subsequent nearly equal down-flux in oxygen at night when photosynthesis was absent. Although light conditions were similar at all sites due to turbid

conditions at shallow sites, we found the average daily oxygen change decreased with depth. With the help of a deep deployment at 38m, we predict a depth around 40m where a daily oxygen flux is no longer experience in the benthic boundary layer.

Todd, Austin

Understanding circulation dynamics and transport in the Florida Big Bend: An application to gag grouper larvae

Ongoing efforts in the Florida Big Bend Region (BBR) of the northeastern Gulf of Mexico seek to understand the migratory life cycle of the gag grouper (*Mycteroperca microlepis*). This reef fish provides over $100 million in value added to the regional economy. However, the physical mechanisms responsible for the migration of gag larvae from offshore spawning grounds to inshore seagrass nurseries along the coast of the BBR remain largely unknown. By using an ocean modeling system developed for the BBR, we investigate the role of bottom Ekman layer dynamics and upwelling to the net transport across-shelf, using transport by particle advection as a proxy for pelagic larval migration. The ocean modeling component consists of the Regional Ocean Modeling System (ROMS) configured at 30 arcsec resolution, and nested within a HYbrid Coordinate Ocean Model (HYCOM) nowcast/forecast system. Lagrangian and Eularian analyses of the simulated circulation are used to decipher possible onshore transport pathways and sources of variability in the shelf circulation. Results are presented from multiple years of simulated model runs, and the variability in flow and transport characteristics are discussed for numerous time scales.

Tremaine, Darrel; P. N. Froelich; B. Kilgore

Speleothem Paleoclimatology and Atmospheric Ventilation: Using ^{222}Rn and ^{13}C as Tracers to Reveal Mixing Pathways Inside Hollow Ridge Cave

Continuous high-resolution time-series of cave-air micrometeorology (humidity, wind speed and direction, barometric pressure, and temperature) and aero chemistry (ρCO_2, ^{222}Rn Activity), coupled with periodic spatial "snapshots" of cave air isotopic composition ($\delta^{13}C$) reveal mixing pathways inside Hollow Ridge Cave (HRC). A collection of 55 individual air samples including atmospheric and soilgas endmembers in and around HRC was analyzed for $\delta^{13}C$ (‰) and ρCO_2 (ppmv). CO_2 concentrations ranged from 500 ppmv (atmospheric) to 4480 ppmv (soilgas), while isotopic composition ranged from -11‰ (atmospheric) to -21‰ (soilgas). A plot of $\delta^{13}C$ vs. $[CO_2]$ reveals inverse mixing throughout HRC, which is to be expected in a two-endmember system. Percent atmosphere of each cave-air sample was calculated by solving a CO_2 mass balance, and data was plotted against distance (from cave entrance) to illustrate mixing pathways. Durridge RAD7 portable radon detectors were then deployed in targeted rooms within the cave to monitor previously unknown ventilation patterns. This transect served to identify a third "entrance" into HRC, which will allow further refinement of the ^{222}Rn-CO_2 exchange model put forth by A. Kowalczk and P. Froelich (EPSL 2009).

Wilson, Rachel Marie

Evaluation of trophic structure changes along an estuarine gradient: Apalachicola, Florida

Not only do dissolved inorganic carbon concentrations vary along estuarine salinity gradients, but DIC isotopic values ($\delta^{13}C$) vary as well. These variations are reflected by primary producers along the salinity gradient and in turn, consumers reflect the isotopic variations of the primary producers upon which they are reliant. Organic matter source availability may also vary along the estuarine gradient. Differences in food source type have the potential to influence trophic structure in these habitats while differences in source isotope values, if not properly accounted for, affect our interpretation of trophic structure. In order to differentiate between these effects, we have used a multi-source, multi-isotope approach to 1) evaluate organic matter sources to consumers in the upper-end, freshwater-dominated region of Apalachicola Bay and 2) determine relative trophic levels of consumers. These results were then compared to marine–influenced bay sites to determine whether organic matter inputs vary between the two bay areas and what effect, if any, such variances have on trophic structure. We found that consumers at low salinity sites were more reliant on terrestrial detritus than consumers from middle bay. Benthic organic matter was an important source for consumers at both sites in the bay. Consumers examined in the freshwater-dominated region of the bay exhibited a range of trophic levels (from 1.6 to 3.8). East Bay teleost fishes exhibited slight, but significant ($p < 0.05$), trophic differences suggesting possible trophic specialization in the freshwater-dominated areas which were not observed at marine-dominated sites.

Winterbottom, H.

Applying a Coupled Atmosphere-Ocean Model to Understand

The use of coupled atmosphere-ocean models applied for the predicting the evolution of tropical cyclone (TC) track, intensity, and structure has increased greatly in recent years. The contention for the use of a dynamical ocean, within these coupled-models, is the role which the ocean plays in modulating the aforementioned characteristics of the TC. This study investigates the impact that the sea-surface temperature (SST) boundary-condition has upon TC track, intensity, and structure. Experiments involving static (non-evolving) SST boundary conditions and those which evolve as a function of a both 1-dimensional (no-horizontal advection) and 3-dimensional (fully-coupled) ocean model are evaluated. Conclusions derived from these experiments, for several TC case studies – each within different atmospheric and oceanic environments and with varying traits (ie. translational velocity, synoptic scale interactions, etc.), will provide additional insight into when the use of a static TC boundary condition is suitable versus a temporally evolving SST boundary condition. Further, the necessity of use for a 1-dimensional ocean model versus that of a 3-dimensional ocean model, within the respective coupled-model environment, will be quantified.

Poster Presentation Abstracts

Blair, S. A.; D. K. Watkins

High-resolution calcareous nannofossil biostratigraphy of the Santonian Stage Boundary, Western Interior Basin

The Ten Mile Creek area (Dallas, TX) is a proposed Global Stratotype Section and Point (GSSP) candidate for the Coniacian/Santonian stage boundary. Before consideration for formal adoption, a complete biostratigraphic analysis must be completed. The Santonian Working Group has nominated the speciation of *Inoceramus (Cladoceramus) undulatoplicatus* as the diagnostic macrofossil bioevent for the base of the Santonian stage. Calcareous nannofossils were examined from sediments of the Bruceville Marl at the Ten Mile Creek proposed GSSP site and from well-preserved sediments of the coeval Smoky Hill Member type area (northwestern Kansas). Nannofossil bioevents were correlated with the lowest stratigraphic occurrence of *I. undulatoplicatus* to create a high resolution biostratigraphic framework and stratigraphic proxy for the Coniacian/Stage transition.

Six nannofossil bioevents are useful for recognition of the Coniacian/Santonian transition within the Bruceville Marl and Smoky Hill Member (Figure 1). The first appearance datums (FADs) of *Prediscosphaera grandis* and *Amphizygus* n. sp. A, as well as the FAD of two rare taxa, *Orastrum campanensis* and *Tortolithus* n. sp. A, are concurrent with the lowerst stratigraphic occurrence of *I. undulatoplicatus*. In addition, two nannofloral acmes occur near the boundary: *Watznaueria quadriradiata* and *Zeugrhabdotus scutula*. The succession of nannofossil bioevents noted in these outcrop sections within the Western Interior Basin provide a link to more coarsely-resolved nannofossil schemes developed in non-outcrop, deep-water studies.

Canion, A.; O. Prakash; S. J. Green; J. E. Kostka

Investigation of the Ecology and Biogeochemistry of N_2-Producing Microbial Communities in Arctic Sediments

Global climate change is expected to alter biogeochemical cycles in polar sedimentary environments, largely through changes in temperature and organic matter delivery to sediments. Knowledge of the diversity and physiology of nitrogen-transforming microbial communities is crucial to our understanding of benthic-pelagic coupling and how the nitrogen cycle may respond to climate change in polar sediments. The objective of this study was to characterize the microbial communities responsible for N_2 production in polar marine sediments using a combination of cultivation-dependent and cultivation-independent techniques. Microbial communities were investigated at three arctic fjord sites (Svalbard, Norway) which varied according to porosity and organic matter content. Potential rates of denitrification and anammox were determined in slurry incubations using ^{15}N tracer methods. DNA fingerprinting by Terminal Restriction Fragment Length Polymorphism (TRFLP) profiling was used in conjunction with clone library construction to describe community diversity and to identify the most abundant taxa. Gene sequences were PCR amplified with three primer sets including general bacterial primers targeted to the 16S rRNA gene (overall bacterial diversity), primers

targeted to the 16S rRNA gene that are specific to *Planctomycetes* (containing the anammox bacteria), and primers targeted to the nitrous oxide reductase (nosZ) gene which codes for the terminal enzyme in denitrification. Potential rates of denitrification and anammox ranged from .062 – 0.168 μmol N_2 L^{-1} h^{-1} and 0.003 – 0.049 μmol N_2 L^{-1} h^{-1}, respectively. Anammox contributed to between 4 – 23 % of N_2 production. Clone library results indicated that the overall bacterial diversity was dominated by the classes Deltaproteobacteria, Gammaproteobacteria, Flavobacteria, and Sphingobacteria. The dominant 16S rRNA gene TRLP peaks (identified by *in silico* digest of sequences from clone libraries) included members of the Flavobacteria, Gammaproteobacteria, Deltaproteobacteria, Alphaproteobacteria, and Planctomycetes. Denitrifying bacteria were further characterized by enrichment, isolation, and physiological screening of pure cultures. A total of 17 isolates, comprising 5 genera and 3 phyla, were obtained. Isolates were from the genera *Arcobacter, Herminiimonas, Pseudomonas, Psychromonas,* and *Shewanella*. Six representative isolates were grown at 4 temperatures (1.5^0C, 5^0C, 15^0C, 25^0C) and grew optimally at 15^0C, indicating that they were all psychrophilic.

Chipman, L.

DOM decomposition in permeable coastal sediments

We tested the hypothesis that DOC is degraded when filtered through permeable shelf sediments. Plankton-derived DOM was mineralized during filtration through 6 cm long sand-filled column reactors, up to 7-times times faster than in dark water-filled column reactors. For common Gulf settings, filtration along a 50 cm long path through sand can remove all highly degradable DOC pumped into the sediment, translating to fluxes of up to 380 mmol DOC m^{-2} d^{-1} or DOC removal from 1000 l coastal water m^{-2} d^{-1}. Bacterial incorporation of ^{13}C and ensuing SIP analysis revealed the immediate response of a diverse community of sedimentary aerobic and anaerobic microbes to advective DO^{13}C supply. EEM analysis of CDOM contained in diatom-derived DOC indicated that microbes removed preferentially components around the fluorescence peak of tryptophan/protein-like substances which may have highest nutritious value. Detailed FT-ICR analysis revealed that filtration through sand removes a broad spectrum of substances from less degradable, humic/fulvic acid like DOC and produces new DOC components. The flushed sand layer between water column and deeper anoxic sediment layers thus acts as effective DOC filter where subsurface horizontal pore water flows promote decomposition of DOC.

Coor, J. L.; J. F. Donoghue; Y. Wang; O. Das; S. A. Kish; J. B. Elsner; X. Hu; A. W. Niedoroda; M. Ye

Determining a Late Holocene Storm History for NW Florida Through Multiple Proxies

The environmental effects of major storms result in significant damage to coastal systems. The historic record of major storms is brief and not representative of the geologic record. A set of coastal dune lakes in NW Florida has provided a natural laboratory for paleostorm study. Due to their unique hydrology, these lakes on the Florida panhandle coast are unusually long-lived and provide a nearly continuous sedimentary record of storm events from the late Holocene to present. The Walton County coastal dune lakes lie directly behind barrier dunes, with surface elevations near present sea level. The lake water is normally fresh to brackish. During major storm events the dunes are breached, commonly forming a temporary inlet, and the lakes are

impacted by marine water and sometimes overwash sediment. In this study, we collected sediment cores from the center of Eastern Lake and Western Lake located in Walton County on the Gulf coast of NW Florida. These cores are mainly composed of organic-rich mud and organic-poor sand. Selected samples were submitted for radiocarbon dating in order to establish a chronological framework for the interpretation of the geochemical data. Radiocarbon dates will allow establishment of the timing of the event and the interpretation of geochemical data in terms of changes in the lake environment. A combination of sediment grain-size analysis, x-radiography, percent moisture, percent organics, and stable isotope data ($\delta^{13}C$, $\delta^{15}N$) has been combined to identify paleostorm signatures. It has been found that no single proxy is a perfect determinant of storm occurrence, but the combination of isotopic and sedimentologic parameters combine to create a more realistic long-term storm history. Comparison of the paleostorm record with the historic storm records suggests that the historic record is not a reliable indicator for long-term storm frequency.

Das, O.; Y. Wang; J. F. Donoghue; J. Coor; S. A. Kish; J. B. Elsner; X. Hu; A. W. Niedoroda; M. Ye

Reconstruction of paleostorm history using geochemical proxies in sediment cores from Eastern Lake, Florida

Analysis of geochemical proxies of coastal lake sediments provides a useful tool for reconstructing paleostorm history. Such paleostorm records can help constrain models that are used to predict future storm events. In this study, we collected two sediment cores (.6 and 1.03 meter long, respectively) from the center of Eastern Lake located on the Gulf coast of NW Florida. These cores, which are mainly composed of organic-rich mud and organic-poor sand, were sub-sampled at 2-3mm intervals for analyses of their organic carbon and nitrogen concentrations as well as $\delta^{13}C$ and $\delta^{15}N$ isotopic signatures. Selected samples were submitted for radiocarbon dating in order to establish a chronological framework for the interpretation of the geochemical data. There are significant variations in $\delta^{13}C$, $\delta^{15}N$, C%, N% and C/N with depth. The δ13C and δ15N values vary from -21.8‰ to -26.7‰ and 2.6‰ to 5‰, respectively. The stable isotopic signatures of carbon and nitrogen indicate that the sources of organic matter in sediments include terrestrial C3 type vegetation, marine input from Gulf of Mexico and biological productivity within the lake, such as phytoplankton and zooplankton growing in the lacustrine environment. The $\delta^{13}C$ and $\delta^{15}N$ values exhibit significant negative excursions by 2‰ in a 30 cm thick sand layer, bounded by a rapid return to the base value. A positive shift in the $\delta^{15}N$ record observed in the upper part of the cores likely reflects increased anthropogenic input of N such as sewage or septic tank effluents associated with recent development of areas around the lake for human habitation. Similarly, organic C% and N% range from 5.8 to 0.4 and 0.4 to 0.1, respectively. A prominent negative shift by 2σ relative to the baseline in C% and N% has been observed at approx. 55 to 58 cm depth, consisting of an organic-poor sand layer. This shift in C% and N% can be correlated with the negative shift in the $\delta^{13}C$ and $\delta^{15}N$ values, indicating a major storm event. Radiocarbon dates will allow establishment of the timing of the event and the interpretation of geochemical data in terms of changes in the lake environment.

Dimova, N.; B. Burnett; J. Chanton; R. Peterson

What we learned about the hydrologic regime of the largest submarine spring system in Florida using salinity and radon: a two-year investigation on Spring Creek Springs

Florida has one of the largest network of springs not only in the US but in the world. Among the approximately 700 documented springs in the state, 33 of them are considered to be first magnitude with discharge of over $2.9x10^5$ m^3/day. With an average annual discharge of $4.9x10^6 m^3$/day, Spring Creek Submarine Springs in Wakulla County is the leader. In the summer of 2007 this spring was observed to have reduced significantly its flow due to extreme drought conditions. Our examination of the springs during this period revealed rather interesting conditions. While the radon-in water-concentrations were still relatively high, the salinity has increased significantly, from 4 in 2004 to 33 in July 2007. This indicates a massive saltwater intrusion into the aquifer. During a two-year investigation between August 2007 to May 2009 we deployed almost on a monthly basis a continuous radon-in-water measurement system (RAD AQUA) and monitored the salinity fluctuations in the area. We observed some extreme salinity and radon variations during this period. For example, as a result of a very strong rain event (total of 173 mm) at the end of February 2008, the salinity dropped from about 27 to 2 only two days after the storm. The radon-in-water concentrations dramatically increased in parallel, from about $20x10^3$ dpm/m^3 to about 400 $x10^3$ dpm/m^3 (Fig.1).

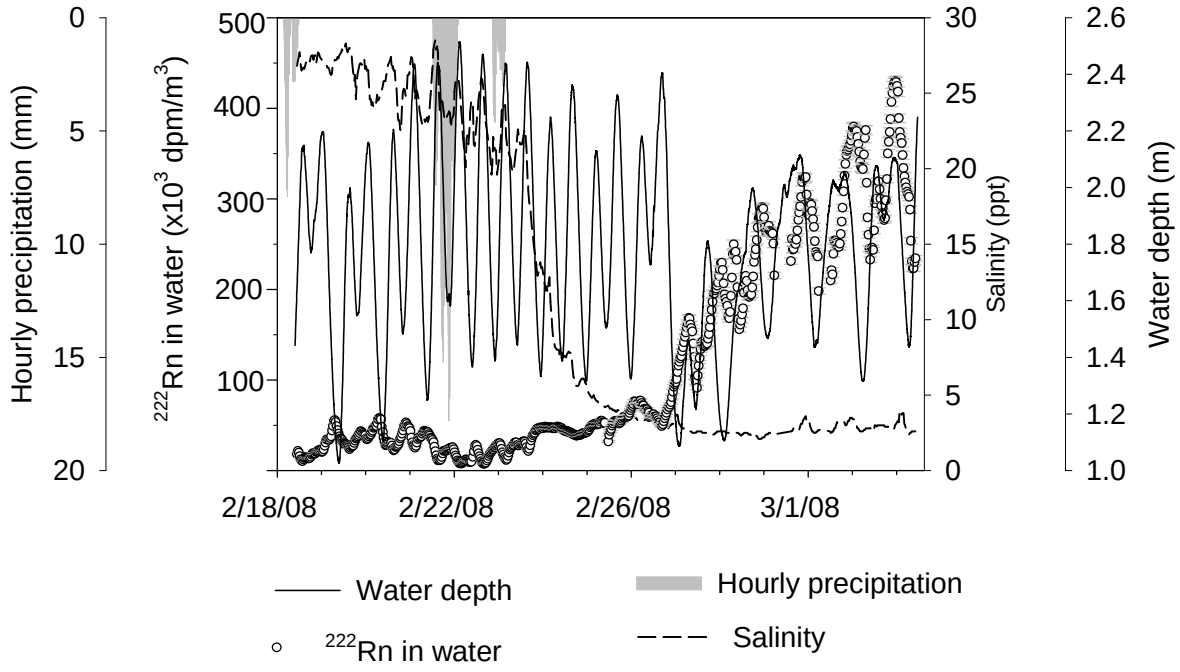


Figure 1 Salinity and radon-in-water time-series measurements during a February 2008 fresh water breakthrough event.

Our two-year observations of the springs' fresh water discharge based on both salinity and radon show that the hydrologic regime of the system is strongly correlated to local precipitation and water table fluctuations. This suggests connections between the deep and the surficial aquifers. Our long-term perspective is to combine this information with climate and geologic data to reveal significant land-ocean linkages in the area.

Dong, J.; K. Speer

The Inverse Result of Current and Transport on the Antarctic Slope along I6S (30°E)

The CLIVAR I6S (2008) hydrographic and current data on the Antarctic Slope were analyzed by inverse method, which provides a consistent dataset, as part of the Weddell Gyre and Antarctic Slope Current system. The result was also compared to the Southern Ocean State Estimate (SOSE) dataset to show the validation.

Easton, Erin

North Pacific deep-sea sediment: environmental variables

Environmental variables of the upper centimeter of sediment were analyzed for stations along two isobaths off the west coast of the United States. Four pairs of stations were sampled with a multiple corer, one of the pair at 2700 m and the other at 3700 m. Environmental variables included bacterial abundance, carbon and nitrogen fractions, chlorophyll *a* concentration, enzyme hydrolyzable amino acid concentration, and grain-size distribution. Initial evaluation of these variables has revealed that some of the stations differ significantly. These data will be used to determine whether correlations exist among the environmental variables and whether one or more of these variables can be correlated with observed patterns of harpacticoid species' ranges and meiofauna abundances, which will also be analyzed.

Gouillon, F.; E. Chassignet

Diagnosing the spurious mixing in the Regional Ocean Modeling System (ROMS)

A commonly used criterion to assess the performance of an ocean numerical model is its ability to accurately simulate (i.e. create, transport, and maintain) water masses and their properties. This is mainly achieved by having realistic mixing rates in the ocean interior. Indeed, many studies show that the equilibrium state of the ocean circulation is very sensitive to the diapycnal diffusivity. Yet, the numerical framework of fixed coordinates ocean models (geo-potential and terrain-following levels) artificially creates a high level of diapycnal mixing that, in some regions, can overshadow the naturally occurring mixing. This spurious diapycnal mixing can unrealistically and irreversibly modify the simulated water masses. Few studies attempt to quantify this numerical diffusion. In this work, we use the tracer flux method to quantify the numerically-induced diapycnal mixing through idealized numerical simulations for the Regional Ocean Modeling System (ROMS), a σ- level model. First, we compare our results for the lock exchange problem with previous numerical studies that use the tracer variance method, and show that we obtain similar diapycnal mixing estimates. Second, we apply the tracer flux method to quantify the diapycnal diffusivity for the case of internal waves propagating within a basin. We show that the spurious mixing has an increased magnitude for this case. We also investigate the impact of the horizontal and vertical resolution choice, as well as the choice of the numerical advection scheme, on the magnitude of the spurious mixing. Preliminary results show that increasing the model resolution or carefully choosing an adapted numerical advection scheme for the considered application reduces the spurious mixing but does not fully alleviate the problem.

Jasrotia, P.; A. Canion; O. Prakash; S. Green; J. E. Kostka

Isolation and characterization of denitrifying fungi and bacteria from low pH, nitrate- and uranium- contaminated groundwater

The subsurface at the U.S. Department of Energy's Oak Ridge Integrated Field-Scale Subsurface Research Challenge (OR-IFRC; Oak Ridge, TN) is contaminated with a mixture of organic and inorganic materials as a legacy of cold war era uranium enrichment. The contaminant driving remediation efforts at many U.S. DOE sites including the OR-IFRC is uranium. However, the development of effective U(VI) bioremediation strategies is limited by the presence of co-contaminants such as nitrate, and the function of subsurface microbial populations that attenuate nitrate are not well understood. To understand the denitrification potential in subsurface groundwater and sediments under acidic conditions, we are adopting the dual approach of culturing the representative acidophilic microorganisms (pH 4-5), and measuring their denitrification potential. Bacterial and fungal isolates have been recovered from the acidic and highly contaminated source zone of the OR-IFRC. Isolates were obtained from enrichment cultures under denitrifying conditions or by spread plating under aerobic conditions. Structural gene (16S rRNA and 18S rRNA) analysis revealed thirteen species of bacteria from four phyla and ten species of fungi from two phyla. Bacterial isolates belonged to the genera *Rhodanobacter* (Gammaproteobacteria), *Streptomyces* (Actinobacteria), *Bacillus* (Firmicutes), *Afipia* (Alphaproteobacteria), *Janthinobacterium, Castellaniella* and *Variovorax* (Betaproteobacteria) and *Sphingobacterium* (Sphingobacteria). The fungal isolates belonged to the genera *Penicillum* and *Aspergillus* (Eurotiomycetes), *Neolinocarpon* and *Coniochaeta* (Sordariomycetes), *Rhodosporodium* (Microbotryomycetes), *Lachnum, Teberdinia* and *Sclerotinia* (Leotiomycetes) and *Heterodermia* (Lecanoromycetes). Denitrification potential experiments with fungal cultures showed the accumulation of nitrous oxide, which is believed to be the most common end product of fungal denitrification. The fungal isolate which showed the greatest denitrification potential (the highest nitrous oxide production in the presence of antibiotics) aligns close to *Teberdinia hygrophila* (99% seq. similarity). Isolation of a broad range of denitrifying bacteria and fungi from the OR-IFRC subsurface suggests adaptation to acidic and high contaminant load conditions, and fungi might play an important role in the transformation of subsurface contaminants, possibly catalyzing denitrification under low pH conditions.

Jemison, K. E.; S. Wise

Diatom biostratigraphy of RV/IB NBP0602A Shaldril II sites 3 and 4 off Seymour Island, Antarctica

The biostratigraphy and paleoecology of Eocene-Oligocene age diatoms from the Antarctic Ocean have long been of great scientific interest due to the low recovery of such sediments from this region. This interval also spans the "Greenhouse" to "Icehouse" transition that saw the formation of the first Antarctic ice sheet to reach sea level during the Cenozoic Era (past 65 m.y.), a harbinger of the climate deterioration that eventually produced present-day Antarctic ice cap.

The SHALDRILL II Cruise of the Research Vessel/Ice Breaker *Nathaniel B. Palmer* in 2006 was the second of two sea-trials funded by the National Science Foundation to test the feasibility of placing a medium-sized sediment coring rig on a scientific ice breaker to recover shallow sediment cores (down to about 300 m below the sea floor) in areas along the Antarctic margin where most other vessels cannot operate. NOP0602A Sites 3 and 4 targeted Paleogene sediments, and a preliminary shipboard examination of these sites raised considerable interest because it indicated that the cores obtained ranged from late Eocene to middle Oligocene in age, i.e., thorough the "Greenhouse-Icehouse" transition at the Eocene-Oligocene boundary. Due to the general scarcity of upper Eocene cores recovered from the region to date, robust diatom biostratigraphy for the critical boundary interval has never been constructed, and little is known about the diatom assemblages. This project, will be a qualitative approach to 1) describe the diatom assemblages from Sites 3 and 4 via light and scanning electron microscopy, 2) to age date and zone the sequence, and 3) to provide insights into the paleoclimatology of the region during the Eocene and Oligocene.

Kostka, B.

Improving conservation of the American Horseshoe Crab in Florida through research, management and education efforts.

The American horseshoe crab, *Limulous polyphemus,* plays an important role in Florida's coastal ecosystems (McLaughlin et al. 2009). The horseshoe crab lives in shallow waters along the state's Atlantic and Gulf coasts. Research has shown that horseshoe crabs strongly influence energy flow and community structure in estuarine systems through predator-prey interactions (Moore and Perrin 2007) and bioturbation (Stephenson 2006). This study investigated current trends in the ecology of horseshoe crabs in order to highlight current management and education efforts to improve their conservation in Florida. Declines in the horseshoe crab population could cause serious impacts to coastal ecosystems. Recent trends indicate that the abundance of horseshoe crabs is declining over much of the species' range, especially the Mid-Atlantic region. (FWC Sea Stats, 2007). Unfortunately, population trends in Florida are unknown as minimal data is available on standing stock. Despite this problem, qualitative data suggest that *L. polyphemus* populations in the Southwest and Florida Key regions of Florida are extremely low. This coupled with the disproportionately high marine fisheries harvesting activity in this area has caused some fisheries managers to express concern for the population's ability to replenish itself if harvesting pressures increase (Gerhart, 2007). It is my recommendation that managers of Florida's wildlife and estuaries make the conduction of baseline surveys of American Horseshoe Crab populations in the state a priority, beginning with the Southwest and Florida Key regions. This baseline data is essential for fisheries management decisions under the Atlantic States Marine Fishery Commission Fishery Management Plan. In addition, a public education initiative should be expanded to promote the importance of the American horseshoe crab in Florida's waters.

Krishnamurthy, N.

Mercury and trace metal deposition into the Pensacola Bay watershed

Event based atmospheric deposition of mercury, trace metals, and major ions have been monitored in the Pensacola Bay watershed over the last 3 years at 3 locations to evaluate the temporal and spatial patterns in atmospheric wet deposition. A goal of this project was to evaluate the contribution of local sources (coal fired power plant and paper mill) to atmospheric deposition. There were no significant differences in the rainfall Hg flux between the three sites or between the Pensacola Bay sites and nearby Mercury Deposition Network monitoring sites along the Gulf Coast. Mercury deposition during the summer months is higher than other months due to higher concentrations in the rainfall throughout the region. Samples were analyzed for total mercury and a suite of 50 other trace elements. Multivariate statistical methods are used to sort these trace elements into factors that represent potential source components that contribute to the rainfall chemistry. Ga, Bi, V, As, Se, Sb, and Sn are all correlated with mercury. Using various Hg/element ratios, we can estimate that 14-23% of the rainfall mercury in the region results from coal combustion. However, we cannot definitely distinguish local vs. regional or distant sources.

Rahter, B.

Observations of Turbulence in the Transition Layer

The oceanic mixed layer is the dynamically active boundary layer by which atmospheric forcing is linked to interior oceanic circulation. By definition, the mixed layer is a region of intense mixing, where turbulence is responsible for homogenizing temperature and salinity distributions down to depths of O(100) m. Below the mixed layer, in the upper layers of the stratified thermocline, turbulent energy levels are greatly reduced. The transition between these two regions is the focus of my investigation. Traditionally, this transition is assumed to take place abruptly at the mixed-layer base. However, observations suggest that enhanced turbulence penetrates significantly into the stratified water just below the mixed layer.

Here, I present an examination of existing turbulence data documenting open ocean conditions with steady wind-forcing in both the sub-tropical Atlantic and Pacific. This analysis establishes statistics for turbulence dissipation levels occurring just below the mixed layer, which have not been previously documented. A preliminary analysis suggests that the transition layer often extends 30 to 60 m below the mixed layer base, and that diabatic fluxes in this region are several times greater than in the thermocline under normal surface forcing conditions.

Rohal, M.

Metazoan meiofaunal abundances and ecological correlates along the west coast of the United States between 2700 m and 3700 m depth

Little is known about the distribution of deep-sea meiofauna in comparison to deep-sea macrofauna. To further our knowledge, a multiple corer was used to collect deep-sea samples from four stations near the 2700-m isobath and four near the 3700-m isobath off the west coast of the United States. From these samples, I will examine the meiofauna abundance (nematodes, harpacticoid copepods, kinorhynchs, and ostracods) and compare them with the environmental data from each station.

Rycyk, A.; C. Deutsch; M. Barlas; D. Nowacek; S. Koslovsky; K. Frisch

Florida manatee behavior during vessel approaches

Florida manatees (*Trichechus manatus latirostris*) inhabit areas with high vessel traffic, and collisions with vessels account for 25% of manatee mortality. Understanding manatee response to watercraft and the cues that mediate that response is an important step in minimizing manatee deaths and injuries from watercraft collisions. To examine manatee behavioral response to approaching vessels, multi-sensor digital archival tags (DTAGs) and Argos-linked GPS buoys were attached to wild manatees in Southwest Florida in 2007 and 2008. Response was measured as changes in heading, depth, fluke stroke rate, 3-dimensional orientation, and movement relative to vessel and to channel. A boat-based observation team gathered information on all vessels within approximately 500 m of the manatee. Data included vessel type, number and type of engines, speed class, closest distance to manatee, and locations calculated from range/bearing measurements recorded with a laser rangefinder and GPS coordinates of the observation boat. This information on the travel paths of all vessels around the focal manatee, the fine-scale 3-dimensional behavioral measurements from the DTAG, and GIS maps of important habitat features (bathymetry, seagrass) were integrated into detailed reconstructions of encounters between tagged manatees and passing boats. These data allowed us to examine factors potentially affecting manatee response to a vessel, such as water depth, manatee depth, and the distance and speed of the approaching vessel. Changes in mobility, speed, and heading of the manatee were all observed responses to boat approaches. The majority of changes in mobility or speed were increases, while the majority of heading changes were away from approaching boats. We will present the results of numerous single and multiple vessel encounters, focusing on boat passes within 50 m of the focal manatee.

Tazaz, Amanda; J.P. Chanton; C. Kelley; J. Poole; B. Bebout

Methane Production in Extreme Environments

A biogeochemical approach was used to illuminate the processes surrounding the formation and cycling of methane in hypersaline environments. Four sites with salinities ranging from 55 ppt to 290 ppt were sampled. Methane bubbles within the microbial mats and evaporitic minerals throughout the various systems were obtained and analyzed for both $\delta^{13}C$ and $\delta^{2}H$ to determine the biogenicity of the gas. The isotopic composition of methane $\delta^{13}C$ and $\delta^{2}H$ ranged from -60 to -30‰ and -450 to -350‰ respectively, indicating that non-competitive methane production pathways were being used. Fractionation factors between methane and carbon dioxide also indicate non-competitive methanogenic pathways with α_C and α_D ranging from 1.03 to 1.06 and 1.1 to 1.6 respectively. To test which non-competitive pathway was dominant, samples of microbial mats and microbial communities incrusted within the gypsum were collected and incubated for methane production rates assays using ^{13}C labeled monomethylamine, acetate, methanol, and bicarbonate. Rate constants, k, for methane production were calculated and are as follows, monomethylamine 0.1, acetate 0.01, methanol 0.07, bicarbonate 0.01, indicating that monomethylamine and methanol are preferred substrate over the traditionally thought substrates, acetate and bicarbonate.

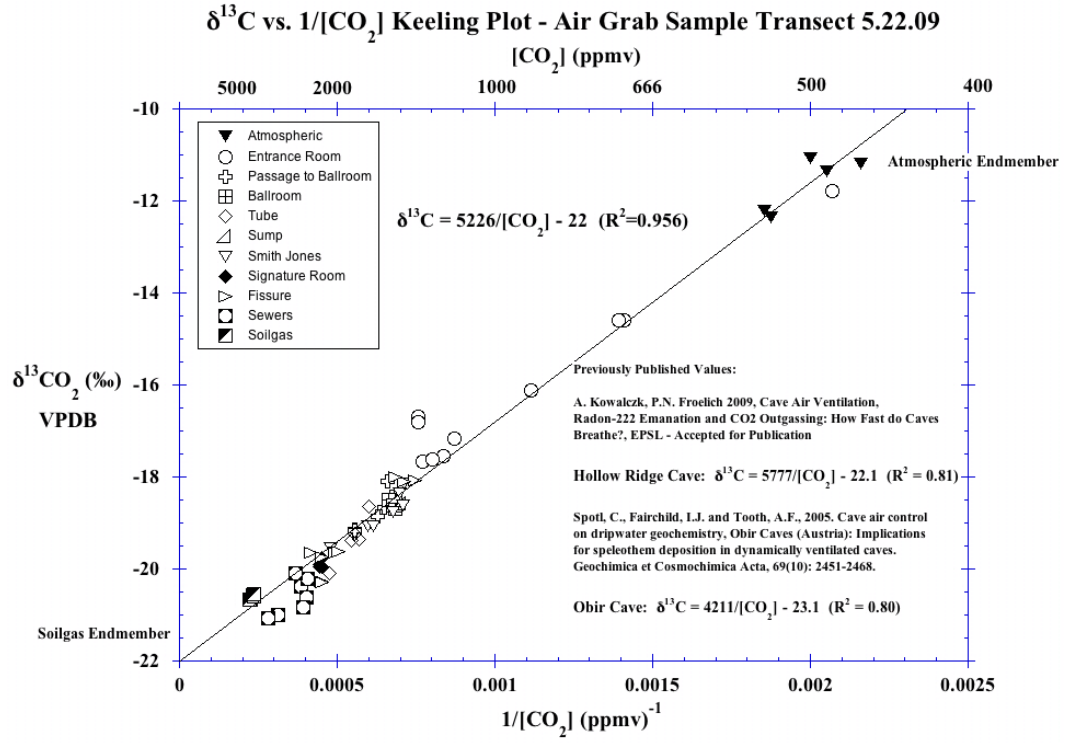
Tremaine, D.; P. N. Froelich; B. Kilgore

Speleothem Paleoclimatology and Modern Proxies: Calcite Farming In a Continuously Monitored Cave

Continuous high-resolution (sub-hourly) time-series of local meteorology (solar irradiance, relative humidity, rainfall, wind speed and direction, barometric pressure, and temperature), cave air chemistry (t, rh, bp, radon-222, pCO_2, air-flow velocity and direction), and cave-ceiling drips in Hollow Ridge Cave in North Florida reveal variations that must color interpretations of annually resolved speleothem records. The style and vigor of ventilation and mixing strongly influence diurnal and seasonal cave-air ^{222}Rn, pCO_2 and $\delta^{13}CO_2$. Cave-air pCO_2 controls CO_2 degassing from drip waters, leading to oversaturation of calcite and dripstones. Periodic high-resolution spatial snapshots of ^{222}Rn and $\delta^{13}C$ gradients taken inside the cave reveal interior ventilation and mixing pathways that help us understand connections between ^{222}Rn-modeled CO_2 exchange and drip rates, drip chemistry, speleothem growth, and soilgas and dripwater contributions to dripstone $\delta^{13}C$.

Drip waters and aquifer water are collected once every two weeks. Isotopes ($\delta^{18}O$, D/H), major anions (Cl^- and SO_4^{2-}), cations (Na^+, K^+, Ca^{2+}, Mg^{2+}, Sr^{2+}) and tracers (Ba, U, Si, Mn) in the drips are related to rainfall, evapotranspiration and soil weathering reactions in the epikarst. Drip composition is then compared to the chemistry of contemporaneous calcite. Sulfate and Mn^{2+} can be interpreted as qualitative proxies for soil redox (saturated epikarst). Chloride correlates negatively with drip rate, while sulfate correlates positively with drip rate.

We are growing artificial speleothems ("calcite farming") on quartz slides under drips atop active speleothems. Early winter calcite precipitation ranged from 0.034~0.161 mg/day. Late winter precipitation ranged from 0.031~0.306 mg/day. Summer yielded no calcite growth. Calcite does not precipitate during months when slow ventilation results in high cave-air pCO_2. A larger number of slides are currently deployed to accumulate an analytical quantity of calcite. Isotopic ($\delta^{13}C$, $\delta^{18}O$) and elemental (Ca, Mg, Si, K, Sr, Ba, U, Mo, Si, Mn, Fe) analyses of the farmed calcite will serve as a modern calibration for interpretation of paleoclimate proxies. For example, $\delta^{13}C$ of cave-air is controlled by mixing between outside air and soilgas (see Keeling Plot below). It is likely that annual $\delta^{13}C$ incorporation into speleothems is a function of this ventilation and seasonal mixing, rather than C3/C4 of overlying vegetation.



Weihs, R.

Resolving the diurnal cycle in sea surface temperatures and its effect on surface turbulent fluxes the Challenges in Forecasting Tropical Cyclone Intensity

In an effort to improve spatial and temporal resolution as well as accuracy of global sea surface temperatures for a multitude of applications, a new global field of diurnally varying sea surface temperatures will be generated and examined. A modified version of the original Fairall 1996 (F96) COARE one dimensional bulk model, called Profiles Of Surface Heating 2009 (POSH model) will be used to model the diurnal cycle of SST's. The POSH model simulates diurnal warming based on improvements of solar absorption at the near surface of the ocean, as well as adding the effects of dissipation of heat and momentum and incorporating a non-linear dependence of the temperature distribution on wind speeds (Gentemann et. al 2009). Winds from a multi-satellite gridded wind product and ISCCP radiative fluxes will be used to estimate the diurnal warming on SSTs (dSST) occurring every three hours on a global 1 degree by 1 degree grid. This final product can then be used to compute and examine surface heat fluxes over the global oceans in order indentify the significance of diurnally varying surface heat flux and SST changes. The examination of global plots of diurnal flux changes for different times of year will be used in order to make regional assessments of fluxes based on deviations from the mean SST flux field.