Student Presentation Abstracts

Session: Remote Sensing
Graduate Student
Skylar Tamke
Montana State University

Handling Multiple Cameras on a Balloon

During the ascent of a balloon flight the ride is quite turbulent, wanting to look in a general direction is nearly impossible with only one camera. While there are solutions of using a mechanical gimbal system this presentation will go over MSGC's solution to using a electric "gimbal" system.

Session: Remote Sensing
Undergraduate
Matthew Thomas
University of Montana

Using Thermal Infrared Imaging to Estimate Soil Hydraulic Parameters: A Novel Approach

In this study, skin temperature measured with a thermal infrared (TIR) camera was used to estimate soil hydraulic parameters. Laboratory experiments were set up to record surface skin temperature response in a clean soil column using a TIR camera after an artificial wetting event. An array of thermocouples, a net radiometer, heat flux sensor and weather station were used to constrain the TIR data and the energy budget during the experiment. The soil column surface was then wetted with a known amount of water over a controlled time period and the thermal response recorded at five minute intervals over the course of 18 hours. Soil hydraulic parameters were then estimated by fitting a water-energy conservation model (ECH2O) to the observed data using a Marqhart-Levenberg least squares minimization method. This inversion of ECH2O was able to estimate soil air entry pressure, soil porosity, and the Brooks-Corey pore size distribution parameter with a relatively high degree of precision; however, the method was not sensitive enough to yield acceptable estimates of hydraulic conductivity. The estimated parameters were compared to several sets of known values based on soil textural classification. Most of the estimates were within the range of standard published values. The Brooks-Corey pore size distribution parameter was estimated with the least error relative to these published values. These results show that soil hydraulic parameter estimation based on TIR skin temperature data could prove to be a fast and useful new tool to characterize the distribution and spatial heterogeneity in soil hydraulic properties at the field scale.

Session: Remote Sensing
Undergraduate
Samuel Hart
University of Montana

Three Dimensional Mapping of Earth's Bow Shock using the IBEX-Hi ENA Sensor

Since 2009, the Interstellar Boundary Explorer (IBEX) has been mapping the interstellar boundary through the collection of incoming energetic neutral atoms (ENAs) from the outer heliosphere. The mission also has a secondary objective of performing magnetospheric science. IBEX is in high earth-orbit, and thus spends some of its time in the Earth's magnetosphere. When the spacecraft passes through the magnetosheath, a region of shock-heated solar wind ions, IBEX-Hi observes a very strong signal from these ions. We use this signal and the position of IBEX to determine when and where IBEX crosses the magnetosheath boundary. IBEX has passed through the magnetosheath over 350 times, allowing us to observe enough points to map the magnetosheath boundary to a distance of 50 RE from Earth. We can use these data to test models which predict the shape of the Earth's bow shock and magnetopause (the outer and inner boundary of the magnetosheath). I will be presenting the data I have obtained and mapped, as well as the best fits of models to the data.

Session: Remote Sensing
Graduate Student
Ruben Behnke
University of Montana

Diurnal variations in humidity across the coterminous United States and southern Canada using regional networks

Historically, the lack of observed humidity data led to the use of minimum temperature as a proxy to the mean daily dew point, and the assumption that dew point (Td) remained constant through the day. These assumptions have been integrated into numerous ecohydrological models, data sets, and studies. Using data from 34 national and regional weather observation networks in the continental United States and southern Canada over the period 1948 – 2014, we examine both of these assumptions in detail. Our results indicate that minimum temperature is a poor proxy to average daily dew point over most of the intercontinental west and high plains regions, especially during the warm months. Additionally, we update an analysis performed over 50 years ago which identifies five specific and consistent diurnal dew point types, based on the climate of a region and season. Based on the diurnal type of a region and season, specific biases in minimum, mean, and maximum daily Td, VP, and VPD can be expected when assuming a constant daily Td. Our analysis indicates that as spatial and temporal resolution of modeling and field studies increases, accounting for variations in diurnal Td becomes more important. Now that the availability of humidity data is on par with that of other meteorological variables, we recommend that end users move away from simplistic

assumptions regarding the diurnal behavior of humidity, and begin to incorporate hourly or even sub-hourly data into their work.

Session: Remote Sensing
Graduate Student
Sylvia Nicovich
Montana State University

An Earth processes approach to understanding Martian alluvial fan dynamics

Alluvial fans of Earth typify depositional environments thought to pervade Mars. Analogues may be drawn from our terrestrial home, especially in arid regions, and applied to our red neighbor. With the advent of satellite imagery to capture the exposed Martian surface, planetary geomorphologists have been enabled to interpret surficial processes of genetic landscapes through comparison to those present on Earth. In combination with acting as a Martian analogue, the San Luis Valley of southern Colorado is an ideal natural laboratory to assess the role of glaciation on alluvial fan development. This high elevation desert valley is bound to the east by the Sangre de Cristo Mountains, a precipitous range with multiple drainage basins that source alluvial fans of the piedmont. These fans are sourced from drainage basins with different levels of glacial influence; those that have hosted moving ice and those that have not. Sedimentary and morphometric analysis of the debris-flow alluvial fans of the western flank Sangre de Cristo Mountains serve as an added instrument to investigate probable geomorphologic processes on Mars, including those effected by cryogenics. This project lays the observational framework for the effects of alpine glaciation on fan sedimentation to be scrutinized while bolstering the breadth of space-related studies, including landscape interpretation of Mars through remote sensing information.

Session: Remote Sensing
Undergraduate
Tyrel Fenner
Salish Kootenai College

Assessing A Surface Weather Station Setup

No Abstract

Session: Engineering I
Undergraduate
Levin Mullaney
Montana Tech

AirCore Control System

The goal of this project was to establish a system for the AirCore with reliable communication, cutdowns, parachute deployment, and tube closure mechanism.

The system uses an Iridium modem and RFD900+ radio modems for communication. Also, an explosive bolt cutdown was developed. Parachute deployment, where multiple small parachutes are deployed on descent, was implemented on this system. A method was developed for sealing the AirCore tube when the payload lands.

The Iridium modem and RFD900+ radio modems can trigger both cutdowns, deploy parachutes, and close the AirCore tube. In addition, the RFD900+ radio modem periodically sends the status of the payload to a ground station computer. This includes information regarding whether the Iridium modem is still connected, if either cutdown was triggered, if any parachutes were deployed, and whether the AirCore tube is open or closed.

The system also operates autonomously in the event that it loses connection with the ground station computer. An altimeter is used to determine the payload's altitude and whether it is ascending or descending. When it determines that the payload is descending and below a set altitude, it deploys the parachutes. The altimeter and an ultrasonic sensor are used to detect the payload's landing to automatically seal the AirCore tube. Also, a timer is used to keep track of the time since the payload's launch. This is used to ensure that certain events occur at approximately the correct time (e.g. a cutdown does not trigger directly after launch). Overall, the system was designed to be flexible and controllable from a ground station computer but also autonomous in the event the payload loses connection with the ground station computer.

Session: Engineering I
Undergraduate
Erik Anderson
Montana State University

Undergraduate Engineering Experience in High Altitude Ballooning

There are several projects which I contributed to that supported the BOREALIS program mission. The mission itself is intended to fly a high-altitude balloon to 100,000 feet, take still images and live stream video of the upcoming solar eclipse this summer on August 21,2017. My specific contributions were improving the balloon landing prediction of the BOREALIS balloon tracking website, as well as troubleshooting issues with the iridium modems used for GPS tracking of a balloon in flight. These problems are important because they allow for better planning of balloon recovery on flight day and with less packet loss from the iridium modems a more accurate flight path record. To solve these problems, I taught myself back-end website software languages to improve the landing prediction. I also learned how to use the software designed to troubleshoot the iridium modems. The results demonstrated that the iridium modems function properly and the packet loss had nothing to do with the iridium modems. Further, I developed a beginner understanding of back-end website software languages. The implications show that the iridium network has a lot of traffic on it and our modems have low priority which is why at times severe packet loss occurs.

Session: Engineering I
Undergraduate
Mackenzie Dwoznik
Great Falls College - Montana State University

Pi in the Sky

No Abstract

Session: Engineering I
Undergraduate
Micaela Moreni
Montana State University

Helium Release Valve for Zero Pressure Balloons

The BOREALIS Program in the past has primarily exercised the use of a cut-down system to terminate for latex balloons. While this is also an adequate method for zero pressure balloons, this project aims to explore the use of a zero pressure helium release valve as an alternative source of termination.

Session: Engineering I
Undergraduate
Kristine Pye
Flathead Valley Community College

FVCC's Four-Channel Polarimeter

This presentation covers the undergraduate physics research at Flathead Valley Community College in understanding and upgrading a four-channel polarimeter.

Session: Engineering I
Undergraduate
David Schwehr
Montana State University

Engineering, Research, Development and the Human Element

Our personal experiences in life contribute to many aspects of our professional and academic behavior. From how we learn, how we teach, and how we perceive challenges and goals are influenced by our past experiences. As engineers and researchers, do these experiences affect our success or outcomes during design development and experiments? How can we use the human element and life experience as a tool in our designs and research? I will explore these questions and the pros and cons of the human element in engineering and research related to my experience while working on the Eclipse Ballooning Project.

Session: Education & Outreach
Undergraduate
Jillian Brown
Flathead Valley Community College

Inland Ocean Education Using Marine Model Ecosystems

There is currently a lack of carbon cycle curriculum for inland students. My research, primarily in science education, focuses on creating carbon cycle and ocean acidification curriculum for inland middle and high school students using marine model ecosystems. The marine model ecosystems represent two distinct coral reef habitats. One ecosystem models a coral reef lagoon, and the other models an open-ocean fore reef. This presentation will discuss the design and maintenance of such model ecosystems as well as curriculum development and testing. One main component of the curriculum will include incorporation of the FVCC designed pHyter device. This device is an affordable, hand-held, precise, and easily operated marine pH meter, that will be indispensable in teaching the designed curriculum.

Session: Education & Outreach
Undergraduate
Caitlin Carroll
Helena College

This Could Be You: Spreading the Joy of STEM with the 2016 Hiscock Space Grant Award

This project was designed in response to an observed need in underserved communities for mentoring and hands-on activities relating to science, technology, engineering, and math (STEM). Volunteers gave short presentations to upper elementary and middle school students, highlighting their STEM backgrounds and their reasons for choosing STEM career paths. With the help of the volunteers, students then completed STEM-related activities with a custom-built hydroponics system or Arduino microcontrollers to encourage a "can-do" spirit for STEM learning.

Session: Education & Outreach
Graduate Student
Amy Singer
University of Montana

Space Public Outreach Program; reaching rural researchers

What makes an innovative leader? What facilitates creative teamwork? The founders of Google, like many, once believed it to be a top ranking student with a diploma from a top ranking school. However, the data showed otherwise. What makes for a leader is complex problem-solving ability. It is not your school, it is you that determines your leadership and innovative characteristics. Every corner of our state, sparsely populated as it may be, has students looking at our world and asking

questions. It is our job through SPOT to show these dreamers that these questions are the heart of STEM. We support teachers and share with students the opportunities they have to reach their dreams, no matter how humble their background. We share the exciting research that we do right here in the state of Montana. Our work has meaning and impacts the worldwide scientific community. SPOT sparks the curiosity that leads a student from UM to head the Curiousity mission on Mars. It leads an MSU graduate to leading solar science. As researchers ourselves, it is our duty to ensure that these oft neglected rural communities not only learn the importance of STEM, but that they too can reach their dreams from their backyard.

Session: Biology & Chemistry
Undergraduate
William Pardis
Flathead Valley Community College

Measuring Protons with Photons: An Optical pH Instrument for Large-Scale Monitoring of Ocean Acidification

pH, a measure of proton concentration, is a critical parameter impacting our global ocean ecology due to its governing nature in chemical equilibrium. Since the onset of the Industrial Revolution, A 0.1 drop in ocean pH has been measured off the coast of Hawaii. Many data sets suggest this is a result of a chemical exchange between Earth's atmosphere and its oceans. 30 to 40% of atmospheric carbon dioxide is absorbed by our oceans. Carbon dioxide reacts with water to produce carbonic acid, which decreases oceanic pH. The implications of this is not fully understood due to its large spatial dimensions.

Usable technology exists to measure pH with sufficient accuracy and precision, but is very expensive and therefore inaccessible to the general public. We developed an indicator-based pH photometer for in-the-field measurements that is easily assembled, inexpensive, handheld, and runs off of a cell phone allowing for web linked geo-referenced data. Five of these instruments were taken and tested in the South Pacific during a student study abroad trip. The instrument proved to be useful for in-field scientific inquiry and competitive relative to other instruments of its class at a fraction of the cost. The photometer, nicknamed the "pHyter", is currently undergoing field testing by the National Oceanic and Atmospheric Administration and lab tests by Sunburst Sensors, a national leader in this technology based in Missoula, MT. A citizen's science effort distributing pHyters on coastlines around the world would surpass the size of this issue and begin a better understanding of this important change in our global system.

Session: Biology & Chemistry
Undergraduate
Kylee Azure
Aaniiih Nakoda College

The bigger the bolder: semiaquatic anoles (Norops aquaticus) with larger relative head sizes are bolder, but not more explorative

Personality is the consistent difference in individual behavior across contexts or over time, and can sometimes explain why individuals do not behave optimally in all situations. Boldness (response to risky environment) and exploration (response in a novel environment) are common personality traits. Bold and explorative individuals tend to be subject to higher predation, but can also have higher mating success. We tested whether boldness and exploration were related to sexually-selected morphological traits (the dewlap and head size) in anole lizards (Norops aquaticus). Male anoles use the bright colorful flap of skin under their chin (the dewlap) in territorial displays, and head size is often an indicator of social status. We measured boldness by time to emerge from a refuge and exploration by the number of grid cells crossed per minute in a novel arena. We tested the lizards twice to determine if these responses were repeatable (which indicates a personality trait). Males with relatively larger heads took less time to emerge from a refuge than those with smaller heads. This behavior was repeatable suggesting that boldness could be a personality trait. Males with larger heads were less explorative than those with smaller heads, but exploration was not a personality trait because it was not repeatable within individuals. Nonetheless, anoles were consistently more explorative on their second trial than their first, suggesting that they were habituating. Anoles with larger heads are bolder and because of this, they might have higher mating success, but also a higher chance of predation risk.

Session: Biology & Chemistry
Undergraduate
Greg Durling
Flathead Valley Community College

Water Temperature on Mo'orea: *Climate Change and the Possible Impacts to Tropical Coral Reef Systems.*

Mo'orea is an island located in the South Pacific, about 16 km northwest of Tahiti. It is home to Gump Research Station: A National Science Foundation (NSF) Long-Term Ecological Research Site (LTER) dedicated to studying Mo'orea's coral reef environments, with a major emphasis on chemistry. Mo'orea is relatively free from large proximal anthropogenic influences, which renders its location ideal for studying varying environmental conditions on a global scale. In May of 2016, nine students from Flathead Valley Community College traveled to the island to study ocean chemistry. One of the first observations was that the coral had undergone bleaching; it was later experimentally determined by FVCC students that approximately 38% of the coral had been bleached. Coral bleaching is a phenomenon in which the coral polyps expel their photosynthetic symbiont and

turn white or sometimes fluorescent colors. This is detrimental for the coral, and many end up not recovering and dying. Why coral reefs bleach is a heavily researched topic, and the direct cause or causes are uncertain. Temperature increases are very often associated with mass coral reef bleaching events. One of the experiments performed by FVCC students involved placing eight HOBO Gear Temp Pro V2 Sensors underwater, in eight different locations throughout the coral reef, all at similar depths. These locations were marked on a GPS using cellular devices and the ESRI Collector app. A map of the different locations was created using Arc GIS software. The sensors remained underwater, taking temperature measurements once every minute for roughly six days before being retrieved and the data downloaded. The data for a single 24-hour period was analyzed using the HOBOware software. The mean temperature at each location ranged from 28.5 °C at Location 7 to 28.7 °C at Location 1. The lowest and highest temperatures were recorded at Location 6, 27.7 °C and 29.6 °C, respectively. The smallest difference between maximum and minimum temperatures was 0.4 °C at Location 7. These temperatures were elevated when compared with NSF data from previous years. Understanding temperature fluctuation and gradients could lend clues to how and why coral reefs bleach, not only in French Polynesia, but also throughout the world.

Session: Engineering II
Undergraduate
Shauna Muns
Missoula College

Emissions measuring system for a rocket mass heater

We researched, engineered, and used a device for measuring the emissions of a rocket mass heater to calculate efficiency and to verify a complete combustion. We used a raspberry pi model b along with k-type thermocouples, CO2 sensor, CO sensor, and an unburned hydrocarbons sensor. We then used python coding to program the raspberry pi to read the sensors and put the results into graphs for easy reading.

Session: Engineering II
Undergraduate
Benjamin Moon
Montana State University

Nanostructured Polarizing Optics for the Infrared: Amplitude and Phase Characterization

Polarizing optics for operation around 1.55 μm have been designed and fabricated on a silicon substrate. The design for these devices is a one-dimensional grating structure in silicon with sub-wavelength period and coated in a thin layer of gold. By varying device parameters such as period, grating separation, fill factor, and gold thickness, different types of polarizing optics can be realized. Both linear polarizers for transmission and reflective quarter-wave plates have been successfully designed, fabricated, and tested in the lab. Reflection and transmission intensity

measurements have been conducted on both families of devices, and phase-resolved characterization of the wave plates was done with a Mach-Zehnder interferometer. Linear polarizers demonstrate high transmission of the TM state while achieving high rejection of the TE state. Measurements of reflective quarter-wave plates show a 90° phase shift between TE and TM polarizations, allowing a linearly-polarized input beam to be transformed into a circularly-polarized output after reflecting from the grating surface. These two families of nanostructured polarization optics have potential applications in remote sensing and biomedical imaging.

Session: Engineering II
Undergraduate
MiKalley Williams
Montana State University

Growth and Applications of Polar Biosurfactants

Biosurfactants are amphiphilic compounds produced by microbes that disperse media, biofilms and hydrocarbons by reducing interfacial tension. These compounds can be grown from a multitude of different organisms, and so can be easily optimized to maximize functionality in different environments. Bacteria isolated from polar regions that are capable of producing biosurfactants therefore have tremendous potential as bioremediation tools or biofilm growth inhibitors in extreme environments. The focus of this project was the growth and interrogation of microbes previously isolated by the Foreman Research Group from a supraglacial stream on the Cotton Glacier, Antarctica. Two Janthinobacteria sp. isolates were selected for their ability to produce biosurfactants in the presence of canola oil, as confirmed by haemolytic activity tests. The produced biosurfactants were chemically extracted and redissolved in various solvents. Work is ongoing to quantitatively measure the biofilm inhibition capabilities and hydrocarbon degradation capacity of these microbial extracts.

Session: Engineering II
Undergraduate
Ryan Foley
Montana Tech

Design of a One-Step Integrated Motor Casing

High-Density Polyethylene in pellet form was heated and cast into a cylindrical form to determine a process by which small motor grains of HDPE could be affordably manufactured. Temperature, pressure and mold times were investigated to help define the casting procedure. In addition the motor grain was cast with different center perforation geometries. The cast grains then served as the mandrel for a filament wound composite casing.

Session: Engineering II
Graduate Student
Andrew Hohne
Montana State University

Design of polarizing spectral bandpass filters for climate science applications

The Nano Optics Group at Montana State University has been researching the use of gold-coated nanostructures as wavelength-selective polarizers for cloud imaging applications. These devices consist of two subwavelength gold gratings separated by a small gap filled with a dielectric material. The Fabry-Perot resonance created by the gap is used to achieve wavelength selectivity. These gratings have been successfully fabricated, optically characterized, and show good wavelength and polarization selectivity. To improve performance, a new design has been proposed based on structuring the gold gratings on top of two different dielectric materials. Having two distinct metal/dielectric interfaces allows for the excitation of two separate localized surface plasmon polaritons (SPPs). Simulation results show that these SPPs can be utilized to increase peak TM transmission, improve the spectral bandpass shape, and decrease out-of-band transmission.

Session: Engineering II
Undergraduate
Amber Freeman
Helena College

The NannyCham - Building an automated and integrated chameleon habitat control and monitoring system

Chameleons, or chams in the reptile world, have only been successfully bred and raised in captivity in the last 30 years. Each of these species, when raised domestically, require very specific environmental factors.
Historically, chameleon breeders have used a variety of technology to achieve the appropriate habitat. It is difficult to maintain the constant changes required throughout the day in a chameleon habitat. The NannyCham was designed and developed to relieve the work required to maintain and monitor this system.
To create a fully integrated chameleon habitat, I designed a system using several automated sensors for data input and output, a website for off site monitoring, and a text alert system for emergency issues. This was controlled by a central unit, the Raspberry Pi3, using a program written in Python.

The NannyCham was tested for 7 weeks and all sensors were fully functional. The website could be accessed locally to view the sensor results and the emergency text system was routed to a personal cell phone. This system relieved the need to be present for monitoring and changing the habitat throughout the day.
The NannyCham system, with one automated unit, relieves the time requirements needed to care for a chameleon habitat and provides an offsite emergency alert system for potential system breaks.

Session: Poster
Undergraduate
Douglas Anderson
Aaniiih Nakoda College

Using Bio assessments to Monitor Mine Impacted Streams Flowing on to the Fort Belknap Indian Reservation

In the 1890, gold was discovered in the Little Rocky Mountains located on the Fort Belknap Indian Reservation in north central Montana. In 1895, the Grinnell agreement removed the block of land containing the gold from the reservation. Small scale mining continued until 1979 when large scale cyanide leaching gold mining operation begun. The leach mining operation was located in the recharge and headwater areas of streams that flow onto the Fort Belknap Indian Reservation. The purpose of this research project is to conduct bio-assessments of the streams impacted by the mining. The bio assessments included comparing macroinvertebrates and diatoms collected from South Bighorn Creek and compare what was collected from North Fork of the Little Peoples Creek which has not been impacted by mining activity.

Preliminary results indicate the macroinvertebrate community collected from South Bighorn Creek, which has been impacted by mining, is made up of organisms that are extremely tolerant to pollution. The macro invertebrate community collected from North Fork of the Little Peoples Creek, which has not been impacted by mining, is made up of a variety of organisms that include many that are sensitive to pollution. The data would indicated that South Bighorn Creek has been impacted by gold mining because of the lack of pollution sensitive Microorganisms.
Although the gold mines are no longer in operation, the disturbance to the mining area continues to impact the couth bighorn creek mainly from acid mine drainage. The acid mine drainage continues to add heavy metals like Iron.

Session: Poster
Undergraduate
Cyrus Antoine
Salish Kootenai College

Network Monitoring Using Raspberry Pi

A 10 week study on the creation and tools used for an automatic network monitoring raspberry pi.

Session: Poster
Middle School Student
Julian Bain
Missoula International School

Focus Pocus: Using Autofocusing Water-Based Lenses at Different Distances.

Many people suffer from myopia or presbyopia, and could benefit from autofocusing eyeglasses. I constructed liquid-filled lenses that focus according to the distance sensed by an ultrasonic sensor. My lenses helped subjects with both moderate myopia and presbyopia at all distances, but did not help subjects with no eye problems or with severe conditions. The result of a one-sample, one-tailed t-test comparing the average improvement in visual acuity to a null hypothesis of no improvement was significant with a P-value of 0.02. These results could inspire eyewear companies to change or improve their methods of construction in order to develop affordable and effective adjustable lenses.

Session: Poster
Undergraduate
Scott Beauvais
Salish Kootenai College

Mapping change in minimum snow and ice field extent in the Mission Mountains, MT

In mountainous regions, and even nationwide, snow melt is a major source for surface water. Predictions indicate that climate change will lead to earlier snow melt leading to low late season stream discharge. Spatial analysis is a powerful tool for analyzing multi-scale analyses of climate change. This project looked at the change in the minimum snowfield extent in the Mission Mountains, MT. This was done by performing a Normalized Difference Snow and Ice index on Landsat imagery from 1972 to 2014. This method was also used on Landsat data collected from the 2005, 2009, and 2013 Flathead Reservation growing season for validation and in an attempt to standardize data collected for the years 1972-2014. The study resulted in a standardization curve that was unusable because the regression applied would lead to some values being negative. The overall trend from 1972 to 2014 showed an increase in minimum snow field extent. Overall, it appeared that the project was marred by converting the rasters to shapefiles so in the future the work should be done just using rasters and getting a statistical analysis program to create a better standardization curve. Also, the change in the snow field over the growing season should also be observed

Session: Poster
Graduate Student
Joseph Bretz
Montana State University

Selective Excitation of Stellar Oscillations of a Magnetar with a Tangled Magnetic Field

Magnetars are strongly magnetized neutron stars. Some of them produce giant flares that exhibit quasi-periodic oscillations which have been attributed to stellar oscillations that modulate the emission. A tangled magnetic field model introduces a spectrum of magnetic normal modes that can explain the observed quasi-periodic oscillations, as expected from stability considerations. We show that reasonable

initial conditions selectively excite stellar oscillations, and find promising agreement with data.

Session: Poster
Undergraduate
Nate Burman
Carroll College

Synthesis and Characterization of Cyanine Dye and Anthracenyl Groups with Theinyl Moeitys

The primary goal of synthesizing and investigating these molecules with theinyl groups bound to them is to eventually synthesize a molecule that can be easily oxidized and participate in a visible-light driven dimerization reaction via a solar cell. In order to identify good candidates for this process, we employed a variety of experiments including NMR spectroscopy, cyclic voltammetry, UV vis spectroscopy, and emission spectra.

Session: Poster
Undergraduate
Benjamin Carroll
Montana State University

EUV Snapshot Imaging Spectrograph (ESIS) Baffle Design

The Extreme Ultra-Violet Snapshot Imaging Spectrograph (ESIS) is a solar camera scheduled to launch on board a sounding rocket in August 2018. ESIS images the sun over a large field of view in multiple spectral orders, allowing it to simultaneously collect spatial and spectral data. Since images are collected in specific wavelengths, any direct illumination of the CCD cameras from the sun would defeat the purpose of the experiment. Optical baffles are used to eliminate the potential for this to occur, as well as limit potential stray light reflecting onto the CCD-s. Due to compact system design, variations in optical geometry, and numerous optical path crossings, designing an effective baffle system for ESIS presented several unique challenges. Using Z-Max ray-tracing; and CREO Parametric modeling software; we created an effective design using six flat baffles along the experiment's length.

Session: Poster
Undergraduate
Caitlin Carroll
Helena College

North American Wolverine Denning Habitat in Glacier and Rocky Mountain National Parks, 1985–2095

This project was designed in response to an observed need in underserved communities for mentoring and hands-on activities relating to science, technology,

engineering, and math (STEM). Volunteers gave short presentations to upper elementary and middle school students, highlighting their STEM backgrounds and their reasons for choosing STEM career paths. With the help of the volunteers, students then completed STEM-related activities with a custom-built hydroponics system or Arduino microcontrollers to encourage a "can-do" spirit for STEM learning.

Session: Poster
Undergraduate
Katie Chamberlain
Montana State University

Theoretical Physics Implications of Gravitational Wave Observations with Future Detectors

The result of some of the most energetic and violent events in the universe, known as Gravitational Waves, are constantly propagating through space-time. These waves were first directly detected in September of 2015, and plans are moving forward to improve and expand the gravitational wave detectors that already exist. Using the projected sensitivity curves for proposed instruments, both space- and ground- based, we took a theory-agnostic approach to determine how well modified theories of gravity could be tested with these future generation detectors. We have found that a combination of future ground-based and space-based detectors will provide drastically better constraints than current gravitational wave detectors can alone.

Session: Poster
Undergraduate
Thomas Colligan
University of Montana

Improving GPS Accuracy for kinematic analysis of balloon flights

The kinematic analysis of balloon payloads is important for detecting updrafts, downdrafts, and oscillations within the troposphere and stratosphere, with applications from meteorology to aircraft safety. Here I suggest a detection technique using GPS data.

Session: Poster
Undergraduate
Bridget Creel
University of Montana

Characterization and Phylogenetic Analysis of Acaryochloris marina: understanding the evolution of unusual far-red light photosynthesis

Despite the global ecological importance of understanding variation in the methods by which autotrophic organisms at the base of food webs photosynthesize, relatively

little is known about the evolution of the bacterium Acaryochloris and their novel methods for photosynthesis using chlorophyll d. Here, I have characterized four novel strains of Acaryochloris isolated from red algae in the intertidal zone of Shelter Cove, California, thus expanding our knowledge of the evolutionary history and distribution of the group. I confirmed by pigment analysis using in vivo and methanol extraction approaches that all four strains produce chlorophyll d. Through Bayesian and maximum likelihood phylogeny construction with 16S ribosomal RNA sequence data, we more completely described the phylogeny of Acaryochloris. All four strains proved to be genetically identical at this highly conserved locus and, as predicted, most closely related to known strains previously isolated from intertidal red algae. Our results inform our understanding of this understudied group, and future research will take a genome-wide approach to investigate the evolutionary mechanisms underlying the innovation of oxygenic photosynthesis using far-red light.

Session: Poster
Undergraduate
Mauri Erickson
Rocky Mountain College

Viral Causes of Fish Tumors in Montana Waterways

Montana Fish, Wildlife and Parks has observed tumors on a variety of fish, including suckerfish and walleye. The cause of these tumors remains unknown. Retroviral particles can often be isolated in such tumors, but only five such viruses have been fully sequenced. Phylogenetic analysis of these viruses shows they represent a newly-discovered genus: the epsilonretroviruses. Retroviruses are unique in that they infect cells as RNA, but then convert their genetic material to DNA and integrate it into the host genome. We are therefore using polymerase chain reaction (PCR), which amplifies DNA, reverse transcriptase PCR (RT-PCR), which converts RNA to DNA and amplifies it, gel electrophoresis, and Sanger sequencing to isolate, amplify and characterize any retroviral RNA and DNA extracted from these tumors. We hypothesize that the analysis of the DNA sequences found in these tumors has the potential to reveal novel retroviruses.

Session: Poster
Undergraduate
Trevor Gahl
Montana State University

Automated Eclipse Balloon Tracking

No Abstract

Session: Poster
Undergraduate
Ayla Grandpre
Rocky Mountain College

SSEL Summer 2016

An overview of my SSEL internship projects during the summer of 2016.

Session: Poster
Undergraduate
Kyle Hook
Salish Kootenai College

Network Controlled Thermostat

No Abstract

Session: Poster
Undergraduate
Jared Kamp
Montana State University

High-Altitude Weather Balloon Payload Spin and Sway Reduction: A Presentation on Dizzying Heights

Montana Space Grant Consortium (MSGC) will record live-streaming video footage of the August 21, 2017 solar eclipse from a high-altitude weather balloon. To help ensure the quality of the video, I recorded and analyzed flight movement data with inertial measurement units (IMU) to evaluate different techniques for reducing the amount of unwanted spinning and swaying of the video camera system during flight.

Session: Poster
Undergraduate
Patrick Krebs
Montana State University - Billings

Benzene Ozone Decay Reactions: Cavity Ringdown Spectroscopy as a method of determining the decay of Ozone

Cavity Ringdown Spectroscopy is an experimental process used to measure the amount of light absorbed by introduced gases or liquids. The method can detect trace amounts of gases trapped within the cavity. A pulse laser shot into the cavity, though a one-way mirror that is 99.997% reflective allowing the laser to travel over large distance. The pulse laser is attuned to a wavelength specific to the substance being tested, and the change in light absorption allows the concentration of

substance present within the cavity. This allows for the observation of ozone decay rates while introduced to a series of benzene concentrations.

Session: Poster
Undergraduate
Jared Kvamme
University of Montana - Western

Using a Stochastic Individual-Based Model to Analyze Population Viability of Goshawks in Southwestern Montana

Individual-Based Stochastic modeling (IBM) techniques allow developers to integrate spatial, life history, and climatic factors at the individual level within a population (Grimm et al 2006). Using nest site preference data collected in southwest Montana and life history data from goshawk breeding territories, we constructed a stochastic IBM to assess population viability and habitat preference of goshawk populations in southwest Montana in response to changing climatic conditions. Because spring precipitation and temperature play an important role in goshawk productivity and prey abundance, a hierarchal Markov climate model constructed from historical NOAA climatic data provided input to the life history model. One prediction for change in short-term climate is extended pacific oscillation resulting in extended and more extreme el niño and la niña events. In addition to directly affecting life history, changing climatic conditions may also lead to nest habitat loss through forest disturbance.

The model was run under four scenarios to determine if the region under study in southwest Montana would be a relative source or sink for the greater northern rocky mountain goshawk population. The four scenarios were: (1) historical weather, (2) historical weather with nest habitat loss, (3) extended pacific oscillation, and (4) extended pacific oscillation with nest habitat loss.

Grimm V, Berger U, Bastiansen F, Eliassen A, Ginot V, Giske J,…DeAngelis D. L. (2006). A Standard Protocol for Describing Individual-Based and Agent-Based Models. Ecological Modelling, 198. 115–126

Session: Poster
Middle School Students
Alex Musco and Joshua Reisenfeld
Missoula International School

Solar Controller

No Abstract

Session: Poster
Undergraduate
Noah Oloff
Rocky Mountain College

Examination of Soil-Plant-Microbe Interactions in Two Saline, Alkaline Lake Basins in the Upper Yellowstone River Watershed

Eastern Montana contains numerous natural saline wetland sites. Anthropogenic influences can increase the natural levels of saline at these sites beyond what the ecosystem has adapted to handle, negatively impacting the salt-tolerant species at the site and requiring remediation. The purpose of this research is to examine the plant, soil, and fungal microbe interactions along a saline/alkaline gradient at Hailstone NWR and Big Lake WMA. Soils were analyzed for pH, electrical conductivity (EC), and sodium adsorption ratio (SAR), The composition of the plant community was examined and three salt tolerant grass species were targeted as good candidates for endophyte analysis, Puccinellia nutalliana (Nuttal's alkaligrass), Distichlis spicata (inland saltgrass), and Thinpyrum poniticum (tall wheatgrass) (endophyte analysis pending). Soil EC and SAR were extremely high in the soils on the lake bed but decreased moving toward the upland soils at both sites. Average soil EC and SAR along the lake bed at Hailstone NWR was above the limits of plant survival for species such as P nutalliana and T. ponticum. The soil EC and SAR levels also were above levels that these species are considered productive at Big Lake WMA. Despite hypersaline-sodic conditions in the soils around the lakes, numerous plant species were still growing. Continuing research will examine microbial endophytes' role in plant survival in these extreme soils

This research examined soil, the composition of the plant communities, and microbial endophytes. Average SAR along the lake bed and shore surpassed 13 showing plants should have trouble growing in such soils. The evidence of plant growth in the very saline, sodic soils is an indication that influences outside the plant adaption to salts are assisting the growth of the three target grass species at Hailstone and Big Lake. The continued examination of the grass seeds for endophyte evidence can assist in explaining the plant growth in the soils. The EC and the SAR were determined to be significantly different at both sites in the soil types. (Big Lake EC and SAR $p < 0.0001$; Hailstone EC $p = 0.002$, SAR $p = 0.01$).

Session: Poster
Undergraduate
Daniel Olsen
University of Montana

Massive Analysis of Land Surface Temperature Mean, Variance, and Coherence

Land Surface Temperature (LST) is important to modeling how global warming will impact the ecology and thermal biology of ectotherms. Studies have focused on using LST both in understanding how organisms currently live in their habitat, and

also in understanding how organisms will be affected by changes to their habitat. Nevertheless, most studies have focused on raw and mean LSTs in their research. This leads to a drastic oversimplification where the variance of LST in a particular microclimate, and the consistency of local microclimates (the coherence) are ignored. This project aims at investigating how data-resolution, latitude, mean LSTs, variance in LSTs, and coherence of LSTs affect one another, providing new and significant insights for future models.

Session: Poster
Undergraduate
Lauren Palys
Carroll College

Synthesis of a family of conjugated carbazole derivatives for applications in OLED technology

Organic light emitting diodes (OLEDs) have many applications in modern technology including smartphones, tablets, and even in NASA's cockpit displays. One benefit of an OLED display is its flexibility; meaning these displays can be curved or bent depending on the intended purpose. Additionally OLED displays are compact and do not require a backlight like other displays, resulting in energy efficiency and savings in operation costs. In order to generate a complete color display, red, green, and blue light emitting molecules are required. Red and green light emitting molecules have been successfully synthesized with relatively long lifetimes and stabilities. However, thus far, synthesis of long lasting and stable blue light emitting molecules has proven difficult. A family of novel organic molecules designed to emit blue light are currently being synthesized and characterized for potential applications in OLEDs. The parent molecule consists of three subunits, a terminal Dendron, a carbazole center, and a conjugated biphenyl unit. Upon synthesis and characterization of the parent molecule, photo emissive properties and durability under oxidative conditions will be studied. Derivatives will also be synthesized to construct a family of novel molecules and variations in wavelength of emission as well as stability to air and heat degradation will be studied.

Session: Poster
Undergraduate
Daniel Rogers
University of Montana

Absolute Photoionization of Rb2+ and Rb3+ Ions for the Determination of Elemental Abundances in Astrophysical Nebulae

Atomic research has historically been motivated by the needs of observational astronomers. Because elements heavier than iron (i.e. trans-iron elements) have only recently been detected by astronomers, there is a new and urgent need for accurate trans-iron atomic data in the astrophysical community.
These elements were first observed in 2008 in planetary nebulae (examples at right), which are remnants of medium mass stars that are also some of the most recognizable objects in the night sky. The determinations of elemental abundances

in these nebulae are used to improve models of stellar nucleosynthesis and the chemical evolution of the Universe. To help improve these abundance determinations and thus the models, we have used the merged-beams technique to measure absolute photoionization cross sections for several trans-iron ions, including Rb2+ and Rb3+ presented here.

Session: Poster
Undergraduate
Tristan Running Crane
Montana State University

Collecting Atmospheric Data From High Altitude Ballooning

No Abstract

Session: Poster
Graduate Student
Dylan Sagmiller
Montana State University

Developing a New Method for Measuring the Volume of Helium in a High Altitude Balloon

When launching various experiments on high altitude balloons it is often vital to know the ascent rate and the burst altitude since these values are needed in calculating an accurate flight path. In the past, the usual method was filling the balloon until it would lift a ballast that was approximately 1.2 times the payload weight and from experience the balloon would have a rise rate of about 1000 ft/min and a maximum altitude of about 100,000 ft. If the wind is blowing the balloon while doing the ballast test however, the usual result is the balloon would become overfilled. Another way of finding the rise rate and burst altitude is to be able to calculate them by first knowing the initial volume of helium used to fill the balloon. One way of calculating the volume of helium is by measuring the volume flowrate (L/min) as the balloon is filled, taking the average flowrate of the balloon fill, and then multiplying that flowrate by the total amount of fill time to find the volume of gas.

This talk focuses on achieving this method by designing and building a Venturi flowmeter that operates on the principle of measuring the pressure difference across a constricting pipe and calculating the flowrate based on the density the gas. The flowmeter was built using 3D printed parts, pressure sensors, and Arduino components. The system was then tested for its accuracy by filling a bag with nitrogen inside a fixed volume while recording the fill time, calculating an experimental flowrate from the fixed volume and fill time, and then comparing the experimental flowrate with the average flowrate from the flowmeter. After multiple tests and modifications, the percent error for the flowmeter came to be approximately 11.5%. However due to the inherent inaccuracy of the validation

method, it is uncertain on whether this error is primarily due to the flowmeter or from a systematic error in the testing method; validation of the system is ongoing.

Session: Poster
Undergraduate
David Schwehr
Montana State University

Balloon Location Tracking From Near Space

A method of simultaneously tracking multiple high altitude balloons and how to display and archive geolocation data of balloons participating in the Eclipse Ballooning Project.

Session: Poster
Undergraduate
Louis Solana
Great Falls College - MSU

Development of Tethered Balloon Platform for Low Altitude Sensing

Aerial sensing platforms are in a constant state of evolution to meet increasing demands in a wide spectrum of disciplines. Many of these platforms are of both the fixed-wing and rotorcraft variety, with drones dominating the market of affordable, versatile aerial sensing. Many drones are unable to stay aloft for lengths of time greater than thirty minutes, and require regular battery swaps to continue their mission objectives. In order to extend the length of time an aerial sensing platform is able to stay aloft, a tethered aerostat was developed that could be deployed by a single individual and could hold several different types of sensing devices attached to a central hub. Future improvements for this platform include a ground mobility platform that allows for lateral movement for the aerial platform and the ability to remain in position utilizing GPS.

Session: Poster
Graduate Student
Katherine Stocker
University of Montana

Detecting Eclipse-Induced Gravity (Buoyancy) Waves Using High Temporal and Spatial Resolution Radiosonde Data Sets

Gravity waves are adiabatic oscillations of a fluid parcel about an equilibrium level generated by a buoyancy force when the stability of the fluid medium is disrupted. Such a disturbance occurs from the obstruction of solar irradiance during a solar eclipse and may possibly generate a gravity wave that can be detected using radiosondes. The University of Montana's Radiosonde project includes multiple

teams and launch sites along the path of the August 21, 2017 US eclipse and is structured to detect a wave directly attributable to the event.

Session: Poster
Undergraduate
Ryan Thompson
Montana State University

Topological Data Analysis of a Celestial Data Set

As the field of Topological Data Analysis (TDA) continues to grow and develop, there are an increasing amount of applications that lend themselves towards this type of data analysis. This research applies the processes of TDA on a celestial data set provided by the Sloan Digital Sky Survey, with the hopes to help show and demonstrate the galactic uniformity that has past been observed. In order to achieve this, the large point cloud must first be parsed into different groups, or "windows", that focus on a select spatial region. This allows for the scope to be narrowed to these smaller, computational manageable sectors. Once these viewing areas are established, the methods of TDA can be employed on each individual region, ultimately producing a persistence diagram that then acts as a descriptor for that chosen window. In order to best sample this data set, two methods will be used: cubical decomposition and a random "cookie-cutter" approach. The number and size of the cubes and "cookies" will be varied to ensure that all aspects of the set are captured. The diagrams that will then be created for each region are able to be compared and contrasted, revealing the spatial nature that is inherently present in these celestial manifolds.

Session: Poster
Undergraduate
Jedd Tougas
Salish Kootenai College

Remote Sensing Climate Change - NGSS Lesson Planning

Bark beetles significantly impact forest management practices, ecological balance, local economies, and available cultural resources in the Mission Mountain Wilderness (MMW). Jackson County, CO (JCC), was used as an illustrative example of remote sensing severe bark beetle outbreaks for use in a lesson plan on climate change. We examined NDVI and NDMI of Landsat images to assess the feasibility of using remote sensing methods to create a lesson plan integrating forest health investigations. Results show that methods used are not applicable to the MMW due to a low severity of beetle outbreaks. The JCC area and the MMW are compared in the tutorial and lesson plan to illustrate bark beetle associated decline in forests.

Session: Poster
Undergraduate
Holly Wendt
Helena College

Determining Prospective Geothermal Potential Using Vegetation Stress and Thermal Imagery

The objective of my project is to determine the feasibility of remotely sensed data when identifying potential geothermal locations if using vegetation stress and surface temperature as primary parameters. I used NDVI, Unsupervised Classifications, and Thermal Imagery to try and detect geothermal features. These methods seemed the most likely to result in a positive outcome. However, the results were inconclusive as there are too many variables, such as cloud cover, resolution, spatial references, and human error, that can interfere within the process, causing inaccurate results.

Session: Poster
Undergraduate
Steven Zimmerman
Helena College

Android Application: On-Site Flight Log

Unmanned aerial systems are a powerful and versatile tool in many fields of research. For Montana University System researchers to use these platforms, accurate and consistent flight documentations must be gathered to satisfy regulation requirements. This research focuses on using on-board flight documentation as well as the development of a standalone Android based application designed specifically for University system UAS research. This represents early investigation into developing a UAS flight control platform that would generate accurate flight logs with limited access to the flight data captured by a consumer grade UAS device.