CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Natalie Gallagher; Connor Lydon

Project Number

S0801

Project Title

Secret of San Lorenzo Valley's Atmosphere: Vertical Meteorological Measurements Part 2

Abstract

Objectives/Goals

To determine the affect of atmospheric inversions on ground particulate matter 2.5 (PM 2.5) levels. To compare San Lorenzo Valley's particulate matter 2.5 levels to neighboring areas. To take into account vapor pressure by using the standard of Virtual Potential Temperature and to determine if this has an effect upon on the atmospheric inversions of PM 2.5 levels. We hypothesize that fluctuations in vapor pressure will have little effect upon atmospheric inversions and ultimately PM 2.5 levels.

Methods/Materials

We used: radiosondes, 200g balloons, helium, parachutes, dereelers, an i-Met 3050 Sounding System, and data from EBAMs. In the 2012/13 season we collected atmospheric data over a period of three months, launching weather balloons three times a week, twice a day to obtain atmospheric inversion data. This year, we launch weather balloons when inversions are forecasted to be present or if other drastic changes in weather patterns are seen. We collect our data by weather balloon, compile, then analyze it.

Results

Particulate matter 2.5 clearly was affected by atmospheric inversions, and increased greatly on inversion days. In some cases, PM 2.5 levels were "unhealthy" on inversion days and "healthy" on non-inversion days (determined by our Modified Air Quality Index table). San Lorenzo Valley#s topography had an evident affect on PM 2.5 levels. Vapor pressure fluctuation did not have a major effect on the inversions (as determined by temperature recordings) and as a result little effect on PM 2.5 levels.

Conclusions/Discussion

Inversions do affect levels of particulate matter 2.5, and due to this San Lorenzo Valley experienced many unhealthy days for particulate matter 2.5. San Lorenzo Valley experiences much higher particulate matter 2.5 levels due to its topography. Differing vapor pressure does not affect atmospheric inversions and as a result does not effect PM 2.5 levels in San Lorenzo Valley. Our data has supported our hypothesis.

Summary Statement

We analyzed the effect of atmospheric inversions on particulate matter 2.5 levels in San Lorenzo Valley with weather gallons and EBAMs; also, vapor pressure has little effect upon atmospheric inversions and PM 2.5.

Help Received

Scott Norton trained us for data collection; Bob Nunes and Mike Gilroy helped us interpret data; and the Monterey Bay Unified Air Pollution Control District donated money and data; intermet donated money and equipment.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Megan Hullander; Emily Imperato

Project Number

S0802

Project Title

Beach Changes During a Period of Low Waves and High Tides

Abstract

Objectives/Goals

Locally, Goleta Beach erosion has become a problem so we chose this area for study and Mesa Lane beach is physically different from Goleta.

Methods/Materials

Materials:2, 5 ft wooden rods, measuring tape, data sheets

Method: Emery 1961

1. Establish an East , Central and West station with reference points at each beach on three dates.
2. At low tide, start rod 1 at reference point. Place rod 2 at significantly different elevation. Measure distance between rod 1 and 2. Find elevation by aligning their eye at rod 1 with the top of rod 2 and the horizon, record the distance from the top of rod 1 at the point which is intersected by this line of sight. Move rod 1 to the seaward side of rod 2 at a different vertical elevation. Continue until rod is fully submerged.

Results

During our research period neither beaches experienced a high wave energy event. No significant sand volume changes occurred at the East or West stations at Mesa Lane beach. Erosion occurred at Mesa Lane#s central station. At Goleta beach Central and East stations at sand was deposited, then eroded, and then returned.

Conclusions/Discussion

At the Mesa Lane East and West stations, lack of wave events created no change in the profiles. The erosion at Mesa Lane#s central station may be related to the large tide fluctuation immediately prior to the profile measuring. The erosion was possibly due to the lack of sand build up in front of the cliff. During the highest tide of the year there was a 9ft difference in the tide, small waves reflected off the cliff, creating more erosion. The sand build up at the other stations prevented the waves from reaching the cliff. The accretion and erosion during our research period at Goleta beach central and Goleta beach east station is due to the sand being carried onto the beach by the small waves. During periods of low tide/wave events, beaches build up with larger volumes of sand. Erosion occurred after the highest tide of the year bringing the profiles back to a physical state similar to their original. Since the seawall can increase erosion, we believe that Goleta beach should not choose to add one to protect the park, but should instead replenish sand deposits from another source or let the ocean run its course.

Contrary to our hypothesis, we found that high-energy waves were not necessary for significant erosion of the beaches. The low energy waves were able to erode the beaches during high tides.

Summary Statement

We used the Emery Method to measure beach profiles in order to determine the affects of wave energy and tides on erosion and deposition.

Help Received

Mentor, Dr.Imperato, helped develop project design and assisted in first experiment trial.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Kerris L. Lassley

Project Number
S0803

Project Title
Which Household Substance Will Increase the Ice Nucleation Process of Dew on Oranges? Year 2 Study

Abstract

Objectives/Goals
The purpose of this experiment is to determine which household substance will increase the ice nucleation process of dew on oranges in orchards, with wind machines and without. In a previous experiment it was determined that flour had the greatest result in protecting oranges when a freezer was used to simulate a freeze. This study will provide a more accurate result due to the oranges remaining attached to the tree, during an actual freeze. This investigation is to find out how to speed up the freezing process of dew on oranges. By doing this, a method will be determined to allow farmers to protect their crops from frost damage, which causes valley farmers to loose thousands of dollars each year depending on the severity of low temperatures.

Methods/Materials
Test Set-up/Mix each independent variable with distilled water to create a 3:1 dilution solution. Applied independent variable solution mixtures to each test orange tree 1/day for 3 days prior to predicted freezes. Administration/Label and designate each tree with yellow tape to avoid any human contamination. Spray each tree completely, including trunk, branches, leaves, and fruit in orange grove with a wind machine and without.Sample collection and processing/After freeze exposure harvest 10 oranges from each tree, section each orange to assess observable freeze damage to fruit by %, log the results in data book. Measure sugar levels with a refractometer and hydrometer in Degrees Brix log the results in data book.

Results
The results of this investigation show that all of my variables increased the freezing process, causing less damage to the oranges. Water with carbon particles had the best affect on increasing the freezing process.

Conclusions/Discussion
In conclusion, by adding carbon particles to water it will increase the ice nucleation process of dew on orange trees. Still not clear if it was the thickness of the droplets or the film that increased the freezing process, by coating the leaves, branches and oranges. This process caused a thermal affect to the trees, protecting the fruit. Research and testing indicate by speeding up the ice nucleation process it will produce smaller crystals, allowing them to melt quicker and cause less damage to oranges, while providing hardiness to the tree. Further research and testing will provide a solution that would help farmers protect crops from frost damage, saving thousands of dollars lost each year.

Summary Statement
Research and testing indicate by speeding up the ice nucleation process it will produce smaller crystals, allowing them to melt quicker and cause less damage to oranges and the trees.

Help Received
mother helped with photos and Josh Marshall supplied Orange Grove

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nicole Matthias; Rhiannon Russell

Project Number
S0804

Project Title
Is the Soil Stable?

Abstract

Objectives/Goals
The purpose of this project is to determine what additives could potentially make saturated soil stronger.

Methods/Materials
We filled PVC pipes with different mixtures of pine needles, leaves, polystyrene, or plain soil. After letting them saturate, we inserted wooden dowels into them, simulated an earthquake, and removed the dowels using a force gauge.

Results
The soil with polystyrene came out to be the strongest while the soil with leaves was the weakest.

Conclusions/Discussion
The polystyrene could have been stronger because it stabilized the soil. Leaves have a waxy surface causing water to easily slide off them, and pine needles did not have enough surface area to keep the soil from liquefying.

Summary Statement
The project is about the stability of different soil types after being saturated and simulated through and earthquake.

Help Received
Mother helped saw PVC pipe and wooden rods as well as drilling holes into PVC pipe

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Karen V. Pham

Project Number

S0805

Project Title

The Effect of Hurricanes and Tropical Storms on Hypoxic Zones: A Seven-Year Study in the Gulf of Mexico

Abstract

Objectives/Goals

The objective of this project is to find a potential correlation between hurricane and tropical storm occurrence and the prevention of the formation of the Gulf of Mexico's hypoxic zone.

Methods/Materials

Data supplied by the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) Godard Space Flight Center, which included amounts of dissolved oxygen, hypoxic zone size, chlorophyll a concentrations, and hurricane and tropical storm occurrences from 2006 to 2012, inclusive, in the Gulf of Mexico were examined to establish the hypothesized correlation. Graphs were created to examine correlation of both hypoxic zone size and amount of dissolved oxygen and the occurrence of tropical disturbances. Observations were made for chlorophyll a concentration images on areas where chlorophyll a concentrations increased or decreased in amount and/or size.

Results

In the dissolved oxygen analysis, the graphs created showed a general increase in dissolved oxygen saturation of the water as tropical disturbances increased, but the R^2 values were very low. In the hypoxic zone size analysis, only the graph of tropical storms vs. hypoxic zone size showed that the hypoxic zone size decreased with increasing occurrence of tropical storms. In the chlorophyll a concentration analysis, there was a general decrease in area and/or concentration of chlorophyll a in areas where tropical disturbances occurred.

Conclusions/Discussion

There appeared to be little to no correlation between tropical disturbance occurrence and ocean hypoxia when dissolved oxygen content and hypoxic zone size were investigated. There was, however, a potential correlation found when the chlorophyll a concentration in the Gulf of Mexico's waters were examined. Thus, the results of the investigation must be deemed inconclusive. Though no solid correlation was found, the general trend uncovered in the chlorophyll a concentration observations is a possible indication that such a correlation may exist. If a strong correlation could be established, such knowledge could be used to slowly diminish - and ideally, to eventually dissolve - the hypoxic zone in the Gulf of Mexico.

Summary Statement

This project attempts to find a correlation between the occurrence of tropical disturbances and the reduction of hypoxic zones in the Gulf of Mexico.

Help Received

Data obtained from public databases run by NOAA and NASA; Mr. Paul Hunt provided advice; Family provided much-needed moral support.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Christopher A. Powers

Project Number

S0806

Project Title

Investigating Vegetation as a Natural Barrier to Reduce Tsunami Power

Abstract

Objectives/Goals

Storm surges, created by high winds of storms, and tsunamis, generated by large disturbances in water, result in damage and flooding to coastlines if left unchecked. Current barriers have problems ranging from high cost to damage to the environment. Vegetation, if effective as a barrier, would remove many of the cons of artificial barriers. My experiment tested different types and configurations of vegetation as barriers to determine their effectiveness at reducing wave power. I hypothesized that mangrove trees in a canal-like grid configuration would reduce wave power most. The other types of vegetation I simulated were vegetated dunes, wetland shrubs, beds of sea grass, and a control. The other configurations were staggered clusters and a single thick patch.

Methods/Materials

I created a wooden wave tank, which included an artificial beach and a pushing mechanism to generate waves. I attached my simulations of each type of vegetation to wooden plates, which could be inserted onto the beach. I tested each barrier ten times at each of three positions: high, medium, and low, in relation to water level. For each barrier, I measured the distance waves traveled up the artificial beach and took slow motion videos for analysis.

Results

I calculated the average distance from the end of the beach, so higher values mean more effective barriers. In their high positions and staggered configurations, the distances away were 9.4" for mangroves, 12.6" for shrubs, and 6.0" for the control. The other barriers were less effective: grass- 6.2", other trees- 7.8", dunes- 7.5". Despite some experimental error, the average standard deviation was only 1.6". Most barriers were more effective at higher positions up the beach, where the splash impact was larger. At lower positions, the wave simply passed over the barrier. The staggered configuration was more effective than the grid configuration for both shrubs and mangroves because it had fewer gaps.

Conclusions/Discussion

Shrubs and mangroves were most effective because they combined highly frictional surfaces, large exposed surface areas, and effective configurations to reduce wave power and distance traveled inland. In the future, I would expand my testing by improving the simulations, testing new barriers/configurations/combinations of vegetation, and comparing their effectiveness to non-vegetative barriers.

Summary Statement

My project researched which type and configuration of vegetation would most successfully act as a tidal barrier by limiting tsunami and/or storm surge erosion and destruction in coastal regions.

Help Received

Father helped create waves while I measured them.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Ken K. Ross

Project Number

S0807

Project Title

The Effects of Bulk Density, Porosity, and Permeability of Land on Liquefaction, Year 2: Mitigation

Abstract

Objectives/Goals

The purpose was to investigate effective liquefaction mitigation methods. The hypotheses were: 1. If it is possible to increase bulk density and decrease porosity of the liquefiable ground (saturated fine sand), by compacting the soil or replacing part of the soil with concrete columns (solidifying), then volume of sinking will decrease. 2. If it is possible to increase permeability of the liquefiable ground, by replacing part of the soil with gravel columns, then volume of sinking will decrease.

Methods/Materials

First, five different mitigation methods were conducted on 10 liters of saturated fine sand (0.12mm - 0.20mm) which was used to simulate liquefiable ground. The five mitigation methods used were: Dynamic Compaction (weight drop), Vibro Compaction (vibrate), Concrete Columns (solidifying pore space), Vibro Replacement (small gravel columns), and Vibro Replacement(large gravel columns). Then, these improved grounds underwent a simulated liquefaction test. A brick, representing a structure, was placed on top of each saturated ground material. A simulated earthquake was created by placing a concrete vibrator probe on the outside of the container for one minute. The volume that the brick sank was measured. Next, sample ground materials used for each ground improvement were tested for bulk density, porosity, and relative permeability. This data was compared and analysed with the simulated liquefaction test results.

Results

1. Concrete columns, which had the highest bulk density and lowest porosity, had the lowest volume of sinking. 2. Large gravel columns, which had the highest permeability, had the second lowest volume of sinking even though it had the highest porosity.

Conclusions/Discussion

The results supported Hypotheses 1 and 2. Concrete columns solidify pore space with cement. This process will bond grains together and prevent water from entering the sand, therefore mitigate volume of sinking effectively. In addition, gravel columns create an additional drainage path in liquefiable land and prevent developing pore water pressure. This is another way to prevent liquefaction by increasing permeability.

Summary Statement

Investigated effective liquefaction mitigation methods by examining bulk density, porosity, and permeability of land.

Help Received

Parents helped with keeping time during experiments

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Grace Xu

Project Number
S0808

Project Title
Where's My Water? The Effect of Contaminants and Organic Compounds in Various Soil Textures on Soil Water Retention

Abstract

Objectives/Goals
The purpose of this project was to investigate how the presence of solutes, CO2, and acidity in water, as well as organic compounds in soils, may interact with soil textures to affect water retention characteristics. Water retention includes two aspects, water saturation, and the soil water potential, which affects the wilting point and amount of effort plants must use to withdraw water. As water becomes more and more scarce, it is not only the amount of water held in soil that is important, but also its accessibility. Therefore, if we understand what can negatively affect usability, we can better manage those factors to reduce the demands of limited water resources.

Methods/Materials
The objective of this project was achieved by applying controlled drying cycles to soil samples saturated with different types of water, and then obtaining their drying curves (moisture content vs. elapsed drying time). Faster drying speed is a reflection of higher water potential and vice versa. Although typical water retention curves are obtained by applying vacuums, drying curves reflect the same water retention characteristics.

Results
This experiment confirms almost all hypotheses. Finer soils do indeed hold more water and have slower drying speeds due to lower water potentials. It was also found that a small amount of humus increased water saturation greatly. The presence of CO2 in water did reduce drying speeds, and thus water potentials, slightly. As expected, the presence of even a small concentration of salt significantly water potentials, and thus drying speed. Vinegar did cause faster drying speeds due to the faster evaporation rate of acetic acid, but the increase was surprisingly significant compared to what was predicted.

Conclusions/Discussion
The findings suggest that a small amount of humus makes a noticeably positive difference in water retention, and is especially helpful in the case of coarser soils, which do not retain water well due to their lower water saturation and higher water potentials. Experiment results also showed that it is very important to prevent accumulation of solutes in soil and water, especially in finer soils where contaminants tend to build up faster and are difficult to leach out. This sustained buildup further reduces water potentials, making water much less accessible by plants. Thus, even a small amount of solutes can have a very significant effect.

Summary Statement
This project studies how various forms of soil water pollutants can decrease soil water potential and thus decrease the amount of water available to plants.

Help Received
Father helped carry out experiment trials and use computer programs to graph and chart data.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Brian Zhang

Project Number
S0809

Project Title
Developing a Self Sufficient Estuary Mesocosm

Abstract

Objectives/Goals
Providing vital services to a vast variety of species, salt marshes retain the distinction as one of the most productive ecosystems on the terrestrial biosphere. Due to increasing global warming and pollution, salt marshes decline at a rapid rate, decimating endangered animals species along with them. Thus, the purpose of this project is to develop a self sufficient estuary ecosystem aimed at restoration to improve the environment to its former condition.

Methods/Materials
First, various native species of each trophic level were collected from the local salt marsh and inner beach. Such organisms included sculpin, microalgae, macroalgae, zooplankton, phytoplankton, nitrogen fixing bacteria, swimming crabs, etc. Prior to collection, a tank was built with two separate tanks, one representing the ocean, and one full of mud serving as the marsh. A bridge between the two simulates a natural salt marsh in addition to a wave maker. The organisms were then placed inside of the ecosystem, where several at a time were added each week. Then, a light simulating the sun was placed above the tanks and accurately emulated wavelengths. After the biological ecosystem was set, a data sonde was obtained and programmed to collect data on abiotic factors such as pH, salinity, nitrates, and temperature.

Results
From analyzing the data, it was found that environmental equilibrium was obtained. Oxygen levels rose and fell depending on the time of day due to photosynthetic factors. There was a steady oscillation in salinity due to evaporation removing water, and various flora and fauna removing salt. Chemicals were kept stable largely by a combination of organisms such as nitrogen fixing bacteria and oysters that removed pollutants such as phosphates. All of the species remained robust, which provides qualitative evidence of a thriving ecosystem.

Conclusions/Discussion
Thus, the hypothesis that a self-sufficient ecosystem can be created through careful simulation of natural conditions. Since it is possible to create such mesocosms, salt marsh estuaries can be restored through production of these ecosystems on a large scale and can be applied to space exploration due to their low maintenance and high efficiency.

Summary Statement
My project is about developing a self sufficient salt marsh ecosystem aimed at restoring salt marshes on the coast in addition to space exploration.

Help Received
Cabrillo Marine Aquarium provided funding, materials, and an area to work in, everything else was done by myself

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Emily B. Hughes

Project Number
S0899

Project Title
Extreme Fossil Snails: A Question of Survival

Abstract

Objectives/Goals
The purpose of this project is to identify two species of Ordovician Gastropods and then determine if either of these species survived the End-Ordovician Extinction and due to what factor. Finally, if one or both survived, to determine whether some of their biological and ecological characteristics are present in modern gastropods today.

Methods/Materials
In the summer, I began documenting and recording information about saltwater periwinkle snails. Later, I compared this information to two species of fossilized gastropods. I researched as much information as I possibly could about these two species, and conducted tests and measurements on their size distribution and average size.
The materials used varied for the different components of the project. Over the summer, I took pictures documenting the periwinkle snails that cluster near the edge of a creek. Later, I counted and classified the fossilized snails from the Ordovician Period, and these each required different materials.
Periwinkle Materials: Notebook, camera, plastic bags, measuring tape, different sized coins, periwinkles
Fossilized Snails: Measuring app, computer, image j app, fossil specimens, camera, taxonomic papers on Ordovician gastropods.

Results
Two fossil snails were identified; the planispiral snail is Clathrospira and the high spired snail is Murchisonia. Based on literature research, I discovered that Murchisonia, the high-spired gastropod survived the end Ordovician extinction but the planispiral species, Clathrospira, did not.
Hypothesis one is falsified.

Size data, as well as morphology and eating habits of the fossil snails were compared to that of the modern periwinkles. In particular, Murchisonia was compared because only this genus survived the mass extinction. The similarities between the periwinkles and Murchisonia are:
1. Both are (were) grazers, unlike the planispiral species.
2. Both have a high spired shell.
3. The two had similar size ranges for adult snails (see analysis).
Hypothesis two is confirmed.

Conclusions/Discussion
My project showed that environment does not affect whether or nor a species will survive a mass

Summary Statement
This project is a research of why gastropods can survive mass extinctions, and it focuses on what factors there are that allows them to.

Help Received
Aunt Carolyn helped take pictures, and Robyn helped find rocks, and gave advice.