Constraining the Relation between Tremor and Slow Slip using Tremor Distributions and PBO Strainmeter Data
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Episodic Tremor and Slip (ETS) is a recently discovered spatiotemporal correlation between subtle seismic signals, and slow slip events on subduction zones. The physics of these events are not well understood, however the process could hold valuable information regarding the seismic hazards addressing residents of Washington. ETS has the potential to act as a real-time indicator of stress loading in the Cascadia earthquake zone and help predict times of high probabilities for large earthquakes near Seattle. Further, understanding the character and locations of tremor epicenters could facilitate locating the locked segments of the Juan de Fuca plate, assisting seismic hazard officials by revealing how close to metropolitan areas these large earthquakes are likely to occur. This study attempts to elucidate the physics of ETS through three separate but interconnected research components: analysis of data collected from field work in the summer of 2010 on the Olympic Peninsula; the derivation of physical constraints for theoretical slip models; and through the examination of tremor migration from PBO borehole strainmeters in Cascadia.

Quantifying Biological Activity of Hydrothermal Vents using Picture Mosaics of Axial Seamount on the Juan de Fuca Ridge
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Hydrothermal vents located on the seafloor can be host to highly diverse biota that are sustained by the chemicals within the vent fluids. Identifying and quantifying this biological activity is difficult due to the inaccessibility of these vents, however measuring spatial biological patterns over single vents and between vents can be even more difficult. By quantifying the potential correlation between the amount and type of biota and their locations on and between vents, potential endemism on active vents and patterns of migration between vents can be examined. Additionally, shifts in biological activity correlated with venting activity can be determined by the location of biota on single vents. Such hydrothermal systems currently being studied exist at Axial Seamount located at the intersection of Cobb-Eickelberg Seamount Chain and the Juan de Fuca Ridge off the coast of Washington state. During a field expedition in 2010, the remotely operated vehicle Jason conducted HD video surveys to visually map out many areas within the caldera of the seamount. Images from these videos will be mosaiced to create both vertical and down-looking picture mosaics of large areas in order to identify and quantify biological distributions within single vents and between multiple vents to look at dispersal patterns of particular biota. Furthermore, these mosaics will play a role in determining sensor and node placement for America’s first underwater cabled observatory—an unprecedented system relaying live data obtained from scientific sensors and instruments on the seafloor and in the water column back to land.

Blue Glacier Meltwater Contribution to the Hoh River Minimum Flow
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Mentor: Edwin Waddington, Earth And Space Sciences
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Understanding how glaciers interact with local river systems is an important factor in determining how rivers will respond in the future. Many people are concerned about how the volume of rivers will change when glaciers disappear completely. Although glaciers do not contribute a large percentage of a rivers total flux, its impact is most pronounced during its minimum flow. The Hoh River is an ideal place to
study this interaction because it is an important spawning location for salmon and there is a long historical record of glacial thinning measurements made at Blue Glacier, one of its largest source glaciers. Glacial contribution was calculated by building a positive degree-day model from temperature measurements and meltwater obtained at two ablation stakes. The glacier was subdivided into sections with known area and meltwater was determined for each section by the positive degree-day method. The total volume of glacial meltwater was then calculated by summing the volume associated with each elevation band. Blue Glacier’s contribution was determined by comparing the volume of glacial meltwater with the volume of the Hoh River at gauges along the river.

Correlating Aqueous Compositions and Surface Morphologies on Mars

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Spectroscopy gives us the ability from orbit to analyze the surface composition of Mars, providing evidence for the presence of liquid water throughout its history. Spectral images from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) aboard the Mars Reconnaissance Orbiter (MRO) were used to identify a variety of minerals on Mars indicating the various processes that were present at the time of their formation. We identify minerals from their unique absorptions at specific wavelengths by examining CRISM surface reflectance data across 438 wavelengths from 1.0 to 3.9 microns. Specifically, our global survey of hydrated mineralogy has targeted zeolite, sulfate and hydrated silica deposits, with a focus on locations within Valles Marineris, Columbus Crater and Mawrth Vallis. By correlating CRISM spectral signatures within these regions with morphological features on the Martian surface pictured in MRO Context Camera (CTX) images, we are able to provide a context for the surface mineralogy to improve our understanding of the conditions present at the time of their formation. Our survey will continue to map the detailed distributions of zeolite, sulfate and hydrated silica deposits to compare with surface morphology. By combining the morphological and mineralogical information, we have stronger and more detailed evidence for the presence of liquid water on Mars that, in turn, indicates the specific conditions conducive for the development of life.