Online Proceedings

Session 1A

Climate Change: Gasses, Clouds, Measurements

Session Moderator: Dennis Hartmann, Atmospheric Sciences

MGH 074

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Understanding the Underlying Structural Differences and Mechanisms between Eastern and Western Tropical Anvil Clouds

Joshua Driscol, Senior, Atmospheric Sciences: Climate, Atmospheric Sciences: Meteorology
Mary Gates Scholar
Mentor: Dennis Hartmann, Atmospheric Sciences

Recent studies like the Coupled Model Intercomparison Project Phase 5, or CMIP5, have sought to quantify how atmospheric variables will change due to climate change. Even from decades of rigorous study, it is still uncertain how cloud feedbacks will respond to a warming climate. However, it is possible to try and minimize this uncertainty in part by examining deep convection, and specifically anvil clouds, in the Tropical Pacific. Anvil clouds are not simulated well by the current generation of climate models, but by studying both large scale motions and small scale, local cloud structural evolution, Professor Hartmann and I seek in this study to determine the underlying mechanisms of the differences in vertical cloud structure in the Eastern and Western Pacific. I use the ERA-Interim, CloudSat, Calipso, and CMIP5 datasets in addition to climate model output from the Community Earth System Model (CESM) to analyze differences in cloud structure and model output. This is important work, because reducing uncertainty in an era of global warming can mean better advanced warning systems and more informed, ethical policy decisions moving forward.

Poster Session 2

Balcony, Easel 86

1:00 PM to 2:30 PM

Evaporative Resistance Equally Important to Albedo in High Latitudes Due to Cloud Feedbacks

Jin Kim, Senior, Atmospheric Sciences: Climate
Mentor: Abigail Swann, Atmospheric Sciences and Biology

It is often assumed that terrestrial surface climate in the Arctic is largely controlled by the surface albedo. As the land surface becomes darker, it will absorb more solar energy. The extra absorbed energy is then released through longwave radiation and turbulent fluxes. If the total amount of latent heating is relatively constant, the extra absorbed radiation leads to warmer temperatures. The evaporative resistance of the land surface sets the difficultly for water to evaporate, and thus changes the partitioning between the turbulent fluxes of latent and sensible heat which could lead to a different surface temperature. These effects are known; however, it is unclear what the relative contribution of evaporative resistance and albedo are for the terrestrial surface climate. We used the albedo and evaporative resistance values derived from two common vegetation types, needleleaf evergreen trees and broadleaf deciduous trees, to simulate the climate response to a change in land surface albedo and evaporative resistance in factorial combinations. We find that changing the evaporative resistance between the two plant types has a large effect on the surface energy budget that is almost if not equivalent to changing albedo alone. Lower evaporative resistances lead to an increase of low clouds relative to higher resistance. As a result, less solar radiation reaches the surface when the evaporative resistance is lower. In contrast, the albedo controls how much of the incoming solar radiation gets absorbed. The reflection of light due to the difference in albedo is of the same magnitude as the loss of incident sunlight due to increased cloud cover under lower evaporative resistance. Our results demonstrate that realistic changes in evaporative resistance can have just as large of an impact on Arctic terrestrial surface climate as changes in surface albedo due to cloud feedbacks.

Poster Session 3

Commons East, Easel 60

2:30 PM to 4:00 PM

Illuminating the Rain Shadow: Characteristics of Clouds and Precipitation on the Lee Side of the Olympic Mountains

Jamin Kurtis (Jamin) Rader, Senior, Atmospheric Sciences: Climate, Atmospheric Sciences: Meteorology
Mary Gates Scholar, UW Honors Program
Mentor: Lynn McMurdie, Atmospheric sciences
Mentor: Angela Rowe, Department of Atmospheric Sciences
Mentor: Joseph Zagrodnik, Atmospheric Sciences

From November 2015 through March 2016, the Olympic Mountains Experiment (OLYMPEX) was conducted on the Olympic Peninsula to study the evolution of wintertime clouds and precipitation in frontal systems passing over this coastal mountain range and to validate satellite-derived precipitation measurements from the U.S.-Japan Global Precipitation Measurement (GPM) mission. While most OLYMPEX research has focused on precipitation processes on the windward (usually southwest) side of the Olympic Mountains, this study uniquely examines the leeward (usually northeast) side of the mountains where there is climatological rain shadow (i.e. a minimum in precipitation relative to the windward side). The vertical structure of the frontal systems over the northern Olympic Mountains is examined using data from a radar managed by Environment and Climate Change Canada on Vancouver Island (EC-XBAND), including intensity inferred from radar reflectivity. Using environmental data from North American Regional Reanalysis on the windward side of the mountains, this study classifies the leeside radar data based on upstream large-scale conditions. The cloud and precipitation structure on the leeward and windward sides of the mountains are compared utilizing the Doppler on Wheels (DOW) radar in the Quinault River Valley, and the EC-XBAND radar. Cloud and precipitation particles measured by in situ aircraft over the windward and high terrain illuminate situations when particles are lofted over the mountains to the leeward side, reducing the rain shadow. These findings will inform local studies of snowpack and water supply in the Olympic Peninsula as many reservoirs there depend on precipitation that occurs on the leeward side. Outside of the Pacific Northwest, these findings can be applied to other midlatitude coastal mountain ranges on the west side of continents around the world.

Poster Session 3

MGH 241, Easel 134

2:30 PM to 4:00 PM

Eco-nomy GO: An Augmented Reality App that Focuses on Environmental Education

Andrew Lutrell (Andrew) Mc Donald, Senior, Interactive Media Design (Bothell)
Reginald D. King, Sophomore, Pre-Major, UW Bothell
Mentor: Dargan Frierson, Atmospheric Sciences

Climate change is misunderstood and largely ignored because people imagine its impacts as far away and they lack education on how to effectively combat it long term. We built this mobile game to shatter various misconceptions by educating users in a fun and engaging way. We allow players to explore environmental concepts by incorporating story, science and community into a single experience that blends real world images taken from the user's mobile device with 3D graphics. This is done by including various mechanics such as collecting, combat, puzzles and exploration in a way that is easily accessible to everyone. With this game we hope to inspire users to not only be more environmentally conscious but also become more financially supportive of sustainable businesses. We built this application from scratch using the power of Unity3D game engine, augmented reality technology and mobile GPS location. With this technology we can immerse users by placing a fantastical world into the real one and incorporating environmental narratives.

Poster Session 4

Commons East, Easel 59

4:00 PM to 6:00 PM

How Mountain Ranges Influence Tropical Rainfall

Rikki Leah Parent, Senior, Atmospheric Sciences: Climate
Haley Margaret Staudmyer, Sophomore, Atmospheric Sciences: Climate
UW Honors Program
Mentor: Dargan Frierson, Atmospheric Sciences
Mentor: Oliver Watt-Meyer, Atmospheric Sciences, Univeristy of Washington

This project aims to better understand the effects of removing global topography on atmospheric and oceanic circulation in numerical climate model simulations. The Community Earth System Model (CESM) was run for a hundred years under three different scenarios: the removal of all mountain ranges, the removal of the Rockies, and the removal of the Tibetan and Mongolian Plateaus. When mountains are removed it results in changes to ocean and atmospheric circulation. This begins with warmer surface temperatures where the mountains were removed (without the elevation-induced cooling) and changes in both vertical and horizontal air motion in the vicinity of the mountains (as the topographic-induced circulations are disrupted). Consequently, rainfall is altered due to changes in temperature and air motion. Our research aims to better understand how mountain ranges affect rainfall, particularly in the tropics. and how this in turn affects local climatology in tropical regions.