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1. **Project Title**
   W.I.S.S.E: Water in Situ Solutions and Education.

2. **High-Level Project Summary**

Ever feel like everyone is talking about climate change... but it doesn't affect you at all? Did you know that more than 7 out of 10 coastal floods are caused by human action? All this information exists and is available, but very few are aware of it. Realizing this problem, we decided to create WISSE, an easy-to-use learning platform with interactive games and activities for people to learn, raise awareness about climate change and its effects, and be part of the solution. For this purpose, we applied data analysis to NASA OLYMPEX mission data and other sources to determine the climatological phenomena affecting Washington's community. We believe everyone can be WISSE, let's take action.

3. **Link to Final Project**
   Web Page: https://nasa-space-apps-2022.github.io/W.I.S.S.E/
   Repository: https://github.com/NASA-space-apps-2022

4. **Link to Project "Demo"**
   https://youtu.be/XJIrC6O_ZFc

5. **Detailed Project Description**
   a. **Introduction**

The challenge we chose was TAKE FLIGHT: MAKING THE MOST OF NASA'S AIRBORNE DATA. The goal of this challenge is to design an application that uses airborne data from one of NASA's five campaigns (Delta-X, OLYMPEX, ABoVE, FIREX-AQ or NAAMES) and any additional data to raise awareness by educating the public about the problems associated with climate change on Earth.

We decided to use the OLYMPEX campaign, this field campaign provides ground validation support of the findings resulting from the Global Precipitation Measurement (GPM) Core Observatory satellite on the Olympic Peninsula in the U.S. Pacific Northwest. The GPM satellite has made it possible to observe the amount and nature of precipitation in remote areas of midlatitudes, including oceans and mountain ranges. OLYMPEX conducted over the Olympic Mountains on the northwest coast of Washington State was designed to provide the means for evaluating the physical basis of the algorithms used to convert GPM satellite measurements to determine the amount and nature of precipitation in midlatitude extratropical cyclones.

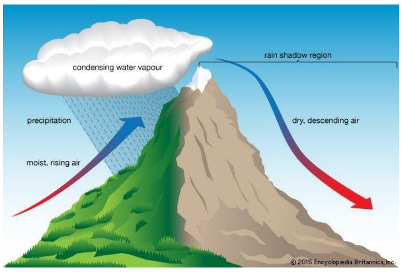
The reason why this challenge and this campaign caught our attention was because we felt identified with the example of the apple harvest in Washington. Here in Mendoza, the amount of snow that falls every year is a serious problem, since the amount of water we will have for domestic consumption and irrigation depends on it. The water emergency in this province is already a decade old and the crisis is increasing: the current scenario is of severe droughts, with 30% less water than the historical average. In our case, we are large wine producers and we also produce cherries, sour cherries, apricots, plums, quinces and walnuts, and this is affected due to our water crisis.

We decided to face the challenge by dividing it into 2 parts. First we made an analysis of the data obtained by the OLYMPEX campaign using different data science methods and models. This database is complemented with other data sources provided by CASEI databases as well as those of institutions and entities of the state of Washington, which allowed us to understand the phenomena occurring in the area. Subsequently, we faced the awareness part with the creation of a web page in which Washington inhabitants and the world could find this valuable information about the climatological phenomena taking place in their region and how climate change will affect them, presenting all the information provided by NASA missions, in a friendly way with interactive sections, involving the SDGs, 3D experiences and games that help them understand each of the phenomena developed in this project, for example, the problem of stink bug plagues due to the conditions that occur in Washington due to climate change.

b. Importance of the Olympic Mountains in Washington's Hydrography

- **Getting to know Washington's hydrography**

The Olympic national park, in which OLYMPEX study was centered, is one of the rainiest places in America. Pacific Ocean winds carry a lot of humidity and deploy water in various forms along the riverside, land, valley and leave their last track of humidity in the western side of the Cascade mountain range. When the wind finally crosses it's extremely low on water.

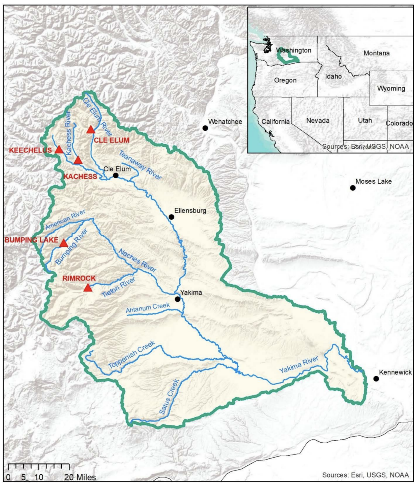


Land in the estern side of the cascades historically has always been dry, in fact nowadays it is artificially irrigated with water extracted from nival rivers and dams. The melting of snow in May, June and July represents 60% of the basin's natural runoff. However, to the west of the Cascades Range, the regime is quite pluvial, without snow but with precipitation from oceanic storms.

East from the cascades, almost every river relies on water defrosting as their primary source. This is the case of Yakima, Methow, and various lakes, which are affluents of the Columbia river, the most important river for Washington State, and Oregon. The river's strong current and the high drop in elevation in a relatively short length give it tremendous potential for electricity production, which has already been exploited. After pumping water through a canal on the left bank to the Banks Lake reservoir , it reaches the Grand Coulee dam, which, with a height of 168 m and a length of 1592 m, has an installed capacity of 6809 MW, making it the largest hydroelectric power generating facility in the United States, only one of the eleven dams and hydroelectric power facilities in Washington state.

Columbia river has more than 60 tributaries some of the most important to mention are the Snake river, Yakima River, Nisqually River, Willamate, Kootenay, Pend Oreille-Clark Fork System, and several smaller rivers and creeks from snowmelt in the Cascade mountain range.

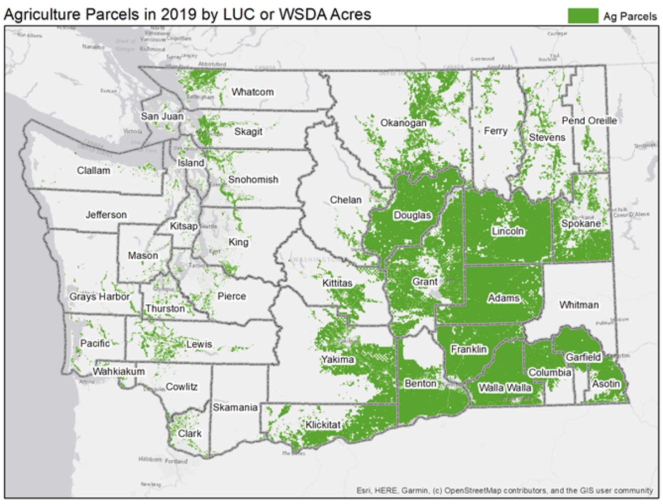
Yakima River is named after the indigenous Yakama people. It is a major tributary of the Columbia River, and originates from the Keechelus Dam in the Cascade Range. Yakima river is an example of high flow river feeding the Columbia river, but there are thousands of creeks and smaller rivers that are affluent that help maintain the different dams water level alongside the Columbia river. These rivers and dams are the source of Washington state water.



- **Washington Irrigation Phenomenon**

The main usage of water in Washington is irrigation, followed by public supply and Industry. Washington State has nearly 15 million acres of farmland with around 39,000 operating farms, each producing necessary agricultural commodities. A few of the most well-known crops that are produced and distributed from Washington State are apples, cherries, hops, raspberries, and pears. Washington's farmers and ranchers directly contribute to more than 160,000 jobs throughout our state with many of those occurring beyond the boundaries of the farm itself. They include jobs related to packaging, transportation, processing and more. In addition to the direct economic contribution the agriculture industry also uses machinery, trucks, fuel, financial services and other goods and services that support local companies and businesses. This activity helps to improve things like the roads we all drive on and the schools our children and grandchildren attend.

Many of the 39,000 operating farms require irrigation to produce much of the aforementioned fruit that gets distributed far and wide, which consumes a large portion of water resources.



There are different problems caused by changing weather conditions. As temperatures rise, the impacts of climate change on agriculture become increasingly apparent.

For example, higher rates of sunburn due to atmospheric water stress and drought. The excess stress being put on crops and growers as they try to produce high-quality crops in the changing climate is only going to become more severe. Water shortages are causing significant concern for the spawning and life cycles of certain salmon species in these rivers and their tributaries. However, most people don't know that lots of people are working on solutions.

Efficient and effective irrigation water management cannot only improve the profitability of agricultural producers, but can result in a decreased need of water and therefore greater in-stream flows for aquatic habitat. Better designed irrigation systems, and more informed and vigilant irrigators can help to accomplish both of these positive outcomes. For example, Washington is 80% sprinkler irrigated and only 5% drip irrigated; sprinkler irrigation requires more water due to partial water vaporization. In Prosser an average of 6 to 8 inches of rain falls per year and apple orchards need about 42 inches of water per year, the difference is extracted from the rivers and dams. This explains this graph.

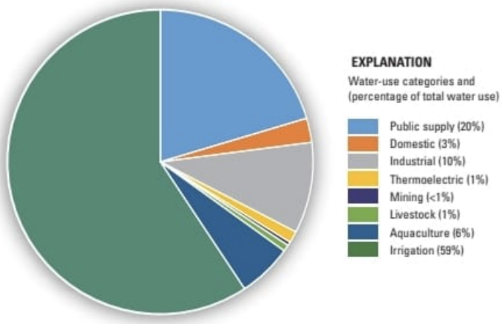


Figure 1. Compilation of water-use categories for 2015 decided by the U.S. Geological Survey National Water-Use Science Project.

More than 59% of water is used for irrigation and only 3% for domestic use. We should focus our efforts in better designing the way we use large scale water usage, not only domestic usage. Potentially, can help conserve water, reduce irrigation costs, and secure irrigation water for small and large producers is regulated deficit irrigation (RDI).

A study made in Washington state university shows that although The RDI trees are watered at approximately 60% of what the control is watered. Preliminary results are showing that the RDI trees are experiencing more stress than the control trees, but not so different that they will have drastic differences in appearance. Regulated deficit irrigation practices have the potential to be a useful tool to conserve water, which in turn can help ensure reliable water for both small and large producers. Water conservation is becoming increasingly important as climate change brings longer and more prominent drought seasons and high temperatures. Crops might react differently to deficit irrigation, and it may take more work to monitor tree stress to determine how much deficit is appropriate.

Another way of decreasing harm is smart irrigation. Smart irrigation collaboration results in new grower-trained watering technology Growers spend an average of 240 hours per acre managing and monitoring their irrigation systems. This manual process leads to costly crop management, inconsistent yields, or even crop loss.

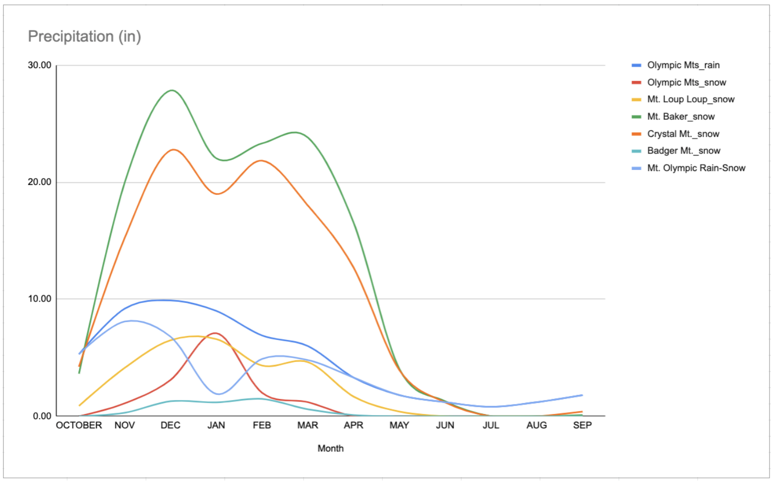
“For the past three years, Vineland has worked in close collaboration with LetsGrow.com to develop a machine learning algorithm to complement the LetsGrow.com software suite to directly address this challenge,” says Hussam Haroun, Director of Automation, Vineland. “Combined with greenhouse environmental data, this new software innovation is able to learn the grower irrigation strategy and provide decisions to create irrigation consistency, as well as optimize water usage and consumption. This can directly help growers by reducing crop losses and demands for labor and highly refine their watering needs.”

- **Validating correlation between olympic mountain precipitation and cascade snowfall and rainfall**

As a premise of our study we based ourselves in the meteorological phenomenon of moisted wind and its deployment in the cascade range. We used rainfall and snowfall data from NASA's OLYMPEX mission and compared it with snowfall data from several mountains in the Cascades

These are the sites where we took information from.

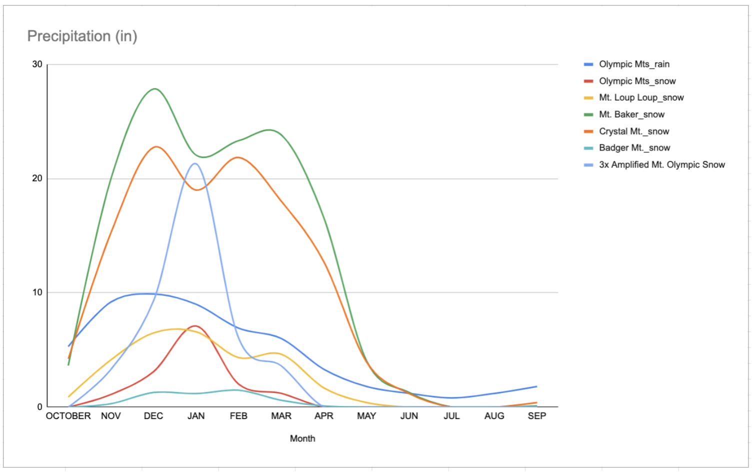
When performing analysis on databases, one of the first relationships that can be found is the following



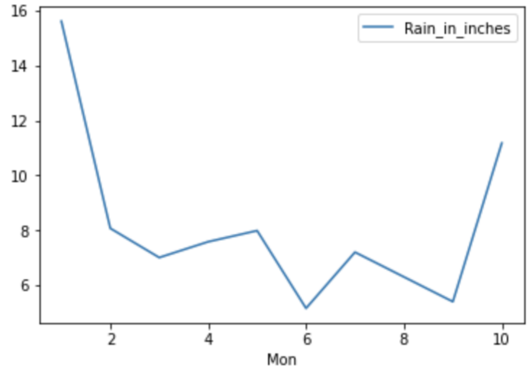
We saw the huge relationship between the average rainfall and snowfall information Mt. Olympic and the Cascade Mountains, so one of the first conclusions we draw is the validation of the information with the data collected by OLYMPEX.

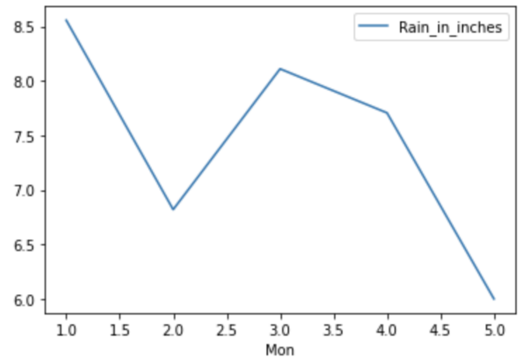
In fact we found out empirically that we subtracted mt. Olympic snowfall inches from rainfall inches the curve that formed had extreme alike snowfall curves from Cascade's Mounts.

Another way of seeing it is that if we augmented snowfall precipitation the curve is quite similar to cascade mounts, only a bit rightly displaced.



As a further validation, we used OLYMPEX data to feed a Python algorithm that performed precipitation curves at Mt. Olympic between 2015-2016. The first graph refers to the period from January to October 2015 and the second to January to May 2016.

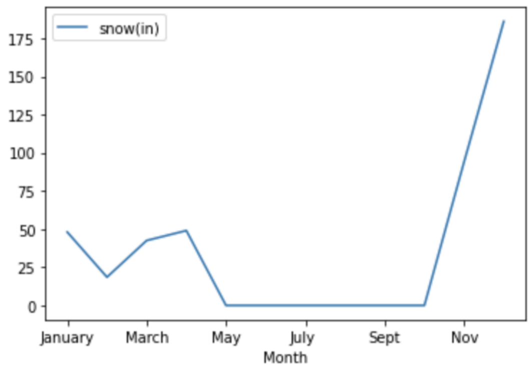


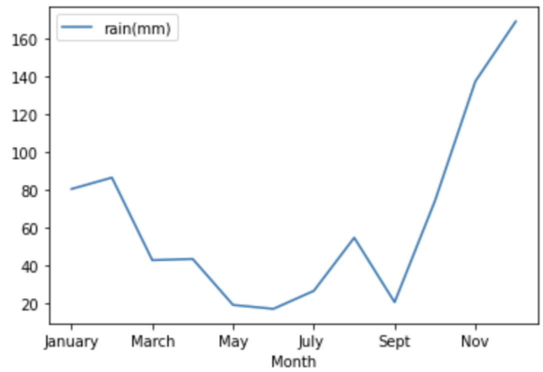


It should be noted that although the information was in mm we converted it to inches for a more direct understanding for our readers.

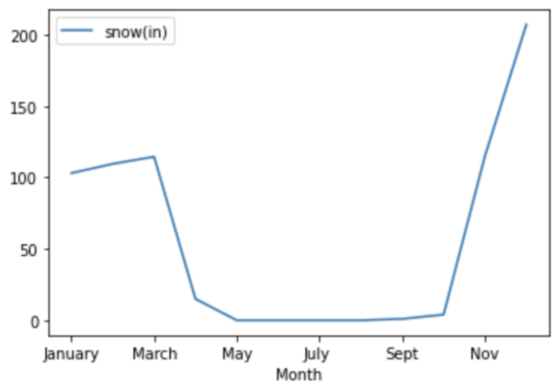
The following information corresponds to the variable snow and rainfall on Mount Baker, one of the many mountains in the Cascade Range.

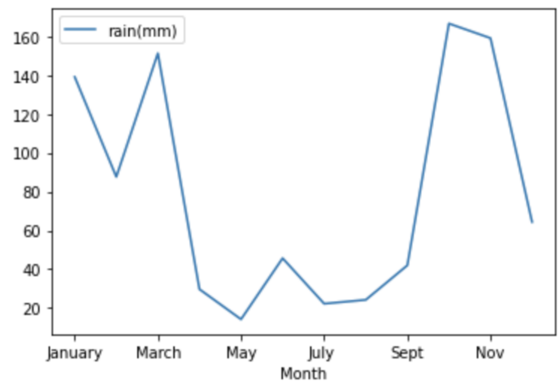
2015





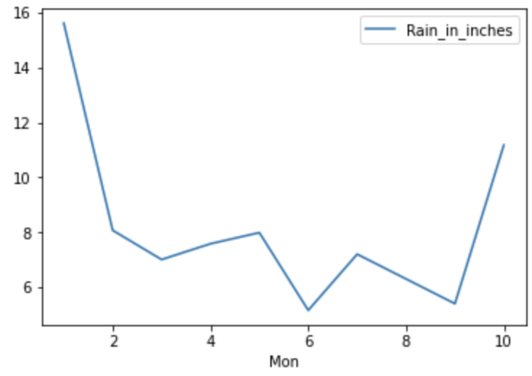
2016



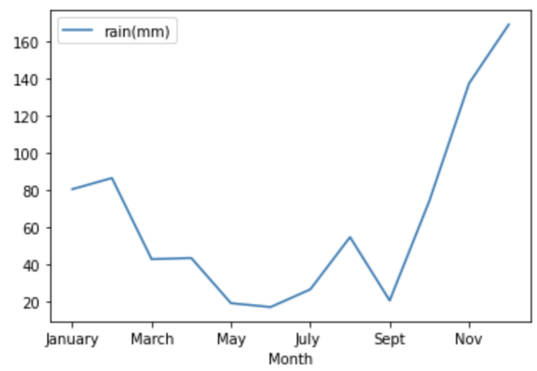


We can notice the strong similarity in shape between OLYMPEX and Mt. Baker curves.

2015

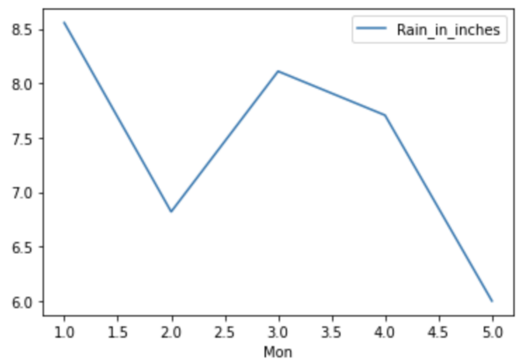


OLYMPEX

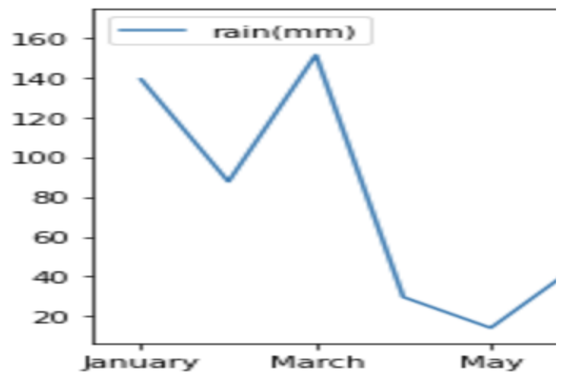


Mt. Baker

2016



OLYMPEX



Mt. Baker

We conclude that there is a strong correlation between rainfall in the Olympic National Park and the Cascades. Although it varies from one point to another, it is determined that it has the same trend, being a similar case to what happens in the northern part of the Cascades. It should be noted that most of the sites have precipitation trends quite similar to those of Mount Baker, on which the Yakima and Columbia Rivers rely heavily to maintain their water levels.

This last reason is the most significant for the study because it provides researchers with indirect information on water levels in the Cascades that will subsequently impact river flows and water for irrigation, industrial and domestic use.

c. Dispersal of BMSB [Brown Marmorated Stink Bug] in Washington

Invasive species threaten the productivity and stability of natural and managed ecosystems. However, predicting their spread is a major challenge, especially in the face of climate change, and even more so when they are rapidly spreading species.

One of the invasive species that has easily established itself in much of the United States is the brown marmorated stink bug (BMSB), and it is because this phenomenon is of such concern to the state of Washington that we have decided to analyse how measurements of variables determined by NASA's aerial campaigns, specifically the OLYMPEX mission, can help us understand its behavior and spread throughout the surrounding regions, both now and in the years to come.

We begin by introducing the challenge and effects that these dispersions bring to society, then proceed to describe what factors promote it and how they alter it. Finally, we conclude on how the OLYMPEX mission parameters contribute to this analysis.

- **Understanding the effects of dispersal on the Washington community.**

The brown marmorated stink bug is a generalist herbivore, known to feast on nearly 170 different plants, including crops and ornamentals. Originally from Asia, this type of stink bug first appeared in the US about 20 years ago and has since spread from coast to coast, being detected in 46 states through various surveys and being considered a pest in 15 of them.

Stink bugs do not bite. They also do not harm people or pets, nor do they spread disease. However, some people are allergic to the compounds released by the stink bug. Symptoms of this allergy can include a runny nose and, if you come in contact with crushed bugs, dermatitis. In addition, "These things really earn their name. They stink," Michael Bush, an entomology and pest management researcher at the Washington State University Extension, says. "When they invade households, people find them creeping around in their house. When they try to remove them, they stink. They stink in protest." Injure them? Hurt them? Squish them? They still stink.

As a polyphagous pest, the brown marmorated stink bug has the potential to inflict damage to several crops, including tree fruit, nuts, vegetables and row crops. During outbreak years the brown marmorated stink bug has caused significant losses to tree fruit producers, damaging apples, berries and pears, all of which are farmed in Washington state. Stink bugs come equipped with big long proboscises they stick into plants to suck up the juices of produce plants. The produce can rot inside. They can contaminate the plant, altering the flavor. They can also leave a thin layer of white film underneath the skin of the fruit. "People cut it open, and there's this little white layer between the skin and the rest of the tomato," Bush says. "People tend not to like that when they see it."

- **Factors involved in this phenomenon**

Empirical evidence has shown that climate change has caused many species, including insects, to shift their native distributions. However, few studies have assessed whether the environmental factors that mediate or determine the emergence of invasive pest species are also those that drive the population dynamics of invasive pest species, and understanding these dynamics is critical to better assess the factors that determine where invasive species are likely to be distributed and the areas where they are likely to have the greatest ecological impacts.

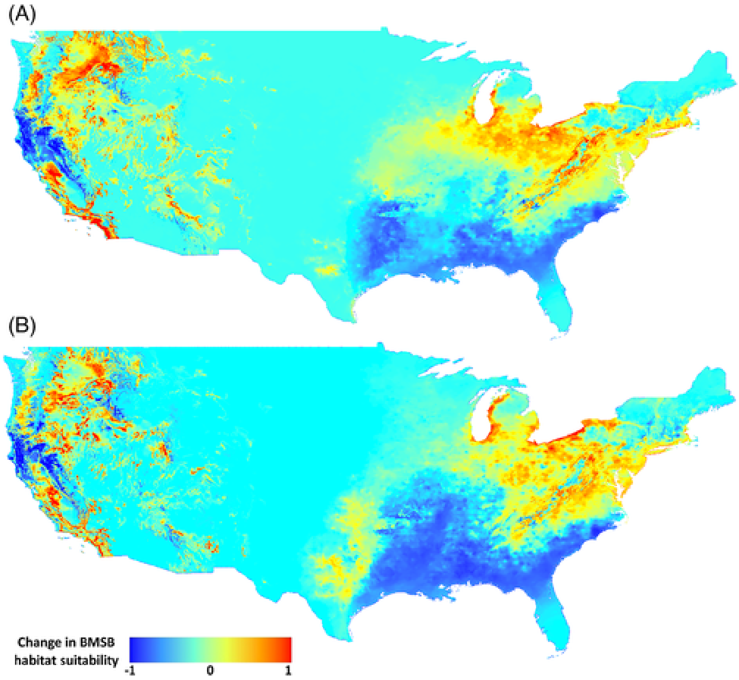
To assess the factors that precisely affect occurrence and abundance, we start from the model developed by Pest Management Science this year, in which climate data were collected from sites for which the population of the species in question was sampled simultaneously between 2017 and 2019. Where for most metrics, climate conditions were acquired from the Parameter Regression Independent Slope Regression Model (PRISM) which links meteorological data, digital elevation models and spatial data to calculate spatially explicit climate, as well as from databases provided by the US National Phenology Network, the Global Evapotranspiration Product and the Global Precipitation Measurement.

In addition, in this model, values affecting BMSB occurrence were assessed using maximum entropy models (MAXENT) and factors affecting abundance with generalized boosted models (GBM). MAXENT models are characterized by comparing locations of occurrence to randomly selected points within a potential habitat to find the greatest dispersion of current conditions relative to a background of environmental variables. These analyses create habitat suitability maps and determine the contributions of specific variables on occurrence patterns. GBM models employed machine learning by combining the strengths of regression trees and momentum to fit a parsimonious model from the results of individual trees. By combining many simple models, GBMs can include different types of predictor variables and can accommodate missing data, which improves predictive performance and minimizes the risks of overfitting.

Validation of the model developed by the PSE showed that both the MAXENT and GBM models accurately captured the current distribution of BMSB in the United States. Although both MAXENT and GBM models effectively predicted the occurrence and abundance of BMSB, the relative contribution of the factors considered between these models differed considerably, reflecting different processes involved in the establishment of an invasive species, as opposed to the dynamics driving the regional population.

In the MAXENT models, distance to urban areas and January precipitation were the most important factors mediating BMSB occurrence. In the GBMs, on the contrary, BMSB abundance was mainly mediated by evapotranspiration and the interaction between photoperiod and solar radiation, followed by soil pH and land cover.

The models showed that habitat suitability for BMSB is likely to change considerably under future climate scenarios. Under both moderate scenarios considered, areas of high habitat suitability are expected to increase in the coming decades. In general, we find that habitat suitability will increase over time towards the north, and for the particular case of the northwest coast we also show that the habitat would become more suitable by moving inland in the coming years, as shown in the following graphs.



In addition, the adopted models show that the role of higher winter precipitation potentially leads to lower mortality of BMSB, in contrast to other species. It is important to note that there is a correlation between increased precipitation during the winter and increased relative humidity and reduced evapotranspiration of the insects at that time.

Additionally, in connection with the behavior of BSMS, it is validated that they have only been found to overwinter in dry and narrow places in nature, such as under bark and deep in the wood of dead trees, but never in humid places such as fallen trees lying on the ground.

In another aspect of this analysis, when studying future climate scenarios, it is observed that BMSB populations have great potential to continue to expand within the United States [10]. According to our models, BMSB may expand its range considerably in the coming decades, threatening crops in regions where it has not yet been detected. However, our models can be used to estimate areas at greatest risk of potential spread so that mitigation and eradication efforts can be implemented in new regions.

In other words, these models, in addition to assessing the potential spread and impacts of an invasive pest species, can be used to guide mitigation and eradication strategies before invaders become established in new regions, while maximizing the effectiveness of the limited resources available to track invasive spread. This is a powerful tool for ecologists and policy makers to better understand the spread of an invasive insect pest in diverse agroecosystems.

- **Contribution of the OLYMPEX mission to the phenomenon**

Recapitulating one of the main observations of the analysis, it is determined that in relation to the factors affecting the occurrence of BMSB, winter precipitation, more specifically that of January, was the most important climatic factor. And as can be seen in the previous sections of the project, the following can be observed

Linking what was developed in the previous section where the OLYMPEX Mission data were validated and the correlation between the mission data and mountain chains near Mount Olympus was established, it is possible to confirm that in the State of Washington the necessary conditions for the occurrence of BMSB were present, as well as their distribution from the coastal regions towards the central part of the state.

d. The impact of floods in Washington

Globally, floods are the most devastating catastrophe and cause the most human casualties and destruction. Floods have accounted for 32% of natural disasters in recent years. Western Washington in particular is one of the most flood-prone regions in the United States and major river floods in the region are the result of heavy rainfall events. It is because of this phenomenon that it has been decided to analyze how measurements of variables determined by NASA's aerial campaigns, specifically the OLYMPEX mission, can help us understand their impact across Washington State in the present as well as in later years.

We begin by developing the societal challenge and effects of these floods, then proceed to describe the factors that promote and alter them. Finally, we conclude on how the OLYMPEX mission parameters contribute to this analysis.

- **Understanding the Effects of Flooding on the Washington Community**

Most rain events occur when a stream of strong winds in the upper atmosphere sweeps from the subtropical North Pacific Ocean into the Pacific Northwest, bringing an unusually warm air mass and an enormous amount of moisture.

Also discussed is the "Pineapple Express" weather phenomenon characterized by a strong and persistent large-scale flow of warm, moist air and associated heavy precipitation, both in the waters immediately northwest of the Hawaiian Islands and extending northeastward to anywhere along the Pacific coast of North America, with the Washington coast being one of the most affected.

Among the detrimental effects of flooding that are and will occur in the Washington region are:

1. Washout and degradation of formed and developing soils;
2. Rapid erosion of the land and its ruggedness;
3. Degradation of land due to accumulation of large sediments;
4. Destruction of qanats;
5. Loss of livestock and wildlife;
6. Destruction of roads, bridges and houses;
7. Rapid filling of lakes;
8. Water spillage and lack of opportunities for water productivity.

- **Factors involved with this event**

Heavy rains usually last between 24 and 36 hours, and are typically 5 to 6 inches in the mountains and between half an inch and 3 inches in the lowlands. These events are fairly common; it is rare to go through a cold season without at least one such event, and more than one is not uncommon; in fact the most flood-prone rivers in western Washington, such as the Snoqualmie River and several others that flow from the western slopes of the Cascades and from the Olympics, usually flood at least once a year.

Another factor to describe is that western Washington is made up of many relatively small drainage basins that flow from the western slopes of the Cascades or from the Olympic Mountains. The short and steep nature of these rivers means that floods develop quickly and as flood waves move rapidly downstream, they have a relatively short life cycle. Flood forecasting and warning is therefore very difficult.

In relation to this factor, empirical evidence has shown that the more precipitation and the more severe the precipitation, the greater the probability of flooding and, as the world warms, a greater percentage of winter precipitation is falling as rain with potentially severe consequences.

So river floods are generated differently in different geographical environments since, as we have been describing, they can be generated by heavy rainfall that exceeds the infiltration capacity of the soil or by rainfall falling on saturated soil; in this case, the amount of flooding from a given amount of rainfall depends on the degree of saturation. In addition, another factor that can generate floods is the melting of accumulated snow; therefore, the effects of climate change on the characteristics of floods vary in space depending on the mechanism of flood generation.

When the degree of saturation is significant, then changes in flood characteristics are influenced not only by changes in intense precipitation, but also by changes in the occurrence of saturated conditions over time; this will depend on both accumulated precipitation and evaporation.

In other words, in regions of Washington where snowmelt flooding is currently significant, future flooding could increase if snow accumulation increases, and would occur earlier if snowmelt occurs earlier; furthermore, if rising temperatures mean that more winter precipitation falls as rain, then snow accumulation would be reduced and snowmelt peaks would be reduced. In the extreme, the flood regime could shift from being dominated by spring snowmelt floods to being characterized by smaller, more frequent winter rainfall floods.

- **OLYMPEX mission contribution to the phenomenon**

The "Pineapple Express" meteorological phenomenon is a more general term for these relatively narrow corridors of enhanced water vapor transport in mid-latitudes around the world. And since the OLYMPEX campaign has an active mid-latitude winter storm track in the northwest corner of Washington State and reliably receives some of the highest annual precipitation amounts in North America ranging from over 2500 mm on the coast to 4000 mm in the mountainous interior, it is the ideal campaign to study this phenomenon in depth. As described above, it involved aircraft, radar and other ground-based sensors to quantify the accuracy and sources of variability and uncertainty inherent in GMO measurements in the study region.

Based on the collected and validated data from the OLYMPEX campaign and the data analysis described throughout this report in the previous sections including both empirical and Machine Learning models, flood risk can be expected to increase. This campaign provided the necessary variables for this study, including measurements related to the decrease in snow cover, the intensification of torrential rains, complemented by those provided by the GMP, such as measurements that determine the rise in sea level.

This study is complemented by those carried out by the Faculty of the Environment at the University of Washington, in which it is determined that the maximum flows of rivers will increase by between +18% and +55% on average in the 12 basins analyzed. And with that carried out by the "States at Risk" project, which determines that rainfall will be more severe in the middle of the century, intensifying rainfall by an average of 19% in the 2080s.

Finally, it should be noted that flood management is not always sufficient to mitigate the increase in flood risk, since, as is the case in several of Washington's rivers, it will continue to be high because the dams only affect part of the basin, with large uncontrolled effluents contributing substantially to flooding downstream.

e. Platform Development

As mentioned before, our team was divided into two parts, while half of this was data analysis, the other part was dedicated to the development of the web page.

We develop and publish a static web page based on React.js and bootstrap. This is a web page focused on teaching the general public, therefore there is no "hard" information on it, but rather it has a simpler approach, explaining the problems addressed with simple words so that a large number of people can understand what is being talked about there, there are also games to bring science closer to the general public.

For the development of the page we decided to keep it simple, that we could close during the hackathon. That's why we chose to make a static web page, developed on an open source template programmed in React.js and Bootstrap.js.

1. Ux-Ui: from the point of view of design and user experience we opted for a simple top-down navigation with buttons that simplify navigation even more. We also opted for a bright color palette that is eye-catching and captures the attention of users.
2. Resources used: all resources used on the website (photos, vector images, sound files and third-party code) are free to use, that is, their authors allow their unrestricted use.
3. Template used: our base was the open source template "argon" that has a wide variety of components that allowed us to be agile in development.
4. Responsive design: the web page is usable on any device due to its responsive design, that is, the web page adapts to the shape and resolution of the screen of the device on which it is opened.

5. Hosting: we decided to post this page on GitHub pages because of the simplicity of our page and the ease of uploading files to github.
6. Technologies: the frontend of this website is made with React.js and bootstrap.js and we decided that it is not necessary to program our own backend due to the simplicity of the website.

By opting for this group of technologies we have a structure with the possibility of being expanded in the future. It is in our plans to continue expanding our project migrated to a backend programmed with the Express javascript library, this will allow us to generate a much larger site without losing performance or comfort for users, we plan to add information about more problems, games and new ways of encourage reading, for example, with a points system that unlocks personalization on the page and video games. It is also important for us that our users can become independent from information intermediaries, so in the future we will add resources to learn about reading graphs and data analysis, so that those who require "simplified" information can start reading the information directly from the source.

f. Conclusions

Based on the main targets reached during the ¨Take Flight¨ challenge we decided to divide our conclusions into two parts:
We begin with the exhaustive research of technical implications and phenomena themselves and, on the other hand; the importance of growing awareness among local communities from a triple impact perspective.

From a technical view, evidence shows that, when it comes to a climate phenomenon, there are plenty of variables that explain it. To understand how two or more phenomena relate, from a causal, consequent or related perspective, it is globally known that correlation and machine learning models are important tools for validation. Based on data from these variables, plus bibliographic research, those theoretical relationships can be accepted or not.

In our case, we valorized data collected in the Olympic Mt. related to snow and rain by validation among other places in Washing affected by climate change, such as the Cascades range and its role in agriculture, Western Washington and its data of floods, and finally, data of Brown Marmorated Stink Bug distribution among the state. The next goal would be to continue collecting data available online and factual evidence to keep supporting and increasing the confirmability of our estimations. The data is available. It is in our hands to give it the best use.

From a social view, we have realized that most of the population is aware of the situation, but wanting to learn more about these topics means several hours of searching for information from different sources. Once again, information is available. The challenge is gathering it together into well-organized and easily comprehended. But that is not all, making it interactive and catchy is another important fact to take into account. The power of gamification comes from inspiring the feeling ¨you are part of it, you know how it works, you can do something about it¨. Thanks to our research and the tools we have implemented, people have the opportunity to learn about the phenomena we have studied, their impacts, and their effects on their living conditions.

In relation to the future projection of this project, it is planned to consist of several phases or sub-projects to be carried out in the following months. These include

- Expansion of the geographical areas analyzed: Due to the adaptability and inference characteristics of the machine learning models used to obtain the climatological phenomena of the regions analyzed, it is hoped to be able to include in the databases future data from more regions of the world that contain similar characteristics to those of Washington. It should be noted that one of the regions of main interest to be analyzed is the Mendoza region, the place where we live.
- Increase in the number of variables analyzed: Due to the properties of the models used for the development of this analysis, it is expected that phenomena such as hail fall, among others, will be studied in the future.
- Increase in interactive spaces: It is expected that in future versions or updates there will be more games and spaces where people can share their concerns about the phenomena presented, connect with other people interested in the subject, and form communities of "Wissers".
- Expansion of the OpenSource database: It is expected that the open access databases will increase over time, as well as the Machine Learning models and sources used.

6. Space Agency Data

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7. **Hackathon Journey**

Our experience was enjoyable and motivating, as it is not every day that you have the opportunity to work on challenges as big as those posed in the hackathon. We learned about the data provided by NASA campaigns and other organizations, which has inspired us to continue working with them in the future.
At the beginning of the challenge we were a bit disoriented and identified that the most complicated thing was to find all the information in one place, we found it difficult to find the Washington water cycle information in one source, we had to look for data from many different sources. So we thought it would be useful if you could find all this information on our website, and we added a section where you can interact with Google Earth and read the information about the whole water cycle in Washington.
We also learned about the weather phenomena that occur in the area, researched them, and spent several hours understanding them in depth.
The approach we used for the site was to learn in a playful and friendly way, we created a prototype game that was fun and informative with an easy-to-understand site interface.
In the end, it was a great experience of teamwork and agile problem solving, we are happy and proud of our performance.
Finally, we would like to thank the entire team of The Mars Society Argentina who encouraged and advised us throughout the challenge, and all the members of NASA Space Apps who guided us on Discord for the information provided.
While finishing this Hackathon may give others a bittersweet feeling, for us it proved to increase our motivation to adapt this tool, originally created for the education of the citizens of Washington, to the people of Mendoza, spreading awareness of water and calcine for action.
Given the great complexity of the challenge we decided to implement agile methodologies through which we divided the development of the solution from a technical vision, validating data available in other surrounding places; and from a social perspective in which we sought to translate this technical information into understandable for affected and interested citizens. In this way, we manage to integrate all sides of the problem and reach a solution as complete and inclusive as possible.
Fun fact, no matter how much time you prepare for the hackathon when you believe in your ideas, time flies by and you forget that the only limit is time.

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9. Tags

#Data #DataAnalysis #Science #NASA #TakeFlight #TAKEFLIGHT #OLYMPEX #Olympex #Washington #Floods #Flood #Climate #ClimateChange #Aware #Awareness #GIS #Water #Metheorology #WetDroughts