Parcel Per Parcel Toward A More Refined Carbon Emissions Estimation For Livermore, CA

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Abstract

Carbon accounting has become imperative in instituting regulations, developing major policies, and in expanding urban metabolism research. For years, city agencies have reported carbon dioxide equivalent (CO2e) emissions across large spatial distributions (city scale). More evidence, however, proves that focus should be turned towards higher spatial resolution estimates (i.e. building scales). Still, how effective are these high-resolution estimates in comparison to city-scale investigations? Do they represent how each sector contributes through the use of natural gas? There have been few attempts to conduct such high-resolution bottom-up emissions analysis, the most refined being performed by the scientists behind the Hestia Project. For this project, an approach related to the Hestia method was applied to the Livermore, California. Residential sector emissions were estimated by down-scaling the 77 Livermore neighborhoods using a variety of geospatial datasets for modeling area; carbon emission sets per household were estimated for the Western United States by the United States Energy Information Administration. Results suggest natural gas upper-level estimations of 201,644 metric tonnes of CO2 per year, while findings show that making utility statistics and analyses available to the public is crucial in further exploring energy consumption.

Introduction

As the global initiative to lower carbon emissions grows, some projects aim to provide real-time carbon emissions visualizations for economic and environmental standards, while others aim to convey annual progress in sustainable building trends. According to the Intergovernmental Panel for Climate Change, both mainstream techniques are transformative and sufficient for the purposes of legislative emissions reform [Tonn, 2007]. The resulting base values of these methods seem to be enough to establish inventories which are important for establishing regulations. Still, in a time when long-term legislation can be kept up-to-date with modern energy-use tracking technologies, neither truly place cultural influences as a major concern, even though such factors may help with reducing carbon emissions. Marginalizing the carbon emissions of an urban setting into sectors and dissecting the major social energy-use tendencies may become a very progressive way of approaching regional carbon accounting.

The downscaling trend for carbon emissions has been separated into two analytical processes: top-down and bottom-up modeling techniques [Lukas et.al., 2009]. The top-down approach to carbon emissions accounting relies on measuring atmospheric concentrations of CO2 and using atmospheric models to infer the surface emission [Blok et. al., 2008]. This method is traditionally used for larger spatial distributions and provides overarching totals as output. An assessment for Salt Lake City recognized the importance of surface monitoring original data and statistical analysis of carbon fluxes, but did not incorporate mapping techniques to downsize the research into a terrestrial representation [McKain et. al., 2012]. In this case, the limitations of the top-down ap-

proach are evident in conveying small-scale contributions to carbon emissions. The bottom-up approach with respect to carbon emissions estimates identifies the subsystems of the project, and then classifies the variables of influence; notably, the accuracy bottom-up approach depends on the diligence of variable classification and analysis [Blok et. al., 2008]. A notable bottom-up study of carbon emissions in the United States is the Vulcan Project, which began just five years after the signing of the Kyoto Protocol [Gurney, 2013]. The Vulcan Project brought to light the importance of analysis from individual urban sectors through a one hundred square kilometer spatial distribution. Energy consumption data was collected primarily from the EIA, while the spatial distribution utilized mainly census data [Parshall et. al., 2010]. A more recently refined attempt at conducting a down-scaling emissions analysis, inspired by the Vulcan Project, was performed by the scientists of the Hestia Project. The first publication of the Hestia Project focuses on Indianapolis, and illustrates how helpful three-dimensional visuals are for carbon emissions modeling [Gurney et. al., 2012]. The written analysis of the Hestia Project provides in-depth descriptions of the variables contributing to urban carbon emissions, which is crucial in this relatively new area of research. It is with the rise of popularity of the Vulcan Project that the bottom-up approach has become the preferred method of carbon accounting in major research initiatives around the world.

What drives this research specifically in California is the establishment of Assembly Bill 32 during the governance of Arnold Schwarzenegger. The bill recognizes the need for regional emissions management, demanding regional climate action plans, such as the Livermore Climate Action Plan for Livermore, California. In the Livermore Climate Action Plan, inventories of the residential, industrial, and commercial sector are referenced in tables as provided by Pacific, Gas and Electric (PG&E). Throughout the West Coast including most of California's Bay Area, PG&E is the majority supplier of energy; by the Livermore Climate Action Plan, it is clear that the residential sector's energy demand is the highest [ICF International, 2012]. Still, there needs to be a manner for comparing inventories with those generalized by the EIA. The goal of this project is to find each sector's contribution of carbon dioxide emissions for Livermore, beginning with the sector of most energy consumption, the residential sector. A reason to investigate the residential sector is because of California's growing population, especially within the East Bay region which includes the city of Livermore [United States Census Bureau, 2013]. Regardless, the inspection of residual carbon dioxide emissions is becoming a more common practice both within and outside the United States.

Projects that served as major references for this investigation in the past decade focused predominantly on residential energy consumption. Since there are limited projects aimed towards residential consumption in the U.S., it should be noted that most of the research referenced is from initiatives abroad. In Serbia, researchers at the Institute of Nuclear Sciences published a study on building stock models in the residential sector as a way to outline the benefits and limitations of bottom-up emissions estimates [Kavgic et. al., 2010]. Other projects based out of China for commercial building energy consumption, as commissioned by the China National Bureau of Statistics, focuses on classifying buildings by age and by type [Xu et. al., 2013]. Residential energy consumption and emission research by building type has also been published in Italy via the TABULA Project, where housing classifications parallel those of the United States, especially in Livermore, California [Ballarini et. al., 2014]. Meanwhile, the research in car-

bon emissions downscaling has even gone so as to transcend the environmental sciences and blend into social science research, as seen through a recent study conducted by researchers in Germany [Weber et. al., 1998]. A more recent extension of this research, with the focus on consumers rather than overall urban lifestyles, was completed in the United States [Bin et. al., 2005]. Researchers in China managed to do a similar study relating lifestyles to carbon emissions for the early millennium as well [Wei et. al., 2007]. One study from UAE even incorporates housing floor plans to demonstrate the influence of lifestyle on carbon emissions in the residential sector [Radhi, 2009]. The projects that embraced the diversity of variables that determine residential energy-use tendencies were ones that had the most influence on this investigation.

A problem that transcends most carbon accounting initiatives is the following: federal agencies are more concerned about generalizing national/state emissions rather than downscaling, making regional data sparse and unreliable in many cases, including Livermore, California. Generalized reports are the ones that states that the U.S. has reached an all-time low in carbon emissions, though most use overall energy demands—rather than energy consumption analyses—to describe the decline. It is only recently that county emissions have become available in a condensed temporal distribution; still, data is not specific enough to urban sectors of a metropolitan area. For this reason, it has been proven difficult for studies in rural as well as urban areas, which gets in the way of the ultimate goal of being able to apply bottom-up emissions analyses to multiple areas, as attempted by Chinese researchers at Nanjing University [Donglan et. al., 2010].

Essentially, there are many broad directions that may be taken to analyze carbon emissions within a sector of a primarily urban setting. A bottom-up emissions analysis for Livermore, California will serve as a preliminary step towards evaluating the carbon emissions directly being measured by the Sandia Tower, a 50 meter tower in Livermore, California from the Lawrence Livermore National Laboratory. Livermore, California is a prime example of the urban development set to occur within Northern and Central California over the next few decades. It is the geographic bridge between the Bay Area and the Central Valley and provides vital trends in how the region is expected to develop over the next several decades, as illustrated in the Livermore Climate Action Plan [ICF International, 2012].

Applying the Vulcan Project would have been possible for Livermore, California, for Livermore does have a total design basis of 65 square-kilometers, less than the 10 x 10 kilometer grid offered as a unit basis for the Vulcan project [Parshall et. al., 2010]. Moreover, the Hestia project, which provides city-specific approximations, has a detailed 0.1 X 0.1o grid scale, which translates to a 8.814 x 8.814 kilometer grid using the Haversine Formula [Gurney et. al., 2012]. Still, this project explores a new method that does not require the extensive efforts of either the Vulcan or the Hestia Project. The method implemented for Livermore, California promotes multidisciplinary engagement, using data from government resources, public real-estate records, as well as energy consumption from the United States Energy Information Administration.

By first examining the residential sector, there is hope in seeing this issue is resolved in verifying regional inventories, or in some way addressed. Incorporating real estate data is innovative because it utilizes information made publicly accessible via Google Maps by people who know the ups and downs of the residential market. It makes for an interesting twist on studying the residential sector; the combination of EIA housing unit energy consumption data

from 2011 and neighborhood housing developments open up the possibility for multiple uses of this research data, within the social and natural sciences. This project's ultimate goal is to be used as a stepping stone towards generalizing the procedure of analyzing carbon emissions for each urban city sector.

Methods

Primary Directions of Research Project

All the datasets used for this project were collected electronically, generated using ArcGIS, Python, and R, and analyzed using energy sustainability concepts. Through this study, it was found that the data originally set for this project, with a refined temporal and spatial distribution, was far too big to extract and manipulate without greater server access; at the same time, after finding the supplementary information for the project set to be emulated for Livermore, California, that the end result was only supposed to be a "comparative" value, it was decided against using this data set as a primary source. To implement the data into ArcGIS, the data went through a series of file transformations using Python and R. After finding and reading the supplementary information for the Hestia, it was discovered that it was only used as a comparative value.

Accommodating for Livermore's Unique Residential Structure

In order to successfully estimate the CO2 emissions for the Livermore urban area, however, a more up-to-date and refined estimate needed to be found and used. The residential sector was chosen as a starting point as netcdf and shape files provided by Alameda County, the city of Livermore, as well as the EIA.gov, showed that this sector contributed to most of the land use in Livermore, California.

Establishing Individual Neighborhoods

First, the residential area was found by looking at residential developments in Livermore, CA. A neighborhood map through the Alain Pinel Realtors Tri-Valley Home Search website helped to distinguish different residential neighborhoods. A KML file download of the neighborhood map was readily available for download through Google Maps. The KML file was converted into a shape (.shp) file to be manipulated in ArcGIS. The area of each neighborhood was calculated by first referencing the attribute table for the neighborhood shape file, and then creating a variable that would calculate and record the geometry of each neighborhood. The areas of the 79 neighborhoods of Livermore, CA were exported into an Excel file and then summed to find the total Residential Land Use Area.

Counting Houses

Houses needed to be counted by individual neighborhood because, by definition, a parcel of land does not necessarily mirror the total square footage of a house in a residential area. This needed to be done systematically because there was no distinct data on how many houses made up a single neighborhood in Livermore, California.

Since Alain Pinel Realtors provided information on the average house sizes and lot sizes per neighborhood, the total homes per neighborhood were calculated through a series of mathematical manipulations. OpenStreetMap terrestrial element files were utilized to better understand the aesthetics of Livermore's residential areas since Livermore has a made an effort to encourage recreational activities in all age groups through its parks

and recreation department. It was imperative to find out whether or not these parks are included in the Alain Pinel Realtor neighborhood shape file. Luckily, they are not; however, roads are. To be able to find the number of houses per neighborhood, total road area was subtracted from the neighborhood areas. Separate layers of OpenStreetMap were downloaded from Think_Geo, an open-source distributor of OpenStreetMap files made available in the public domain. Once the neighborhood shape file was projected into a more useful coordinate system, the shape file was split into 79 different shape files using Python, and the roads attributes were "clipped" to each neighborhood polygon by also using Python. The sum of the road lengths per neighborhood was calculated by first referencing the attribute table for the clipped road shape file, and then creating a variable that would calculate and record the sum of roads in each neighborhood (Figure 1).

Since the goal of this project is to make an individualized carbon emissions estimate for the city of Livermore, it is important to know the all there is about houses for the residential sector on-site emissions. To verify the Housing Variables that are suitable inputs of carbon emissions downscaling, pictures from Google Maps were consistently referenced to see whether or not residential areas are integrated with commercial businesses.

Knowing average plot size and assuming 1 house per plot, an approximate value of how many houses per neighborhood was found. Using a 2008 estimate for carbon emissions in Livermore due to residential energy, an estimate was made per neighborhood area, assuming emissions per neighborhood are equal (Figure 2). Information supported the idea that the majority of houses built in Livermore and are inhabited were constructed until the early 2000's, making the neighborhood map valid. Using a variety of mapping geospatial datasets, and referencing the EIA for compare and investigate potential tools that emulate the Hestia approach (Table 2). The accuracy of Livermore Inventory was verified through a trajectory of this year's population (Figure 3).

Results

Assuming that inhabitants of the city of Livermore, California live exclusively in its residential sector, the total Residential Land Use Area of Livermore, California is 29.9 square kilometers. Knowing that the spatial distribution of Livermore has been cited as 65.190 square kilometers by the United States Census Bureau, the residential sector makes up 0.458983867, or 45.9 of Livermore. Through this method, 74,913 houses were calculated, while the expected number of households in 2012 is approximately 73,234 based on city data3.

As shown in Figure 1, neighborhood roads pertaining to neighborhoods with duplicate or irregular names were summed manually using tools provided by ArcGIS. Total road lengths in Livermore were classified as residential, secondary, primary, and/or service roads and calculated to be 338 kilometers. These road types were included in the area analysis because they accounted for the roads used most often by inhabitants. Assuming that the roads in all of the neighborhoods of Livermore, California can fit 4 cars side by side (1 car lane in each direction, 1 car in front of houses), road lengths were multiplied by 6.096 meters (20 feet) to find road areas. Total road area for Livermore is 2.05 square kilometers, 2.05E6 square meters; residential roads, therefore, make up 6.88 of Livermore. Neighborhood areas were subtracted by neighborhood roads areas to obtain adjusted housing area for the residential sector, 27.9 square kilometers. Residential houses, therefore, make up 43.7 of Livermore, California.

Through this method, 74,913 houses were calculated, while the expected number of households in 2012 is approximately 73,234 based on city data [Advameg Inc., 2012]. Average carbon emissions using average on-site energy consumption due to natural gas were referenced from the 2009 Residential Energy Consumption Survey (RECS) released by the United StatesEnergy Information Association on January 11, 2013. The data sets that provided significant information were classified by age and by square footage (Table 1). Combining all the variables as attribute tables to the appropriate neighborhoods made it possible to a total residential carbon emissions 2008 estimate of 201,644 metric tonnes of CO2 per year.

Discussion

To understand the roundabout nature of this project, it must be noted that privacy issues come as a limitation to residential energy-use analyses. It is rare to be able to conduct such studies as in Japan for residential energy consumption, where researchers were able to follow the "living activities" of a family in Osaka City [Shimoda et. al., 2004]. Therefore, the three figures provided summarize each step in making an elaborate estimate of Livermore's residential carbon emissions without knowing the privacy infringing information such as the exact number of houses per neighborhood at the time.

As shown in Figure 1, it was found that the residential sector makes up most of Livermore, California, and with the structure of a predominantly residential area, high emissions should be expected from this sector. At the same time, Figure 1demonstrates that it is possible to estimate the number of houses for Livermore, without knowing the exact number of houses per neighborhood.

Figure 2 proves that it is possible to integrate two unlikely sources of data, the neighborhood ages of construction and average square footages made available on the Alan Pinel Realtors Tri-valley Home Search website and the end consumption values from the United States Energy Information Association. Since Livermore has 79 distinct neighborhoods, projecting the variables onto a map ended up being the best way to find the residential end consumption trends was by projecting the variables onto a map. Even though the totals are big in comparison to those listed in the Livermore Inventory, the trends are important to recognize; Figure 2 shows that the major areas of concern are the oldest neighborhoods that are closest to the freeway that runs through the middle of Livermore.

Figure 3 represents the Livermore Inventory base value when it is exuded evenly across all the neighborhood areas; this would be possible only if it is assumed that all the houses in Livermore emit the same amount of CO2. In actuality, this map serves as a comparative visual to Figure 2. As expected, the carbon emissions stacks are significantly smaller in Figure 3 than in Figure 2. Interestingly enough, however, similar trends remain of emissions per neighborhood, especially in neighborhoods that are of concern in central and northeastern parts of Livermore. In both maps, the most consumption was found in areas that have the oldest houses with smallest square footage (also known as Central Livermore), as well as in areas that have newest houses with largest square footage (Northeastern Livermore).

It is through the maps that the issue of urban sustainability is evident: Does it really sound reasonable that newer houses emit just as much as older, much smaller houses? Using such inferences and inquiries could help in future analyses; eventually, such visuals may be the key to creating more sustainable urban environments.

Conclusion

Due to the limited sources made readily available in the public domain, there are various knowledge gaps in this research method. Using averages for square footage to categorize average on-site energy consumption, as well as making an estimate using even distribution, is not ideal in this area of research. Although the numbers are outrageous in comparison, it is the trends of each neighborhood's on-site energy consumption that can be compared and are important to recognize. In effect, the incorporation of real estate data to regional carbon accounting is novel and innovative, serving as a bridge between the technical variables and the cultural implications on-site energy consumption has on residential communities.

Essentially, this type of research will be beneficial to projects that extend beyond the environmental science and engineering realm; rather, it can be used to enlighten the public on how much of an impact lifestyles have on an urban region's metabolism. In the case that Livermore becomes the residential hub uniting the Bay Area and the Central Valley, extensions of this research may keep residents well-informed and environmentally conscious of not only Livermore's urban sustainability, but also inspire communal proactivity in such concerning issues. Ultimately, projects such as this one will be important in analyzing expansion trends of Northern and Central California in the near future.

Figure 3: City map of Livermore, CA, including neighborhoods and roads of residential sectors

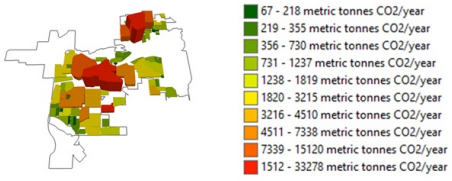

Figure 4: Figure 2: City map of Livermore, CA, including neCity map of Livermore, CA, including annual neighborhood CO2 emissions due to natural gas energy consumption in metric tonnes; statistical averages used to generate this map were originally reported by the Energy Information Administration

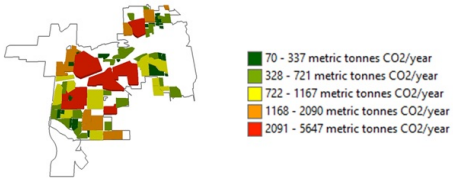

Figure 5: City map of Livermore, CA, including annual neighborhood CO2 emissions due to natural gas energy consumption in metric tonnes; values used to generate this map are a representation of CO2/km2, as approximated using a bulk value provided by Livermore's Climate Action Plan completed by ICF International

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Ana Živanović

Ana Živanović is a fourth-year undergraduate student studying environmental engineering and is exploring the Hestia approach, a method of spatial analysis used to analyze the carbon emissions on a building point basis. With the decision to take a fifth year and graduate in the spring of 2015, Ana plans to continue preserving a proficient academic standing by doing well in her classes and pursuing further research opportunities in the areas of energy and urban sustainability. At the same time, Ana hopes to maintain her campus leadership titles such as committee leader for the annual, student-run You See Leaders Conference. Instinctively shy, being able to gain the respect of her university peers has been life changing for Ana; spending most of her childhood summers in Serbia, making friends was easy, yet upholding friendships proved to be difficult. Using her diverse cultural experiences, linguistic skills and extensive background in the liberal arts, Ana desires not only to enter the work force as a well-rounded individual, but also serve as a mentor to other students emerging into the fascinating field of engineering.

Acknowledgements

The UC Merced Undergraduate Research Journal has been expanding and changing under the direction of Dr. Iris Ruiz. We have learned a great deal from this experience and we thank her for her dedication and time spent with the journal. With her guidance, we were able to host our first Undergraduate Research Journal Symposium. Sam Malaythong, owner of Sam's Café, was kind enough to work with our budget and provide us with the delicious food we had for the symposium.

Submissions have increased since the journal was first made by Anne Zanzucchi and Robert Ochsner. The journal's expansion into the online venue, Escholarship, reflects the hard work of the URJ staff throughout the years. We hope the success and submission to the journal keeps growing and exceeding expectations.

We would like to recognize the following individuals for all of their support: Tanya Golash-Boza, Anne Zanzucchi, Robert Ochsner, Cindy Roberts, Linda Hart-Tolley, Sam Malaythong, and Sandra Mora. Special thanks to the Merritt Writing Program and the Associated Students of UC Merced.

-UC Merced Undergraduate Research Journal Editors

Editorial Staff

Tina Gutierrez : Web Designer

Tina is a fourth year international relations student at the University of California, Merced. In 2013, Tina ventured out to live and study in Italy for a semester, though visits to Paris, Barcelona, the Nederlands, and Ireland were inevitable. She returned that summer picking up two internships–one in marketing and social media and the other in public relations. With her ambition, she found herself in Washington, DC the fall semester of 2013 taking classes and interning through the UCDC program. While in Washington, DC Tina interned for the Bipartisan Policy Center's Communications department. In helping plan events inside the Capitol and several hotels and private venues around the District, it is no surprise Tina hopes to return to the heart of our country to continue her career in international communications this upcoming fall.

Natalie Felix : Treasurer

First generation student, Natalie Felix, is a fourth year at the University of California, Merced. She came from Bakersfield, CA and has fallen in love with small rural town, Merced. Natalie wants to finish her bachelor's degree in Management with minors in wiring and art. She found inspiration in all types of writing that will be submitted to the Undergraduate Research Journal. She also wants to polish her critiques of fellow peers writing. In her spare time she loves to listen to music, read fiction books, and play games.

Joshua Espano : Classroom Presentation Director

Josh Espano decided to study at UC Merced after graduating from Northview High School in Southern California with the goal of becoming a history teacher. His goal changed after hearing a Cognitive Science lecture, prompting him to pursue a career in researching the mind. After working as a research assistant for two years in several psychology labs, he now wants to pursue social work to apply all of his research knowledge and skills in changing the lives of children at-risk of maltreatment and their families. When he is not busy thinking about goals, papers, and philosophy, he likes to work out, play video games, watch movies, and teach children.

Ignacia Chu-Jacoby : Senior Editor

Ignacia Chu-Jacoby is a fourth year student at UC Merced pursuing a Bachelor's degree in Literature and Cultures with a minor in Psychology. Her interest includes; film, dance, music and classic literary works. Originally from Fresno California, Ignacia is a recent transfer student who has learned a lot about the ins and outs of the college system.

As a recent transfer student from Willow International college, Ignacia has gained the passion for education and mentoring future UC and CSU students with the transitional process for transferring. She hopes one day to make a difference and further advocate for further change in the system.

She hopes one day to work in publishing as an editor and or journalist. Her main focus is social media, editorial work and mentoring transfer students. In her free time, she likes to spend it with friends, family and creating films and choreography pieces. She hopes one day to combine all of her knowledge in the performing arts and the University system in her career.

Haruka Motomatsu : Student Editor

Haruka Motomatsu is a senior year undergraduate student at the University of California, Merced pursuing a Bachelor degree in Cognitive Science. Haruka have taken interest in this field of study since she wanted to gain more knowledge about the human brain and how it could be applied to society and technology. Originally from the city of Tokyo, Japan, Haruka have finally gotten used to the rural areas of Merced. After Haruka graduates in 2014, She would like to continue her interest in cognitive science and proceed to graduate school.

Neibi Villa: Photographer

Neibi Villa is a psychology major and cognitive and information sciences minor. More specifically, she is interested in bio-psychology, a branch of psychology that is focused on analyzing how the brain and neurotransmitters influence someone's behavior, thoughts, and feelings. She joined the undergraduate research journal because she hopes to develop her writing abilities in general, all while gaining a greater understanding of how the publishing process works. Most importantly, she hopes that the skills that she will obtain while being part of the journal will prove useful in other disciplines.

Thalinna Fuentes : Student Editor

Thalinna Fuentes is a fourth year and a Literature and Cultures major with a minor in Writing at the University of California, Merced. She has been working for food services at the Yablakoff Dining Center on campus and is going on her second year as a worker. She has also had personal interest in being a part of an on campus Christian ministry called Chi Alpha since she was a freshman and has found joy in being a more active member as a worship leader for year. She enjoys volunteering and traveling for purposes that include, but are not limited to, involving children. She is a flexible and well rounded social individual who enjoys communicating and meeting new people. In her leisure time she finds between being an undergraduate student and working part time, she reads, writes, bikes and sings for fun.

Jared Aguirre: Graphic Designer

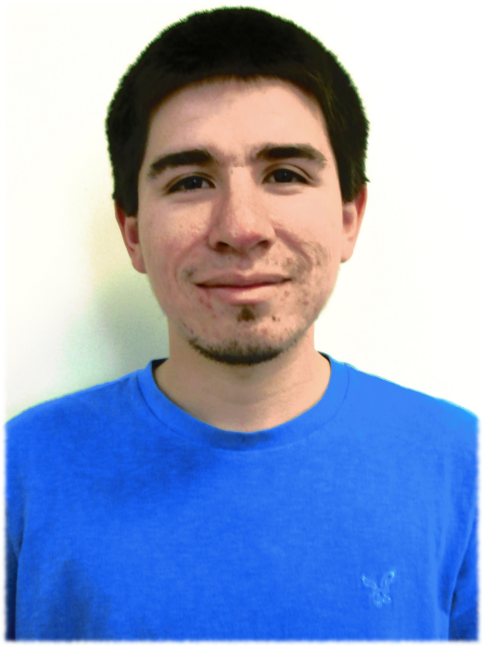
Jared Matthew Aguirre is a writer; that's all you need to know. There isn't much to tell about his, to which is why he writes. Stories of the uncanny; poetry of the dark; artwork of the grim. He has self-published two poetry collection, and another for short stories. An eye for minute detail and design, Jared made sure to bring his best work forward. In confession, you may have seen him around, but never bothered to talk to him. With Merced being incredibly unknown, why house a UC? Well, for that reason alone, it's why Jared chose it: demure isolation.

Luis Fernando Gonzalez Haro: Public Relations Manager

Luis was born on January 2nd, 1994. He has humble roots from Mexico and believes in hard work and dedication.He is a second year student and hopes to earn his bachelors of science in Business Economics.He is a proud member of Alpha Kappa Psi, and sees himself using his social skills to move up in the corporate world. He believes in the interdisciplinary approach of the Undergraduate Research Journal. As an editor he has been able to test his skills, and has gained experience on what it means to collaborate and manage people.

Vanessa Rafanan: Tabling Director

As a third year undergraduate, Vanessa has a wide range of both academic and extracurricular interests, reflecting her interdisciplinary degrees in Cognitive Science and Writing in progress. On campus, Vanessa is involved in a number of organizations including, but not limited to, UCM's Pilipino American Alliance, Pilipino Americans in Science and Engineering, Dance Coalition, and Alpha Phi Omega. She currently works as a student assistant for SSHA Advising and as a research assistant with hopes to publish her own work one day. After graduating from UC Merced, she plans to attend medical school for psychiatry and aims to eventually work with the U.S. Department of Veterans Affairs as a psychiatrist to cater to those who have served our country, thereby, and as the saying goes, "paying it forward." Vanessa doesn't enjoy doing anything in particular during her free time because, well, she doesn't have any.



Agustin Roldan: Layout/E-scholorship Director

Agustin Roldan lives for the pursuit of knowledge. Currently studying Mechanical Engineering and minoring in writing, he invests his time in understanding the inner workings of creative thought and expression through knowledge acquisition. Before serving as Layout Editor for the Undergraduate Research Journal, Agustin has served as President for the Society of Automotive Engineers, the Society of Hispanic Professional Engineers and The Entrepreneurial Society at UC Merced. Having held leadership positions in the fields of grant writing,engineering and logistics; Agustin hopes to further contribute to the journal. Roldan is described by others as a terribly enthusiastic individual without the decency to give up on even his most absurd dreams.

Cristina Gomez: Student Editor

Hailing from Avenal, California, Cristina Gomez is a senior at UC Merced. As a young Literature major, writing and reading has become a lifestyle. Being academic, both in and out of the classroom, she has done research for a professor and her senior thesis. She has contributed in research for UC Merced professor Jan Goggans. Outside of school, she has worked at the Kings Country Library and the Merced Art Hop. One of the first signs of her taste for writing, Cristina won a Halloween short story contest. From there, she has continued to have a skillful ability to write.

”If I have seen further, it is by standing on the shoulders of giants”- Newton