The Certified Environmental Professional
The Newsletter of the
Academy of Board Certified Environmental Professionals

http://www.abcep.org June-July 2016

President's Message

As I unloaded boxes in my new office this month I couldn't help but notice how many reference documents I had in my possession that were obsolete, out of date, or had been superseded by newer more relevant documents. Some were 15 years old! In this industry, with regulations changing all the time, and constant technological advances happening all around us, a 15 year-old document is likely of little value. I felt like a hoarder… don't judge me.

Every day as we work in this industry we encounter those who change with the times, who modify old science with new science, old knowledge with new knowledge and old ideas with new ideas that expand how we deal with an ever-increasingly complex political, social, and environmental climate. I always appreciate it when someone emails me a new regulation, a change to existing regulations, or a novel way of approaching a problem. This tells me two things: I am associating with people who are always on the lookout for evolution in the profession, and they think I'm the same kind of person.

As CEP's we ought to strive not to be **ON** the cutting edge of novel thinking but we should **BE** the cutting edge. For example, I received an interesting email this week from a colleague. This email contained a very well-thought-out solution to a complex problem that many minds associated with this particular project had not considered. One of my first responses was to check and see if this colleague was a CEP. He should be.

Let us be among the standard bearers. Let us, as CEPs be the vanguard of environmental progress in our particular areas of expertise. ABCEP is striving to do just this. In the past several years we've made great strides and progress due to the diligent efforts of the volunteers in the group. Our web site and CEP Express are valuable tools that I hope you will use frequently. I also hope that you will volunteer with the organization. Join the ranks of the Certification Review Board (CRB). It will provide to you, wonderful exposure to many of our number who do things differently from you. I suspect you will learn a tremendous amount.

In six months' time, we will begin our election process for expiring board positions. Over the winter months, please consider running for an open position. Don't wait for the announcement to come out regarding elections. Come to the board and get involved early so you'll have great momentum.

I am encouraged by the number of CEPs and CEP-ITs who have stepped up and assisted the Board in the many activities we have going on with the various committees. As always my door is open for discussion.

Best to you,

Mark Gerber
ABCEP President

Mark F. Gerber
ABCEP President

This Issue - Climate Change

Articles:

Get Connected:

LETTER FROM THE EDITOR

Dear CEPs:

Climate change affects us all in many ways; some of you deal with the effects and work to develop strategies to address it on a daily basis. For others, it is only brought to our attention by television programs or bickering politicians. As fellow environmental professionals, I ask each of you to explore the facts presented by many sources and form your own opinions about the subject. I hope the information presented in this newsletter sparks your journey.

I want to thank those authors that submitted articles on our first focus topic - CLIMATE CHANGE. I hope you will also take notice that most of the authors are not CEPs - as Mark stated in his message, maybe they should be. I hope as CEPs you'll take notice and not want to be out shone in future newsletter additions.

The August newsletter will focus on **TRANSPORTATION** - a key area of CEP practice. This is a topic near and dear to my heart and I know there are many of you in the audience that share that same passion. I look forward to seeing what you share with our community.

The deadline for submittal of your articles is **August 15, 2016**. If that doesn't get your juices flowing, then sharpen your pencils for REGULATORY UPDATES in September.

I'll continue to beat that same old drum - we can't have a newsletter without your participation.

Your support is needed and will be appreciated!

Shari Cannon-Mackey, CEP, ENV SP
Newsletter Editor

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.

Source: USEPA; www3.epa.gov/climatechange

Global warming refers to the recent and ongoing rise in global average temperature near Earth's surface. It is caused mostly by increasing concentrations of greenhouse gases in the atmosphere. Global warming is causing climate patterns to change. However, global warming itself represents only one aspect of climate change.

Source: USEPA; www3.epa.gov/climatechange

January-June 2016

the warmest respective months globally in the modern temperature record (which dates to 1880)

Source: NASA's Goddard Institute for Space Studies

97%

of climate scientists agree that climate warming trends over the last 100 years are due to human activities

Source: NASA

8 out of 10

of the top one-day precipitation events have occurred since 1990, nationwide.

Source: USEPA

'Scientific evidence for warming of the climate system is unequivocal.'

Intergovernmental Panel on Climate Change

23%

the reduction in the thickness of the snowpack that has occurred in the Western US from 1955-2015

Source: USEPA

81%

of greenhouse gas emissions are in the form of carbon dioxide; of which the primary sources are:

37% | 31% | 15% | 10% | Misc. 7%

Source: USEPA

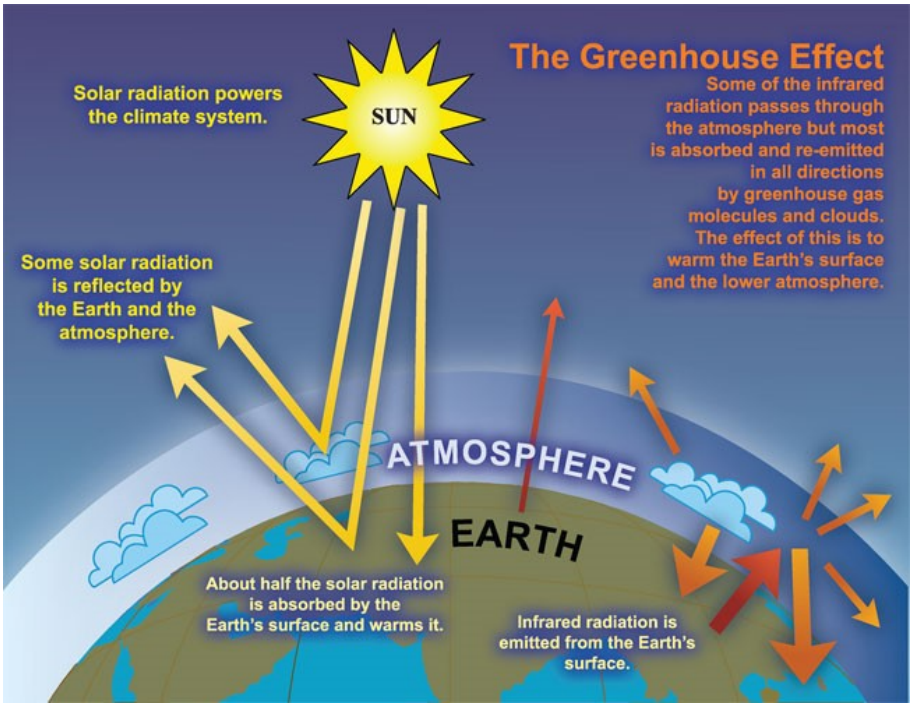
The evolution of regulating greenhouse gas emissions

Mary Hauner-Davis, Burns & McDonnell

The regulation of greenhouse gas (GHG) emissions has been on the horizon for many years, throughout the world. However, it took several additional years until the United States determined that it was time to regulate these emissions. In 1970, Congress created the Environmental Protection Agency (EPA) and passed the Clean Air Act (CAA), giving the Federal government authority to clean up and reduce air pollution in the United States. The CAA, a comprehensive Federal law, regulates air emissions from stationary and mobile sources. Among other things, this law authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants.

The CAA originally regulated six criteria pollutants: particulate matter, ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. These pollutants were shown to be capable of harming health and the environment. The CAA allowed the EPA to set and achieve NAAQS in every state by directing states to develop state implementation plans (SIPs), applicable to appropriate industrial sources in the state. The Act was amended in 1977 and 1990 primarily to set new goals (dates) for achieving attainment of NAAQS since many areas of the country had failed to meet the initial deadlines.

Since the CAA has been promulgated, the EPA has developed and implemented many different air pollution regulations such as the New Source Performance Standards, Prevention of Significant Deterioration, Acid Rain, and



Gases that trap heat in the atmosphere are called greenhouse gases. Each of these gases can remain in the atmosphere for different amounts of time, ranging from a few years to thousands of years.

Sources: Intergovernmental Panel on Climate Change, 2007; USEPA Overview of Greenhouse Gases.

For more information visit: www3.epa.gov/climatechange/ghgemissions/gases

Gas	Sources	% of emissions (2014)
Carbon dioxide (CO_2)	Burning of fossil fuels, solid wastes, trees and wood products; and certain chemical reactions	81%
Methane (CH_4)	Production /transport of coal, natural gas, and oil; decay of organic waste, and livestock	11%
Nitrous oxide (N_2O)	Agricultural/industrial processes; combustion of fossil fuels and solid waste	6%
Fluorinated gases	Industrial processes	3%

Continued from page 4

many others. These regulations were set to reduce the amount of pollution in the air with respect to the criteria pollutants and hazardous air pollutants. While greenhouse gas discussions had been occurring internationally, the EPA had not yet decided to regulate GHG emissions until the 2000s.

Starting with the Supreme Court's 2007decision in Massachusetts vs. EPA, GHGs became an "air pollutant" subject to regulation under the Clean Air Act. Next, EPA's Endangerment Finding determined that greenhouse gases may "reasonably be anticipated to endanger public health and welfare." EPA found that GHG emissions from new motor vehicles contribute to elevated atmospheric concentrations of greenhouse gases, which endanger public health and welfare by fostering global "climate change." This ruling denominated a "single air pollutant" the "combined mix" of six greenhouse gases that it identified as the main cause of human-induced climate change: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Further, this finding identified that a source's GHG emissions would be measured in "carbon dioxide equivalent units" (CO_2e), which would be calculated based on each gas's "global warming potential."

Next, EPA issued its final decision regarding the prospect that motor-vehicle greenhouse-gas standards would trigger stationary-source permitting requirements (the Triggering Rule.) EPA announced that beginning on the effective date of its GHG standards for motor vehicles, stationary sources would be subject to the Prevention of Significant Deterioration (PSD) program and Title V on the basis of their potential to emit GHG. As expected, EPA then promulgated GHG emission standards for passenger cars, light-duty trucks, and medium-duty passenger vehicles to take effect on January 2, 2011.

EPA next announced steps it was taking to "tailor" the PSD program and Title V for air emissions permitting to GHG emissions. This would come to be known as the "Tailoring Rule." Tailoring the PSD program was necessary because the PSD program and Title V programs were designed to regulate a relatively small number of large industrial sources, and requiring permits for sources with GHG emissions above the statutory thresholds would expand those programs by an immense degree, making them unmanageable. EPA then stated that there would be a phased-in approach to the Tailoring Rule over 18 months.

The Tailoring Rule has not gone without opposition and challenges. In Utility Air Regulatory Group vs. EPA, the Supreme Court decided that the EPA did not have the authority to regulate GHG under the PSD program unless another pollutant was already subject to PSD. Therefore, today, the regulations stand that unless another criteria pollutant is subject to PSD, GHG cannot be regulated under the PSD regulations by itself. If another pollutant is subject to PSD and if GHG exceeds the 75,000 tons per year "tailored" threshold, only then GHG is also subject to PSD.

In 2015, the much anticipated Clean Power Plan and the New Source Performance Standards for GHG emissions from electrical utilities units were finalized. The New Source Performance Standard for GHG emissions basically sets a combined-cycle GHG limit for all fossil-fuel fired electrical generating units above a certain threshold. No coal unit exists that can meet this limit without employing a carbon capture and sequestration type control, which has not yet been shown to operate on large, utility -scale coal boilers.

The Clean Power Plan allows each state to choose between a rate-based state goal measured in pounds per megawatt hour (lb/MWh), a mass-based state goal measured in total short tons of CO_2, or a mass-based state goal with a new source complement measured in total short tons of CO_2. Each state will need to achieve the interim CO_2 emissions performance rates over the period of 2022 to 2029 and the final CO_2 emission performance rates, rate-based goals or mass-based goals by 2030. In February 2016, the Supreme Court stayed the Clean Power Plan pending judicial review. Most states have halted work on their state plan until the Clean Power Plan is reinstated; however, the EPA is encouraging states to continuing working on their plans.

Future GHG regulations and the status of current GHG regulations are unknown. The DC Circuit Court will hear arguments in September on the Clean Power Plan. The losing side will most likely appeal it to the Supreme Court and a final decision will be made late 2016 or early 2017 on the fate of the Clean Power Plan.

Author

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Analyzing the dynamic effects of climate change on wildfire regimes, risks, and projections within the United States

Richard Olawoyin, Oakland University

Abstract

This study explores trends and effects of wildfire potentials under a changing climate in the United States (US) and associated increased; wildfire regimes, fire risks, and major wildfire projections. Temperature changes over the past 50 years including the levels of; rainfall, drought, and wildfires within the US were analyzed. To better comprehend the effects of wildfires on populated areas, these effects were compared to costs associated with; fatalities, property destruction, and environmental damages. Benefits of wildfires were also explored to identify the feasibility harnessing the economic importance of the wildfire events. The fire warming trend shows a 4.4˚F increase in 50 years, which is projected to increase fire potentials (especially in the summers and falls) in the Pacific coast, Southwest and Southeast, and the northern Great Plains. This trend with increased fire potentials is found to be increasing across the continental U.S. in recent five decades, which also indicates the increased need for resources, development and management efforts for wildfire disaster prevention and recovery.

Key words: Climate Change, Wildfires, Wildland, Temperature, Wildland-Urban Interface (WUI), Suppression, Safety, Fire Adaptation

Introduction

Climate change is projected to increase in intensity of extreme weather conditions, the frequency, duration, and associated droughts (Karl et al., 2008), with potentials to drastically increase wildfire regimes in the United States (US). Over the past decades, the climate has continued to change and has affected many different areas within the US and around the world. Climate change is caused by the rising levels of carbon dioxide and other heat trapping vapors in the atmospheric environment, this leads to warmer temperatures, changes in rainfall patterns, and even the melting of snow (Ekrem and Adelsman, 2012). Climate change entails the combination of different seasons and their contributions towards different levels of precipitation, humidity, temperature, and even wind. Over that past 50 years, the temperatures within the US have continued to rise. From 1965 to 2015, the average annual temperature within the US has increased a total of 4.4˚F – when focusing on comparing the highest temperature to lowest temperatures. Increases in temperature are one of the effects of climate change; it also contributes to natural disasters – such as wildfires. These warmer temperatures have the ability to increase the amount of wildfires within the US. This is damaging to the environment because it causes an increase in the number of fire days that lead to more hazardous and threatening wildfires.

Studies have shown that temperature rise can be attributed to increased global aridity, due to the higher atmospheric demand for moisture and fluctuating atmospheric exchange of moisture, resulting to extreme conditions of quicker snowmelt in the spring and decreasing snowpack in the western US (Dai, 2011; Goode et al., 2012; Hamlet et al., 2013). The impact of decreasing snowpack in the interchange between wildfire and climate change is important, since the resultant effect of wildfires is often decreased canopy cover and decreased snow albedo based on the action of black carbon (Mahat et al., 2015). Consequently exposing the snowpack to intense sunlight and accelerated snowmelt, which increases the potential for larger areas to be susceptible to fire and be burnt. Additional consequences of the phenomenon may lead to; the deterioration of forest ecosystem (Rocca et al., 2014), erosive effects over mountain watershed (Gould et al., 2016), extended periods of wildfire seasons and more susceptible areas to burn (Jolly et al., 2015). Wildfires have also been attributed to adverse environmental degradation, emitting approximately 2.0 Pg C annually, between 1997 and 2009, this amounts to a third of the total carbon emissions (van der Werf et al., 2010). The US forest Service manages 193 million acre of national forests and grasslands in the US and the cost of suppressing fire from destroying this forest is projected to increase to approximately $1.8 billion by 2025 (USFS 2015).

The interplay between wildfire and the changing climate has been the focus of many studies and the government due to the incidence of cataclysmic big-fires and resultant potential effects (Wotton et al., 2010; Liu et al., 2013). These increasing fire activities trends have been empirically attributed to extreme weather anomalies, such as drought and intense heat in many areas across the country (Stocks et al., 2003, Heilman et al., 2015)), with direct impact on fire regimes during the seasons. Knowledge on the future projections of wildfire trends is crucial to evaluating wildfire's potential impacts and damages to; people, ecosystems, property and the environment in the future,

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and to effectively design and implement essential measures and interventions to mitigate these effects.

It has been noted that the total number of U.S. wildfires have decreased, the number of acres burned each year however has increased. For example, The National Interagency Fire Center noted that as of October 30th, an estimated 9,407,571 acres have burned down in the US, (Roman, 2015). Whereas for the same year, through October 8th, there had been a little over 51,000 wildfires in the US; this was lower than the 10-year average of about 60,500 wildfires, (Roman, 2015). One of the reasons behind these larger fires is due to population growth within the US; specifically, the growth in the Wildland-Urban Interface (WUI). The WUI is where unoccupied land and human development reach, these areas are at a great risk for wildfires (Stein et al, 2013). As more people live around forests, grasslands, shrub lands, and other areas in which wildfires are most likely to occur, the challenges of mitigating and managing wildfires increase. The continued population growth makes it harder for forest service managers, fire departments, National, State, and local governments to prepare for and help reduce the devastating effects of wildfires.

In order to decrease not only the number of wildfires, but the intensity and effect they have on the number of acres burned, communities must become more fire adaptable. The creation of a fire-adapted community is a proactive process that creates a community wide commitment to creating pre-fire strategies, taking actions to reducing risks, and also finding ways to reduce the costs (i.e. damage, suppression, and loss of life). These communities that are fire-adapted do not have to rely on suppression activities to protect themselves after the wildfire starts, but would be better prepared to; remove fuel sources, reduce ignition sources, and modify structures to make them fire-proof. Participation is a key aspect of a fire-adapted community. Residents, businesses, government agencies, emergency responders, etc., must all be involved in the collective effort of dealing with the menace of fire disasters. The communication between these groups of people is also important, it strengthens the mindset and idea that everyone is on the same page – working towards the end goal of reducing wildfires.

This report assesses the variety of effects that climate change has on; fire regimes, fire risks, and major fire projections – with a special focus on its effects on wildfires in the US.

Recognizing the effects of climate change on wildfires and realizing the different strategies in which communities can take to reduce the damages from those wildfires are quintessential.

Description of Affected Population

The entire US is increasingly at risk of wild fires, with higher risks to civilians and firefighters. In 2014, the US population was 318.7 million (Colby and Ortman, 2015), of which 42.3 million have citizenship in foreign countries, while 13.3% of the total population are foreign born. Figure 1 illustrates the demographic breakdown of different races, ethnicity, age and gender in the US.

This data is important relative to understanding the best possible method for public safety and protection. The

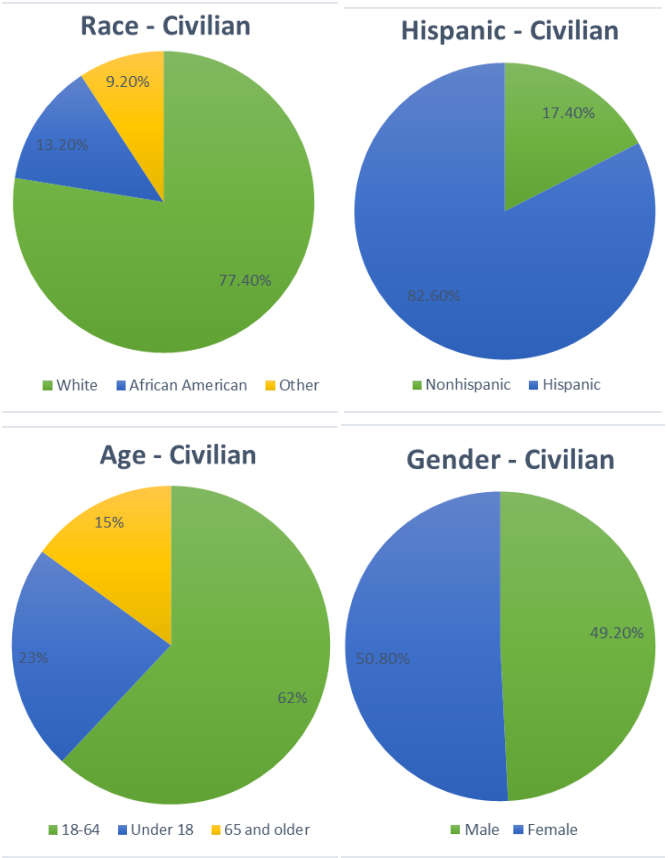

Figure 1: Demographic distribution in the United States (Courtesy, United States Census Bureau, 2014)

language and cultural diversity in the American society needs to be taken into account for emergency response and preparedness. These steps are quintessential in making sure that the consequences of climate change triggering posing enormous threat and risk to people, property and the environment can be mitigated. As presented in Figure 1, approximately 23% of the US population is

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under 18 years of age (Fig. 1), having a program that involves children and teenagers is also another example of a proactive way to avert the consequences of these uncontrollable wildfires.

An effective method to engage children and teenagers is to educate them through computer interactive programs. This will have a higher chance of being effective among this age group, and it is a proven method for training children on complex topics and behavior adaptive issues in the 21st century. While this method may be more successful among younger Americans, older Americans may prefer human interactive learning.

Economic status is essential to this conversation. It is estimated that about 14.8% of the population is living in poverty (US Census Bureau, 2014). These individuals, as well as the elderly (Fig. 1 – 15% of the population), may not be able to safely evacuate, stop incipient fires or clean their yards of extra debris (i.e. tress, clutter, combustible materials) either financially or physically. It would be beneficial to include all of these in the preparedness plan for the most susceptible communities in the nation and create volunteer groups (in addition to fire firefighters) that would assist with ensuring that residents are adequately catered for in the event of a wildfire. As reported, in 2014, there were 1,134,000 firefighters in the US. Only 31% are career while 69% are volunteer (Haynes and Stein, 2016).

Methods of Study

This study investigated the temperature changes from 1965-2015; comparing the effects of climate changes to fire incidents (wildfires) and associated effects such as; costs, fatalities, destruction, and benefits. This data was compared to other socio-economic variables such as: wealth creation, employment rate, and public safety; providing innovative solutions to address the identified problems; and lastly recommending possible solutions to mitigate the devastating effects of wildfires as a consequence of climate change.

Research Strategy/Significance

The study focused on wildland fires in the US and data was gathered to assess the long term effect of climate change on wildland fire regimes. The study shows that since the 1960's, the shift in climate and precipitation has changed the wildfire season, severity, and intensity for the worse. The study also showed that as the destruction increases from wildfires, population expands further into rural areas with even more imminent threats to human lives. With the wildland urban interface being encroached upon more regularly, new training and awareness programs for residence in these areas are quintessential. Firefighters and civilians are at risk for property destruction, injury, and death. The goal of this study is to assess the risk and provide recommendation for mitigation. This can be achieved through; civilian involvement, firefighter communication, and the use of fireproofing materials.

Approach

New methods of communicating with residents are constantly introduced and made even more efficient due to digitalization. Using the internet to provide information to the population of the wildfire urban interface helps with intervention activation and emergency preparedness. Taking the technology a step further by sending automatic emails, text messages, and pamphlets to the residence of these vulnerable areas have been helpful. These notifications will help inform people of the risks of wildfires as well as new fire safety advisories in each notification. It would also provide individuals the capabilities to send pictures of their property for experts to review, who would then give suggestions on how to protect their homes against wildfires. Opening up communication line between wildland and local firefighters should be done through radio communication, which would not be expensive. The government could provide tax breaks for using fire proof building material. It should be enough to get individuals to seriously consider using this material on their own property. A tax break that does not provide enough incentive to buy the fire proof building material may be ineffective to achieving this aim.

Economic Importance of Climate Change

Temperature Changes and Consequences on Wildfires

The National Oceanic and Atmospheric Administration's (NOAA) Centers for Environmental Information is responsible for preserving, monitoring, assessing, and providing public access to the US climate and historical data and information, they provide information, presented as "Climate at a Glance", which allows the public to research temperature changes, annually over a specific time span. Figure 2 illustrates information obtained from the Climate at a Glance. The time span assessed was 50 years from 1965-2015, and the figure presented the temperature differences in degrees Fahrenheit. The results showed that over the past 50 years, the temperature has risen a total of 4.4°F. This shows that over time, climate has continued to change in the US and has created a warmer climate over a 50-year span. From the figure, it can be

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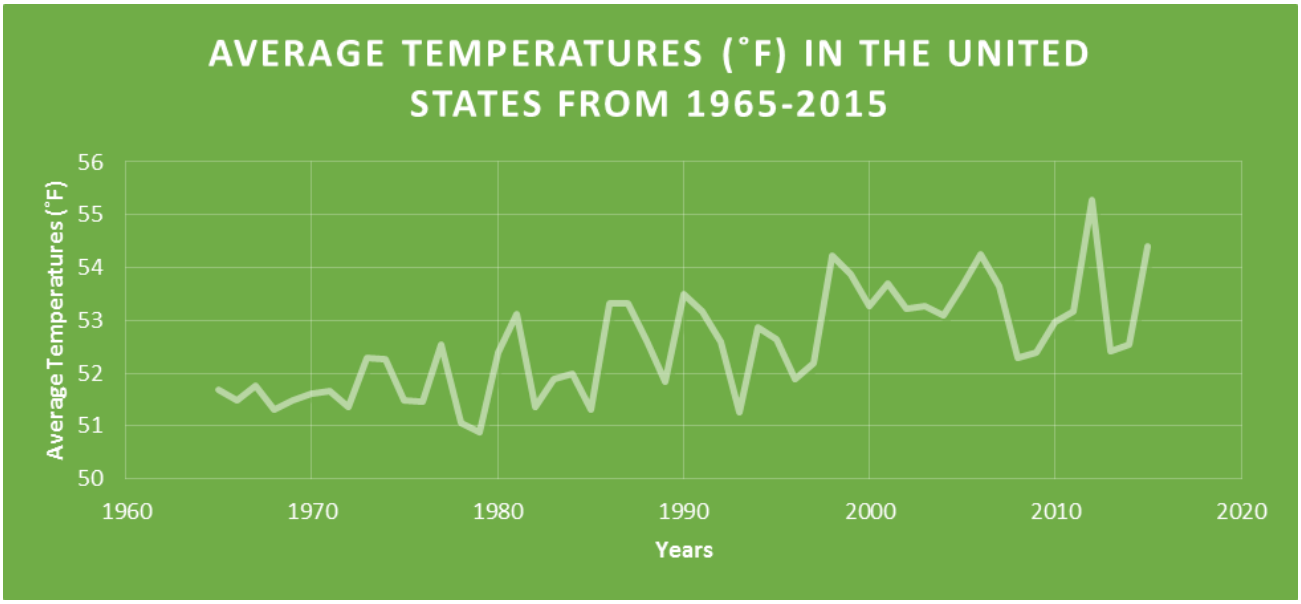

Figure 2: The average annual temperatures ˚F from 1965-2015 in the United States.

SOURCE: NOAA's "Climate at a Glance"

projected that temperatures will continue to fluctuate (and or increase) over time.

Effects of Wildfires

The effects of climate change may not fully understood yet, however, there is increasing evidence that the warming climate has steadily increased the severity of wildfires. This means that on average, the amount of acreage that is being burned is increasing (Liu & Wimberly, 2016). There are more extreme weather events happening which have resulted to major shifts in the amount of precipitation around the country. If there is an extended wet period in certain areas, the vegetation will grow accordingly at a faster pace than drier periods. When a dry period follows the wet period, the risk of a significant fire increases. This is because there would be a higher fuel load for fire to burn through the wild. Another reason why the amount of acreage burned is increasing is because the vegetation is changing in the areas that are warming. There are plants that are in areas that have never been present in those areas previously. This vegetation tend to migrate more pole-ward which creates quite a bit of uncertainty on how the fires are going to behave when they do start up. It is believed that this change in vegetation will have significant impacts on the severity of wildfires in the future.

The most common cause of wildfire is by lightning strikes. Dry thunderstorms with associated lightning increase the risk of fires events. These thunderstorms are most prevalent in the western parts of the US and the fire types that result from these events, are the most dangerous because they have the slowest reaction time for controlling the fires (Flannigan, et. al., 2000). Due to these slow reaction times, the potential for these fires to grow out of control is higher. Another important hazardous factor is that, they are difficult to detect at the incipient stages, since a lightning strike that occurs over an unpopulated area or in the middle of a forest is not easily detectable. Hence, the damage of this lightning strike is hard to determine because of the vegetation that is in the way and lack of people in the area.

Secondary cause of wildfires is by humans. This is the most common way that fires start, but they are usually the least likely to spread and grow out of control, especially if the fire is set by accident. There is a quicker reaction time to be able to control and potentially put out the fire, meaning that the success rate is higher than a lightning strike fire.

The costs, fatalities, damage, and even benefits due to the wildfires within the US were examined in this study. It was important to research these items in order to quantify the effects of the wildfires relative to the constantly changing climate. The costs and damages included the suppression systems, loss of vegetation, property loss, recreational activities, timber resources, utilities, and even prevention strategies put in place to prevent wildfires from starting. Fatalities can include the loss of

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life by firefighters, residents, and even animals.

Socio-Economic Effects

In order to limit the effects wildfire on the economy and wealth creation, this study found that limiting the expenses on suppressions and put that spending to better use could create an improvement in wealth among communities in the US. Providing education to the local residents by making fire-adapted communities that provide proactive strategies to mitigate wildfires before they begin. This would then limit the costs of suppression and damage replacement. Reducing the risks, reduces the money being spent, which then increases the opportunity to create wealth throughout the different communities in the US. These adapted communities also then improve life safety and reduce the losses of life.

Wildfires cause a lot of destruction; certain areas are more affected than others due to their placement within wildlife. The jobs within these certain areas can be destroyed by natural disasters, such as these wildfires. Climate change that is increasing longer summers are also increasing the amount of fire days within a given year. This can destroy certain activities such as hiking, skiing/snowboarding, recreational parks, etc., (Stein et al, 2013). Agricultural businesses that rely on vegetation to provide communities with food and other resources will also be affected by these damages, (Nielson-Pincus et al, 2012). Several jobs and potentials for business growth are lost as a consequence of the changing climate, which in turn, increases the intensity of the wildfires in different communities, especially those that are more prone to this hazard.

Cost of Wildfires

The cost of fires has been increasing steadily over the past decade. The most significant increase has been for the suppression of wildfires. From 2000 to 2008, the funding for fire suppression had increased from 25 % to 44% (Bureau of Land Management, 2010). This means that there has been a more proactive approach in preventing wildfires from growing out of control. There are several costs that are taken into account for the calculation of the total amount spent on wildfires. These costs are direct cost, indirect cost, and rehabilitation cost.

- The direct cost is the most easily calculated cost as it takes into account the expenditures on; aviation, engines, firefighting crews, and agency personnel. These costs also can include; private property losses, damage to recreation facilities, loss of timber resources, and aid to evacuate residents. These costs have been rising steadily over the past few decades due to the intensity of the fire combated.
- The indirect cost is much more difficult to calculate. The indirect cost and the rehabilitation costs are interrelated. Some of the factors that are included in the indirect costs is the loss of tax revenues and the amount that property values fall after a wildfire. These costs can be much more than the direct cost.
- The rehabilitation costs deal with the longer term effects of the wildfire. They tend to occur days to months after the wildfire is put out. There are different agencies that handle this type of cost. The agencies that tend to be involved is the federal, state and local agencies (Bureau of Lang Management, 2010). It is difficult to calculate the exact amount of rehabilitation costs because of the long term effects of the devastation associated with this cost.

Benefits of Wildfires

There are many benefits of wildfires to the environment and to humans. Some of these benefits are now being realized, and these benefits are taking into consideration when wildfires are tackled by the fire department. New vegetation flourishes right after a wildfire burns through an area. Wildfires get rid of dead vegetation that is non-productive, clean the forest floor and help reshape the landscape to create a friendly environment to the animals that live in the area (Flannigan, et. al., 2000). This can be beneficial to humans because new species will grow in the area and this new species could be beneficial to the health of humans. It helps create diversity in the area and helps get rid of invasive species that could potentially be foreign to the area. Other benefits include, eradicating diseases that could be potentially harming trees or present in small pockets of stagnant water. It is estimated that "more trees die each year from insect infestation and disease than from fire". This helps the environment keep the trees healthy and able to defend themselves from these issues. Also, this will in turn benefit humans through the food web system, since the trees will help absorb moisture when it rains. This could also prevent flooding in these areas and create a much sustainable environment. These benefits however are only available if the wildfire is controllable, otherwise, the devastation that the wildfire brings would be unfavorable.

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Potential Solutions

Effective surveillance through technological observatories for public safety and the creation of fire-adapted communities are some of the potential solutions recommended from the findings in this study. These are proactive steps to help people make better decisions and become more knowledgeable about preventing wildfires from starting, or spreading. Other short term solutions may include; treating dry forests, and reducing the amount of fire load available on the forest floors. These specific ideas will be beneficial in preventing incipient fires, protecting against developing fires and providing extended time for residents' evacuation in the case of emergency situations.

By communicating to the public, opening up firefighter communications, and by incorporating fire proof building materials, loss of life and property damage can be reduced. Creating "fire adapted" communities is not only beneficial to civilians but firefighters as well, both wildland and local. These communities will have introduced ways around their homes to reduce the fire's ability to spread, thus reducing the amount of damage on the property as well as increasing the firefighters' ability to control the fire. This will reduce the chances of a firefighter getting injured or killed because the fire will not be spreading as quickly, making it easier to manage. Open communication between wildland firefighters and local firefighters is crucial. If wildland firefighters are unable to stop the spread of a fire, local firefighters need to be prepared to protect the community. It also allows for cooperation and the pooling of resources, making it easier for the fire to be extinguished in manageable time. This may decrease injury and fatalities for both groups. Fireproof building material is one of the best ways to protect against wildfires. These materials help prevent the spread of fire as well as minimize damage done.

The easiest way to get the community involved would be through the development and publicity of a disaster management website. It would also be the cheapest. The website would be specifically tailored for home and business owners looking for ways to protect themselves and their property against wildfires. This would include information on what types of material should be removed from the property as well as how far vegetation should be from the home. There would be a section tailored towards children with games and tutorials. This way, residents could have fun while learning about wildland fire safety. To make the website more proactive but also a little less expensive, home and business owners could send in pictures of their homes and surrounding property through a secured network with all security and privacy precautions taken. Experts could review the pictures and e-mail owners back about ways to improve fire safety around their property. This may not be as effective as a home visit but it would be less expensive and still provide valuable information for public safety. Volunteers would be an integral part in making the program a success. As mentioned, the elderly and those without the financial means may be challenged with cleaning their yard of debris and removing vegetation. Volunteers could also do community outreach to help clear the yard of fire hazards. They could go to schools, work during fundraisers, and speak during community events. Getting children interested in the topics of

Overall, the implementation of these could decrease the amount of injuries and deaths, for both civilians and firefighters, due to wildfires. Increasing community awareness and involvement would be beneficial for in house and business fire protection. This would decrease the spread of the fire, allowing wildland firefighters to extinguish the fire more quickly. This leads to less property destruction and harm to individuals. By increasing communication between wildland and local firefighters, it expands the amount of resources of each group while keeping everyone informed. Finally, by providing incentives to buy fireproof material, it will decrease the spread of fire. Again, this would decrease the amount of damage done as well as provide a form of protection to firefighters.

Discussion

The increasing future wildfire potential and longer dry seasons could increase the likelihood for more intense wildfire activity in the US, consequently, increasing human fatalities, property damages and environmental degradation. Sequentially, there would be higher demand for resources to prevent these disasters and to implement community recovery. Heightened extreme fire events will lead to higher particulates, toxic gases and carbon emissions, consequently producing more unfavorable detriment effects to the environment, including atmospheric feedback of increased particulate matter emissions and the overall impact on the air quality in the environment.

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More studies are need to understand the specific effects of climate change on the spread and speed of developed wildfires. Additional research is required to enhance the current projection capabilities for wildfires and to understand better the trend, pattern and impacts of wildfires in the US. This will include adequate sensitivity analysis for the quantification and categorization of uncertainties surrounding the selection of the appropriate weather parameters for local/global climate models, relative to wildfire prediction and effect. Since wildfire behavior cannot be determined solely by climate conditions and weather parameters, other parameters such as the condition of the fuel and anthropogenic activities should be included in the forecast model for the more accurate prediction of the fire; severity, occurrence, seasonality and the potential burn area. This study reviewed the effects of the changing climate on intense wildfire regimes, with the aim of assessing potential solutions for protecting people, property and the environment. It also helps to build the capacity to address traditional and emerging hazards relative to wildfires.

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Global warming potentials of greenhouse gases

Russell C. Henning, P.E. and Terri Rector Fann, P.E. ; HDR

A Primer

The EPA maintains a list of air pollutants that contribute to global warming – these are collectively called greenhouse gases, often abbreviated as GHG. The list can be found in EPA's mandatory GHG reporting rules (40 CFR 98). Carbon dioxide is a GHG. Methane is too, and there are others. However, not all GHG are created equal. On a pound for pound basis, certain greenhouse gases are considered to warm the earth more than others. For example, over a 100-year period, methane is considered to be many times more potent than carbon dioxide.

To compare and sum emission from different greenhouse gases, the EPA utilizes a calculated value called the Global Warming Potential (GWP), for each pollutant. The calculated GWP for each gas reflects how long the gas remains in the atmosphere and how strongly it absorbs infrared (IR) energy. Basically, gases with higher GWP absorb more energy than gases with lower GWP.

The GWP provides a common and standard way to compare emissions of one GHG with that of another. This allows comparisons for purposes of determining if a reduction in one is worth the increase of another, and allows for totaling of emissions of various GHGs into a single total (based on carbon-dioxide equivalents, or CO_2e).

Of the GHGs, carbon dioxide is the baseline with a GWP of 1. Chemicals that might garner a GWP of less than 1 are considered either too short-lived, too low a concentration and/or too limited in their IR absorbance that they do not contribute significantly to the greenhouse effect. Table 1 shows estimated 100-year GWPs for various greenhouse gases, in order from most potent to least potent. The GWPs other than for carbon dioxide are modeled estimates, and may change as scientists learn more about chemical processes affecting their disposition and longevity in the environment.

The values presented in Table 1 are taken primarily from the International Panel on Climate Change (IPCC) 2007 Fourth Assessment Report (https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html).

Although the IPCC has updated their calculated GWPs more recently, primarily 2007 values were utilized in EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014* that was released in April 2016 (https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf). Because information in this article draws from data in the April 2016 EPA report, the related GWP in Table 1 was drawn accordingly.

Table 1: 100-Year GWPs

Greenhouse Gas	Global Warming Potential (GWP)
sulfur hexafluoride	22800
nitrogen trifluoride	17200
perfluorocarbons	Range 7390-12200
hydrofluorocarbons	Range 12-14800
nitrous oxide	228
methane	25
carbon dioxide	1

The GWP concept was developed by the IPCC and published in 2001 (https://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_full_report.pdf). Then and now IPCC defines the GWP of a greenhouse gas as "the ratio of the time-integrated radiative forcing from the instantaneous release of 1 kilogram (kg) of a trace substance relative to that of 1 kg of a reference gas." As mentioned, the reference gas was, and continues to be, carbon dioxide.

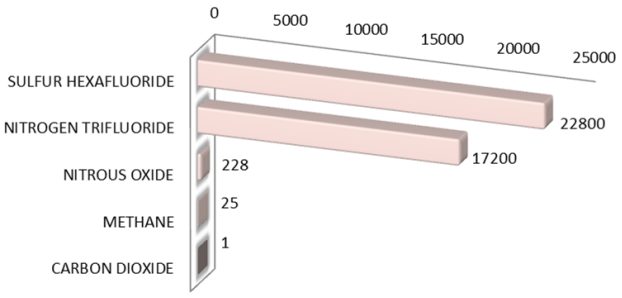

Figure 1: 100-Year GWP Comparisons for Selected Greenhouse Gases

Although meaningful, and in some ways simple, it's important to take the accuracy of GWPs with a grain of salt. Even when the first GWPs were estimated, the IPCC recommended utilizing GWP for simple or general

Continued from page 14

comparisons only. Since that time the IPCC has updated calculated GWP values periodically based on atmospheric changes and new information. The GWP time period of 100-years is also somewhat arbitrarily used in reported GHG comparisons; in addition, although not as widely used, there have been other GHG comparison models developed.

The way the GWP is used to estimate greenhouse gas emissions is to simply multiply the pollutant's emission rate (in units of weight per time), by its GWP. Then you have the pollutant's emission rate estimated in carbon dioxide equivalents, or CO_2e.

Add up all the GWP-weighted emission rates, and you will get a total greenhouse gas emission rate in CO_2e.

The GWP was used to estimate the breakdown of U.S. man-made greenhouse gas emissions in 2014 in the U.S. shown in Figure 2.

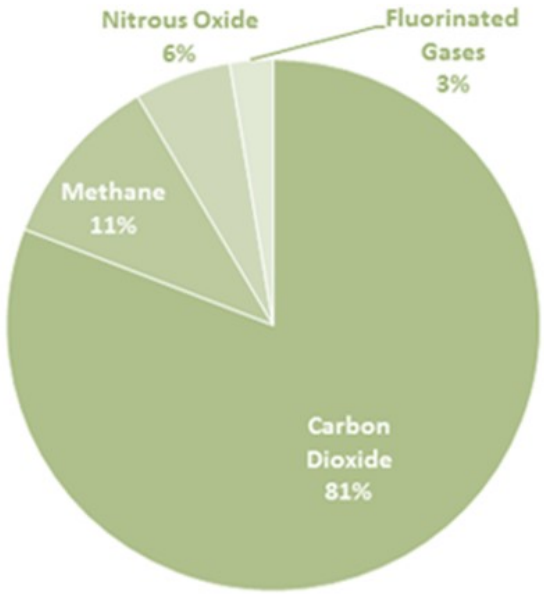

Figure 2: **U.S. Greenhouse Gases Emitted from Human Activities in 2014 on CO_2e Basis (source:www.epa.gov/climatechange/ghgemissions/gases.html)**

If the greenhouse gas breakdown had been based on unweighted emissions, the graphed results would have appeared a bit differently. Without using the GWP to weight each pollutant, for 2014, nearly the entire pie would be colored dark blue. Specifically, 99.5 percent of the emissions would be attributed to carbon dioxide, 0.5 percent to methane, and 0.02 percent or less to each of the other pollutants.

By use of the GWP, we can quickly get a grasp of the higher impact from the non-carbon dioxide pollutants. Using GWP weighting, nitrous oxide is not negligible, for example.

And there you have it – the global warming potentials of various greenhouse gases, and how to use the GWPs to interpret greenhouse gas emissions information that is presented in terms of carbon dioxide equivalents.

A More In-Depth Look at GWPs

The atmosphere's energy budget is determined by the balance between incoming solar radiation and outgoing infrared radiation. Radiative forcing (RF) is the measure of the influences on the balance between incoming solar radiation and outgoing infrared radiation. The chemicals discussed in this article tend to absorb solar radiation and terrestrial infrared radiation and re-emit it as infra-red back to the earth's surface. Thus, they tend to increase the earth's energy balance and promote positive RF.

The calculation of GWP is an attempt to predict the effect (relative to the effect of carbon dioxide) that a specific chemical in the atmosphere will have on long term global radiative forcing. The calculation is complex, but the key variables driving the calculation are pretty straightforward:

- Radiative efficiency
- Persistence
- Spatial distribution in the atmosphere

The radiative efficiency of a chemical has to do with its molecular structure. When a molecule absorbs a photon, electrons get bumped up to higher energy levels. The exact physics vary from one chemical to the next because they depend upon what electrons are available to get bumped up and what higher energy levels are available to receive them. If and when the molecules get a chance to revert to their ground state, the energy is converted to heat, meaning that the molecules vibrate and rotate faster. If the molecules are now more energetic then their surroundings, the heat is dissipated, mostly in the form of emitted infrared radiation.

Spatial distribution refers to how far a particular GHG spreads geographically and to what layers of the

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atmosphere (troposphere, stratosphere, mesosphere, and thermosphere) it migrates. Of these layers, the mesosphere (31 to53 miles up) is thought to be the most important with regard to the effects of greenhouse gases. Spatial distribution and persistence inter-relate in complex ways. The more persistent a chemical, the more time it has to move vertically and horizontally in the atmosphere. The temperature, reactants, and radiation level in the layer where the molecule ends up affect both its persistence and its spatial distribution.

The calculation of GWP is an integration of a chemical's radiative efficiency over its expected atmospheric life (with numerous other variables and assumptions tossed in to keep things interesting). Because GWP values are based on integrated radiative efficiency, they depend on the time span over which the potential is calculated. Short-lived GHGs initially have large effects that become less significant over time relative to carbon dioxide, since the integrated GWP of carbon dioxide increases over time. Methane, for example, has a GWP of approximately 25 over 100 years but 62 over 20 years. The EPA currently uses the 100 year GWP for rulemaking reporting.

Additional information on GWP calculation variables can be found in the IPCC Fourth Assessment Report: Climate Change 2007 [http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14], where Table 2.14 therein presents a list of common industrial chemicals, their persistence in years, their radiative efficiencies, and their estimated 20-year, 100-year, and 500-year GWPs.

Note that this article has addressed the somewhat basic question of "what is global warming potential?" for designated GHGs, but note that water vapor, clouds and aerosol particles have their impacts in the atmosphere as well. Studies and information exchanges continue.

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Wildfires Heat Up Across the West

US Department of the Interior - Blog - July 19, 2016

The wildfires blazing in the U.S. are threatening communities and natural resources. Already, more than 29,000 wildfires have burned over 2.6 million acres, increasing concerns that we could see yet another busy, dangerous and costly fire season. Last year was the most severe on record, with more than 10 million acres burned. That's more than twice the size of the state of Massachusetts. It was also the costliest at $2.1 billion.

Climate change is only making it worse. Wildfire seasons are now hotter, drier and longer than in the past. Check out our blog and video.

https://www.doi.gov/blog/wildfires-heat-across-west

For more information and statistics on climate change visit the National Oceanic and Atmospheric Administrations (NOAAs) webpage - State of the Climate at:

http://www.ncdc.noaa.gov/sotc/

DOI Wildland Fire Resilient Landscape Program

The Resilient Landscapes program, proposed in the Fiscal Year (FY) 2015 President's Budget, defined several key concepts - the integration and coordination between US Department of the Interior (DOI) and other Federal, tribal, state, and local government and nongovernmental partners, to leverage funds to restore and maintain fire resilient landscapes.

The program established a new "Resilient Landscapes" activity to be implemented by the DOI to restore natural vegetation landscapes to specific conditions and maintain fire resiliency. A pilot initiative was approved by Congress in the FY 2015 Fuels Management program to fund resilient landscape activities.

Visit the following site for more information: https://www.doi.gov/wildlandfire/wildland-fire-resilient-landscapes-program

Climate change education bill in Congress

Senate Bill 3074, introduced in the U S Senate on June 16, 2016, would, if enacted, authorize the National Oceanic and Atmospheric Administration to establish a climate change education program.

Observing that "the evidence for human-induced climate change is overwhelming and undeniable," the bill assigns NOAA the task of "broaden[ing] the understanding of human-induced climate change, possible long-term and short-term consequences, and potential solutions" through providing formal and informal learning opportunities to people of all ages. Included is a grant program aimed at improving climate change education at the K-12 level.

The sponsor of the bill is Ed Markey (D-Massachusetts), who unsuccessfully broached a similar piece of legislation in 2015.

A Calendar of Climate Change and Water Events for the US Environmental Protection Agency can be found at this website:

https://www.epa.gov/climate-change-water-sector/calendar-climate-change-and-water-events

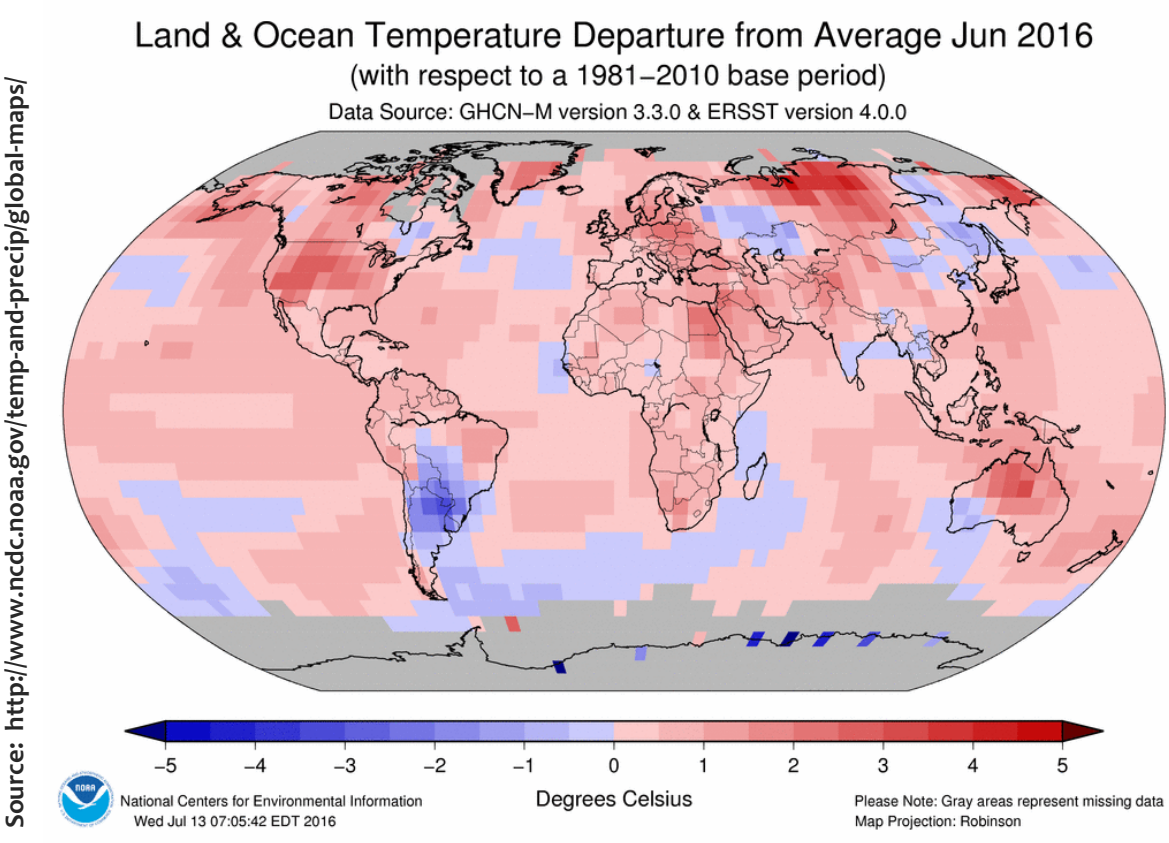
National Climate Assessment

To read the Report visit - http://nca2014.globalchange.gov/report

The National Climate Assessment summarizes the impacts of climate change on the United States, now and in the future. A team of more than 300 experts guided by a 60-member Federal Advisory Committee produced the report, which was extensively reviewed by the public and experts, including Federal agencies and a panel of the National Academy of Sciences.

The full report provides an in-depth look at climate change impacts on the U.S. It details the multitude of ways climate change is already affecting and will increasingly affect the lives of Americans:

- Our Changing Climate - explore how warming over the past half century has caused extreme weather , ice melting, and rising sea levels.
- Sectors - explore how climate change affects health, water, agriculture, energy, urban and rural areas, and indigenous peoples.
- Regions - see evidence of change occurring in every region.
- Response Assessment - discover actions to reduce emissions and ways to adapt to changing climate.



Considerations in analyzing the effects of climate change on coastal zone development

Tina Richards, CEP-IT, MS

Abstract

In the near future, coastal areas may become inundated by rising ocean levels due to the long-term effects of climate change. As evidenced by ice core samples from the arctic and dendrologic core samples from trees across the continent, the gradual change in climate and rising of the earth's temperature will have a ripple effect across many ecosystems including coastal zones. This article provides recommendations to environmental professionals and local entities to assess the effects of the changing climate on development in coastal areas.

Indicators From the Past

As evidenced by ice core samples, dendrological cores from trees and fossils, earth's climate has always changed and fluctuated throughout time. Scientists are united in the belief that the climate is warming at a heightened rate (EPA, 2016), but the debate if the rate increase is linked to anthropocentric activities has roared in the political atmosphere.

Assessment of Present Conditions

Today, in 2016, there is scientific consensus that climate-warming trends are likely due to human activities (NASA, 2016). As Environmental Professionals we need to be prepared and educated on the ways climate change will impact our work. The factors of climate change that pose the biggest threat to coastal developments are sea-level rise and extreme weather events. NASA's data reflect that the level of the sea rose almost 5 inches from 1870 to 2000 and predicts a 1-4 foot rise by 2100.

When developing a strategy to analyze the effects of climate change on a coastal zone development at a local level, it is important to commission expert scientists, local decision makers and local stakeholders, and organize them into climate change sub-committees that each has a specific goal and purpose. Three potential sub-committees are:

1. Public Engagement
2. Ecological Assessment and Modeling
3. Infrastructure Assessment and Economic Impact

Public Engagement

The first sub-committee to be convened is **public and stakeholder education and outreach**, which will stay active for the duration of the assessment project (or period). For this committee, it would be advantageous to incorporate staff from local governments (e.g., county/city environmental agency or extension service), local non-profit organizations, local media professionals, and local schools. This committee would host public forums to inform the public and gather opinions, suggestions, and information regarding changes they have witnessed in the local environment. They would oversee on-going media campaigns that facilitate getting their message out to the public, elected officials, and other agencies. The inclusion of the public would enhance the project by facilitating education and understanding of the local environment and the assessment project.

Ecological Assessment & Modeling

The second sub-committee to be formed would **assess the local environment (including existing hazards and the history of the community), and model the project area.** This committee should include contracted or government scientists, property managers of local parks and green spaces, and representatives of homeowners associations. The Ecological Assessment and Modeling Committee would address questions such as:

- Is there currently coastal erosion taking place and is there data that indicates the level of severity of erosion?
- Are there current beach re-nourishment initiatives in place?
- Is there data reflecting that a storm surge occurs during high rain events?
- Are there existing complaints from the community regarding flooding and storm surge issues?
- When was the last hurricane and how did it impact this area?
- Does the geologic record indicate fluctuations in sea level for this area or has there steadily been coastal stability?
- Were there many fluctuations in the shoreline with a period of stability and if so, when did that period occur?
- What does the topography look like and how has it changed over time?
- Are there historical aerials of the area? If so, what do their trends indicate?

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Additionally, this sub-committee would assess what conservation lands exist in the area and if **natural habitat corridors** are present for species to retreat inland from the coast. Scientists have demonstrated range shifts in certain species, which are anticipated to continue to change as the climate alters (Breed, 2012). The Ecological Assessment and Modeling Committee would also seek answers to the following questions:

- How much conservation land exists?
- Is it fragmented by roads or other human matrices?
- What is the quality of the conservation land and are their species regulated by state and Federal laws?
- If corridors exist and are being used by wildlife/plant species, consideration should be given to protect or acquire such areas. If the corridors don't exist, would their implementation be a priority for decision makers?

Models traditionally used for predictions in sea level rise are considered "bathtub models" and do not reflect how the topography will change *as* the water rises. Changes in nature and to infrastructure are more unpredictable and existing models don't reflect how erosion will occur over time. Instead of using existing bath-tub models that are less specific, the sub-committee would create a base model for the project area using GIS (ArcGIS-Geospatial Information System) and LiDAR, a surveying technology that measures distance by illuminating a target with a laser light, to determine landscape elevation. Government agencies, such as the Florida Division of Emergency Management, have created coastal storm surge models which could be integrated into the model for enhanced accuracy (FDEM, 2016). Scientific models are only as good as the data and equations used to build them, so the modeling effort should incorporate all available data. However, the model would provide insight as to how the water would move over the land, modeling current trends for tidal flux, seasonal change and storm surge to be compared to predicted increases. In developing the model parameters to better understand flood susceptibility within the project area, the following would need to be answered:

- What does modeling the current normal high reflect with a one foot increase, two foot increase, and so on?
- What does the normal high look like at the year 2050?
- At what date and prediction do we get to permanent submergence?
- Would the water over take the local barrier island dunes or move first to the estuary flooding areas and flood from behind?

Modeling would provide an understanding of critical information such as points of highest and lowest elevation. This model would provide a means to derive a percentage of inundation and a cumulative percentage of land affected by a specific rise in sea level. For example, if we entered that the sea level would rise 3 feet, then 10% of the area in question would be inundated.

The sub-committee would also obtain geological information for the area. Non-porous, bedrock exists in other places of the world, however in Florida the land that meets the ocean has a porous limestone foundation. This means that the water will not only enter on the surface as demonstrated by bath tub models, but into the porous limestone itself. This has already proven to be a problem in coastal areas of Florida, where **salt water has intruded**

National Coastal Zone Management Program

Our nation's coastal zone is vital to the well-being of our country. It is home to roughly half of the nation's population and supports ecologically important habitats and natural resources. The National Coastal Zone Management Program, administered through NOAA, works with coastal states and territories to address coastal issues, including climate change, ocean planning, and planning for energy facilities and development.

The program is a voluntary partnership. All 35 coastal (with the exception of Alaska) and Great Lakes states and territories participate in the program authorized by the Coastal Zone Management Act (CZMA) of 1972 to address national coastal issues. The program is administered by NOAA.

The national program takes a comprehensive approach to coastal resource management—balancing the often competing and occasionally conflicting demands of coastal resource use, economic development, and conservation.

For more information on the CZMA or the management program, visit: https://coast.noaa.gov/czm/about/

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into aquifers used for drinking water. Some coastal municipalities had to relocate their wells farther inland to be able to obtain fresh water. Freshwater is an integral part of a development and since sea level poses a threat to coastal freshwater supplies, consumption analysis of the local population, modeling of salt water intrusion into the aquifer, followed by the proposing potential solutions would have to be included in the assessment. Questions pertaining to this area include:

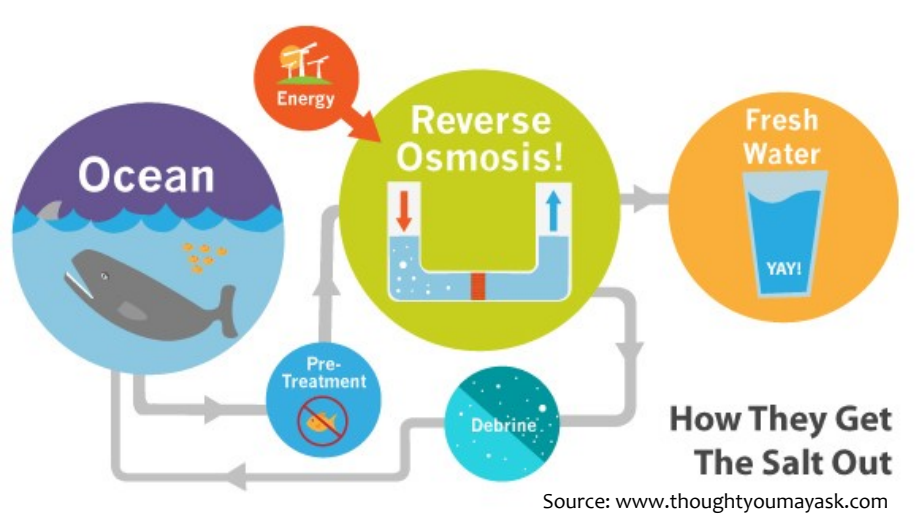
- How much water does the local community consume and what are the largest users, residential, commercial, agricultural, or other?
- How does the model predict the water will intrude and in what qualities?
- What are some creative solutions?

Desalination is extremely costly; however changes in technology could make it more likely. The Central Florida Water Initiative has begun to assess surface water resources and proposes their use as a likely alternative to continued aquifer depletion and saltwater intrusion. The consumption of surface water can pose further issues as current water treatment facilities are not equipped to deal with certain pollutants identified by the Florida Department of Environmental Protection, such as pharmaceuticals. The catchment and treatment of rainwater on a more local level may also be a solution for further evaluation.

Infrastructure Assessment & Economic Impact

The third sub-committee could be in charge of inventorying **critical infrastructure assets** and performing an

Desalination



Source: www.thoughtyoumayask.com

Desalination/distillation is one of mankind's earliest forms of water treatment, and is still used throughout the world today. In ancient times, many civilizations used this process on ships to convert sea water into drinking water. Today, desalination plants are used to convert sea water to drinking water on cruise ships as well as in arid regions of the world, and to treat water in areas that is fouled by natural and unnatural contaminants. In nature, the sun supplies energy that causes water to evaporate from surface waterbodies (e.g., lakes, oceans, and streams). The water vapor eventually comes in contact with cooler air, where it re-condenses to form dew or rain. Using alternative sources for heating and cooling, the process is now conducted artificially and more rapidly than in nature. For some quick facts:

- 30% (estimate) of the world's irrigated areas suffer from salinity problems
- In 2002 there were approximately 12,500 desalination plants around the world across 120 countries. They produce almost 14 million cubic meters/day of freshwater, which is less than 1% of total world consumption
- 76% of the worldwide desalinated water capacity is used by populations in the Middle East (mainly Saudi Arabia, Kuwait, the United Arab Emirates, Qatar and Bahrain); and North Africa (mainly Libya and Algeria)
- The United States is one of the most important industrialized users of desalinated water, particularly in California and parts of Florida

Sources: http://water.usgs.gov/edu/drinkseawater.html; Water Education Foundation, Corpus Christi TAMU-CC Public Administration.

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economic impact assessment. The Infrastructure Assessment and Economic Impact sub-committee would be composed of state government representatives (department of transportation, DEQ, tourism), local and regional planning organizations, real estate professionals, and economists. The inventory of existing infrastructure assets critical to the area would be conducted and would include:

- Location of buildings, roads and bridges, public facilities and community centers, hospitals, law enforcement, major utilities, canals, marinas, and other facilities integral to defining the quality of life for the local citizens, Record using GIS.
- Current value for each asset identified and plans for future improvement
- Current stresses or risks being asserted upon the assets – located in flood zones, highly erodible areas, areas subject to redevelopment or zoning change
- Emergency facilities, evacuation and response plans, public health plans

Impacts to key facilities and infrastructure also **affect the local economy**. For example, communities with economies focused on tourism could be adversely affected in the short-term or long-term if major infrastructure is damaged by flood events. The Great Barrier Reef had 2.19 million visitor days in 2014, but the Australian government has identified climate change including increased frequency of severe weather events, ocean acidification, rising sea temperature, and rising sea levels as one of the greatest threats to the long-term health of the Great Barrier Reef (Aust. Gov., 2016). Having industry professionals and economists on the team would provide the expertise to accurately quantify these impacts in terms of dollars and the corresponding effect on local and regional economies. They could also assist with cost estimations for proposed solutions. Identifying the infrastructure and economic connection is vital because it will:

- Provide a perspective of how much it will cost to turn the proposed solutions into action
- Give policy makers a "bottom line cost" for the threats posed to the local economy
- Analyze how the area's trade economies will be hindered by the impacts of climate change; and how imports into the community may be affected by climate changes occurring in other regions or countries

Predicting the future effects of climate change

A force working against coastal developments, in addition to sea level rise, is an increase in **extreme weather** and more erratic weather patterns. Predictions of how the climate will change vary across the earth, however, more intense hurricanes, changes in seasonal flowering phenology (which disrupts the food-web and reproductive cycles in animals), changes in precipitation patterns (which will lead to changes to stream flows) and increased drought are all predicted; some of which scientists have already begun to document.

Conclusion

Communities concerned about climate change should consider forming and working with subcommittees on public engagement, ecological assessment and modeling, and infrastructure assessment and economic impact to help assess existing conditions and addressing plans for coastal development. Each sub-committee should designate a liaison to participate in a final analysis; communicating their sub-committees findings to the other professionals on the final analysis team. The final analysis team would work to integrate the findings from each sub -committee into a final comprehensive report. The final report would be provided to the overseeing authority, local and state governments, presented at scientific conferences and universities, and made available to the general public.

Recommendations for the community response to climate change are typically to **protect, retreat, or accommodate.** Decisions made at the local level will need to consider the value of the assets jeopardized and the extent of the potential threat and timeline imposed by the rising sea. Long-term and short-term planning needs to be implemented, along with creation of local and regional partnerships to facilitate such plans. In the face of such drastic scientific evidence and the current global political climate, I remain optimistic. Looking back on major environmental disasters countries were able to come together to issue policies that assisted in remedying the problem; for example the Montreal Protocol and the hole in the ozone layer, the Superfund toxic waste sites such as Love Canal and the international 2001 Stockholm Convention on Persistent Organic Pollutants, and the Comprehensive Nuclear Test Ban Treaty (just to name a few). History shows us that there is a pattern among policy makers and the public of questioning the science, questioning proposed solutions, and questioning the economic feasibility of collective action to remedy the issues at

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hand (which is a process in of itself that can take years of revising and negotiating), and in the end changes that are eventually implemented. With that in mind, as scientists we must remain optimistic, dedicated, accurate, and ethical when involved with climate change conversations and projects.

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Newsletter Policy

In the interest of presenting material on which our members can formulate their own views regarding environmental matters, we present articles representing a variety of viewpoints. Whereas there may be limitations which trammel inquiry elsewhere, we take the position that it is through continual and fearless sifting and winnowing of information from various sources can the truth be found.

Should you take issue with an article appearing in this Newsletter, you are encouraged to submit an article with your viewpoint which will be published in a future issue.

Upcoming Newsletter Topics:

AUGUST

Transportation

(due August 15, 2016)

SEPTEMBER

Regulatory Updates

(due September 15, 2016)

OCTOBER

Sustainability

(due October 15, 2016)

NOVEMBER

Government (CEP Area of Practice)

(due November 15, 2016)

DECEMBER

Innovation (impact analysis tools and technologies)

(due December 10, 2016)

Send all articles to
scannonmackey@burnsmcd.com

CEP-IT IN ACTION

UCF Alumna Puts Conservation into Practice

Courtesy of https://news.cos.ucf.edu

University of Central Florida (UCF) Biology alumna and former UCF Arboretum employee, Tina Richards, '06, '13, embraced her passion for the environment at UCF. From her instrumental role in the growth of the UCF Arboretum to becoming a full-time biologist, Tina's path to success can be traced back to her time spent at UCF.

In 2006, Tina received her B.A. in Interdisciplinary Studies with a focus in Biology and Behavior & Social Sciences. Soon after graduation, she began working with the UCF Arboretum as a full time employee. Her time with the arboretum influenced her pursuit of a Professional Science Master's degree in Conservation Biology at UCF, which she received in 2013.

In relating her story to UCF News Tina noted,

> *In my academic studies and internship, I was able to learn valuable theoretical concepts and real-world skills that I used in my previous position at the UCF Arboretum.*

Tina Richards works as a biologist for the Water Sciences section of the Orange County Environmental Protection Division (OCEPD).

At the arboretum, Tina led guided tours, developed the volunteer program, and planned numerous events. In 2014, she was honored with the opportunity to teach an undergraduate course on behalf of her mentor, Rani Vajravelu, Ph.D., in Ethnobotany. Towards the end of her tenure, she facilitated the UCF Arboretum partnership with COS-IT to obtain a grant to fund Wi-Fi in the Timothy R. Newman Nature Pavilion.

In her position at OCEPD, Tina monitors surface water quality by collecting aquatic macroinvertebrates and plants from streams and lakes. She also serves as a certified trainer for the statewide University of Florida LAKEWATCH Program where she conducts sample collection trainings for volunteers within Orange County and coordinates transportation of samples to the Gainesville lab for processing. The program seeks to improve the efficiency of data collection across Florida's lakes and rivers.

Tina maintains her involvement with the UCF Arboretum by partnering with them for events such as the OCEPD Jr. Naturalist program, a free environmental education program that aims to teach K-12 students about environmental topics. In January, the UCF Arboretum hosted a class on trees of Florida for the program. She also recently trained arboretum staff to collect water and bacteria samples from Lake Claire and Lake Lee. Tina also mentors several interns, taking great pride in their success.

CEP and CEP-IT IN ACTION!

We want to hear about the great things CEPs and CEP-ITs are doing in the community - share your stories by sending them to scannonmackey@burnsmcd.com

Our newsletter is only as strong as our members can make it.

So don't be afraid and GET INVOLVED!

The Certified Environmental Professional

The ABCEP Newsletter is published monthly and is intended to be a:

- Communication vehicle for the Board of Trustees and ABCEP Committees to inform and engage with CEPs and CEP-ITs on current activities within ABCEP and its future direction.
- Forum to report on current and emerging environmental issues, regulation and policy changes, and professional trends.
- Forum to provide professional guidance and advice to expand the professional growth and knowledge of members.
- Means for members to communicate with one another on current accomplishments, interesting projects, or lessons learned on the job with new approaches and successful problem solving solutions.
- Platform to acknowledge, highlight, and welcome active CEPs and CEP-ITs.

All members are encouraged to be active in their profession and affiliated professional organization.

If you have a topic of interest that you would like presented in *The Certified Environmental Professional* newsletter please submit your topic request or completed article to Andrea Bower at office@abcep.org or Shari Cannon-Mackey, CEP ENV SP, at scannonmackey@burnsmcd.com.

Thank you,

Shari Cannon-Mackey, CEP, ENV SP
Editor