

Score row	Total number of points earned: 38 (out of 42 possible points)	Scoring Commentary
IWA-1	6	The research question is clearly stated, has a reasonable scope and was motivated by the poem in the source materials.
IWA-2	6	The essay acknowledges some of the critics of global warming but not to the same degree as those advocating its effects.
IWA-3	6	The argument uses evidence from a wide variety of sources from Greenpeace to the EPA.
IWA-4	4	The essay does not address the credibility of the sources making most of the predictions aside from the IPCC. Two sources are credited with being professors, not really sufficient credentials.
IWA-5	6	The argument is logically organized and complex and is driven by the research question.
IWA-6	4	The essay links claims and evidence but little attention is paid to the dangers of extrapolation from current situations; a better vetting of sources might have made this more visible.
IWA-7	3	The essay appears to accurately attribute and cite all sources used and the citation format is consistent.
IWA-8	3	The essay contains few flaws in writing or grammar and clearly communicates. The pictures enhance the discussion.

How Will Global Warming Affect Maps and What Are the Social, Environmental, and Economic Implications of These Changes?

I frequently hear about the controversial topic of global warming which most scientists believe will eventually affect every single person on Earth. Elizabeth Bishop wrote in her poem "The Map," "Land lies in water; it is shadowed green. Shadows, or are they shallows, at its edges." Reading this passage led me to question how global warming will result in the increasing sea levels that may change the map over time, to ponder how the land will be less and the edges farther inland. Although there are people who would argue that global warming is not occurring, ninety-seven percent of scientists believe it is a real threat and fear the effects it will have on the world in the future.¹ Based on convincing evidence, global warming could severely impact our country and the world within the next century. The Intergovernmental Panel on Climate Change (IPCC), a group of scientists representing 195 countries in the United Nations, claims in their 2007 Fourth Assessment Report that global warming is having a harmful effect on the world and that the damage is irreversible at this point.²

Lonnie G. Thompson is an award winning professor at Ohio University and is one of the many scientists that believes the theory of global warming and is studying the effects on glaciers. Based on his observation and research over the past fifty years, he has confirmed that the glaciers are melting.³ He said, "And the longer we delay, the more unpleasant the adaptations and the greater the suffering will be." There are people who believe that humans are a prime cause of global warming. We release many greenhouse gases such as carbon dioxide and methane with our daily activities such as driving and through

¹ "Climate Change: Consensus - Global Climate Change - Nasa." 2013. 17 Dec. 2013
<<http://climate.nasa.gov/scientific-consensus>>

² "Climate change - IFRC." 2011. 16 Dec. 2013
<<http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/aggravating-factors/climate-change/>>

³ "OSU School of Earth Sciences: About." 2006. 16 Dec. 2013
<http://www.geology.ohio-state.edu/faculty_bios.php?id=52>

industrial processes. Refrigeration, especially in the past, has also contributed because the use of chlorofluorocarbons for the process has destroyed the ozone layer, causing less of the sun's radiation to be absorbed and more to heat Earth's waters. We are destroying our forests so excess carbon dioxide is not absorbed during photosynthesis, causing more to be released into the atmosphere.⁴

It is estimated that eighty percent of the heat that is trapped by global warming is stored in the ocean. As the water is warmed, it expands and increases the sea level.⁵ The increasing temperature is also directly causing glaciers and sea ice to melt with the most substantial changes coming from the Greenland Ice Sheet and the West Antarctic Ice Sheet that are being melted from underneath the ice up to 2.4 inches per day or 36 square miles per year. Together they contributed one-fifth of the 2.2 inches increase in sea level since 1992.⁶ Although the sea level is only expected to rise an average of one inch per decade around the globe, it is possible if we are not able to control the increase of the greenhouse gases being emitted into the atmosphere, that eventually this could cause sea level to rise one foot per decade. It is inevitable with the carbon pollution that is already in the atmosphere that we are looking at a four foot sea level rise which will, at high tide, cover 316 cities along the United States coast and will destroy 3.6 million people's homes. By the end of the century, potentially 18 million people could be severely affected. It is apparent that as waters heat up resulting in thermal expansion and the glaciers melt and pour more water into the oceans, coastlines will be pushed inland and continents will gradually become smaller, therefore affecting the way maps look today.⁷

⁴ "Global Warming -- National Geographic." 2008. 16 Dec. 2013

<<http://environment.nationalgeographic.com/environment/global-warming/>>

⁵ "Deep ocean warming contributes to sea level rise - Reporting ..." 2010. 17 Dec. 2013

<<http://www.reportingclimatescience.com/this-issue/oceans-and-polar/deep-ocean-warming-contributes-to-sea-level-rise.html>>

⁶ "Warm Water Under Antarctic Glacier Spurs Rapid Melting ..." 2013. 17 Dec. 2013

<<http://www.livescience.com/39606-melting-ice-pine-island-glacier.html>>

⁷ "Sea Level Rise 'Locking In' Quickly, Cities Threatened | Climate ..." 2013. 16 Dec. 2013

<<http://www.climatecentral.org/news/sea-level-rise-locking-in-quickly-cities-threatened-16296>>

The elevation of the land affects where global warming and subsequent sea level increases will have the greatest impact. For example, southern Florida and the Atlantic Coast have elevations of less than five meters above sea level. If global warming continues at this rate, it is certain that by 2030, Hollywood, FL will be affected; by 2050, Miami, FL will find many areas submerged; and by 2060, Virginia Beach will be affected.⁸ Many highly populated cities like these in the United States, which is 3,794,083 square miles in size, could even disappear.⁹ Other cities that are in danger of partial or eventual complete flooding include Boston, Massachusetts; New York City, New York; New Orleans, Louisiana; Sacramento, California; Los Angeles, California; and even Savanna, Georgia.¹⁰ This is partially due to erosion of land as water rises to cover it. The Netherlands, England, and Mediterranean regions in Europe will likely flood if there is a continued increase in sea level. During the 20th century, Europe's temperature rose 35 percent more than the global average rise due to its location and size. Scientists expect Switzerland's glaciers to be three-fourths of the way melted by 2050, which is the greatest climate change that has occurred in Europe in 5,000 years. As glaciers melt in the north, the population along the coasts will eventually be forced to move towards areas closer inland.¹¹ In China, an increase of 4 meters will consume the city of Shanghai and a large portion of the Eastern coast. The land completely surrounding the Caspian Sea dividing Europe and Asia will be submerged inland for miles because the area is at a low elevation.¹² There are also many cities along Africa's coasts that are at risk of being destroyed by the rising waters. Between the years of 1990 and 2080, it is expected that melting glaciers around the

⁸ "Sea Level Rise 'Locking In' Quickly, Cities Threatened | Climate ..." 2013. 16 Dec. 2013
<<http://www.climatecentral.org/news/sea-level-rise-locking-in-quickly-cities-threatened-16296>>

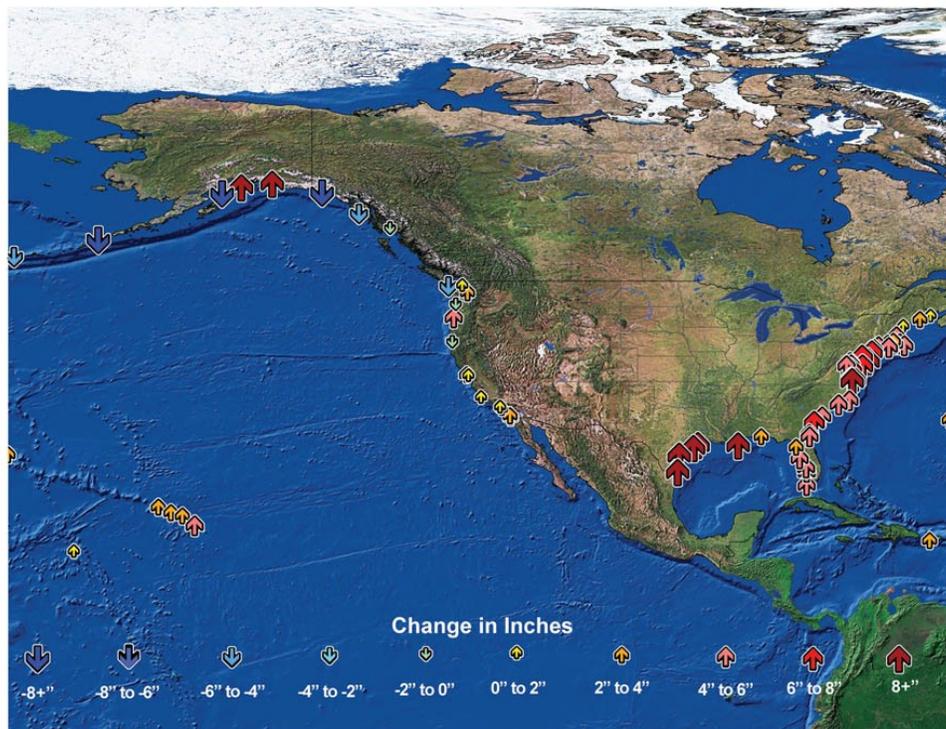
⁹ "US States: Area and Ranking - EnchantedLearning.com." 2002. 16 Dec. 2013
<<http://www.enchantedlearning.com/usa/states/area.shtml>>

¹⁰ "14 U.S. Cities That Could Disappear Over The Next ... - Huffington Post." 2013. 16 Dec. 2013
<http://www.huffingtonpost.com/2013/08/26/global-warming-flooding_n_3799019.html>

¹¹ "Europe Facing Environmental Disaster Through Global Warming ..." 2012. 16 Dec. 2013
<<http://www.dw.de/europe-facing-environmental-disaster-through-global-warming/a-1796073-1>>

¹² "Sea Level Rise Explorer - Global Warming Art." 2008. 17 Dec. 2013
<<http://www.globalwarmingart.com/wiki/Special:SeaLevel>>

north and south poles will cause sea level to rise around these coasts 22 to 34 centimeters.¹³ Professor Jagdish Shukla, from George Mason University, once stated, “The consequences of global climate change constitute one of the most serious threats facing humanity. While the poor and the impoverished will suffer the most, the potential for catastrophic climate change that can adversely affect the habitability of the entire planet is quite real.”¹⁴ The map below illustrates how much the sea level rose in the areas marked by inches between the years of 1958 and 2008.¹⁵



A specific example of a city that will be affected by the rising sea levels is Port St. Lucie in southern Florida. I chose this city because I have family living there. The average elevation of Port St. Lucie is thirteen feet above sea level. If the rate of increase of sea level continues, the city will be

¹³ "African cities at risk due to sea-level rise - Maps - Professional ..." 2008. 16 Dec. 2013
<<http://www.preventionweb.net/english/professional/maps/v.php?id=5645>>

¹⁴ "Scientist and Economists' Personal Quotes | Union of Concerned ..." 2013. 16 Dec. 2013
<http://www.ucsusa.org/global_warming/solutions/reduce-emissions/scientist-and-economists.html>

¹⁵ "Climate Impacts on Coastal Areas | Climate Change | US EPA." 2012. 17 Dec. 2013
<<http://www.epa.gov/climatechange/impacts-adaptation/coasts.html>>

flooded by 2090.¹⁶ The city currently has an increasing population of 167,000 residents living on its 116 square mile expanse.¹⁷ As the emissions of greenhouse gases continue to heat our atmosphere and the water level rises, it gradually gets closer to my family's homes. Once this city is under water, where will these thousands of residents move? They will be pushed farther inland with the other 18 million people who have lost their homes.

As the coastlines recede and people are forced to move farther inland, congested areas will develop causing social issues. As the world population rapidly grows from the current population of 7,131,123,776 people, about 317,251,985 of which are from the United States, the amount of land available will slowly decrease, at least partially due to global warming.¹⁸ After the sea level rise, the new coastlines will be very congested because people will be traveling away from their destroyed homes and will crowd the already existing population. This will affect state population maps, specifically influencing the demographic maps and will affect the way the state looks in general. Florida is a particularly good example. The effects of the rising of sea level is shown through stages with a one-, two-, four-, and six-meter rise in the left image below.¹⁹ The image on the right shows how Florida is predicted to look on the map in the future.²⁰ Along with this destruction of land comes the destruction of the homes of animals. Environmental effects include the migration of animals inland with the humans and their adaption to different surroundings. The ocean creatures that will be in the submerged cities may also be affected by the flooded industries, gas stations, and other places with harmful materials. Also, the marine animals may not be able to adapt to the increase in ocean temperatures and may become extinct. According to

¹⁶ "Sea Level Rise 'Locking In' Quickly, Cities Threatened | Climate ..." 2013. 16 Dec. 2013 <<http://www.climatecentral.org/news/sea-level-rise-locking-in-quickly-cities-threatened-16296>>

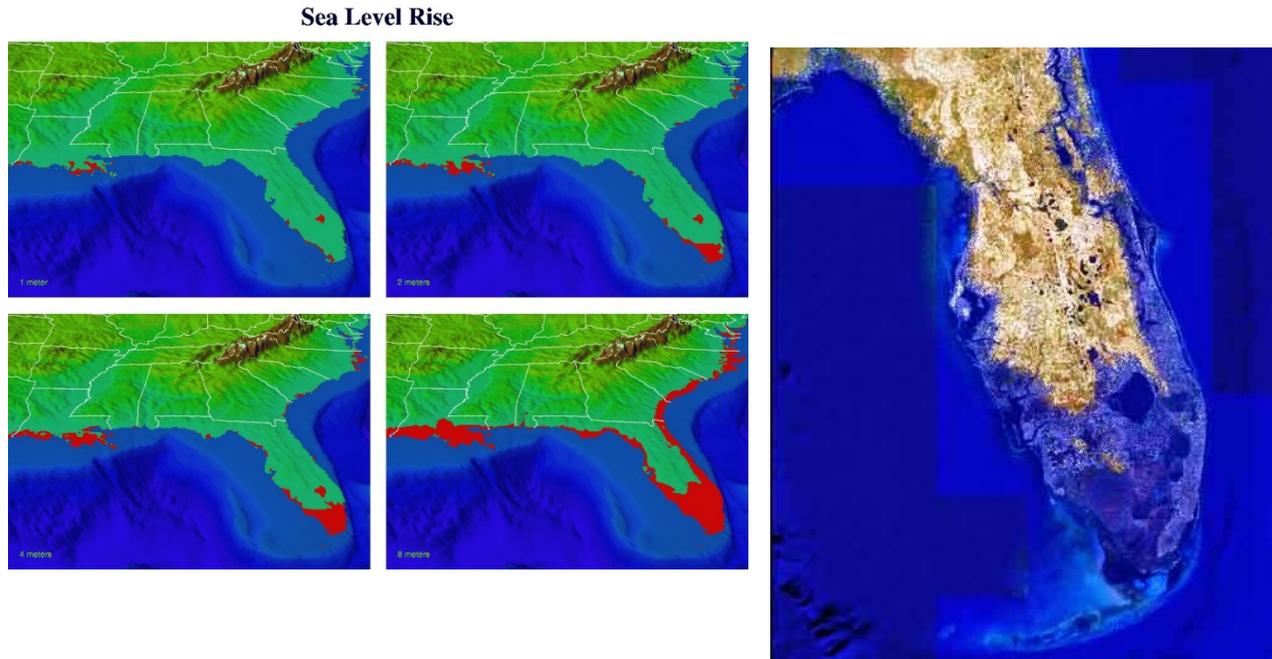
¹⁷ "Trash Pick-Up and Recycling Information - City of Port St. Lucie." 2011. 16 Dec. 2013 <<http://www.cityofpsl.com/city-manager/trash-recycling-information.html>>

¹⁸ "Population Clock - Census Bureau." 2013. 16 Dec. 2013 <<http://www.census.gov/popclock/>>

¹⁹ "Climate Change Could Leave Florida Hotter, Smaller | PlanetSave." 2010. 17 Dec. 2013 <<http://planetsave.com/2007/12/03/climate-change-could-leave-florida-hotter-smaller/>>

²⁰ "World Mysteries - Global Warming." 2007. 17 Dec. 2013 <http://www.world-mysteries.com/newgw/sci_globalw2.htm>

this map of Florida, the entire Everglades National Park that is home to many species of fish, birds, reptiles, and mammals will be completely immersed.



There are also many economic effects caused by the receding coastlines. With the current global warming rates, there is a potential economic impact of \$20 trillion US dollars per year due to climate change by the year 2100.²¹ Along with this loss, there will be an impact on tourism because many popular vacation locations that had brought in money will be affected all around the world, like the Great Barrier Reef in Australia, Glacier National Park, and the Caribbean.²² There will also be a loss of land used for agriculture. This is especially true in Africa where by 2050, they could potentially lose 247 million acres of farmland. Their production rate of goods like rice, grain, and corn also decreases because according to

²¹ "Climate Change Costs - World Preservation Foundation." 17 Dec. 2013
<<http://www.worldpreservationfoundation.org/topic.php?cat=economicCosts>>

²² "Global warming: ten most affected areas - Telegraph." 2009. 17 Dec. 2013
<<http://www.telegraph.co.uk/earth/environment/globalwarming/6486612/Global-warming-ten-most-affected-areas.html>>

the National Academy of Sciences, every degree Celsius the temperature rises, production decreases by ten percent.²³

With the overwhelming evidence, it is remarkable that there are critics of global warming who say the world is actually cooling. They state that their research shows that over the last century, Greenland's temperatures have shown a decrease although they admit to a short spike. Some people that disagree with the global warming theory say that the change in temperature and sea level is insignificant. Without our advanced technology and use of satellites, we would not be able to detect the small decrease in the size of the Greenland ice sheet.²⁴ Experts from the Hydrometeorological Center of Russia support a new theory that Earth has been going through a time of cooling since 1997 and that there is a possibility for another "little ice age" as previously recorded in the 12th, 15th, 17th, and 19th centuries and is expected to cycle around again in 2014. This new ice age should last for about two hundred years.^{25 26} Events like the recent record cold temperatures in the United States, with Winter Storm Ion, along with stories from around the world, such as the Russian ship that was trapped in Antarctic ice, feeds the skeptic's argument. Skeptics also claim there are flaws in the computer models used to prove the effects of global warming. William Hunt, a research scientist at the National Oceanic and Atmospheric Administration, says computer models do not consider all of the variables when they map the effects of global warming so the conclusions are flawed. No one definitely knows how climate affects the melting of the glaciers.²⁷ Also, there is not enough factual data to document a trend during previous periods of global warming and

²³ "Global Farmland Disappearing - Farmland Forecast - Colvin & Co. LLP." 2009. 17 Dec. 2013
<<http://farmlandforecast.colvin-co.com/2009/06/18/global-farmland-disappearing.aspx>>

²⁴ "C3: Quotes From Global Warming Critics, Dissenters, Non-Believers ..." 2009. 17 Dec. 2013
<<http://www.c3headlines.com/quotes-from-global-warming-critics-skeptics-sceptics.html>>

²⁵ "New Ice Age to Begin in 2014 :: Russia-InfoCentre - Russia-IC." 17 Dec. 2013
<<http://russia-ic.com/news/show/13717>>

²⁶ "Global warming? No, actually we're cooling, claim ..." - Telegraph." 2013. 17 Dec. 2013
<<http://www.telegraph.co.uk/earth/environment/climatechange/10294082/Global-warming-No-actually-were-cooling-claim-scientists.html>>

²⁷ "C3: Quotes From Global Warming Critics, Dissenters, Non-Believers ..." 2009. 17 Dec. 2013
<<http://www.c3headlines.com/quotes-from-global-warming-critics-skeptics-sceptics.html>>

ice ages so it is difficult to predict what will happen in the future.²⁸ If global warming does not occur as predicted or if we are headed for another ice age, the coastline should not change and coastal residents will not have to worry about their homes being flooded.

However, the majority of climatologists agree that human activities are contributing to global warming. This increase in temperature is being absorbed by the oceans and is heating the water. This results in thermal expansion and deteriorates the ice sheets and glaciers that holds seventy percent of the earth's fresh water. Although there are many critics that argue against the majority of scientists that the Earth is headed for a new ice age, the overwhelming research points in favor of global warming which will directly increase the sea level that will overtake many square miles of coastal land. With about twenty-three percent of the worlds population living near the coasts and with a population density three times higher than the global average, the changes will affect a substantial number of people.²⁹ The shape of the continents on future maps will drastically change due to the heating of the Earth's atmosphere that will increase the sea level of our oceans.

²⁸ Bevis, M. "Is Antarctica losing or gaining ice? - Skeptical Science." 2009.

<<http://www.skepticalscience.com/antarctica-gaining-ice.htm>>

²⁹ "Sea level rise | Greenpeace International." 2010. 17 Dec. 2013

<http://www.greenpeace.org/international/en/campaigns/climate-change/impacts/sea_level_rise/>