Climate changes resulting from human activities are among the most significant challenges confronting human societies. Climate change is primarily a consequence of the burning of fossil fuels such as coal, natural gas and petroleum. As fossil fuels are burned, carbon dioxide and other greenhouse gases are released into the atmosphere. As greenhouse gases accumulate in the atmosphere, they allow light from the sun to enter, but then trap a portion of the outward-bound infrared radiation, which makes the air increasingly warmer.

In the 19th century and before, carbon dioxide levels in the atmosphere were about 284 ppm. Since then, carbon dioxide levels have increased by more than 36 percent to 387 ppm in 2009. The rate of increase has become greater as progressively larger amounts of fossil fuels are burned each year.

To provide some indication of fossil fuel usage, the United States consumes about 21 percent of the energy utilized worldwide. About 84 percent of the energy used in the U.S. is derived from fossil fuels. Less than one-half (44.5 percent) of the fossil fuel energy consumed in the United States is from petroleum, of which 71 percent is used in the transportation sector. Thus about one-fourth of the energy consumed in the U.S. is for transportation and this energy keeps approximately 250 million vehicles on the road. According to the Energy Information Administration, about 378 million gallons of gasoline are consumed by these vehicles each day in the U.S.

Evidences of climate change proliferate. On average the Earth’s temperature has increased by 1.2 degrees Fahrenheit in the past century with 1998 and 2005 the warmest years on record. From 2003 to 2007, the 11 western states averaged 1.7 degrees Fahrenheit warmer than the region’s 20th century average.

In the 19th century, there were 150 named glaciers in Glacier National Park in Montana. Today this number is down to 26, and several of these are mere remnants of their former selves. Estimates are that all of the glaciers in the park will soon be gone. The temperature of the oceans is increasing leading to more frequent and more severe storms. Further, temperature changes shift vegetation community boundaries, the centers of distribution for various species have changed, and globally the area affected by drought has increased. These changes make some habitats and some species extremely vulnerable.

Consequences are even more dramatic in the Arctic regions where average temperatures have increased almost twice the rate of the rest of the world. As a result, there is widespread melting of glaciers and sea ice.

Overall, the geographic extent of arctic sea ice has declined steadily since the late 1970s and has now decreased by 15 to 20 percent. The Columbia Glacier in Alaska, which discharges into Prince William Sound, has shrunk by nine miles since 1980 and is discharging nearly two cubic miles of ice annually. Decreasing sea ice,
associated with melting of glaciers, especially in Greenland and Antarctica, are resulting in rising sea levels. Further, the extent of arctic snow cover has declined and river flows have increased, the permafrost is melting and the permafrost’s southern limit has moved north by a significant amount. As a result, vegetation zones are shifting northward, the frequency and intensity of forest fires and insect disturbances have increased, and a number of marine species that are dependent on sea ice, including polar bears, seals and walruses are declining and some may face extinction.

Unless major changes are implemented, the amount of greenhouse gases in the atmosphere will continue to grow, and the consequences could be disastrous. If CO$_2$ levels can be sustained at 450 ppm, projections indicate that the eventual temperature rise will be between 1 and 3.75 degrees Celsius. Under these circumstances, deserts are likely to spread, crops fail, the number of people affected by hunger will grow, the melting of the Greenland ice sheet will be irreversible, cities such as Tokyo, New York and London will be threatened by rising seas, and there will be a substantial increase in hurricane damage in the United States. Should CO$_2$ levels increase beyond this level, consequences could be progressively more catastrophic.

While everyone on earth will deal with the impacts of climate change, the West may be especially susceptible to adverse consequences. This is primarily because the region already faces severe water shortage concerns and climate change is expected to increase the frequency and severity of droughts and reduce mountain snowpack. Fortunately, western researchers and Extension Specialists are deeply involved in work to address climate change issues. This issue of Rural Connections includes articles written by some of these individuals. Our hope is that these articles will stimulate the sharing of ideas across state lines and trigger others to become involved in this important work.