GLOBAL EDITION

Human Geography

Places and Regions in Global Context

SEVENTH EDITION

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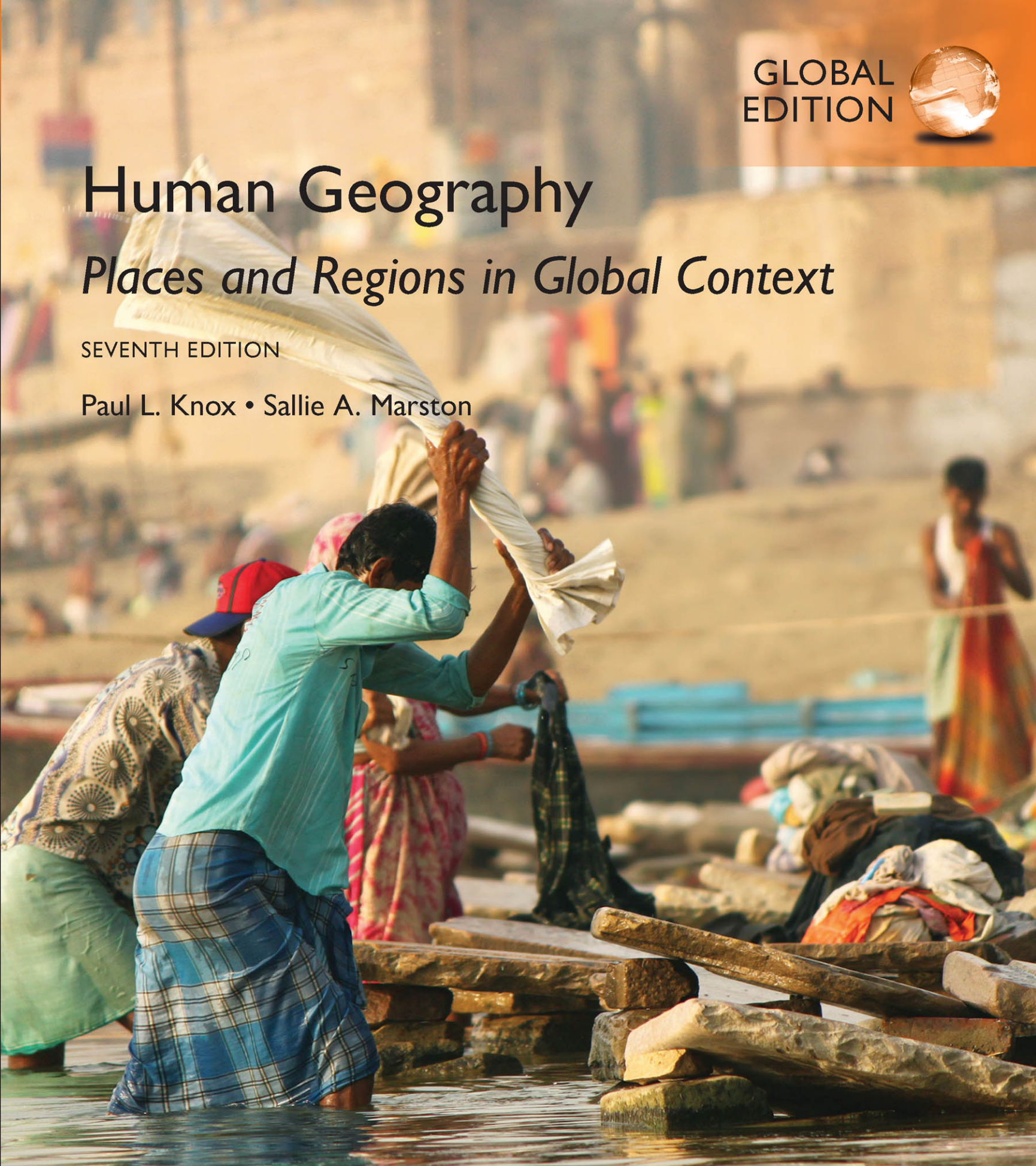

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HUMAN GEOGRAPHY

Places and Regions in Global Context

7TH Edition

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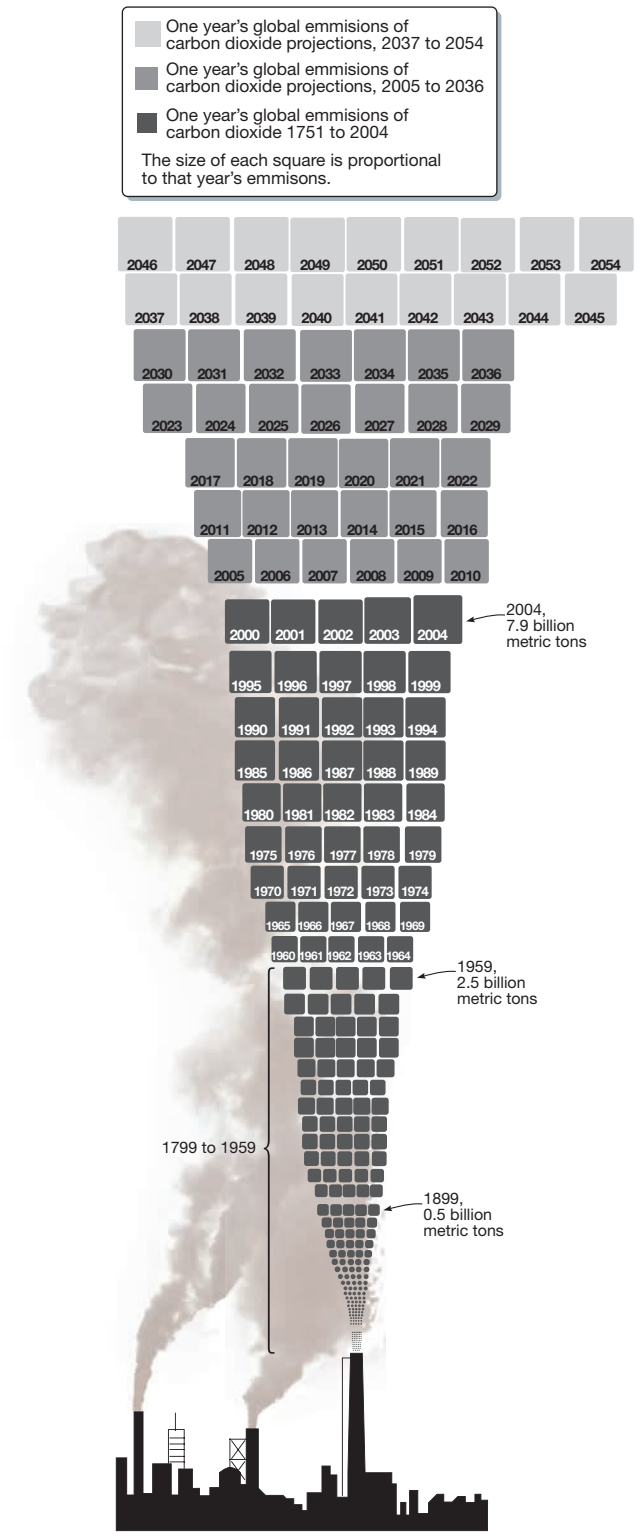


▲ **Figure 4.13** Global emissions of carbon dioxide Each square represents one year's global emissions of carbon dioxide, measured by the weight of carbon it contains. (*Source:* Adapted from *New York Times*, December 16, 2007. http://www.nytimes.com/interactive/2007/12/16/weekinreview/20071216_EMISSIONS_GRAPHIC.html, accessed June 22, 2014.)

greenhouse gases (GHGs) result from human activities such as the burning of fossil fuels, cement production, and deforestation. Greenhouse gases act to trap heat within the atmosphere, resulting in its warming as well as that of Earth's surface.

How Do We Know Climate Is Changing?

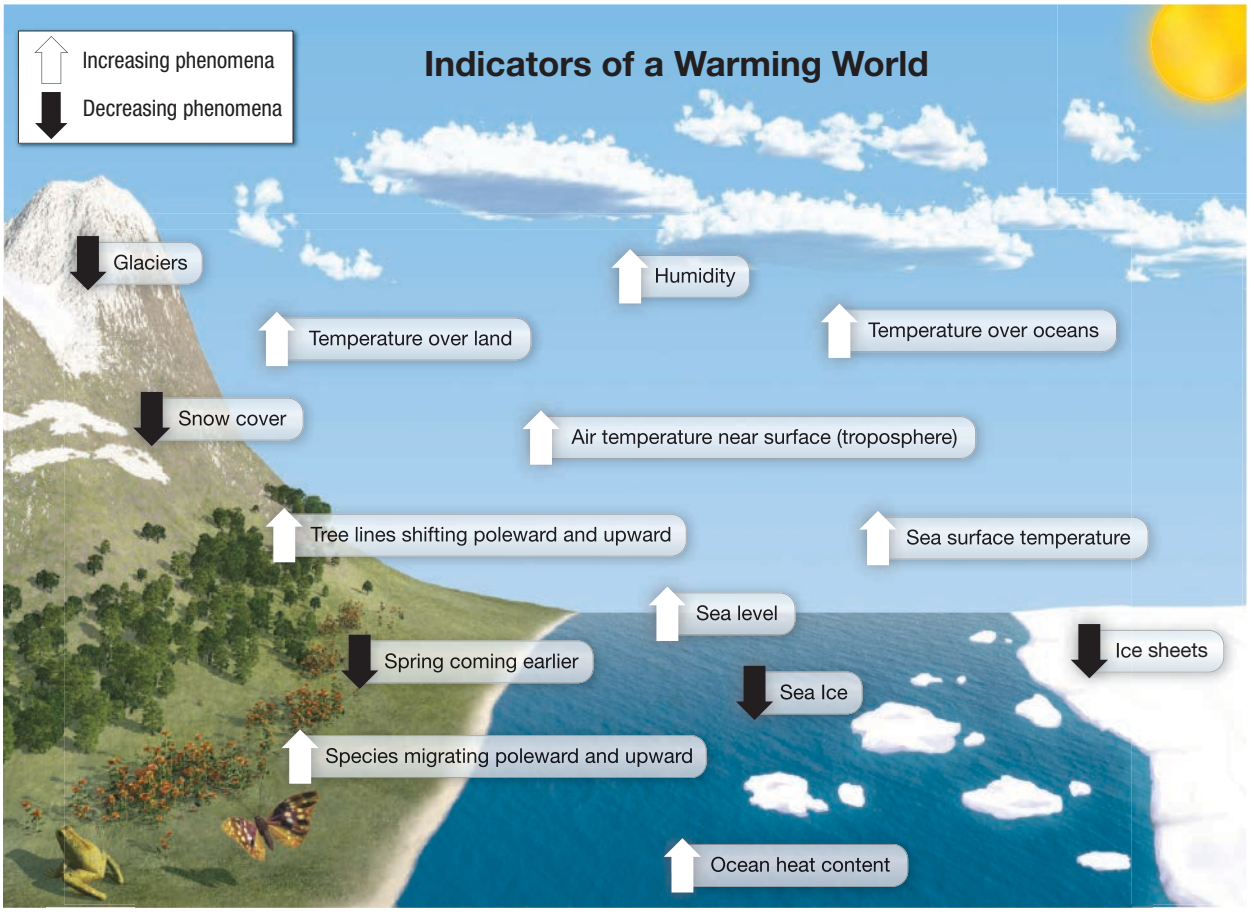
It's important to appreciate that climate change is not an assertion based on a speculative theory or a political agenda. The evidence for it is based on facts, many of which are identified next.

- Temperature increase is widespread over the globe and is greater at higher northern latitudes. In the past 100 years, average Arctic temperatures have increased at almost twice the global average rate.
- Global average sea level rose at an average rate of 1.8 (1.3 to 2.3) mm per year over 1961 to 2003 and at an average rate of about 3.1 (2.4 to 3.8) mm per year from 1993 to 2003.
- Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 (2.1 to 3.3) percent per decade, with larger decreases in summer of 7.4 (5.0 to 9.8) percent per decade. Mountain glaciers and snow cover have declined on average in both hemispheres.
- Since 1900, precipitation has increased significantly in eastern parts of North and South America, northern Europe, and northern and central Asia, whereas precipitation declined in the Sahel, the Mediterranean, southern Africa, and parts of southern Asia. Globally, the area affected by drought has likely increased since the 1970s.
- Average Northern Hemisphere temperatures during the second half of the twentieth century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years.

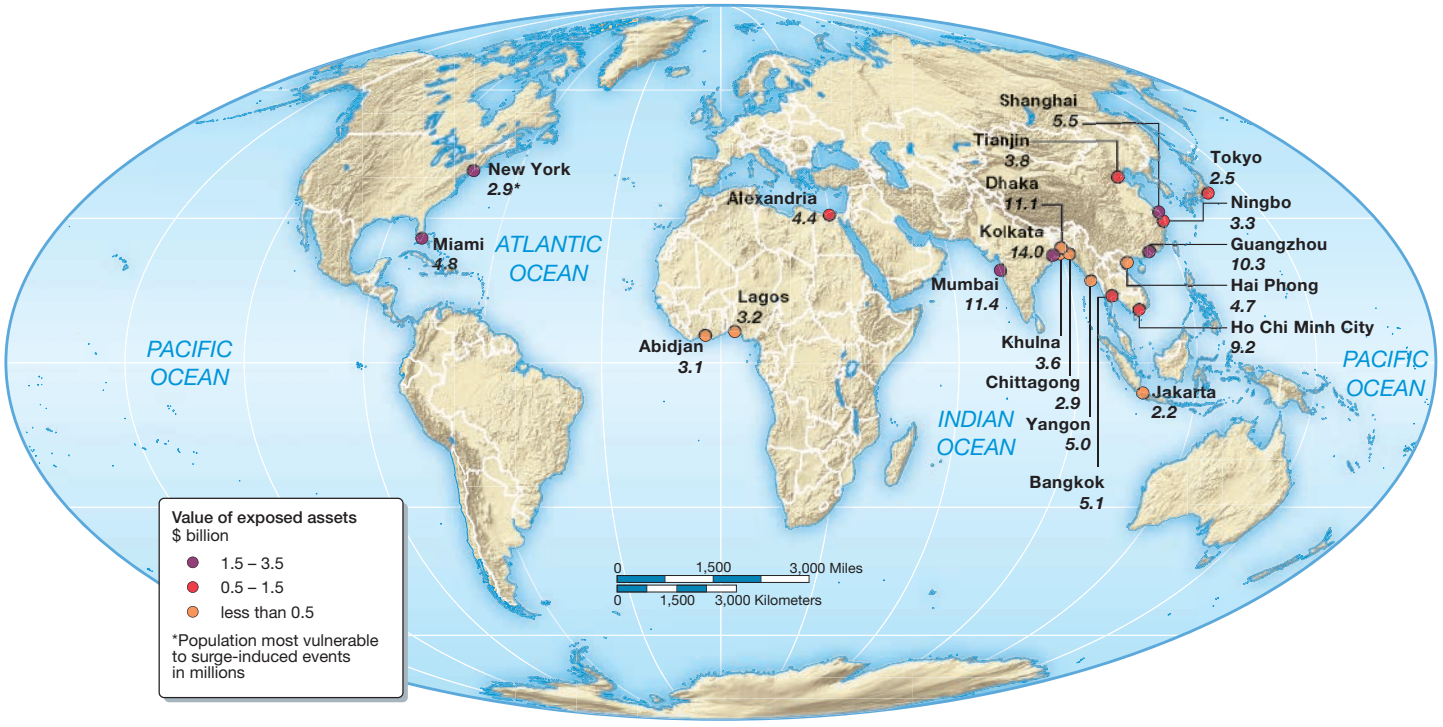
What Are Some Projected Impacts of These Changes?

The effects of climate change are not only expected to happen in the future, many of them are already occurring.

- Based on a range of models, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases of tropical sea-surface temperatures.
- Crop productivity is projected to increase slightly at mid- to high latitudes for local mean temperature increases of up to 1° to 3°C, depending on the crop, and then decrease beyond that in some regions. At lower latitudes, especially in seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increases (1° to 2°C), which would increase the risk of hunger.
- Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. A rising sea level would be disastrous for some countries. About 70 percent of Bangladesh, for example, is at sea level, as is much of Egypt's most fertile land in the Nile delta (**Figure 4.15**).



▲ **Figure 4.14** Major indicators of climate change This diagram shows the major observed indicators of climate change, including higher temperatures over land and oceans, higher humidity, and higher sea levels.



▲ **Figure 4.15** Effect of rising sea level on major cities This graphic shows the largest cities vulnerable to rising sea waters by the year 2070.

(*Source:* http://phys.org/news/2012-11-sea-levels-faster-ipcc.html, accessed June 22, 2016.)

- The health status of millions of people is projected to be affected through, for example, increase in malnutrition; increased deaths, diseases, and injury due to extreme weather events; increased burden of diarrheal diseases; increased frequency of cardiorespiratory diseases due to higher concentrations of ground-level ozone in urban areas related to climate change; and the altered spatial distribution of some infectious diseases.
- Global climate change is causing sea levels to rise as polar ice caps melt which will greatly affect coastal areas across the globe. This effect is already occurring in northern polar regions as well as among small islands in the southern hemisphere.
- Population growth patterns and the changing geography of economic development allow us to predict with some confidence that the air and water pollution generated by low-income countries will more than double in the next 10 to 15 years as they become more industrialized.
- Climate change is already exacerbating current stresses on water resources from population growth and economic and land-use change, including urbanization.
- The resilience of many ecosystems is already compromised in some places and is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land-use change, pollution, fragmentation of natural systems, overexploitation of resources).

The causes and consequences of these global climate changes vary considerably by where in the world they are unfolding. For example, the industrial countries have higher carbon dioxide emissions. Increased carbon dioxide emissions are contributing to rising temperatures through the trapping of heat in Earth's atmosphere. In order to survive in many of the world's peripheral regions, the rural poor are often impelled to degrade and destroy their immediate environment by cutting down forests for fuelwood, leading to the destruction of forests, which help to cool Earth's surface (**Figure 4.16**). Thus, both the core and the periphery are contributing to the problem of global climate change in different, but significant, ways. Moreover, environmental problems are becoming inseparable from processes of demographic change, economic development, and human welfare and are becoming increasingly enmeshed in matters of national security and regional conflict.

What's to Be Done?

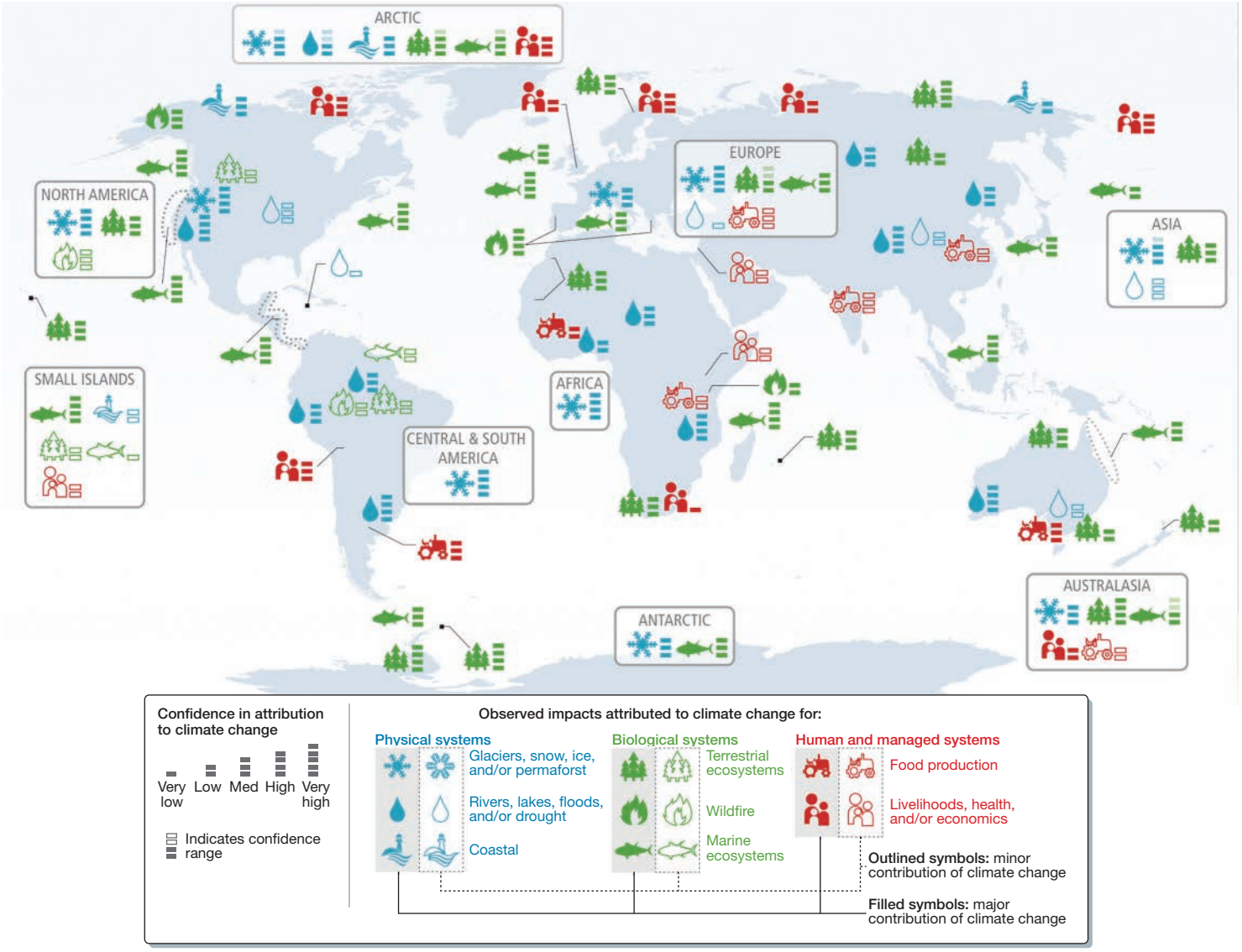
There are many ways that individuals, organizations, and governments can begin to address the effects of climate change as described earlier, from using compact fluorescent light bulbs, buying local produce, and using reusable water bottles instead of disposable ones; developing and expanding local food resources; and supporting clean energy sources such as solar and wind power.

One increasing popular strategy for reducing GHGs is emissions trading. Already an established practice, emissions trading allows governments to regulate the amount of emissions produced in aggregate by setting the overall cap but allowing corporations the flexibility of determining how and where the emissions reductions will be achieved. Corporations that want to limit their emissions are allocated allowances, with each allowance representing a ton of the relevant emission, such as carbon dioxide. Corporations can emit in excess of their allocation of allowances by purchasing allowances from the market. Similarly, a company that emits less than its allocation of allowances can sell its surplus allowances.

The Climate Change Controversy

Despite overwhelming consensus from the international scientific community, a small number of critics—known as climate change deniers or skeptics—do not accept that Earth's climate is being changed by human activities. These individuals are generally not climate scientists and they do not publish in

► **Figure 4.16** Deforestation in the state of Para, Brazil Shown here is a section of the Jamanxim National Forest where illegal clear-cutting has occurred. Large areas of deforestation like this one are not uncommon in the Amazonian rainforest.



▲ **Figure 4.17** Climate change impacts on earth systems The Fifth IPCC Report provides helpful information on the already observed impacts of climate change, such as on physical systems, biological systems, and human and managed systems, as shown here. (*Source:* http://ipcc-wg2.gov/AR5/press-events/press-kit/, accessed June 22, 2014.)

peer-reviewed scientific journals or engage in debate at conferences on climate science. Yet many of them are influential individuals as members of Congress or as chief officers of large corporations and as such have access to news media that feel compelled to offer a balanced perspective on the problem. The objective of this group of climate skeptics is to delay or prevent action by government to address climate change such as initiatives to push for alternative energy sources or tighter regulations for high-polluting energy like coal. Their approach has been to insist that global warming is a theory, not a fact, and as such, little or no regulatory action is needed.

A comprehensive study of 928 articles published on climate change in peer-reviewed scientific journals over a ten-year period found that not one of the articles disagreed with the scientific consensus that human-induced climate change is occurring. To gain a better understanding of the arguments advanced by climate change deniers click on the following link to an article in Scientific American that addresses them. It provides fact-based evidence to rebut climate change skepticism.

Response to Climate Change Denialists
http://goo.gl/wdlYga

The IPCC's *Fifth Assessment Report: Mitigation of Climate Change* (2014) provides helpful data about the state of the world's climate and efforts to mitigate the effects of global warming in a format that is easily accessible to a lay audience. The report understands mitigation as an effort to stabilize greenhouse gases in the atmosphere to prevent the dangerous effects of human-induced change. It also recognizes that mitigation must be achieved in such a way that ecosystems will not be fatally threatened, food production will not be compromised, and economic development will occur in a sustainable manner (**Figure 4.17**).

IPCC Fifth Assessment Report
http://goo.gl/QEqZCm

APPLY YOUR KNOWLEDGE

1. List some of the physical evidence for climate change. Why do you think climate change is considered controversial?
2. Do you see climate change effects in your everyday life? If so, what are they? Where does your food come from (vegetables, dairy, meat, and fish) and have you noticed changes in access, price, and quality over time? Has your home region experienced more or fewer hurricanes, tornados, tidal waves, flooding, heat waves, droughts, fires, or blizzards, for example, over the last 50 years?

ENERGY, LAND-USE CHANGE AND ENVIRONMENT

Certainly the most central and significant technological breakthrough of the Industrial Revolution was the discovery and utilization of fossil fuels: coal, oil, and natural gas. Although the very first factories in Europe and the United States relied on waterpower to drive machinery, hydrocarbon fuels provided a more constant, dependable, and effective source of power. A steady increase in power production and demand since the beginning of the Industrial Revolution has been paralleled, not surprisingly, by an increase in resource extraction and conversion. **Box 4.2**, "Spatial Inequality: Energy Consumption and Production" provides insight into the global variation that exists in energy use.

Energy Needs and Environmental Impacts

The burning of home heating oil, along with the use of petroleum products for fuel in internal combustion engines, also launches harmful chemicals into Earth's atmosphere—causing air pollution and related health problems. The production and transport of oil have resulted in oil spills and substantial pollution of water and ecosystems. Media images of damage to seabirds and mammals after tankers have run aground and spilled oil have shown how immediate the environmental damage can be. Indeed, the oceans are acutely affected by the widespread use of oil for energy purposes. There is no better example of the damage of oil spills to the environment than the accident that occurred when British Petroleum's *Deepwater Horizon* oil rig exploded and caught fire on April 20, 2010, in the Gulf of Mexico, 400 km (250 miles) offshore of Houston.

The explosion killed 11 people and injured at least two dozen more when a blowout preventer, intended to check the release of oil, failed to activate. As the well continued to leak an estimated 40,000 barrels of oil a day before it was effectively capped, oil slicks spread across the Gulf from Florida to Texas, contaminating the environment and seriously damaging the Gulf coastal fisheries and tourism economy, especially in Louisiana, Mississippi, Alabama, and northern Florida. When the well was finally capped three months after the explosion, it is estimated that a total of 4.9 million barrels, or 205.8 million gallons, of oil had been released into the environment. As the world's largest accidental oil spill to date, it will continue to contaminate or damage marine and terrestrial life—both human and nonhuman (**Figure 4.18**). Despite the huge cost of the Gulf oil spill cleanup (estimated at $40 billion) to British Petroleum, the company registered a 17 percent profit in its 2011 first-quarter earnings.

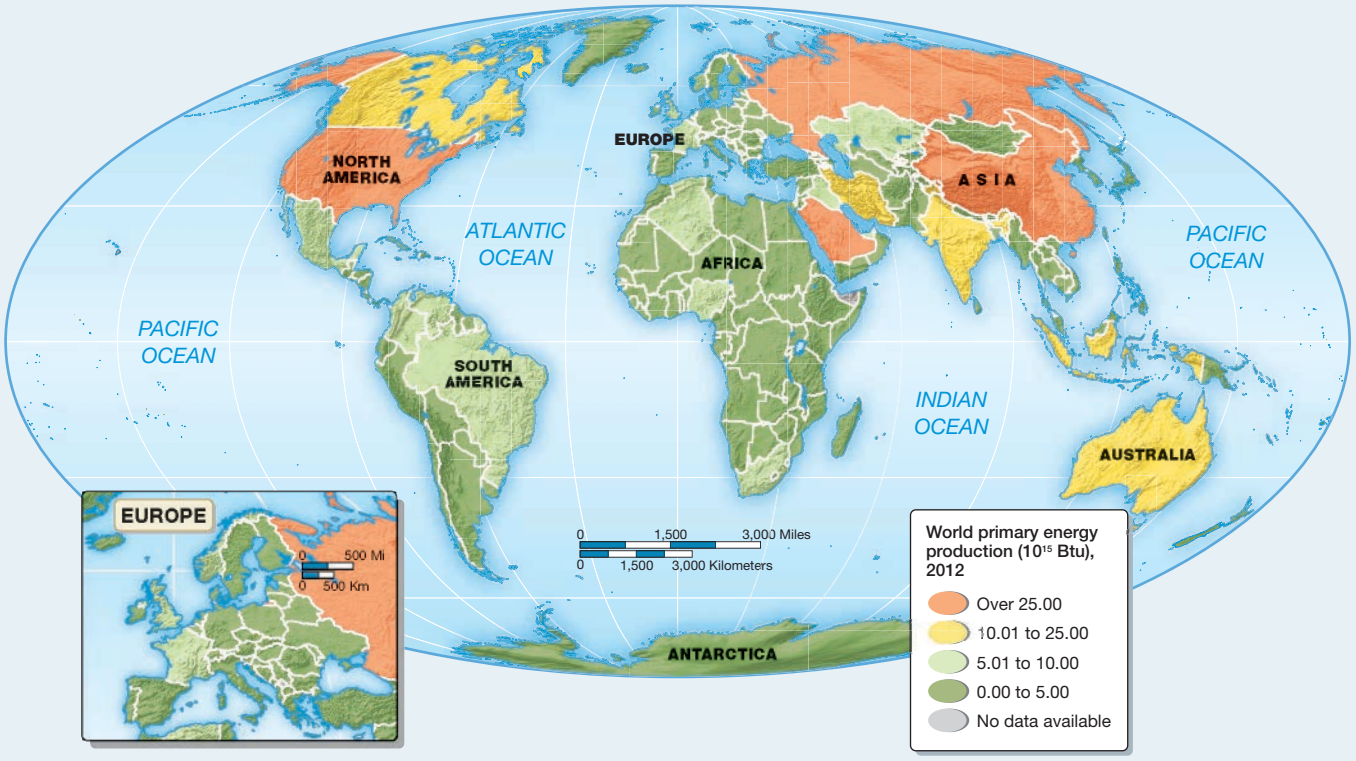
Natural gas is one of the least noxious of the hydrocarbon-based energy resources because its combustion is relatively clean. Now supplying nearly one-quarter of global commercial energy, natural gas is predicted to be the fastest-growing energy source in this century. Reserves are still being discovered, with Russia holding the largest amount—about one-third of the world's total (**Figure 4.19**). While regarded as a preferred alternative to oil and coal, natural gas is not produced or consumed without environmental impacts. The risk of explosions at natural gas conversion facilities is significant; groundwater contamination and leakages and losses of gas from distribution systems contribute to the deterioration of Earth's atmosphere, as well as increasingly, some of the unintended effects of fracking as a form of natural gas mining.

▶ **Figure 4.18** Oil spill caused by the explosion of the *Deepwater Horizon rig* Pictured is an aerial view of crude oil on May 24, 2010, in Elmer Island, Louisiana. Skimmer ships, floating containment booms, anchored barriers, and sand-filled barricades were assembled along shorelines as chemical dispersants were used to attempt to prevent hundreds of miles of beach and wetlands from the spreading oil. In addition, underwater plumes of dissolved oil not visible on the surface and a 210 kilometer (80 square mile) "kill zone" surrounding the blown well were reported by scientists.

4.2 Spatial Inequality

Energy Consumption and Production

At present, the world's population relies most heavily for its energy needs on nonrenewable energy resources that include fossil fuels and nuclear energy, as well as renewable resources such as biomass, solar, hydroelectric, wind, and geothermal power. The distribution and production of the world's energy resources as well as its consumption, however, are deeply spatially uneven (**Figure 4.D** & **4.E**). Currently, 30 percent of the world's oil supplies are



▲ **Figure 4.D** Global energy production, 2012 This map provides a picture of energy production around the world. The United States is the largest producer. (*Source:* Adapted from US Energy Information Administration http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm#.)

located in the Middle East, and most of the coal is mined from the Northern Hemisphere, with China accounting for 41 percent of world production, followed by the United States at 19 percent, and the former Soviet Union at 8 percent. Nuclear reactors are a phenomenon of the core regions of the world as well. For example, France has 59 nuclear reactors operated by government-owned Electricité de France, supplying the country with over 430 billion kilowatt hours of electricity per year, which is 78 percent of the total generated there.

The consumption of energy is also spatially unequal as it relies on the ability to pay as well as the ability to afford the mitigation costs of its environmental impacts. In one year, global energy consumption is equal to about 1.3 billion tons of coal. What is most remarkable is that this is four times what the global population consumed in 1950 and 20 times what it consumed in 1850. The affluent core regions of the world far outstrip the peripheral regions in energy consumption. With nearly four times the population of the core regions, the peripheral regions account for less than one-third of global energy expenditures. Yet consumption of energy in the peripheral regions is rising quite rapidly as globalization spreads industries, energy-intensive consumer products such as automobiles, and energy-intensive agricultural practices into regions of the world where they were previously unknown. It is projected that within the next decade or so, the peripheral regions will become the dominant consumers of energy-dependent products from appliances to homes to vehicles.

Finally the effects of energy production and consumption are also unevenly experienced. Every stage of the energy conversion process—from discovery to extraction, processing, and utilization—has an impact on the physical landscape as well as the populations who live on or near that landscape. In the coalfields of the world, from the U.S. Appalachian Mountains to western Siberia, mining results in a loss of vegetation and topsoil, in erosion and water pollution, and in acid and toxic drainage. It also contributes to cancer and lung disease in coal miners. Coal burning, is associated with relatively high emissions of environmentally harmful gases, such as carbon and sulfur dioxide, most directly affects populations living close to coal plants, especially in countries with limited environmental regulations.

1. Why is energy consumption on the rise for peripheral countries?
2. Compare the effects of nuclear, coal, and oil energy consumption on the social and natural environments. Is one fuel source more destructive than the others? Why?