

Figure 1.12
Concepcion, Chile. Satellite image of the cities of Concepcion and Hualpen, Chile hours after an 8.8 magnitude earthquake occurred in 2010. The damage to the city is not noticeable in this satellite image except for the smoke plume from an oil refinery in the lower left corner.
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Figure 1.13
Concepcion, Chile. Chile has broadly adopted engineering and architecture practices that lessen the impact of earthquakes. Although the 2010 earthquake caused over \$30 billion worth of damage, it could have been much worse without these building practices. Most of the damage in Concepcion was to residential buildings like this one. © AP/Wide World Photos.

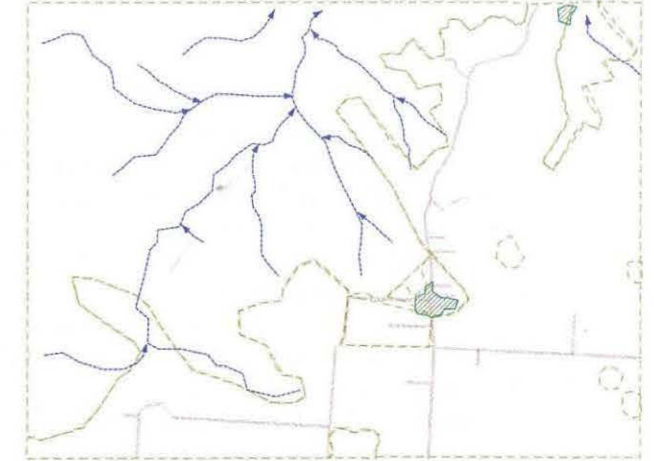
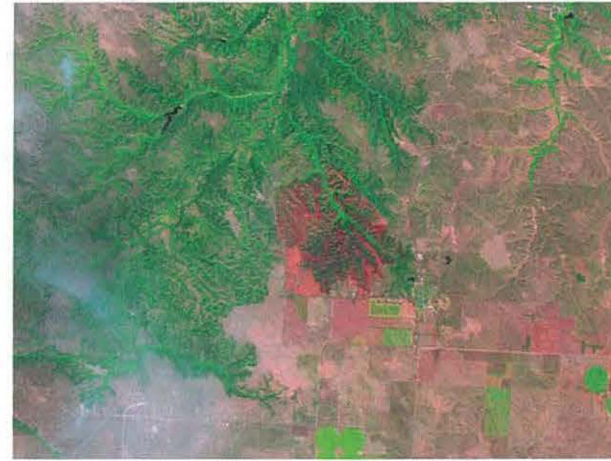


Figure 1.14
Two Representations of St. Francis, South Dakota. (left) panchromatic raster satellite image collected in 2002 at 10 m resolution during a grassland wildfire; (right) vector data—rivers, roads, cities, and land use/land cover digitalized from the image. Courtesy of: Joseph J. Kerski using ArcGIS software from Environmental Systems Research Institute, Inc.

Geographers also use GIS to analyze data, which can give us new insights into geographic patterns and relationships.

Geographers use GIS in both human and physical geographic research. For example, political geographers use GIS to map layers showing voters, their party registration, their race, their likelihood of voting, and their income in order to determine how to draw voting districts in congressional and state legislative elections. In this case, a geographer can draw a line around a group of people and ask the computer program to tally how many voters are inside the region, determine what the racial composition is of the district, and show how many of the current political representatives live within the new district's boundaries.

Geographers trained in GIS employ the technology in countless undertakings. Students who earn undergraduate degrees in geography are employed by software companies, government agencies, and businesses to use GIS to survey wildlife, map soils, analyze natural disasters, track diseases, assist first responders, plan cities, plot transportation improvements, and follow weather systems. For example, a group of geographers working for one GIS company tailors the GIS software to serve the branches of the military and the defense intelligence community. The vast amounts of intelligence data gathered by the various intelligence agencies can be integrated into a GIS and then analyzed spatially. Geographers working in the defense intelligence community can use GIS to query a vast amount of intelligence, interpret spatial data, and make recommendations on issues of security and defense.

The amount of data digestible in a GIS, the power of the location analysis that can be undertaken on a computer platform, and the ease of analysis that is possible using GIS software applications allow geographers to answer compli-

cated questions. For example, geographer Korine Kolivras analyzed the probability of dengue fever outbreaks in Hawaii using GIS (Fig. 1.15). The maps Kolivras produced may look as simple and straightforward as the cholera maps produced by Dr. John Snow in the 1800s, but the amount of data that went into Kolivras's analysis is staggering in comparison. Dengue fever is carried by a particular kind of mosquito called the *Aedes* mosquito. Kolivras analyzed the breeding conditions needed for the *Aedes* mosquito, including precipitation, topography, and several other variables, to predict what places in Hawaii are most likely to experience an outbreak of dengue fever.

A new term of art used in geography is GISci. Geographic information science (GISci) is an emerging research field concerned with studying the development and use of geospatial concepts and techniques to examine geographic patterns and processes. Your school may have a program in GISci that draws across disciplines, bringing together the computer scientists who write the programs, the engineers who create sensors that gather data about the Earth, and the geographers who combine layers of data and interpret them to make sense of our world.



Use Google Earth to find a place where a humanitarian crisis is occurring today (such as Haiti or Pakistan) and study the physical and human geography overlaid on Google Earth in this place. How does studying this place on Google Earth change your mental map of the place and/or your understanding of the crisis?