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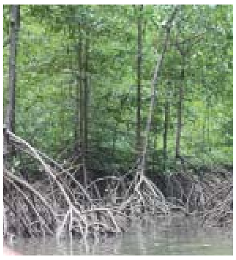
Ancient water is used to irrigate a desert

Murzuq Basin, Libya

Ninety-five per cent of Libya's water comes from "fossil water" in aquifers that are not being significantly recharged



Environmental Science Alert

Global mangrove extent much smaller than previously estimated

Research based on thousands of high-resolution satellite images reveals that mangrove forests have declined by 12 per cent more than previously estimated

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Satellite images record how wildfires have destroyed one million hectares of forests in western Russia

Wildfires during the summer of 2010 burned one million hectares of forest, harmed some 40 000 ha of protected area, and destroyed 20 per cent of Russia's wheat crop

Did You Know?

Botswana has the world's highest human to elephant ratio, at 14 to 1 (UNEP 2008).

Environmental Hotspot Alert

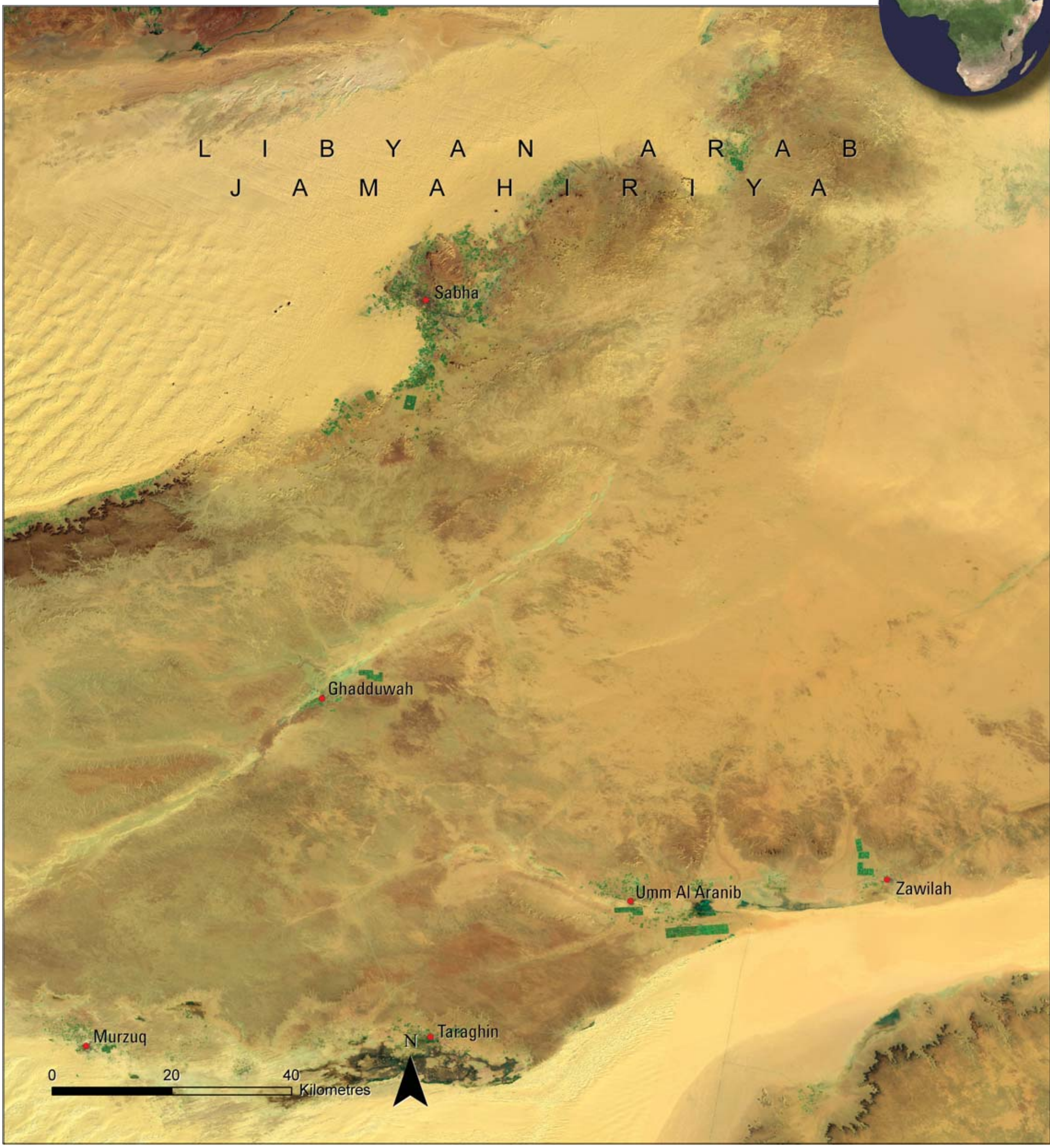
Thematic Focus: Resource Efficiency and Ecosystem Management

Ancient water is used to irrigate a desert
Murzuq Basin, Libya

Why is this issue important?

Libya relies on groundwater to meet 95 per cent of its water requirements; it is primarily "fossil water" from non-recharging aquifers such as the Nubian Sandstone Aquifer System, the North-Western Sahara Aquifer System and the Murzuq Basin Aquifer System (Alker 2008). In the 1960s, the discovery of water in deep aquifers located under Libya's southern desert inspired an enormous water

Figure 1: Satellite imagery from 1987 shows some irrigation in the Murzuq Basin.



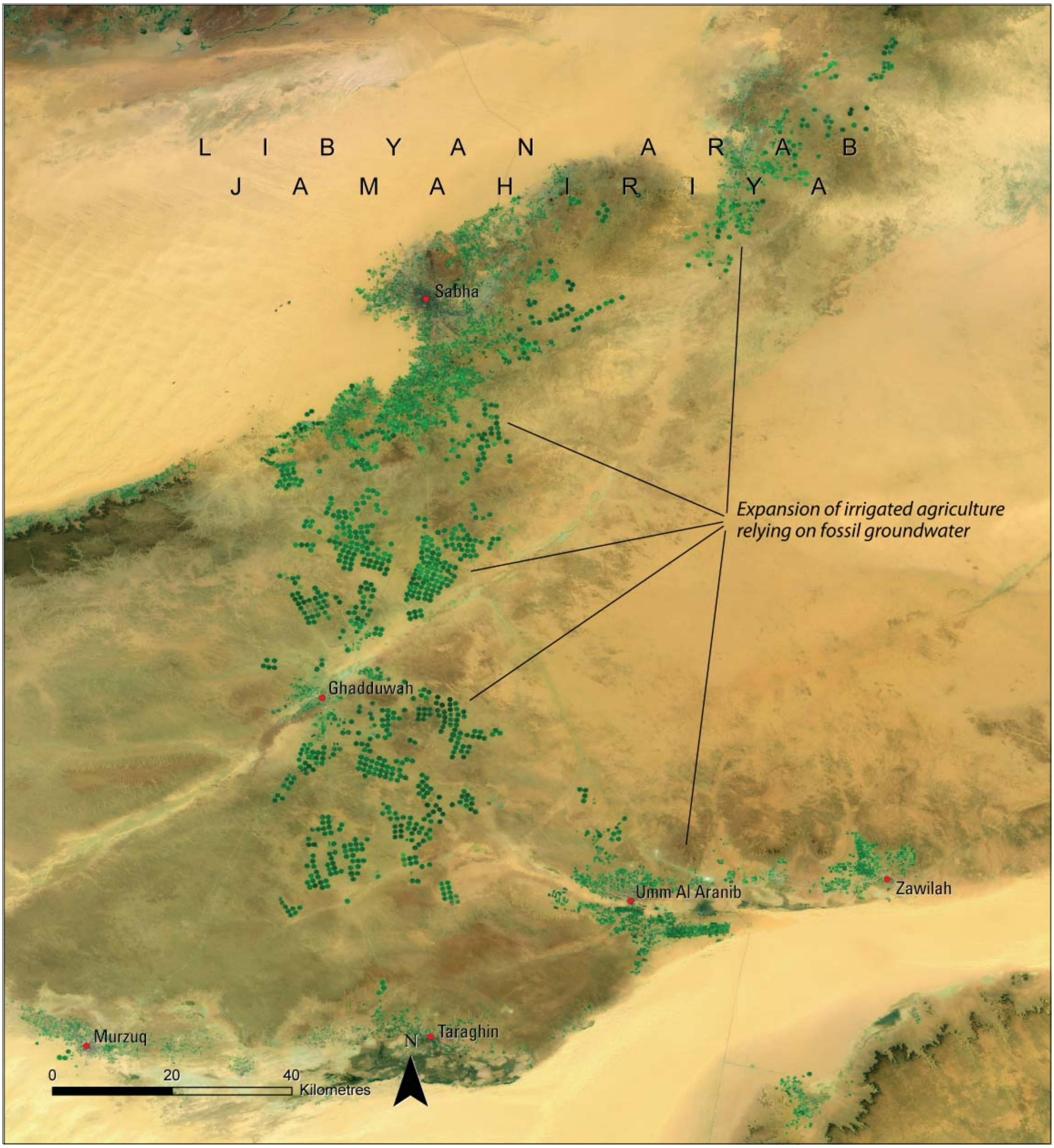
transfer scheme—the Great Man-Made River Project. Begun in the 1970s, the project brings water from well fields in the Sahara to Libya's settlements, which are generally concentrated along its northern coast. The system is among the largest civil engineering projects in the world.

The majority of the system's water comes from Libya's two largest groundwater resources—the Murzuq and Kufra groundwater basins. Located in Libya's southern desert they hold over two-thirds of Libya's groundwater reserves (Alghariani 2007). While the total volume of water in the two aquifers is enormous, neither receives significant recharge. Heavy usage could draw the water down to levels that would eventually make its extraction prohibitively expensive (Shaki and Adeloye 2006, Alghariani 2003).

What are the findings and implications?

The satellite image pair (Figures 1 and 2) shows the large increase in centre-pivot irrigation on the Murzuq Basin in southeastern Libya between 1987 and 2010. The water is drawn from the East and North East Jabal

Figure 2: Green squares and circles of irrigated crops stretch across the Murzuq Basin in this March 2010 satellite image.



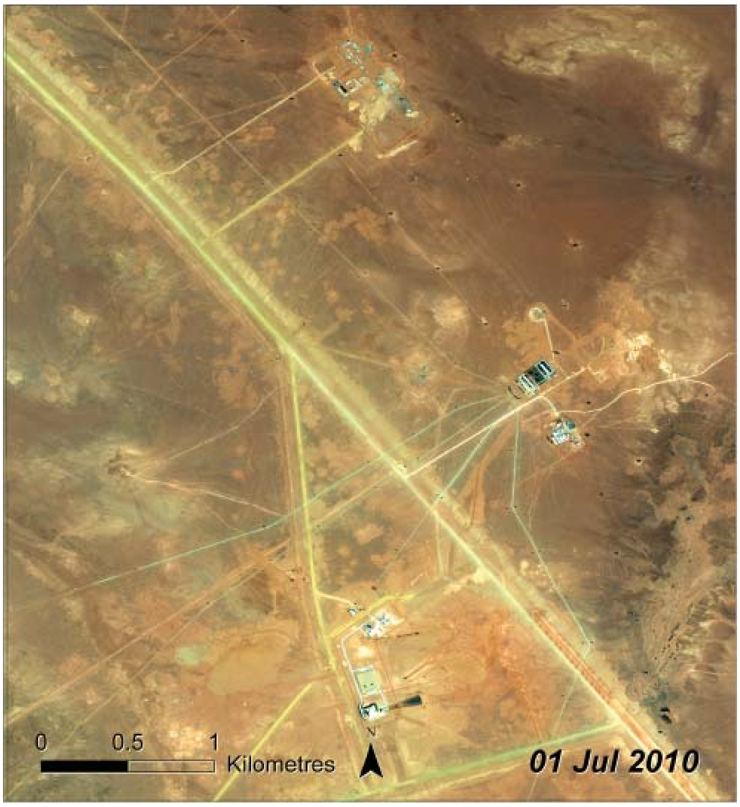


Figure 3: Wells and pipelines like these at the Jabal Hasaouna well fields supply water for Libya's Great Man-Made River Project.

Hasaouna well fields, which abstract around two million m^3 of water daily from the Murzuq Basin Aquifer (Abdelrhem and others 2008).

As much as 80 per cent of Libya's water is used for agriculture, including wheat, alfalfa, vegetables and fruits (Alghariani 2007). Water and agricultural demands are driven by Libya's population growth, which was increasing at just over two per cent a year in 2008, down from five per cent a year in the early 1980s (World Bank 2010). Since the initiation of the project in 1983, the cost of alternative sources of water, particularly desalinization, has become competitive with water delivered by the Great Man-Made River transfer scheme (Alghariani 2003) and will likely become less expensive in the foreseeable future (USGS 2010; Khawaji and others 2008).

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Environmental Science Alert

Thematic Focus: Ecosystem Management, Disasters and Conflicts, and Climate Change

Global mangrove extent much smaller than previously estimated

Why is this issue important?

As confirmed by the impacts of the December 2004 Asian tsunami and Hurricane Katrina in 2005, intact mangroves help stabilize shorelines and thus protect lives and property from such natural disasters. They also provide other ecosystem services, such as breeding and nursing grounds for marine species and sources of food, medicine, fuel, and building materials for local communities. In addition, living mangroves store carbon, keeping it out of the atmosphere. It is possible that mangroves and the soils they grow in could sequester about 22.8 million metric tonnes of carbon each year. Mangrove forests occur between the sea and land and are thought to cover about a quarter of the world's tropical and subtropical intertidal zones, mostly between 5° N and 5° S latitude. Research reveals that the forests have been declining at an alarming rate, however—perhaps even faster than inland tropical forests—and much of what is left is degraded. From1980 to 2000, mangroves around the world declined by an estimated 35 per cent. Remaining mangrove forests are under immense pressure from clear cutting, especially for farming and aquaculture; encroachment; hydrological alterations; chemical spills; storms; and climate change. Until recently, however, little was known about their current distribution, rate and causes of deforestation, and potential rehabilitation sites (Giri and others 2010).

What are the findings and implications?

In 2010, the most comprehensive and globally consistent worldwide mangrove database to date was created using thousands of satellite images with the highest resolution (30 m) possible (Giri and others 2010). Analysis found that the total area of mangroves in the year 2000 was 137 760 km^2 in 118 countries and territories in the world's tropical and subtropical regions. The largest mangrove extent is found in Asia (42 per cent) followed by Africa (20 per cent), North and Central America (15 per cent), Oceania (12 per cent) and South America (11 per cent). Approximately 75 per cent of mangroves are concentrated in just 15 countries. Only 6.9 per cent fall within existing protected areas networks (under IUCN's I-IV categories). Analysis of the satellite imagery found that mangroves have declined significantly more than previously estimated—they cover an area that is 12.3 per cent smaller than the most recent estimate by the Food and Agriculture Organization (FAO) of the United Nations.

A previous study of satellite images of coastal areas affected by the 2004 tsunami (Giri and others 2007a) shows that from 1975 to 2005, the region lost 12 per cent of its mangrove forests. Agricultural expansion was the major cause, accounting for 81 per cent of losses. Although aquaculture was responsible for only 12 per cent, the industry is growing rapidly. In Thailand, agricultural expansion accounts for half the mangrove losses, but aquaculture is now responsible for 41 per cent. As aquaculture develops, there is a clear need to consider the mangrove forest's value in protecting coastlines and other ecosystem services, which in some areas may be higher in the long term than the economic value of shrimp farming (Ranganathan and others 2008). Giri and others (2007b) shows that mangrove conservation and development need not be mutually exclusive. Population density around the Sundarbans mangrove forests in Bangladesh and West Bengal is the highest in the world. The area covered by mangroves, however, has changed little over the past 25 years, due to the presence of reserves and other conservation areas, although human activities are degrading the forest's condition.

The information generated by these studies can be used to better understand the role of mangrove forests in saving lives and property from natural disasters such as tsunamis; identify possible areas for conservation, restoration and rehabilitation; and improve estimates of the amount of carbon stored in mangrove vegetation and the associated marine environment (blue carbon).

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Near Real-Time Environmental Event Alert

Thematic Focus: Resource Efficiency, Harmful Substances and Hazardous Waste, Disasters and Conflicts, Environmental Governance, and Ecosystem Management

Satellite images record how wildfires have destroyed one million hectares of forests in western Russia

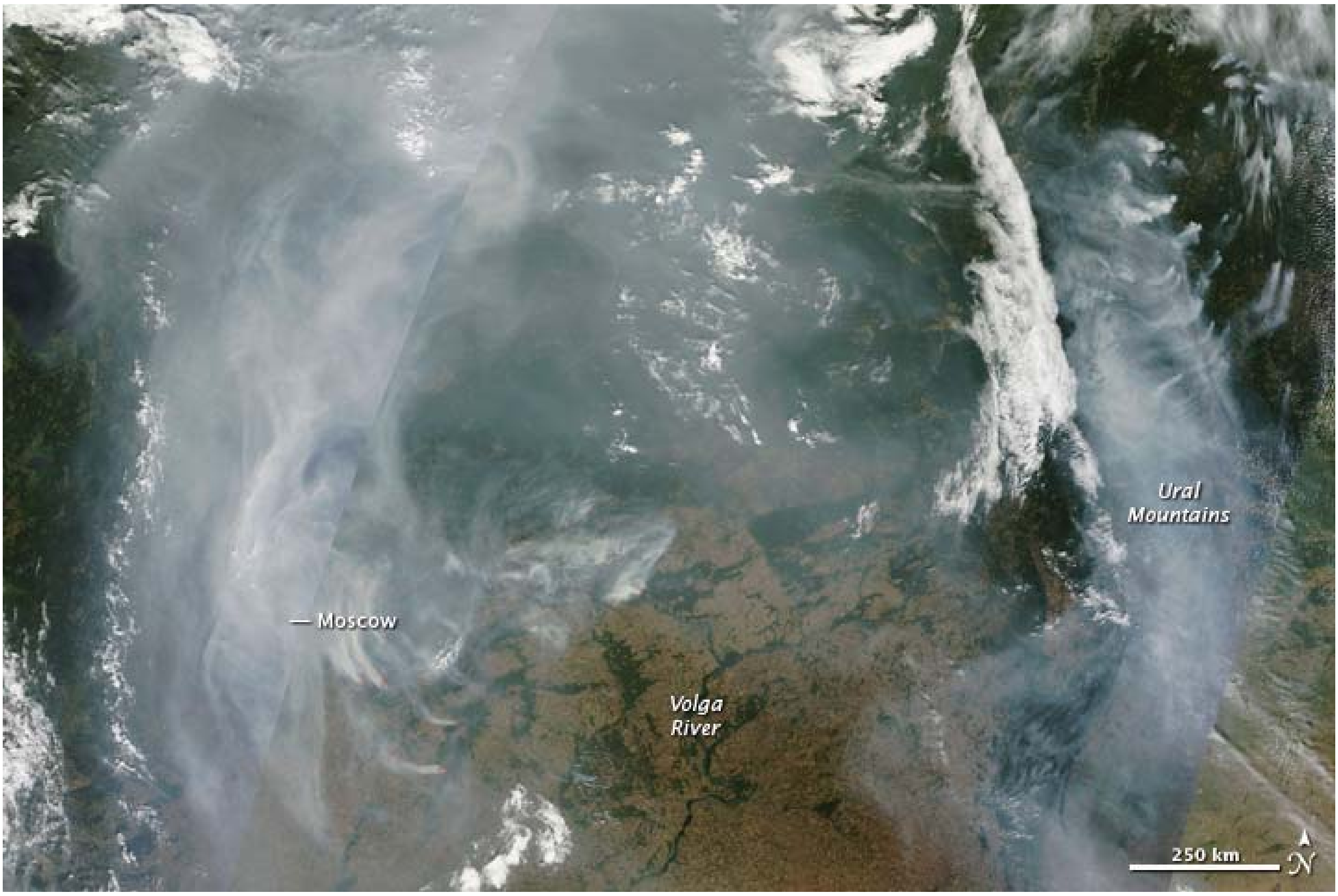
Why is this issue important?

Some types of forest ecosystems in Russia are adapted to wildfires and fire-tolerant trees such as pine (*Pinus*) can withstand high temperatures. Such forests regenerate quickly after fires have swept through. The summer of 2010 was the hottest in Russia in 130 years, however, and frequent temperatures as high as 40°C dried trees that are not fire-tolerant (such as birch), other vegetation, and peat bogs, making them a fire hazard. The heat wave began in June, and by August, fires started by lightning or careless human activity had burned more than 15 million ha of vegetation, including forests and crops (Gilbert 2010). Heat waves and forest fires can also destroy crops: Russia produces about eight per cent of the world's wheat (Hernandez and others 2010), so any threat to its harvest has global repercussions. In addition, smoke, ash and dangerous gases from wildfires affect air quality, with impacts on human health, while forest fires can consume homes and other infrastructure and cause human casualties.

What are the findings and implications?

Recent satellite images show that the summer fires in 2010 destroyed more than one million hectares of forests in western Russia alone and harmed approximately 40 000 ha of protected forest area (UNEP 2010). At one point, states of emergency were in effect in 14 regions in Russia. Forest fires in the western region around Moscow (Figures 1) produced smoke, dust, and dangerous gases that polluted the air; in some places, carbon monoxide was 10 times the permitted maximum (Figure 2). At least 53 people have died and 806 have needed medical attention. Houses

Figure 1: Extensive forest fires in the western region around Moscow and in the Ural region produce clearly visible smoke clouds larger than 1 000 km in extent (Source: NASA 2010).



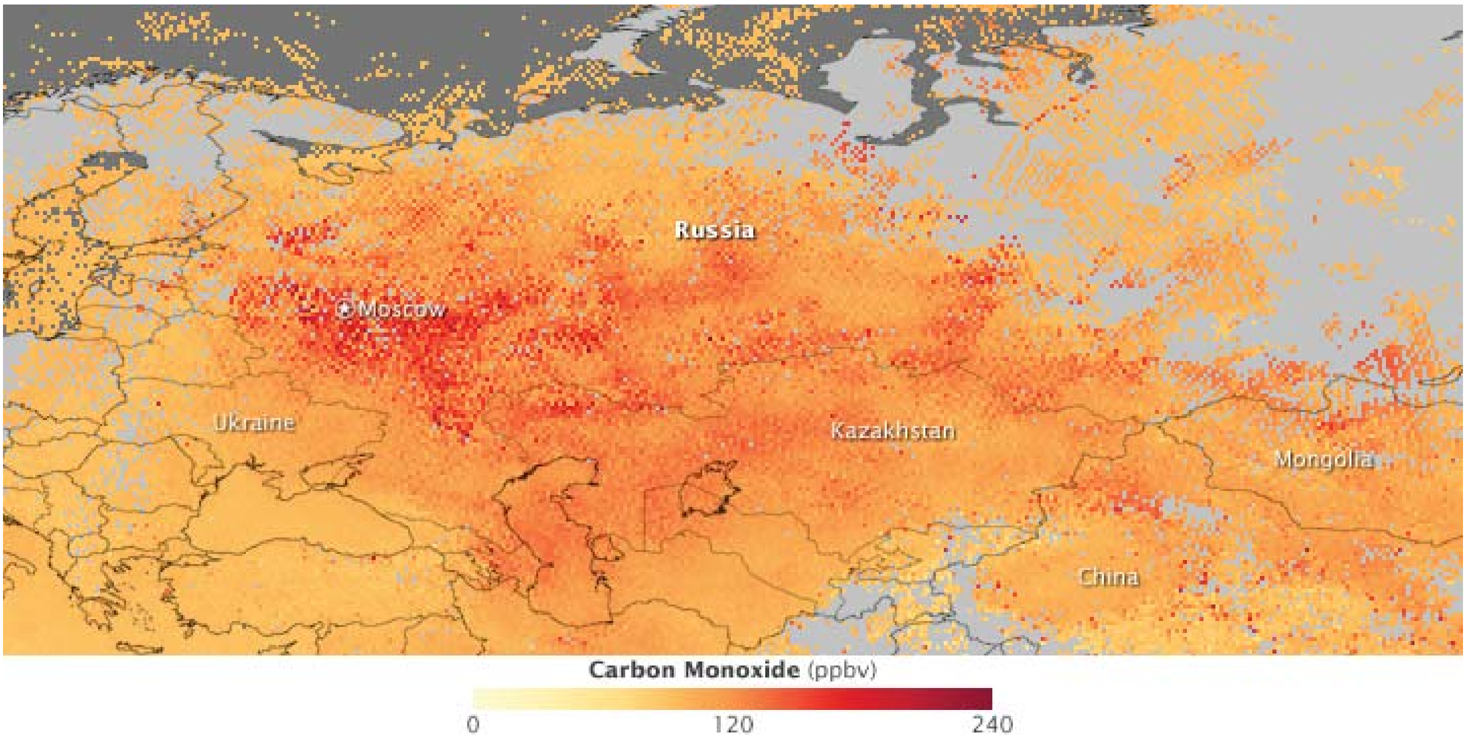


Figure 2: Carbon monoxide concentrations in the atmosphere between 2 and 8 km above Russia as recorded from 1 to 8 August 2010 by NASA (MOPITT). Ground concentrations of this dangerous gas are reported to be much higher, causing people to report headaches, dizziness, and other more serious conditions.

The forest fires near Moscow cover the Red Square in smoke and ash

have burned and harvests have been lost—including some 10 million hectares of grain (Gilbert 2010).

The recent drought and associated fires destroyed 20 per cent of Russia's wheat crop, which represents a 1.6 per cent decline in the global wheat supply (Gilbert 2010). As a result, Russia froze the export of grain, including wheat, barley, rye and corn, from 15 August to 31 December 2010. Forecasts suggest a 38 per cent decline in the 2010 harvest compared to 2009 (Hernandez and others 2010), with likely implications for food security in some regions.

The Russian meteorological agency has noted that the number of dangerous climate events, including heat waves, has doubled over the past 15 years (InfoRussia EU 2010). Climate change and increased climate variability could make such wildfires more common and extend their spread (UNEP 2010). Some areas could also continue to dry out, preventing forests from growing back and leading to the encroachment of grasslands, which are more vulnerable to wildfires. New legislation in 2007 making local regions responsible for forest management, and the lack of capacity of these agencies to protect forests and peat lands may have had a role in the fire severity (WWF 2010).

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