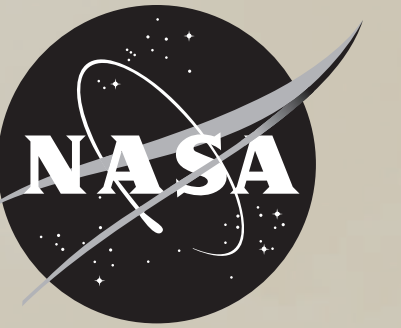


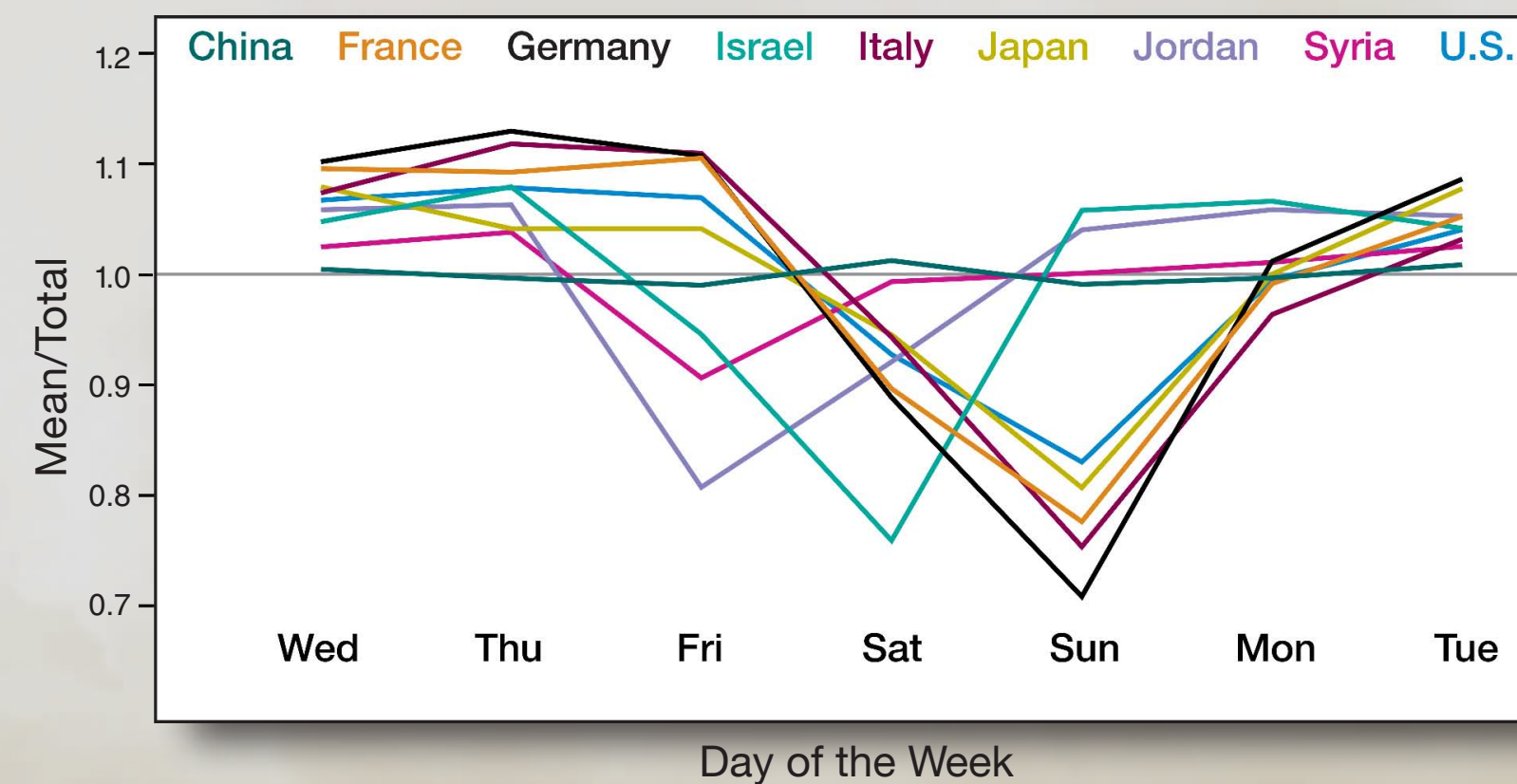
Nitrogen Dioxide



Nitrogen dioxide—or NO_2 —is a toxic gas found in our atmosphere. This gas is a common air pollutant identified by its reddish-brown color. Most NO_2 is emitted by combustion (fossil fuels, wildfires). At high temperatures associated with combustion, molecular nitrogen (N_2) and oxygen (O_2) split into atoms. Once this occurs, the atoms of oxygen and nitrogen can undergo reactions leading to the formation of NO_2 . Motor vehicles, coal-fired power plants, and metal refineries are some of the most common sources of NO_2 , all of which are due to human activity. Soil microbes break down nitrates in soil through natural processes, releasing NO_2 into the atmosphere. NO_2 can also be produced by lightning.

According to the World Health Organization, 2.4 million deaths each year are directly attributable to air pollution. Exposure to relatively high levels of the pollutant NO_2 can cause respiratory problems, especially for those with preexisting health conditions. In addition, NO_2 can react with other pollutants in the atmosphere near Earth's surface to produce high levels of ozone, a gas that is dangerous to breathe and harmful to plants.

NASA's Earth-observing satellites measure air pollution from high above Earth's surface. Measurements of NO_2 are a good indicator of the geographical location of air pollution because NO_2 has a life span of about a day and thus is concentrated near its sources. Maps of NO_2 produced by Aura's Ozone Monitoring Instrument (OMI) science team give us a global picture of industrial and agricultural activity providing valuable information for scientific researchers, and decision- and policy-makers worldwide.

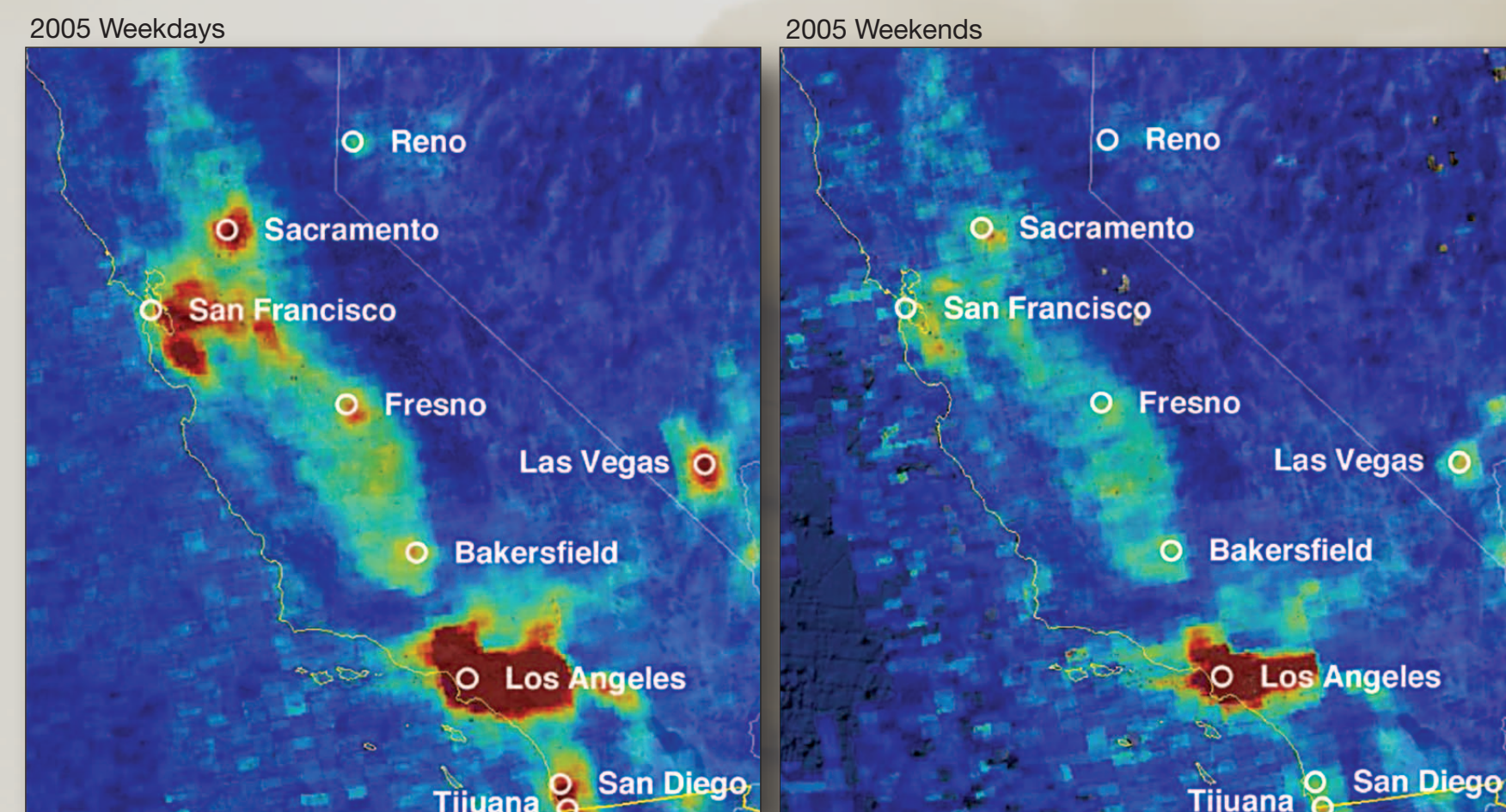
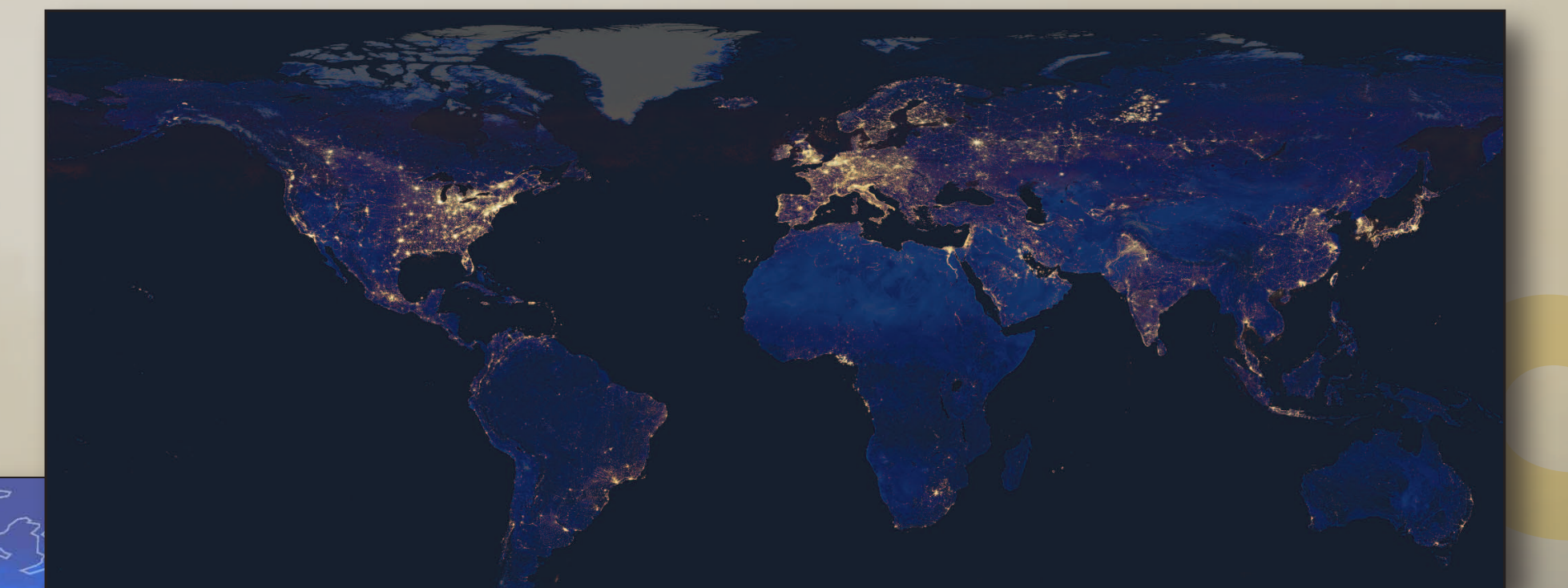


Weekly traffic patterns appear in many cities around the world as a result of heavier or lighter travel. Scientists have observed this so-called weekend effect in the NO_2 data from OMI—see graph.

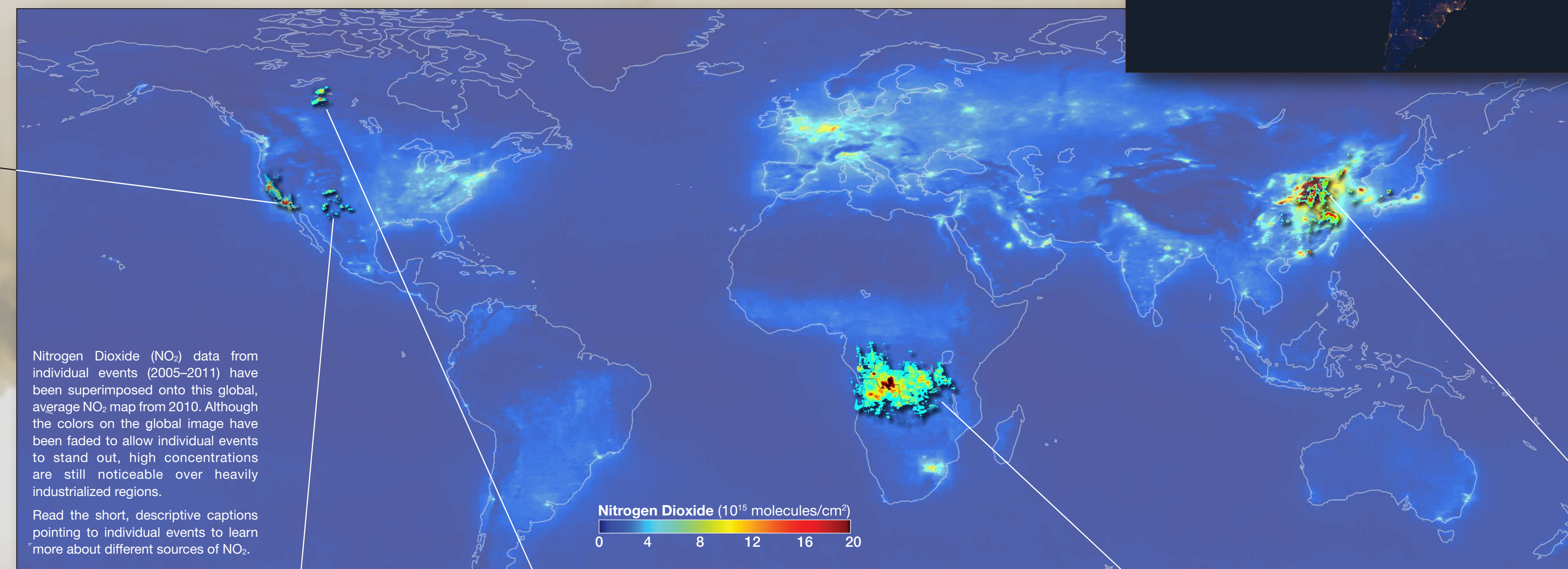
Observance of religious days of the week seems to have an effect on weekly NO_2 levels. The U.S., Germany, Italy, France, and Japan show a pronounced Sunday minimum, while in Israel the minimum occurs on Saturday—the Sabbath, and in Syria and Jordan it happens on the Islamic day of prayer—Friday. In contrast, there is no significant weekend effect for NO_2 levels in China.

The ability to observe this weekend effect is useful because it provides yet another tool to help scientists distinguish between different sources of NO_2 . Each source might exhibit a different weekly pattern (or be constant) and thus helps to distinguish the amount of pollution coming from different sources.

A map of city lights (below), observed by the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS), reveals a unique look at industrialization around the globe. Typically, the highest concentrations of nitrogen dioxide (NO_2) are found in urban areas, along busy roadways, near factories and other large industrial buildings. Looking at the distribution of NO_2 on a world map, some of the highest levels are found in cities such as New York, Beijing, and Brussels. Much cleaner air is found in less populated and industrialized areas, such as in Greenland, northern South America, and western Australia.



A comparison between weekdays (Tuesday-Friday) and weekend days (Saturday-Sunday) shows dramatic differences in atmospheric NO_2 levels above urban cities in California in summer 2005. To learn more about this phenomenon, read the caption above describing the weekly NO_2 plot.



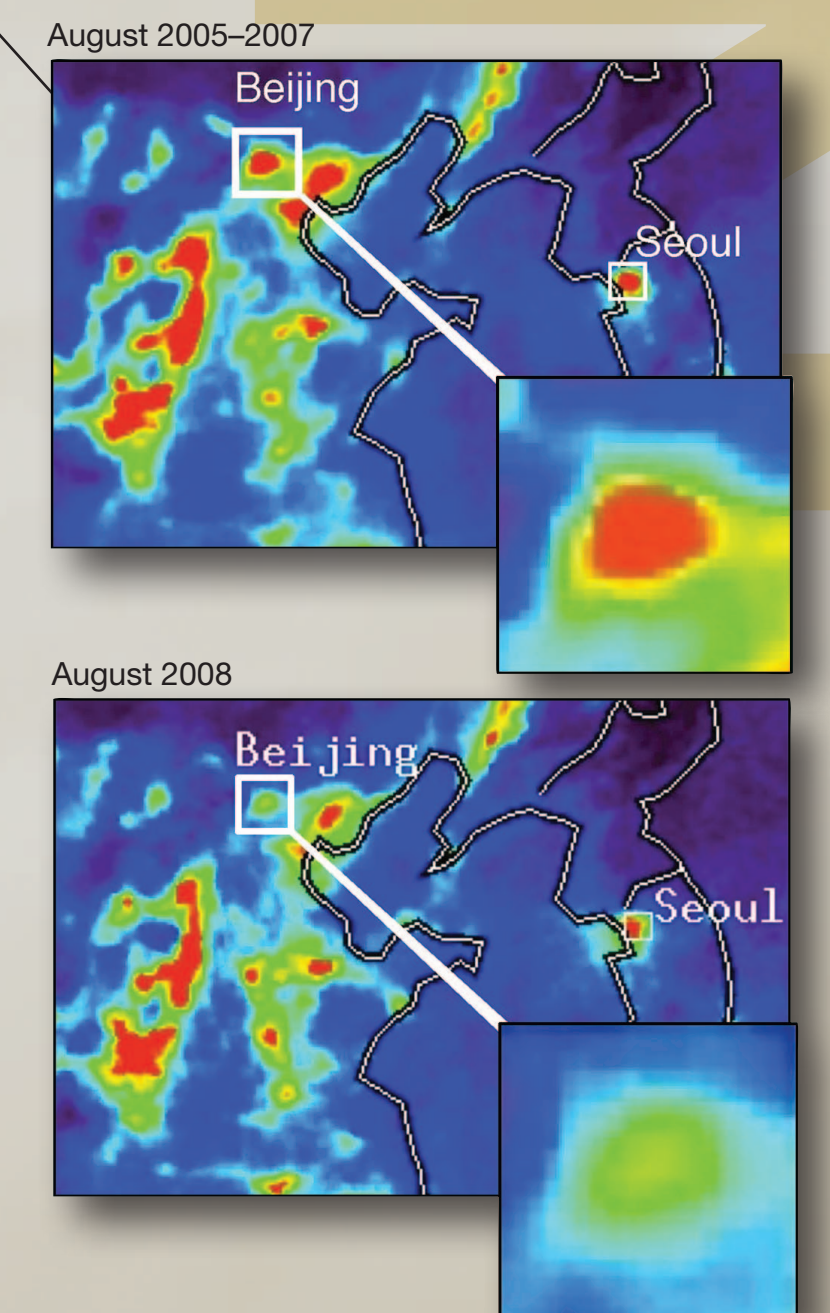
Nitrogen Dioxide (NO_2) data from individual events (2005–2011) have been superimposed onto this global, average NO_2 map from 2010. Although the colors on the global image have been faded to allow individual events to stand out, high concentrations are still noticeable over heavily industrialized regions. Read the short, descriptive captions pointing to individual events to learn more about different sources of NO_2 .

Chinese government regulators had clearer skies and easier breathing in mind for the summer of 2008 when they temporarily shuttered some factories and banished many cars in a pre-Olympic sprint to clean up Beijing's air. The images below depict average NO_2 levels in the atmosphere over eastern China near Beijing.

The first map (below) shows high levels of NO_2 pollution in Beijing during August 2005–2007.

In contrast, the second map shows how levels of NO_2 plunged nearly 50 percent in and around Beijing in August 2008 after officials instituted stringent traffic restrictions in preparation for the Olympic games. Compare that to the area around Seoul, where pollution abatement measures were not taken, but where industrial growth continued between 2005–2008.

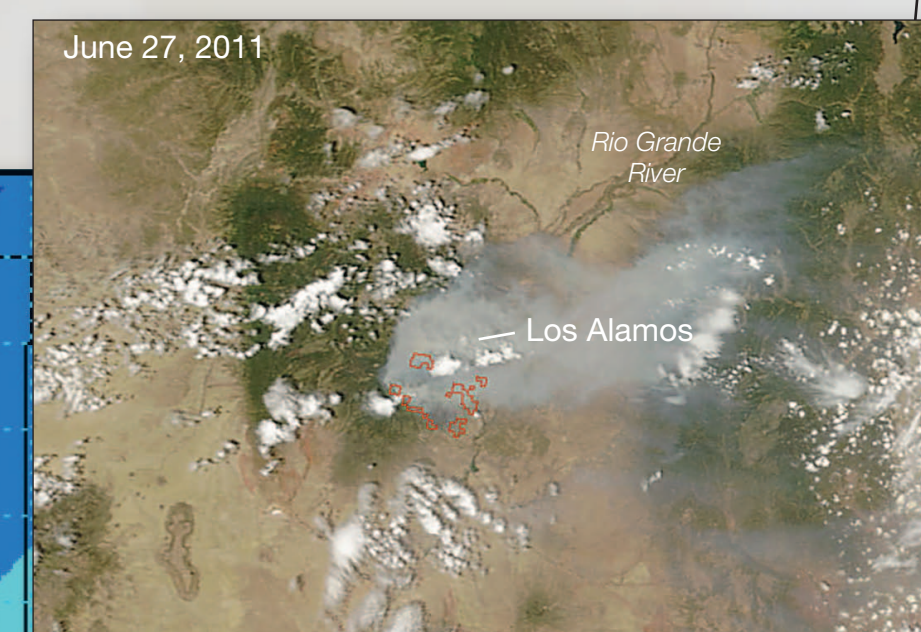
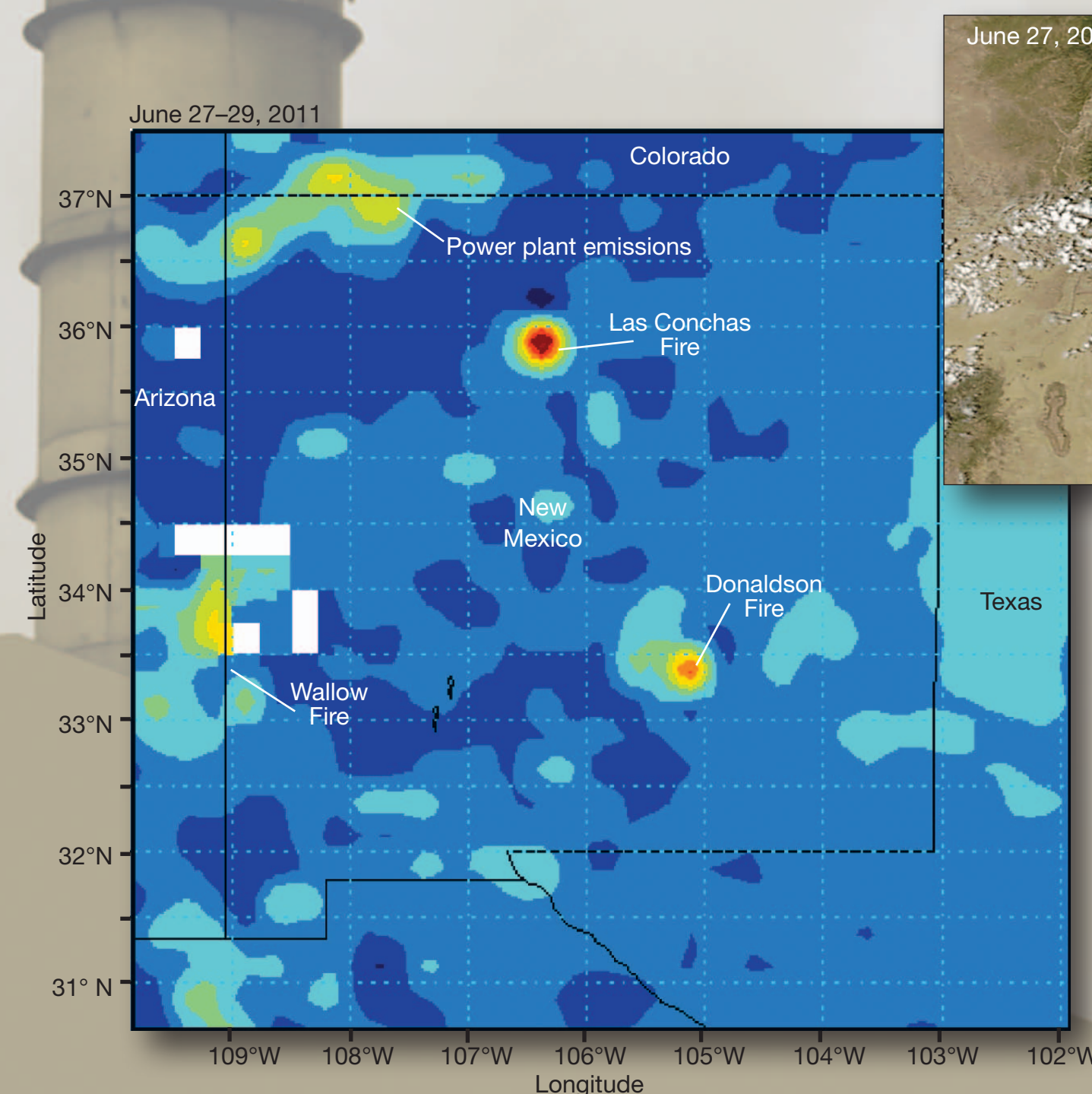
This image pair reveals the dramatic difference humans can have on atmospheric NO_2 and other pollution levels.



Smoke from the fierce Las Conchas forest fire threatened the town and National Laboratory in Los Alamos, New Mexico, while also releasing copious amounts of pollutant gases and smoke.

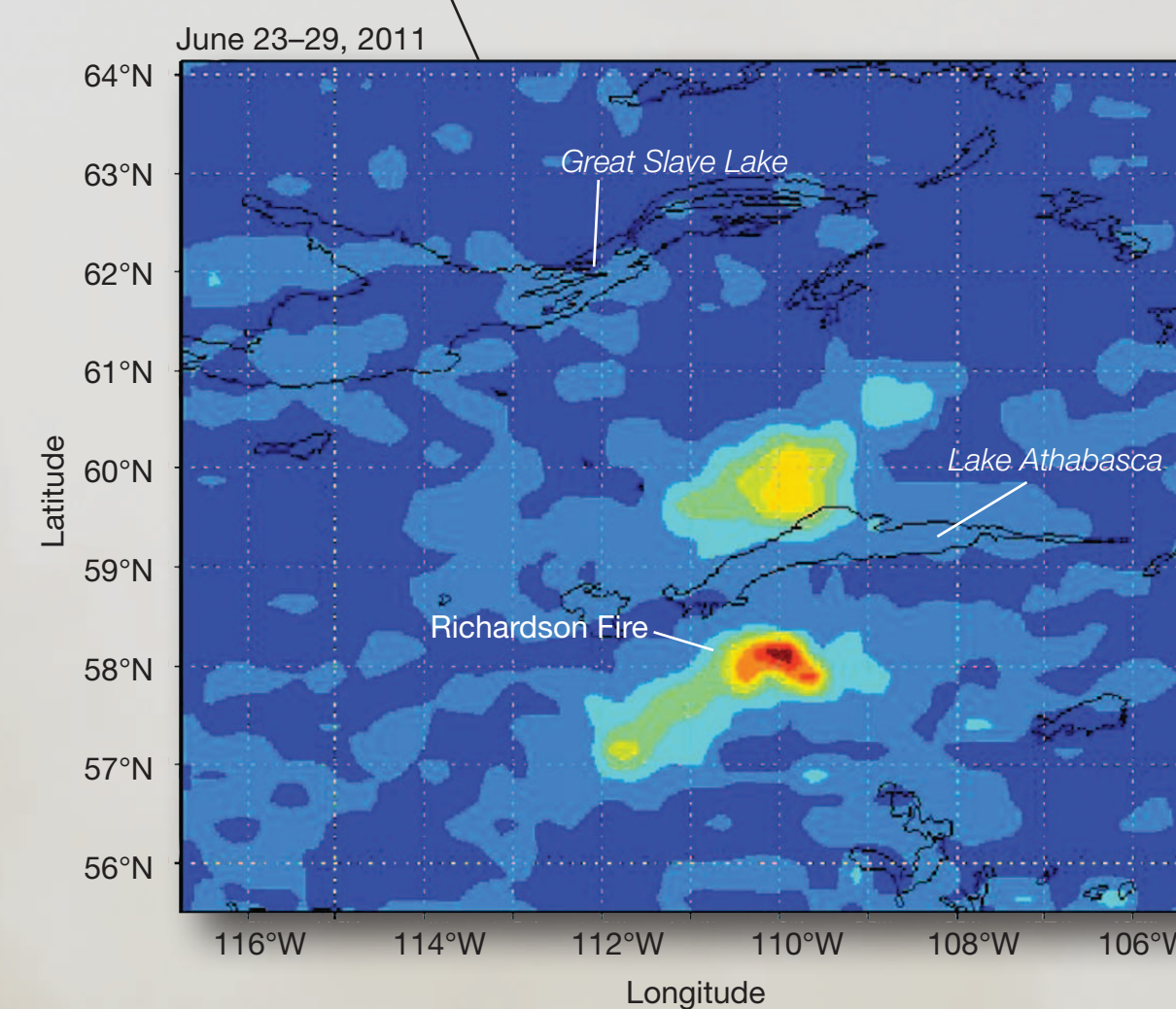
The Ozone Measuring Instrument, onboard NASA's Aura satellite, measured atmospheric concentrations of nitrogen dioxide (NO_2) across Arizona and portions of its neighboring states during June 27–29, 2011.

The highest levels of NO_2 are located at the burn site of the Las Conchas Fire in north central New Mexico. The bull's-eye like target indicates the intensity of NO_2 , with highest concentrations shown in red. The Donaldson Fire also reveals high concentrations of atmospheric NO_2 , revealed by a less well-defined bull's-eye pattern. Elevated NO_2 levels from the Wallow Fire, located in Arizona near the New Mexico border, as well as coal-burning power plants in northwest New Mexico, are also visible.



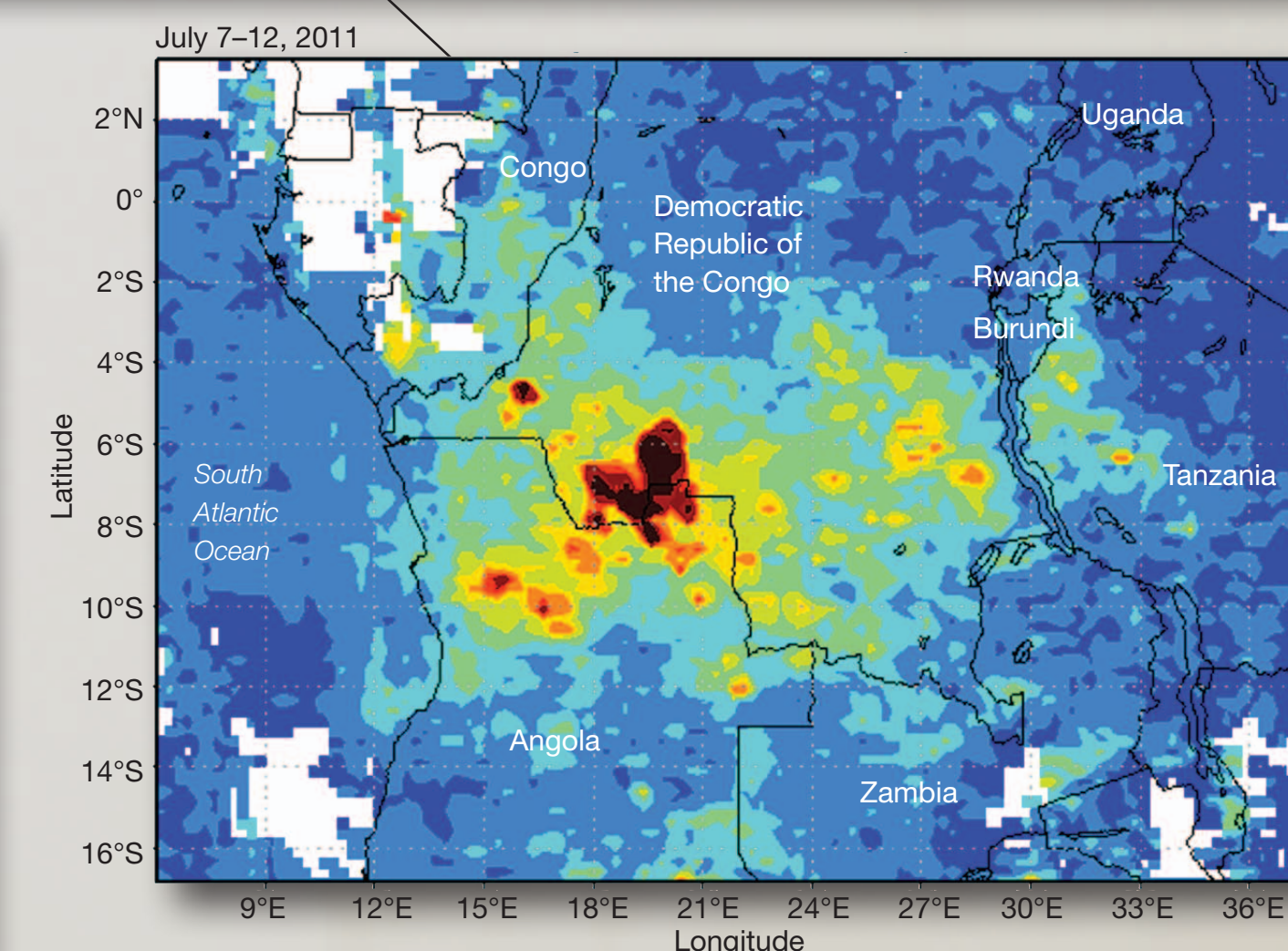
The Las Conchas Fire, burning southwest of Los Alamos, New Mexico, continued to spread on June 27, 2011. The image above reveals data from the Moderate Resolution Imaging Spectroradiometer on NASA's Terra satellite. Thick smoke from the fires covers Los Alamos and Rio Grande Valley to the east. Active fire locations are outlined in red.

By the end of the day on June 27, the Las Conchas Fire had burned 43,597 acres (17,643 hectares) since starting around 1:00 p.m. on June 26, 2011.



Forest fires can be an important source of pollution around the world, especially in boreal forests in Canada, Alaska, and Russia.

NASA's Aura Satellite has provided a view of one pollutant, nitrogen dioxide (NO_2), coming from forest fires in Canada's Northwest Territory, Alberta, and Saskatchewan, June 23–29, 2011. Air quality worsened near the fires. NO_2 concentrations near the Richardson Fire (south of Lake Athabasca) appear to be the highest (red).



Controlled agricultural fires in central Africa generated high amounts of nitrogen dioxide (NO_2) that showed up in data collected by Aura's Ozone Monitoring Instrument during July 7–12, 2011. The highest concentrations of NO_2 are revealed by the dark red butterfly shape, located over southern parts of the Democratic Republic of the Congo and northern Angola.

Each year, people in this region burn croplands to clear fields after harvests. Burning is also used to generate new growth in pastures and move grazing animals to new locations.