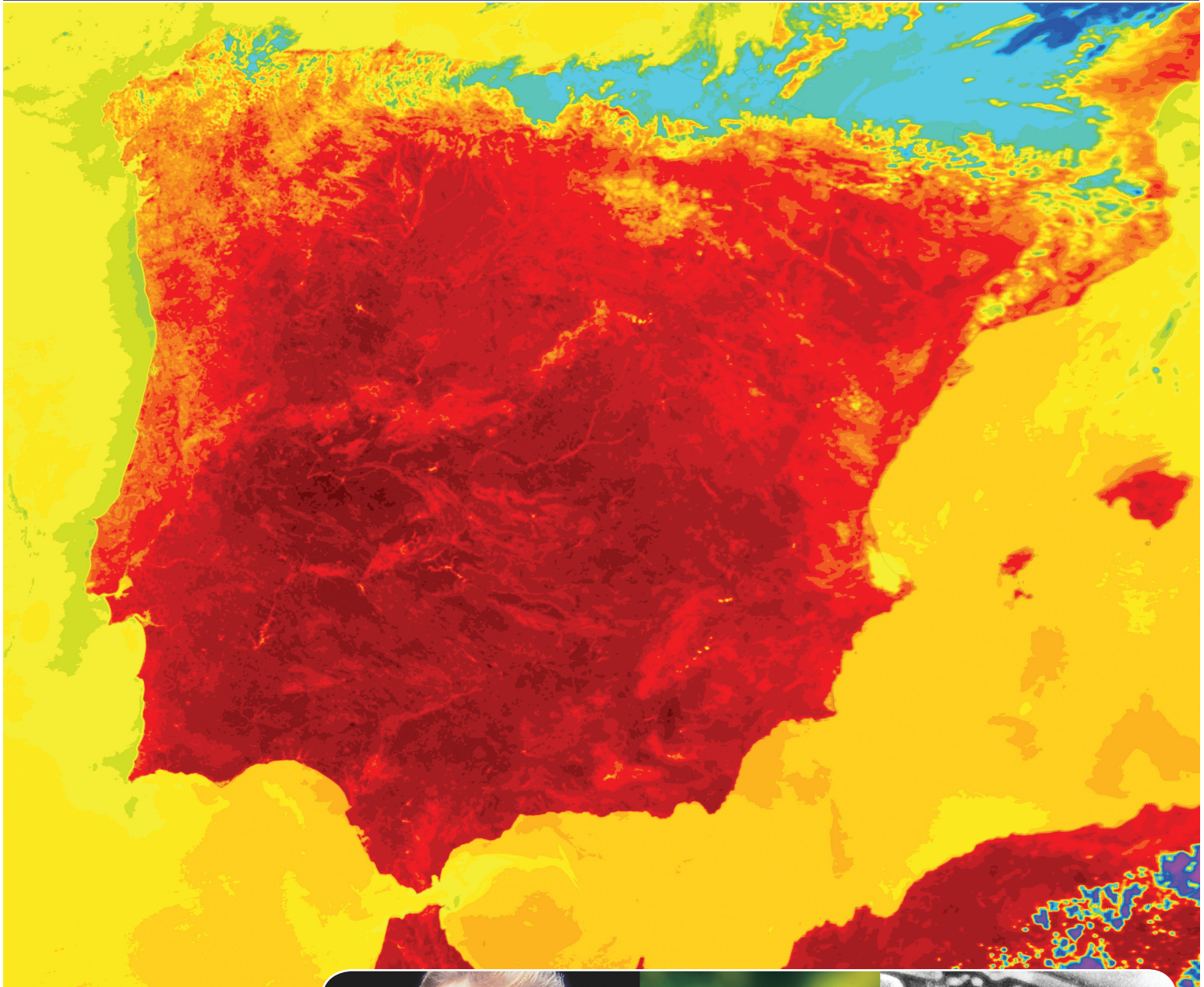
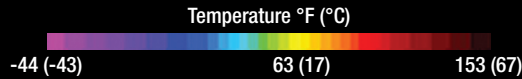


## SCIENCE SERVING SOCIETY: PUBLIC HEALTH

In July 2004, the Iberian Peninsula (Spain and Portugal) and North Africa were in the grips of a severe heat wave that cost several people their lives. Scientists could study the heat wave from space. The Moderate Resolution Imaging Spectroradiometer (MODIS) on the Aqua satellite acquired an image of this region on July 1, 2004. The colors tell us how warm the surface is and range from pinkish-purple (coldest temperature) to blackish-red (warmest temperature). The majority of the land surface shows up as deep red in this image [temperatures as high as 138° F (58.8° C) were observed].



Public health managers use information derived from NASA Earth Observing satellite observations and model predictions to help them track disease vectors from space. The information helps them target disease prevention efforts and predict when environmental conditions are favorable for the spread of vector borne disease.





## SCIENCE SERVING SOCIETY: PUBLIC HEALTH

### Overview of the Program

At present, an array of Earth observing satellites are in orbit, and additional launches both by NASA and others will continue throughout the next decade. Our ability to observe our home planet from space has never been greater. Increasingly, studies of the Earth focus on understanding the Earth's land, atmosphere, oceans, and life as a whole integrated system rather than as individual independent elements. NASA is an important contributor in this systems approach to Earth science studies.

In addition to providing Earth observing capabilities, NASA forms strategic partnerships with other government, academic, private, and international organizations. Through these partnerships, NASA's Earth science observations and measurements are linked to practical applications. NASA data, information, and predictive models help NASA's partners, and nontraditional users of Earth science, make timely and accurate decisions regarding management of resources and development of policy. The agency's goal is to maximize the benefit of science and technology to stakeholders by smoothly flowing Earth science data and information from NASA satellites to society.

### Public Health

The spread of chronic and infectious diseases is a serious threat to public health. Research has shown that many chronic and infectious diseases are related to environmental conditions. Organisms such as ticks and mosquitoes (called *disease vectors*) transport these diseases, and variability in rainfall and temperature has a major influence on the distribution and quantity of these pests. Recent outbreaks of West Nile Virus and other vector-borne diseases have illustrated the importance of having accurate and timely information to predict and respond to epidemics.

The Centers for Disease Control and Prevention (CDC) issues forecasts of these vector-borne disease outbreaks to alert the public to the dangers they pose. NASA provides observations and predictions to help the CDC correlate the incidence frequencies of chronic and infectious diseases to weather, climate and other key environmental factors. Once verified, validated and benchmarked, these relationships can be incorporated into surveillance systems such as the Environmental Public Health Tracking Network to track and predict disease. Other partners, such as the Environmental Protection Agency (EPA), are part of this effort.

To successfully monitor the spread of infectious diseases, decision makers need access to a wide range of environmental information. NASA Earth observing satellites provide a unique global viewpoint from space and offer a wealth of useful information. For example, both the Terra and Aqua satellites carry the Moderate Resolution Imaging Spectroradiometer (MODIS), which contributes a wide range of information relevant to tracking disease vectors. Landsat 7 is the latest in a series of satellites that have been obtaining high-resolution imagery of the Earth for over 30 years. Scientists use this long running series of images of the same location to track how land surfaces change over time and see how vector habitats might be impacted by these changes. The Tropical Rainfall Measuring Mission (TRMM) provides important data on precipitation, which can have a major impact on vector habitats, and will eventually be succeeded by the Global Precipitation Measurement (GPM) mission.

Another serious health concern is excessive levels of heat and humidity, especially over prolonged periods. Excessive heat can increase the incidence of respiratory and cardiovascular disease and cause illnesses such as heat exhaustion or heat stroke. Terra flies MODIS as well as the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), both of which are helpful tools for tracking surface temperature (see heat wave image from MODIS on the front). In addition, TRMM, Terra, and Aqua all carry an instrument called Clouds and the Earth's Radiant Energy System (CERES) that is used to study the Earth's radiation balance, and has been used to track heat waves.

Still another serious public health concern is protecting the quality of the air we breathe. Pollution in the lower part of Earth's atmosphere can also pose significant health risks for certain segments of the population—particularly the very young and the elderly. Excessive amounts of certain pollutants such as ozone and particulate matter can worsen respiratory diseases such as asthma and emphysema.

Several of NASA's Earth observing missions contribute to improving our understandings of the physical processes that regulate the quality of the air we breathe. In fact, this is one of the main objectives of NASA's Aura mission. The Dutch built Ozone Monitoring Instrument (OMI) builds on the legacy of the Total Ozone Monitoring Spectrometer (TOMS) and offers the most detailed information on ozone that has ever been obtained. Meanwhile, the Tropospheric Emission Spectrometer (TES) offers unprecedented ability to track ozone and other pollutants as they are transported around the globe. Combining the information obtained from these instruments helps scientists better predict when pollutants like ozone and particulate matter will pose a danger to the public.

NASA shares the information from its satellites with EPA. The EPA monitors concentrations of ground level ozone, particulate matter, and other atmospheric pollutants, and issues warnings when the air quality becomes unhealthy. The EPA uses NASA information to improve the accuracy of the air quality forecasts they issue. As new information gets incorporated into the tools used to issue forecasts, scientists may also be able to predict times when the air quality will be unhealthy further in advance than is currently possible, which could potentially save lives for at-risk populations.

Acts of bioterrorism represent an even more ominous threat to the air we breathe and also to the water we drink, placing basic societal needs in jeopardy. Therefore, NASA has made it a high priority to ensure that Earth science satellite observations and predictive model capabilities are readily available for use by Department of Health and Human Services (DHHS) and the Department of Homeland Security (DHS) officials to help them respond in the event of a bioterror emergency.

NASA works collaboratively with national and international scientists as well as with its Federal partners to provide quality science observations from its Earth observing satellite missions for use in public health applications. These observations are incorporated into public health forecast tools such as those described above. The result is science that serves the practical needs of society. NASA is committed to expanding the use of science research results to meet societal needs.