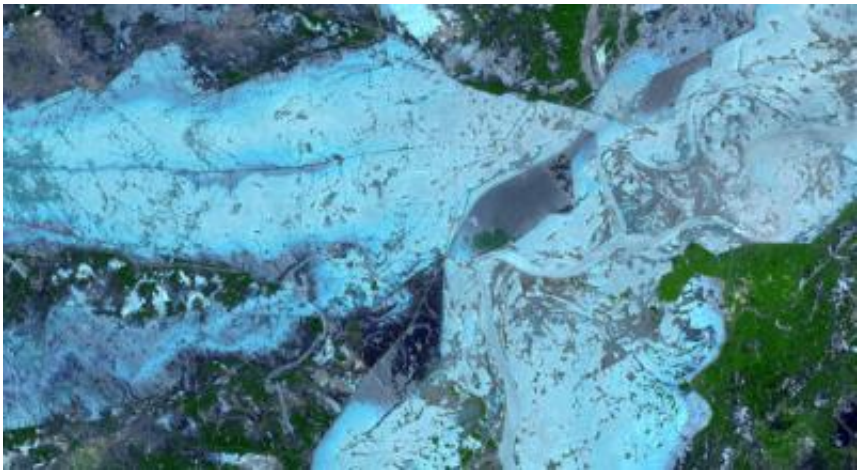
NASA images show anatomy of pakistan flood disaster

August 23 2010



ASTER image from Aug. 18, 2010, shows the extent of flooding in and around the city of Sukkur in Pakistan's Sindh Province. The Indus River, Pakistan's longest, snakes vertically through the image. Image credit: NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team

In late July 2010, flooding caused by heavy monsoon rains began across several regions of Pakistan. According to the Associated Press, the floods have affected about one-fifth of this country of more than 170 million. Tens of thousands of villages have been flooded, more than 1,500 people have been killed, and millions have been left homeless. The floodwaters are not expected to recede fully before late August.

NASA's CloudSat satellite captured the genesis of the flooding event as

it flew over the region on July 28, 2010. At that time, a large area of intense thunderstorms covered much of Pakistan. Between July 28 and 29, up to 400 millimeters (16 inches) of rain fell from these storm cells, triggering flooding along the Indus and Kabul Rivers. Storms with similar structures to this one have become common this summer as tropical monsoon moisture, coupled with a strengthening La Nina (which has different effects around the world), dominate this region's weather patterns.

A series of NASA images shows the anatomy of the flood disaster. Click here to view all five images.

The top portion of the first image, from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on NASA's Aqua spacecraft, reveals the bright white cloud tops of the cluster of thunderstorms. The blue vertical line shows CloudSat's path at the time the MODIS image was acquired. CloudSat's path cut through a large thunderstorm cell in the northern section of the country.

The Cloudsat data are shown in the bottom portion of the first image. As seen in the top half of the bottom image, CloudSat classified the majority of the clouds present at the time as deep convective (cumulonimbus) clouds, typical of thunderstorms. The bottom half of the lower image shows the 3-D vertical structure of the storm along the satellite's flight path, revealing its heavy precipitation. CloudSat measured the cloud heights along the radar's flight path at around 15 kilometers (9.3 miles) in the areas of deepest convection.

The next pair of images was taken by the vertical-viewing camera on the Multi-angle Imaging Spectroradiometer (MISR) instrument aboard NASA's Terra spacecraft. The image on the left was taken Aug. 8, 2009, while the one on the right is from Aug. 11, 2010. These false-color views display the instrument's near-infrared, red and green bands as shades of

red, green and blue. The colors distinctly highlight the contrast between water and vegetation on the river banks, since vegetation appears bright in the near-infrared portion of the electromagnetic spectrum.

The region of southern Pakistan shown here includes the Sindh Province. The Indus River, Pakistan's longest, can be seen snaking across the image from lower left to upper right. The feature near the bottom and left of center is Manchhar Lake. Water appears as shades of blue and cyan, though sediment content can add a tan color, as seen in the upper right. Clouds appear white. In the image from 2009, the Indus is typically about 1 kilometer (0.6 miles) wide. In contrast, in the 2010 image, the river is around 23 kilometers (14 miles) wide in spots, and flooding is very evident in much of the surrounding region, particularly in the Larkana District west of the river.

A different before-and-after perspective of the floods is provided by the next pair of false-color images, taken by the Atmospheric Infrared Sounder (AIRS) instrument on NASA's Aqua spacecraft using its four visible and near-infrared channels. These images also show southern Pakistan and the Sindh Province. The Indus River appears to enter from the upper right and winds its way southwestward toward the lower left. The image at the left was taken before the flooding on July 9, 2010, while the right-hand image was taken on Aug. 10, 2010.

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument on NASA's Terra spacecraft provides the next image, a cloud-free view over the city of Sukkur, Pakistan, taken on Aug. 18, 2010. Sukkur, a city of a half million residents in southeastern Pakistan's Sindh Province, is visible as the gray, urbanized area in the lower left center of the image. It lies along the Indus River, which snakes vertically from north to south through the image and forms the basis for the world's largest canal-based irrigation system. As reported by the British Broadcasting Corporation, Sukkur is one of the

few urban areas in the region that has so far escaped widespread destruction from the flooding, which has affected an estimated 4 million people in the province. Relief camps have sprung up across the city to house some of these displaced people. The land along the Indus River in this region is largely agricultural, and the flooding has taken a heavy toll on the region's crops and fruit trees.

The final image was created with data from the Advanced Microwave Sounding Unit instrument, which flies on NASA's Aqua spacecraft as part of the AIRS instrument suite. It shows how surface emissivity-how efficiently Earth's surface radiates heat-changed in the affected region over a 32-day period between July 11 and August 12. Surface emission, in this case in the microwave region of the electromagnetic spectrum, depends strongly on what type of surface is present. For dry land, surface emission is high-measuring close to 1 (land radiates heat very efficiently); while for water, it is quite low-measuring less than 0.5 (water tends to retain heat better than land). The image shows that the emission dropped over this time span by up to 0.4 in large areas surrounding the Indus River, indicating that these areas are almost completely underwater.

Scientists can use this technique to estimate how much of the land surface has been inundated. A significant advantage is that the technique works both day and night, and under both clear and cloudy conditions.

Provided by JPL/NASA