International Space Station Data Collection for Disaster Response

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Natural disasters – including such events as tropical storms, earthquakes, floods, volcanic eruptions, and wildfires –effect hundreds of millions of people worldwide, and also cause billions of dollars (USD) in damage to the global economy. Remotely sensed data acquired by orbital sensor systems has emerged as a vital tool to identify the extent of damage resulting from a natural disaster, as well as providing near-real time mapping support to response efforts on the ground and humanitarian aid efforts. The International Space Station (ISS) is a unique terrestrial remote sensing platform for acquiring disaster response imagery. Unlike automated remote-sensing platforms it has a human crew; is equipped with both internal and externally-mounted remote sensing instruments; and has an inclined, low-Earth orbit that provides variable views and lighting (day and night) over 95 percent of the inhabited surface of the Earth. As such, it provides a useful complement to free-flyer based, sun-synchronous sensor systems in higher altitude polar orbits.

While several nations have well-developed terrestrial remote sensing programs and assets for data collection, many developing nations do not have ready access to such resources. The International Charter, Space and Major Disasters (also known as the “International Disaster Charter”, or IDC; http://www.disasterscharter.org/home) addresses this disparity. It is an agreement between agencies of several countries to provide – on a best-effort basis – remotely sensed data of natural disasters to requesting countries in support of disaster response. The lead US agency for interaction with the IDC is the United States Geological Survey (USGS); when an IDC request or “activation” is received, the USGS notifies the science teams for NASA instruments with targeting information for data collection.

In the case of the ISS, the Earth Sciences and Remote Sensing (ESRS) Unit, part of the Astromaterials Research and Exploration Science Directorate and supporting the ISS Program Science Office at NASA’s Johnson Space Center, receives notification from the USGS and coordinates targeting and data collection with the NASA ISS sensor teams. If data is collected, it is passed back to the USGS for posting on their Hazards Data Distribution System and made available for download. The ISS International Partners (CSA, ESA, JAXA, Roscosmos/Energia) have their own procedures for independently supporting IDC activations using their assets on ISS, and there is currently no joint coordination with NASA ISS sensor teams.

Following completion of ISS assembly, NASA remote sensing assets began collecting IDC response data in May 2012. The initial NASA ISS sensor systems available to respond to IDC activations included the ISS Agricultural Camera (ISSAC), an internal

multispectral visible-near infrared wavelength system mounted in the Window Observational Research Facility, or WORF; the Crew Earth Observations (CEO) Facility, where the crew collects imagery through Station windows using off-the-shelf handheld digital visible-wavelength cameras; and the Hyperspectral Imager for the Coastal Oceans (HICO), a visible to near-infrared system mounted externally on the Japan Experiment Module Exposed Facility. The ISSAC completed its primary mission and was removed from the WORF in January 2013. It was replaced by the very high resolution ISS SERVIR Environmental Research and Visualization System (ISERV) Pathfinder, a visible-wavelength digital camera, telescope, and pointing system.

Since the start of IDC response by NASA sensors on the ISS in May 2012 and as of this report, there have been eighty IDC activations; NASA sensor systems have collected data for twenty-three of these events. Of the twenty-three successful data collections, five involved 2 or more ISS sensor systems responding to the same event. Data has also been collected by International Partners in response to natural disasters, most notably JAXA and Roscosmos/Energia through the Urugan program.

Data collected in response to IDC activations is delivered by the ISS sensor teams to the ESRS for quality review and transfer to the USGS, where it is ingested into the Hazards Data Distribution System, or HDDS (https://hdds.usgs.gov/hdds2/; figure 1). This system allows the local agencies that issued the IDC activation request to review and download data. The data is then used to develop secondary products useful for humanitarian response such as flood maps. As of this report, approximately 1000 images collected by NASA ISS sensor systems have been downloaded from the HDDS, indicating that the ISS has assumed a valuable role in disaster response efforts.

The ISS is also a unique platform in that it will have multiple users over its lifetime, and that no single remote sensing system has a permanent internal or external berth. This scheduled turnover provides for development of new remote sensing capabilities relevant to disaster response –as well as both research and applied science—and represents a significant contribution to continuance and enhancement of the NASA mission to investigate changes on our home planet.

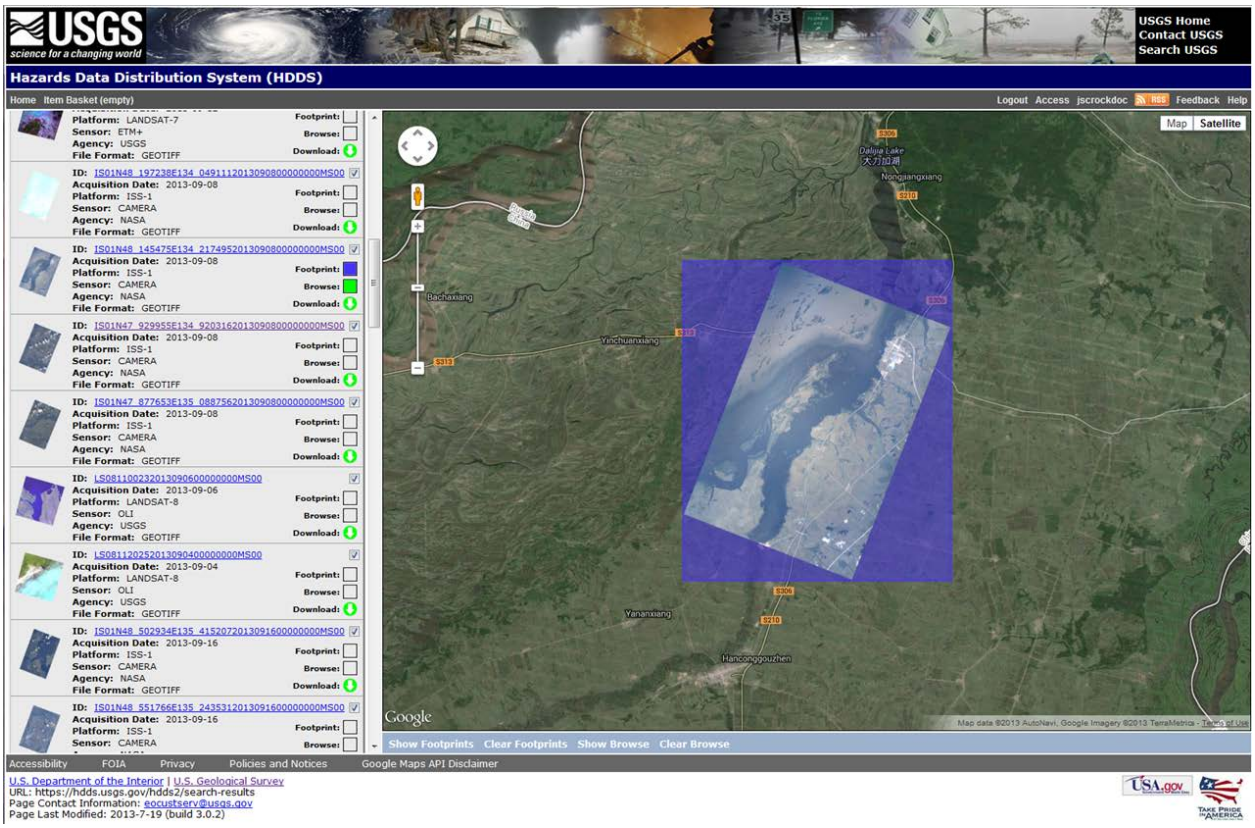

Figure 1. ISERV image acquired on September 8, 2013 in response to IDC activation for flooding in Russia. Georeferenced image is displayed in the USGS Hazards Data Distribution System.