ONLINE VISUALIZATION AND ANALYSIS OF GLOBAL HALF-HOURLY INFRARED SATELLITE DATA

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Infrared (IR) images (~11-μm channel) recorded by satellite sensors have been widely used in weather forecasting, research, and classroom education since the Nimbus program. Unlike visible images, IR imagery can reveal cloud features without sunlight illumination; therefore, they can be used to monitor weather phenomena day and night. With geostationary satellites deployed around the globe, it is possible to monitor weather events 24/7 at a temporal resolution that polar-orbiting satellites cannot achieve at the present time. When IR data from multiple geostationary satellites are merged to form a single product—also known as a merged product—it allows for observing weather on a global scale. Its high temporal resolution (e.g., every half hour) also makes it an ideal ancillary dataset for supporting other satellite missions, such as the Tropical Rainfall Measuring Mission (TRMM), etc., by providing additional background information about weather system evolution.

The Goddard Earth Sciences Data Information Services Center (GES DISC) houses an archive of the global merged IR product known as the NCEP/CPC 4-km Global (60°N–60°S) IR Dataset, which serves as one of TRMM's ancillary datasets. The global merged product consists of global IR brightness temperature data (equivalent blackbody temperatures) merged from all available geostationary satellites (U.S. GOES-East

FIG. 1. The HDAT Web interface.

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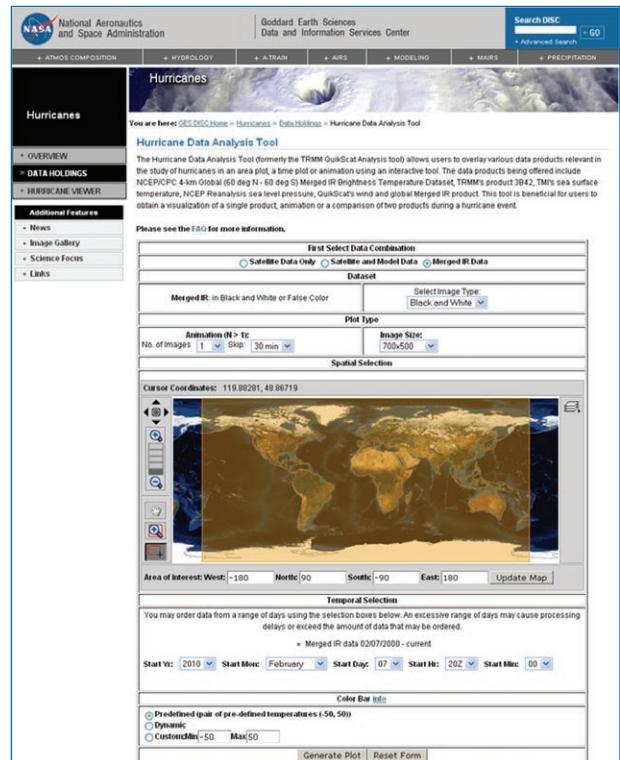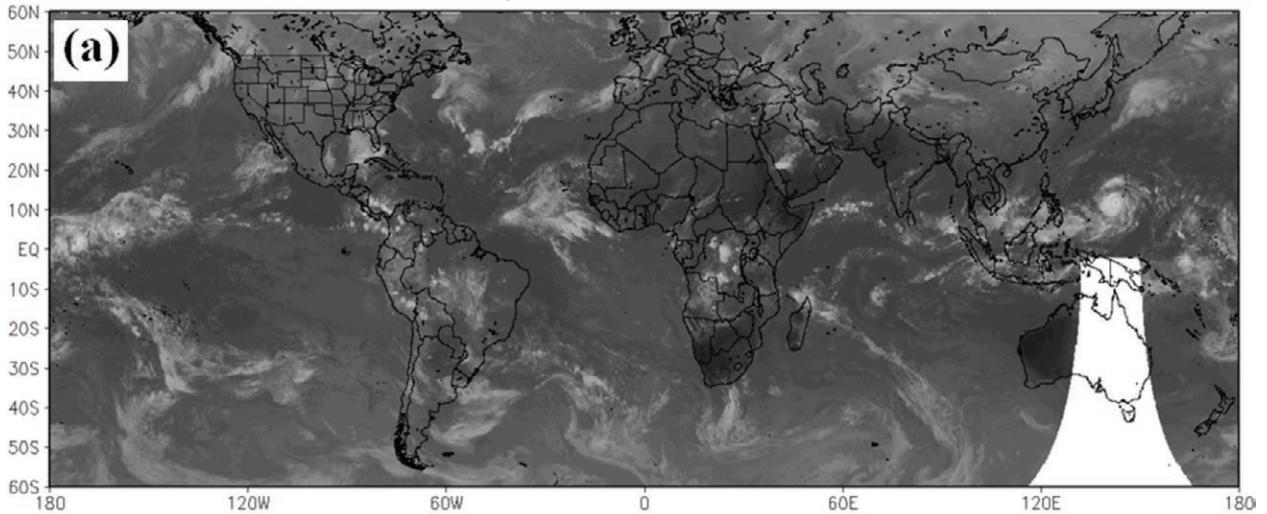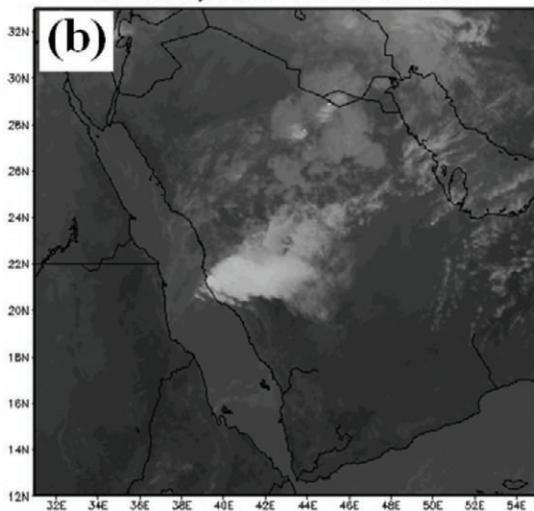
75°W and West 135°W; European Meteosat 0° and 57°E; and Japanese GMS/MTSAT 135°E). GES DISC has collected more than 11 years of this data (from February 2000 to the present), creating an archive that likely is of particular importance to researchers, students, and others who are interested in the research and education of past weather events, as many existing Web services only focus on providing images for current weather events.

Although the merged IR dataset can be downloaded directly via ftp, its large volume of approximately 97,203 files (~5.8 TB, as of 11 March 2011) likely poses a challenge for many users—especially to nonprofessional users and those in developing countries. To make this dataset easily accessible and maximize its use, we developed a simple system to overcome any difficulty with making such a large amount of data available: the Hurricane Data Analysis Tool (HDAT).
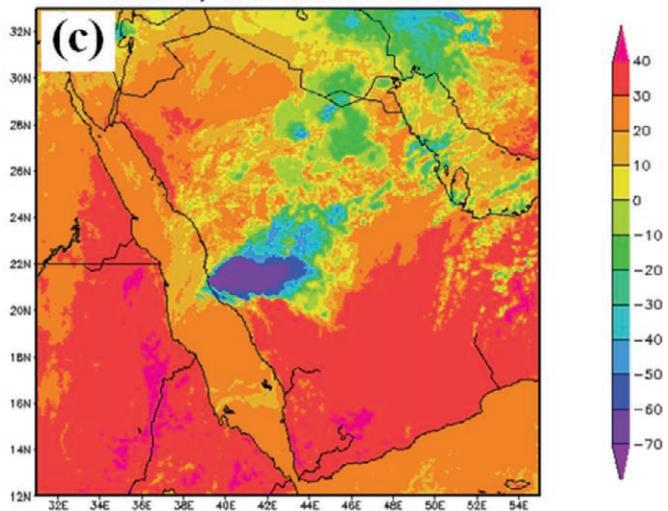
Global Merged IR (00min09Z25NOV2009)
Created by NASA Goddard GES DISC

FIG. 2. A global image (a) on 25 Nov 2009, and regional images [(b) IR; (c) false color in degrees C] showing rainstorms hitting Jeddah, Mecca, and the Arafah plains in Saudi Arabia. The heavy rains, which were equal to *two-thirds of the average annual total rainfall* in this region, caused severe flooding, resulting in property damage and human casualties.

WEB RESOURCES

GIOVANNI: http://giovanni.gsfc.nasa.gov
NCEP Reanalysis: http://www.esrl.noaa.gov/psd/data/
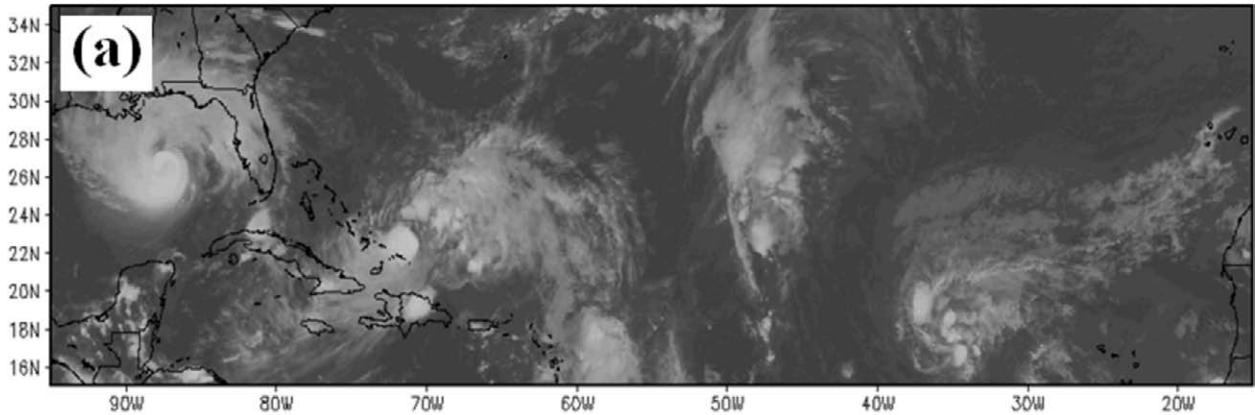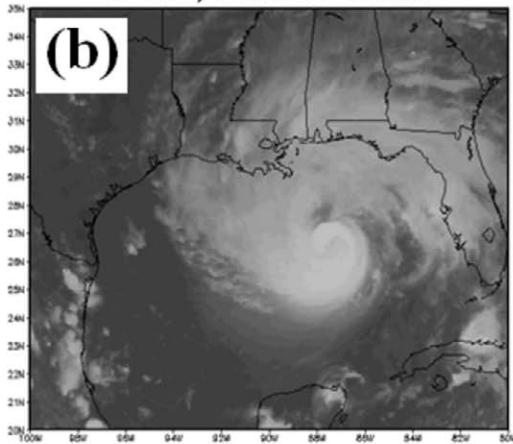gridded/data.ncep.reanalysis.html
QuikSCAT: http://podaac.jpl.nasa.gov/DATA_
CATALOG/quikscatinfo.html
TMI: http://www.ssmi.com/tmi/tmi_description.html
TMPA: ftp://meso-a.gsfc.nasa.gov/pub/trmmdocs/
3B42_3B43_doc.pdf
TOVAS: http://disc2.nascom.nasa.gov/Giovanni/tovas

HDAT is a Web-based interactive tool that allows users to display and overlay various remote-sensing and model products for hurricane research. The available products include the NCEP/CPC 4-km Global IR Dataset, the TRMM Multi-Satellite Precipitation Analysis (TMPA 3B42), the TRMM Microwave Imager (TMI) sea
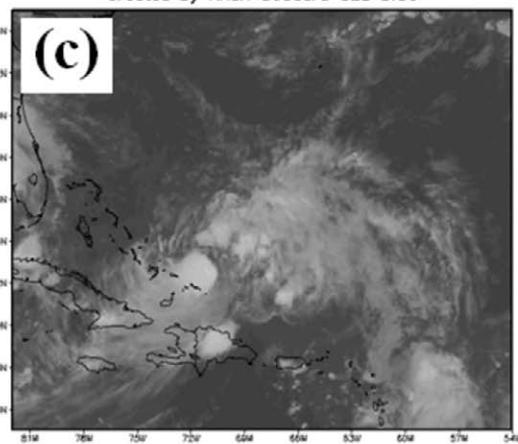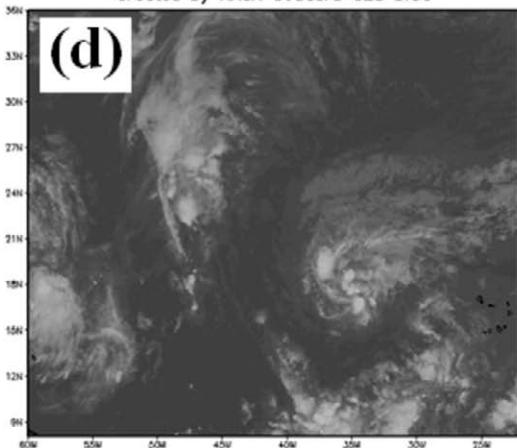
Fig. 3. Hurricane Gustav was the second major hurricane of the 2008 Atlantic hurricane season. Along its path, Gustav caused heavy damage and casualties in Haiti, the Dominican Republic, Jamaica, the Cayman Islands, Cuba, and the United States, and triggered the largest evacuation in U.S. history, according to news reports. A large-scale image (a) at 2300 GMT on 31 Aug 2008 shows (from left to right) Hurricane Gustav, Tropical Storm Hanna, and Tropical Storm Ike, while the smaller images [(b), (c), and (d)] show each of the three storms, respectively.

surface temperature, NCEP Reanalysis, and the Quick Scatterometer (QuikSCAT) ocean surface wind. This tool allows users to obtain an area plot, time series plot, or animation without downloading data and software.

HDAT's architecture is based on the TRMM Online Visualization and Analysis System (TOVAS), which primarily consists of TRMM products and has been in operation since March 2000 to support various research, application, and education activities. TOVAS is a part of the GES DISC Interactive Online Visualization and Analysis Infrastructure, or "Giovanni." The principle design goal for Giovanni was to provide a quick and

simple interactive means for science data users to study various geophysical phenomena by trying various combinations of parameters measured by different instruments, arrive at a conclusion, and then generate graphs suitable for publication. Alternatively, Giovanni would provide a means to ask relevant what-if questions and get back answers that would stimulate further investigations. This would all be done without having to download and preprocess large amounts of data.

Via the HDAT Web interface, a user can now select the merged IR dataset and then choose the geographical region, the temporal extent, and the type of image to be produced. Basic functions available are

- selection of area of interest;
- image type (black/white, false color);
- single image or animation;
- time increment (30 minutes to 24 hours);
- image size selection; and,
- color bar for false color images.

Users can save an animation as a file (animated GIF) and import it into other presentation software, such as Microsoft PowerPoint.

Future tasks include further improvement in performance, additional functionalities (e.g., Hovemöller diagrams), simple image processing algorithms, and creation of a dedicated tool for the merged IR dataset that can be used to analyze events outside the tropics.

To view HDAT, visit http://disc.sci.gsfc.nasa.gov/ HDAT.

FOR FURTHER READING

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