

Each quarter, the Global Hydrology Resource Center (GHRC) coordinates with NASA Earthdata on creating a banner, or masthead, for the Earthdata Website. GHRC uses the masthead to showcase unique activities or interesting projects. This can involve any topic GHRC is actively supporting with a NASA focus, from lightning to collaborations with the Advanced Microwave Scanning Radiometer (AMSR) shown here. Each masthead remains on earthdata.nasa.gov for approximately two weeks. GHRC then uses the image for the GHRC website banner for the quarter.

The Advanced Microwave Scanning Radiometer surface rain rate (color fill) took this observation of Tropical Cyclone Amphan in the Bay of Bengal on May 18, 2020. This particular observation was taken near Amphan's peak intensity and it was the strongest cyclone in the region since 1999. The observation range is from < 0.5 mm/hr (purple) to ≥ 25 mm/hr (white).



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ABOUT GHRC

The Global Hydrology Resource Center (GHRC) is one of NASA's Distributed Active Archive Centers (DAACs) and is managed jointly by the Earth Science Department at NASA's Marshall Space Flight Center and the University of Alabama in Huntsville's Information Technology and Systems Center. The NASA GHRC DAAC is a member of national and international data organizations including NASA's Earth Science Data and Information System (ESDIS), the Federation of Earth Science Information Partners (ESIP), and the International Council for Science (ICSU) World Data System (WDS).

GHRC'S MISSION STATEMENT

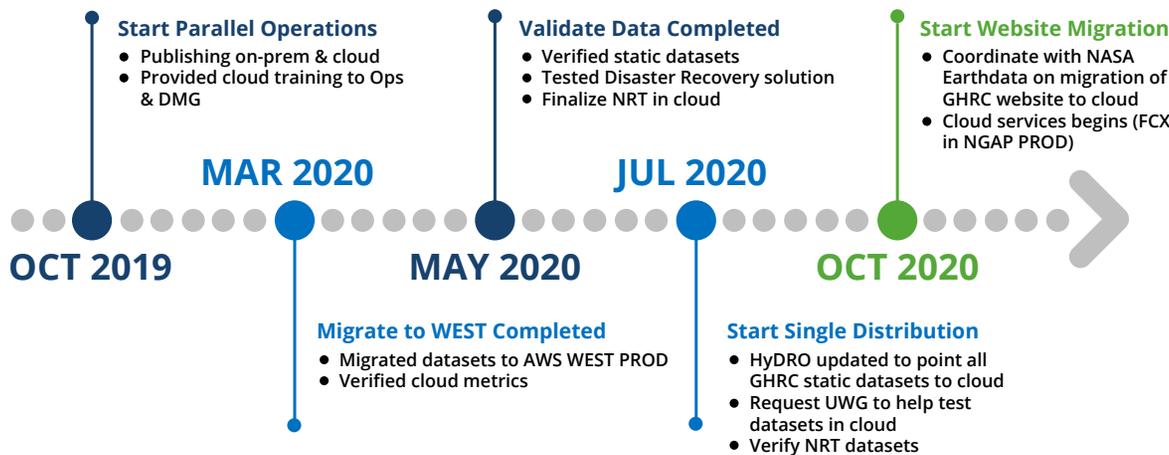
"The GHRC provides a comprehensive active archive of both data and knowledge augmentation services with a focus on hazardous weather, its governing dynamical and physical processes, and associated applications. Within this broad mandate, GHRC focuses on lightning, tropical cyclones and storm-induced hazards through integrated collections of satellite, airborne, and in-situ data sets."

TOP STORIES

GHRC DAAC TRANSITIONS TO THE CLOUD

The Global Hydrology Resource Center (GHRC) DAAC has continued its efforts to transition to a fully cloud-based DAAC this fiscal year. These efforts began in 2017 with the initial prototype effort. The GHRC DAAC was focused on what requirements were needed in order to bring the DAAC's holdings to the cloud. This included the development of a framework to ingest, archive, and distribute data. With this prototype, GHRC shifted to migration activities in 2018. This is where the DAAC began hands-on training, as well as learned how to operate with the new, cloud-specific tools that were needed. Furthermore, sample workflows were developed, and each effort was in collaboration with the NASA Earth Science Data and Information System (ESDIS). Last year, these efforts culminated in the GHRC DAAC being selected as the cloud pathfinder for all of NASA's DAACs.

FY20/21



This figure shows the detailed actions taken this year as part of GHRC's cloud transition in preparation for cloud-only activities.

At the end of fiscal year 2019, GHRC became the first DAAC to transition all data holdings to the cloud. This enabled GHRC's transition to begin operational activities in the cloud for fiscal year 2020. This year has seen a number of activities. First and foremost, GHRC is operating in a hybrid state. Data ingest, processing, and publication efforts are using both the legacy on-premises systems as well as the newly developed cloud-based workflows. This enables vital dataset validation to ensure that data granules have not been lost

using the new cloud-based methodologies. The GHRC team is also using this time to re-examine workflows and streamline the processes involving the operations and data management teams. GHRC recently started the process of updating the HyDRO search client to point to GHRC datasets located in the cloud. This process will continue into the Fall as we incorporate near real-time and on-going datasets. As pathfinder, GHRC updated and tested an operational recovery cloud archive which serve as the baseline that DAACs will use for cloud data disaster recovery. All these efforts are focused on GHRC DAAC retiring the legacy on-premises activities and becoming a cloud-only DAAC in fiscal year 2021.

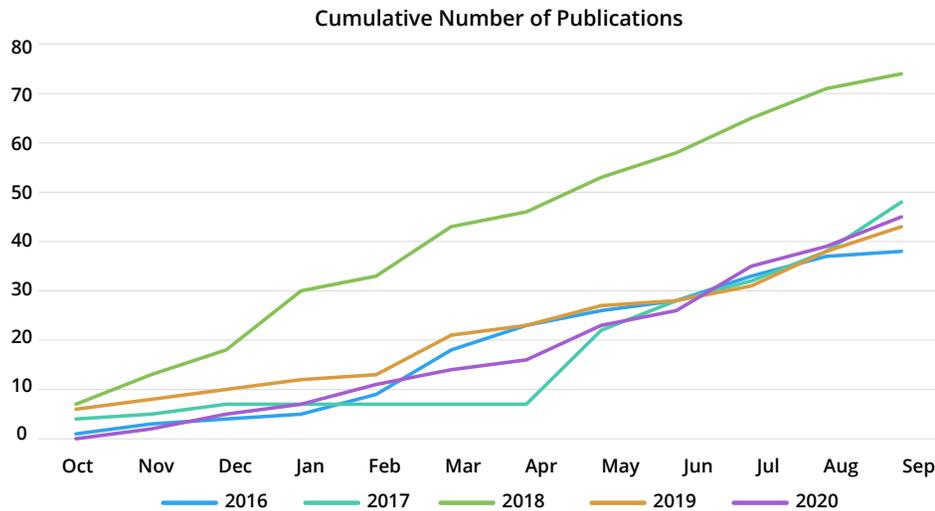
This year has also been a year to celebrate GHRC's cloud transition efforts. This summer, the GHRC cloud migration team was honored with the 2020 NASA Group Achievement Award. This agency-level award was, "For commitment to innovation, collaboration, and teamwork in the transition of the NASA Global Hydrology Resource Center data center to the cloud." GHRC is grateful for this recognition.

EARTHDATA PUB

In January 2020 developers from GHRC and ORNL were organized into the "Earthdata Pub" development team, a cross-DAAC effort to develop a cloud-hosted common software framework for data publication. Since January the Earthdata Pub development team has prototyped and integrated the backend API and systems, built the Forms and Dashboard infrastructure, as well as developed a standalone metrics capture system. The team is now working to integrate the API with the frontend Dashboard and Forms so that external testers will be able to evaluate Earthdata Pub and provide feedback by the end of the calendar year.

GHRC DATASET PUBLICATIONS

The past year has been another eventful year with the global pandemic requiring GHRC to work remotely. In spite of this and dual-publishing both on-premise and in the Cloud, GHRC personnel maintained steady progress on publication efforts with a particular focus on the new IMPACTS field campaign. As a result, GHRC has published 45 datasets for the year.



INVESTIGATION OF MICROPHYSICS AND PRECIPITATION FOR ATLANTIC COAST-THREATENING SNOWSTORMS (IMPACTS)

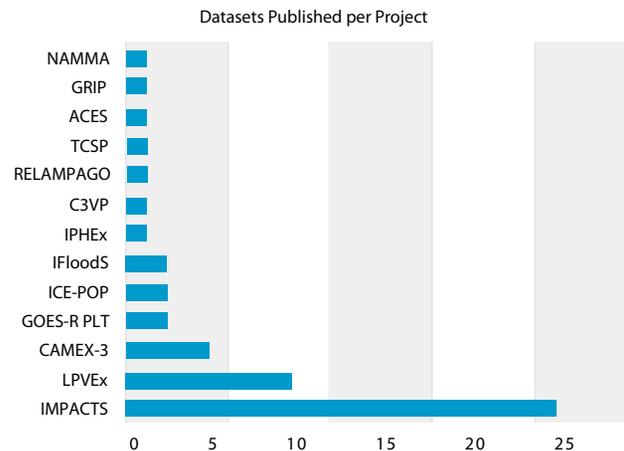
This year, GHRC actively participated with the IMPACTS team to assess the new incoming data and coordinated with the PIs. This includes receiving sample data files and documentation about the datasets. Thanks to these efforts, GHRC has published 16 datasets so far. These publication efforts will continue and be completed partly through the next fiscal year. Once completed, publication efforts for Year 2 will begin. Most of the Year 2 publications will be updates to the already-published IMPACTS datasets.

DUAL PUBLICATION EFFORTS AND MIGRATING TO THE CLOUD

The GHRC have been transitioning publishing dataset from on-premise to the cloud requiring changes to the publication workflow. During this transition process, GHRC has been publishing datasets both on-premise and on the cloud until fully transitioned to the cloud. This comes with both challenges and successes. Dual-publishing requires more steps, so a slightly longer publication time; however, the metadata associated with these data are of higher quality due to the amount of testing required to be in the cloud.

Last year, GHRC received all datasets from the GOES-R Post Launch Test (PLT) and most of the datasets from the GPM Ground Validation ICE POP field campaigns. These datasets were published early this

fiscal year. In addition, GHRC has received most of the IMPACTS datasets for year 1 and additional GPM Ground Validation datasets this fiscal year. All of the additional GPM Ground Validation datasets and 21 IMPACTS datasets have been published so far for the year. All of the metadata updates for each dataset have been completed this year. Also, the [GPM Ground Validation Validation Network \(VN\)](#) dataset was updated in April 2020. Lastly, GHRC completed all of the required Analysis and Review of Common Metadata Repository fixes.



NEW DATASETS ACCEPTED FOR PUBLICATION

In addition to these activities, GHRC coordinated with the PIs on four separate datasets to obtain NASA ESDIS approval for archival at GHRC. The first is the SEA FLUX dataset. This includes a variety of ocean surface variables. Already, a subset of these data have been published as part of the ICE POP field campaign. The recent approval is for the full 31 year period of record of SEA FLUX from January 1988 through December 2018. The next three are with the Geostationary Lightning Mapper (GLM) and continue to emphasize GHRC as NASA's lightning DAAC. This includes global GLM Level 2 products, early beta GLM data from the GOES-R Post Launch Field Campaign, and a science level reprocessing of the GLM Level 2 data to improve flash analysis with the GLM Cluster Integrity, Exception Resolution, and Reclustering Algorithm (GLM-CIERRA).

GHRC OUTREACH AND USER SERVICES

GHRC's Outreach and User Services (OUS) group is designed to compliment the efforts of the other teams within GHRC. This is done through a variety of methods. This includes support documentation for published datasets, presentations, conferences, and journal publications. One of the most recognizable OUS efforts is the creation of [Micro Articles](#). These short, two to three page documents are meant to link together GHRC data and key science concepts. They are designed to give users additional insight into how various datasets can be used for additional research purposes.

MICRO ARTICLES

The most common outreach performed by GHRC is the creation of Micro Articles. This is a short document that brings together GHRC data and key science concepts. GHRC has six types of micro articles; Applications, Events, Field Campaigns, Instruments, Phenomena, and Publications. GHRC averaged one micro article per quarter this year. Looking forward to 2020, GHRC will emphasize instruments from the IMPACTS field campaign as well as unique events and phenomena.

- [MA: Cloud Radar System \(CRS\)](#)
- [MA: ER-2 X-band Doppler Radar \(EXRAD\)](#)
- [MA: Micro Rain Radar \(MRR\)](#)
- [MA: Autonomous Parsivel Unit \(APU\)](#)
- [MA: Advanced Microwave Precipitation Radiometer \(AMPR\)](#)
- [MA: Dual-frequency, Dual-polarized Doppler Radar \(D3R\)](#)
- [MA: Airborne Vertical Atmospheric Profiling System \(AVAPS\)](#)
- [MA: Lightning Instrument Package \(LIP\)](#)
- [MA: High Altitude Imaging Wind and Rain Airborne Profiler \(HIWRAP\)](#)
- [MA: Conical Scanning Millimeter-wave Imaging Radiometer \(CoSMIR\)](#)
- [MA NASA S-band Dual Polarimetric Radar \(NPOL\)](#)
- [MA: Pluvio² Precipitation Gauge](#)
- [MA: Water Isotope System for Precipitation and Entrainment Research \(WISPER\)](#)

DATA RECIPES

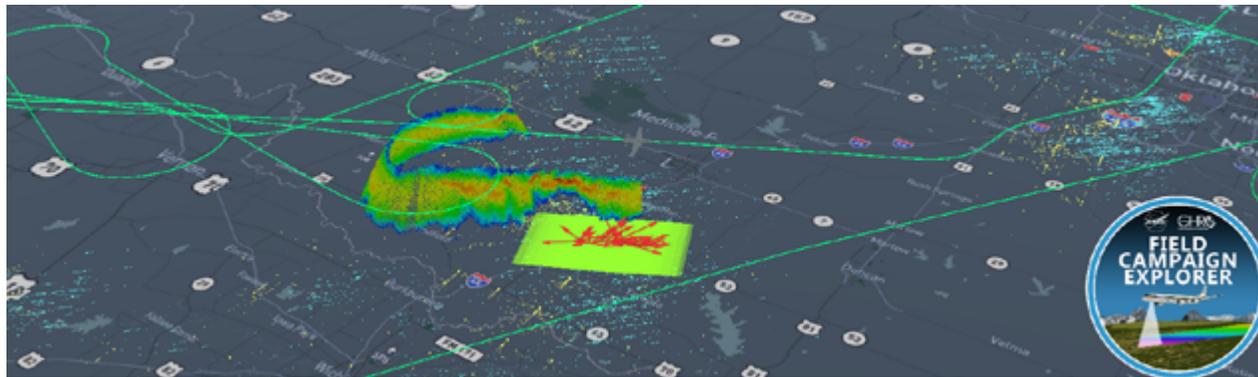
Another support effort from OUS is the development of [Data Recipes](#). The code, now moving to use Python 3.0 is designed to provide users a basic look at how to manipulate a particular GHRC dataset. This code is not exhaustive in its capabilities, but provides users basic capabilities to read a dataset and to create sample graphics. Users can then employ the data recipes either as a foundation for or a conceptual model of how to manipulate the data in their own work. For fiscal year 2020, the OUS team's emphasis has been on developing the instrument micro articles. This will continue into fiscal year 2021. However, late in fiscal year 2020, the OUS team has begun to work with the data provided by IMPACTS and the visualization efforts done by the Field Campaign Explorer team. This is enabling OUS to start assembling code for a number of IMPACTS instruments. However, the OUS team is making a concerted effort to ensure code compatibility with not just the IMPACTS data, but also IMPACTS instruments that have flown in previous campaigns archived at GHRC. This will greatly expand the utility of the data recipe. In cases where the separate deployments are too different, individualized data recipes will be created. Aside from this effort, GHRC published one data recipe in response to GHRC's 2019 Earthdata webinar. At users' request, a data recipe for the [Optical Transient Detector](#) was released that matches the capabilities of the previous data recipe for the [Lightning Imaging Sensor](#).

PUBLICATIONS

GHRC helped author the article, Three Years of the Lightning Imaging Sensor Onboard the International Space Station: Expanded Global Coverage and Enhanced Applications. In addition to being accepted for publication in the American Geophysical Union's Journal of Geophysical Research - Atmospheres, the article was selected as a highlight article for AGU's EOS. The article is available at <https://doi.org/10.1029/2020JD032918>.

WEB UPDATES

[GHRC's web page](#), and associated social media platforms, serve as another means of communication. Regular maintenance to the web page occurs throughout the year to ensure links are active and retired datasets (typically from newer versions) are moved to the retired dataset page. This year, the web page received a number of minor updates to improve links and update the lightning page. One of the largest updates was based on user feedback from NASA's Airborne Data Management Group (ADMG). ADMG has found GHRC's field campaign landing pages for several of the GPM Validation Missions extremely valuable. These landing pages provide a DOI for the entire campaign's holding as well as links to each archived dataset among other details. ADMG requested that GHRC do this for each archived field campaign. That task was completed this summer, enabling users to go to the field campaigns tab on the main page, select the campaign they wish to view, and then explore the available data and supporting documentation.



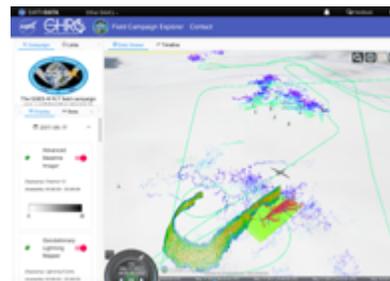
Click on the image above for the webinar

GHRC SUPPORTS NASA EARTHDATA RESEARCH

GHRC and the other eleven DAACs collaborate with NASA Earthdata to each provide an annual webinar. This year's webinar was titled, Improving the DAAC User Experience with Cloud-based Capabilities. The presentation focused on GHRC's transition to being a cloud-based archive and how this transition can improve the user experience. The highlight was the first-ever live public demonstration of the Field Campaign Explorer. The presentation is available as a [direct link](#) or through [YouTube](#).

FIELD CAMPAIGN EXPLORER (FCX)

Field Campaign Explorer (FCX) is now released in an operational mode on NASA Cloud. It can be accessed from <https://ghrc.earthdata.nasa.gov/fcx/index.html>. Currently, GOES-R PLT field campaign is available through FCX interface. More field campaigns will be made available in FY21.



NORTH ALABAMA LIGHTNING MAPPING ARRAY (LMA)

GHRC DAAC, NASA Lightning team, and New Mexico Institute of Mining and Technology (NMT) are working to transition the ingest, archive and distribution of the NALMA full-rate and decimated data to the GHRC DAAC from NMT. GHRC DAAC anticipates having the NALMA full-rate raw and solution data available for our users in FY2021.

LANCE NRT AMSR2

All LANCE near real-time (NRT) AMSR2 products are now being generated with the latest AMSR-U science algorithms. These are the same science algorithms (with slight modifications for NRT) that are being used to create the standard science quality AMSR-U2 products that are available at the NSIDC DAAC (https://nsidc.org/data/amsre_amsr2). LANCE NRT AMSR2 is available at: <https://lance.nsstc.nasa.gov/>

ISS LIS

The Lightning Science Team and GHRC have been focused on creating the validated version 1.0 Quality-Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) datasets. These science level quality-controlled data that have undergone extensive, manual checks will be published in early fiscal year 2021. We have also been working on the next version 2.0 non-quality controlled and NRT datasets. The version 2.0 science code is currently in Operational Acceptance Testing (OAT) at the GHRC. The version 2.0 improvements include the following:

- Viewtime correction for solar panels
- Viewtime correction for 1 second dropout
- Correction of short files (less than 5 minutes)
- Conversion to time in file names instead of orbit numbers

The near real-time data are available through GHRC's partnership with NASA's Land, Atmosphere Near real-time Capability for EOS (LANCE) site. The latest ISS LIS data can be found on GHRC's Hydro search page, the ISS LIS dataset page, and through LANCE.

CONFERENCE INVOLVEMENT

Conferences remain one of the primary means of communicating the work of GHRC. This past year, GHRC presented at the 100th meeting of both the American Geophysical Union and American Meteorological Society meetings, with four and three presentations, respectively. GHRC also attended the winter ESIP meeting in January. The COVID-19 outbreak has prevented travel since March, 2020, but GHRC has continued to participate in virtual conferences. This includes the IMPACTS field campaign science meeting, the 2020 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), the Geostationary Lightning Mapper (GLM) science meeting, and the World Data System Members' Forum.

GHRC TEAM MEMBERS

NEW STAFF

The GHRC has welcomed several new team members this year supporting a variety of activities.



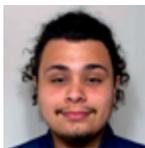
Sravani Koppala just graduated with a Masters degree in Computer Science from UAH. She previously worked with GHRC as a Research Assistant in developing the Bulk Downloader extension tool for the Earth Data Search Website. Currently, she is working full-time for CAPRI as a front-end developer in Angular for visualizing data as a 2D histogram and also on maps using CesiumJS.



Navaneeth Selvaraj is a Research Scientist at GHRC. He was a Graduate Research Assistant prior to joining full-time. He is a subject matter expert in AWS and front-end technologies. He is a part of the Cloud Migration team developing solutions for cloud hosted datasets and Metadata Extractor for data publication.



Taylor Wright completed U.S. Peace Corps service in 2012, then applied her volunteer experience to project coordination in the UAH College of Education and the Earth Systems Science Center. She later became an agile Release Train Engineer to support the cloud migration activities of multiple NASA DAACs, including the GHRC, and this collaboration led to her joining the team early this year as the GHRC lead for agile processes.



Eddie Campos is pursuing a Masters Degree in Computer Science from UAH, while working as a Computer Scientist at GHRC. He currently works on the cloud migration and Earthdata Pub teams supporting the development of efficient cloud based systems for GHRC as well as other NASA DAACs.

GHRC COVID-19 RESPONSE

Starting in mid-March, the GHRC began work from home operations in response to coronavirus and recommendations by NASA and UAH. After an initial transition period, GHRC has successfully continued operations throughout this period. The work from home guidelines will continue into the next fiscal year.

NEW STUDENTS

GHRC's affiliation with The University of Alabama in Huntsville (UAH) means we have talented students on our team who can help out in many areas while gaining professional experience.



Anupam Dahal is an international student from Nepal, currently in his Junior year at UAH pursuing CS/Math dual major. Anupam works in the Bulk Downloader team and are building a browser extension for the EarthData Search website that performs single click downloads.

2019 USER WORKING GROUP

The Global Hydrology Resource Center (GHRC) hosted its annual User Working Group meeting on October 22-23, 2019. This meeting is designed to bring experts from the various fields supported by the GHRC to Huntsville. These fields include lightning, severe weather, the Global Precipitation Measuring mission, hurricane sciences, and applications. During the meeting, GHRC provides our responses to the user working group from the previous year, highlights activities since the previous meeting, and states planned activities for the year ahead. The process is interactive as the user working group discusses GHRC's activities, provides recommendations for the year ahead, as well as provides strategic guidance as to how GHRC should best position itself for the future. This year, the primary focus for GHRC was discussing its role in transitioning to being a cloud-native Distributed Active Archive Center. This included our efforts for the past year to bring our data holdings to the cloud, a demonstration of the field campaign explorer, as well as discussions with the user working group on their recommendations for continued cloud work that can enhance and improve the user experience.

METRICS FROM FISCAL YEAR 2020

For fiscal year 2020 (October 1, 2019 through September 30, 2020) GHRC DAAC continued to have consistent web usage. Almost half of these users came from the United States. The remaining users were predominantly from eight countries: India (7%), China (4%), United Kingdom and Canada (3%), and Germany, Brazil, Japan, and Australia each at 2%. The remaining users are scattered across the globe, but each with total percentages of 1% or less.

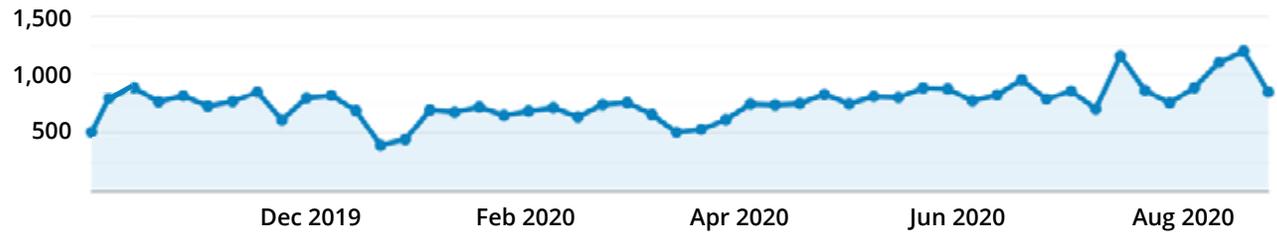
13.7%
New Visitors

86.3%
Returning Visitors

FY2020 GHRC WEB USERS: NEW VS. RETURNING

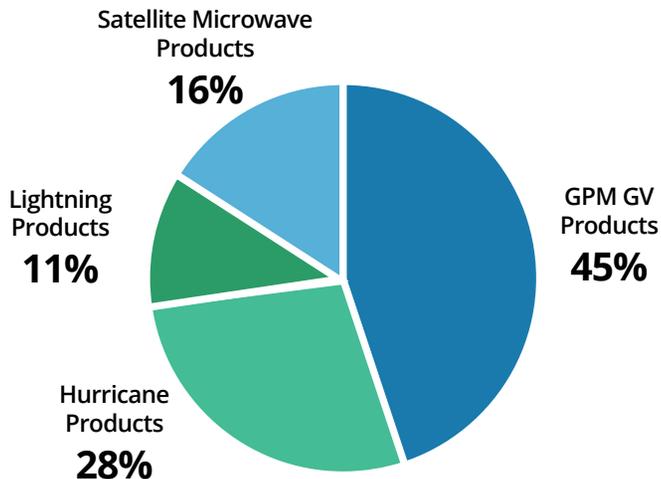
A review of our web users for fiscal year 2020 was again consistent with previous years (FY18 and FY19). As the figure at the left shows, 13.7% of visitors to the GHRC site were new.

Total User Count by Week



FY2020 GHRC WEEKLY TOTAL USER COUNT

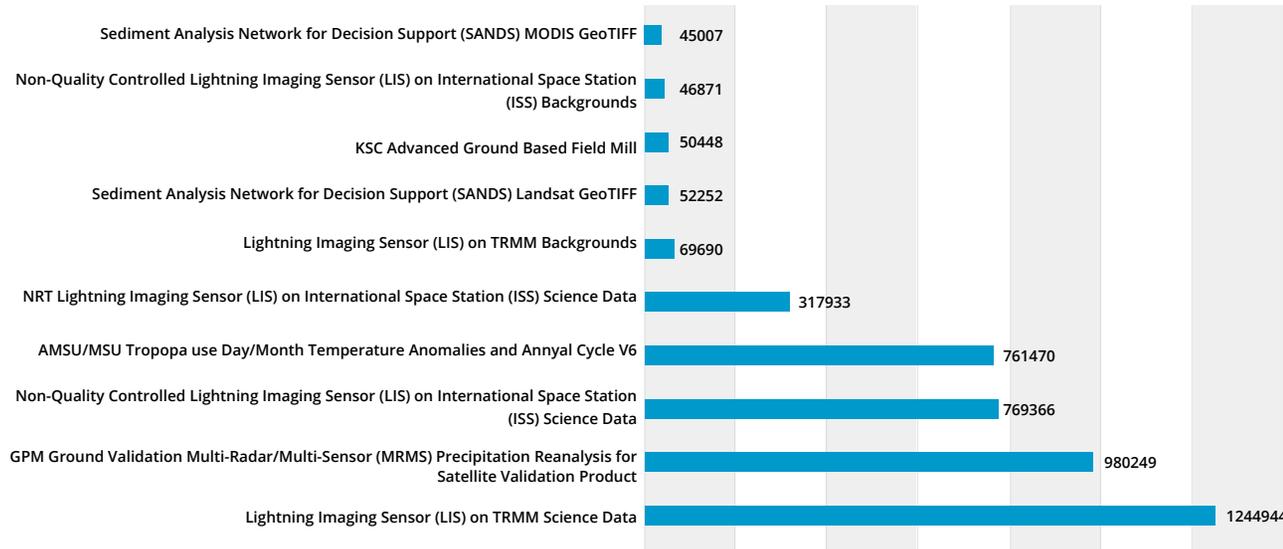
This chart shows the total user count by week for fiscal year 2020. Our lowest rate was during the Christmas holiday and then quickly picked up at the beginning of the new year. There were two peaks in July and August.



GHRC DATA HOLDINGS BY COLLECTION NAME

GHRC continues to group its data holdings into various collections making similar data more easily discoverable by end users. As the previous fiscal year, the primary collection is with the GPM ground validation program, covering 45% of all holdings. However the Hurricane Products and Satellite Microwave Products collections have grown significantly this fiscal year.

Number of Downloads for the Top 10 Datasets



TOP 10 DATASETS FOR FY2020

GHRC continues to track data usage by evaluating the number of downloads associated with each dataset. The figure above shows the top 10 most downloaded datasets from the GHRC's holdings for fiscal year 2020. Lightning datasets make up five of the top ten datasets with TRMM LIS science data being the most download which is the same as the previous fiscal year.

IMPACTS AND COLLABORATIONS

In addition to the metrics of total datasets, users, and downloaded data, GHRC DAAC aims to monitor how data from our archive supports the wider science and research community. This aligns with NASA's agency-wide efforts to document impacts for the community. Part of GHRC's fiscal year 2021 efforts will be to improve the collection of this information. The list of impacts presented here is not all-inclusive, but a high-level view of several impact results.

GHRC has supported four graduate research assistants this year. Two work directly with GHRC with two others using GHRC data for their projects with NASA's Short-term Prediction Research and Transition program. Additionally, a Kayako report came from a member of the Boy Scouts thanking GHRC for available lightning data for a badge project.

The GHRC program is also involved in a variety of collaborations with both NASA and non-NASA groups. This include:

- ISS LIS (funded)
- NALMA (funded)
- GHRC-GESDISC cloud data analysis
- Earthdata Pub
- Earthdata Pub Info Group
- Cloud data services (with Justin Rice)
- Member of the World Data System (WDS) through the International Council for Science World Data System (ICSU)
- Member of the Federation of Earth Science Information Partners (ESIP)
- Earth Science Data System Work Groups
- User Needs Technical Interchange Meeting via EOSDIS
- Science Teams: IMPACTS field campaign and the Geostationary Lightning Mapper

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LOOKING AHEAD TO 2021

The 2020 fiscal year ends with several notable milestones and accomplishments. This has ranged from beginning operations in the cloud, conducting the first publications with the IMPACTS field campaign, being approved for several new datasets such as the gridded Geostationary Lightning Mapper products, the public release of the Field Campaign Explorer, and earning the prestigious NASA Group Achievement Award. Although work from home activities will continue for the foreseeable future, GHRC plans to continue these and other activities in fiscal year 2021.

The largest upcoming goal for GHRC is the upcoming retirement of our on-premises dataset publications as the DAAC shifts to working in the cloud exclusively. Concurrent with this effort will be GHRC focusing on refresh plans for the web page. In addition to the usual actions of updating content, GHRC will aim to implement changes that will better support the search for and browsing of data. The Field Campaign Explorer (FCX) will be integral to this as it allows for the visualization of a wide array of data, particularly airborne datasets. GHRC will continue to explore cloud-based science applications. One effort that is currently underway is a collaboration with the Goddard DAAC. This is attempting to leverage datasets in the cloud to enhance cross-DAAC applications. The International Space Station Lightning Imaging Sensor will also receive an update to version 2 of the validation code. Meanwhile, the IMPACTS field campaign will remain a high priority for data publication as the second deployment occurs in January 2021. GHRC will also publish the new datasets that received approval from NASA ESDIS. Each effort will provide new opportunities for both GHRC's end users and in-house projects.



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