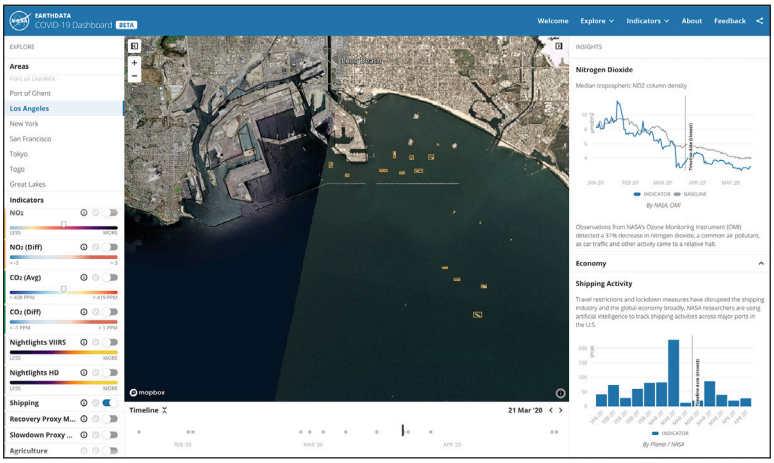
IMPACT
Interagency Implementation and Advanced Concepts Team

# IMPACTful NEWS

*Updates from the Interagency Implementation and Advanced Concepts Team*

## Machine Learning the Impact of COVID-19




*COVID-19 Dashboard*

IMPACT team members, under the guidance of Dr. Manil Maskey, participated in the unveiling of the international tri-agency Earth Observing Dashboard on June 25th. The dashboard incorporates resources and expertise from three agencies to help strengthen our global understanding of the environmental and economic effects of the COVID-19 pandemic. Users can explore how indicators based on remote sensing data from the European Space Agency, the Japan Aerospace Exploration Agency, and NASA have evolved over time and investigate how pandemic guidelines and safety measures have affected Earth's air, land, water, and economic activities.

IMPACT's machine learning team, led by Iksha Gurung and Muthukumaran R., assisted in this effort by building machine learning models trained to identify shipping, vehicle, and airplane traffic in satellite imagery. The IMPACT team utilized high-temporal resolution, small satellite imagery to derive multi-class object detections over many locations and dates. The models developed by the team were trained on open source benchmark datasets. Then the results were synthesized into a reflection of the change in tracked indicators over time.

[EOS article on the COVID-19 dashboard]
[NASA-ESA-JAXA Trilateral COVID-19 dashboard]
[NASA COVID-19 dashboard]

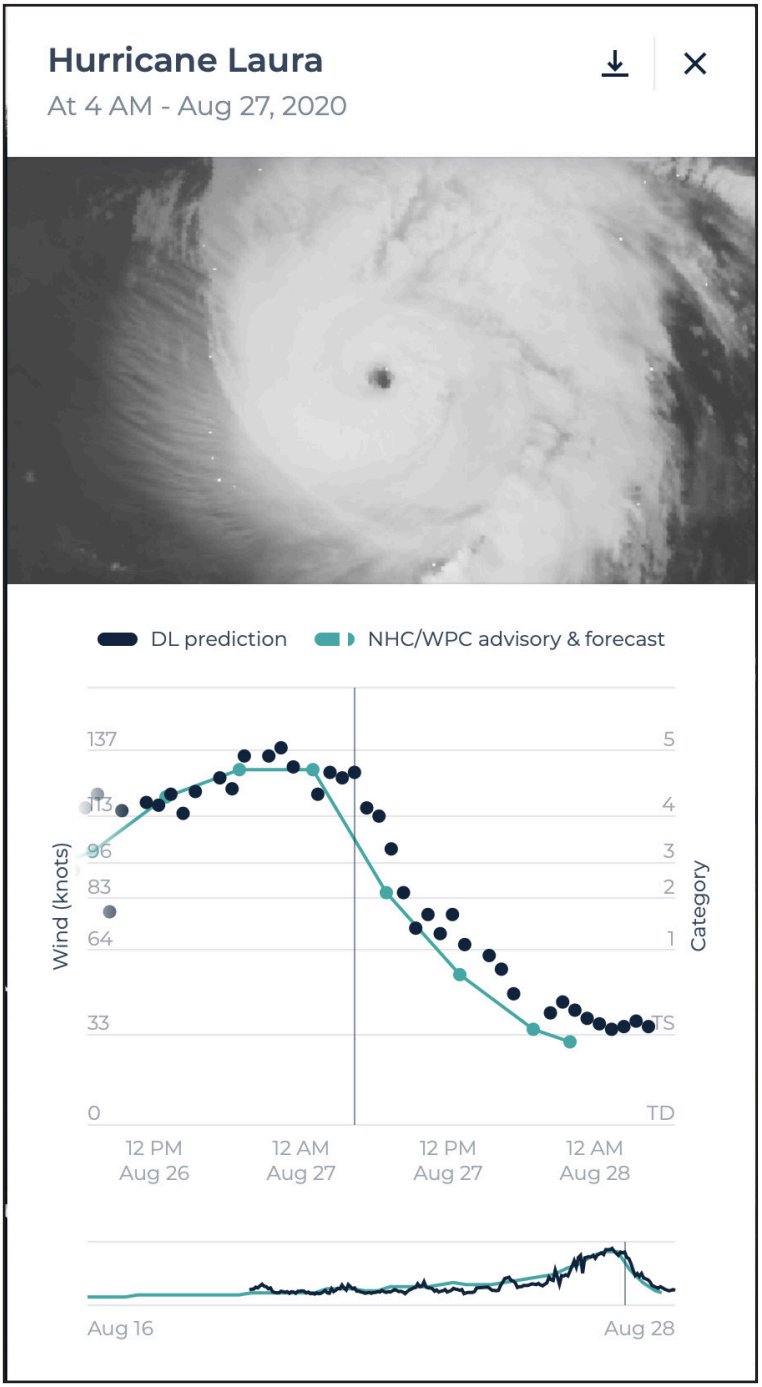
ALSO IN THIS ISSUE

# Deep Learning-based Tropical Cyclone Intensity Estimation

A cross-disciplinary team at IMPACT implemented a situational awareness tool to monitor tropical cyclone intensities. The tool objectively determines the intensities using a deep-learning technique on infrared satellite imagery. The Deep Learning-based Hurricane Intensity Estimator is an experimental framework investigating the application of artificial intelligence technologies and cloud computing resources to provide automated and accurate estimation of tropical cyclone intensity. The goal of this investigation is to apply cognitive neural networks to satellite data feeds to objectively estimate the tropical cyclone intensity in near real time.

This intensity estimation portal has been tested, and its output was validated by subject matter experts. The feedback obtained from experts was incorporated back into the tool. This portal is a collaborative effort between IMPACT, hurricane scientists, and Short-term Prediction Research and Transition Center (SPoRT) teams within the MSFC Earth Science Branch.

Details of the methods and models that underlie the intensity predictions displayed by the tool are discussed in the article "Deepti: Deep-Learning-Based Tropical Cyclone Intensity Estimation System" published in the Institute of Electrical and Electronics Engineers (IEEE) Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS).

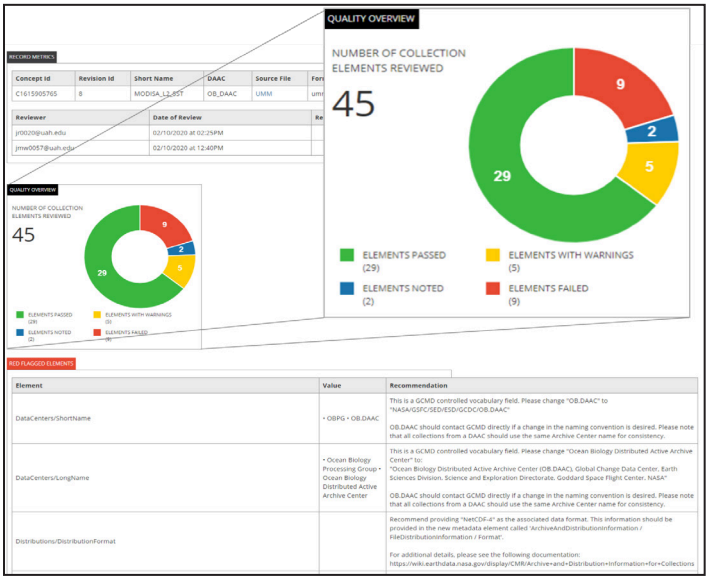



*Intensity Estimation Track*

# ARCing Through Metadata

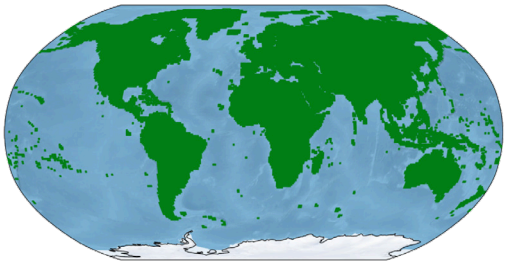
Metadata quality is dependent on the level of attention it receives. This is where the efforts of the Analysis and Review of Common Metadata Repository (CMR) (ARC) team are crucial. Under the leadership of Jeanné le Roux, the ARC team assists in making NASA's Earth science data easier for both scientists and the general public to find, access, and use by focusing on metadata and the role it plays in connecting users to data.

So far, ARC has conducted quality assessments of over 6,000 NASA metadata records in the CMR. They evaluate the information provided in each metadata record for correctness, completeness, and consistency. The ARC team provides metadata quality reports (shown right) to all twelve of the Distributed Active Archive Centers (DAACs) with recommendations on how to improve the metadata. They follow up with re-checks after changes have been made.




*ARC Quality Report*

The end result is an increased consistency in metadata across the DAACs, more complete metadata records, and the addition of new elements resulting in updated and improved metadata content.



*Coverage Area for "Global" HLS L30 and S30 Data Products (shaded in green)*

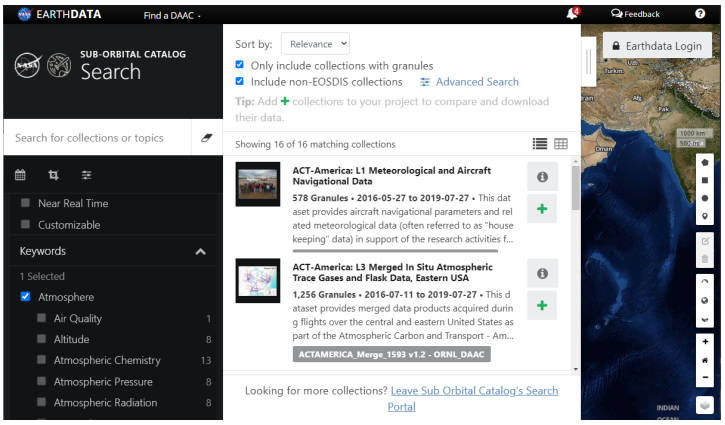
# Harmonized Landsat/ Sentinel 2 Data Released

The Harmonized Landsat/Sentinel 2 (HLS) project, led by the IMPACT project, harmonizes both Landsat and Sentinel-2 observations to form a virtual constellation that generates analysis-ready surface reflectance observations at 30-meter resolution. HLS consists of two data products, the Landsat component of the constellation (L30) and the Sentinel-2 component of the constellation (S30). On October 5, 2020, the Land Processes (LP) DAAC, which is responsible for the archiving and distribution of the HLS data products generated by IMPACT, released a provisional version of the S30 data product to the public.

The S30 data product is available through the Earthdata Search platform and imagery will soon be available in NASA Worldview. HLS is the first data product in the Earth Observing System Data Information Systems (EOSDIS) data archive that is fully generated in the cloud and marks the beginning of a new chapter for data production and distribution for NASA's Earth Science Data Systems (ESDS).

# ADMG Making a Difference

The 2018 Satellite Needs Assessment identified the need for a centralized airborne data and information resource with improved discovery and data access capabilities. The Airborne Data Management Group (ADMG) has worked to provide support to both data producers and DAACs, to improve discovery, access, and use of NASA airborne Earth science data and information, and to standardize and organize NASA airborne data stewardship.




*Earthdata Sub-orbital Portal*

Successes this past year have included the development of a website containing links to resources for investigation teams, updates to existing policies and procedures, support of the third round of Earth Venture Suborbital projects, locating and preparing historical airborne data for archival at DAACs, development of an exhaustive inventory of NASA airborne data, and creation of common definitions and decision trees for use in inventory development. The team works tirelessly to add to and improve metadata that describe platforms, instruments, and the investigation context surrounding data collection. All this effort helps to improve airborne data use and value. A new Sub-orbital Portal is now available that speeds data access while the Catalog of Archived Earth Science Investigations (CASEI) is constructed. The user interface to the CASEI airborne inventory will be released next year.

# Advancing the Application of Machine Learning Tools

Dr. Manil Maskey and Dr. Rahul Ramachandran organized the workshop on Advancing Application of Machine Learning Tools for NASA's Earth Observation Data (ML4EO). The workshop was sponsored by the NASA Earth Science Data Systems (ESDS) program and co-sponsored by the IEEE Geoscience and Remote Sensing Society (GRSS). The Radiant Earth Foundation hosted the workshop which included machine learning (ML) practitioners from various Earth science fields to discuss how best to create training datasets to accelerate ML for Earth observation. Dr. Maskey and Dr. Ramachandran participated in working groups which aimed at evaluating recent advancements, identifying existing obstacles and developing best practices guidelines to enhance the adoption of ML techniques. Dr. Maskey also served on the science committee for the workshop and assisted in synthesizing a report with suggested recommendations and best practices.

**Visit the new IMPACT project website!**

# Team In Profile

This year has been a year of accomplishment for the entire team at IMPACT. Below are but a few of the team members who have made a difference.

As part of their airborne inventory metadata curation initiative, the **Airborne Data Management Group** (ADMG), led by Deborah Smith, curated metadata for 26 campaigns and over 170 airborne and field instruments.

The **Multi-Mission Algorithm and Analysis Platform** (MAAP) data team, led by Kaylin Bugbee, was instrumental in the D1 release of the ESA/NASA collaborative analysis platform.

The **Algorithm Publication Tool** (APT) development team, led by Ashish Acharya, built a tool for publishing and managing algorithm theoretical basis documents. The tool was released for beta testing in October 2020.

In support of the **Satellite Needs Working Group** (SNWG), a team led by Dr. Katrina Virts, developed an automated process which ingests federal agencies' Earth observation data needs from the 2020 SNWG survey and outputs satellites and datasets that are relevant to each need.

**Commercial Smallsat Data Acquisition (CSDA) Program** team, led by Aaron Kaulfus, developed and released the Smallsat Data Explorer for making commercial GNSS-R and imagery data discoverable and orderable to NASA funded investigators.

The **Data Curation and Discovery** (DCD) team, led by Jeanné le Roux, improved the discoverability of NASA Earth science data in trusted catalogs and platforms such as in Data.gov and assisted agencies in incorporating NASA Earth observation data into their workflows.

Summer intern, Talha Khan, was featured in The Marshall Star for his work on dust detection as part of IMPACT's **Phenomena Detection** team.

## Congratulations Corner

**Dr. Rahul Ramachandran** was recognized for his contributions to the field of computer science by his selection for the High Performance Computing Technical Computing Advisory Panel.

**Iksha Gurung**, **Shawn Foley, Muthukumaran R., Olaf Veerman**, **Dr. Zhuangfang NaNa Yi**, **Lilly Thomas**, and **Drew Bollinger** were recognized by NASA HQ for exceptional performance for helping to realize the vision of the NASA/ESA/JAXA's COVID dashboard and enabling international partnership in a time of need.

**Prasanna Koirala**, **Carson Davis**, **Ankur Shah**, **Aaron Kaulfus**, and **Muthukumaran R.** spearheaded IMPACT's contribution to NASA's Space Apps Challenge.

**Jeanné le Roux** and **Jenny Wood** curated the Resilience community, which was recognized as one of the deepest sets of content on the GeoPlatform site.

**Dr. Emily Foshee** successfully defended her dissertation "Mesoamerican Mountain Gap Winds: Forecasting and Understanding the Impact on Regional Weather" on applying machine learning to forecasting mountain gap winds.

# IMPACT FY 2020 by the Numbers


## Publications

- "Advancing Open Science Through Innovative Data System Solutions: The Joint ESA-NASA Multi-Mission Algorithm and Analysis Platform (MAAP)'s Data Ecosystem"
- "Standardized Algorithm Documentation for Improved Scientific Data Understanding: The Algorithm Publication Tool Prototype"
- "A Quantitative Analysis on the Use of Supervised Machine Learning in Earth Science"
- "Employing Deep Learning to Enable Visual Exploration of Earth Science Events"
- "ES2Vec: Earth Science Metadata Keyword Assignment using Domain-Specific Word Embeddings"
- "Analogy-based Assessment of Domain-specific Word Embeddings"
- "Deepti: Deep-Learning-Based Tropical Cyclone Intensity Estimation System"

## Upcoming AGU Fall 2020 Chaired Sessions by IMPACT Members

- End-to-End Machine Learning for Earth Science: Tools, Frameworks, and Practical Applications
- Commercial Smallsat Data: Research and Applications in Earth Science
- Scalable Cloud Optimized Spatiotemporal Data Platform (SDP) for Data Driven Analytics
- Solving Training Data Bottleneck for Artificial Intelligence/Machine Learning in Earth Science
- Using Unstructured Data in Earth Science
- Data for All: Open Data Sharing to Empower Science
- Linking knowledge in the Earth and Space Sciences: Pioneers of a New Paradigm
- Recent Advancements in Earth Science Data Discovery and Metadata Stewardship Practices
- Dashboards to Explore Effects of COVID19 Using Earth Observations

## Learn more about IMPACT

Gain an overview of IMPACT within Earth Science Data Systems.

Visit the IMPACT project website for more about IMPACT projects and access to tools.

Read the latest IMPACT news.