Atmospheric Science Data Center's Suborbital Tools and Services
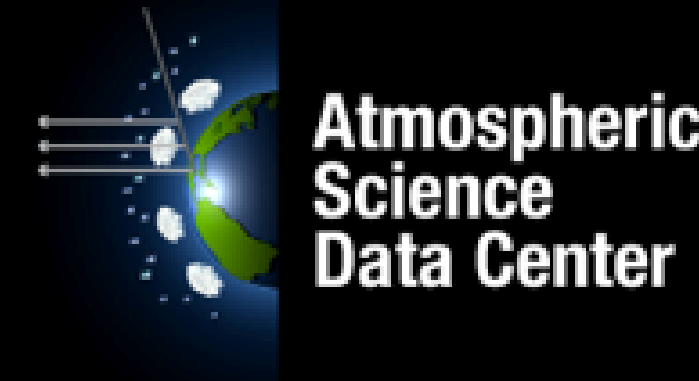
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Atmospheric Science Data Center (ASDC)

The NASA Earth Observing System Data and Information System (EOSDIS) is designed as a distributed system, with major facilities located throughout the United States known as Distributed Active Archive Centers (DAACs). DAACs are a part of the NASA Earth Observing System (EOS) mission and are critical in ensuring data will be easily accessible to users. The main objective of DAACs is to process, archive, document, and distribute data from NASA's past and present Earth-observing satellite missions and field campaigns. EOSDIS is home to 12 DAACs: Alaska Satellite Facility (ASF) DAAC, the Atmospheric Science Data Center (ASDC), Crustal Dynamics Data Information System (CDDIS), Global Hydrometeorology Resource Center (GHRC) DAAC, Goddard Earth Sciences Data and Information Services Center (GES DISC), Land Processes DAAC (LP DAAC), Level 1 and Atmosphere Archive and Distribution System (LAADS) DAAC, National Snow and Ice Data Center (NSIDC) DAAC, Oak Ridge National Laboratory (ORNL) DAAC, Ocean Biology DAAC (OB.DAAC), Physical Oceanography DAAC (PO.DAAC), and the Socioeconomic Data and Applications Center (SEDAC).

Figure 1: Map of NASA EOSDIS DAACs

Established in 1991, the ASDC is in the Science Directorate located at the NASA Langley Research Center (LaRC) in Hampton, Virginia. The Mission of the ASDC is to "be a leading provider of atmospheric science data products and services to the science community through agility, innovation, and technical excellence." The Science Directorate's Climate Science Branch, Atmospheric Composition Branch, and Chemistry and Dynamics Branch work with science teams to study changes in the Earth and its atmosphere. The ASDC supports over 60 projects and provides access to more than 1000 archived collections. Data products produced by campaigns translate into meaningful knowledge that inspires action by scientists, educators, decision makers, and the public. The ASDC has four focus areas: Radiation Budget, Clouds, Aerosols, and Tropospheric Composition.

Data Ingest, Archive, and Distribution Process

The data ingest, archival, and distribution process is an extensive process that involves several teams at the ASDC. A lot of the processes can be done in parallel to help reduce the time it takes from data creation and transfer to public distribution. The first step is for the science team to work with the ASDC to write an abstract describing the campaign, when and where it occurred, goals and objectives, and measurement platforms. The abstracts are then posted to the ASDC website to create a "landing page" for the project. The landing page is a hub where the abstract, data, and other related materials (outreach materials/documentation) live. Once the abstract has been published, the ASDC will continue to create necessary documentation to fulfil our requirements. These documents include a 90-day DAAC plan of accession and a data management plan (DMP). The DMP may need to be written by the science team depending on the stage of the project, for example if the project is active or upcoming, the science team will be expected to submit the DMP. The goal of the DMP is to detail how the ASDC plans to organize and maintain the data.
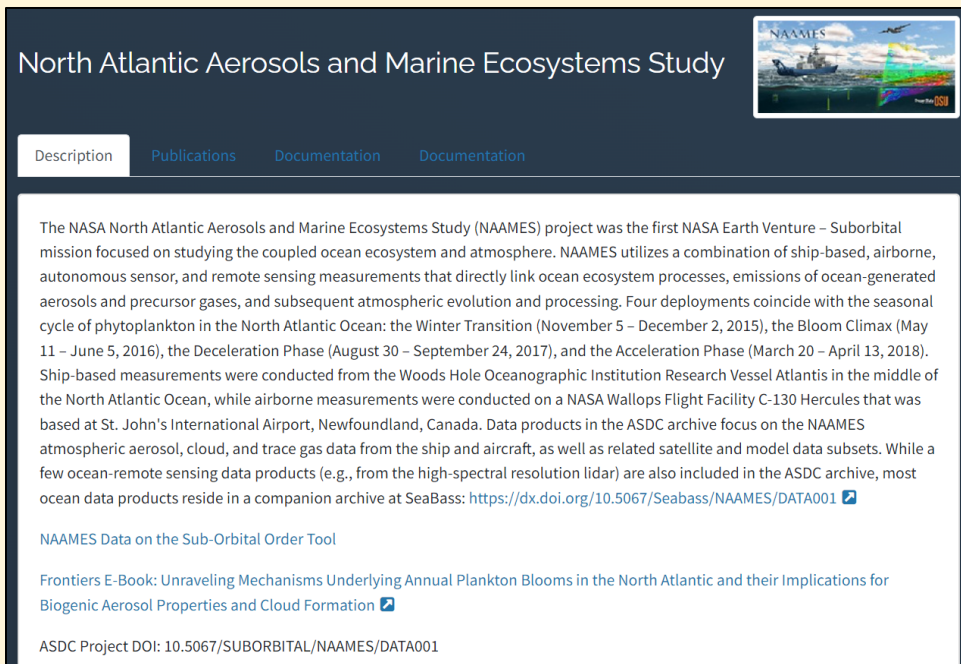

Figure 2: NAAMES landing page at the ASDC

Once the documentation is complete, the ASDC will begin the metadata compilation process which begins with submitting a request to add a GCMD (Global Change Master Directory) Project Keyword which enables data to appear on Earthdata Search and the ASDC's landing page for the project. What happens next is the decision on how the collections, or data products, for a project will be organized. Data products are a logically meaningful group of data with the same basic characteristics but have multiple variables. After the data is defined and organized, the ASDC works with the science team to gather metadata to add to the metadata repository which can assist with defining the collections. These metadata include: DOI (Digital Object Identifier), temporal range, spatial range, platforms/instruments (may require new keywords which can be requested), collection abstract, data contacts, science and location keywords ,and related URLs. Once the storage configurations are ready in the ASDC's ingest/archive systems, the data transfer process can begin.

Data can be transferred to the ASDC in many ways (Box, OneDrive, email, field repositories, etc.). Once the SUBorbital Support (SUBS) team has received the data, it is processed through our metadata extraction pipeline which extracts the metadata needed to make the data available once it's archived at the ASDC. Following the extraction of the file metadata, the files and their corresponding metadata files are transferred to the ingest/archive system. After files are archived, they are made publicly available. Only after all collections are made available on the ASDC website will the DOIs be registered. DOIs are reserved and registered at both the collection and project level, with project level DOIs leading to the ASDC project landing page. The DOIs are reserved prior to data ingest, during the metadata curation process, and are then registered after the data is made public.

Outreach at the ASDC

The ASDC also works with science teams to create various outreach material promoting data access and use for the mission. The outreach material range from a news article announcing the release of data to micro-articles to ArcGIS StoryMaps with interactive maps displaying the campaigns data. The goal of creating outreach material is not only to promote data access, but to make NASA campaigns, data, and scientists more available to and digestible by the public who may not know about atmospheric science. Creating these outreach material highlighting campaigns and their data is also in compliance with NASA's Open-Source Science Initiative, which is a long-term commitment to creating an inclusive open science community. Open sharing of software, data, and knowledge (algorithms, papers, documents, ancillary information, etc.) as early as possible in the scientific process is the major goal of NASA's Open Science Initiative. Outreach material can be found on the ASDC website.
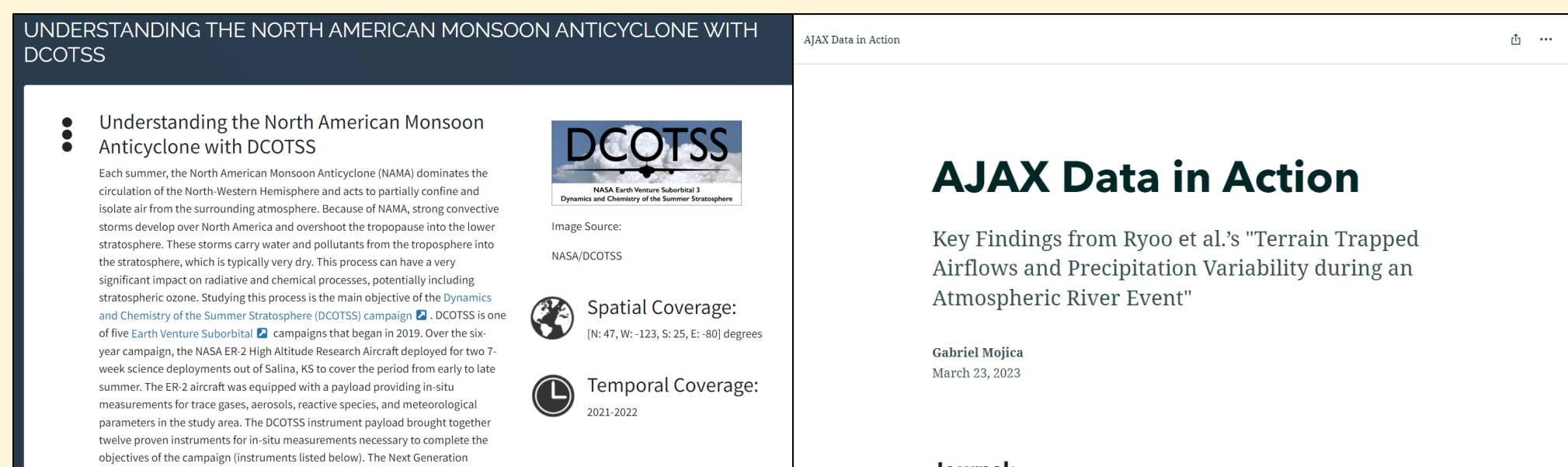

Figure 3: Left: DCOTSS Microarticle Right: AJAX Data in Action StoryMap

SUBorbital Support (SUBS) Team

The SUBS team is a specialized group within the ASDC who works specifically with atmospheric science, data ingest, archival, and distribution, data science, and outreach. The SUBS team works with science mission teams and guided them through the data process at the ASDC.

While the ASDC ingests, archives, and distributes data from NASA campaigns involving atmospheric science, including satellite and suborbital missions, the SUBS team focuses only on the suborbital missions, or missions that occur within the Earth's atmosphere. These missions typically use instrument payloads aboard aircraft, boat, mobile labs, or ground stations. Satellite data can also be used in suborbital missions as a validation method for aircraft measurements. The following is a list of some of the campaigns the SUBS team has been assigned to perform data distribution on:

SUBS Team Members

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Short Name	Long Name	Platform(s)	Short Name	Long Name	Platform(s)
ACTIVATE	Aerosol Cloud meTeorology Interactions oVer the western ATlantic Experiment	Aircraft, satellite	NAAMES	North Atlantic Aerosol and Marine Ecosystem Study	Aircraft, satellite, sondes, research vessel
AJAX	Alpha Jet Atmospheric Experiment	Aircraft	ORACLES	ObseRvations of Aerosols above CLouds and their intEractionS	Aircraft
CALIPSO-NVF	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations – Night Validation Flights	Aircraft, satellite	OWLETS	Ozone Water-Land Environmental Transition Study	Aircraft, satellite, ground station, research vessel
CAMP2Ex	Cloud, Aerosol and Monsoon Processes-Philippines Experiment	Aircraft, satellite, ground station	SCOAPE	Satellite Coastal and Oceanic Atmospheric Experiment	Ground station, sondes, research vessel
CPEX-AW, CPEX-CV	Convective Processes Experiment, Aerosol & Winds, Cabo Verde	Aircraft, satellite, sondes	SOLVE	SAGE III Ozone Loss and Validation Experiment	Aircraft, satellite, ground station, sondes, rocket
DCOTSS	Dynamics and Chemistry of the Summer Stratosphere	Aircraft, satellite, ground station, sondes	SONEX	Subsonic Assessment – Ozone and Nitrogen Oxide Experiment	Aircraft, satellite
DISCOVER-AQ	Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality	Aircraft, satellite, ground station, sondes	STAQS	Synergistic TEMPO Air Quality Science	Aircraft, ground station
FIREX-AQ	Fire Influence on Regional to Global Environments and Air Quality	Aircraft, satellite, sondes	TOLNet	Tropospheric Ozone Lidar Network	Ground station
MOOSE	Michigan-Ontario Ozone Source Experiment	Aircraft, ground station, mobile station	TRACER-AQ	Tracking Aerosol Convection ExpeRiment – Air Quality	Aircraft, ground station, sondes

Data Access

All the campaigns archived at the ASDC can be found on the ASDC webpage. To access ASDC data on SOOT, Earthdata Search, and DDD, you need to have a free Earthdata Login which you can create at urs.earthdata.nasa.gov.

Earthdata Search: Collection-based data access and search mechanism providing access to NASA Earth Science data.
Direct Data Download: Provides the ability to access and download all ASDC publicly available data collections via https; Scripts for downloading data are available.

Data Access Resources

ASDC Website: asdc.larc.nasa.gov/
Earthdata Search: search.earthdata.nasa.gov/search
ASDC Direct Data Download (DDD): asdc.larc.nasa.gov/data/
Sub-Orbital Order Tool (SOOT): asdc.larc.nasa.gov/soot/power-user

Figure 4: Left: ASDC website "Browse Projects" section. Right: ACTIVATE data on NASA Earthdata Search

The Sub-Orbital Order Tool (SOOT)

The Sub-Orbital Order Tool (SOOT) is a data accession tool at the ASDC which was designed to promote suborbital research and analysis. On SOOT, you can discover and access the airborne and field campaign data archived at the ASDC. SOOT's Power User Interface is intended for experienced airborne data users and airborne science teams. In the ASDC, the Transformers team develops, updates, and maintains SOOT. Currently, there are 15 campaigns on SOOT with data readily available to download.

Figure 5: The homepage of the SOOT website.

Data Accession on SOOT

SOOT makes it very easy to access and download data. However, you must first have an Earthdata account to download data from SOOT. When on the SOOT website, you are presented with a list of campaigns and their deployment/dataset dates. You can either chose a specific campaign and year, or only a campaign. There is also a section for support documentation which includes publications affiliated with the campaign, data products, related websites, and other campaign-related documentation. Once you select a campaign, you will be presented with the campaign abstract and a list of dates and platforms to further refine your search (Figure 6). You will then select the desired year and platform which will bring up the related Principal Investigators (PIs) and data IDs for the instruments those platforms (Figure 7).
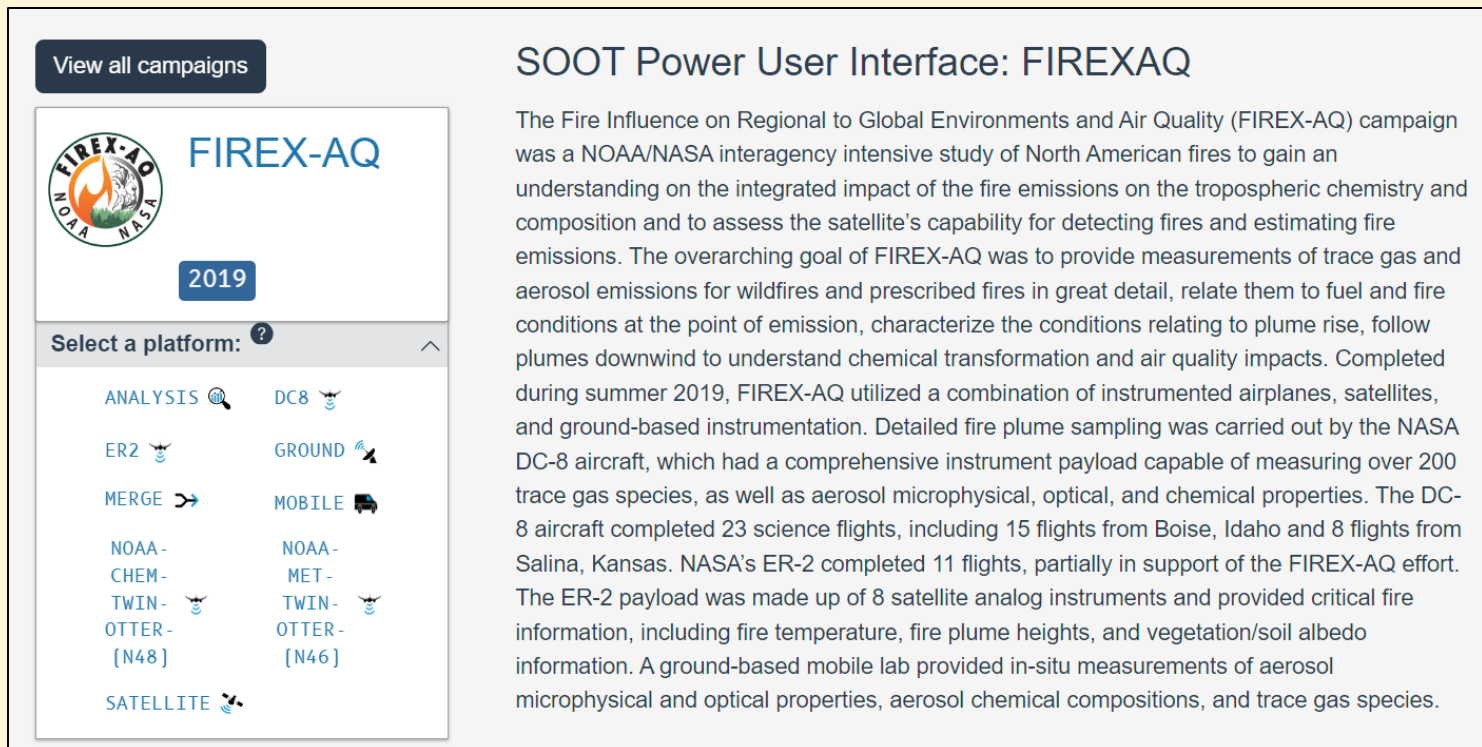
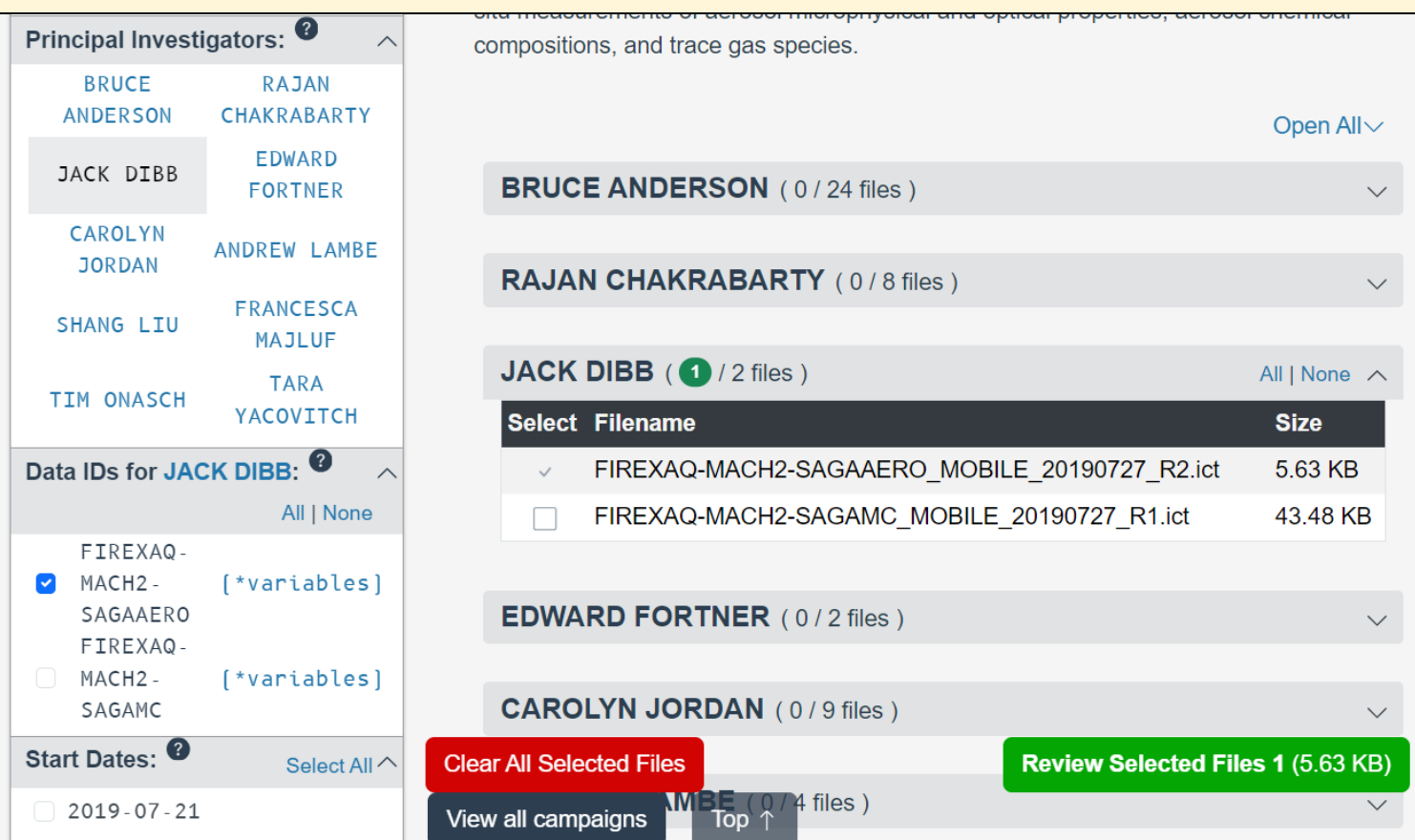You can then further filter by selecting a PI to view only their data IDs, or you can select a specific data ID without filtering by PI. Once you select a data ID you will be prompted to download the selected file (Figure 8). One additional feature of SOOT is the Merge Feature. This allows you to select multiple files starting at the same time and day and "merge" them into one file that includes the variables from all individual files. This must be performed on the same campaign and the files must have the same start day and time. Currently, the Merge Feature is in Beta testing, and welcomes feedback which you can provide on the SOOT website when you download data. If you have any questions about SOOT, please contact them at: larc-dl-asdc-soot-poc@mail.nasa.gov
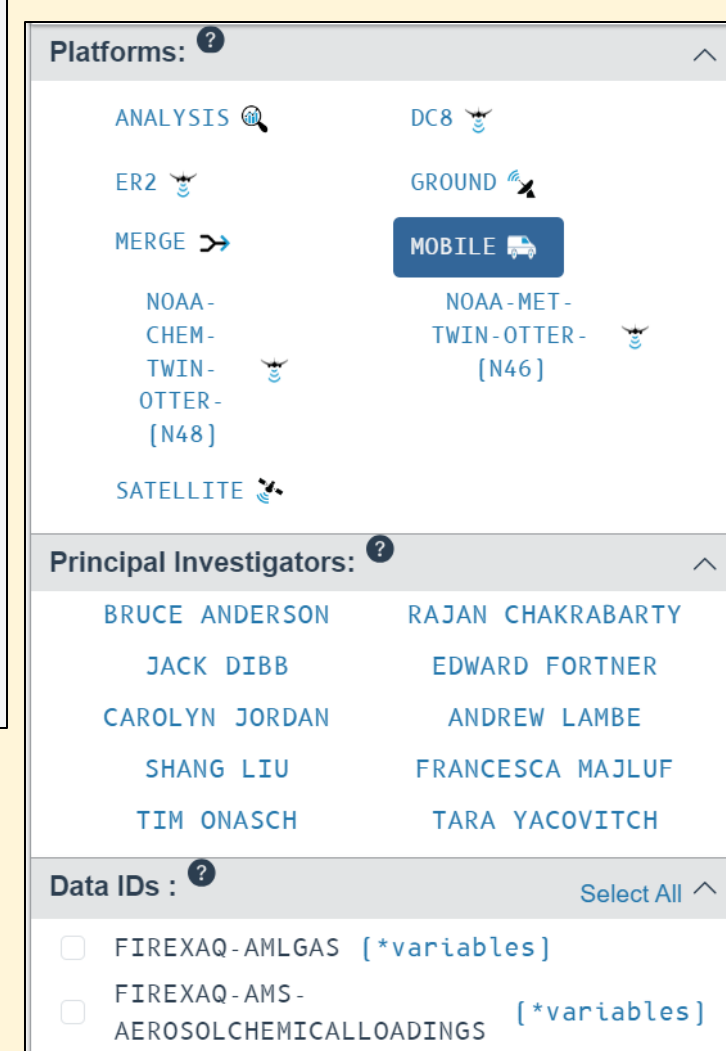

Figure 6: FIREX-AQ page on SOOT

Figure 7: Platforms, PIs, and Data IDs for FIREX-AQ on SOOT

Figure 8: Selected file ready for download on SOOT

References and Resources

1. https://asdc.larc.nasa.gov/
2. https://asdc.larc.nasa.gov/soot/power-user
3. https://science.nasa.gov/researchers/open-science/
4. https://www.earthdata.nasa.gov/eosdis/daacs