





ABoVE Science Cloud on ADAPT/Explore

Liz Hoy - NASA Carbon Cycle and Ecosystems Office Jim Shute, Ryan Forbes, Ellen Salmon, Matt Stroud & others - NCCS Team Mark Carroll - NASA Data Science Group and Innovation Lab & ABoVE Science Team







- Background
- NCCS Capabilities
- Large Datasets
- Analysis Ready Products from the Innovation Lab
- ASC Research Highlights
- Account Setup
- Demos
- Questions

ABoVE Data Workflow



Augmented from Rüegg et al 2014 in Front Ecol Environ



NASA Center for Climate Simulation (NCCS) Geospatial Capabilities Briefing

Jim Shute NCCS Cloud Computing and Data Services (CCDS) Lead james.k.shute@nasa.gov

NASA Center for Climate Simulation – https://www.nccs.nasa.gov







- NCCS Mission
- NCCS Systems
- Functional Area Overviews
- Spatial Platform
- GIS Development Paradigm
- GIS Development Options
- Example Workflows
- Accessing the Systems
- Demo
- Strengths and Challenges



NCCS Mission

The NCCS provides high performance computing for NASA-sponsored scientists and engineers. Our integrated set of computational capabilities includes High Performance Computing, Cloud Computing, Analytics, Data Sharing and Tools, Visualization, and Climate Data Services. The purpose of the NCCS is to enhance NASA capabilities in Earth science, with an emphasis on weather and climate prediction, and to enable future scientific discoveries that will benefit humankind.

ABoVE Science Team Meeting (ASTM5), 2019

Building 28, Goddard Space Flight Center

Piers J. Sellers Data Visualization Theater

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

NCCS Systems

- NCCS flagship high performance computing (HPC) cluster
- Upgraded every 1 to 2 years with scalable computing units (SCUs)
 - Recently deployed SCU16
 - SCU17 inbound (late '22)
- Platform specifications
 - 3,564 nodes
 - 127,232 CPU cores (5.57 PFLOPs)
 - 573TB RAM
 - 48PB GPFS file storage

Discover SCU 16

Discover-based analysis Moder-Ers Rerespective analysis for Research and Applications (MERA-C) Precipitation Rate [mm/day] Climate Moar

Centralized data store, accessible by all NCCS platforms/subsystems.

- CSS 1 15PB usable storage
- CSS 2 15PB usable storage
- CSS 3 inbound (Q2 '22)

- ABoVE: 80 TB
- Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC) datasets, including over 130 archived as part of ABoVE.
- National Snow and Ice Data Center (NSIDC) DAAC datasets, including LVIS products archived in support of ABoVE.
- Alaska Satellite Facility (ASF) datasets related to L-band SAR
- AMSR-2: 5 TB
- AVHRR/Polar: 40 TB on ADAPT and 10 GB on CSS
- **CFHA: 250 TB**
- ► CMIP5: 105 TB
- CREATE-IP: 79 TB
- CSDA-Spire: 30 TB

Note: Access permission required, please contact NCCS suppor

- DSCOVR: 72 TB (L1B)
- DSCOVR: 72 TB (L2_CLOUD_03)
- FLDAS: 40 TB
- ► GeoMIP: 14 TB
- ► Geostationary (GOES): Ingest starting now, planning for 1 PB
- GEOS-IT: 420 TB
 Note: Public access coming soon.
- ► GEOS-5 Nature Runs (g5nr): 5 PB
- ► HIMAT Snow Reanalysis: 5 TB
- ► ICEBridge: 2 TB
- ► ICESat: 8 TB
- ► ICESat-2: 161 TB
- ▶ IMERG: 15 TB
- Landsat: 186 TB
- MAIAC: 107 TB

Subset of datasets stored on CSS

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

CSS 1 and 2 (30PB total usable storage)

ADAPT/Dataportal

- Original virtualization environment
- Three subsystems
 - Legacy ADAPT hypervisors
 - Legacy OpenStack on-premise cloud
 - Dataportal data sharing applications/websites
- Platform specifications
 - 144 hypervisors
 - 3,456 CPU cores
 - 37TB RAM
 - 6PB GPFS file storage
 - Supports approximately 350 virtual machines
 - Multiple bare metal GPU systems

Nvidia DGX Next generation 8-GPU node

PRISM 22-node GPU cluster

- Next generation on-premise cloud
- Multiple availability zones (B28 and B32)
- Current specifications
 - 104 hypervisors
 - 4,352 CPU cores
 - 28.6TB RAM
- Full operating capability specifications (Q4 '22)
 - 280 hypervisors
 - 8,704 CPU cores
 - 72TB RAM
 - 6PB next generation storage

Explore Cloud Control Plane and Initial Compute

Explore Cloud OpenStack Web Interface

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| | Compute | ~ | In | stances | | | | | | | | | | | | |
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| | | Images | Disp | playing 16 items | | | | | | | | | | _ | | |
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| Identity | | > | 0 | dpdrgdev07 | | 10.81.38.47 | gis-standard | | Active | ω. | compute | None | Bunning | 4 months, 1 week | Create Snapshot | • |
| | | | 0 | dpdgdev06 | | 10.81.38.46 | gis-advanced | 4 | Active | ÷ | compute | None | Bunning | 4 months, 1 week | Create Snapshot | • |
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Spatial Platform Logical Architecture

GIS Development Paradigm

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

GIS Development Options

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

Example Workflow – Automation

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

NCCS Spatial Analytics Platform – https://maps.nccs.nasa.gov

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Source Data (Multiple types)

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

Example Workflow – Service Publishing

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

Accessing the Systems

Moderate Access Level Required Smartcard

RSA Tok

Agency User

Smartcard Log In Alternate User Log In Access Level: High Full access to authorized application

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- Secure shell (ssh)
 - Majority of users
- Web services
 - Esri Portals
 - Custom applications
 - Data sharing services
- Windows desktop access
 - Guacamole (open source, Citrix equivalent)

- Abundant compute resources
- Abundant storage resources
- NASA-wide Enterprise License Agreement (ELA)

Strengths

- Latest versions of the Esri software (10.9.1)
- Enterprise software (ArcGIS Server and Portal)
- Desktop software (ArcGIS Pro and ArcGIS Desktop)
- Proximity of data archives to GIS analysis and visualization capabilities
- Bridging the gap between Linux and Windows
- Full life-cycle support
 - Analysis (Linux) > Publication (Windows) > Visualization (Web)

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

Esri License Breakdown

| Row Labels | Sum of License Count |
|--|----------------------|
| 3D Analyst | 30 |
| ArcGIS for Desktop Advanced | 30 |
| ArcGIS Image Server | 8 |
| ArcGIS Pro for Desktop Advanced | 30 |
| ArcGIS Server Enterprise Advanced | 16 |
| ArcGIS Server Network Analyst Extension Standard | 4 |
| ArcGIS Workflow Manager Extension Advanced | 4 |
| Geostatistical Analyst | 30 |
| Network Analyst | 30 |
| Portal for ArcGIS (qty is # of seats) | 250 |
| Spatial Analyst | 30 |
| Tracking Analyst | 5 |
| Workflow Manager | 5 |
| Grand Total | 472 |

- Most users do not consider their work to be GIS/geospatial
- Low adoption of:
 - Esri Portal application capabilities
 - Esri ArcGIS Server web service capabilities
- Filesystem stability
 - Will be mitigated with arrival of next generation storage platforms
- Finding time to automate critical workflows, due to context switching, etc.

Questions?

| Contact Information | | | | | | | | | | | | |
|--|--------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
| NCCS Cloud Computing and Data Services (CCDS) Lead | Jim Shute (james.k.shute@nasa.gov) | | | | | | | | | | | |
| NCCS GIS Manager | Ryan Forbes (ryan.s.forbes@nasa.gov) | | | | | | | | | | | |
| NCCS Website | https://www.nccs.nasa.gov | | | | | | | | | | | |
| NCCS Spatial Analytics Platform | https://maps.nccs.nasa.gov | | | | | | | | | | | |
| NASA Disasters GIS Platform | https://maps.disasters.nasa.gov | | | | | | | | | | | |

- ABoVE Science Cloud is part of ADAPT/Explore
- ADAPT has both Linux & Windows Virtual Machines (VMs)
- Incorporates storage, compute, and cloud computing capabilities
- Designed for large-scale data analytics

Info on ADAPT:

https://www.nccs.nasa.gov/systems/ADAPT

>12 PB of Maxar Imagery Available on ADAPT

To access ADAPT & Maxar Imagery: <u>https://above.nasa.gov/sciencecloud.html</u>

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

► ABoVE: 80 TB

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- ICEBridge: 2 TB
- ► ICESat: 8 TB
- ICESat-2: 161 TB
- ► IMERG: 15 TB
- 🕨 Landsat: 186 TB
- MAIAC: 107 TB
- ► MERRA: 86 TB
- ► MERRA2: 320 TB
- Selected MODIS data: 679 TB +
- NEX GDDP: 11 TB
- ► NEX DCP30: 11 TB
- ▶ NGA: 12000 TB (~ 12 PB)

80 TB of ABoVE-Archived Data are on ADAPT

ADAPT brings together all ABoVE datasets in a single location for users.

NASA Distributed Active Archive Center (DAAC) at NSIDC LVIS Data NASA Land, Vegetation and Ice Sensor Facility

DAAC Home > Get Data > NASA Projects > Arctic-Boreal Vulnerability Experiment (ABoVE)

Arctic-Boreal Vulnerability Experiment (ABoVE)

Overview

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign being conducted in Alaska and western Canada, for 8 to 10 years, starting in 2015. Research for ABoVE links field-based, process-level studies with geospatial data products derived from airborne and satellite sensors, providing a foundation for improving the analysis, and modeling capabilities needed to understand and predict ecosystem responses to, and societal implications of, climate change in the Arctic and Boreal regions.

Related Links

Browse ABoVE datasets Search ABoVE datasets C Publications citing ABoVE

ABoVE project site

- 29.2 million images
- 12.8 petabytes
- Sensors
 - GE01 (1,948,067)
 - IK01 (322,417)
 - OV03 (227)
 - QB02 (3,470,713)
 - WV01 (6,362,592)
 - WV02 (11,796,075)
 - WV03 (5,234,308)
 - WV04 (13,505)

- Years
 - 1999 (10), 2000 (25,485), 2001 (34,174), 2002 (176,934), 2003 (260,623), 2004 (274,672), 2005 (252,903), 2006 (309,937), 2007 (482,251), 2008 (740,694), 2009 (802,602), 2010 (1,197,106), 2011 (1,772,616), 2012 (1,990,030), 2013 (1,914,354), 2014 (1,753,856), 2015 (1,886,852), 2016 (2,150,556), 2017 (2,297,327), 2018 (1,923,486), 2019 (1,580,714), 2020 (2,733,255), 2021 (2,560,723), 2022 (2,021,130), 2023 (5,615)

NGA/Maxar Data Coverage

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

Analysis Ready Data from the Innovation Lab

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

NCCS ABoVE GLAD ARD Product

- Landsat Analysis Ready Data (ARD) tiles are produced from Landsat Collection 2 data by the Global Land Analysis and Discovery Lab (GLAD) at the University of Maryland.
- The dataset is distributed as 16-day interval composites, with 23 intervals for each year (i.e., Interval ID 5 corresponds to DOY 65 to 80).
- We have downloaded and made available the entirety of this dataset through October 2022 across the ABoVE Study domain, including the Extended Region. There is currently a total of 18TB, with more data to come.
- The GLAD Landsat ARD C2 product has been gridded to the ABoVE Reference Grid at moderate resolution (B) and reprojected to Canada Albers Equal Area Conic (ESRI: 102001).

/css/above/glad.umd.edu/Collection2/GLAD_ARD/ABoVE_Grid

| Table 1. A | Table 1. Available bands | | | | | | | | | |
|------------|-----------------------------------|--|--|--|--|--|--|--|--|--|
| ID | Band | | | | | | | | | |
| 1 | Blue band | | | | | | | | | |
| 2 | Green band | | | | | | | | | |
| 3 | Red band | | | | | | | | | |
| 4 | NIR band | | | | | | | | | |
| 5 | SWIR1 band | | | | | | | | | |
| 6 | SWIR2 band | | | | | | | | | |
| 7 | Normalized brightness temperature | | | | | | | | | |
| 8 | Observation quality flag (QF) | | | | | | | | | |
| | | | | | | | | | | |

ABoVE.GladARD.200511.Bh002v003.001.20220919.tif

| 200511 | data reference date, given by year and interval ID |
|-----------|--|
| Bh002v003 | position within the ABoVE reference B grid |
| 001 | product version |
| 20220919 | production date |

Potapov, P., Hansen, M.C., Kommareddy, I., Kommareddy, A., Turubanova, S., Pickens, A., Adusei, B., Tyukavina A., and Ying, Q., 2020. Landsat analysis ready data for global land cover and land cover change mapping. *Remote Sensing 12, 426*; doi:10.3390/rs12030426

VHR Analysis Ready Data for Alaska

Montesano, Carrol, Neigh, Macander, Caraballo-Vega, Tamkin in prep. 2023

70 -

GE01

QB02

- 13 publications list the use of ADAPT in their acknowledgements (more are in-process)
- 39 data products using/used EXPLORE in their development (more to come)
 - 30 archived datasets at a NASA DAAC
 - 7 planned products
 - 2 public products

ENVIRONMENTAL RESEARCH LETTERS

LETTER

Time-series maps reveal widespread change in plant functional type cover across Arctic and boreal Alaska and Yukon

Matthew J Macander^{1,*}⁽⁰⁾, Peter R Nelson²⁽⁰⁾, Timm W Nawrocki³, Gerald V Frost¹⁽⁰⁾, Kathleen M Orndahl⁴⁽⁰⁾, Eric C Palm⁵⁽⁰⁾, Aaron F Wells⁶⁽⁰⁾ and Scott J Goetz⁴⁽⁰⁾

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A systematic evaluation of influence of image selection process on remote sensing-based burn severity indices in North American boreal forest and tundra ecosystems

Dong Chen 🖄 🖾, Tatiana V. Loboda 🖾, Joanne V. Hall 🖾

Global Change Biology

PRIMARY RESEARCH ARTICLE

Extensive land cover change across Arctic–Boreal Northwestern North America from disturbance and climate forcing

Jonathan A. Wang 🔀, Damien Sulla-Menashe, Curtis E. Woodcock, Oliver Sonnentag, Ralph F. Keeling, Mark A. Friedl

First published: 22 August 2019 | https://doi.org/10.1111/gcb.14804 | Citations: 26

Cover Change

≤ -20% -19.9 – -15% -14.9 – -10%

985-2020

Time-series maps reveal widespread change in plant functional type cover across Arctic and boreal Alaska and Yukon

Macander et al. (2022) Environmental Research Letters.

- Documented increases in Deciduous and Evergreen Shrub, Conifer and Broadleaf Tree top cover.
- Associated decreases in Graminoid and Lichen top cover with fire disturbance and shrub increase
- These changes are highly relevant to resource management applications, including wildlife habita

A Database of Simulated Vegetation Change at Sites Across the Taiga-Tundra Ecotone

P. Montesano, B. Osmanoglu, H. Epstein, E. Heffernan, B. Gay

These simulations are assembled in a database to explore the variation in expected changes in vegetation structure and composition across the taiga-tundra ecotone in North America. The forest growth model **SIBBORK-TTE** is run on ADAPT to track the growth of individual trees and shrubs through time (1900-2100) and across bioclimatic gradients using spatial inputs from ArcticDEM, SoilGRIDS, MERRA2, CMIP6, & NASA cloud cover

200 years of change in vegetation structure & composition at sites in the taiga-tundra ecotone

Modeling Emissions and Analyzing Variability in Burned Areas

S. Potter, B. Rogers, et al.

- Over 8,000 jobs submitted on ADAPT
- Using ORNL DAAC datasets to build a statistical model of emissions
- Using MODIS and Landsat data to identify burned areas & model carbon emissions
- Applying a combustion model to estimate carbon emissions from belowground and aboveground sources (for 2001-2019)

Using High-resolution Satellite Imagery and Deep Learning to Track Dynamic Seasonality in Small Water Bodies

Mullen et al., 2023 (in review)

-40

Trained model with >13,000 hand-delineated water bodies on PRISM GPU cluster. Training data development relied heavily on 2 m Maxar WorldView imagery from NGA archive.

When researchers publish research based on the use of NCCS resources, please acknowledge these NASA-provided resources with language similar to this example:

"Resources supporting this work were provided by the NASA High-End Computing (HEC) Program through the NASA Center for Climate Simulation (NCCS) at Goddard Space Flight Center."

Gaining Access – ABoVE Website:

- Instructions under "Data", "ABoVE Science Cloud", link to Science Cloud Setup Instructions
- Need NASA identity, IT Security training, RSA soft token, process takes a while
- Optional: signed NGA paperwork, new version in process
- Links to monthly webinars, other instructional videos

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

NCCS Website: <u>https://www.nccs.nasa.gov/systems/adapt</u>

- How to login, data locations, Windows FAQ, ABoVE FAQ, including orthorectification instructions
- Instructional Video Collection: <u>https://www.nccs.nasa.gov/nccs-users/instructional/instructional-videos</u>
- Account Setup Questions <u>elizabeth.hoy@nasa.gov</u>
- Questions/Issues Using NCCS Systems <u>support@nccs.nasa.gov</u>

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

- Accessing ADAPT
 - Linux VM
 - Windows VM
- Jupyter Hub
- Data Discovery Tool

• Global View (polygons are hidden at this scale)

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

• Zoom to area of interest (polygons enabled; reduces server impact)

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

• Click a polygon to see the attributes, to include image thumbnail

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

• Click the previewurl "More info" link or the thumbnail to see the image in more detail

• Click Spatial Search – select point/line/polygon, set buffer distance

• After selection, system will generate buffer and zoom to location

• Click Footprints to see the images within that buffered location

NASA Center for Climate Simulation – https://www.nccs.nasa.gov

• Click the Download button () to save the results as a csv file

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| 6 | 1736574 { | 147670BC-C G | E01_10500 GE01_20 | 0180 pending | 105001001 | 10 50237 | 764880 P1B | S US | | Panchromati 20 | 18-06-06T | 0.007 | 57.1860552 | -170.333 | 37888 | 31744 | 4 16 | 6 NITF | 27.5 | 55.4 | 0.509 | 83 | -11.1 GE | 01_20180 | /css/nga/GE | 01/1B/2018/157/G | E01_105001001062C60 | 0_P1BS_502376488040_ | 01/GE01_2 GE | 01 | 1, |
| 7 | 18525017 {2 | 2685145C-7 Q | 302_10100 QB02_2 | 0040 validated_ | v1 101001000 | 16 50585 | 5338901 P18 | 5 US | | Panchromati 20 Panchromati 20 | 04-05-18T | -999 | 57.1589454 | -170.35349 | 27648 | 31744 | 4 16 | | 6.2 | 51.9 | 0.619 | 83 | -5.7 QB | 02_20040 | Coss/nga/QB | 02/18/2004/139/0 /01/18/2012/208/ | (B02_1010010002F1A5 | 00_P1BS_505853389080 | 01/QB02_2QB | 02 | 1, |
| 9 | 25916695 {(| 0C7E5584-7 W | V02_1030(WV02_2 | 020 validated | v1 10300100A | A6 50542 | 213760 P18 | s us | | Panchromati 20 | 20-03-29T | 0.176 | 57.166194 | -170.29785 | 35840 | 29696 | 6 16 | 6 NITE | 12.9 | 36.6 | 0.489 | 83 | -12.7 WV | V01_2013 | /css/nga/W\ | /02/1B/2020/089/ | WV02_10300100264770 | 200 P1BS 50542137608 | 01/WV02W | /02 | 1/ |
| 10 | 25916697 {1 | 1EA898EC-8 W | V02_1030(WV02_2 | 2020(validated_ | v1 10300100A | A6 50542 | 2137601 M18 | IS US | | Multispectra 20 | 20-03-29T | 0.216 | 57.166194 | -170.29778 | 9216 | 8192 | 2 16 | 6 NITF | 12.9 | 36.6 | 1.957 | 83 | -12.7 WV | V02_2020 | <pre>/css/nga/W\</pre> | /02/18/2020/089/ | WV02_10300100A65BE | 200_M1BS_50542137608 | 0_01/WV0 W | /02 | 8 / |
| 11 | 3413937 {2 | 2A691EE3-1 W | V01_1020(WV01_2 | 2020(validated_ | v1 102001009 | 91 50427 | 773200: P1B | S US | | Panchromati 20 | 20-04-13T | 0.183 | 57.1688566 | -170.29577 | 27648 | 35840 | 0 16 | 6 NITF | 33 | 33.7 | 0.683 | 83 | -25.5 WV | V01_2020 | /css/nga/W\ | /01/1B/2020/104/ | WV01_1020010091C99 | 100_P1BS_504277320010 | _01/WV01 W | /01 | 1, |
| 12 | 13654498 { | FE32A2AB-5 W | V01_1020 WV01_2 | 2020(validated_ | v1 102001009 | 91 50426 | 508640(P1B | S US | | Panchromati 20 | 20-04-13T | 0.183 | 57.1688566 | -170.29577 | 27648 | 35840 | 0 16 | 6 NITF | 33 | 33.7 | 0.683 | 83 | -25.5 WV | V01_2020 | /css/nga/W\ | /01/18/2020/104/ | WV01_1020010091C99 | 100_P1BS_504260864060 | _01/WV01 W | /01 | 1, |
| 13 | 26024240 {8 | EC159C03-E W | V01_1020(WV01_2 | 2020(validated_ | v1 102001009 | 96: 50424 | 467840: P1B | 5 US | | Panchromati 20 | 20-04-13T | 0.143 | 57.1660528 | -170.29711 | 27648 | 35840 | 0 16 | 6 NITE | 29.1 | 33.8 | 0.631 | 83 | -24.5 WV | V01_2020 | (/css/nga/W\ | /01/18/2020/104/ | WV01_1020010096377 | 300_P1BS_504246784010 | _01/WV01 W | /01 | 1, |
| 14 | 26024239 {0 | 00349FB8-4G | 01_1020 WV01_2 | 0180 validated | v1 102001009 v1 1.05F+1 | 15 50585 | 556080 M18 | s us | | Multispectra 20 | 20-04-131 18-08-13T | 0.145 | 57 1849474 | -170 36931 | 27648 | 3584L 921£ | 6 16 | 6 NITE | 29.1 | 33.8 46.7 | 1 912 | 83 | -24.5 WV | 01 20180 | /css/nga/w\ | 01/18/2020/104/ | F01 105001001963770 | 00_P185_50427732506 | 01/GE01 GE | 01 | 1, |
| 16 | 18430592 { | 726FE7D3-F G | 01_10500 GE01_20 | 0180 validated | v1 1.05E+1 | 15 50585 | 556080 P18 | 5 US | | Panchromati 20 | 18-08-13T | 0.176 | 57.1848977 | -170.36928 | 37888 | 36864 | 4 16 | 6 NITF | 24.2 | 46.7 | 0.477 | 83 | 2.5 GE | 01_20180 | /css/nga/GE | 01/1B/2018/225/G | E01_105001001193000 | 0_P1BS_505855608040_ | 01/GE01_2 GE | 01 | 1 |
| 17 | 24131903 {6 | 6C23B439-3 W | V02_1030 WV02_2 | 2013(validated_ | v1 103001002 | 21: 50006 | 592321(P1B | 5 YY | | Panchromati 20 | 13-04-08T | 0.067 | 57.16209 | -170.29696 | 22528 | 35840 | 0 16 | 6 NITF | 44.1 | 40.4 | 0.889 | 83 | -34.9 WV | V02_2013 | /css/nga/W\ | /02/18/2013/098/ | WV02_1030010021352 | 000_X1BS_500069232160 | _01/WV02 W | /02 | 1, |
| 18 | 24164026 {/ | A99F483E-3 W | V02_1030 WV02_2 | 2013(validated_ | v1 103001002 | 21:50006 | 592321(M1B | S YY | | Multispectra 20 | 13-04-08T | 0.067 | 57.1621041 | -170.29682 | 6144 | 9216 | 6 16 | 6 NITF | 44.1 | 40.4 | 3.555 | 83 | -34.9 WV | V02_2013 | /css/nga/W\ | /02/18/2013/098/ | WV02_1030010021352 | 000_X1BS_500069232160 | _01/WV02 W | /02 | 8, |
| 19 | 13503657 {/ | ABF167AE-4 W | V02_1030(WV02_2 | 2020(validated_ | v1 10300100A | A5 50544 | 484170! P1B | 5 US | | Panchromati 20 | 20-03-29T | 0.487 | 57.1851191 | -170.29727 | 35840 | 24576 | 6 16 | 6 NITF | 32.2 | 36.6 | 0.642 | 83 | -13.5 WV | V02_2020 | /css/nga/W\ | /02/1B/2020/089/ | WV02_10300100A5C4B | F00_P1BS_50544841705 | 0_01/WV02W | /02 | 1, |
| 20 | 6899385 { | 1153E10D-2 W | V02_1030(WV02_2 V01_1030(WV01_2 | 2020 validated_ | v1 10300100A | A5 50544 | 484170: M18 | S US | | Multispectra 20 Papebromati 20 | 20-03-29T | 0.485 | 57.1851137 | -170.2972 | 9216 | 6144 | 4 16 | 6 NITE | 32.2 | 36.6 | 2.565 | 83 | -13.5 WV | V02_2020 | (/css/nga/W\ | /02/18/2020/089/ | WV02_10300100A5C4B | F00_M185_50544841705 | 0_01/WV0 W | /02 | 8, |
| 22 | 8179140 { | FA989601-0 W | V01_1020(WV01_2 | 2021(validated_ | v1 10200100A | AF 50528 | 802660 P18 | s us | | Panchromati 20 | 21-04-11T | 0.034 | 57.1593077 | -170.29938 | 35840 | 22528 | 8 16 | 6 NITE | 35.1 | 34.5 | 0.703 | 83 | -6.3 WV | V01_2011 | (/css/nga/W\ | /01/18/2021/101/ | WV01_1020010012055 | 900 P1BS 505280266090 | 01/WV01 W | /01 | 1 |
| 23 | 2306300 {6 | 683120AE-7 W | V02_1030 WV02_2 | 2010 validated | v1 103001000 | 04:05280 | 071300 P18 | S YY | | Panchromati 20 | 10-03-20T | 0 | 57.1482476 | -170.31713 | 34816 | 35840 | 0 16 | 6 NITF | 23.7 | 33 | 0.548 | 83 | -13.1 WV | v02_2010 | /css/nga/W\ | /02/1B/2010/079/ | WV02_10300100043E3I | 000_X1BS_052807130080 | _01/WV02 W | /02 | 1 , |
| 24 | 1275644 { | B4F81CC1-4 W | V02_1030(WV02_2 | 2010(validated_ | v1 103001000 | 04:05280 | 0713001 M18 | IS YY | | Multispectra 20 | 10-03-20T | 0 | 57.1482305 | -170.31709 | 9216 | 9216 | 6 16 | 6 NITF | 23.7 | 33 | 2.195 | 83 | -13.2 WV | V02_2010 | /css/nga/W\ | /02/1B/2010/079/ | WV02_10300100043E3 | 000_X1BS_05280713008 | _01/WV02 W | /02 | 4 , |
| 25 | 28083232 { | FE708B46-F W | V01_1020(WV01_2 | 2022(validated_ | v1 102001000 | C3(50645 | 556650! P1B | S US | | Panchromati 20 | 22-05-16T | 0 | 57.1955967 | -170.29674 | 35840 | 26624 | 4 16 | 6 NITF | 31 | 43.4 | 0.654 | 83 | -13.4 WV | V01_2022 | l/css/nga/W\ | /01/18/2022/136/ | WV01_10200100C3CA8 | 000_P1BS_506455665050 | _01/WV01 W | /01 | 1, |
| 26 | 24711565 {9 | 9A1E4A85-7W | V01_1020(WV01_2 | 2021(validated_ | v1 10200100A | AF 50530 | 097330: P18 | 5 US | | Panchromati 20 | 21-04-11T | 0.046 | 57.1493237 | -170.29898 | 35840 | 34816 | 6 16 0 16 | | 8.4 | 34.4 | 0.512 | 83 | -7.9 WV | V01_2021 | (/css/nga/W\ | /01/18/2021/101/ | WV01_10200100AF43E | 100_P1B5_505309733010 | _01/WV01 W | /01 | 1, |
| 28 | 10920338 { | 5A1C8102-7 W | V01_1020(WV01_2 | 2008 validated | v1 102001000 | 04:05280 | 046330 P18 | S YY | | Panchromati 20 | 08-09-26T | 0.201 | 57.1872098 | -170.27803 | 35840 | 35840 | 0 16 | 6 NITE | 14.9 | 30.9 | 0.532 | 83 | 11.3 WV | V01_2008 | l/css/nga/W\ | /01/18/2008/270/ | WV01_1020010004895 | 200_X1B5_052804633030 | 01/WV01 W | /01 | 1 |
| 29 | 10795518 {4 | 4D22F830-6 W | V01_1020(WV01_2 | 2008(validated_ | v1 102001000 | 03:05280 | 045950: P1B | S YY | | Panchromati 20 | 08-08-27T | 0.028 | 57.187699 | -170.27927 | 34816 | 35840 | 0 16 | 6 NITF | 16.2 | 41.8 | 0.539 | 83 | 10.4 WV | V01_2008 | /css/nga/W\ | /01/18/2008/240/ | WV01_10200100033D1 | 500_X1BS_052804595030 | _01/WV01 W | /01 | 1, |
| 30 | 7275505 {8 | E1439B15-B W | V01_1020(WV01_2 | 2011(validated_ | v1 102001001 | 14,05280 | 050300: P1B | S YY | | Panchromati 20 | 11-08-04T | 0.058 | 57.1436117 | -170.30896 | 35840 | 35840 | 0 16 | 6 NITF | 15.1 | 49.9 | 0.535 | 83 | -12 WV | V01_2011 | (/css/nga/W\ | /01/18/2011/216/ | WV01_1020010014A28 | 500_X1BS_052805030020 | _01/WV01 W | /01 | 1, |
| 31 | 13897911 { | 1DD98515-F W | V01_1020(WV01_2 | 2010 validated_ | v1 102001000 | OD 05280 | 046441(P1B | S YY | | Panchromati 20 | 10-03-24T | 0 | 57.1461704 | -170.30076 | 32768 | 35840 | 0 16 | 6 NITF | 23.3 | 34.6 | 0.584 | 83 | -20.6 WV | V01_2010 | (/css/nga/W\ | /01/18/2010/083/ | WV01_102001000D63E | 000_X1BS_052804644100 | _01/WV01 W | /01 | 1, |
| 32 | 15063037 {1 | 1D5D65F4-8 W | V02_1030(WV02_2 | 2014(validated_ | v1 103001003 | 33 50543 | 392940! M18 | S US | | Multispectra 20 Danshromati 20 | 14-06-19T | 0.07 | 57.1490684 | -170.29287 | 9216 | 6144 | 4 16 | 6 NITE | 40.4 | 56.2 | 3.163 | 83 | -39.9 WV | V02_2014 | l/css/nga/W\ | /02/18/2014/170/ | WV02_10300100337DF | 300_M1BS_50543929409 | 0_01/WV0 W | /02 | 8, |
| 34 | 11175110 (8 | FA556D53-FG | 02_1030 00002_2 | 0120 validated | v1 105001003 | 03:05401 | 192140: P1B | 5 US 5 YY | | Panchromati 20 | 12-02-06T | 0.005 | 57.2048237 | -170.35898 | 28672 | 37889 | 8 16 | 6 NITE | 21.9 | 17 | 0.473 | 83 | -35.5 WV | 01 20120 | /css/nga/GF | 01/18/2012/037/6 | F01 105041000320100 | 0 X1BS 054019214030 | 01/GF01 2 GF | 01 | 1 |
| 35 | 11064874 { | FA454630-A G | 01_10504 GE01_2 | 0120 validated | v1 105041000 | 03:05401 | 192140: M18 | IS YY | | Multispectra 20 | 12-02-06T | 0 | 57.2048237 | -170.35899 | 7168 | 10240 | 0 16 | 6 NITF | 21.9 | 17 | 1.893 | 83 | -21.4 GE | 01_20120 | /css/nga/GE | 01/1B/2012/037/G | E01_1050410003201C0 | 0_X1BS_054019214030_ | 01/GE01_2 GE | 01 | 4 , |
| 36 | 3903292 {[| D59A6E5E-C W | V01_1020 WV01_2 | 2008: validated_ | v1 102001000 | 04 05280 | 046030! P1B | 5 YY | | Panchromati 20 | 08-11-08T | 0.11 | 57.1940991 | -170.27939 | 33792 | 35840 | 0 16 | 6 NITF | 23.7 | 15.8 | 0.585 | 83 | 20 WV | V01_2008 | css/nga/W | /01/18/2008/313/ | WV01_1020010004799 | 00_X1BS_052804603090 | _01/WV01 W | /01 | 1, |
| 37 | 11314006 {(| 0FE22D15-E W | V01_1020 WV01_2 | 2009(validated_ | v1 1.02E+1 | 15 05280 | 0465501 P1B | S YY | | Panchromati 20 | 09-03-19T | 0 | 57.2061972 | -170.30722 | 35840 | 35840 | 0 16 | 6 NITF | 13.9 | 32.4 | 0.529 | 83 | -13.8 WV | V01_2009 | /css/nga/W\ | /01/18/2009/078/ | WV01_1020010006273 | 200_X1BS_052804655080 | _01/WV01 W | /01 | 1, |
| 38 | 3122702 {5 | 5D44C0F2-E W | V02_1030(WV02_2 | 2021(validated_ | v1 103001008 | BB 50531 | 158850 P18 | 5 US | | Panchromati 20 | 21-03-09T | 0 | 57.1445548 | -170.28494 | 35840 | 34816 | 6 16 | 6 NITE | 4 | 28.1 | 0.47 | 83 | 2.6 WV | V02_2021 | (/css/nga/W\ | /02/18/2021/068/ | VV02_10300100BB00B | 500_P1BS_50531588507 | 0_01/WV02W | /02 | 1, |
| 40 | 15459515 { | A1474941-6 W D7RDA4A4- W | V02_1030(WV02_2 V01_1020(WV01_2 | 2021(validated_ | v1 103001008 | 001 50584 | 158850 MIE 160041(P1B) | 5 US | | Panchromati 20 | 21-03-091 10-02-27T | 0.04 | 57.2132425 | -170.31276 | 35840 | 31744 | 6 16 4 16 | 6 NITE | 17.2 | 28.1 | 0.543 | 83 | 2.6 WV | V02_2021 | (/css/nga/W\ /css/nga/W\ | /02/18/2021/068/ | VV02_1030010088008 | 500_M185_5053158850 | 0_01/WV01W | /02 | 8, |
| 41 | 11418795 {0 | C1C8F2E1-1 W | V01 1020 WV01 2 | 2009: validated | v1 102001000 | 0A 05280 | 046340: P18 | 5 YY | | Panchromati 20 | 09-10-31T | 0.022 | 57.2023172 | -170.38846 | 35840 | 35840 | 0 16 | 6 NITF | 6.4 | 18.6 | 0.51 | 83 | 4.4 WV | V01 2009 | /css/nga/W\ | /01/18/2009/304/ | WV01_102001000A747 | 100 X1BS 05280463403 | 01/WV01 W | /01 | 1 |
| 42 | 7539449 { | 94D0EBC8-EW | V01_1020 WV01_2 | 2015(validated_ | v1 102001003 | 3A 50031 | 128430: P18 | S YY | | Panchromati 20 | 15-02-24T | 0 | 57.2112606 | -170.36574 | 30720 | 35840 | 0 16 | 6 NITF | 20.2 | 23.7 | 0.563 | 83 | -8.5 WV | v01_2015 | /css/nga/W\ | /01/1B/2015/055/ | WV01_102001003A46A | 200_X1BS_50031284303 | _01/WV01W | /01 | 1 , |
| 43 | 5974592 { | 5FA15EEC-8 W | V02_1030(WV02_2 | 2013(validated_ | v1 103001002 | 20! 50006 | 592401! P1B | S YY | | Panchromati 20 | 13-04-08T | 0.052 | 57.1358558 | -170.29911 | 25600 | 35840 | 0 16 | 6 NITF | 34.9 | 40.5 | 0.678 | 83 | -34.9 WV | V02_2013 | l/css/nga/W\ | /02/1B/2013/098/ | WV02_1030010020587 | COO_X1BS_500069240150 | _01/WV02 W | /02 | 1 / |
| 44 | 5947698 { | 3D0FB4B4-8 W | V02_1030(WV02_2 | 2013(validated_ | v1 103001002 | 20! 50006 | 592401! M1B | S YY | | Multispectra 20 | 13-04-08T | 0.052 | 57.1358462 | -170.29902 | 7168 | 9216 | 6 16 | 6 NITF | 34.9 | 40.5 | 2.711 | 83 | -34.9 WV | V02_2013 | l/css/nga/W\ | /02/1B/2013/098/ | WV02_10300100205870 | C00_X1BS_500069240150 | _01/WV02 W | /02 | 8 / |
| 45 | 24679390 {4 | 4A7311A8-E W | V03_1040(WV03_2 | 2016(validated_ | v1 104001001 | 17 50322 | 230910: P18: 230910: M18 | 5 US | | Panchromati 20 Multispectra 20 | 16-02-06T | 0.376 | 57.1310993 | -170.34588 | 43008 | 35840 | 0 16 6 16 | 6 NITE | 25.7 | 17.4 | 0.372 | 83 | -23.1 WV | V03_2016 | /css/nga/W\ //css/nga/W\ | /03/18/2016/037/ /03/18/2016/037/ | WV03_1040010017CCF: WV03_1040010017CCF: | 100_P1B5_503223091020 | _01/WV03 W | /03 | 1/ |
| 40 | 22844726 { | EE14621D-9 W | V01 1020 WV01 2 | 2022(pending | 102001001 | C8 50676 | 537170 P1B | 5 US | | Panchromati 20 | 22-08-09T | 0.375 | 57.1484317 | -170.26771 | 35840 | 30720 | 0 16 | 6 NITF | 25.4 | 41.1 | 0.5 | 83 | -20.2 WV | V01 2022 | /css/nga/WV | /01/18/2022/221/ | WV01 102001001700F | A00 P1BS 50676371705 | 0 01/WV01W | /01 | 1 |
| 48 | 20428737 {0 | C96D0549-2 W | V01_1020 WV01_2 | 2022(validated_ | v1 10200100B | BD 50616 | 530480 P18 | 5 US | | Panchromati 20 | 22-01-25T | 0.051 | 57.2062155 | -170.28128 | 35840 | 32768 | 8 16 | 6 NITF | 18.3 | 9.1 | 0.553 | 83 | -16.2 WV | V01_2022 | css/nga/WV | /01/18/2022/025/ | WV01_10200100BD27A | 800_P1BS_50616304809 | 0_01/WV01W | /01 | 1 |
| 49 | 18964117 {2 | 2DF85A94-F W | V01_1020 WV01_2 | 2019(validated_ | v1 102001008 | 87! 50584 | 461830 P18 | S US | | Panchromati 20 | 19-05-04T | 0.294 | 57.2041394 | -170.27613 | 35840 | 32768 | 8 16 | 6 NITF | 21.1 | 39.9 | 0.565 | 83 | -20.5 WV | V01_2019 | /css/nga/W\ | /01/18/2019/124/ | WV01_10200100875A8 | 000_P1BS_505846183040 | _01/WV01 W | /01 | 1 , |
| 50 | 26316127 {0 | 0F1028DF-0 W | V02_1030(WV02_2 | 2014(validated_ | v1 103001003 | 33(50540 | 057381(P1B | S US | | Panchromati 20 | 14-06-19T | 0.083 | 57.1359239 | -170.28903 | 35840 | 22528 | 8 16 | 6 NITF | 45.5 | 56.2 | 0.925 | 83 | -40.1 WV | V02_2014 | /css/nga/W\ | /02/18/2014/170/ | WV02_10300100336F80 | 000_P1BS_505405738100 | _01/WV02 W | /02 | 1, |
| 51 | 26316124 {6 | 6605886B-2 W | V02_1030(WV02_2 | 2014(validated_ | v1 103001003 | 33(50540 | 057381(M18 | IS US | | Multispectra 20 | 14-06-19T | 0.083 | 57.1358725 | -170.28891 | 9216 | 6144 | 4 16 | | 45.5 | 56.2 | 3.702 | 83 | -40.1 WV | V02_2014 | /css/nga/W\ | /02/1B/2014/170/ | WV02_10300100336F80 | 00_M1BS_50540573810 | 0_01/WV0:W | /02 | 8, |
| 52 | 11621169 (| 283FFF01-1 W | V01_1020(WV01_2 | 2022(validated_ | v1 10200100C | 13,05280 | 0500801 P18 | 5 US 5 VV | | Panchromati 20 | 22-05-161 11-05-11T | 0 | 57.2158281 | -170.2984 | 32768 | 35840 | 2 1t 0 16 | 6 NITE | 12.8 | 43.5 | 0.52/ | 83 | -12.5 WV | V01_2022 | (/css/nga/W\ | /01/18/2022/136/ | WV01_10200100C4921 | 400_F185_506451962030 400_X185_052805008080 | 01/WV01W | /01 | 1/ |
| 54 | 17372400 {3 | 311410B9-6 Q | 302 10100 OB02 2 | 0051 validated | v1 1.01E+1 | 15 50585 | 551790 P18 | s US | | Panchromati 20 | 05-10-12T | 0.357 | 57.1943002 | -170.26116 | 27648 | 29696 | 6 16 | 6 NITF | 7.8 | 25.3 | 0.622 | 83 | -7.1 QB | 02 20051 | 1/css/nga/QB | 02/1B/2005/285/0 | 802 101001000494900 | 00 P1BS 505855179070 | 01/QB02 2 QB | 02 | 1 |
| | ▶ Foo | otprints (1) | + | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | e e el con | | | | | _ | | | | | _ | | | | | | | | | | | | | _ | | | | | - | | 10001 |

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• With Advanced Search, specify search parameters (sensor, cloudcover, etc.) and export the resulting footprint feature class

