2024 Satellite Needs Working Group (SNWG) Agency Survey: Aggregate Information

SNWG Background

The SNWG partners with federal civilian agencies to identify high-priority sustained and unmet needs for satellite Earth observations. Starting in 2016, the SNWG has conducted a biennial survey to formally document and communicate satellite Earth-observing needs to NASA and other spaced-based Earth observation providers NOAA and USGS. The Satellite Needs Survey obtains information about key agency objectives that require the application of satellite Earth observations, as well as specific measurement requirements.

Use of the 2024 SNWG Survey Aggregate Information Report

The 2024 Satellite Needs Survey featured 124 responses from 25 agencies. Each response represents an agency's satellite data need. This report presents aggregate statistics about agency measurement requirements as well as a subset of other quantifiable aspects of agency needs. Agency-identifying information, including specific needs, cannot be released publicly and is not included in this report. In interpreting these statistics, please note the following caveats:

- The Satellite Needs Survey is a voluntary reporting in which each agency's leadership chooses whether to participate and which, if any, satellite needs to submit
- The survey responses represent only a subset of the full satellite Earth observation needs of the federal civilian agencies, and the subset and derived statistics cannot be assumed to be unbiased

This report is intended to give readers information about the types of satellite data that agencies request in order to support their needs, including:

- The geophysical feature, parameter, or phenomenon the agency needs to observe
- Technical specifications of data that could support their work, including resolution, coverage, latency, and other data characteristics
- Processing aspects of data use, including data discovery, access methods, and formats

Take-Home Messages

Across five survey cycles, there is a steady increase in the need for continuous, routinely collected, high-quality, free data.

Specific findings from 2024:

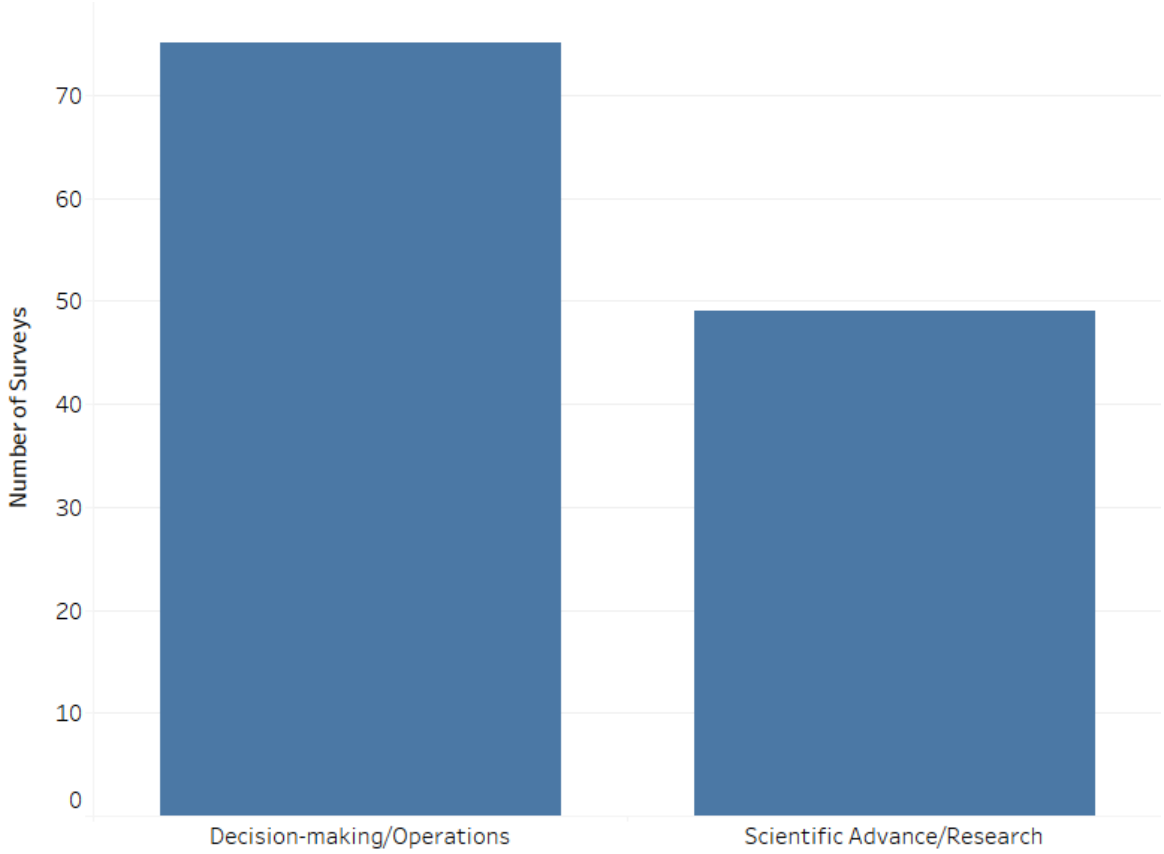
- The observables most frequently requested by agencies were those pertaining to the atmosphere, biosphere, land surface, and oceans.
    - Atmospheric observation needs frequently encompass multiple related variables, e.g. wind-related needs combining wind direction, wind speed, and turbulence.

    - Biosphere needs often include observables related to fire ecology, vegetation, and human-influenced ecosystems.
- Decision-making and operational requirements constituted 60% of identified needs, often necessitating high-level data products such as gridded datasets harmonized from observations of multiple satellites.
- Geographically, the majority of requests were focused on U.S. states and territories, with about one-third requesting global imagery.
- Spatial resolution remained the most critical attribute to agencies, with a broad need for 10-30 m to <1 m spatial resolution data.
- Daily data and one-day latency remained the most common requests, although one-third of submissions continued to request sub-daily frequency and latency.
- Across cycles, data volume remained the most commonly cited obstacle to the use of satellite data, followed by lack of computational and human resources.
- Training in cloud use (44% of surveys), data processing (35%), and data interpretation (32%) were the most-requested training needs.
- Optical imagery from the Landsat and Sentinel-2 satellite series continued to be most-identified by agencies as helpful in meeting their needs, with 33% and 31% percent of responses indicating use or interest in these missions respectively. Additionally, over 27% of responses indicated an interest in commercial satellite optical imagery.
- NASA data center search tools and USGS EarthExplorer were reported to be the most commonly used discovery tools for locating satellite datasets.

Aggregate Statistics

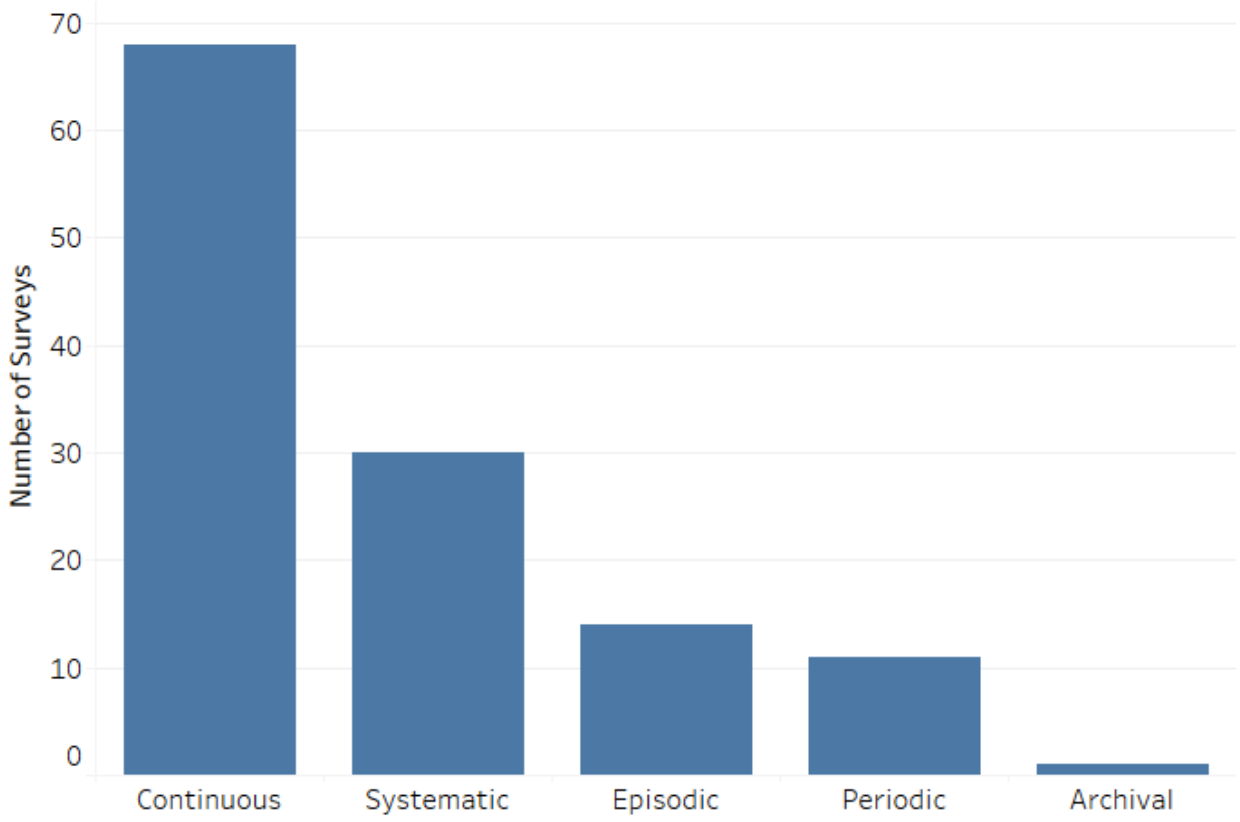
Context for Satellite Measurement or Data Product Need

Which of these descriptions best fits the nature of the need? (1)



Option	**# of Surveys (%)**
Decision-making/Operations	75 (60%)
Scientific Advance/Research	49 (40%)

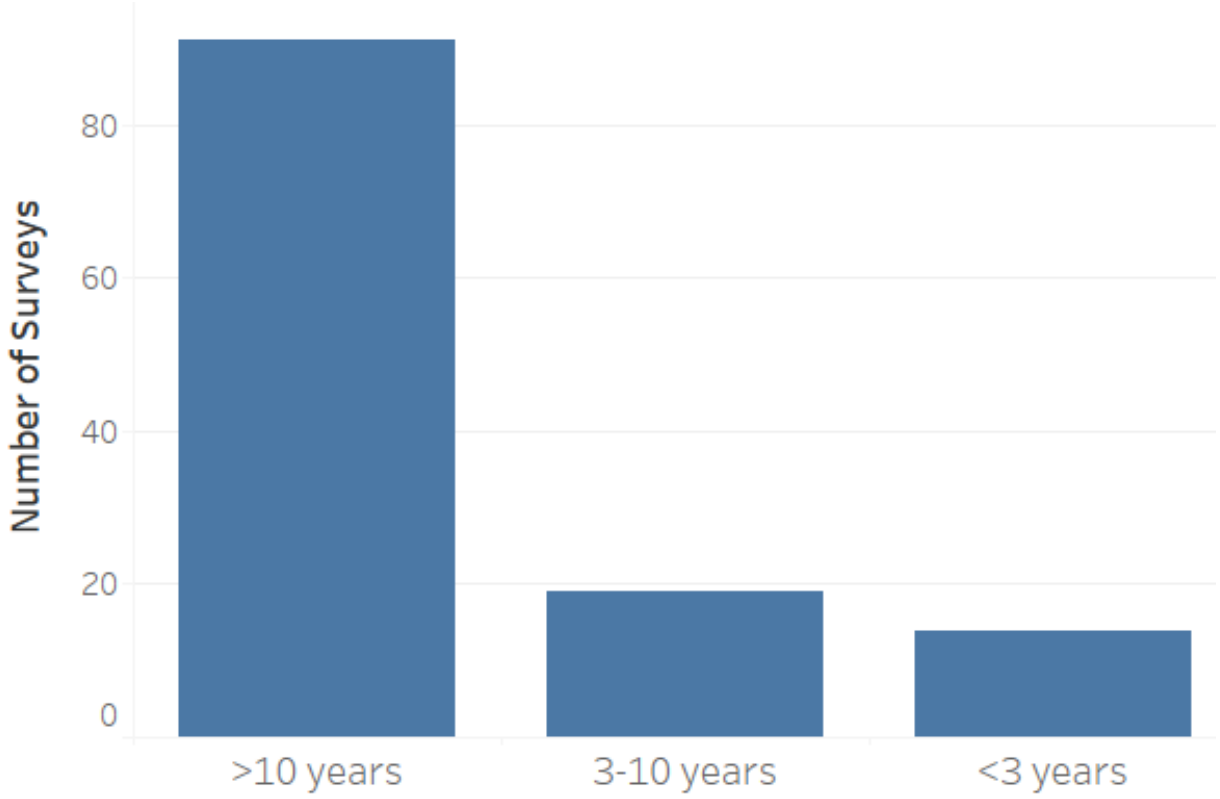
Which of these descriptions best fits the nature of the need? (2)



Option	**# of Surveys (%)**
Continuous	68 (55%)
Systematic (Examples: time-series to detect landslide motion, volcanic unrest, land-use change, or ecosystem disturbance)	30 (24%)
Episodic (Examples: imagery during forest fires or volcanic eruptions)	14 (11%)
Periodic (Examples: crop health during the growing season or reservoir levels after spring snow melt)	11 (9%)
Archival	1 (1%)

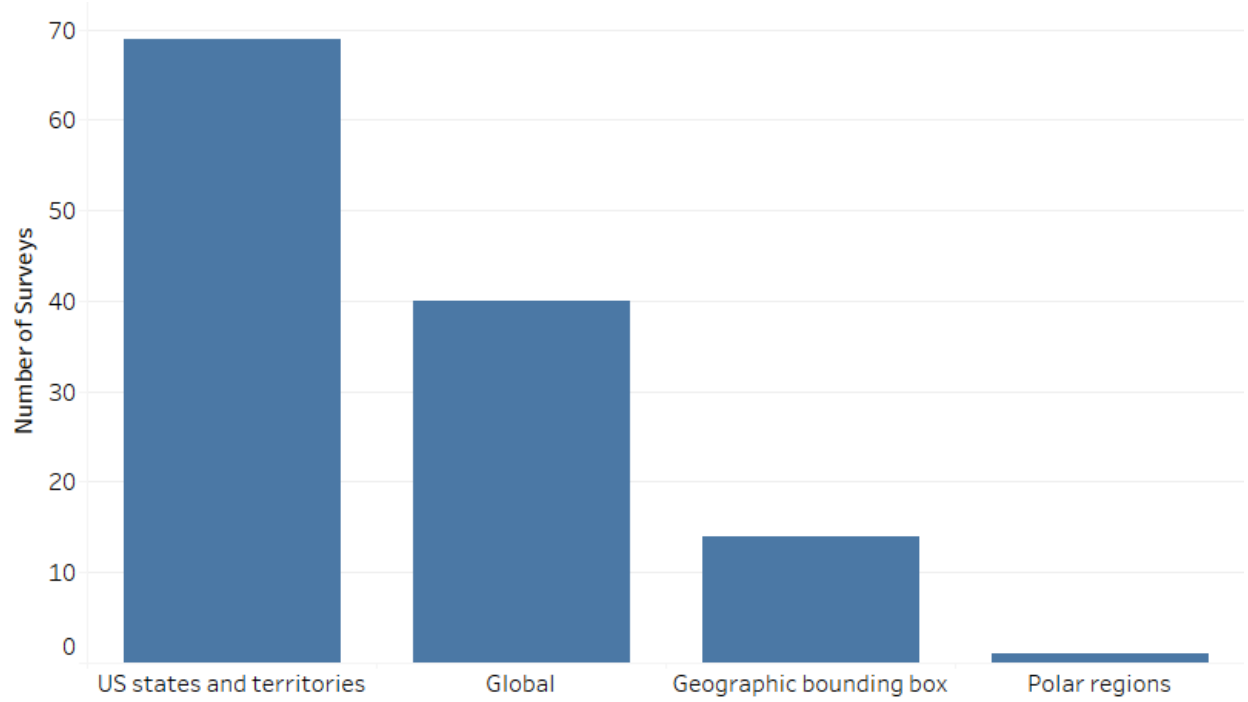
Specific Satellite Measurement or Product Need

How long has this data been required in order to meet your agency objectives?



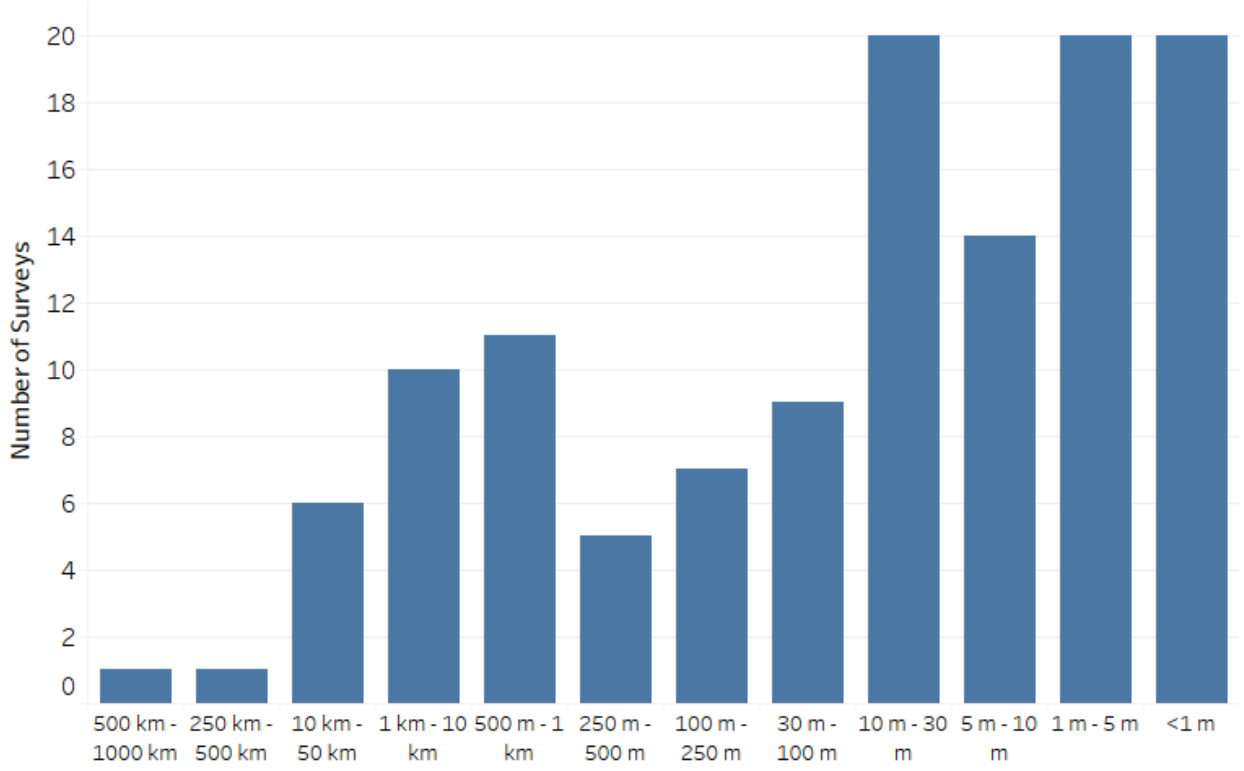
Option	# of Surveys (%)
>10 years	91 (73%)
3-10 years	19 (15%)
<3 years	14 (11%)

What is the optimal geographic coverage to meet your satellite measurement or product need?



Option	**# of Surveys (%)**
US states and territories	69 (56%)
Global	40 (32%)
Geographic bounding box	14 (11%)
Polar regions	1 (1%)
Tropics	0 (0%)

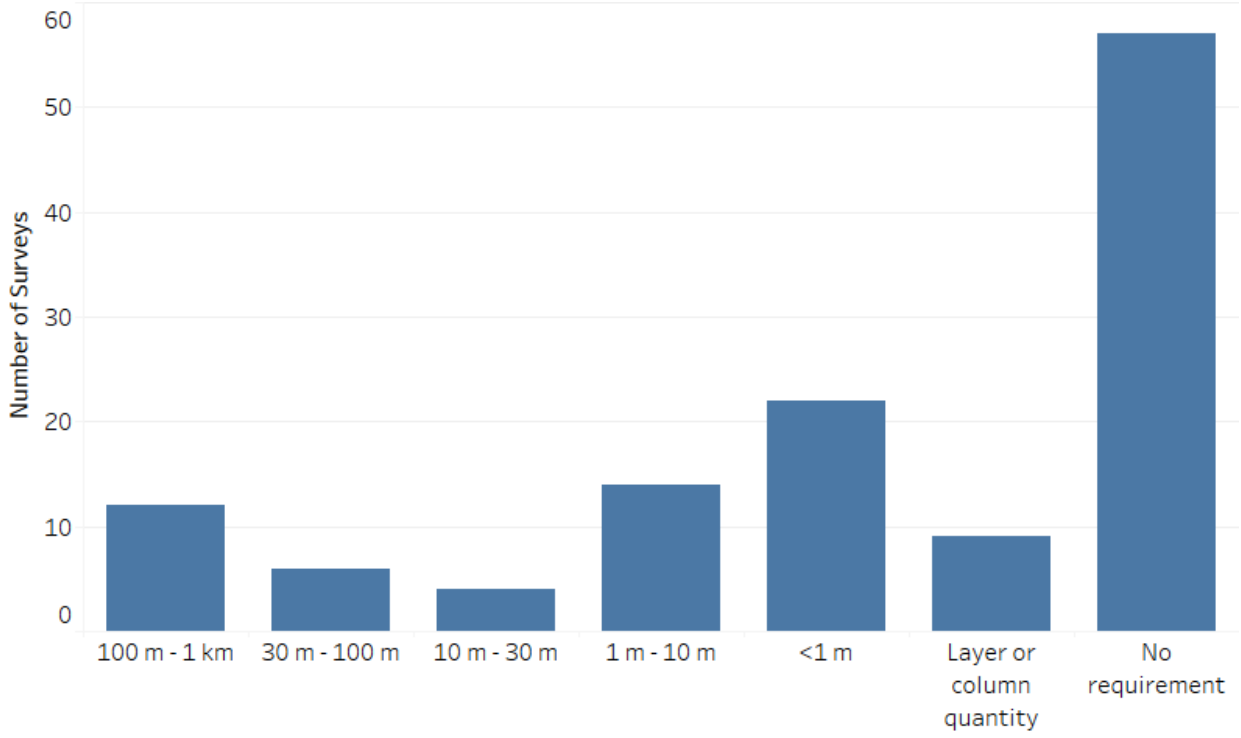
What is the optimal horizontal spatial resolution to meet your need?



Option	# of Surveys (%)
>1000 km (>10 degrees)	0 (0%)
500 km - 1000 km (5-10 degrees)	1 (1%)
250 km - 500 km (2.5-5.0 degrees)	1 (1%)
100 km - 250 km (1.0-2.5 degrees)	0 (0%)
50 km - 100 km (0.5-1.0 degrees)	0 (0%)
10 km - 50 km (0.09-0.5 degrees)	6 (5%)
1 km - 10 km (0.01-0.09 degrees)	10 (8%)
500 m - 1 km	11 (9%)
250 m - 500 m	5 (4%)
100 m - 250 m	7 (6%)
30 m - 100 m	9 (7%)
10 m - 30 m	20 (16%)

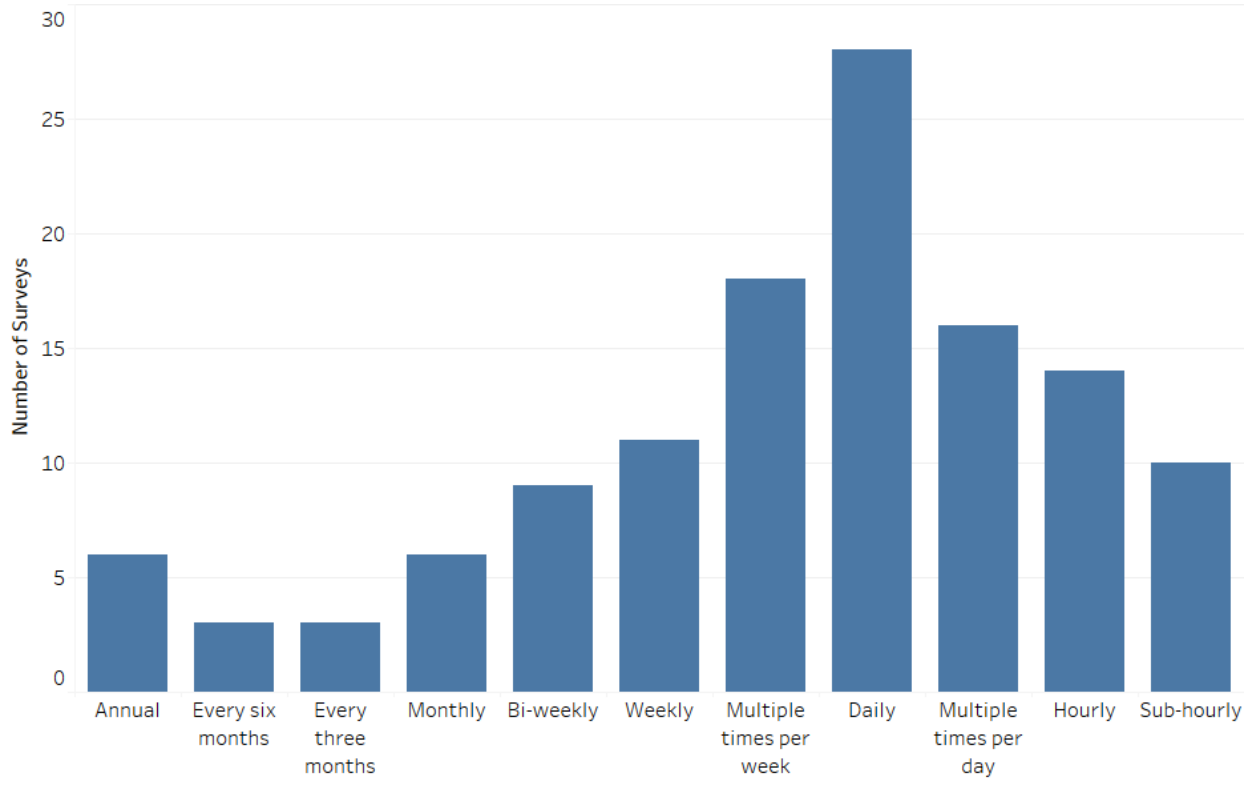
5 m - 10 m	14 (11%)
1 m - 5 m	20 (16%)
<1 m	20 (16%)

What is the optimal vertical spatial resolution to meet your need?



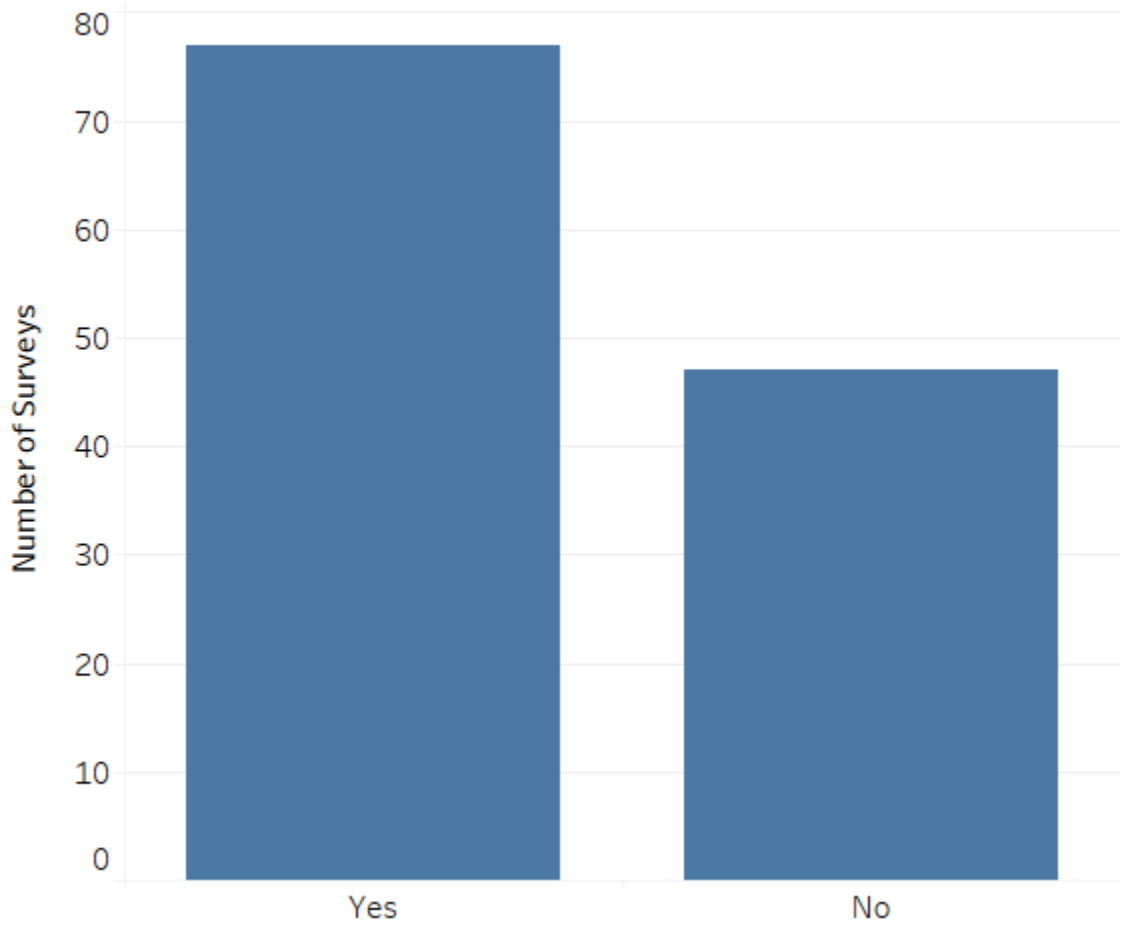
Option	**# of Surveys (%)**
>1 km	0 (0%)
100 m - 1 km	12 (10%)
30 m - 100 m	6 (5%)
10 m - 30 m	4 (3%)
1 m - 10 m	14 (11%)
<1 m	22 (18%)
Layer or column quantity	9 (7%)
I do not need vertically resolved measurements	57 (46%)

What is the optimal measurement or data product temporal frequency?



Option	**# of Surveys (%)**
Annual	6 (5%)
Every six months	3 (2%)
Every three months	3 (2%)
Monthly	6 (5%)
Bi-weekly	9 (7%)
Weekly	11 (9%)
Multiple times per week	18 (15%)
Daily	28 (23%)
Multiple times per day	16 (13%)
Hourly	14 (11%)
Sub-hourly	10 (8%)

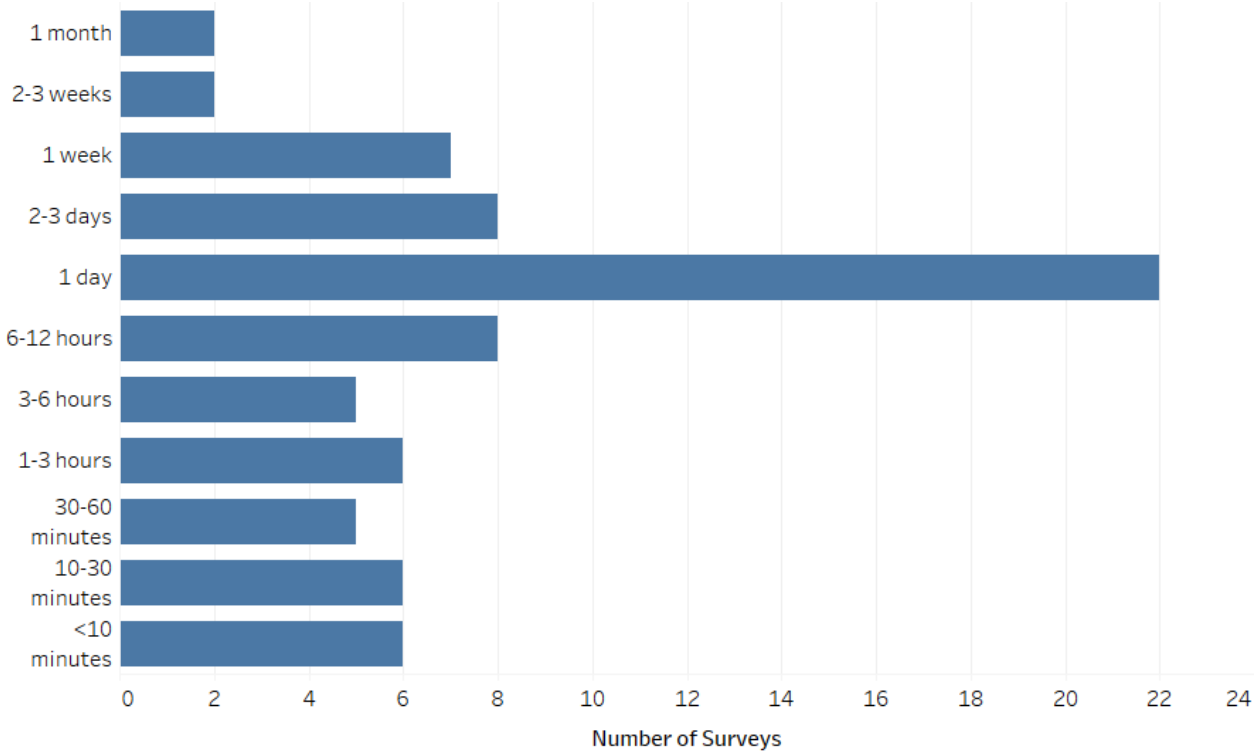
Is data latency a critical attribute for these needs?



Option	# of Surveys (%)
Yes	77 (62%)
No	47 (38%)

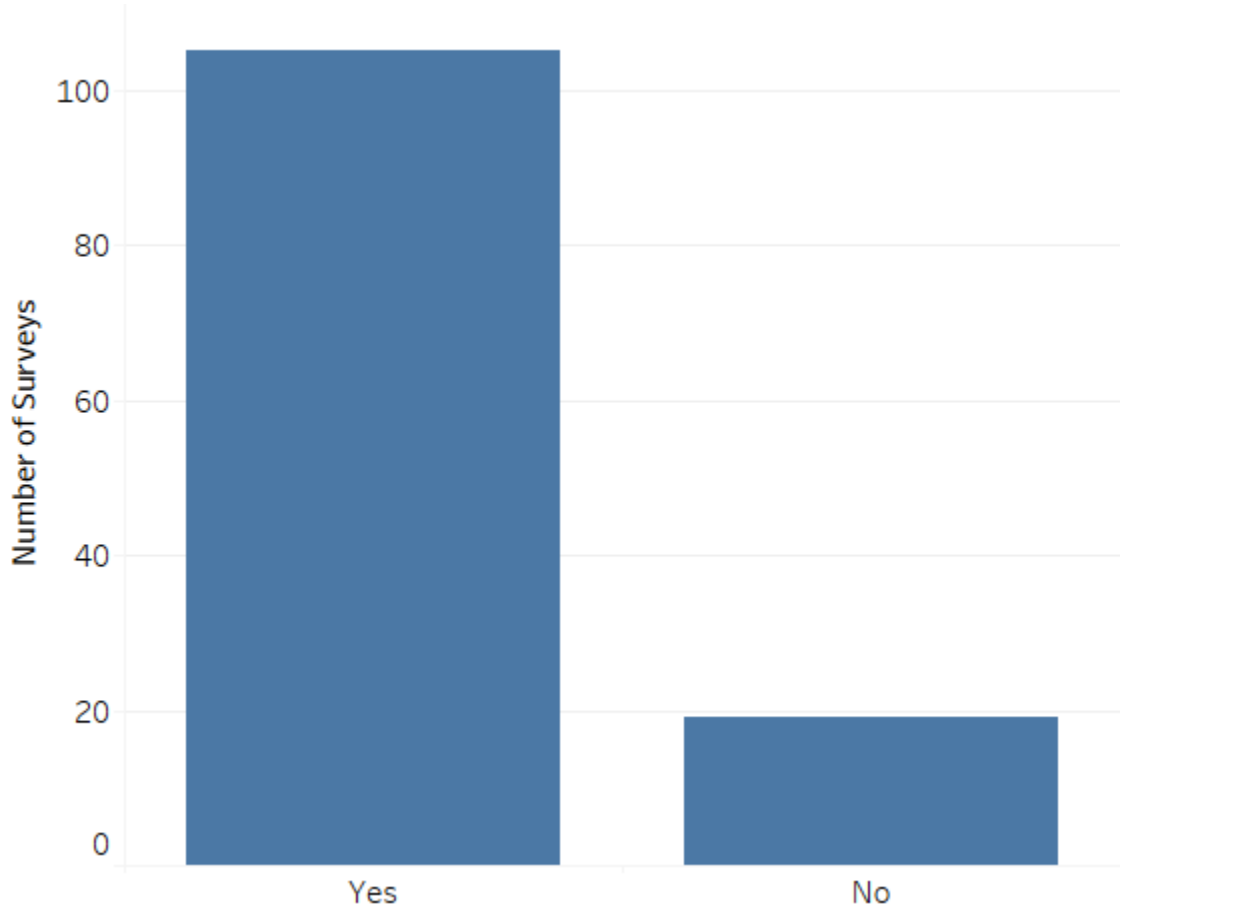
What is the optimal data latency to meet your measurement or product need?

For the 77 surveys (62%) that indicated a critical data latency need:



Option	# of Surveys (% of those responding)
1 month	2 (3%)
2-3 weeks	2 (3%)
1 week	7 (9%)
2-3 days	8 (10%)
1 day	22 (29%)
6-12 hours	8 (10%)
3-6 hours	5 (6%)
1-3 hours	6 (8%)
30-60 minutes	5 (6%)
10-30 minutes	6 (8%)
<10 minutes	6 (8%)

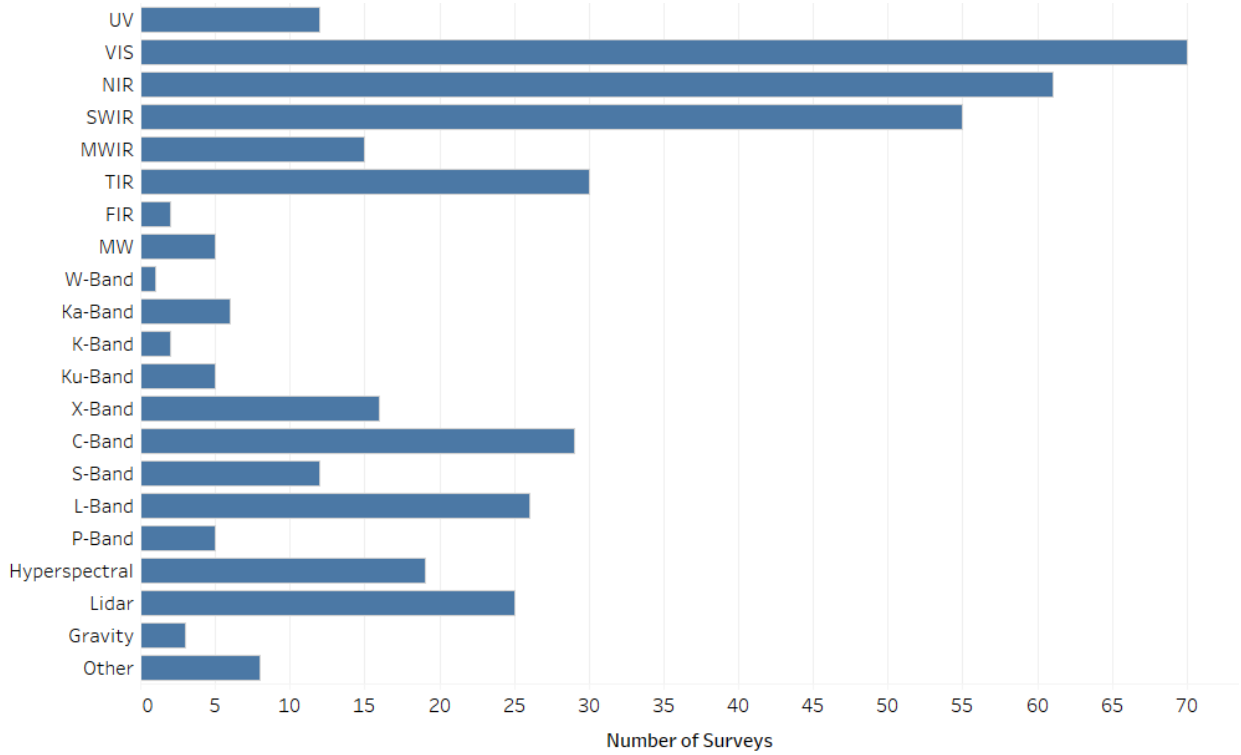
Are specific spectral bands critical in meeting your need?



Option	# of Surveys (%)
Yes	105 (85%)
No	19 (15%)

What are the optimal spectral bands to meet your measurement or data product need? (select all that apply)

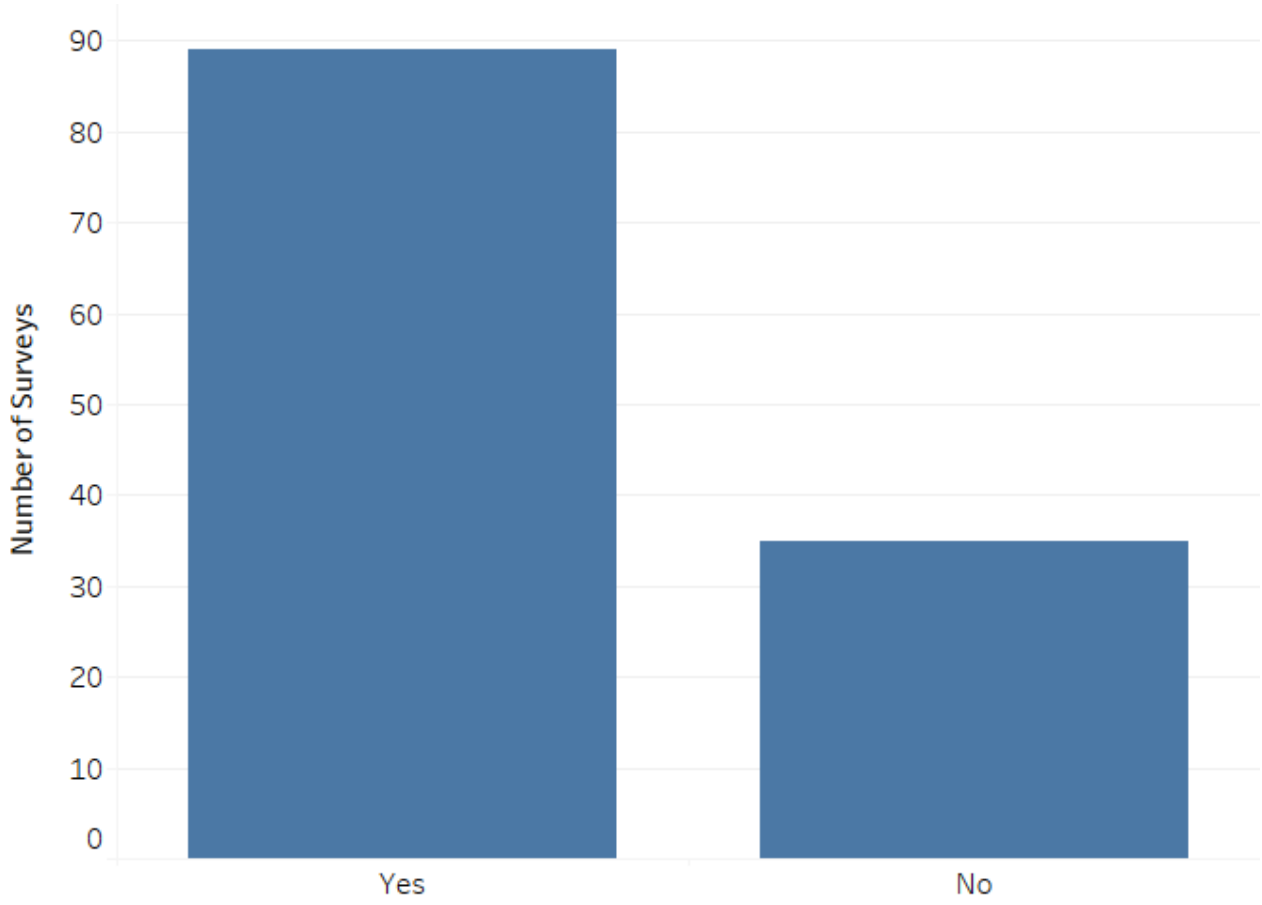
For the 105 surveys (85%) that indicated a critical spectral band need:



Option	# of Surveys (% of those responding)
UV (~0.01 µm - ~0.40 µm)	12 (11%)
VIS (~0.40 µm - ~0.75 µm)	70 (67%)
NIR (~0.75 µm - ~1.3 µm)	61 (58%)
SWIR (~1.3 µm - ~3.0 µm)	55 (52%)
MWIR (~3.0 mµ - ~6.0 µm)	15 (14%)
TIR (~6.0 mµ - ~15.0 µm)	30 (29%)
FIR (~15.0 µm - ~0.1 cm)	2 (2%)
MW (~1.0 cm - ~100 cm)	5 (5%)
W-Band (94 GHz)	1 (1%)
Ka-Band (26.5 - 40 GHz)	6 (6%)

K-Band (18 - 26.5 GHz)	2 (2%)
Ku-Band (12.5 - 18 GHz)	5 (5%)
X-Band (12.5 - 8 GHz)	16 (15%)
C-Band (8 - 4 GHz)	29 (28%)
S-Band (4 - 2 GHz)	12 (11%)
L-Band (2 - 1 GHz)	26 (25%)
P-Band (0.999 - 0.2998 GHz)	5 (5%)
Hyperspectral	19 (18%)
Lidar	25 (24%)
Gravity	3 (3%)
Other	8 (8%)

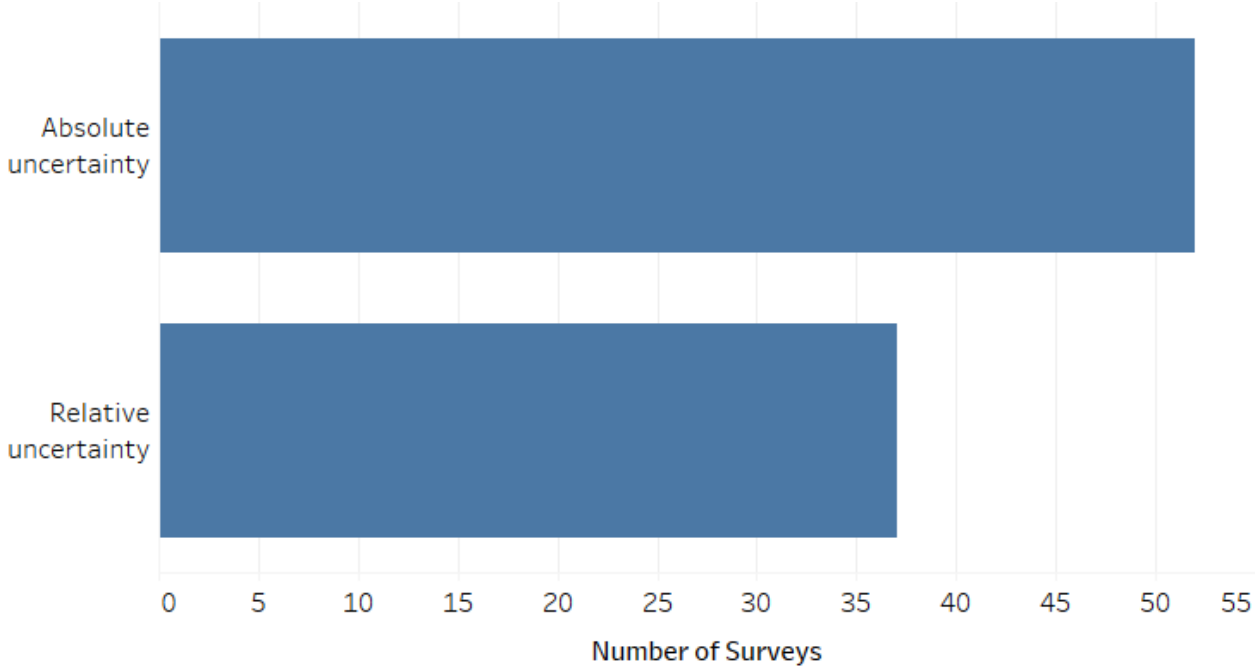
Is measurement uncertainty a critical attribute in meeting your need?



Option	# of Surveys (%)
Yes	89 (72%)
No	35 (28%)

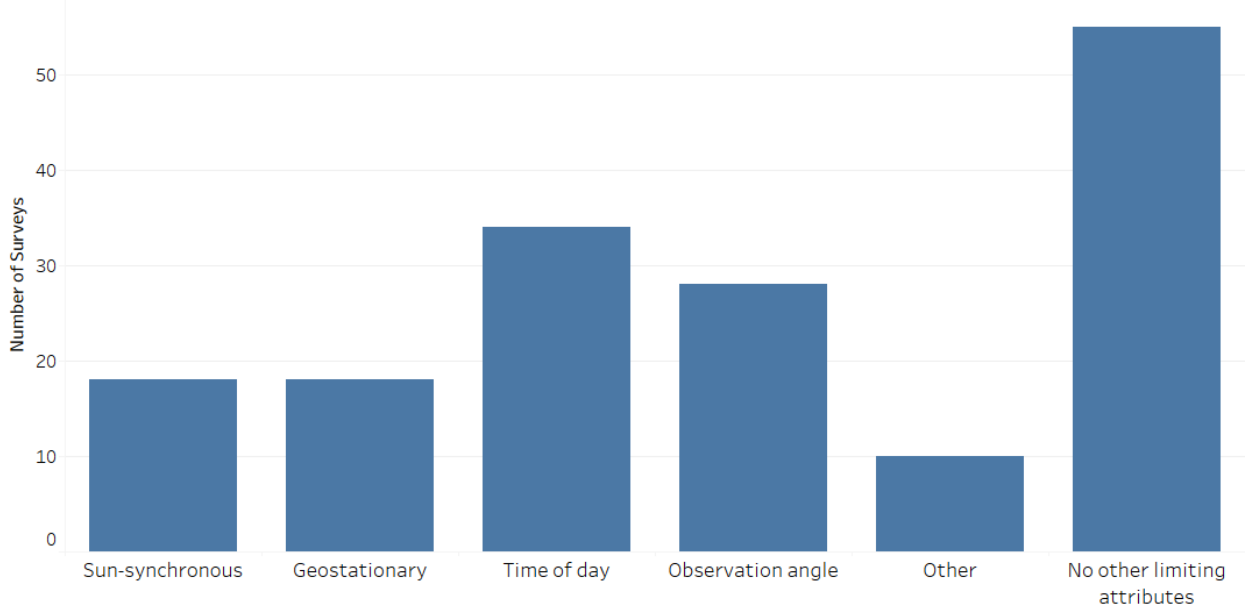
Which type of uncertainty is more important in meeting your need?

For the 89 surveys (72%) that indicated a critical measurement uncertainty latency need:



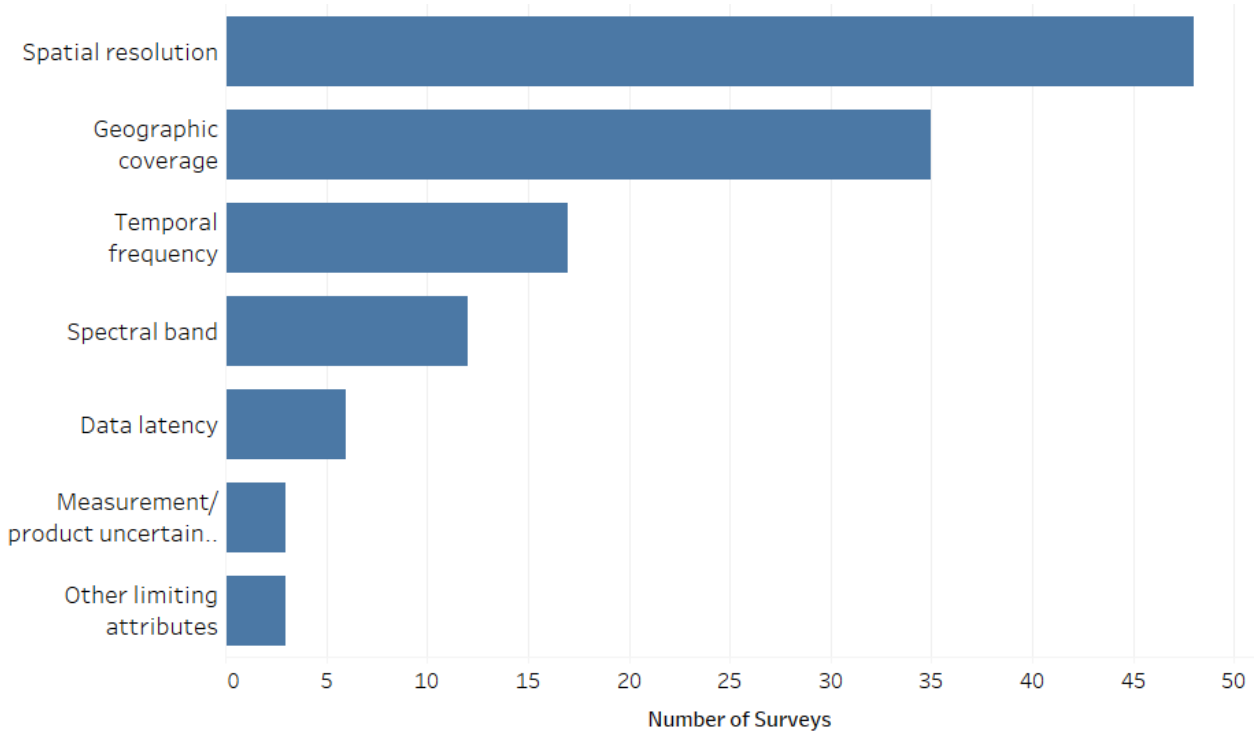
Option	# of Surveys (% of those responding)
Absolute uncertainty (e.g., +/- 0.1 m)	52 (58%)
Relative uncertainty (e.g., within 5%)	37 (42%)

Are there other limiting attributes such as the following? (select all that apply)



Option	**# of Surveys (%)**
Sun-synchronous	18 (15%)
Geostationary	18 (15%)
Time of Day	34 (27%)
Observation angle (e.g., overhead, oblique)	28 (23%)
Other	10 (8%)
No other limiting attributes	55 (44%)

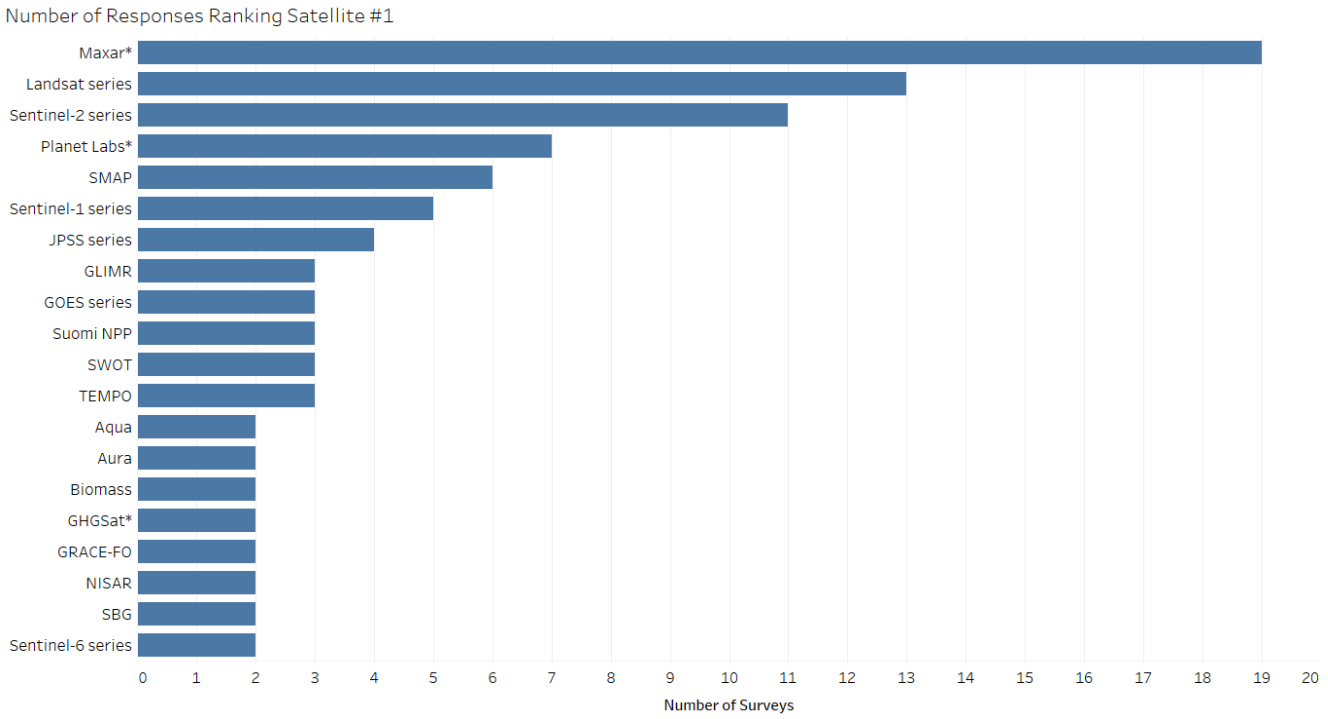
Rank how critical each of the above attributes is for meeting your need, with 1 = most important.

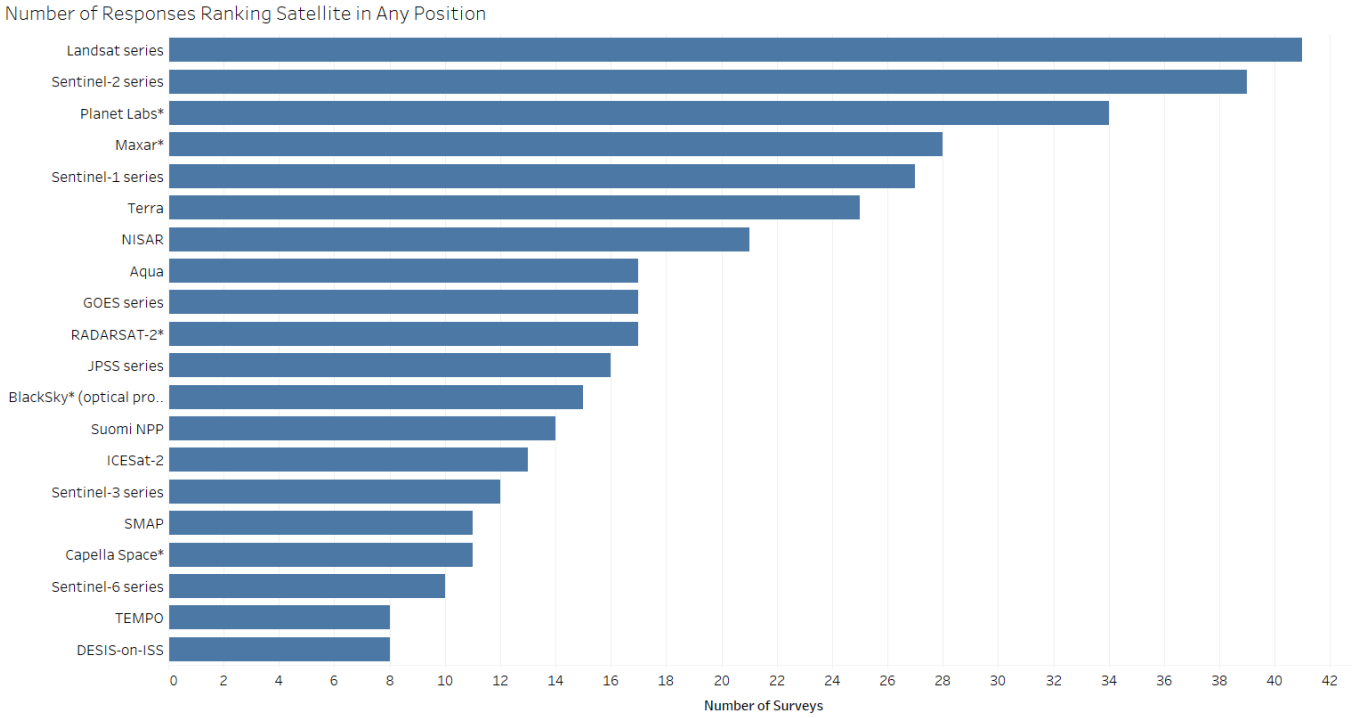


Option	# of Surveys Ranking #1 (%)	# of Surveys Ranking #2 (%)
Spatial resolution	48 (39%)	36 (29%)
Geographic coverage	35 (28%)	21 (17%)
Temporal frequency	17 (14%)	38 (31%)
Spectral band	12 (10%)	15 (12%)
Data latency	6 (5%)	6 (5%)
Measurement/product uncertainty	3 (2%)	5 (4%)
Other limiting attributes	3 (2%)	3 (2%)

If you know which satellite mission or sensor is currently or could be used to satisfy your needs, please rank in order of priority, with 1 = most important.

Note: responses marked with an asterisk signify that the mission or sensor is commercial





Option	# of Surveys Ranking #1 (%)	# of Surveys Ranking Overall (%)
I don’t know	14 (11%)	14 (11%)
ADM-Aeolus	1 (1%)	3 (2%)
ALOS series	0 (0%)	6 (5%)
ALTIUS	0 (0%)	0 (0%)
Aqua (AIRS, AMSR-E, AMSU-A, CERES, HSB, MODIS)	2 (2%)	17 (14%)
Aura (HiRDLS, MLS, OMI, TES)	2 (2%)	4 (3%)
Arctic Weather Satellite	0 (0%)	1 (1%)
Biomass	2 (2%)	2 (2%)
BlackSky (optical products)	1 (1%)	15 (12%)
CALIPSO	0 (0%)	3 (2%)
Capella Space	0 (0%)	11 (9%)
Carbon Mapper	0 (0%)	5 (4%)
CLARREO Pathfinder-on-ISS	0 (0%)	0 (0%)
CloudSat	0 (0%)	2 (2%)
COSMIC-2	1 (1%)	1 (1%)
COSMO-SkyMed series	0 (0%)	2 (2%)
CryoSat-2	0 (0%)	4 (3%)
CYGNSS	0 (0%)	5 (4%)
Deimos-1	0 (0%)	0 (0%)
DESIS-on-ISS	0 (0%)	8 (6%)
DMC3	0 (0%)	0 (0%)
DMSP series	0 (0%)	2 (2%)
DSCOVR	0 (0%)	0 (0%)
EarthCARE	1 (1%)	1 (1%)
ECOSTRESS-on-ISS	0 (0%)	4 (3%)
EMIT-on-ISS	0 (0%)	6 (5%)
EnMAP	1 (1%)	2 (2%)
FLEX	0 (0%)	0 (0%)
FORUM	0 (0%)	0 (0%)
GCOM series	0 (0%)	1 (1%)

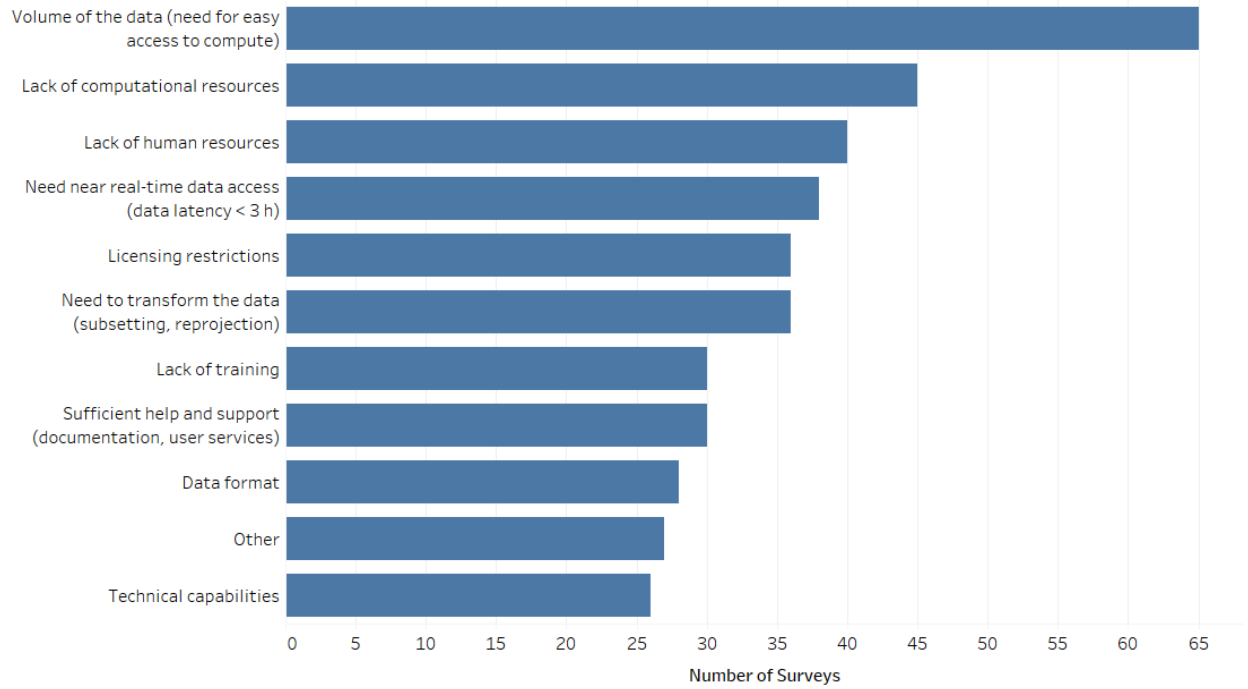
GEDI-on-ISS	0 (0%)	7 (6%)
GeoOptics	0 (0%)	0 (0%)
GHGSat	2 (2%)	6 (5%)
GLIMR	3 (2%)	3 (2%)
GOES series	3 (2%)	17 (14%)
GOSAT series	0 (0%)	3 (2%)
GPM	0 (0%)	4 (3%)
GRACE-FO	2 (2%)	6 (5%)
Himawari series	0 (0%)	4 (3%)
HydroGNSS	0 (0%)	0 (0%)
Hyperion	0 (0%)	1 (1%)
ICESat-2	1 (1%)	13 (10%)
ICEYE	0 (0%)	6 (5%)
INCUS	0 (0%)	0 (0%)
Jason-3	1 (1%)	6 (5%)
JPSS series	4 (3%)	16 (13%)
LAGEOS series	0 (0%)	0 (0%)
Landsat series	13 (10%)	41 (33%)
LIS-on-ISS	0 (0%)	0 (0%)
LLITED	0 (0%)	0 (0%)
MAGIC	0 (0%)	0 (0%)
MAIA	1 (1%)	2 (2%)
Maxar (Worldview series/GeoEye-1)	19 (15%)	28 (23%)
Meteosat series	1 (1%)	3 (2%)
MethaneSat	0 (0%)	2 (2%)
Metop series	1 (1%)	3 (2%)
METOP-SG A series	0 (0%)	2 (2%)
METOP-SG B series	0 (0%)	1 (1%)
MTG-I series	0 (0%)	0 (0%)
MTG-S series	0 (0%)	1 (1%)
NISAR	2 (2%)	21 (17%)

NOAA-18/NOAA-19	0 (0%)	3 (2%)
OCO series	0 (0%)	3 (2%)
Odin	0 (0%)	0 (0%)
PACE	0 (0%)	3 (2%)
Planet Labs [PlanetScope (Dove), RapidEye, SkySat]	7 (6%)	34 (27%)
Pleiades series	0 (0%)	6 (5%)
PREFIRE	0 (0%)	0 (0%)
RADARSAT-2	0 (0%)	17 (14%)
RCM series	0 (0%)	4 (3%)
RESOURCESAT series	0 (0%)	0 (0%)
SAGE-III-on-ISS	0 (0%)	0 (0%)
SAOCOM series	0 (0%)	2 (2%)
SARAL	0 (0%)	4 (3%)
SBG	2 (2%)	5 (4%)
SCATSAT-1	0 (0%)	2 (2%)
SCISAT-1	0 (0%)	0 (0%)
Sentinel CHIME series	0 (0%)	0 (0%)
Sentinel CIMR series	0 (0%)	1 (1%)
Sentinel CO2M series	0 (0%)	1 (1%)
Sentinel CRISTAL series	0 (0%)	1 (1%)
Sentinel LSTM series	0 (0%)	1 (1%)
Sentinel ROSE series	0 (0%)	0 (0%)
Sentinel-1 series	5 (4%)	27 (22%)
Sentinel-2 series	11 (9%)	39 (31%)
Sentinel-3 series	1 (1%)	12 (10%)
Sentinel-4 series	0 (0%)	3 (2%)
Sentinel-5 series	0 (0%)	7 (6%)
Sentinel-6 series	2 (2%)	10 (8%)
SMAP	6 (5%)	11 (9%)
SMOS	0 (0%)	5 (4%)
Spire	0 (0%)	2 (2%)

Suomi NPP	3 (2%)	14 (11%)
SWOT	3 (2%)	6 (5%)
TanDEM-X	0 (0%)	4 (3%)
TEMPO	3 (2%)	8 (6%)
Terra (ASTER, CERES, MISR, MODIS, MOPITT)	1 (1%)	25 (20%)
TerraSAR-X/PAZ	0 (0%)	3 (2%)
TROPICS series	0 (0%)	0 (0%)
TRUTHS	0 (0%)	0 (0%)
TSIS series	0 (0%)	0 (0%)
Other	1 (1%)	17 (14%)

Processing for Satellite Measurement or Product Need

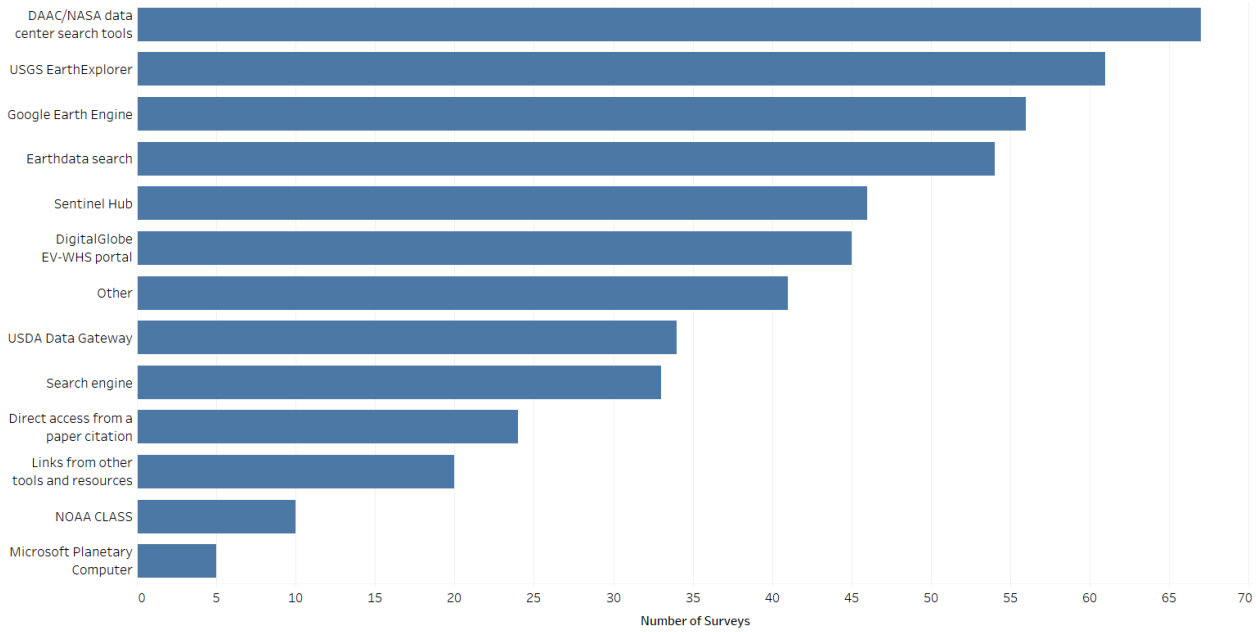
What factors limit your ability to use satellite data? (select all that apply)



Option	**# of Surveys (%)**
Volume of the data (need for easy access to compute)	65 (52%)
Lack of computational resources	45 (36%)
Lack of human resources	40 (32%)
Need near real-time data access (data latency < 3 h)	38 (31%)
Need to transform the data (subsetting, reprojection)	36 (29%)
Licensing restrictions	36 (29%)
Sufficient help and support (documentation, user services)	30 (24%)
Lack of training	30 (24%)
Data format	28 (23%)
Other	27 (22%)

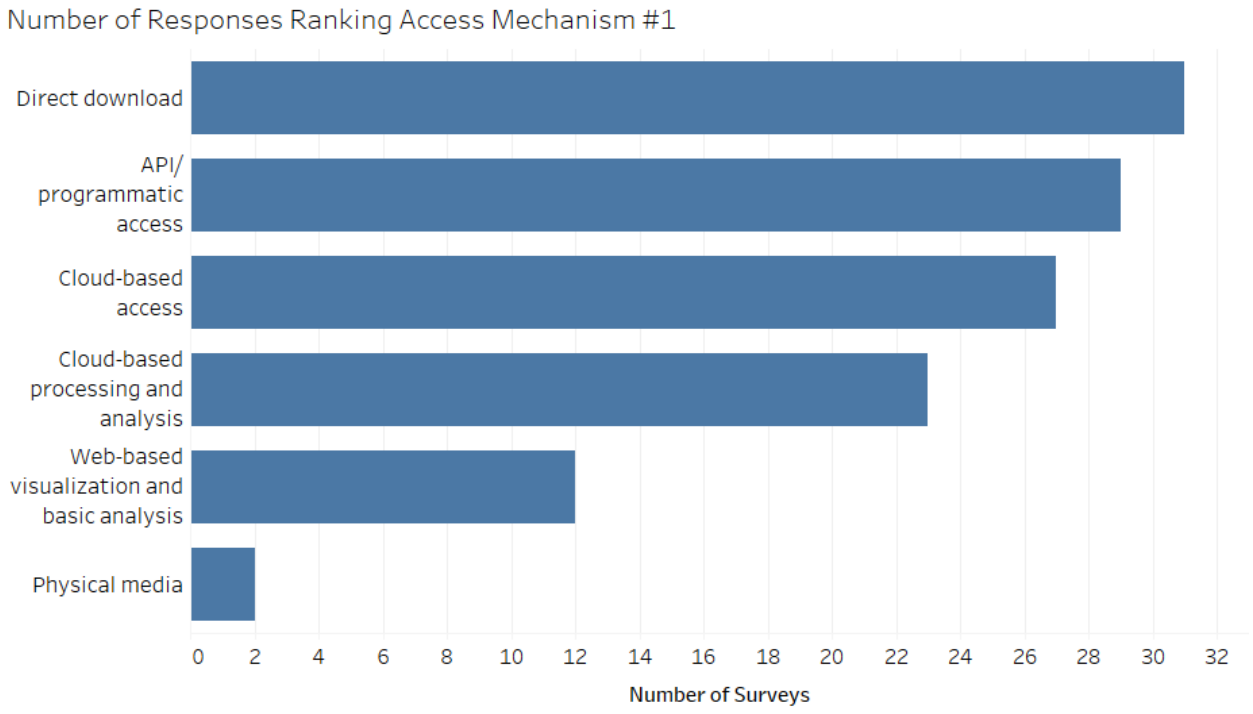
Technical capabilities	26 (21%)

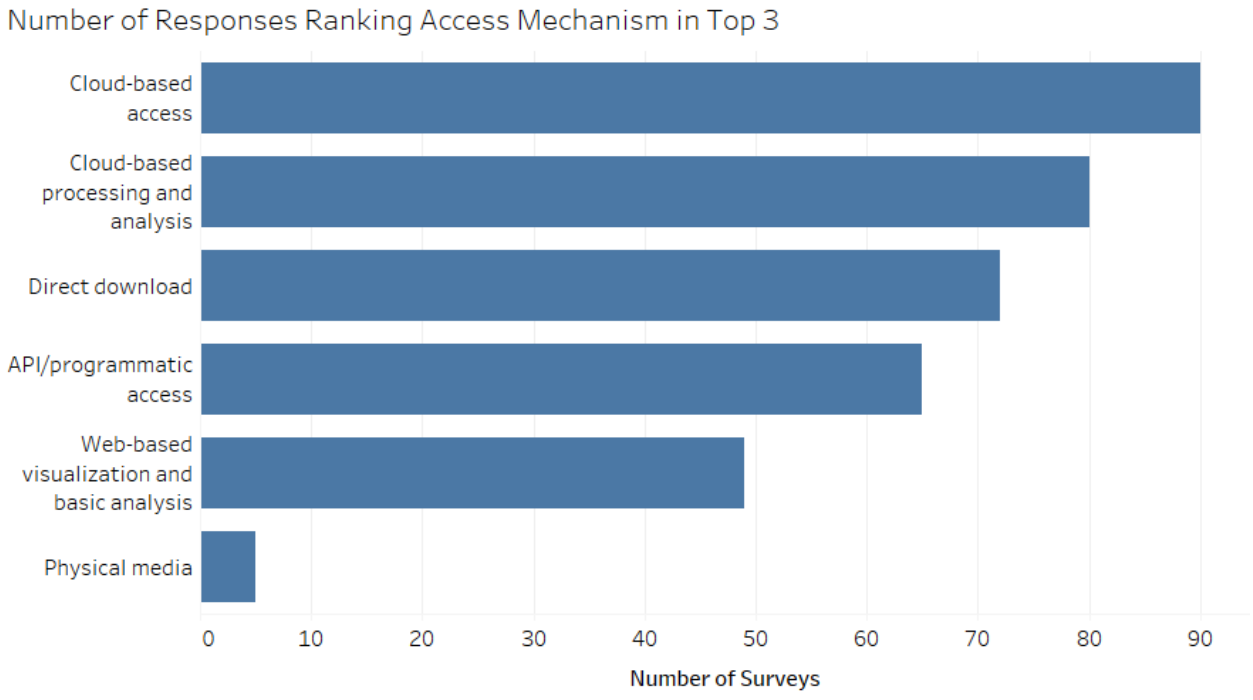
Which data discovery tools have you used to find satellite datasets? (select all that apply)



Option	**# of Surveys (%)**
DAAC/NASA data center search tools	67 (54%)
USGS EarthExplorer	61 (49%)
Google Earth Engine	56 (45%)
Earthdata Search	54 (44%)
Sentinel Hub	46 (37%)
DigitalGlobe EV-WHS portal	45 (36%)
Other	41 (33%)
USDA Data Gateway	34 (27%)
Search engine	33 (27%)
Direct access from a paper citation	24 (19%)
Links from other tools and resources	20 (16%)
NOAA CLASS	10 (8%)
Microsoft Planetary Computer	5 (4%)

Rank the following access mechanisms in order of preference, with 1 = most preferred.

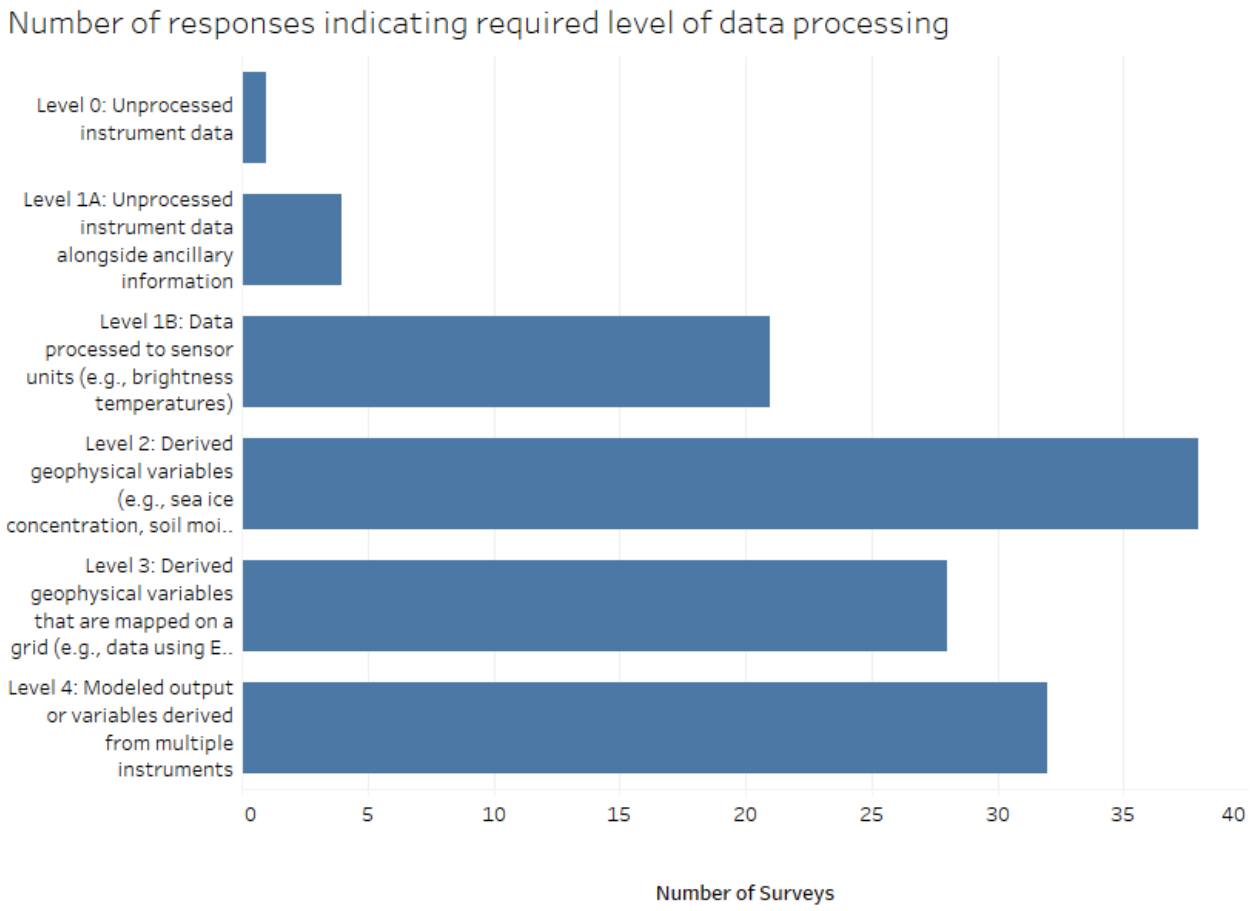


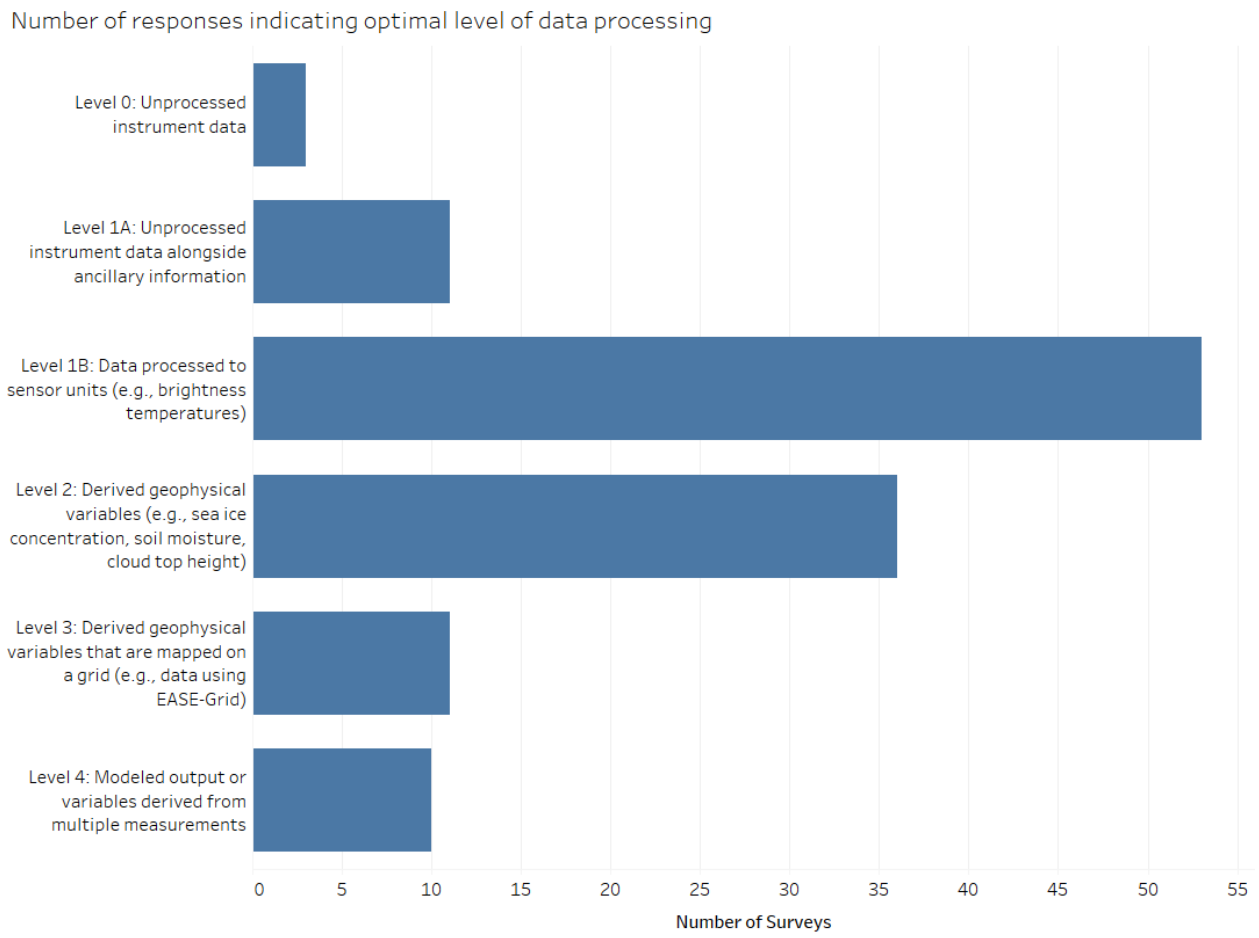


Option	# of Surveys Ranking #1 (%)	# of Surveys Ranked Top 3 (%)

Direct download (FTP, HTTPS)	31 (25%)	72 (58%)
API/programmatic access	29 (23%)	65 (52%)
Cloud-based access (i.e., no download)	27 (22%)	90 (73%)
Cloud-based processing and analysis	23 (19%)	80 (65%)
Web-based visualization and basic analysis	12 (10%)	49 (40%)
Physical media	2 (2%)	5 (4%)

What would be the required and optimal levels of data processing for your agency to exploit the satellite measurements or products requested? (A full description of data processing levels is available at: https://www.earthdata.nasa.gov/learn/earth-observation-data-basics/data-processing-levels)

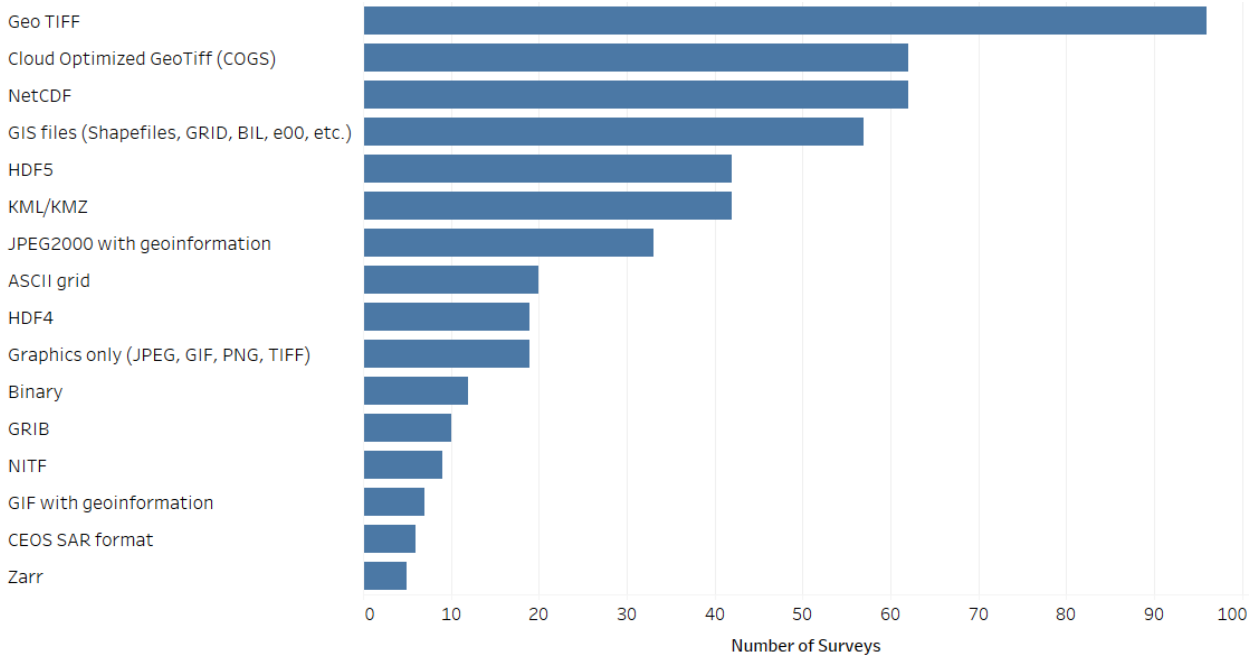




Option	**# of Surveys Selecting "Required" (%)**	**# of Surveys Selecting "Optimal" (%)**
Level 0: Unprocessed instrument data	1 (1%)	3 (2%)
Level 1A: Unprocessed instrument data alongside ancillary information	4 (3%)	11 (9%)
Level 1B: Data processed to sensor units (e.g., brightness temperatures)	21 (17%)	53 (43%)
Level 2: Derived geophysical variables (e.g., sea ice concentration, soil moisture, cloud top height)	38 (31%)	36 (29%)
Level 3: Derived geophysical variables that are mapped on a grid (e.g., data using EASE-Grid)	28 (23%)	11 (9%)
Level 4: Modeled output or variables	32 (26%)	10 (8%)

derived from multiple measurements		

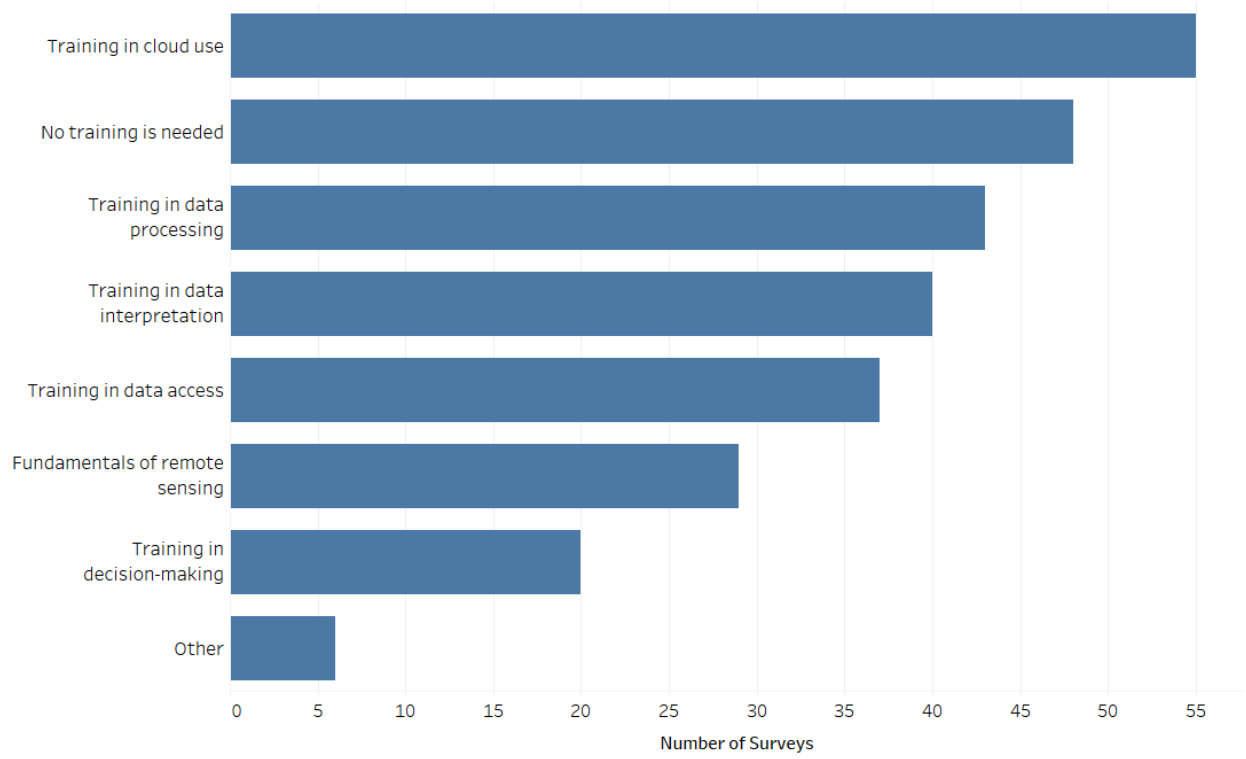
Select your top 5 preferred data formats. If you are able to make use of fewer than 5 formats, select only those that you can use.



Option	**# of Surveys (%)**
GeoTIFF	96 (77%)
Cloud Optimized GeoTIFF (COGS)	62 (50%)
NetCDF	62 (50%)
GIS files (Shapefiles, GRID, BIL, e00, etc.)	57 (46%)
HDF5	42 (34%)
KML/KMZ	42 (34%)
JPEG2000 with geoinformation	33 (27%)
ASCII grid	20 (16%)
HDF4	19 (15%)
Graphics only (JPEG, GIF, PNG, TIFF)	19 (15%)
Binary	12 (10%)
GRIB	10 (8%)
NITF	9 (7%)

GIF with geoinformation	7 (6%)
CEOS SAR format	6 (5%)
Zarr	5 (4%)

Do you need training in data use? (select all that apply)



Option	**# of Surveys (%)**
Training in cloud use	55 (44%)
No training is needed	48 (39%)
Training in data processing	43 (35%)
Training in data interpretation	40 (32%)
Training in data access	37 (30%)
Fundamentals of remote sensing	29 (23%)
Training in decision-making	20 (16%)
Other	6 (5%)

Aggregate Geophysical Observables

What feature or quantity do you need to observe? (E.g., evapotranspiration, aerosol optical depth, land surface deformation)

Agencies provided free-form text responses to this survey question. From these, individual geophysical observables were extracted and, where possible, mapped to the Global Change Master Directory (GCMD) keywords, described by NASA as "a hierarchical set of controlled Earth Science vocabularies that help ensure Earth science data, services, and variables are described in a consistent and comprehensive manner." The table below shows the number of instances where a mapped observable falls under the first three levels of the GCMD Earth Science hierarchy, along with a list of the fourth level keywords with mapped instances. Note that keywords with no mapped instances are excluded, and that 11 extracted observables could not be mapped to a GCMD keyword.

GCMD Keyword Hierarchy	# of Instances (%)
Earth Science	**498 (100%)**
Earth Science > Agriculture	**15 (3%)**
Earth Science > Agriculture > Agricultural Plant Science	10 (2%)
Earth Science > Agriculture > Plant Commodities	1 (0%)
Earth Science > Agriculture > Soils	4 (1%)
Earth Science > Atmosphere	**109 (22%)**
Earth Science > Atmosphere > Aerosols	28 (6%)
Earth Science > Atmosphere > Air Quality	4 (1%)
Earth Science > Atmosphere > Altitude	1 (0%)
Earth Science > Atmosphere > Atmosphere/Surface Interactions	4 (1%)
Earth Science > Atmosphere > Atmospheric Chemistry	26 (5%)
Earth Science > Atmosphere > Atmospheric Pressure	2 (0%)
Earth Science > Atmosphere > Atmospheric Radiation	3 (1%)
Earth Science > Atmosphere > Atmospheric Temperature	7 (1%)
Earth Science > Atmosphere > Atmospheric Water Vapor	13 (3%)
Earth Science > Atmosphere > Atmospheric Winds	8 (2%)
Earth Science > Atmosphere > Clouds	5 (1%)

Earth Science > Atmosphere > Planetary Boundary Layer	1 (0%)
Earth Science > Atmosphere > Precipitation	4 (1%)
Earth Science > Atmosphere > Weather Events	3 (1%)
Earth Science > Biological Classification	**11 (2%)**
Earth Science > Biological Classification > Animals/Vertebrates	9 (2%)
Earth Science > Biological Classification > Bacteria/Archaea	1 (0%)
Earth Science > Biological Classification > Protists	1 (0%)
Earth Science > Biosphere	**95 (19%)**
Earth Science > Biosphere > Ecological Dynamics	23 (5%)
Earth Science > Biosphere > Ecosystems	26 (5%)
Earth Science > Biosphere > Vegetation	46 (9%)
Earth Science > Climate Indicators	**2 (0%)**
Earth Science > Climate Indicators > Biospheric Indicators	1 (0%)
Earth Science > Climate Indicators > Cryospheric Indicators	1 (0%)
Earth Science > Cryosphere	**3 (1%)**
Earth Science > Cryosphere > Glaciers/Ice Sheets	2 (0%)
Earth Science > Cryosphere > Snow/Ice	1 (0%)
Earth Science > Human Dimensions	**61 (12%)**
Earth Science > Human Dimensions > Boundaries	2 (0%)
Earth Science > Human Dimensions > Economic Resources	1 (0%)
Earth Science > Human Dimensions > Environmental Impacts	8 (2%)
Earth Science > Human Dimensions > Habitat Conversion/Fragmentation	5 (1%)
Earth Science > Human Dimensions > Human Settlements	4 (1%)
Earth Science > Human Dimensions > Infrastructure	18 (4%)
Earth Science > Human Dimensions > Natural Hazards	22 (4%)
Earth Science > Human Dimensions > Population	1 (0%)

Earth Science > Land Surface	**78 (16%)**
Earth Science > Land Surface > Erosion/Sedimentation	1 (0%)
Earth Science > Land Surface > Geomorphic Landforms/Processes	4 (1%)
Earth Science > Land Surface > Land Surface Color	1 (0%)
Earth Science > Land Surface > Land Use/Land Cover	27 (5%)
Earth Science > Land Surface > Landscape	4 (1%)
Earth Science > Land Surface > Soils	13 (3%)
Earth Science > Land Surface > Surface Radiative Properties	5 (1%)
Earth Science > Land Surface > Surface Thermal Properties	6 (1%)
Earth Science > Land Surface > Topography	12 (2%)
Earth Science > Oceans	**68 (14%)**
Earth Science > Oceans > Bathymetry/Seafloor Topography	6 (1%)
Earth Science > Oceans > Coastal Processes	5 (1%)
Earth Science > Oceans > Marine Environmental Monitoring	1 (0%)
Earth Science > Oceans > Marine Sediments	2 (0%)
Earth Science > Oceans > Ocean Chemistry	9 (2%)
Earth Science > Oceans > Ocean Circulation	2 (0%)
Earth Science > Oceans > Ocean Heat Budget	2 (0%)
Earth Science > Oceans > Ocean Optics	6 (1%)
Earth Science > Oceans > Ocean Temperature	1 (0%)
Earth Science > Oceans > Ocean Waves	4 (1%)
Earth Science > Oceans > Ocean Winds	7 (1%)
Earth Science > Oceans > Salinity/Density	1 (0%)
Earth Science > Oceans > Sea Ice	16 (3%)
Earth Science > Oceans > Sea Surface Topography	4 (1%)
Earth Science > Oceans > Water Quality	2 (0%)
Earth Science > Solid Earth	**6 (1%)**

Earth Science > Solid Earth > Gravity/Gravitational Field	3 (1%)
Earth Science > Solid Earth > Rocks/Minerals/Crystals	1 (0%)
Earth Science > Solid Earth > Tectonics	2 (0%)
Earth Science > Spectral/Engineering	**6 (1%)**
Earth Science > Spectral/Engineering > Infrared Wavelengths	1 (0%)
Earth Science > Spectral/Engineering > Radar	3 (1%)
Earth Science > Spectral/Engineering > Radio Wave	1 (0%)
Earth Science > Spectral/Engineering > Sensor Characteristics	1 (0%)
Earth Science > Terrestrial Hydrosphere	**44 (9%)**
Earth Science > Terrestrial Hydrosphere > Ground Water	3 (1%)
Earth Science > Terrestrial Hydrosphere > Snow/Ice	13 (3%)
Earth Science > Terrestrial Hydrosphere > Surface Water	14 (3%)
Earth Science > Terrestrial Hydrosphere > Terrestrial Hydrosphere Change	1 (0%)
Earth Science > Terrestrial Hydrosphere > Water Quality/Water Chemistry	12 (2%)