

UAV Technologies

ENGINEERING INTELLIGENCE STANDARD

EIS-002

Earth Observation Data Quality and Acceptance Standard

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Public-use notice. EIS-002 is an original UAV Technologies company standard. It establishes internal acceptance criteria for Earth Observation data used in UAV Technologies Engineering Intelligence products. It is not a government, ISO, CEOS, OGC, or other consensus standard and does not represent third-party certification or accreditation.

Document Control

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1. Purpose

EIS-002 establishes the minimum technical requirements UAV Technologies uses to determine whether Earth Observation (EO) data are suitable for visual screening, quantitative Engineering Intelligence, multi-temporal change analysis, or another defined analytical purpose. The standard is designed to prevent data that are visually compelling but technically unsuitable from being used to support conclusions beyond their evidentiary capability.

EIS-002 converts the fit-for-purpose principle in EIS-001 into an operational acceptance process. It requires the analyst to evaluate data quality within the actual Area of Interest (AOI), rather than relying solely on scene-level metadata or provider labels.

2. Scope and Relationship to EIS-001

This standard applies to satellite, aerial, and other remotely sensed EO datasets used by UAV Technologies when they materially support an Engineering Intelligence product. It applies to raw or processed raster products, analysis-ready data, derived indices, classification layers, quality masks, and multi-date datasets.

EIS-001 governs the overall Engineering Intelligence methodology. EIS-002 governs the acceptance and quality control of EO evidence used within that methodology. Project-specific customer requirements, contracts, licensing conditions, authoritative product specifications, and applicable law take precedence when they impose more stringent requirements.

Vendor neutrality. EIS-002 does not prescribe a specific satellite, provider, or commercial platform. Sentinel-2, Landsat, commercial satellite imagery, aerial imagery, and other sources may be accepted when their technical characteristics are fit for the defined engineering objective.

3. Core Data-Quality Principles

- AOI-first quality. Usable coverage within the analytical AOI is more important than scene-wide quality statistics alone.
- Native information content governs. Resampling, sharpening, interpolation, or display enlargement does not create new spatial or spectral information.
- Quantitative work requires quantitative data. Rendered imagery shall not substitute for calibrated or otherwise documented analytical values when numerical conclusions are required.
- Quality masks are evidence. Cloud, shadow, saturation, fill, snow/ice, aerosol, terrain occlusion, and other provider quality information shall be considered when relevant.
- Comparability must be demonstrated. Two valid images are not automatically valid for change detection.
- Metadata are part of the dataset. Acquisition, processing, scaling, coordinate reference, and quality information shall be retained or recoverable.
- Acceptance is purpose-specific. A dataset rejected for quantitative change detection may still be acceptable for contextual visualization or screening.
- Limitations follow the data. Known weaknesses that survive acceptance shall be carried into the analysis and report.

4. Terms and Definitions

Term	Definition
Analysis-ready data (ARD)	EO data processed and organized so that defined analytical operations can be performed with limited additional preprocessing, while retaining documented quality and provenance.
Analytical raster	A raster whose pixel values retain documented physical, reflectance, temperature, index, categorical, or other analytical meaning.
Rendered imagery	A visualization product such as a screenshot, JPG, PNG, web tile, or color-stretched image whose display values may not preserve the original analytical measurements.
Valid pixel	A pixel that passes the quality conditions defined for the intended analysis.
Valid AOI coverage	The proportion of the AOI or analytical unit represented by valid pixels after applicable masking and exclusions.
Native resolution	The sensor/product spatial resolution before user resampling or display enlargement.
Registration	The spatial correspondence of the same ground location between datasets.
Temporal comparability	The degree to which acquisition timing and environmental/operational conditions permit a defensible comparison.
Quality mask	A provider or analyst-generated layer indicating pixel conditions that affect usability.
Acceptance disposition	The final determination: Engineering Intelligence Quality, Screening Quality, Accept with Limitations, or Reject for Intended Analysis.

5. EO Data Acceptance Framework

Each material EO dataset shall receive a documented acceptance disposition before it is used to support a released Engineering Intelligence conclusion. Acceptance shall consider the intended decision question and the following control areas:

Control area	Primary question
Source / provenance	Do we know what the product is, who produced it, when, and how it was processed?
Coverage	Does the dataset adequately cover the AOI and required analytical units?
Spatial suitability	Can the sensor resolve the feature or change relevant to the decision?
Spectral / measurement suitability	Does the product contain the bands or measurements required by the method?
Radiometric suitability	Are values calibrated, scaled, and documented sufficiently for the intended numerical use?
Quality contamination	Are cloud, shadow, haze, saturation, fill, occlusion, snow/ice, or other artifacts controlled?
Temporal suitability	Is the acquisition date/time appropriate to the condition being assessed?
Registration	Are datasets sufficiently aligned for the scale and type of change analysis?
Comparability	Are seasonality, sensor differences, processing differences, and acquisition conditions controlled or disclosed?
Reproducibility	Can the material analytical transformation be reconstructed from retained data and method records?

6. Source and Product Requirements

- Source/provider, product name, acquisition date/time, processing level, and relevant product version or collection shall be known or recoverable.
- For quantitative reflectance analysis, atmospherically corrected surface-reflectance products are preferred when scientifically appropriate to the application.
- Where digital numbers require scale factors, offsets, bit decoding, or other transformations, those parameters shall be obtained from authoritative metadata or product documentation and applied before interpretation.
- Quality layers supplied with the product shall be retained when they affect analytical acceptance.
- Original or analysis-ready files shall be retained for material quantitative work when licensing and customer requirements permit.
- Rendered exports may be retained as figures but shall be labeled as visualization products when their pixel values are not the analytical measurements.

For example, Landsat Collection 2 Level-2 products include pixel, saturation, aerosol, and other QA information, while surface-reflectance values require documented scaling. Sentinel-family products similarly require product-specific interpretation of processing level, masks, offsets, and native resolution. EIS-002 therefore requires analysts to follow the authoritative specification for the actual product used rather than applying a universal assumption.

7. Spatial Suitability

7.1 Resolution-to-feature relationship

The analyst shall determine whether native spatial resolution is sufficient to observe the feature, condition, or change being assessed. A feature occupying only a fraction of a pixel may contribute to the signal without being independently resolved.

Use condition	Disposition guidance
Feature/change clearly resolved by multiple native pixels	Potentially suitable, subject to other controls.
Feature approximately one to a few native pixels	Use caution; suitable primarily for detection/screening unless validated.
Feature materially smaller than native pixel	Do not claim direct geometric resolution; treat as mixed-pixel or contextual evidence.
Data have been upsampled	Evaluate using native resolution, not displayed pixel size.

7.2 AOI and coordinate reference

- AOI geometry shall be documented or reproducible.
- CRS shall be known for spatial analysis.
- Area, distance, and buffer calculations shall use an appropriate projected or geodesic method rather than assuming geographic degrees are uniform metric units.
- Reprojection shall use a documented method appropriate to the data type; categorical masks should not be silently interpolated using continuous-value methods.

8. Radiometric and Spectral Suitability

Quantitative spectral conclusions require pixel values with documented analytical meaning. The analyst shall verify data type, valid range, scaling factor, offset, no-data/fill value, saturation behavior, and processing level when material to the calculation.

- Do not calculate physical or spectral indices from colorized visualization RGB values unless the visualization is explicitly documented to preserve the required numerical bands.
- Do not assume a 32-bit TIFF is quantitative merely because its storage type is floating point; the content must still preserve meaningful analytical values.
- Band selection shall match the index or physical relationship being evaluated.
- Native spectral response and band center differences shall be considered when comparing different sensors.
- Radiometrically saturated pixels shall be excluded from calculations requiring valid reflectance or radiance.

9. Atmospheric, Cloud, Shadow, and Quality-Mask Controls

Scene-level cloud percentage is a screening aid, not an acceptance criterion by itself. Acceptance shall be based primarily on valid coverage over the AOI and the location of contamination relative to material features.

- Cloud and cloud-shadow pixels shall normally be excluded from quantitative land-surface change calculations.
- Cirrus, haze, aerosol, snow/ice, terrain occlusion, saturation, and adjacency effects shall be evaluated when relevant to the product and decision.
- Provider QA/SCL layers should be used when available and technically suitable; manual or supplemental masks may be used when documented.
- Mask dilation or buffers around cloud/shadow may be applied where edge contamination could affect results; the method shall be recorded.
- If quality masks are known to have limitations in the environment being studied, the analyst shall visually inspect and, when appropriate, supplement them.

Why AOI-first matters. A scene with 30% cloud cover may be fully usable if the AOI is clear. Conversely, a scene reported as 5% cloudy may be unusable if the cloud or shadow covers the only asset or field being analyzed.

10. Temporal and Multi-Date Comparability

Multi-temporal analysis shall establish that observed differences are not more reasonably explained by acquisition timing, phenology, tide/water level, crop cycle, illumination, storm timing, operational state, or other known temporal factors.

- Same-day-of-year or a fixed +/- day window is not an absolute requirement. The appropriate temporal tolerance depends on the engineering question.
- For vegetation/agricultural analysis, seasonal and phenological comparability shall be explicitly considered.
- For coastal/wetland analysis, tide, water level, recent rainfall, and storm effects shall be considered when material.
- For construction or infrastructure monitoring, acquisition frequency shall be appropriate to the expected rate of change.
- For disaster response, recency may outweigh seasonal comparability; the limitation shall be stated.
- When possible, persistent change should be tested against more than two dates to distinguish a durable signal from transient variability.

11. Geometric Registration and Alignment

Pixel-level or small-feature change detection requires spatial correspondence between dates. Registration acceptance shall be proportional to the size of the feature and the change being measured.

Analysis type	Default registration objective	Disposition
Regional screening / broad land-cover change	≤ 1 native pixel relative displacement	Normally acceptable if edge effects are not material.
Field / parcel / corridor quantitative comparison	≤ 0.5 native pixel where practicable	Preferred for quantitative change; inspect boundaries and high-contrast edges.
Small-feature / object-level change	Sub-pixel alignment appropriate to the feature scale	May require higher-resolution data, control points, or specialized co-registration.
Misregistration comparable to expected change	Not acceptable	Reject pixel-level change result or use a coarser analytical method.

These are UAV Technologies default objectives, not universal sensor specifications. Project-specific thresholds may be more or less stringent when technically justified and documented.

12. Quantitative Indices and Derived Products

- Indices shall be calculated from documented analytical bands using the correct mathematical expression and scaling.
- Input bands shall represent compatible spatial support. If bands of different native resolutions are combined, the resampling method and effective analytical resolution shall be documented.
- Index values shall be masked for invalid source pixels before statistics are reported.
- Thresholds used to classify change, stress, moisture condition, disturbance, or another state shall be identified as empirical, literature-based, customer-defined, statistically derived, or validated.
- A color ramp is not a measurement. Numerical statements shall derive from the analytical values, not the visual appearance of a rendered index.
- Derived results shall not be converted into causal diagnoses without independent evidence.

Common examples include NDVI, NDMI, NDWI/MNDWI, NDRE, NBR/NBR2, land-surface temperature, and other sensor-appropriate products. Inclusion in this list does not imply that any index is suitable for every application.

13. AOI Valid-Coverage Requirements

The following default thresholds govern the proportion of an AOI or analytical unit remaining after required quality masks. Project-specific thresholds may supersede them when justified.

Valid coverage	Default disposition	Use guidance
$\geq 90\%$	Engineering Intelligence Quality candidate	Generally suitable for quantitative AOI statistics, subject to spatial distribution of missing pixels.
75% to $<90\%$	Accept with Limitations	Quantitative use may be acceptable if missing pixels do not bias the decision; disclose limitation.
50% to $<75\%$	Screening Quality	Use primarily for screening, localized valid-area analysis, or targeted observations; avoid unqualified AOI-wide statistics.
$< 50\%$	Reject for AOI-wide quantitative analysis	Acquire another date/source or narrow the analytical unit unless a specific localized finding remains valid.

Coverage percentage alone does not control acceptance. Missing 5% concentrated over the critical asset may be more damaging than randomly distributed missing 25%. The analyst shall evaluate both amount and spatial distribution.

14. Data Quality Classes and Disposition

Class	Minimum meaning	Permitted use
Engineering Intelligence Quality	Data are fit for the defined quantitative or evidentiary purpose and material limitations are controlled.	Quantitative analysis, change metrics, engineering observations, and decision support within stated scope.
Accept with Limitations	Data support the intended analysis but a known limitation materially affects part of the result.	Quantitative or qualitative use with explicit limitation and, where needed, restricted AOI/claim.
Screening Quality	Data support visual or analytical screening but do not meet the evidentiary threshold for the intended quantitative conclusion.	Hypothesis generation, prioritization, contextual interpretation, and identification of follow-up needs.
Reject for Intended Analysis	Data are not fit for the defined purpose.	Do not use to support the intended conclusion. May be retained for context if clearly identified.

A single dataset may receive different dispositions for different questions. For example, a rendered image may be Engineering Intelligence Quality for identifying a clearly resolved runway geometry while remaining Screening Quality or rejected for quantitative vegetation-index analysis.

15. Cross-Sensor and Cross-Product Analysis

- Cross-sensor comparisons shall account for differences in spatial resolution, spectral response, viewing geometry, radiometric processing, temporal sampling, and quality masks.
- Values from different sensors shall not be assumed interchangeable merely because the bands have similar names.
- Where harmonized products are used, the harmonization method and authoritative product documentation shall be retained.
- Comparisons between top-of-atmosphere and surface-reflectance products require explicit technical justification and shall not be treated as directly equivalent by default.
- Resampling to a common grid establishes computational alignment, not equivalent information content.

16. Documentation and Provenance

The acceptance record for each material dataset shall preserve enough information for another qualified reviewer to understand why the data were accepted and reproduce the material preprocessing.

Record element	Minimum requirement
Dataset identification	Provider, sensor/platform, product, acquisition date/time, processing level/version.
AOI	Geometry or reproducible reference.
Native characteristics	Spatial resolution; relevant bands/variables; data type.
CRS / grid	Source CRS and analysis CRS/grid when transformed.
Radiometric handling	Scale factor, offset, valid range, no-data/fill, saturation treatment when applicable.
Quality handling	QA/SCL/masks used; excluded classes; manual edits; buffers/dilation.
Temporal basis	Reason the date(s) are comparable or limitation statement.
Registration	Method and estimated/observed alignment quality when multi-date.
Derived products	Formula/method, inputs, resampling, thresholds, and output resolution.
Acceptance disposition	Class, rationale, limitations, analyst, reviewer, and date.

17. Quality Review and Release Controls

- Material EO acceptance decisions shall be reviewed as part of the EIS-001 technical review process.
- The reviewer shall verify that analytical data, rather than rendered figures, support quantitative claims.
- The reviewer shall check that masks, scaling, coordinate handling, registration, and derived calculations are appropriate to the product.
- The reviewer shall challenge whether missing coverage or temporal differences could bias the reported result.
- Figures may be contrast-enhanced or colored for communication, but captions shall not imply that display enhancement changed the analytical measurement.
- Released reports shall state material EO limitations when those limitations could affect customer reliance.

18. Exceptions and Deviations

A project may deviate from a default EIS-002 threshold when the engineering objective, sensor characteristics, customer requirement, or available evidence justifies another approach. The deviation shall identify the affected requirement, technical rationale, resulting limitation, and approval/disposition. A deviation does not permit unsupported conclusions.

19. Continuous Improvement

UAV Technologies shall periodically review EIS-002 using project lessons learned, technical-review findings, new sensor/product capabilities, changes in authoritative product specifications, and developments in EO quality practice. Numerical defaults may be revised when experience or validation demonstrates a better decision threshold.

Appendix A - EO Data Acceptance Checklist

- Engineering objective and intended EO use defined.
- AOI and analytical units defined.
- Provider, sensor, product, date/time, processing level/version recorded.
- Native spatial and spectral/measurement characteristics verified.
- CRS and grid verified.
- Radiometric scaling/offset/no-data/saturation verified when quantitative.
- Quality mask(s) identified and decoded correctly.
- Cloud/shadow/aerosol/snow/occlusion/saturation impacts evaluated as applicable.
- Valid AOI coverage calculated or otherwise documented.
- Feature size versus native resolution evaluated.
- Temporal comparability evaluated.
- Multi-date registration evaluated when applicable.
- Cross-sensor differences evaluated when applicable.
- Derived-product formulas, inputs, resampling, and thresholds documented.
- Acceptance class assigned.
- Limitations carried forward to analysis/report.
- Independent technical review completed.

Appendix B - Default Screening Thresholds

Control	Default threshold / objective	Important qualification
Scene cloud metadata	No absolute pass/fail value	Use as search/filter aid only; AOI valid coverage controls acceptance.
AOI valid coverage	>=90% for Engineering Intelligence Quality candidate	Spatial distribution of invalid pixels may override percentage.
Multi-date registration	<=1 native pixel for broad screening; <=0.5 pixel preferred for field/parcel quantitative comparison	Expected change magnitude and feature scale control final suitability.
Seasonal alignment	No universal +/- day requirement	Use application-specific phenology, hydrology, operations, or hazard timing.
Rendered imagery	Screening/visualization by default	May support direct geometric observations if fit for purpose; not quantitative spectral measurement unless values are demonstrably preserved.
Quantitative indices	Analytical source bands + valid masks required	Document scaling, resampling, formula, thresholds, and effective resolution.
Two-date change	Permitted with limitation	Persistent/causal interpretations should use additional dates or independent evidence when practicable.

Appendix C - Example Acceptance Record

Field	Example
Dataset	Sentinel-class Level-2 surface-reflectance scene, 14 Aug 2026
Intended use	Agricultural vegetation/moisture change screening and quantitative index comparison
AOI	Defined Lajas Valley agricultural screening polygon
Analytical bands	Visible, NIR/red-edge, SWIR bands required by selected indices
Quality controls	Scene classification / provider mask; cloud and shadow excluded
Spatial suitability	10-20 m native information content; field-scale analysis, not individual irrigation-component inspection
Temporal basis	Compared with seasonally relevant historical observations; crop cycle and rainfall remain interpretive factors
Registration	Common grid verified; pixel-level comparison accepted at field scale
Derived products	NDVI, NDMI, NDRE, NBR2 calculated from analytical raster values
Disposition	Engineering Intelligence Quality for regional/field-scale spectral change; not sufficient by itself for parcel-level causal diagnosis
Limitation	Drought, irrigation performance, harvest, crop type, and abandonment require independent corroboration for causal attribution

Informative Technical Basis

EIS-002 is an original UAV Technologies standard. Product-specific technical facts shall be verified against the authoritative documentation applicable to the dataset actually used. The following public sources illustrate the types of authoritative specifications that inform EO quality control:

- U.S. Geological Survey, Landsat Collection 2 Level-2 Science Products and Quality Assessment documentation.
- U.S. Geological Survey, Landsat Collection 2 Surface Reflectance documentation, including scaling, metadata, QA, and analysis-ready-data characteristics.
- Copernicus / European Space Agency Sentinel-2 product and Level-2A documentation, including spatial resolution, processing, classification/quality information, and radiometric conventions.
- Committee on Earth Observation Satellites (CEOS) Analysis Ready Data concepts, where applicable to a selected product.

Customer transparency. Publication of EIS-002 allows customers to understand the minimum EO data-quality and acceptance controls referenced in UAV Technologies proposals, case studies, and Engineering Intelligence reports.