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|  | **Analysis Ready Data** ***For Land*** | **Product Family****Specification** |

**Description**

**Product family title**

Surface temperature, expressed in Kelvin

**Applies to**

*Data collected by medium resolution (10-100m) multispectral TIR sensors.*

**Requirements**

**General metadata**

*A metadata records describing a distributed collection of pixels must comply with the following requirements. The collection of pixels must be contiguous in space and time.*

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| **Item** | **Threshold requirements** | **Breakthrough requirements** |
| **Traceability** | Not applicable | Data must be traceable to SI reference standard. |
| **Metadata machine readability** | Metadata is provided in a structure that enables a computer algorithm to be used to consistently and automatically identify and extract each component part for further use. | As threshold, but metadata is formatted in accordance with ISO 19115-2. |
| **Data collection time** | The start and stop time of data collection is identified in the metadata, expressed in date/time, to the second, with the time offset from UTC unambiguously identified. | Acquisition time for each pixel is identified (or can be reliably determined) in the metadata, expressed in date/time at UTC, to the second. |
| **Geographical area** | The surface locations to which the data relates is identified, typically as a series of four corner points, expressed in WGS84 coordinates. | The location to which each pixel refers is identified (or can be reliably determined), expressed in projection coordinates with reference datum. |
| **Coordinate reference system** | The metadata lists the coordinate reference system that has been used. | As threshold |
| **Map projection** | The metadata lists the map projection that has been used, and any relevant parameters required in relation to use of data in that map projection. | As threshold |
| **Geometric correction source** | Not applicable | The geometric correction source is identified in the metadata. DOIs are used.*Note 1: for example, the GCP chipset and digital elevation model versions are identified.* |
| **Geodetic correction methods** | Not applicable | The metadata describes the geodetic correction methods used, including reference database and elevation model(s) versions. DOIs are used. |
| **Geodetic accuracy** | Not applicable | The metadata includes metrics describing the assessed geodetic accuracy of the data, expressed in projection units. Uncertainties expressed as root mean square error (RMSE) for the model and independent verification. |
| **Instrument** | The instrument used to collect the data is identified in the metadata. | As threshold, but including a reference to the relevant CEOS Missions, Instruments and Measurements Database record. |
| **Spectral bands** | The central wavelength for each band for which data is included is identified in the metadata, expressed in SI units. | As threshold, Instrument spectral response details also included in the metadata, or directly accessible using details in the metadata. Central wavelength and bandwidth at full-width half maximum value of the relative spectral response function. Are provided. |
| **Sensor calibration** | Not applicable | Sensor calibration parameters are identified in the metadata, or can be accessed using details included in the metadata.Note 1: for example, a calibration parameter file located through a DOI. |
| **Radiometric accuracy** | Not applicable | The metadata includes metrics describing the assessed absolute radiometric accuracy of the data, expressed as absolute radiometric uncertainty relative to a known reference standard.*Note 1: for example, this may come from comparison with routine and rigorously collected in situ measurements*  |
| **Algorithms** | All algorithms, and the sequence in which they were applied in the generation process, are identified in the metadata. | As threshold, but only algorithms that have been published peer-reviewed journal, and are openly available to users of the data, are identified.DOIs for each algorithm are identified in the metadata. The versions of the algorithms are identified. |
| **Ancillary data** | The metadata identifies the sources of ancillary data used in the generation process, expressed as DOIs. The ancillary data can be requested from the owner.*Note 1: a requestor may be required to pay for the ancillary data.**Note 2: ancillary data includes aerosol data source,*  | As threshold, but the ancillary data is also available for free online download, contemporaneously with the product. |
| **Processing chain provenance** | Not applicable | The metadata includes a description of the processing chain used to generate the product, including the versions of the software used. |
| **Data access** | The metadata identifies a location from where the product can be retrieved, expressed as a DOI. Manual and offline interaction action (e.g. log in) may be required. | The metadata identifies an online location from where the data (including any available new records as they are generated) can be consistently and reliably retrieved by a computer algorithm without any manual intervention being required.*Note 1: Some manual interaction action may be required on a ‘one off’ basis to establish ongoing access to the data.* |
| **Overall data quality** | Not applicable | Machine-readable metrics describing the overall quality of the data are included in the metadata, at minimum:* Percentage of pixels contaminated by cloud and cloud shadows
* For coastal scenes, percentage of land pixels contaminated by clouds and cloud shadows
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**Per-pixel metadata**

*The following minimum metadata specifications apply to each pixel. It is at the discretion of the data provider whether the metadata is provided in a single record that is relevant to all pixels, or is provided separately for each pixel.*

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| **Item** | **Threshold requirements** | **Breakthrough requirements** |
| **Metadata machine readability** | Metadata is provided in a structure that enables a computer algorithm to be used to consistently and automatically identify and extract each component part for further use. | As threshold, but metadata is formatted in accordance with ISO 19115-2. |
| **No data** | Pixels that do not correspond to an observation (‘empty pixels’) are clearly flagged. | As threshold. |
| **Untested pixels** | The metadata identifies pixels for which the per-pixel tests (below) have not all been successfully completed.*Note 1: this may be the result of missing ancillary data for a subset of the pixels.* | The metadata identifies which tests have, and have not, been successfully completed for each pixel. |
| **Saturation** | Metadata indicates where one or more spectral bands are saturated. | Metadata indicates which, if any, pixels are saturated in any spectral band. |
| **Cloud** | Metadata indicates whether a pixel is assessed as being cloud. | As threshold, with the metadata referencing a citable peer-reviewed algorithm for cloud/cloud shadow detection, expressed as a DOI. |
| **Cloud shadow** | Metadata indicates whether a pixel is assessed as being cloud shadow. |
| **Distance from clouds** | As threshold. | Metadata indicates estimated distance that each pixel is from clouds, in metres or kilometres. |
| **Uncertainty associated with land target** |  | Uncertainty, in units Kelvin, of the surface temperature for each pixel is also accompanied by distance from cloud (above) and atmospheric transmission (intervals, i.e. .4 - .55, .55 - .7 etc)). |

**Radiometric corrections**

*The following requirements must be met for all pixels in a collection. BRDF correction is optional.*

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| **Item** | **Threshold requirements** | **Breakthrough requirements** |
| **Atmospheric** | Atmospheric correction is applied to derive surface brightness temperature. The metadata references a citable peer-reviewed algorithm, expressed as a DOI. | Atmospheric correction and emissivity correction applied to derive land surface temperature. The metadata references citable peer-reviewed algorithms, expressed as DOIs. |
| **Emissivity correction** | Not applicable. |

**Geometric corrections**

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| **Item** | **Threshold requirements** | **Breakthrough requirements** |
| **Accuracy** | Sub-pixel accuracy in geolocation, less than or equal to 12m radial root mean square error (rRMSE). rRMSE value is included in metadata. | Piixels are located with sub-pixel accuracy relative to an independent spatial referencing system. Metadata provides references to published and citable correction methods, which are expressed as DOIs.*Note 1: This requirement is intended to enable cross-referencing with non-image spatial data such as GIS layer and terrain models, and also with other data sources that meet this level of correction.* |