Comments from Public Consultation on ECV Requirements 13/01 – 13/03 2020 for:

# Land Surface Temperature

## ECV Product: Land Surface Temperature (LST)

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| --- | --- | --- | --- | --- | --- |
| **Name** | Land Surface Temperature (LST) | | | | |
| **Definition** | Land Surface Temperature (LST) is a measure of how hot or cold the surface of the Earth would feel to the touch. When derived from radiometric measurements of ground-based, airborne, and spaceborne remote sensing instruments, LST is the aggregated radiometric surface temperature of the ensemble of components within the sensor field of view. From a climate perspective, LST is important for evaluating land surface and land-atmosphere exchange processes, constraining surface energy budgets and model parameters, and providing observations of surface temperature change both globally and in key regions. | | | | |
| **Unit** | K | | | | |
| **Note** | ECV Requirements derived from 77 responses from an online user survey of LST climate community in LST CCI Project | | | | |
| **Requirements** | | | | | |
| **Item needed** | **Unit** | **Metric** | **[1]** | **Value** | **Derivation and References and Standards** |
| Horizontal Resolution | km |  | G | < 1 | Reflect the primary application of the climate users in the survey. The three most popular primary applications are model evaluation, evapotranspiration/vegetation or crop monitoring and urban climate, all of which may quite feasibly require data with a spatial resolution of 1 km or better. Only polar orbiting satellites can currently provide data at these resolutions. |
| B | < 1 |
| T | 1 |
| Vertical Resolution | N/A |  | G |  |  |
| B |  |  |
| T |  |  |
| Temporal Resolution | h |  | G | < 1 | Only Geostationary data can provide data at these resolutions but these are regional datasets. In contrast polar orbiting satellites cover the whole globe but are restricted to day/night temporal resolution. |
| B | 1 |
| T | 6 | Very nearly met by day/night temporal resolution from polar orbiting satellite, which satisfies 70% of climate users in survey. |
| Timeliness | N/A |  | G |  |  |
| B |  | Note, a survey of 80 non-climate users for timeliness from the ESA DUE GlobTemperature Project revealed the a “threshold” need of 1 month for long-term data records, and a “breakthrough” of 48 hours for long-term data records. |
| T |  |
| Required Measurement Uncertainty |  | An estimate of the expected spread of the distribution of possible values | G | < 1 K | This is the required total uncertainty per pixel combining the four groups of uncertainty components: random, locally correlated atmospheric, locally correlated surface, and large scale systematic. There is a requirement for knowledge on correlation length scales |
| B | < 1 K |
| T | < 1 K |
| Stability | K per decade | Assessment of whether a monotonic trend exists with respect to ground-based Fiducial Reference Measurements or related ECV datasets (such as near-surface air temperature) | G | 0.1 | For climate modeling community long-term product stability is noted as high priority. Temporal stability of the LST products need to be sufficient for global and regional trends in LST anomalies to be calculated. |
| B | 0.2 |
| T | 0.3 |
| Standards and References | Bulgin, C., & Merchant, C. (2016). DUE GlobTemperature Requirements Baseline Document.  Ghent, D., Veal, K., Trent, T., Dodd, E., Sembhi, H., and Remedios, J. (2019). A New Approach to Defining Uncertainties for MODIS Land Surface Temperature. Remote Sensing, 11, 1021. doi: 10.3390/rs11091021  Good, E. J., Ghent, D. J., Bulgin, C. E., & Remedios, J. J. (2017). A spatiotemporal analysis of the relationship between near‐surface air temperature and satellite land surface temperatures using 17 years of data from the ATSR series. Journal of Geophysical Research: Atmospheres, 122(17), 9185-9210. doi:10.1002/2017JD026880  LST CCI (2018) User Requirements Document, Reference LST-CCI-D1.1-URD - i1r0  LST CCI (2019) End-to-End ECV Uncertainty Budget Document, Reference LST-CCI-D2.3-E3UB - i1r0  Merchant, C. J., Paul, F., Popp, T., Ablain, M., Bontemps, S., Defourny, P., Hollmann, R., Lavergne, T., Laeng, A., de Leeuw, G., Mittaz, J., Poulsen, C., Povey, A. C., Reuter, M., Sathyendranath, S., Sandven, S., Sofieva, V. F., and Wagner, W. (2017). Uncertainty information in climate data records from Earth observation. Earth System Science Data, 0, 511-527. | | | | |
| **Adaptation and Extremes** | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| **Adaptation[2]** | Y | Y | These products can be used for adaptation in cities for example to drive policy of green infrastructure. They can be used also for improving water use efficiency through change in irrigation regimes. | | |
| **Extremes[3]** | Y | Y | These products are relevant for extremes such as heat waves and drought. These can be at both regional scales or local scales, such as cities or agricultural fields. | | |

[1]Goal (G); Breakthrough (B)(not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review)

[2] Is the ECV Product directly relevant to support Climate Adaptation?

[3] Can the ECV Product be used to monitor climate extremes or aspects of extremes?

### Comment 1

|  |  |
| --- | --- |
| Author: Chris Merchant | Email: c.j.merchant@reading.ac.uk |
| I am doubtful about the threshold requirements for horizontal resolution: resolution of < 1km as a goal does indeed release genuine and climate-relevant possibilities, but data at resolutions less fine than 1 km are useful and are used for various climate applications. I suggest the threshold should be more like 5 km (still a useful resolution for delineating regional heatwaves, for example).  On the measurement uncertainty, it doesn't seem ideal to have T, B and G all the same, nor to have the thresholds too strict. Given that there is an irreducible definitional uncertainty in LST when considering complex surfaces such as heterogeneous vegetation canopies, there is surely no clear purpose in defining measurement uncertainties more ambitious than the definitional uncertainties. Threshold, breakthrough and goal of 1.5, 1.0 and 0.5 K would seem broadly appropriate for complex target areas.  I agree about the useful comment on correlation length scales: note that the correlations in question relate both to measurand correlations (over what scale does a measurement at A inform me about the LST at location B?) and the error correlations (are the errors in the measured values at A and B in common or independent or intermediately correlated)? These may be different. | |

### Comment 2

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| Author: Elizabeth Good | Email: elizabeth.good@metoffice.gov.uk |
| Reviewed by checking the LST CCI User Requirements Document avaiablle from http://cci.esa.int/sites/default/files/LST-CCI-D1.1-URD%20-%20i1r1%20-%20User%20Requirement%20Document.pdf, or which I was co-author.  Corrections:   * Name: 'Total lightning stroke density' -> 'Land surface temperature' * In the 'Note' section, '77' should be '76' - i.e. survey responses were received from 76 users in the LST\_cci User Requirements Document (URD) * Uncertainty: the LST\_cci URD obtained threshold 1 K, breakthrough 0.5 K and goal 0.3 K for both accuracy (‘the closeness of agreement between a measured LST dataset and a true LST’) and precision (‘the closeness of agreement that would be obtained if multiple measurements of a single LST were made under identical conditions’). Suggest the values here for uncertainty are updated to 1K (treshold), 0.5 K (breakthrough) and 0.3 K (goal). * Stability /Derivation and References and Standards: 'Climate modelling' -> 'Climate monitoring'.   LST stability is absolutely critical for climate monitoring, but is less important for climate modeling. Current global surface temperature trends are ~0.2 K/decade so to detect global trends of this magnitude, we must have stability of better than this to detect them robustly. However, regional trends may be smaller or larger than this figure, so LST data sets with stability worse than 0.2 K/decade may still be useful for some applications.  Additions:  For climate monitoring, I would suggest threshold 1 month (this is similar to what is currently achieved for many air temperature data sets), breakthrough 48 hours (useful for real time monitoring of heat waves for example) and goal <24 hours (more useful for real time monitoring of extreme temperature events).  Other comments:  For spatial resolution the goal value should be better than the breakthrough, so although the values in the table match those in the LST\_cci user survey, a value of <<1 Km could be specified for the goal target. However, I agree with the previous comment on this that many application areas can use data with spatial resolution of lower than 1 km so a lower threshold value, e.g. 0.05 deg would be appropriate. For example, 0.05 deg spatial resolution is actually the highest spatial resolution that is manageable and practical for global and regional climate monitoring. Note in the LST\_cci URD: 'For dataset spatial resolution (Figure 16), the threshold requirementis 1 km[LST-URD-REQ-12-O], whereas both the breakthrough and objective spatial resolutions are <1 km[LST-URD-OPT-12-O].These results differ from the GlobTemperature survey results for climate applications (Table 9), where most climate users were satisfied by data at a much coarser spatial resolution than 1 km (e.g. 0.05-0.5°). However, they are close to the requirements obtained at the NCDC workshop (Table 5), where the spatial resolution required for most applications is 1 km or better, and the NASA white paper on LST (Table 4), where the spatial resolution for regional and local applications is better than 5 km.The results of this survey may reflect the high proportion of respondents who use MODIS data (Figure 5), whose native resolution is ~ 1km, and L2 data (Figure 6), which is at the native resolution of a sensor (e.g. MODIS, (A)ATSRdata are 1 km).The results may also reflect the primary application of the respondents (Figure 2): the three most popular primary applications are model evaluation, evapotranspiration/vegetation or cropmonitoring and urban climate, all of which may quite feasibly require data with a spatial resolution of 1 km or better.' | |

### Comment 3

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| Author: Rivo Randrianarison | Email: herrnews@gmail.com |
| See in table below | |

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| --- | --- | --- | --- | --- | --- |
| **Name** | Land Surface Temperature (LST) | | | | |
| **Definition** | Land Surface Temperature (LST) is a measure of how hot or cold the surface of the Earth would feel to the touch. When derived from radiometric measurements of ground-based, airborne, and spaceborne remote sensing instruments, LST is the aggregated radiometric surface temperature of the ensemble of components within the sensor field of view. From a climate perspective, LST is important for evaluating land surface and land-atmosphere exchange processes, constraining surface energy budgets and model parameters, and providing observations of surface temperature change both globally and in key regions. | | | | |
| **Unit** | K | | | | |
| **Note** | ECV Requirements derived from 77 responses from an online user survey of LST climate community in LST CCI Project | | | | |
| **Requirements** | | | | | |
| **Item needed** | **Unit** | **Metric** | **[1]** | **Value** | **Derivation and References and Standards** |
| Horizontal Resolution | km | m | G | < 1 | Reflect the primary application of the climate users in the survey. The three most popular primary applications are model evaluation, evapotranspiration/vegetation or crop monitoring and urban climate, all of which may quite feasibly require data with a spatial resolution of 1 km or better. Only polar orbiting satellites can currently provide data at these resolutions. |
| B | < 1 |
| T | 1 |
| Vertical Resolution | N/A |  | G |  |  |
| B |  |  |
| T |  |  |
| Temporal Resolution | h |  | G | < 1 | Only Geostationary data can provide data at these resolutions but these are regional datasets. In contrast polar orbiting satellites cover the whole globe but are restricted to day/night temporal resolution. |
| B | 1 |
| T | 6 | Very nearly met by day/night temporal resolution from polar orbiting satellite, which satisfies 70% of climate users in survey. |
| Timeliness | N/A |  | G |  |  |
| B |  | Note, a survey of 80 non-climate users for timeliness from the ESA DUE GlobTemperature Project revealed the a “threshold” need of 1 month for long-term data records, and a “breakthrough” of 48 hours for long-term data records. |
| T |  |
| Required Measurement Uncertainty |  | An estimate of the expected spread of the distribution of possible values | G | < 1 K | This is the required total uncertainty per pixel combining the four groups of uncertainty components: random, locally correlated atmospheric, locally correlated surface, and large scale systematic. There is a requirement for knowledge on correlation length scales |
| B | < 1 K |
| T | < 1 K |
| Stability | K per decade | Assessment of whether a monotonic trend exists with respect to ground-based Fiducial Reference Measurements or related ECV datasets (such as near-surface air temperature) | G | 0.1 | For climate modeling community long-term product stability is noted as high priority. Temporal stability of the LST products need to be sufficient for global and regional trends in LST anomalies to be calculated. |
| B | 0.2 |
| T | 0.3 |
| Standards and References | Bulgin, C., & Merchant, C. (2016). DUE GlobTemperature Requirements Baseline Document.  Ghent, D., Veal, K., Trent, T., Dodd, E., Sembhi, H., and Remedios, J. (2019). A New Approach to Defining Uncertainties for MODIS Land Surface Temperature. Remote Sensing, 11, 1021. doi: 10.3390/rs11091021  Good, E. J., Ghent, D. J., Bulgin, C. E., & Remedios, J. J. (2017). A spatiotemporal analysis of the relationship between near‐surface air temperature and satellite land surface temperatures using 17 years of data from the ATSR series. Journal of Geophysical Research: Atmospheres, 122(17), 9185-9210. doi:10.1002/2017JD026880  LST CCI (2018) User Requirements Document, Reference LST-CCI-D1.1-URD - i1r0  LST CCI (2019) End-to-End ECV Uncertainty Budget Document, Reference LST-CCI-D2.3-E3UB - i1r0  Merchant, C. J., Paul, F., Popp, T., Ablain, M., Bontemps, S., Defourny, P., Hollmann, R., Lavergne, T., Laeng, A., de Leeuw, G., Mittaz, J., Poulsen, C., Povey, A. C., Reuter, M., Sathyendranath, S., Sandven, S., Sofieva, V. F., and Wagner, W. (2017). Uncertainty information in climate data records from Earth observation. Earth System Science Data, 0, 511-527. | | | | |
| **Adaptation and Extremes** | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| **Adaptation[2]** | Y | Y | These products can be used for adaptation in cities for example to drive policy of green infrastructure. They can be used also for improving water use efficiency through change in irrigation regimes. | | |
| **Extremes[3]** | Y | Y | These products are relevant for extremes such as heat waves and drought. These can be at both regional scales or local scales, such as cities or agricultural fields. Higher LST may be useful for detecting occurence of heat island phenomena where land observations are coarser. | | |

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[1]Goal (G); Breakthrough (B)(not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review)

[2] Is the ECV Product directly relevant to support Climate Adaptation?

[3] Can the ECV Product be used to monitor climate extremes or aspects of extremes?

### Comment 4

|  |  |
| --- | --- |
| Author: Click here to enter text. | Email: djg20@le.ac.uk |
| For the measurement uncertainty since the LST\_cci URD report threshold 1 K, breakthrough 0.5 K and goal 0.3 K for both accuracy and precision if we interpret the RMSE as a measurement of the uncertainty then the values would be 1 K (T), 0.7 K (B), and 0.4 K (G) | |

## ECV Product: Soil Temperature

### Comment 1

|  |  |
| --- | --- |
| Author: Jiankai Wangf | Email: asd464680@gmail.com |
| Name Soil temperature  Definition Soil temperature at different depth  Unit Celsius (℃)  Note Add the Soil temperature into Essential Climate Variables. Soil temperature is an important variable and its usage is similar to the sea surface temperature(SST) in meteorology and climate.  The difference between SST and LST. Some experts may think the land surface temperature(LST) is more like SST. In fact LST and soil temperature, the LST and SST both are very different. The SST has better relation with the sea temperature at different depth(such as 1m, 10m) than LST. As a result, the SST could represent the real thermal energy of sea which has very important usage. But the LST always could not represent the thermal energy of land. The specific heat capacity of soil is much smaller than the specific heat capacity of water. Compared to water, soils conduct heat very slowly. The LST is just the skin temperature of land and changed quickly.  The reason choosing the soil temperature.  Firstly, the soil temperature at different depth could represent the thermal energy. The standard depths for soil temperature measurements are 5, 10, 20, 50 and 100 cm below the surface according to the CIMO guide (0cm is an additional in CMA); additional depths may be included.  Secondly, The LST is more difficult to measure using thermometer insitu. The temperature sensor is difficult to fit tightly to the ground and remains stable. In the case of precipitation, the fitness will change and cause unstable measurement results. The position of the temperature sensor needs to be adjusted manually. Infrared temperature sensors are expensive, so it is difficult to build them globally.  Last but not the least, soil temperature is better to represent the soil thermal energy than LST. Soil temperature is easy to measure using thermometer(0/5/10 cm) or temperature sensor( 5/10/20/50/100 cm). | |

### Comment 2

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| --- | --- |
| Author: Click here to enter text. | Email: wjkaoc@cma.gov.cn) |
| See table below | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Soil temperature | | | | |
| Definition | Soil temperature at different depth | | | | |
| Unit | Celsius (℃) | | | | |
| Note | Add the Soil temperature into Essential Climate Variables. Soil temperature is an important variable and its usage is similar to the sea surface temperature(SST) in meteorology and climate.   1. **The difference between SST and LST**. Some experts may think the land surface temperature(LST) is more like SST. In fact LST and soil temperature, the LST and SST both are very different. The SST has better relation with the sea temperature at different depth(such as 1m, 10m) than LST. As a result, the SST could represent the real thermal energy of sea which has very important usage. But the LST always could not represent the thermal energy of land. The specific heat capacity of soil is much smaller than the specific heat capacity of water. Compared to water, soils conduct heat very slowly. The LST is just the skin temperature of land and changed quickly. 2. **The reason choosing the soil temperature.**   Firstly, the soil temperature at different depth could represent the thermal energy. The standard depths for soil temperature measurements are 5, 10, 20, 50 and 100 cm below the surface according to the CIMO guide (0cm is an additional in CMA); additional depths may be included.  Secondly, The LST is more difficult to measure using thermometer insitu. The temperature sensor is difficult to fit tightly to the ground and remains stable. In the case of precipitation, the fitness will change and cause unstable measurement results. The position of the temperature sensor needs to be adjusted manually. Infrared temperature sensors are expensive, so it is difficult to build them globally.  Last but not the least, soil temperature is better to represent the soil thermal energy than LST. Soil temperature is easy to measure using thermometer(0/5/10 cm) or temperature sensor( 5/10/20/50/100 cm). | | | | |
| Requirements | | | | | |
| Item needed | **Unit** | **Metric** | **[[1]](#footnote-1)** | **Value** | **Derivation and References and Standards** |
| Horizontal Resolution | km | 2.5 degrees of longitude | G | 50 | ***GUIDE TO THE GCOS SURFACE NETWORK (GSN) AND GCOS UPPER-AIR NETWORK (GUAN) (GCOS-144) (WMO/TD No. 1558):***  For the GSN, the horizontal distance between two network stations should not be less than the length of 2.5 degrees of longitude at that location (278 km at the equator). For stations beyond 60 degrees latitude (north or south) the minimum distance is fixed at the length of 2.5 degrees of longitude at 60 degrees latitude (139 km). Consequently, the minimum spacing varies from 278 km at the equator to 139 km in the polar regions.  Goal, Breakthrough: according to requirement from the OSCAR about the sea surface temperature |
| B | 150 |
| T | 139-278 |
| Vertical Resolution | cm |  | G | 0,5,10,20,50,100,180 | ***WMO GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION (WMO-No.8):***  The standard depths for soil temperature measurements are 5, 10, 20, 50 and 100 cm below the surface; additional depths may be included.  LST is important for the satellite observation. So zero depth could be included.  Goal: At the depth of 180cm the temperature is useful for long term climate monitor and prediction.  Breakthrough: Automatic Weather Station observe could observe the soil temperature at these depth.  Threshold: The thermometer can be used at these depth. Suitable for observing stations without automatic weather stations. |
| B | 0,5,10,20,50,100 |
| T | 0,5,10,20 |
| Temporal Resolution | h |  | G | 3 | ***GUIDE TO THE GCOS SURFACE NETWORK (GSN) AND GCOS UPPER-AIR NETWORK (GUAN) (GCOS-144) (WMO/TD No. 1558):***  Regarding surface synoptic observations: the main standard times shall be 0000, 0600, 1200 and 1800 UTC. The intermediate standard times shall be 0300, 0900, 1500 and 2100 UTC. Every effort should be made to obtain surface synoptic observations four times daily at the main standard times, with priority being given to the 0000 and 1200 UTC observations required for global exchanges. |
| B | 6 |
| T | 24 |
| Timeliness | N/A |  | G |  |  |
| B |  |
| T |  |
| Required Measurement Uncertainty | K |  | G | 0.1 K | ***WMO GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION (WMO-No.8):***  Sea-surface temperature Achievable measurement uncertainty: 0.2 K  Sea-surface temperature required measurement uncertainty: 0.1 K |
| B | 0.2 K |
| T | 0.2 K |
| Stability |  |  | G |  |  |
| B |  |
| T |  |
| Standards and References | ***WMO GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION (WMO-No.8)***  ***GUIDE TO THE GCOS SURFACE NETWORK (GSN) AND GCOS UPPER-AIR NETWORK (GUAN) (GCOS-144) (WMO/TD No. 1558)*** | | | | |
| Adaptation and Extremes | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| Adaptation[[2]](#footnote-2) | Y | Y | Can be used to monitor frozen ground conditions. | | |
| Extremes[[3]](#footnote-3) | Y | Y | Monitoring of meteorological drought is critical. | | |

### Comment 3

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| --- | --- |
| Author: ECMWF | Email: ecresgcosreqs@gmail.com |
| We agree that Soil Temperature should be considered in the list of ECVs, or at least be a product of Land surface temperature. Part of the energy absorbed by the Earth' surface is stored in the continental masses, with all consequences in surface and surface-near surface physical processes. Soil temperature can be used as a climate indicator over sufficient long time series. We also propose to list as products a shallow-layer soil temperature (up to 5 cm) and a deeper soil temperature up to 1 meter.  Horizontal resolution (km): the current technology should allow to improve the horizontal resolution: T (100), B (50), G (10).  Timeliness almost similar as temporal resolution, with a threshold of 48h | |

## ECV Product: Total lightning stroke density

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| --- | --- | --- | --- | --- | --- |
| **Name** | Total lightning stroke density | | | | |
| **Definition** | Land Surface Temperature (LST) is a measure of how hot or cold the surface of the Earth would feel to the touch. When derived from radiometric measurements of ground-based, airborne, and spaceborne remote sensing instruments, LST is the aggregated radiometric surface temperature of the ensemble of components within the sensor field of view. From a climate perspective, LST is important for evaluating land surface and land-atmosphere exchange processes, constraining surface energy budgets and model parameters, and providing observations of surface temperature change both globally and in key regions. | | | | |
| **Unit** | K – average over grid cell | | | | |
| **Note** | ECV Requirements derived from 77 responses from an online user survey of LST climate community in LST CCI Project | | | | |
| **Requirements** | | | | | |
| **Item needed** | **Unit** | **Metric** | **[1]** | **Value** | **Derivation and References and Standards** |
| **Horizontal Resolution** | km | Size of grid cell | G | < 1 | Reflect the primary application of the climate users in the survey. The three most popular primary applications are model evaluation, evapotranspiration/vegetation or crop monitoring and urban climate, all of which may quite feasibly require data with a spatial resolution of 1 km or better. Only polar orbiting satellites can currently provide data at these resolutions. |
| B | < 1 |
| T | 1 |
| **Vertical Resolution** | N/A |  | G |  |  |
| B |  |  |
| T |  |  |
| **Temporal Resolution** | h |  | G | < 1 | Only Geostationary data can provide data at these resolutions but these are regional datasets. In contrast polar orbiting satellites cover the whole globe but are restricted to day/night temporal resolution. |
| B | 1 |
| T | 6 | Very nearly met by day/night temporal resolution from polar orbiting satellite, which satisfies 70% of climate users in survey. |
| **Timeliness** | N/A |  | G |  |  |
| B |  | Note, a survey of 80 non-climate users for timeliness from the ESA DUE GlobTemperature Project revealed the a “threshold” need of 1 month for long-term data records, and a “breakthrough” of 48 hours for long-term data records. |
| T |  |
| **Required Measurement Uncertainty** |  | An estimate of the expected spread of the distribution of possible values | G | < 1 K | This is the required total uncertainty per pixel combining the four groups of uncertainty components: random, locally correlated atmospheric, locally correlated surface, and large scale systematic. There is a requirement for knowledge on correlation length scales |
| B | < 1 K |
| T | < 1 K |
| **Stability** | K per decade | Assessment of whether a monotonic trend exists with respect to ground-based Fiducial Reference Measurements or related ECV datasets (such as near-surface air temperature) | G | 0.1 | For climate modeling community long-term product stability is noted as high priority. Temporal stability of the LST products need to be sufficient for global and regional trends in LST anomalies to be calculated. |
| B | 0.2 |
| T | 0.3 |
| **Standards and References** | Bulgin, C., & Merchant, C. (2016). DUE GlobTemperature Requirements Baseline Document.  Ghent, D., Veal, K., Trent, T., Dodd, E., Sembhi, H., and Remedios, J. (2019). A New Approach to Defining Uncertainties for MODIS Land Surface Temperature. Remote Sensing, 11, 1021. doi: 10.3390/rs11091021  Good, E. J., Ghent, D. J., Bulgin, C. E., & Remedios, J. J. (2017). A spatiotemporal analysis of the relationship between near‐surface air temperature and satellite land surface temperatures using 17 years of data from the ATSR series. Journal of Geophysical Research: Atmospheres, 122(17), 9185-9210. doi:10.1002/2017JD026880  LST CCI (2018) User Requirements Document, Reference LST-CCI-D1.1-URD - i1r0  LST CCI (2019) End-to-End ECV Uncertainty Budget Document, Reference LST-CCI-D2.3-E3UB - i1r0  Merchant, C. J., Paul, F., Popp, T., Ablain, M., Bontemps, S., Defourny, P., Hollmann, R., Lavergne, T., Laeng, A., de Leeuw, G., Mittaz, J., Poulsen, C., Povey, A. C., Reuter, M., Sathyendranath, S., Sandven, S., Sofieva, V. F., and Wagner, W. (2017). Uncertainty information in climate data records from Earth observation. Earth System Science Data, 0, 511-527. | | | | |
| **Adaptation and Extremes** | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| **Adaptation[2]** | Y | Y | These products can be used for adaptation in cities for example to drive policy of green infrastructure. They can be used also for improving water use efficiency through change in irrigation regimes. | | |
| **Extremes[3]** | Y | Y | These products are relevant for extremes such as heat waves and drought. These can be at both regional scales or local scales, such as cities or agricultural fields. | | |

[1]Goal (G); Breakthrough (B)(not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review)

[2] Is the ECV Product directly relevant to support Climate Adaptation?

[3] Can the ECV Product be used to monitor climate extremes or aspects of extremes?

### Comment 1

|  |  |
| --- | --- |
| Author: Jiankai Wang | Email: asd464680@gmail.com |
| There are some differences in the results of thermometers and infrared sensors measuring the LST. Compared with the two instruments, the infrared sensor is better to calibrate satellite products, and then make remotesensing LST products.  There are few observation stations installed with infrared sensors, and thermometers are generally used for observation. Calibration satellite products need to establish a dedicated observation station with a large area of uniform underlay to ensure that the temperature of several pixels is similar.  Observation stations use thermometers to observe ground temperature, which can be used to weather forcast and agricultural meteorology. | |

1. Goal (G); Breakthrough (B)(not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review) [↑](#footnote-ref-1)
2. Is the ECV Product directly relevant to support Climate Adaptation? [↑](#footnote-ref-2)
3. Can the ECV Product be used to monitor climate extremes or aspects of extremes? [↑](#footnote-ref-3)