GCOS Land Surface Temperature ECV
Land Surface Temperature & Climate

**Climate Monitoring**
- Spatially continuous proxy for surface temperature (but LST ~ Tsfc relationship is complex)
- Key information for verification of bias adjustments of Tsfc records, and the statistical interpolation methods used.
- High profile (and much criticised) climate indicator
- Fundamental measure in UNFCCC Paris Agreement
- Key variable in surface energy and moisture balance
- Evaluation of land surface energy exchange processes, and development of LSMs
- Driver of vegetation phenology, agriculture
- Necessary for the study of extreme heatwaves and urban heat islands, epidemiology
- Verification of model estimates of skin temperature, particularly where *in situ* measurements are sparse.
- Essential for monitoring polar regions, snow melt and permafrost.
## Land Surface Temperature

### GCOS Requirements

<table>
<thead>
<tr>
<th></th>
<th>Freq.</th>
<th>Resolution</th>
<th>Uncertainty</th>
<th>Stability/decade</th>
</tr>
</thead>
<tbody>
<tr>
<td>LST</td>
<td>3 hr</td>
<td>1 km</td>
<td>1 K</td>
<td>0.1 K</td>
</tr>
</tbody>
</table>

Also:

- Report emissivity
- Land surface radiometric temperature
- GCOS Implementation Plan Actions: T43, T44, T46
Land Surface Temperature: Key Users

Key Users of the LST ECV

European and international climate science organisations that:

- Develop land surface components of climate models
- Perform climate model intercomparison and verification studies (CMIP projects)
- Developers and providers of climate services (agriculture, heat stress, drought, etc)
- Developers of global land surface air temperature records (e.g. ISTI, CRUTEM, GISS)
- Drought, wildfire and desertification processes, and impacts of climate change on agriculture
- Investigation of elevation dependent climate warming
- Producers of land cover, snow, permafrost and soil moisture ECVs
LST: International Context

**ILSTE** - International Land Surface Temperature and Emissivity Working Group

**CEOS-WGCV-LPV Land Surface Temp and Emissivity**

**CMIP6 projects:** LS3MIP, ALMIP2, GABLS, GLACE-CMIP, ...

**TOPC** – link to GCOS

**ISTI** – International Surface Temperatures Initiative

**EDW** – Elevation Dependent Warming initiative

**GEWEX** – Global Energy and Water Cycle Experiment

**EUMETSAT Land-SAF**

**H2020 Projects:**

- **FIDUCEO** – FCDR development
- **EUSTACE** – Developing usage of LST for surface air temperature analyses

**Copernicus Services** - Climate Change and Global Land
LST: Satellite Instruments

TIR Radiometers:

- Polar Orbiters: AVHRR, (A)ATSR, ASTER, MODIS, VIIRS, SLSTR
- Geostationary: MVIRI, SEVIRI, GOES, MTSAT, Himawari-8/9
- Hi-Res TIR: Landsat

Passive Microwave Radiometers:

- SMMR, SSM/I, AMSR, SSMIS, TMI, ...
LST: Key Issues for CCI+ (1)

• Diurnal Cycle: Need to merge multi-mission geostationary and polar orbiter data to provide global long term record of LST including its diurnal variation.

• Merging approaches:
  - Develop consistent algorithms to be applied to LEO and GEO Level-1 data
  - Angular dependence of LST
  - Quality of the FCDR

• Long term ECV stability assessment (changing instrument characteristics, breakpoints, calibration drifts, orbit drifts, ...)

• Reduce uncertainties related to land surface emissivity

• Develop per-pixel product uncertainty estimates (and validate them)
LST: Key Issues for CCI+ (2)

- Cloud-clearing – major source of uncertainty in current products
- $T_{\text{sfc}} \sim \text{LST}$ relationship
- Use of LST in models – needs model development.
- Clear-sky bias of IR measurements (passive microwave, in-situ)
- Relationship between PMW and TIR LST measurements, with aim to develop an integrated LST product.
- Ice and Snow surface temperature
- Validation – few high quality in-situ radiometers