Documentation of MeteoSwiss Grid-Data Products

Monthly and yearly satellite-based Land Surface Temperature

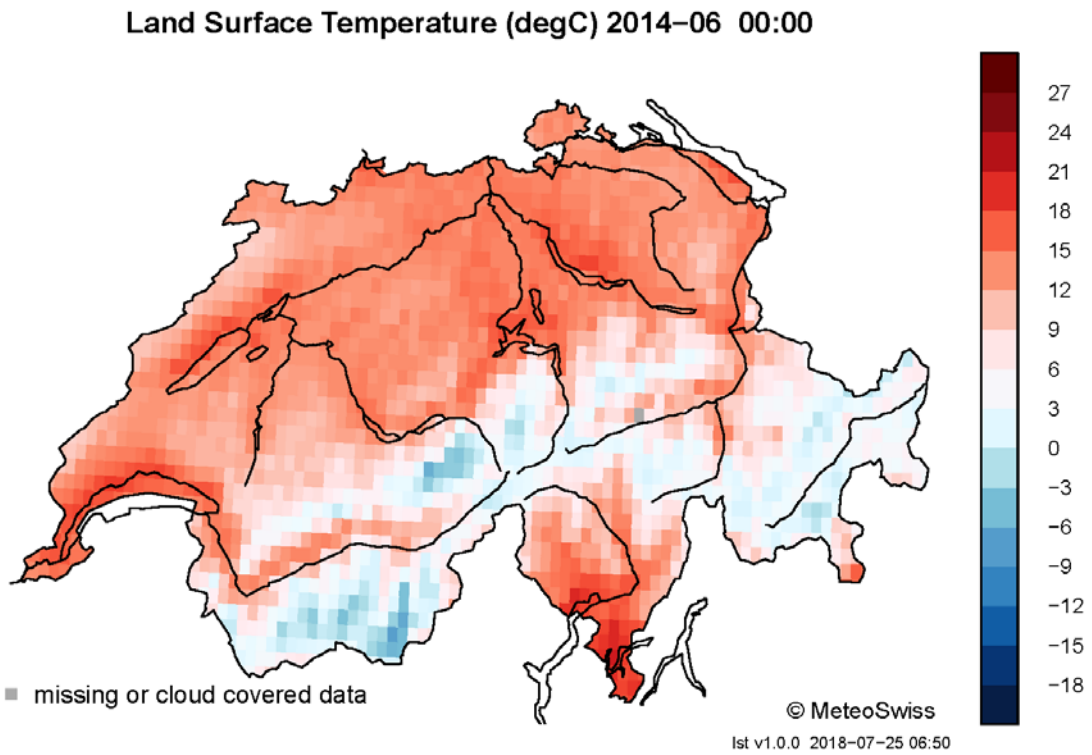

Figure 1: Monthly Mean Land Surface Temperature over Switzerland from June 2014 at midnight.

Variable

Clear-sky Land Surface Temperature (LST) in K. Land Surface Temperature is a measure on how hot or cold the uppermost surface of the Earth is. Satellites measure the Earth temperature only under clear sky conditions i.e. the provided LSTs include only clear sky observations.

Mean monthly and yearly quantities back to 1991. Land surface temperatures are provided as diurnal cycle composites i.e. mean values are provided for every hour of the day.

Application

From a climate perspective, the Earth skin temperature is essential to study land surface and land-atmosphere exchange. Complementary to the air temperature, it is an independent temperature measure.

Satellite-based Cloud Cover

Climate Analysis, Weather- and Climate Model validation, Drought and heat wave analysis, Land-atmosphere exchange studies.

Overview

The dataset provides land surface temperature on a high resolution grid with validated accuracy. The dataset is entirely derived from Meteosat satellite measurements by use of a physical, radiative-transfer based-retrieval algorithm. The method has been validated using skin temperature measurements in Africa and Europe. Satellites measure the Earth temperature only under clear sky conditions i.e. the provided LSTs include only clear sky observations.

This data set is linked to our international collaboration with the EUMETSAT sponsored Satellite Application Facility on Climate Monitoring (CM SAF) where we derive land surface temperatures for the full Meteosat disk for the whole range of Meteosat satellite sensors since 1991.

Data base

The MVIRI (Visible and InfraRed Imager) and SEVIRI (Spinning Enhanced Visible and Infrared Imager) sensor on board the EUMETSAT Meteosat First and Second Generation satellite serves as the foundation for this data set.

The Land Surface Temperature data is derived from two Meteosat heritage channels. MVIRI data are carefully inter-calibrated using daily calibration coefficients provided by EUMETSAT to ensure climate quality. For the processing Level 1.5 data are used. The data is processed at 15 minutes intervals at the native satellite resolution. Data gaps might occur during satellite calibration, satellite maneuvers or technical failures in the transmission or EUMETSAT processing facilities. To ensure consistency between medium resolution MVIRI and high resolution SEVIRI data, the data are resampled to a 0.05° latitude and longitude grid after the processing.

Method

The Land Surface Temperature data is derived from a single MFG MVIRI and MSG SEVIRI thermal channel. The implemented model is a radiative transfer-based approach proposed by Duguay-Tetzlaff et al. (2015) for climatological LST retrieval. Cloud screened and inter-calibrated infrared top-of-atmosphere satellite radiances are corrected for atmospheric path radiances and surface emissivity to obtain LST. Radiative transfer models can be used to estimate the upward and downward atmospheric path radiance and the atmospheric transmittance in the thermal infrared for a specific atmospheric profile. The atmospheric path radiances and the atmospheric transmittance is estimated using the Radiative Transfer for TOVS (RTTOV) radiative transfer model. The atmospheric temperature and moisture profiles required for the radiative transfer runs are taken from ECMWF ERA-Interim profiles. The surface emissivity is surface emissivity is taken from the satellite-based University of Wisconsin Baseline Fit Emissivity Database (Seemann et al. 2008).

The algorithm is described in detail in Duguay-Tetzlaff et al. (2017).

Target users

Climate Modelers, Climate Researchers.

Accuracy and interpretation

The accuracy of the data is characterized in Duguay-Tetzlaff et al. (2017). Monthly data reveal a mean bias of 0.8 K and a bias corrected root mean square error of 0.9 K compared to more than 50,000 in-situ LSTs measurements over Africa and Europe. The selected validation stations include different climate zones. Root mean square differences are generally below 2 K, except for very moist atmospheres. The decadal stability is 0.4 K when

compared with ECMWF ERA-Interim skin temperatures and LST time series from other satellite sensors. Shortcomings are a larger positive bias during summer.

Grid structures The dataset is available in the following grid structures:

ch05.lonlat: A grid in regular longitude and latitude increments covering the territory of Switzerland (5.5-11.0 deg E, 45.5-48.0 deg N). The grid spacing is 0.05° in longitude and latitude, corresponding to approximately 5.6 km (3.9 km) in the North-South direction (West-East direction).

Versions Current version: 1.0

Previous versions: none

Update cycle The monthly and yearly dataset is updated every year. Please note that this is not a real-time dataset.

Data format NetCDF (CF standard v1.6)

Contact point Data service at MeteoSwiss (dataservice[at]meteoswiss.ch)

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